Information and Advertising Policy

A Study of Fat and Cholesterol Consumption in the United States, 1977-1990

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Bureau of Economics Staff Report
Federal Trade Commission
Washington, D. C. 20580

September 1996

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EXECUTIVE SUMMARY

This study examines fat, saturated fat, and cholesterol consumption in the United States during the years 1977 to 1990 in an effort to better understand the effects of information on consumer behavior. Public health organizations, such as the American Heart Association, and the popular press have been spreading information on the role of saturated fat and cholesterol in heart disease since at least the 1960s. Government joined these efforts in the mid-1970s, with dietary guidelines and a variety of public education programs, including the National Cholesterol Education Program in the post-1985 period.

In the mid-1980s, a series of policy pronouncements by the Federal Trade Commission (FTC) for food advertising and by the Food and Drug Administration (FDA) for food labeling changed the regulatory environment to make it easier for firms to discuss diet-disease issues in food advertising and labeling. While still subject to the normal rules that govern all claims -- claims must be truthful and not deceptive -- the new environment increased the economic pressure on firms to compete on the nutritional characteristics of foods. A number of major food companies began to link food choices to disease risks explicitly, and health-related claims of all types became more frequent in advertising and labeling as the decade progressed. Thus, this study examines dietary changes in the years before and after 1985 to provide some evidence on whether these policy changes appear to have led to improvements in food choices, or as some fear, to confusion sufficient to undermine consumers' success in responding to the continuing public health advice on dietary choices.

Overall, the study provides substantial evidence that fat, saturated fat, and cholesterol consumption fell significantly between 1977 and 1990, as information spread to consumers. The available evidence also indicates that improvements in these dietary characteristics occurred more rapidly and more consistently across food choices after 1985, when health-related claims became more explicit and more frequent in advertising and labeling.

In assessing this evidence, it is important to recognize some caveats implicit in any study of this type. First, this type of evidence cannot definitively prove or disprove that any two events are causally related. What we can do is test hypotheses to determine which hypotheses are consistent with the available evidence, and thus, more likely to be true. Moreover, measurement of any consumer behavior as complex as food consumption is difficult, and every data set relevant to the issue has limitations. Because the quality of the available data is a topic of continuing academic scrutiny, we examine three major, independent federal datasets relevant to consumer knowledge and food consumption. Consistent findings across these independent data sets provides greater assurance that the findings are a reflection of behavior and not an artifact of the data. Finally, as in any study of the effects of policy change, it is important to recognize other factors that could affect behavior. In particular in our case, public education efforts continued to evolve throughout the period of interest, including the consolidation of the federal government's heart disease education efforts in the National Cholesterol Education Program in the post-1985 period. Little quantitative information is available, however, to assess the effectiveness of these efforts and whether their effectiveness changed over time.

With these caveats in mind, this report describes a variety of evidence on changes in consumers' fat, saturated fat, and cholesterol consumption over the period. This evidence is generally consistent with the information hypothesis for producer claims, that is, the hypothesis that the relaxation of advertising and labeling policies that allowed more explicit diet-health claims added information and competitive pressure to food markets, thus, complementing other sources of information and leading to reduced consumption of these dietary components. The available evidence is generally inconsistent with the alternative deception/confusion hypothesis, in which producer claims are hypothesized to undermine public health advice, leading to overall deteriorations in consumers' diets. The study presents several types of evidence that suggest reasons why advertising and labeling claims, when added to the flow of other health information, may have been an important part of the information environment that appears to have helped consumers make better dietary choices during the late 1980s.

When more recent data become available, the evidence from this study will also provide a baseline against which we can begin to assess the effects of the changes in food claim policy developed under the Nutrition Labeling and Education Act of 1990. This evidence, together with other studies currently underway, should help us better understand how information spreads in consumer markets and how the rules for advertising and labeling can be refined to best serve consumer interests.

Why Study Consumption of Fats and Cholesterol?

In an earlier study, we examined changes in the ready-to-eat cereal market, where fiber-cancer claims were the first major category of health claims during this period (Ippolito and Mathios 1989, 1990). The cereal study indicates that consumer knowledge and behavior improved

significantly once producer claims helped spread the information that fiber cereals might reduce colon cancer risks. Product development also shifted to reflect this enhanced ability to market a cereal's nutritional characteristics.

Health claims also spread to other markets, including some in which the primary focus was the role of fats and cholesterol in the development of heart disease. Several potentially important differences exist between the fat-heart case and the fiber-cancer case, however. For instance, the scientific basis for heart-disease claims is considerably older than that for fiber-cancer claims, and public and private efforts to spread the heart information had been substantial for many years. Moreover, some heart-disease claims focused on saturated fat (the primary risk component) without a comparable focus on other negative components of the product, such as total fat, raising concerns about the net effect of the claims. These types of differences led us to undertake this comprehensive study of fat, saturated fat, and cholesterol consumption over the 1977-1990 period in an effort to assess whether the results found in the cereal study generalize to other cases.

The study examines detailed food consumption data from the U.S. Department of Agriculture's (USDA) *Nationwide Food Consumption Surveys (NFCS)* in 1977 and 1987/88 and from its *Continuing Surveys of Food Intakes By Individuals (CSFII)* in 1985, 1986, and 1989/90, knowledge data from the Food and Drug Administration's *Health and Diet Surveys* in 1984, 1986, and 1988, and aggregate annual food *production* data for major commodity categories for the years 1977 to 1990, also from USDA.

These data allow us to examine consumer knowledge and behavior from several perspectives with different types of independent data. This

multifaceted approach allows a more comprehensive assessment of whether and how diets changed, as information continued to flow to the market from many sources, and as the policies governing diet-disease claims in advertising and labeling were relaxed in the mid-1980s.

Changes in Average Daily Consumption of Fat, Saturated Fat, and Cholesterol, 1977-1990

To examine the average consumption of fat, saturated fat, and cholesterol between 1977 and 1990 the study uses 1-day recall data on all foods eaten during a 24-hour period from the USDA's food consumption surveys. The NFCS surveys from 1977 and 1987/88 are national population surveys that cover the entire year, but the CSFII surveys from 1985 and 1986 are limited to subsamples of adults during particular seasons of the year. Some data, such as education, are collected only for heads of households in the NFCS surveys.

Since a primary purpose of this study is to examine changes over time, the analysis is restricted to subpopulations consistently sampled by the USDA in the years available and for which the basic variables of interest are collected. Thus, the study focuses on adults, 19-50 years of age, who are heads of households, in spring for women and in summer for men.

For both men and women, these data indicate that average daily fat consumption falls between 1977 and 1985, and the rate of decline accelerates between 1985 and 1990. Average fat consumption for women is 73.3 grams per day in spring 1977 and declines significantly by 3.7 grams in the eight years between 1977 and 1985. Average fat consumption falls significantly by an additional 7.5 grams per day in the next four years, so that fat consumption for women in the 1989/90

sample is 62.1 grams per day. For men, fat consumption in summer 1977 is 112.8 grams per day, which declines significantly by 5.3 grams by 1985. Fat consumption falls significantly by an additional 14.9 grams per day in the post-1985 period, resulting in a 92.6 grams per day average by 1989/90.

Changes in saturated fat consumption generally parallel changes in fat consumption. As with fat, the absolute reductions in saturated fat consumption are larger in the post-1985 period than in the pre-1985 period. For women saturated fat consumption is 26.2 grams per day in spring 1977 and drops by 1.0 grams by 1985. Consumption falls by an additional 3.5 grams per day in the 1985-1989/90 period, to 21.7 grams per day in 1989/90. For men, average saturated fat consumption declines by 1.0 grams per day from 1977 to 1985 and an additional 7.2 grams per day in the following years, to 32.4 grams per day in 1989/90.

Cholesterol consumption shows the same pattern of accelerated decline in the post-1985 period, and the magnitude of the acceleration is more pronounced than for the other food components, though a change in the cholesterol data for eggs in 1987 suggests the need for caution in assessing the magnitude of this result. For women, daily cholesterol consumption declines from 345.3 milligrams in 1977 to 304.9 milligrams in 1985. By 1989/90 average daily cholesterol consumption falls to 221.2 milligrams (this number is estimated to be approximately 266 milligrams if the old cholesterol data for eggs are used). For men, average daily cholesterol consumption is 498.9 milligrams in 1977, 446.6 milligrams in 1985, and 389 milligrams in 1989/90.

In summary, these aggregate results indicate that the average consumption of fat, saturated fat, and cholesterol declined significantly during the years 1977 to 1990 for both men and women. This evidence

is consistent with the view that consumers respond to information on health issues. The evidence also indicates that the rate of decline is significantly greater after 1985. Thus, these consumption data are consistent with the information hypothesis for producer claims, that is, that the policy changes that induced producers to focus more on diet-disease issues in advertising and labeling added information to the market and complemented other information sources, leading to a faster rate of improvement in consumers' diets in these dimensions. This aggregate evidence is inconsistent with the alternative hypothesis that the diet-disease claims confused or deceived consumers sufficiently to cause either a deterioration of diets in these dimensions or a slowing in the rate of improvement underway prior to the changes in policy.

Consumer reactions to diet-health information about fats and cholesterol can be measured in several ways. We focus on changes in the average levels of fat, saturated fat, and cholesterol in the diet per day because we believe these are more appropriate measures for a study of consumer responses to information. Nutrient density measures, such as the percentage of calories from fat or saturated fat, are alternative measures often used in nutrition research, because these measures allow the researcher to abstract from individuals' different caloric needs and to use uniform standards in evaluating consumption across the population. Also, density measures have advantages if food consumption is randomly underreported in the surveys over time, and the available evidence suggests that consumption may be underreported.

Nutrient density measures have a number of disadvantages, however, which we believe make them inappropriate as the primary measure in a study of consumers' responses to diet-health information. Nutrient density measures reflect both the consumption of the nutrient in question and of calories. Changes in the density measure can be caused

by changes in either of these underlying components. Thus, the use of a nutrient density measure alone requires an assumption that caloric consumption is itself irrelevant to the topic under study and unlikely to change, an inappropriate assumption in a study of consumer information. One of the major diet-health recommendations throughout the period of this study is that individuals should consume only the calories necessary to achieve and maintain a desirable body weight. Given the observed and possibly increasing percentages of overweight adults in the U. S., average caloric intakes cannot be assumed to be stable. Also, any independent movements in calories could affect these density measures for reasons having nothing to do with the successful absorption of information. The increasing consumption of soft drinks and alcoholic beverages during this period provides an example of this concern; the additional calories from these drinks acts to reduce the percentage of calories from fat, even if nothing else in the diet had changed.

As described in Chapter 3, the evidence on these issues supports the view that a careful assessment of underlying nutrient levels is important in assessing dietary change. Caloric consumption is found to vary considerably over time in the surveys and these changes have substantial effects on the observed density measures. For instance, the percentage of calories from fat is found to fall faster in the years before 1985 than after, but this greater reduction is primarily the result of an increase in reported consumption of calories between 1977 and 1985, rather than a relatively greater reduction in fat versus nonfat calories as would be predicted if information had caused the shift. The percentage of calories from saturated fat falls at approximately the same rate before and after 1985, but again the reduction in the early period is primarily due to an increase in calories, while the reduction after 1985 is due to a relative

reduction in calories from saturated fat compared with those from other sources.

To the extent that these changes in caloric intake reflect behavior, conclusions based on density measures can be inaccurate indicators of consumers' success in absorbing diet-health information. On the other hand, if some of the observed change in caloric intake is due to changes in survey design and execution, the movement in calories may overstate changes in behavior. These issues suggest the need for caution in assessing this type of data and the importance of understanding the source of observed changes at the lipid and calorie level. These issues also reaffirm the value of examining other independent data sources, as we do, for confirmation of basic results.

Changes in Consumer Knowledge of Fat-Disease Issues

The study next examines data on consumers' knowledge of the relationship between fats and disease risks from the FDA's *Health and Diet Surveys* for 1984, 1986, and 1988, a series of national telephone surveys dealing with diet-disease issues. Unfortunately, the earlier and later surveys in the series do not contain fat-disease questions comparable to those in the core years examined here. In order to parallel our consumption analysis, these data are analyzed for men and women who are 19 to 50 years of age.

While not directly tied to behavior, knowledge data offer some advantages for assessing the information questions in this study. Knowledge measures are a direct attempt to gauge the spread of information. Moreover, knowledge measures should not be affected by confounding events, such as price changes or new information on other diet-disease issues that might indirectly affect consumption. Finally,

knowledge data represent independent evidence, collected by a different organization for different purposes, and thus provide independent observations on changes during the 1980s.

These survey data provide substantial evidence that consumer knowledge of the fat-heart disease issue increases after 1984. For instance, consumers are asked the questions "Have you heard about *heart disease* or heart attacks being related to things people eat or drink?" and if they answer yes, "What things people eat or drink make them *more* likely to get heart disease or heart attack?" In 1984, 30 percent of women and 18 percent of men give fat-related answers. By 1986 these responses rise to 66 percent for women and 69 percent for men; and by 1988, 76 percent of women and 70 percent of men give fat-related responses.

Taken as a whole, these and other questions from the knowledge surveys indicate that knowledge of the fat-heart disease issue is considerable in 1984 and rises significantly by 1988. The prominence of dietary fat as a heart disease risk shows particularly strong growth between 1984 and 1988. Knowledge about fat as a cancer risk is considerably less than that for heart disease throughout the period, though key measures here also show significant increases. Unfortunately, data from the 1970s are not available to test whether improvements in knowledge occurred prior to 1984 and at what rate, but the level of knowledge of heart disease issues in 1984 suggests that this information was absorbed by many during this earlier time period.

Trends in Per Capita Food Production

From a research perspective, self-reported data, such as the data in the previous two sections, always raise a concern that respondents may

color answers to give desired responses. Whenever possible, reevaluation of research results using data that are not self-reported provides an important assurance of key findings. In the case of fat consumption, such an opportunity is provided by the food production data gathered by USDA directly from producers or other intermediaries in the supply chain. These annual data, often referred to as *disappearance data*, measure basic food supplies moving through trade channels towards domestic consumption, and thus, measure the amount of food available for U.S. consumers.

This study uses two approaches to examine whether information affects dietary choices during the years of interest. First, trends in broad food categories that comprise a sizable portion of the overall diet are examined to determine if consumption shifts away from higher-fat and cholesterol categories towards lower-fat and cholesterol categories. In particular, trends in red meat, poultry, fish, fats and oils, and dairy products are examined, as are those in the lowest-fat categories, such as flour and cereals, fruits, and vegetables. The second approach uses more refined tests of the information hypotheses by focusing on particular food substitutions for which other factors are not likely to play an important role. These foods are required to be similar enough that potential confounding factors, such as movements in input prices and other changes in demand, are common to both products. The substitute foods identified in the USDA production data that meet these requirements are types of milk, ice cream and ice milk, butter and margarine, creamed cottage cheese and low fat cottage cheese.

For each food group, the underlying trend is estimated, as is any change in trend during the 1985-1990 period, when advertising and labeling policies were relaxed. The evidence is consistent with the hypothesis that information spread to consumers throughout these years

if underlying trends are negative for higher-fat food categories and positive for lower-fat categories. If the relaxation of the policies towards producer health claims added to the available information, these trends should improve during the post-1985 period, that is, the trends should become more negative for higher-fat categories and more positive for lower-fat categories. Alternatively, if producer claims add confusion to the market that undermines public health advice, the trends should deteriorate, with the opposite effects on post-1985 trends.

The per capita production data provide substantial evidence that during the 1977-1985 period information about fats and disease spread to consumers, leading to improvements in some important aspects of diet. Per capita production of red meat, eggs, and whole milk all fall significantly during the pre-1985 period, and the lower-fat categories of poultry, fish, low fat milk, flour and cereals, and fruit all increase. The evidence for this period is not entirely consistent, however. Per capita production of some higher-fat products (*e.g.*, cheese and cream products, and fats and oils) increase during the pre-1985 period, contrary to expectations. In fact, only 12 of the 20 coefficients for the underlying trends have the expected sign (11 of the 12 are significant). Eight of the 20 coefficients have the wrong sign (7 of the 8 are significant), indicating that consumers were increasing consumption of some higher-fat categories and decreasing consumption of some lower-fat categories, contrary to expectations if they were successfully absorbing information. Together, this evidence provides a mixed picture of dietary progress during the pre-1985 period.

The production evidence for major food groups provides a more consistent picture during the post-1985 period. Per capita production trends for food categories with the highest levels of fat either stay on the trend that existed prior to 1985 or decline relative to that trend.

Similarly, the lower-fat food categories all show a consistent pattern of added consumption relative to the underlying trend during this period. Overall, 19 of the 20 trend coefficients for the post-1985 period have the correct sign (11 of the 19 are significant), and the 1 inconsistent sign is insignificant. Thus, the production data provide no evidence that the added health-related claims had adverse effects on the rate of dietary improvement. Examination of specific food substitutions also supports the hypothesis that during the post-1985 period movements towards lower-fat substitutions accelerate compared with the pre-1985 period.

Taken together, the individual consumption data, the knowledge data on fat-disease issues, and the production data provide evidence supporting the view that consumers responded to information about dietary issues between 1977 and 1990. The evidence also indicates that the period between 1985 and 1990, when advertising and labeling claims about diet-disease issues became more explicit and more frequent, is one where dietary changes occurred more rapidly and more consistently, supporting a positive role for such claims. None of this aggregate evidence supports the hypothesis that the relaxation of the policy towards health claims harmed consumer diets when measured against the fats and cholesterol levels in 1985 or against the rate of change in these levels prior to 1985.

Changing Sources of Fats and Cholesterol in the U.S. Diet

In an effort to better understand the roles of different information sources in the market, the study also examines some of the relative advantages and disadvantages of the key sources of diet-health information. Theoretically, government and public health organizations, together with other general information sources, should provide a credible and broad perspective on the major diet-disease relationships

and the primary food categories where changes could improve diet. Thus, these sources should have their greatest effect in reducing consumption from the easily identified high-fat or high-cholesterol food categories, such as meat, dairy, and eggs, and in increasing consumption of "good" food categories, such as grain products, fruits, and vegetables.

In contrast, if nutrition becomes a focus of competition, producer-provided information is likely to contain information about a particular brand of a particular food, identifying where the brand is superior to its competition and why consumers should consider this difference important enough to buy the product. Producers are presumably less credible than public health authorities on diet-disease issues, but cites to authorities or confirmation by background information may be sufficient to overcome this credibility deficit. If producers' claims are generally informative, the more detailed claims, added to the flow of other diet-disease information, should lead to improvements across a broader range of product categories, as consumers are made aware of more food substitutions that could contribute to their dietary goals and the basic health message is reinforced through repetitive advertising claims. On the other hand, if producer claims mislead consumers, either because claims are false or sufficiently incomplete to lead to inappropriate substitutions on average, we would expect the added producer claims to lead to deteriorations in food choices in a broad range of categories.

To examine these hypotheses, foods in the USDA consumption surveys are classified into 16 mutually exclusive categories that reflect typical consumer choices. This food group analysis indicates that in 1977 the *Meat* category contributed 37 percent of the fat consumed by women and 42 percent of the fat consumed by men. Between 1977 and 1985 the largest reduction in fat consumption by far comes from the *Meat* category, which falls by 10.3 grams per day for women and 15.5

grams per day for men. Only 5 other categories experience any declines in fat for either sex, and 3 of these are specifically mentioned in government dietary advice from the period, namely *Eggs*, *Fats and Oils*, and *Milk*. While reductions in the *Meat* category are quite substantial and responses occur in the other specifically named categories, fat consumption increases enough in 10 other food categories to eliminate approximately 70 percent of the fat reductions in *Meat*, resulting in the moderate overall reductions of 3.7 grams per day for women and 5.3 grams per day for men.

In contrast to the concentrated pattern of reduction and the substantial compensation in the pre-1985 period, fat consumption falls across a large number of food categories in the post-1985 period, and compensation is seen in very few categories; fat declines in 10 of the 16 categories for both sexes and increases by more than 0.5 grams per day in only 2 food categories for women and in only 4 categories for men.

Thus, this food category analysis indicates that the larger overall reduction in the post-1985 period reflects broader and more consistent reductions across the range of food categories, in contrast to the more concentrated reductions prior to 1985.

The data indicate very similar results for saturated fat consumption. During the 1977-1985 period, saturated fat from the *Meat* category falls substantially, but that decline is largely offset by increases in 10 other categories. During the post-1985 period, saturated fat declines in 10 of the 16 food categories and increases by more that 0.2 grams per day in only 2 categories for women and 3 categories for men. In most cases, the saturated fat movements parallel the fat movements quite closely, but a few important exceptions exist. For example, health claims were a major theme in a number of advertising campaigns in the *Fats & Oils*

category, and saturated fat falls disproportionally in this category in the post-1985 period, as consumers apparently shift their fat and oil choices to the lower saturated fat options within the category at a more rapid pace than in the pre-1985 period.

Finally, in 1977 cholesterol consumption is highly concentrated to two product categories, *Eggs* and *Meat*. Between 1977 and 1985 daily cholesterol consumption from these categories falls significantly for both sexes; by 61.4 mg for women and by 75.6 mg for men. No other category loses more than 3 mg of cholesterol for either sex. Thus, reductions in cholesterol are essentially confined to these two food categories, which are specifically identified in government dietary advice from the period. Between 1985 and 1989/90 average cholesterol consumption from the *Eggs* category continues to decline for women but not for men. However, unlike the earlier period, reductions in cholesterol occur across a broad number of food categories. Thus, qualitatively, the results for cholesterol mirror the results for fat and saturated fat, with reductions from more categories producing a larger overall reduction in the post-1985 period.

Who Consumed Less Fat and Cholesterol and Who Reacted After 1985?

In each year, differences in consumption across individuals are presumably the result of differences in the taste for these food components, in consumers' valuation of health, in the effectiveness of government and general sources of diet-disease information in reaching different types of individuals, in the incremental effectiveness of producer sources after 1985, and in differences in consumers' abilities to use the available information to change their diets. Multiple regression analysis is used to examine how these various factors affect

consumption of fat, saturated fat, and cholesterol in each year. An analysis of calcium consumption is also presented because of calcium's potential to confound the fat equations.

The key results of this cross-section analysis are the following:

- *Higher education is generally associated with lower levels of fat, saturated fat, and cholesterol consumption throughout the period for men and women. Individuals at all education levels shared approximately equally in the reductions observed between 1977 and 1990.*

When compared to college graduates, individuals with less education are usually found to have higher consumption levels for the three lipids examined, other things equal. Evidence suggests that calcium information colors our interpretation of the basic equations somewhat, especially in 1985, when calcium consumption increased dramatically and when higher education is strongly associated with higher calcium consumption for women. This year is the one case where higher education is not associated with lower levels of fat or saturated fat consumption for women.

No significant movements in education differences over time are found for either sex, suggesting that the observed reductions in average fat, saturated fat, and cholesterol consumption were shared approximately equally by individuals at all education levels during this period, other things equal, with the possible exception of the least educated men.

o *Black women and black men may not have experienced the same reductions in fat and saturated fat consumption as individuals in other racial and ethnic groups.*

The results for black women and black men show a consistent movement over time. In 1977 no significant difference is found in fat or saturated fat consumption for black versus white women, other things equal, but black women consume significantly more fat in the 1987/88 and 1989/90 equations, and more saturated fat in the 1989/90 equation. For black men, the significantly lower levels of fat and saturated fat consumption found in 1977 eroded over the period, so that by the 1989/90 equation, no significant differences are found between black men and white men. Thus, for both sexes our estimates indicate that blacks did not share in the same rate of reduction in fat or saturated fat consumption as the rest of the population, other things equal. Cholesterol consumption follows the same pattern for men, but not for women. Black women had significantly higher cholesterol consumption in 1977 and no change occurs over time in this relative position. These results suggest that information from all sources did not reach blacks as effectively as the rest of the population during this period.

Women of other races (primarily Asians) and Hispanic women tend to consume less fat and other lipids compared to whites during this period; these differences do not change significantly over the period. Consumption differences for men in these racial and ethnic groups are quite variable, probably reflecting the small samples involved, and show no systematic movements over the period of this study.

A note of caution is warranted in assessing these racial results. The data for other seasons in the 1987/88 and 1989/90 samples do not confirm the higher levels of consumption for black women found in the

spring samples, raising the concern that the small samples for minorities in the later years may not be adequate for assessing these differences with confidence. A larger data set that focuses more directly on minority populations may be needed to assess racial differences in consumption over time.

o *Smokers tend to consume more fat and saturated fat than nonsmokers, other things equal. Women smokers also consume more cholesterol.*

With the exception of cholesterol consumption by men, smokers consistently consume more fats and cholesterol than their nonsmoking counterparts in the post-1985 estimates, where we have data on smoking behavior. This result is consistent with the hypothesis that individuals who value health more highly will adopt more healthful choices across behaviors on which they have the relevant information.

In contrast to our expectations, however, regular users of vitamin supplements do not consume significantly less (or more) fat, saturated fat, or cholesterol during this period.

o *Older age within the 19-50 range is usually associated with lower fat and cholesterol intakes, but these differences are statistically significant only for men in the 1987/88 and 1989/90 equations.*

o *Men and women in households with 2 adult heads do not consume more or less fat, saturated fat, or cholesterol than their single-adult-head counterparts throughout this period.*

o *Income is not significantly associated with fat and cholesterol consumption in most years examined here, other things equal.*

The only exception to this finding is in the 1977 data, where women living in households with higher incomes consumed *more* fats and cholesterol than their lower income counterparts. This evidence indicates that income is not primarily reflecting higher human capital beyond that reflected in the education variables.

o *The other dietary controls are consistently important predictors of fat, saturated fat, and cholesterol consumption. Food eaten on weekends, holidays, or away from home shows substantially higher fats and cholesterol content on average. Those on special diets or sick on the survey day had significantly lower levels of fats and cholesterol consumption. The size of the weekend difference for fat and saturated fat consumption has fallen significantly for women since 1985.*

Who Has Diet-Disease Knowledge? Do These Knowledge Differences Match Consumption Differences?

Finally, we examine how knowledge of these diet-disease issues varies with individual characteristics, and how these differences compare to those found in consumption.

The key findings are the following:

o *Higher education levels are consistently associated with greater fat-heart-disease knowledge for women. The education relationship is especially strong in 1984 and remains important in 1988.*

In 1984 at least one education coefficient is statistically significant for each of the 5 knowledge measures examined, and the magnitudes of the differences are large. Women at all education levels show significant gains in these knowledge measures. These results are

broadly consistent with our findings for consumption, which also show approximately equal improvements by women at all education levels. The knowledge measures differ only in that the gains are somewhat stronger for less educated women.

o *Education is also strongly associated with knowledge of fat-heart-disease issues for men, but the change over time is somewhat less consistent.*

For men education is significantly associated with these measures of fat-heart knowledge in most years, and this knowledge generally increases at all education levels. Men with the lowest level of schooling generally showed increases in knowledge but not as consistently as those with higher education levels. These results closely parallel our findings in the consumption data, where reductions in lipid consumption are approximately equal across education levels, with the possible exception of the least educated men.

o *Racial characteristics, especially being black, are associated with less knowledge on these diet-disease measures, other things equal. Knowledge improved significantly for black men on all measures between 1984 and 1988, reducing black-white differences for 4 of the 5 measures. Black women showed increased knowledge on 2 of the 5 measures, and no significant movements on the other 3 measures.*

The less consistent improvements in knowledge for black women may explain the smaller reductions in lipid consumption observed in the consumption analysis. For black men, the knowledge data and consumption data are not consistent; the knowledge data show more rapid improvements relative to the base group, but fats and cholesterol consumption did not improve as rapidly.

Men and women of other races (usually Asian) report lower levels of knowledge of these diet-disease measures, suggesting that the lower fats and cholesterol consumption levels found above may reflect the underlying advantages of the Asian diet.

o *Smokers show some tendency to have less diet-disease knowledge than nonsmokers, but differences are often not significant.*

This finding is consistent with our interpretation of the significant smoking results in the consumption analysis, namely, that smokers consume more fats primarily because they place less value on long-term health than nonsmokers.

o *Income is a significant predictor of diet-disease knowledge in several measures of knowledge in 1984. Income differences in knowledge fade by 1988.*

Contrary to the consumption results, knowledge data suggest that income may reflect human capital advantages beyond those reflected in education variables, as hypothesized in the previous analysis. The role of income as a measure of human capital may not be observed in the consumption data, because this effect may not be large enough to dominate the income effects also reflected in the consumption data (since key high fat foods, such as meat and desserts, are relatively expensive).

o *Age is consistently associated with more knowledge, especially for women, as found in the consumption analysis.*

o *Living in a household with two adults had no relationship to fat-heart-disease knowledge, also as found in the consumption analysis.*

Finally, the report examines knowledge of the calcium and osteoporosis issue in order to assess whether the potential confounding effects of calcium information on the fat equations in the mid-1980s is supported by the available knowledge data. The key calcium result is:

o *Education is very strongly related to calcium-osteoporosis knowledge in 1986 and had equalized somewhat by 1988, the two years for which we have direct measurements.*

The best knowledge evidence on this issue is derived from the question "What health problems might be related to not consuming enough calcium?" available in the 1986 and 1988 surveys. In 1986, knowledge is very strongly related to education; the predicted probability of knowledge is 30 percent for women with less than a high school education, 60 percent for high school graduates, 71 percent for those with some college, and 86 percent for college graduates, other things equal. These predicted probabilities had risen to 63 percent, 62 percent, 88 percent, and 89 percent, respectively in 1988, a substantial reduction in the strength of the education relationship.

These and other calcium results generally support the view that calcium knowledge increased in the mid-1980s, especially among more educated women, but that education differences fell in the later 1980s. These knowledge results suggest that the one case where we found no education differences in fat and saturated fat consumption (in the 1985 equations for women) may indeed reflect the confounding effects of the new calcium information released at that time.

Overall, the knowledge results parallel the consumption results quite well, and thus add confidence to those findings.

Conclusion

Producer health claims have been controversial. While always subject to the normal legal rules for all claims -- claims must be truthful and not deceptive -- some believe that the increased use of health and nutrition claims in advertising and labeling during the late 1980s may have undermined consumers' ability to make more informed dietary decisions and may even have harmed consumers. The results of this report do not support this premise, at least as it relates to fat, saturated fat, and cholesterol consumption. Between 1977 and 1985, available evidence indicates that consumption of these lipids fell, but between 1985 and 1990, when the regulatory environment governing diet-disease claims was relaxed to make it easier to make explicit claims, consumption of lipids fell faster. Individual food consumption data and food production data support the view that improvements in the consumption of fat, saturated fat, and cholesterol occurred faster in the post-1985 period and that the gains are widely shared across the population. Data on diet-disease knowledge is generally consistent with the behavioral evidence.

While we cannot conclusively determine how much of the added improvement is due to the information environment created by health claims *per se*, as opposed to continuing government and public health efforts to inform consumers, or to the general media coverage of these issues, nothing in the evidence suggests that these producer claims undermine consumer learning or efforts to improve diets. In fact, the available evidence examined here suggests that these diet-disease claims may have been beneficial to consumers overall by helping to foster an environment in which firms compete more directly on the nutritional features of their products and in which consumer learning and dietary change proceed more rapidly.

I

INTRODUCTION

In the last 30 years, scientific understanding of the role of diet in chronic disease risks has changed significantly. In the United States, diet is now believed to be linked substantially to five of the top ten causes of death, and diet-disease research is continuing at a rapid pace (U.S. Surgeon General 1988). Individuals have much to gain from information that would allow them to incorporate this evolving science into basic dietary decisions. Chronic diseases, such as heart disease and cancer, entail high costs for the many individuals who suffer the resulting years of poor health, early death, and the medical costs of treating these diseases. Research designed to measure how government policies aid or inhibit consumers' efforts to incorporate evolving information into their daily lives could help to reduce these human and monetary losses.

The question of how best to get developing information about diet and health to consumers has been much debated in policy circles, especially as it relates to producers' role in disseminating this information. At the core of this debate are widely varying presumptions about how effective producers are in reaching consumers compared to, or in addition to, government and other potential information sources, and about the best approaches for controlling misleading or deceptive claims.

This study examines changes in key aspects of the American diet in an effort to understand more about the role of producers and the market, together with government and other information sources, in helping

consumers incorporate diet-health knowledge. In particular, this study focuses on fat, saturated fat, and cholesterol consumption in the U.S., and on whether information linking fats and cholesterol to heart disease and cancer affected consumers' food choices. This study also examines whether changes in policies governing producer claims in the mid 1980s, which allowed producers to link diet to disease risks more explicitly in advertising and labeling, appear to have improved food choices, or as others fear, to have confused consumers sufficiently to slow improvements in diet that would have otherwise occurred.

The benefits of permitting diet-disease claims in advertising and labeling depend, in part, on whether other sources of information are sufficient to inform consumers about the reasons for dietary change and to produce the competitive environment in which firms focus appropriately on the nutritional characteristics of their food products. Evidence currently exists that public education efforts can communicate health information to consumers in ways that change behavior. For instance, public education efforts on the risks of cigarette smoking have led to large changes in behavior.[1] Public education efforts on diet-disease issues have been substantial for twenty years.[2] Private health

[1] See, for instance, Ippolito, Murphy and Sant (1979), Schneider, Klein and Murphy (1981), Porter (1986), or Viscusi (1992) on the cigarette market.

[2] Recent public education efforts in the diet-health arena include the *Dietary Guidelines for Americans*, developed in the mid 1970s and revised periodically since (U.S. Senate 1977 and U.S. Departments of Agriculture and Health and Human Services, 1980, 1985, 1990, 1995), which give overall guidelines for dietary change to reduce disease risks; the Food and Drug Administration (FDA) and National Heart, Lung, and Blood Institute's (NHLBI) sodium initiative begun in 1981, which publicized the relationship between sodium and hypertension (Heimbach 1986); the NHLBI's National Cholesterol Education Program, initiated in 1985 to improve awareness, treatment, and control of high cholesterol levels (Schucker et al. 1991); and the National Cancer Institutes's 5-A-Day program, initiated in 1991 to spread information about the

(continued...)

organizations, such as the American Heart Association and the American Cancer Society, have also devoted significant resources to informing the public of diet-disease risks.[3] Studies of public education efforts indicate that they often have a significant impact on behavior.[4]

Despite the efforts of government and other general information sources to communicate the link between diet and health, the typical American diet still deviates substantially from dietary recommendations. In 1985, the average adult man, 19-50 years of age, derived approximately 36 percent of calories from fat, and the average woman in this age group derived 37 percent of calories from fat (U.S. Surgeon General 1988), significantly exceeding the long recommended level of less than 30 percent. Similarly, cholesterol intake in 1985 was approximately 300 mg/day for women and 455 mg/day for men (U.S. Surgeon General 1988), compared to the recommended levels of 250-300 mg/day. Adult sodium intake was approximately 1500 mg/1000 kcal (National Research Council 1989), which is near the upper limit of the recommended 550-1650 mg/1000 kcal range. While we cannot conclude that these consumption levels reflect a lack of information about diet and health (since many consumers may knowingly trade long-term health costs for taste and other things they value), these data do raise the likelihood that public education campaigns have not been fully successful.

(...continued)
potential protective effects of fruits and vegetables.

[3] For instance, since the early 1960s the American Heart Association has advised Americans to reduce their saturated fat and cholesterol intake, as outlined in Chapter 2.

[4] See, for instance, Heimbach (1986), Levy and Heimbach (1989), and Frank et al. (1992) on the sodium and cholesterol initiatives.

Our earlier study of the ready-to-eat cereals market (Ippolito and Mathios 1989, 1990) examined the effectiveness of government and general sources of information in spreading knowledge about the potential role of fiber in reducing cancer risks and whether the addition of producer-provided claims appears to have increased information. In the cereals market, producer health claims appear to have been a substantial information source, leading to significant increases in fiber cereal consumption and the development of new types of fiber cereals. Moreover, the study found that prior to the use of health claims, differences existed in the types of cereals chosen across demographic groups. Some of these demographic differences faded after the policy change, suggesting that government information may be successful in reaching particular population segments, but producer advertising may provide a broader distribution of knowledge across population groups. For instance, black women and women in single adult households had low levels of fiber cereal consumption during the government information period, but their consumption increased disproportionately once producer health claims were allowed. Moreover, consumption was concentrated among the most educated women prior to 1984, but increased across all education levels in the health claims period.

The cereals study focused on a particular health issue in a particular market. More research is clearly needed to establish whether the findings in the cereals case extend to other food issues, and more generally, whether advertising and labeling play an important information role in consumer good markets.

From an economic perspective, there are strong theoretical reasons to believe that a policy of allowing a broad range of truthful diet-disease claims would be beneficial, since this policy would increase the opportunity, and thus the competitive pressure on firms, to market the

nutritional features of foods effectively. Also, if producer claims are an important source of information for many consumers, a greater freedom to make valid claims could spread the information more effectively to a larger portion of the population. Whether the competitive process and the usual policies governing all marketing claims are adequate to fill in missing information and to control deception is, of course, open to question and empirical test.

This study uses several types of data, including individual food consumption data, individual knowledge data, and aggregate food production data, together with a variety of statistical techniques to examine the spread of information about the role of fats and cholesterol.[5] The study focuses on two periods: first, the years 1977-1985, when government and general sources continued to spread information about the disease risks of fat and cholesterol consumption; and second, the years 1985-1990, when in addition to these government and general sources, policies were changed to allow producers to promote the disease-prevention attributes of lower fat, saturated fat, and cholesterol foods more clearly in advertising and labeling

The years examined in this study predate the implementation of the Nutrition Labeling and Education Act of 1990,[6] which was passed in part due to a concern that the changes in labeling rules were too great and should be restricted in several important respects. Thus, the study also provides a baseline against which the new labeling rules can ultimately be judged.

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[5] Throughout the remainder of the paper we will sometimes use the words fat or fats to refer to both saturated and total fat consumption.

[6] Pub. L. No. 101-535, 104 Stat. 2353 (1990) (codified in part at 21 U.S.C. 343(i)(q),(r)). See also Ippolito and Mathios (1993) for a description of key features of these new labeling rules.

As in any in-field experiment, testing the effects of policy change is difficult. Certainly, other things may have also changed during the period when policy shifts occurred, making a conclusive assessment of the causal relationship between advertising and labeling policies and market outcomes difficult. Nonetheless, while more controlled experimental techniques offer some advantages in research design, evidence from real markets also has important advantages.[7] Most notably, market data reflect the reaction of the entire market system, which most controlled experiments are forced to ignore, including producers' actions and the competitive responses to them under the changed rules. Moreover, if the effects of the policy change are large -- whether beneficial or harmful -- they should show themselves in measured market changes despite other noise in the system.

This study, like our study of the cereal market, does not attempt to resolve the policy debate concerning health claims in advertising and labeling. Rather it provides a compilation of a broad range of empirical

[7] A number of experiments examine issues in communicating nutrition information and other general questions raised by the food advertising policy issue. Recent examples include Brucks, Mitchell and Staelin (1984), which tests the impact of nutrient claims and detailed nutrition information in ads; Russo et al. (1986), in which experimental efforts to increase the perceived benefits of foods fail to change behavior, but efforts to reduce the cost of processing nutrition information succeed; Feich, Herrmann, and Warland (1986), in which consumers are found to seek information from a variety of sources and to search more when perceived benefits are higher; Achabal et al. (1987), in which point-of-purchase nutrition information is found to have little effect; Moorman (1990), in which consequence information (a health claim) is found to have significant effects on motivation and decision measures; Viscusi and Magat (1987) and Magat and Viscusi (1992), in which a number of issues in conveying hazard information are explored; Cole and Balasubramanian (1993), in which age is negatively correlated with the ability to use nutrition labeling to select foods with preferred characteristics; and Ford et al. (1996), in which the effects of health claims are mitigated by the presence and content of nutrition labeling. See, also, Moorman and Matulich (1993) for a recent review of some of this literature.

evidence on knowledge and consumption from several major government data sources for the years 1977 through 1990. Portions of this data have been analyzed by other researchers for various time periods using various statistical techniques, but we believe this is the first effort to provide a comprehensive assessment of the available data for a consistent sample over this time period. The report provides evidence on basic trends in knowledge and behavior, as well as several more detailed analyses of differences in consumption across consumers and across food groups.

Our primary goal in this research report is to contribute to the empirical base available to inform consumer information policy as advertising and labeling rules evolve for food products. Nonetheless, the broad range of basic statistical information about the rate and nature of improvements occurring in fat, saturated fat, and cholesterol consumption should also interest the broader nutrition research community attempting to better understand differences in dietary patterns of these food components.

II

DEVELOPMENTS IN THE MARKET FOR FATS AND CHOLESTEROL

SCIENTIFIC DEVELOPMENTS

In any study designed to better understand how information spreads in markets, it is important first to examine when the information under study was available for dissemination. Thus, this chapter begins with a brief review of some of the major scientific developments that led to the current understanding of the role of dietary fats and cholesterol in heart disease and cancer risks.[8] This review demonstrates that the basic knowledge that fats and cholesterol appear to play a significant role in increasing these disease risks, especially for heart disease, was available many years before the changes in policy regarding the use of health claims for food products.

Developments Related to Heart Disease

Early in the century, evidence linking diet to heart disease was suggested when rabbits fed meat, milk, and eggs developed artery lesions (arteriosclerosis) similar to those found in humans (Ignatovski

[8] Our discussion of the scientific research in the area is taken in large part from *Diet and Health: Implications for Reducing Chronic Disease Risk* (National Research Council 1989) and from *The Surgeon General's Report on Nutrition and Health* (U.S. Surgeon General 1988).

1908). In these early studies, cholesterol was identified as the likely agent responsible for the disease condition, and a number of studies confirmed the ability to produce such lesions in a variety of animal species. By the mid 1930s, studies noted that the incidence of arteriosclerosis in humans across the world was positively correlated with fats and cholesterol consumption (Rosenthal 1934). Later, a number of researchers noted that the incidence of lesions in Scandinavia declined during World War II, a time when meat, eggs, and dairy products were scarce.[9] Thus, by the 1950s reasonably strong evidence indicated that fats and dietary cholesterol were linked to higher levels of heart disease.

During this same period, research linking serum cholesterol levels and heart disease emerged. A number of studies found that those with heart disease had higher levels of serum cholesterol than controls.[10] The Framingham study of coronary heart disease risk factors was begun in 1949 and by 1957 had established that a 1 percent reduction in serum cholesterol led to approximately a 2 percent reduction in the risk of heart disease (Dawber, Moore, and Mann 1957).

More evidence relating diet to heart disease through its effect on serum cholesterol developed soon after the Framingham study. The work by Keys, Anderson, and Grande (1957) and Hegsted *et al.* (1965) in the 1950s and 1960s established a strong empirical link between the consumption of fats and serum cholesterol levels. These studies suggested that saturated fat in the diet is especially linked to higher

[9] See, for instance, Biorck (1956), Malmros (1950), Strom and Jensen (1951), and Vartiainen (1946).

[10] See, for instance, Davis, Stern, and Lesnick (1937), Gertler, Garn, and Lerman (1950), Lerman and White (1946), and Poindexter and Bruger (1938).

serum cholesterol levels, while polyunsaturated fat intake is linked to lower serum cholesterol levels.

Since these studies, the flow of scientific research has continued, providing a more detailed understanding of the links between serum cholesterol and heart disease, and between the consumption of fats and dietary cholesterol, and serum cholesterol. For example, in *The Seven Countries Study*, serum cholesterol and coronary heart disease were examined across 16 populations of middle-aged men living in seven countries. The correlations for median serum cholesterol with age-standardized coronary heart disease death rates for the 16 cohorts was .82 (Keys 1970). In another major project, *The International Arteriosclerosis Project*, a correlation of .76 was found between the extent of arteriosclerosis and mean serum cholesterol in 19 populations (Scrimshaw and Guzman 1968). In the 1960s and 1970s, autopsy studies also found strong association between cholesterol levels prior to death and the extent of arteriosclerosis at autopsy (McGill 1968).

Studies also continued to support the relationship between dietary fats and serum cholesterol levels. In *The Seven Countries Study*, the correlation between the percentage of calories from fat and serum cholesterol levels was estimated to be .67. The correlation was .94 in the Israeli Heart Disease Study (Kahn *et al.* 1969).

While studies across populations suggested a strong correlation between serum cholesterol levels and fat consumption, cross-sectional studies within a population yielded strong results only for serum cholesterol levels above 200 mg/dl. These cross-sectional studies also found strong correlations between the type of fat in the diet and serum cholesterol. Early in the 1950s, results indicated that diets high in vegetable fats resulted in lower serum cholesterol levels, especially when compared to diets with similar amounts of animal fat (Kinsell *et*

al. 1952 and Groen *et al.* 1952). These initial studies were followed by a number of studies verifying that serum cholesterol levels were more strongly linked to saturated fat than to total fat. Later, *The Lipid Research Clinics Coronary Primary Prevention Trial* again demonstrated a strong positive correlation between saturated fat and serum cholesterol levels and a negative correlation between polyunsaturated fat and serum cholesterol levels (Gordon *et al.* 1982).

In summary, the basic scientific research linking dietary consumption of fats, especially saturated fat, and cholesterol to serum cholesterol levels, and, in turn, to heart disease was relatively well developed by the 1950s and has gathered continued support since then. Numerous research studies can be found in the 1960s, 1970s, and 1980s documenting and refining scientific understanding of the links between dietary fats and cholesterol, and serum cholesterol levels, and between serum cholesterol levels and heart disease.[11]

Developments Related to Cancer

Epidemiological studies and experiments on animals also provide support for a relationship between fat intake and the incidence of some types of cancer. While the basic scientific evidence linking fat consumption to heart disease was developed by the 1950s, the evidence linking fat intake and cancer accumulated later, developing significantly with human studies in the mid 1970s, though animal studies performed in the 1940s and 1950s had suggested a possible association considerably earlier.

[11] Recent reviews of the newer literature are available in U.S. Surgeon General (1988), National Research Council (1989), and in the review done for the recent FDA rulemaking for label claims (Grundy 1991).

In the 1970s substantial epidemiological evidence developed supporting the relationship between fat intake and breast and colon cancer. These studies indicated a strong correlation between the risk of breast cancer and fat consumption across countries.[12] During the same period, evidence from international comparisons associated the risks of colon and prostate cancer with fat consumption.[13]

Studies throughout the 1970s and 1980s have generally confirmed some of these results, but questions have arisen, especially for breast cancer. By 1982, the evidence had accumulated sufficiently for the National Research Council's (NRC) Committee on Diet, Nutrition and Cancer to conclude "that of all the dietary components it studied, the combined epidemiological and experimental evidence is most suggestive for a causal relationship between fat intake and the occurrence of cancer." Both epidemiological studies and experiments in animals provide evidence that higher fat consumption increases the incidence of cancer at certain sites, particularly the breast and colon (NRC 1982, 205). In 1989, the National Research Council's review of the additional evidence developed during the 1980s led it to conclude that the evidence indicated an association between total fat and the risk of several cancers, with the evidence most consistent for colorectal cancer, and less so for prostate and breast cancer (NRC 1989, 215).[14]

[12] See, for instance, Armstrong and Doll (1975), Gray, Pike and Henderson (1979), and Hirayama (1977).

[13] See, for instance, Armstrong and Doll (1975), Carroll and Khor (1975), Knox (1977), and Liu *et al.* (1979).

[14] More recent evidence from the Nurses' Health Study does not support a breast cancer link (Willett *et al.* 1992). For a review of recent evidence see Carroll (1991). This evidence was published after the period examined in this study.

INFORMATION DISSEMINATION TO CONSUMERS

As scientific understanding of the role of fats and cholesterol increased, information began to flow to the public through several channels. Public health organizations, government, and the press were all significant sources of this information. Food producers also attempted to bring this information to the public, though significant regulatory constraints limited their actions during much of the period.

In the remainder of this chapter, evidence is provided indicating that government and other public health and general information sources actively reported the growing scientific evidence linking fat and cholesterol consumption to disease risks for many years prior to the mid 1980s. The regulatory constraints that limited producers' role are also outlined, together with changes during the period examined in this study. Economic theories are outlined suggesting that the regulatory restrictions on truthful producer claims may have significantly limited the information flow to consumers and may have substantially reduced producer incentives to develop better food products. Finally, the chapter describes the basic hypotheses to be tested in this study.

Government and Other General Sources of Diet Information

A variety of evidence indicates that news media and some public health organizations spread the information linking consumption of fats and cholesterol to heart disease for many years prior to the change in the policies governing producers. For example, by the early 1960s, articles were appearing regularly in the popular press discussing the relationship between saturated and polyunsaturated fat and serum cholesterol, and

their relationship to heart disease.[15] By the early 1960s, the American Heart Association (AHA) assumed a leading role in advising consumers that they could reduce their risk of heart attack by limiting saturated fat and cholesterol consumption.[16] The Inter-Society Commission for Heart Disease Resources (1970) recommended that the general public reduce cholesterol consumption to less than 300 mg per day, fat to less than 35% of calories, and saturated fat to less than 10% of calories. The Council on Nutrition and Food (1965) of the American Medical Association gave similar advice, but directed it to physicians as the basis for advising patients with high cholesterol levels and those most vulnerable to heart disease, specifically young men and those with other coronary risk factors. A 1972 joint statement with the Nutrition Board of the National Science Foundation gave similar advice. Articles in the

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[15] Examples of articles in widely circulating magazines include "Are You Eating Your Way to a Heart Attack?" *Saturday Evening Post*, December 1, 1956; "The Perilous Fat of the Land," *Readers Digest*, April 1961, 123; "Fat, food and heart disease," *Consumer Reports*, August 1962, 410; Gordon G. Greer, "Where do we stand on medicine's big three? Cancer, Heart Disease, Stroke," *Better Homes & Gardens*, August 1962, 13; "How Can I Help My Husband Avoid a Heart Attack?" *Readers Digest*, September 1962, 69; "Can Diet Prevent Heart Attack? *Saturday Evening Post*, January 1964, 66; "Four fats in the blood: Which cause heart attack," *Time*, June 19, 1964; "Cholesterol: Guilty or Not Guilty?" *Readers Digest*, November 1964; "What you can do to help your husband avoid a heart attack?" *Good Housekeeping*, April 1965, 180; "Killer at the table? How diet affects risk of heart disease?" *Newsweek*, January 17, 1966, 81; J. D. Ratcliff, "I am Joe's Heart," *Readers Digest*, April 1967, 59; "Plain Talk About Your Diet and Heart Attacks," *Better Homes & Gardens*, August 1971, 4.

[16] In 1960, a major panel of the AHA issued a report advising "coronary-prone" persons to alter their diets to reduce calories and fat and to substitute polyunsaturated fat for a substantial part of the saturated fat in their diets (*New York Times*, December 11, 1960, 57). In 1964, the AHA extended their recommendations to the entire population (*New York Times*, June 9, 1964, 71) and repeatedly refined and publicized these recommendations through the 1960s and 1970s.

popular press did not appear to report on the relationship between fat and cancer until well into the 1970s.[17]

The evidence also suggests that government played a role in disseminating this information, though considerably later than other sources. Prior to the 1970s, government dietary advice focused on the need to obtain sufficient energy and nutrients from foods to prevent nutritional deficiencies. For instance, the Recommended Dietary Allowances (RDAs), which were adopted in the 1940s and revised periodically, were designed to prevent deficiency diseases. As a result, no RDAs were established for fat, saturated fat, cholesterol, or sodium.

By the 1970s, however, the focus of national nutrition policy began to shift to dietary components associated with chronic disease, though these moves often generated considerable controversy from interested parties. The shift in emphasis can be seen in rules for voluntary and triggered nutrition labeling adopted in 1973, which allowed labeling of fat content by type and cholesterol content, but the shift is most clearly reflected in a series of U.S. Senate hearings held between 1973 and 1977 on the role of diet in the development of chronic disease (U.S. Senate 1974, 1976, 1977). These hearings included testimony from prominent researchers on coronary heart disease, as well as from major health organizations in the U.S., and resulted in the report *Dietary Goals for the United States* (U.S. Senate, January 1977). These hearings and the resulting dietary guidelines received considerable publicity. Quantitative recommendations were issued for several aspects of food consumption, including recommendations to increase consumption of complex carbohydrates (55-60 percent of energy), and decrease

[17] Searches of the *Guide to Periodical Literature* and the *New York Times Index* show little public discussion of this evolving science until the 1970s.

consumption of refined and processed sugar (less than 15 percent of energy), fat (less than 30 percent of energy), saturated fat (less than 10 percent of energy), cholesterol (300 mg/day), and salt (3 gm/day).[18]

In 1979, the Surgeon General also published dietary advice for the public, including recommendations that Americans consume "only sufficient calories to meet body needs and maintain desirable weight (fewer calories if overweight)," "less saturated fat and cholesterol," "less salt," "relatively more complex carbohydrates such as whole grains, cereals, fruit and vegetables," and "relatively more fish, poultry, legumes (*e.g.*, beans, peas, peanuts), and less red meat" (U.S. Surgeon General, 1979). Similar public advice was given in 1980 and revised several times since in *Dietary Guidelines for Americans*, issued jointly by the Department of Agriculture and the Department of Health and Human Services (USDA/DHHS 1980, 1985, 1990, 1995).[19] In 1979 on the basis of evolving science, the National Cancer Institute advised Americans to lower their fat consumption to reduce cancer risks (U.S. Surgeon General 1987, 43, and National Cancer Institute 1979).

[18] The Senate recommendations were controversial at the time, with some industry and medical groups opposed to issuing dietary guidance outside a doctor-patient context (U.S. Senate, November 1977).

[19] The National Research Council also issued dietary guidelines in 1980 but did not recommend reductions in fats or cholesterol due to concerns about the strength of the science supporting specific recommendations, and instead limited its advice to: "be guided by your physician if you exhibit any specific risk factors, avoid obesity, do exercise, do not smoke, strive for a lower salt consumption, allow your reduced caloric intake to guide the amount of fat you ingest, and, above all, eat a variety of foods in moderation." This absence of fat and cholesterol recommendations created considerable controversy at the time. See, for instance, Jane E. Brody, "Dispute on Americans' Diets," *New York Times*, May 28, 1980, 18, Karen DeWitt, "Scientists Clash on Academy's Cholesterol Advice," *New York Times*, June 20, 1980, and U.S. Senate (1981).

A consensus panel convened by the National Heart, Lung, and Blood Institute (NHLBI) also issued guidelines recommending both drug and dietary strategies to lower serum cholesterol levels in late 1984 (*Consensus Statement* 1985). The National Cholesterol Education Program was created in 1985 to spread this information to physicians and the public. In addition to the standard government pamphlets and other printed materials in such efforts, public service announcements were made available to the press in Fall 1986, and a national public information campaign to stress cholesterol testing, featuring a "Know your cholesterol number" theme, was reported in the advertising trade press as beginning in October 1987 with outdoor, print, radio, and television public service announcements available to the media.[20]

In 1988 *The Surgeon General's Report on Nutrition and Health* provided another major review of the scientific literature on the relationship between diet and health and issued similar dietary recommendations for Americans, including recommendations to "maintain desirable weight" and "avoid too much fat, saturated fat and cholesterol." In 1989 the National Research Council also issued a major review with similar dietary recommendations in its report *Diet and Health: Implications for Reducing Chronic Disease Risk.*

This series of dietary recommendations paralleled those in other countries, including specific numerical guidelines for fat issued jointly

[20] See, for instance, *Advertising Age*, October 12, 1987, 8; Judann Dagnoli, "Ads pump low-cholesterol claims," *Advertising Age*, November 2, 1987, 4; or "Expert Report on Adult Cholesterol Approved by Federal Panel," *Food Chemical News*, October 12, 1987, 15. Government does not pay for television or radio time or for print space for public service announcements but relies on private parties' voluntary provision of these resources. We are unable to determine the market value of the advertising time and space devoted to these messages. Also, a major focus of the program was to educate physicians on appropriate treatment protocols for elevated cholesterol levels (Sempos *et al.* 1993).

by Sweden, Finland, and Norway in 1968, similar guidelines by most western European countries in the mid-1970s, and by the World Health Organization in 1982.[21]

Thus, government and other general information sources appear to have made considerable efforts to communicate the growing scientific evidence linking diet to heart disease and cancer. The American Heart Association began its effort in the early 1960s and was joined by government and other public health bodies by at least the mid-1970s. These efforts continued throughout the 1980s and include the National Cholesterol Education Program in the post-1985 period.

Regulatory Constraints on Producers

Food producers were also an information source throughout this period, though producers faced constraints in providing some types of information. Claims on food labels are primarily regulated by the Food and Drug Administration (FDA), and claims in advertising are primarily under the jurisdiction of the Federal Trade Commission (FTC). The types of claims allowed on labels or in advertising changed over time. For example, after producers reformulated margarine and cooking oil products to reduce saturated fat levels and began promoting their products' heart-related characteristics in the late 1950s, the FDA prohibited any label claims regarding cholesterol or fat content by type.[22] During the early 1970s enforcement of the ban on labeling these characteristics appears to have ended, and by 1973 the labeling policy

[21] For a more detailed discussion of international developments, see text surrounding Table 28-3 in National Research Council (1989).

[22] See "Vegetable Oils Are Enjoying a Boom," *New York Times*, March 4, 1962, III-1, "Advertising: Dairy Men Open Counterattack," *New York Times*, August 7, 1962, 36, "Oil-Food Labels Held Misleading, Government Against Use of 'Polyunsaturated' Label," *New York Times*, May 28, 1964, 75.

was explicitly changed to allow cholesterol and fat composition disclosures and simple nutrient claims about these characteristics on labels.[23] The FTC allowed simple nutrient claims about fats and cholesterol in advertising throughout this period as long as the claim was not deceptive or misleading, though the agency did propose additional rules for nutrient content claims in its Food Rule, as described below.

Despite the policy change regarding fat and cholesterol labeling, manufacturers' claims linking these or any other dietary component to disease risks was explicitly prohibited on labels throughout the 1970s and into the 1980s.[24] Thus, for instance, from 1973 to the mid 1980s a manufacturer could label the fat, saturated fat, and cholesterol content of a food product but could not on the label cite the health reasons *why* consumers should care about these characteristics, namely, the potential to reduce heart disease and cancer risks. From the early 1960s, this label prohibition appears to have been actively enforced[25] and the labeling

[23] For a discussion of the history of FDA regulation of cholesterol, see Calfee and Pappalardo (1989) or Pappalardo and Ringold (forthcoming). The FDA required a disclosure whenever cholesterol or type-of-fat content information was listed on the nutrition label that stated that the information was provided "for individuals who, on the advice of a physician, are modifying their dietary intake" of fats or cholesterol.

[24] See, for instance, "Food Labeling: Tentative Positions of Agencies," 44 *Federal Register*, December 21, 1979 or Hutt (1986, 42-50).

[25] For example, Hutt (1986, 32-34) reports that the agency seized Nabisco Shredded Wheat, because the label contained information linking serum cholesterol to heart disease in 1964, Gold-N-Sweet Safflower Shortening in 1962, for labeling claims about its high polyunsaturated fatty acid content that "represent and suggest that the article is adequate and effective to prevent atherosclerosis," and Golden Heart Cooking and Salad Oil in 1963, American Beauty Enriched Thin Spaghetti in 1964, and Kraft's Miracle-Egg Brand Instant Egg White Mix with Golden Egg Yolk Substitute in 1963 for similar claims. See also Calfee and Pappalardo (1989, 47). In 1976, the ITT Continental Baking Company was required to terminate a labeling campaign linking high fiber food to colon cancer, and in 1978 Kellogg was required to stop a similar campaign (U.S. House

(continued...)

policy prohibiting health claims was restated on several occasions by the agency.[26]

Rules for advertising never formally prohibited diet-disease claims or other more general health-related claims. Advertising cases are usually brought under the FTC's authority to pursue *deceptive* business practices. An assessment of what the agency considers deceptive must be determined from cases or other agency pronouncements during the period of interest. In the case of food claims, a variety of evidence suggests that diet-disease claims and other health-related claims in advertising raised substantial legal risk at the FTC during the period from the mid 1970s to at least the beginning of 1983 for disease claims, and until 1980 for more general health-related claims. A primary indication of agency thinking at the time can be taken from the progress of the FTC's Food Rule, a broad rulemaking undertaken in the mid 1970s to regulate food claims in advertising through explicit industry-wide rules and whose progress was reported regularly in the trade press.

(...continued)
Committee on Government Operations 1988, 4). See also the extensive discussion in Pappalardo and Ringold (forthcoming, Chapter IV).

[26] In its nutrition labeling rules adopted in 1973, the agency explicitly prohibited health claims, declaring that a food is misbranded if its labeling represents, suggests or implies: "That the food because of the presence or absence of certain dietary properties, is adequate or effective in the prevention, cure, mitigation, or treatment of any disease or symptom" (21 CFR 101.9(i)(1) (1985)). Also these 1973 rules provided for a limited number of fatty acid claims and explicitly prohibited any other claim dealing with fatty acid issues. In 1979 after public hearings and solicited comments, the FDA again concluded that it should "maintain the present policy of not allowing disease-related claims to appear on the labeling of conventional food products" (39 *Fed. Reg.* 76,007 (1979)). In 1985 in Congressional hearings the head of the agency reiterated that the agency's past policies would not allow heart-related claims (*Food and Chemical News*, April 1, 1985, 49).

In the original 1974 proposal for the Food Rule, the FTC staff recommended a ban of all diet-disease claims as inherently deceptive in advertising, as in the FDA labeling restrictions, and proposed to prohibit other general health-related claims, such as the term "health food."[27] The Commission itself did not propose to ban all health claims, instead reserving its options while soliciting comments on the issue in the rule's *Federal Register* notice.[28] By 1978 staff recommendations explicitly

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[27] See 39 *Federal Register*, November 11, 1974, 39862, Rosch (1975), or Weitzmann (1975). The specific staff proposal banning general health-related claims was presented in section 437.10 (b) as:

> A food shall not be represented in advertising as a "health food" or as containing "health foods," or otherwise be depicted, described or designated by any term or demonstration of similar import.

See also, Richard L. Gordon, "FTC on food: 'Health' is out; calories count," *Advertising Age*, March 20, 1978, 1.

[28] Specifically regarding heart-health claims, the agency asked for comments on the following questions:

> What claims, if any, concerning food and heart or artery-disease or any attendant conditions of the fat, fatty acid, or cholesterol content of the food, which are forbidden by 21 CFR 1.18 [the FDA rule] to be made in food labeling, should be permitted in advertising? Why should such claims be permitted in advertising but not in labeling? Is any such claim, even if literally true, likely to carry with it any additional implication(s) which would be deceptive or unfair? (39 *Federal Register*, November 11, 1974, 39850.)

Similar questions were asked about diet-disease claims in general.

Two years before the Food Rule notice, the FTC had acted to stop heart-health claims by Standard Brands for its Fleischmann's margarine advertising. The consent order in the case prohibited any claims that "represent that the use of Fleischmann's Margarines or other food fats or food oils will prevent or mitigate heart and artery disease," but explicitly provided a safe harbor for more general claims about cholesterol reduction in a dietary context, namely "that Fleischmann's Margarines can be used as part of a diet to reduce serum cholesterol which can contribute to such effect." (*In the Matter of Standard Brands, Inc., et al.*, 82 FTC, 1176.) See also "Fine Distinctions Drawn in FTC Consent Order Against Fleischmann's," *Food Chemical News*, January 8, 1973, 43.

dropped the proposal to ban heart-health claims and began discussing potential criteria for such claims (Orlans 1981). These rules would have required nutrition labeling and other restrictions for all such ads. By 1980 these proposals had been pared back considerably, but still proposed certain nutrition information in all such ads, as well as a *scientific controversy* statement, namely that "...experts disagree about the relationship between fat and cholesterol in the diet and the risk of heart or artery disease..."[29] These 1980 proposals were tentatively approved by the full Commission on May 21, 1980 and returned to staff to prepare final regulations.[30] At this point the Commission also voted to drop the proposed blanket prohibition of more general health-related claims, as typified by the term "health food."[31]

By 1982 the FTC had begun expressing reservations about many of the remaining features of the Food Rule, which ultimately led to a vote to terminate the rulemaking on December 17, 1982 and a formal public

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[29] "Staff Recommendations for Modification of Phase I of the Proposed Trade Regulation Rule on Food Advertising (16 CFR Part 437)," February 19, 1980, Federal Trade Commission, Washington, D.C. or Orlans (1981).

[30] See, for instance, "FTC works to get trim food bill in top shape," *Advertising Age* May 26, 1980, 3 or "FTC Tentatively Approves Weaker Rules Regulating Claims for Food Advertising," *Wall Street Journal*, May 22, 1980, 14.

[31] On April 8, 1980, the Commission published a request for public comment on its plan to terminate Phase II and Phase III of the Food Rule proceeding. Phase II primarily would have set standards for so-called "emphatic claims," primarily nutrient claims emphasizing the positive nutritional features of products, such as "high in vitamin C" or "high fiber," and Phase III would have required affirmative disclosure of nutrition information in all food advertising. Phase II would have also limited an advertisement from representing that a food was "*nourishing*, *wholesome* or *nutritious*, or ... any other term of similar import which in any way states, suggests or implies that such food is a valuable or significant source of nutrition" unless the food met strong nutritional criteria laid out in the regulation (*Federal Register*, November 11, 1974, 39841). Thus, the vote to terminate Phase II of the Food Rule in April 1980 also reduced the risk in making specific or general claims about the nutritional contents of foods.

notice ending the rulemaking in May 1983 in favor of case-by-case enforcement against *deceptive* food claims of all types.[32] In terminating the heart-health provisions in the rulemaking, officials expressed the concern that the "scientific controversy" statement and other requirements in the rule would inappropriately discourage valid diet-health claims in advertising and limit information on this topic for consumers. Thus, by May 1980 these FTC decisions in the Food Rule created considerably less legal risk for truthful claims in food advertising using general health-related claims, and by May 1983 less risk for claims that specifically referred to diet-disease risks, though no particular guidance was given on the form for such claims.

A diet-disease claim in advertising continued to raise the risk of prosecution by the FDA, however. Under FDA law, a diet-disease claim in advertising allowed the FDA to declare the product a "drug," and thus, subject to drug law requirements.[33] Although we know of no case where a food manufacturer was prosecuted solely on the basis of a health claim in advertising, this regulatory risk appears to have been taken seriously by advertisers at the time.[34] For instance, in July 1983 (following the termination of the Food Rule proceeding), the Kellogg Company asked the FTC for "safe harbor" guidance for diet-disease claims and

[32] See 48 *Federal Register*, May 24, 1983, 23270-71.

[33] See Hutt (1986), 25, or "FDA May Strengthen Ban on Cholesterol-Reduction Claims," *Food Chemical News*, January 25, 1971, 21-22.

[34] The courts have upheld the agency's position in supplement cases, however, finding that a product for which disease claims are made, even if not directly on labels, may be a *drug* under the agency's statute and as such, subject to all requirements for drug products (see, for example, *Alberty Food Products, Co. v. United States* 194 F. 2nd 463). Legal commentaries also regularly discussed the implication of advertising and other extra-labeling claims in affecting a product's definition under the labeling rules. See, for instance, Hutt (1986, 25), Davis (1987, 367), and Cooper, Frank, and O'Flaherty (1990, 691).

specifically requested coordination with the FDA to preclude the interpretation of a diet-disease claim in advertising as an "impermissible drug claim" by the FDA.[35] In arguing for a more open policy towards truthful diet-disease claims, the Kellogg letter states:

> Of course, in order to carry this out, a significant involvement by the Food and Drug Administration would have to be assumed. That agency's policy of attacking all advertising or labeling, which mentioned the name of a disease, would have to be changed. However, a more open approach to such advertising by the Commission could be the important first step toward allowing the American consumer access to important scientific and medical evidence.

The policy banning health claims on labels, with its implications for advertising, was effectively relaxed in 1985 following the introduction of Kellogg's highly publicized All-Bran advertising and labeling campaign explicitly using the National Cancer Institute's statements on the potential relationship between fiber and cancer to promote its high fiber cereals. The FDA's decision not to challenge this prominent campaign, which was in direct violation of the prohibition of diet-disease claims on labels, presumably led firms to perceive a reduced legal risk in using accurate and well founded health claims in advertising and labeling. FDA published a proposed rule to govern health claims on labels under a general deception standard in 1987,[36] but agency officials

[35] See, for instance, "Kellogg Asks for 'Safe Harbor Rule' for Nutrition, Health Ad Claims," *Food Chemical News*, August 22, 1983, 29, or Stanley E. Cohen, "FTC says ad filings light," *Advertising Age*, July 25, 1983, 3.

[36] See 52 *Federal Register*, August 4, 1987, 28843.

had publically supported a change in policy earlier and had announced that well founded claims would not be prosecuted in the interim.[37]

Thus, regulatory events over this period suggest that possibly as early as 1983 in advertising and by sometime around 1985 in labeling, producers faced considerably less regulatory risk in making truthful claims about diet-disease relationships supported by reputable science.[38] General health-related claims in advertising appeared to face less regulatory risk earlier, after the 1980 FTC decision on this issue. A number of food manufacturers first began to use general health-related claims and then later to promote the relationship between fats and

[37] FDA officials were often quoted in trade press articles during 1985 and 1986 as supporting valid health claims and promising an official change in policy to allow them. For instance, in 1986 the FDA's General Counsel commenting on likely enforcement during the debate about new rules: "Unless and until the agency makes some kind of determination on what its policy will be, if someone makes a reasonably accurate claim we are probably going to be doing the things we did and didn't do in the Kellogg's health message." (Marian Burros, "Health Claims on Food Put FDA in a Corner," *New York Times*, February 19, 1986, C1). See also, "Quaker TV spots pitch good health," *Advertising Age*, April 7, 1986 and Hutt (1986, 19 and 49) citing speeches by FDA and FTC agency officials.

[38] Advertising trade press reported the Kellogg event as a significant policy change that was likely to lead to more claims of this type. For example, *Advertising Age* articles referred to the All-Bran campaign as "breakthrough" advertising (October 29, 1984, 6) that "broke new ground" and "spurred a barrage of health-related ads from other leading food producers" (January 25, 1985). See also, Ronald Alsop, "More Food Advertising Plays On Cancer and Cardiac Fears," *Wall Street Journal*, October 8, 1987, 33; Patricia Picone Mitchell, "Making Health Claims," *Washington Post*, August 12, 1987, E1; Marian Burros, "Health Claims on Food Put FDA in a Corner," *New York Times*, February 19, 1986, C1; and Zachary Schiller, "The Great American Health Pitch," *Business Week*, October 9, 1989, 114.

cholesterol consumption and heart disease explicitly, as the policy debate continued on how best to regulate such claims.[39]

[39] Examples of heart-health claims during this period include several widely distributed two-page ads for Kellogg cereals, with headlines such as "If you've spent a lifetime raising your cholesterol, here's how you can help lower it in just six weeks," and after a discussion of heart disease issues: "A great place to start is breakfast. One of the most popular times to eat high fat and cholesterol foods ... just think of it; bacon, eggs, donuts..." (*Women's Day*, March 8, 1988, also see *Advertising Age*, January 25, 1988) or "She has her mother's eyes and her father's cholesterol" and text discussing the importance of giving children good dietary habits for heart health when young (*Good Housekeeping*, September 1989); four health ads for Quaker oatmeal, featuring Wilford Brimley, were tested in spring 1986 and began national distribution later, discussing the "right thing to do for your heart, ... your blood..." (*Advertising Age*, April 7 and June 30, 1986); ads for Le Menu Light Style frozen dinners that focused on the NHLBI's dietary recommendations for fat, cholesterol, and sodium, with comparisons to competitors' products (*Women's Day* August 15, 1989); the "Eat Well, Living Right" campaign for Stouffer's Right Course frozen dinners featuring two-page advertisements detailing American Heart Association recommendations to lower fat consumption for heart health (*Newsweek*, January 15, 1990); Healthy Choice frozen dinner ads, introduced in 1989 with a "Listen to your heart. Make a healthy choice." theme and ad focus on National Cholesterol Education Program dietary recommendations for fats, cholesterol and sodium; ads for Promise margarine with "Heart smart" claims began in 1986 with text "Recent medical evidence has shown that your family's risk of heart disease can be reduced by lowering their serum cholesterol levels. And because both cholesterol and saturated fat can raise those levels, you should try to include foods that are low in both in your family's diet... Like Promise Spread... it's lower in saturated fat than any margarine and has absolutely no cholesterol." (*Women's Day*, March 8, 1988); ads for Fleischmann's margarine: "One out of four adults faces the risk of heart disease. It's frightening but true ... Fleischmann's has zero cholesterol and low saturated fat. And a low cholesterol, low saturated fat diet with foods like Fleischmann's can help stack the odds in your favor." (*Good Housekeeping*, March 1990); ads for Pam cooking spray citing the American Medical Association "Campaign Against Cholesterol," with ad copy stimulated by recent margarine "no cholesterol" advertising with "Has someone been twisting the truth about margarine and cholesterol?" and focusing on the importance of saturated fat in addition to cholesterol to lower serum cholesterol levels (*Good Housekeeping*, June 1989); ads for Puritan 100% canola oil, which was introduced in 1986 and developed into a major campaign of this type, focused on its low saturated fat levels and heart-health, citing a recommendation from the American College of Nutrition and noting that "Saturated fat raises blood cholesterol more than anything else you eat. So it's important to lower saturated fat in the diet... Oils with less saturated fat are a better

(continued...)

Ideally, we would like to quantify explicitly the change in advertising and labeling content over time to better assess the timing and magnitude of any changes in the use of more explicit claims about diet-disease issues, and whether greater use of these claims increased the competitive pressure on firms to focus on the nutritional dimensions of their food products more generally. Advertising and labeling content is very difficult to study, however, because the required data must be collected at considerable cost from original sources, which, in practice, is usually limited only to advertising in magazines and other print media. This is a particular problem for food advertising, because most ad spending for food products is for television advertising (82 percent in 1990), and we know of no archive of television advertising available for research purposes. Similarly, we know of no way to trace claims on labels directly. In Appendix A we describe the limited evidence on print advertising available in the literature. We also review evidence from a sample of food advertising from one magazine, *Good Housekeeping*, that we conducted to refine and confirm the findings from these other sources, as well as evidence from the trade press about changes in advertising during the period of the study.

This assessment of the available evidence leads us to conclude that beginning in 1980, the regulatory environment changed to allow producers to become an additional source of information linking diet *generally* to health, and then by 1983 to explicit disease conditions. The regulatory uncertainties in the area seemed to lead firms to enter this field cautiously, but available evidence indicates that major firms did not

(...continued)
choice for a heart healthy diet." (*Newsweek*, October 9, 1989).

make direct health claims between 1977 to 1983,[40] that campaigns with diet-disease claims started slowly, with at least one campaign (for Mazola products) beginning in 1983, and with several health claim campaigns running in 1985 and 1986.[41] By 1987 a number of firms were making heart-health claims in major advertising campaigns and the frequency grew considerably between 1987 and 1990. General health-related claims seemed to arise earlier, beginning in 1980 and increasing to 1985, when the increase in health-related claims shifted to more explicit diet-disease claims. The use of health claims by some firms also seems to be associated with greater use of nutrient claims in the market more generally.[42]

The next section considers economic advantages and disadvantages of the alternative sources of information and formulates hypotheses about how these changes in the regulatory environment might affect consumer and producer behavior.

[40] We did find evidence that two smaller brands made diet-heart claims in print advertising, as described in the appendix.

[41] For instance, Promise margarine, which was lower in saturated fat than margarines at the time, introduced its "Heart smart" theme in 1986 with a national campaign focused explicitly on the role of saturated fat in coronary disease risks. Puritan, a 100% canola oil, was introduced in 1986 with a major advertising campaign of this type. In 1985 print ads for the newly introduced Fleischmann's 100% Corn Oil cited a recent study's conclusion that "lowering serum cholesterol can help reduce the incidence of coronary heart disease in high-risk middle aged men..." (*McCall's*, March 1985, 144). A TV campaign by Nabisco for Fleischmann's lower saturated fat margarine, featuring a 30-year-old man talking about his recent heart attack and discussing the role of diet in prevention, also ran in 1986 (See "Margarine health themes spread," *Advertising Age*, September 29, 1986, and "Ads pump low cholesterol claims," *Advertising Age*, November 2, 1987).

[42] See, for instance, "Margarine health themes spread," *Advertising Age*, September 29, 1986, "Ads pump low cholesterol claims," *Advertising Age*, November 2, 1987, and for claims in margarine and fats and oil advertising, Pappalardo and Ringold (forthcoming).

HYPOTHESES FOR CONSUMER AND PRODUCER BEHAVIOR UNDER ALTERNATIVE REGULATORY RULES

Government and Other Sources of Diet-Health Information

Government has some advantages as a source of diet-health information. As with all public goods, government is in a unique position to tax the population to fund the development and dissemination of information and thus avoid the complexities introduced by attempting to price information. Moreover, if the public interest theory of government is reasonably accurate in this arena (in which government is assumed to maximize social welfare), government would be an unbiased and credible information source that would dispense information whenever its benefits justified the cost of spreading it.

However, government provision of information also has potential disadvantages, especially if private information sources are prohibited. For instance, if government is the sole or major source of such information, great power is concentrated in one body. This can be a significant problem if the process is susceptible to errors, or if any of the other theories of government behavior apply. For instance, if the "capture" or "special interest" theories of government are valid (Stigler 1971 and Peltzman 1976), special interest groups might have undue influence on the types of information developed and disseminated, possibly blocking or slowing dissemination adverse to their interests. Similarly, if bureaucratic incentives influence government actions, decisions may be excessively risk averse or otherwise unresponsive to changes in science or the marketplace (Niskanen 1971).

Finally, the nature of government and the pressures to which it responds influence the way information is likely to be dispensed. In the nutrition area, for instance, information is usually disseminated through

the release of government studies or scientific panel recommendations. These releases are initially limited to one-time reports in the news media, though a second-round dissemination takes place through the popular press that reports nutrition information and through public service announcements voluntarily provided by the various media outlets.[43] Government brochures and other public education efforts are also conducted through various welfare programs and in schools. Most of this information is highly concentrated in the news and print media, and therefore, likely to be absorbed disproportionately by those reached by these information channels and those most efficient at processing information.[44]

Moreover, the information is generally released in generic form (*e.g.*, "Reduced saturated fat consumption may reduce your risk of heart disease.") and not in product-specific form (*e.g.*, "Brand X margarine contains less saturated fat than other margarines, and less saturated fat in your diet may reduce the risk of heart disease.") Generic information requires that consumers have other sources of information and a greater understanding of the basic issues to turn the information into behavior, again creating a potential bias towards those most efficient in processing information and those with better access to other sources of health information.

Like government, major public health organizations tend to be credible information sources, providing broad guidance on diet-disease

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[43] A number of studies have found that the effects of information that is not repeated frequently can be short-lived. See Russo *et al.* (1986), for instance, for such a finding on the effects of nutrition information in supermarkets.

[44] Feick, Hermann, and Warland (1986), for instance, find that more educated consumers are significantly more likely to acquire nutrition information from print media than their less educated counterparts.

issues. These organizations generally do not provide detailed information on particular food choices, especially at the brand level. These groups rely on voluntary contributions for funding, and thus, tend to have relatively limited resources to devote to public education.

On the basis of these theoretical considerations, we can formulate several hypotheses subject to empirical testing about how government and related general sources of information might affect fat and cholesterol consumption. Other things equal, we hypothesize that the continuous flow of government and general information about the health implications of diet on heart disease and cancer led to a decline in the average consumption of fat, saturated fat, and cholesterol in the U.S. We hypothesize that these declines will be disproportionately concentrated among consumers who are best reached by print and news media and those most efficient at processing information. We also hypothesize that these declines will be concentrated in those food categories where broad statements can be made, such as meat and dairy products. Finally, because of the expected limited spread and general nature of the information, we hypothesize that the government information will have spurred the development of more healthful food products, but that these effects will be limited.

Producers As a Source of Diet-Health Information

Food producers are another potential source of diet-health information. Certain food products have, or can be formulated to have, desirable nutritional characteristics that may not be well understood by potential consumers. If these potential consumers could be informed about these product features at a low enough cost, demand for the product would increase enough to create profit opportunities. This mechanism creates an incentive for producers to provide the missing

nutrition information to potential consumers and to compete by developing more nutritious products.[45]

Producers have several advantages as providers of diet-health information. First, producers should be willing to devote substantial resources to information provision, if public knowledge has significant deficiencies and if products can be sold profitably as a result of providing this new information. Thus, producers are capable of adding large amounts of some types of diet-health information to the market, when it is needed. Second, producers' incentives are to provide nutrition information in product-specific form. Thus, as compared with government or general information, producer-provided nutrition information is more directly tied to potential behavioral changes, making it easier to act upon. Finally, producers have strong incentives to find the best methods to communicate information to those who would use. These considerations should improve consumer access to the information, especially for subgroups within the population that do not have the information, and should reduce the information processing requirements necessary to turn the information into behavior.

Producer-provided information also has potential disadvantages, however. One important issue is credibility. Consumers cannot usually verify relationships between diet and health directly (especially for long-term effects). Unless the market or government has mechanisms to punish firms that lie, or consumers can verify the information by

[45] Producer provision of information raises a host of issues that are beyond the scope of this paper but that are important for understanding these incentives and for designing policy in the area. For example, if the information is provided in generic form, other producers of similar products will simply "free-ride" on the information and reduce the benefits to the original producer. Thus, producers are unlikely to provide health information unless they can tie it directly to particular products. See Calfee and Pappalardo (1989) and Ippolito (1986, 1988) for discussions of these general issues.

references to authorities or in some other way, consumers would be expected to be skeptical of producer-provided information, limiting food producers' incentives to make claims.

A second issue is the inherent bias of producer-provided information. Assuming they can be credible when they make claims, producers have strong incentives to provide nutrition information that is positive about their product, but they have little incentive to provide negative information. Despite this inherent bias at the individual firm level, economic theory indicates that in many cases competition among producers can eliminate this bias in the information provided by the market as a whole (Grossman 1981).

For instance, this theory would predict that if some firms advertise the no-cholesterol benefits of their product and are gaining sales by omitting information on other dimensions, such as saturated fat, competing firms with no-cholesterol and low saturated fat products have incentives to advertise these facts. This "unfolding" theory suggests that despite firms' initial reluctance to highlight "bad" nutritional characteristics, competition will often induce all but the worst firms to disclose the features of available products, if the market values the information. As long as consumers are skeptical of firms that do not disclose additional features, the market would generate information allowing consumers to rank products on most key features; in our example on both cholesterol and saturated fat.[46]

Our discussion of producers' incentives to provide information suggests several possible effects from allowing producers to advertise the diet-health effects of fats and cholesterol consumption. First, other things equal, if producer claims are sufficiently credible, we hypothesize

[46] See footnote 39 for examples of such claims from this period.

that producer advertising of the health benefits of reducing fat and cholesterol consumption will add to the available information about diet's role in heart disease, leading more individuals to make dietary improvements. Second, because advertisers have strong incentives to be effective in reaching and conveying information to the public, we expect such information to reach a broader distribution of the population compared with that provided by government and other general sources. Third, because of the greater ability to communicate the value of nutritional features of their products, we expect an increase in the number of new products that are healthier on the relevant dimensions. Fourth, we expect producer claims to be more effective in generating improvements in food categories where broad statements cannot be made easily, such as in mixed food categories, but where marginal improvements can be made with more detailed information. Finally, we hypothesize that despite the absence of a legal requirement to disclose types of fat and cholesterol, competitive pressures will increase the number of products disclosing these features. As a result, we would not expect consumers to improve on one dimension, while unknowingly worsening their diets on another (*e.g.*, reducing cholesterol, while increasing fat consumption).

Implicit in these information hypotheses is a presumption that existing regulatory constraints are sufficient to discipline most deceptive claims that would lead consumers to make undesirable food changes. Thus, it is important to state clearly our alternative hypothesis, which we will usually refer to as the *deception/confusion hypothesis* for producer claims; namely, the hypothesis that producer health claims made under the enforcement rules at the time are sufficiently incomplete, misleading, or deceptive to lead consumers to make inappropriate changes in diet, resulting in a deteriorating rate of improvement in the fat, saturated fat, and cholesterol content of diets. Thus, for instance, if

this alternative hypothesis is valid, we would expect to see a decline in fat, saturated fat, and cholesterol consumption due to the flow of government and general information prior to the mid-1980s, and a slowing or reversal in that rate of improvement, once the restrictions on producer health claims are relaxed. This deception/confusion hypothesis for producer health claims is believed to be valid by some critics of the health claim policy in effect during 1985-1990 period, and was part of the basis for the enactment of the NLEA in 1990 and the labeling rules adopted under it by the FDA.

OUTLINE OF EMPIRICAL APPROACH

With these hypotheses developed, we briefly outline our empirical approach before beginning the detailed analyses in the following chapters.

The majority of our analysis focuses on *individual consumption behavior* in an attempt to identify changes in the average consumption of fat, saturated fat, and cholesterol over time. We also attempt to determine which types of consumers responded to government and general sources of information and whether relaxation of the restrictions on producer health claims appears to have spread the information to more consumers or different types of consumers. We also examine which food choices were affected most during the two periods, that is, which food categories contributed to changes in fat and cholesterol consumption in the U.S. diet under the two policies. These aspects of the study rely on USDA surveys of individuals' food consumption for seasonally matched samples of men and women, 19-50 years of age, from 1977, 1985, 1986, 1987/88, and 1989/90.

Due to the limits of available data, we focus on two time periods, the years 1977-1985, when government and other general information

sources were the primary providers of diet-disease information, and the years 1985-1990, when the restrictions on health claims were relaxed on labels and in advertising. As discussed above, the available evidence suggests that heart-health claims actually started somewhat before 1985, but grew more rapidly after 1987. Thus, using 1985 as the start of the health claims period for heart-health claims is open to question.[47] Whenever possible, we also provide statistics by year to allow a finer assessment of the issue.

The study also examines aggregate *production* or *disappearance* data for available food categories during the years under study. This allows us to determine whether these more aggregate data show the same pattern of movement as the individual consumption data and to determine where changes occurred for these product classes and whether these changes match those found in the consumption data.

Finally, FDA knowledge surveys from 1984, 1986, and 1988 are analyzed to examine changes in individuals' reported *knowledge* of various diet-health relationships related to fat and cholesterol consumption, again with the goal of assessing the information hypotheses described above.

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[47] For instance, if the evidence indicates that diets improved faster during the period in which health claims were allowed, compared to the period when they were prohibited, we will overstate the effectiveness of government and general information somewhat, since some health claims were made in advertising prior to 1985.

III

CHANGES IN DAILY CONSUMPTION OF FATS AND CHOLESTEROL

INTRODUCTION

In this chapter detailed consumer survey data on food consumption for 1977, 1985, 1986, 1987/88, and 1989/90 are used to estimate changes in the average daily consumption of fat, saturated fat, and cholesterol. The average consumption of fats and cholesterol in 1977 should reflect all of the information that consumers had absorbed about the health implications of consuming these lipids by that time. Consumption data for 1985 should allow us to determine the changes in average consumption that occurred between 1977 and 1985. During these years, producers were allowed to label cholesterol content and fat content by type. Thus, this analysis should give us some indication of the rate at which government and other information sources, together with producer content claims, reached consumers and affected the fat and cholesterol content of their diets.

Average consumption during the years 1985-1990 is examined next. In particular, this chapter tests the hypothesis that consumption of fats and cholesterol fell faster during the period when the policy towards producer health claims was relaxed, against the alternative deception/confusion hypothesis that the policy change was detrimental

to consumer efforts to improve their diets, leading to increased consumption of these nutrients or to a slower rate of reduction.

DESCRIPTION OF THE USDA CONSUMPTION DATA

This portion of the study uses the basic samples from the 1977 and 1987/88 USDA Nationwide Food Consumption Surveys (NFCS) for individuals, and from the 1985, 1986, and 1989/90 Continuing Surveys of Food Intakes by Individuals (CSFII), all of which provide detailed food consumption data for individuals. These surveys are based on multistaged, stratified probability samples representative of the 48 contiguous states for the sex-age groups sampled.[48] Weights are included in the NFCS and CSFII data to correct for sampling probabilities and differential response rates. All of the analyses in this report use these weights to adjust the data.[49]

The 1977 and 1987/88 surveys are large scale, full population surveys, but the 1985 and 1986 surveys focused on particular subpopulations, specifically on women 19-50 years of age in spring

[48] The stratification plan took into account socioeconomic considerations, so that the number of eligible households in each stratification cell reflects the proportion of the respective number of households in each cell in the population. However, adjustments to the sample are required, because not all eligible households agreed to participate, not all eligible individuals in eligible households agreed to participate, and not all interviews yielded complete dietary information. We use data from the basic samples only, which are designed to be representative of the population.

[49] For a detailed description of how these weights were determined see the NFCS and CSFII documentation (USDA various years). Weighted data were used for nonregression analyses, because failure to weight the data in these cases could distort resulting statistics. Less consensus exists on the use of such weights in multivariate techniques. We use weighted ordinary least squares with White's correction of the standard errors in our regression analyses, as described in more detail in Chapter 7. Nevertheless, our tests indicate that the results and conclusions of this report are generally not sensitive to whether weighted or unweighted data are used for either type of analysis.

1985, men 19-50 years of age in summer 1985, and women 19-50 years of age in spring 1986.[50] The 1989/90 survey is a smaller scale, full population survey. Finally, the 1977 and 1987/88 surveys collected some types of demographic data only for adult heads of household. One of these variables is education, a characteristic of primary interest for our study. Since one of the purposes of this study is to examine changes in consumption over time, it is important that the base of analysis be consistent over time. For this reason, this study focuses on data for subpopulations that are consistently sampled by the USDA in the years available and for which the basic variables of interest are available.

In particular, this study analyzes those data from the USDA basic surveys[51] that constitute 1-day recall data on food consumed in a 24-hour period in spring 1977, 1985, 1986, 1987/88, and 1989/90 for women, 19-50 years of age, who are heads of households and who consume at least 300 calories on the interview day.[52] The study also uses similar data in summer 1977, 1985, 1987/88, and 1989/90 for samples of men, 19-50 years of age, who are heads of households and who consume at least 300 calories on the interview day. Selected results are also presented for

[50] Data on young children are available in spring 1985 and 1986, but these data are not used in this study.

[51] Low income samples were not used in this study. The low income sample designs changed more substantially over time, and such samples are not available in every year. Thus, to keep the basis of comparison as consistent as possible over time, this study is based only on the basic samples that constitute the main portion of the USDA data, which were designed to be probability samples of the age groups surveyed.

[52] Use of only one person per household allows us to avoid the potential statistical problems introduced when multiple individuals from the same household are used in this type of analysis. Also since part of this study explores changes in the types of foods consumed over time, this calorie restriction is added to remove individuals who essentially ate nothing on the interview day. Our statistical tests indicate that the results are not sensitive to this criterion.

summer samples for women and spring samples for men, where available, to allow an assessment of seasonality issues.

In each of the surveys, detailed data are reported for all food eaten within a 24-hour period either at home or away from home, including the amount of each item consumed. The databases link each food with nutritional values developed by USDA's Human Nutrition Information Service (HNIS) for use with the NFCS and CSFII data. These nutrition databases contain representative nutrient values for thousands of food items, including information on sodium, fat, calcium, and other nutrients. In addition to the intake data, the USDA data contain demographic information, including household income, education of the household heads, whether the household has both male and female heads, region, race, urbanization, and a host of other characteristics.

The 1985 and later nutrition data also include the saturated fat and cholesterol content of each food. USDA provides a program that links the saturated fat and cholesterol content of foods in 1985 to the most similar food item in the 1977 database. We use these linked 1985 data to calculate saturated fat and cholesterol consumption in 1977.[53]

The 1987/88 USDA data were collected from April 1987 through August 1988, and thus, we have more than one year of data for spring and summer. However, the 1987 and 1988 data for each season are treated as a joint sample, because the weights are determined for the

[53] One limitation of this linking program is that it does not reflect changes in the nutritional makeup of foods during the period. If, for example, producers reduced the cholesterol content of products by 1985, assigning the 1985 cholesterol value in 1977 would lead us to underestimate the actual cholesterol consumption in 1977. Consequently, the 1977 values of cholesterol and saturated fat may be biased downwards, if producers responded to market pressure resulting from the information about cholesterol and saturated fat. We examine the potential magnitude of this bias below.

combined sample. Approximately two-thirds of the spring data are from 1988 and approximately 85% of the summer data are from 1987.

The response rate in the 1987/88 survey is 31% of eligible individuals. This rate is considerably below the response rates for the other years of the USDA surveys; the response rate is 57% in 1977, 68% in 1985, 75% for women in 1986, and 54% in 1989/90. The lower response rate in the 1987/88 survey raises the concern that the 1987/88 data may be particularly affected by nonresponse bias.[54] There is no way to test this issue directly, because the USDA did not conduct a nonrespondent survey. Unfortunately, for analytical purposes, the 1987/88 survey is the large national survey; recall that the 1986 survey did not include men and the 1989/90 survey is considerably smaller.

The potential problem with the 1987/88 data leads us to adopt a more careful strategy for analyzing the post-1985 period. In particular, we report the 1985, 1986, 1987/88, and 1989/90 results separately by year, whenever possible, to allow us to gauge whether differences found after 1985 reflect a continuation of changes observed in the various years of data. If the 1987/88 data give us results that are inconsistent with changes that had occurred by 1986 and 1989/90, the evidence will bolster concerns about potential nonrespondent problems with the 1987/88 survey. However, if the results in 1987/88 are consistent with movements in the 1986 and 1989/90 data, our concerns will be assuaged.

[54] The low rate appears to be the result of a shift to computer-assisted personal interviewing techniques in the 1987/88 survey (using lap-top computers), which were not adequately field-tested, resulting in a high loss rate of experienced interviewers. See General Accounting Office (1991) for a discussion of the survey response rate, or see "Major U.S. Survey on Food Use and Pesticides Is Drawing Fire," *New York Times*, September 11, 1991, C1.

Finally, the nutrition database is continually modified by the USDA in an attempt to reflect the nutritional characteristics of foods in the market accurately over time. As in any effort of this type, adjustments to the nutrition database often take place in discrete increments that do not necessarily reflect the incremental changes occurring in the market. Because we examine consumption changes over time, significant modifications to the nutrition database could affect our results and are examined as we report results.

The 1977 sample contains 1,309 male and 1,704 female observations in spring, and 720 male and 1,097 female observations in summer. The 1985 sample includes 1,259 female observations in spring, and 582 male observations in summer. The 1986 sample contains 1,293 female observations in spring. The 1987/88 sample provides data for 705 males and 889 females in spring, and for 230 males and 323 females in summer. Finally, the 1989/90 survey provides data for 365 females and 266 males in spring, and for 391 females and 306 males in summer.

MEASUREMENT ISSUES

Consumer reactions to diet-health information about fats and cholesterol can be measured in several ways. We focus on changes in the average levels of total fat, saturated fat, and cholesterol in the diet per day, rather than solely on changes in nutrient density measures, such as the percentage of calories from fat or saturated fat. Nutrient density measures are often used in nutrition research, because they allow the researcher to abstract from the different caloric needs of individuals and to use uniform standards in evaluating key characteristics of consumption across the population. Also, nutrient density measures are

preferable if food consumption is randomly underreported in the surveys.[55]

Despite these advantages, nutrient density measures are less desirable for our purposes of evaluating the absorption of diet-health information over time. First, use of nutrient density measures presumes that caloric consumption itself is irrelevant to the topic under study. For a study of consumers' reaction to diet-health information, this is not an appropriate assumption. One of the major diet-health recommendations during the period covered by this study concerns the benefits of maintaining a desirable body weight by controlling caloric intake. If many consumers are overweight, as studies show,[56] and if consumers absorbed this information, we would expect average caloric consumption to fall during the period. As a result, movement in a nutrition density measure, such as the percentage of calories from fat, mixes consumers' reaction to information regarding caloric intake with their reaction to information about fats and cholesterol consumption.

A second problem arises from independent movements in caloric intake. Any change in average caloric consumption could affect an assessment of consumers' reaction to diet-health advice using density measures. Examination of the 1977 and 1985 USDA data provides a useful illustration of this potential problem. As we will see below, reported caloric intake increased significantly between 1977 and 1985.

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[55] If the underreporting is not random, however, this advantage is removed, especially in studies such as this one, which is concerned with changes over time.

[56] See, for instance, Kuczmarski *et al.* (1994), which reports that approximately 25 percent of the population aged 20 to 74 years of age is overweight in the 1976-1980 NHANES II sample and this estimate increased to 33 percent in the 1988-1991 NHANES III sample, where the overweight criterion is set at a fixed body mass index over time. Other studies with similar results are also cited there.

Much of the increase in calories can be accounted for by increased consumption of soft drinks, fruit-flavored drinks, and alcoholic beverages. This increased consumption of "empty" calories has the effect of decreasing the percentage of calories from fat, even if consumers do not react at all to information about fat. To attribute such an improvement in the percentage of calories from fat to consumers' reaction to health information would be inappropriate.

Consequently, in evaluating consumers' reaction to diet-health information, it is important to assess whether consumption of fats changed, calories changed, or both, and in what direction. For these reasons, we report the level of each dietary characteristic separately to allow a more accurate assessment of whether the movement represents a reaction to diet-health information or to other factors.

RESULTS

Fat Consumption

As shown in Table 3-1, average daily fat consumption for both men and women fell during the 1977-1985 years, and the rate of decline accelerated during the period after 1985. Average fat consumption for women declined significantly by 3.7 grams in the eight years from spring 1977 to spring 1985 (t=-2.6),[57] and fell an additional 5.7 grams in the nearly 3 years ending in spring 1987/1988, and 7.5 grams in the nearly 5 years between the 1985 and 1989/90 samples, with 1987/88 fat consumption between the 1986 and 1989/90 averages. The changes during the post-1985 period are statistically significant in simple means tests for both the 1985-1987/88 and 1985-1989/90 comparisons (with t= -3.7 and -3.9, respectively). For men, fat consumption in summer

[57] This result is consistent with the negative trend in fat consumption in the U.S. that began in the 1960s. For instance, see Stephen and Wald (1990).

Table 3-1 Average Daily Consumption of Fat, Saturated Fat, Cholesterol, and Calories (Primary Seasons)

Women, 19-50, Spring[1]	1977	1985	1986	1987/88	1989/90
Fat (g)	73.3	69.6+	66.8	63.9*	62.1*
Saturated Fat (g)	26.2[2]	25.2	24.6	22.9*	21.7*
Cholesterol (mg)	345.3[2]	304.9+	303.0	245.2*[3]	221.2*
Calories (kcal)	1581.7	1676.0+	1607.4*	1534.0*	1574.7*
% Cal. from Fat	40.9	36.8+	36.7	37.0	35.3*
% Cal. from Sat. Fat	14.6	13.3+	13.4	13.2	12.3*
Without Drinks[4]					
Calories (kcal)	1458.8	1499.6	1461.7	1396.8*	1407.2*
% Cal. from Fat	44.5	40.8+	40.2	40.7	39.4*
% Cal. from Sat. Fat	15.8	14.7+	14.7	14.5	13.6*
N	1704	1259	1293	889	365
Men, 19-50, Summer[1]					
Fat (g)	112.8	107.5	NA	94.1*	92.6*
Saturated Fat (g)	40.1[2]	39.1	NA	33.4*	32.4*
Cholesterol (mg)	498.9[2]	446.6+	NA	367.0*[3]	389.0*
Calories (kcal)	2406.5	2592.0+	NA	2246.7*	2275.5*
% Cal. from Fat	41.7	36.6+	NA	36.9	35.8
% Cal. from Sat. Fat	14.8	13.2+	NA	13.0	12.4*
Without Drinks[4]					
Calories (kcal)	2200.3	2231.1	NA	1965.1*	1985.8*
% Cal. from Fat	45.5	42.3+	NA	42.1	40.9*
% Cal. from Sat. Fat	16.3	15.2+	NA	14.9	14.2*
N	720	578		230	306

DATA. USDA NFCS and CSFII Surveys, 1977, 1985, 1986, 1987/88 and 1989/90.

NOTES. All means weighted. NA = not available. + indicates significant difference from 1977 at the 95 percent level; * indicates significant difference from 1985.

[1] Includes only heads of households.

[2] Saturated fat and cholesterol are derived from 1977/85 matched nutrition data.

[3] In 1987 egg cholesterol content was reduced 22 percent; in 1987 cholesterol intake would be approximately 266.5 mg for women and 398.9 mg for men with the old data.

[4] Excludes soft drinks, and fruit-flavored and alcoholic beverages.

declined by 5.3 grams during the 1977-1985 period (t=-1.6), and an additional 13.4 grams in the 1985-1987/88 years (t=-3.3) and 14.9 grams between 1985-1989/90 (t=-3.8).

Table 3-2 gives fat consumption in the off-season, where we have no matching 1985 data to assess the relative rates of decline between the two regulatory regimes. These data indicate that fat consumption tends to be higher in summer than in spring in those years where we can make the comparison, and that for men the rate of decline in fat consumption may be larger in spring as well.

In Figures 3-1 and 3-2, fat consumption is shown as a percentage of its 1977 value to illustrate the changes in fat consumption during this period. The evidence indicates that average fat consumption per day fell during the 1977-85 period, prior to the change in policy, and fell at a faster rate during the health claims period of 1985-1989/90. Regardless of the season, consumption in 1989/90 is significantly below 1977 levels for both sexes, and where we can assess consumption in 1985, the evidence indicates that considerably more of the reduction occurred in the post-1985 period.

The percentage of calories from fat and caloric intake are also shown in Table 3-1 for women in spring and men in summer. During the 1977-1985 period, the percentage of calories from fat for women fell by 4.1 percentage points (t=-11.0) and by an additional 1.5 percentage points (t=-2.6) by 1989/90, though the 1987/88 data indicate that it remained essentially constant between 1985 and 1987/88. For men the percentage of calories from fat fell by 5.1 percentage points between 1977 and 1985 (t=-9.6) and by 0.8 percentage points between 1985 and 1989/90 (t= -1.2), with the 1987/88 data again showing no change (t=0.3). Thus, the changes in the percentage of calories from fat for men show a different

Table 3-2 Average Daily Consumption of Fat, Saturated Fat, Cholesterol and Calories (Auxiliary Seasons)

Women, 19-50, Summer[1]	1977	1987/88	1989/90
Fat (g)	76.7	63.1+	64.5+
Saturated Fat (g)	27.3[2]	22.8+	22.5+
Cholesterol (mg)	355.4[2]	258.0+[3]	258.0+
Calories (kcal)	1634.4	1568.6	1640.2
% Cal. from Fat	41.5	36.1+	34.8+
% Cal. from Sat. Fat	14.8	13.0+	12.2+
Without Drinks[4]			
Calories (kcal)	1518.5	1414.7	1456.5
% Cal. from Fat	44.8	39.8+	39.2+
% Cal. from Sat. Fat	15.9	14.4+	13.8+
N	1097	323	391
Men, 19-50, Spring[1]			
Fat (g)	113.5	89.9+	83.3+
Saturated Fat (g)	40.7[2]	31.9+	28.9+
Cholesterol (mg)	528.7[2]	353.5+[3]	294.9+
Calories (kcal)	2404.9	2136.7+	2157.3+
% Cal. from Fat	41.7	37.8+	34.4+
% Cal. from Sat. Fat	15.1	13.4+	11.8+
Without Drinks[4]			
Calories (kcal)	2200.0	1910.1+	1880.9+
% Cal. from Fat	45.6	42.2+	39.5+
% Cal. from Sat. Fat	16.4	15.0+	13.6+
N	1309	705	266

DATA. USDA NFCS and CSFII Surveys, 1977, 1987/88, 1989/90.

NOTES. All means weighted. + indicates significant difference from 1977 at the 95 percent level.

[1] Includes only heads of households.

[2] Saturated fat and cholesterol derived from 1977/85 matched nutrition data.

[3] Cholesterol content of eggs reduced 22 percent in 1987.

[4] Excludes soft drinks, and fruit-flavored and alcoholic beverages.

Figure 3-1 Fat and Saturated Fat Consumption Women, 19-50 Years, Spring and Summer

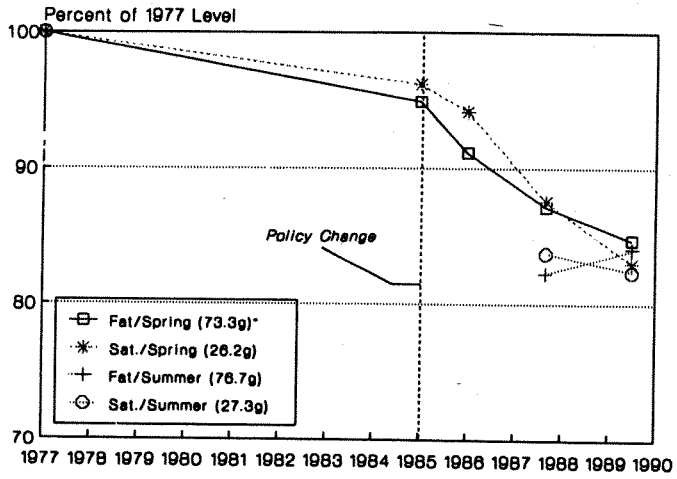
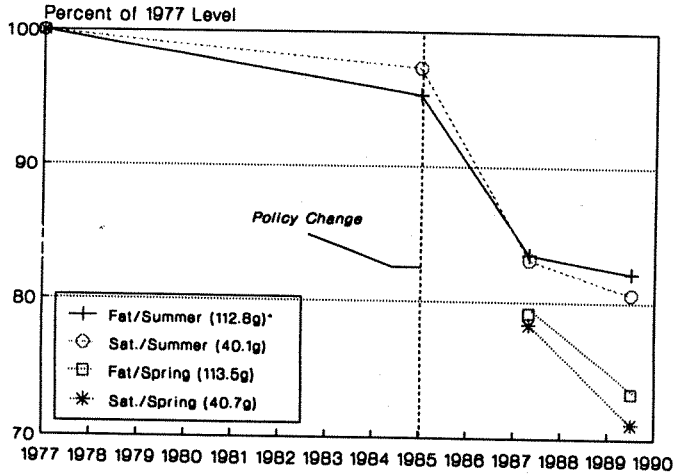


Figure 3-2 Fat and Saturated Fat Consumption Men, 19-50 Years, Spring and Summer



DATA. USDA NFCS & CSFII surveys, 1977, 1985, 1986, 1987/88, 1989/90.
NOTES. * Average fat or saturated fat in 1977 in parentheses.

pattern of movement than that found for fat consumption itself for both the 1987/88 and 1989/90 data.

The alternative season data, shown in Table 3-2, indicate substantial movement in the percentage of calories from fat between 1987/88 and 1989/90 for both sexes (t=-1.7 for women and t=-5.1 for men), however. As illustrated in Figures 3-3 and 3-4, for both sexes the decline in the post-1987 period occurs at a greater rate in spring, but at approximately the same rate in summer, compared with the pre-1985 period.

In assessing the changes in these density measures, it is important to note that reported caloric intake also changed significantly over the period.[58] For women, calories increased significantly by 94.3 kcal between 1977 and 1985 (t=3.6), contrary to expectations if consumers were absorbing diet-health information, and fell significantly by 142 kcal between 1985 and 1987/88 (t=-4.6), and by 101 kcal when measure with the 1989/90 data (t=-2.6), with 1986 caloric consumption between the 1985 and 1987/88 averages. For men, the data follow a similar pattern, rising 185 kcal between 1977 and 1985 (t=3.1), and falling 345 kcal in the 1985-1987/88 period (t=-4.5) or 317 kcal when measured with 1989/90 data (t=-4.1).

The significant movements in calories, first rising between 1977 and 1985 and then falling in 1986 and again in 1987/88, before rising modestly in 1989/90, are somewhat surprising and raise the concern that a change in survey methodology in 1985[59] or the lower response rate in

[58] Other studies have also found that the various measures of fat consumption can show different patterns over time and should be assessed carefully. See, for instance, Crane *et al.* (1992), which parallels our results for the pre-1985 period.

[59] Beginning in 1985, an effort was made to better train surveyors to probe for missing food consumption and for the details of food consumption (*e.g.*, whether fat on

(continued...)

Figure 3-3 Percentage of Calories from Fat Women, 19-50 Years, Spring and Summer

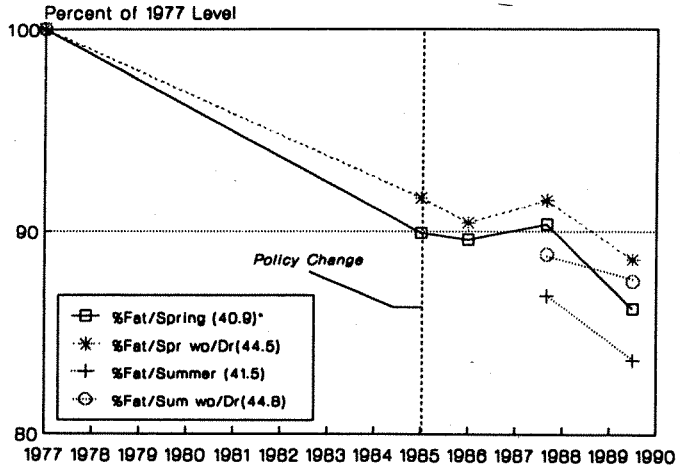
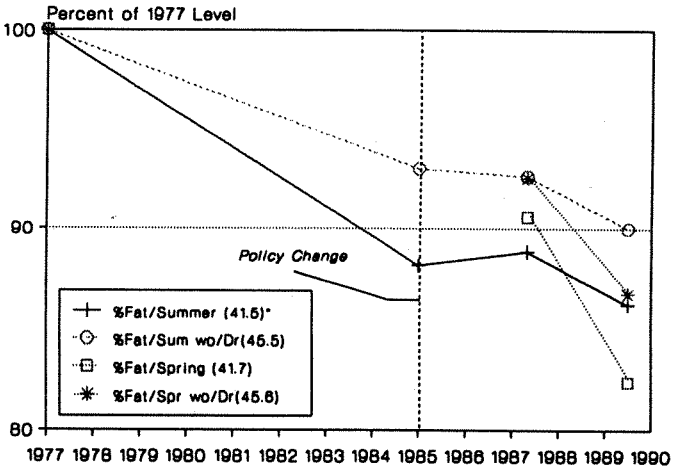


Figure 3-4 Percentage of Calories from Fat Men, 19-50 Years, Spring and Summer



DATA. USDA NFCS & CSFII surveys, 1977, 1985, 1986, 1987/88, 1989/90.
NOTES. * Percentage of calories from fat in 1977 in parentheses. Mean without drinks (wo/Dr) excludes soft drinks, and fruit-flavored and alcoholic beverages.

1987/88 may be responsible for these differences. However, two types of evidence suggest that the movements in average calories in large part reflect behavioral changes. First, for both sexes the data indicate that caloric consumption is lower in all of the post-1985 years compared to 1985, suggesting that the drop in reported calories is not the result of the lower response rate in the 1987/88 survey or the change in survey procedure beginning in 1985.

Second, much of the movement in calories in the 1977-1985 period can be attributed to movements in calories from carbonated soft drinks, fruit-flavored drinks, and alcoholic beverages.[60] Table 3-1 gives daily averages for calories and for the percentage of calories from fat, when soft drinks, fruit-flavored drinks, and alcoholic beverages are excluded. These drink categories show significant movements in reported consumption over the period, which are consistent with movements in external sales data.[61] For women, 53 kcal of the 94 kcal increase in the

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(...continued)
meat was eaten and how food was prepared).

[60] As shown below in Chapter 6, a significant increase in calories is also found in the consumption of desserts and snacks, increases which are also supported by industry sales data.

[61] Soft drink sales data indicate movements consistent with those in the USDA data. Soft drink sales increased substantially during the period of the study, from 30.8 gallons per capita in 1977 to 40.8 gallons in 1985 to 44.1 gallons in 1987 to 46.4 gallons in 1989. The share of diet soft drinks also increased during the 1980s, from less than 15% of the market in 1980 to 28% in 1989 (*Beverage World*, March 1992, 66-79). Diet Coke, one of the most successful new products of the 1980s, was introduced in 1982 and by 1991 had 12.3% of all soft drink sales. Diet soft drinks were disproportionately consumed by women during this period (*Beverage World, Beverage Industry Annual Soft Drink Report*, March 1990, Supplement). See also, Putnam and Allshouse (1993, 63) or National Research Council (1989, 61) for supply data on soft drink consumption that supports an increase in consumption.

Industry sales data also indicate that per capita beer consumption increased from

(continued...)

daily calorie total between 1977 and 1985 is due to these drinks; for men, 154 kcal of the 186 kcal increase is due to these drinks.

The substantial drop in reported caloric intake in 1986 and later years is not fully explained by changes in the calories from drinks, however. Between 1985 and 1987/88, 28% of the drop in calories for women and 23% of the drop for men can be explained by reduced consumption of soft drink, fruit-flavored drinks, and alcohol calories. When examined using the 1989/90 data, 9% of the caloric reduction for women and 14% of the reduction for men can be attributed to a reduction in calories from these drinks. As shown in Table 3-1 and Figures 3-5 and 3-6, reported calories are more stable over the period if these drink calories are excluded, but the data for reported calories still show a significant tendency to fall in the post-1985 period.

If the effect of the increased consumption of these "empty" calories on the density measures is removed,[62] the percentage of calories from fat follows a pattern closer to that observed for fat consumption, dropping between 1977 and 1985 but at a less rapid rate, especially for men, and then dropping further between 1985 and 1989/90 for both sexes, though the 1987/88 data show no significant movement in this measure. When drink calories are excluded, the percentage of calories from fat in the

(...continued)
22.5 gallons/year in 1977, to 23.6 gallons/year in 1985, to 23.9 gallons/year in 1987, and then fell to 23.3 gallons in 1989. Per capita wine consumption increased from 1.8 gallons/year in 1977, to 2.4 gallons/year in 1985, and then declined to 2.2 gallons/year by 1989 (*Beverage Industry Annual Manual 1990/91*, Edgell Communications, Cleveland, Ohio). These data are generally consistent with the movements found in the USDA consumption data.

[62] The issue of drink calories coloring differences in nutrition quality when using density measures has been recognized in nutrition studies, though the focus is usually limited to the effects of alcoholic beverage consumption. See, for instance, Murphy *et al.* (1992) and Subar *et al.* (1994).

Figure 3-5 Calories Per Day
Women, 19-50 Years, Spring and Summer

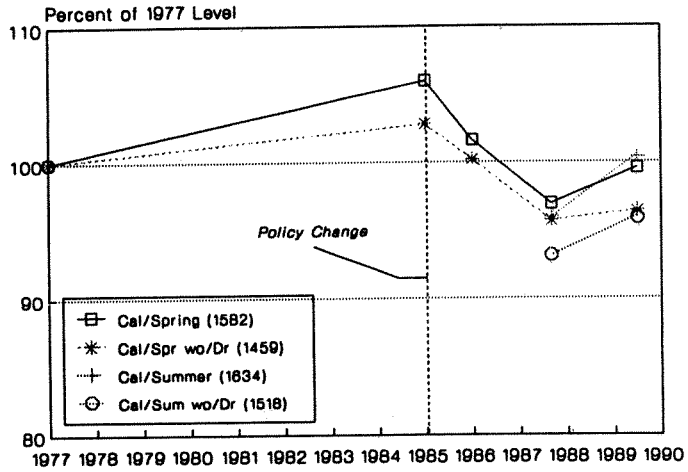
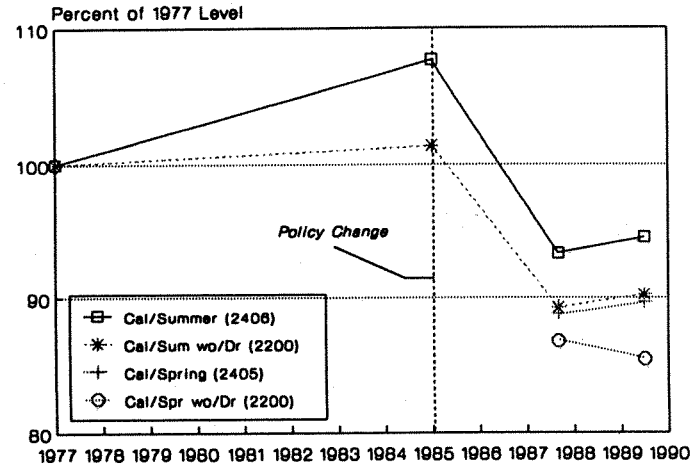


Figure 3-6 Calories Per Day
Men, 19-50 Years, Spring and Summer



DATA. USDA NFCS & CSFII surveys, 1977, 1985, 1986, 1987/88, and 1989/90.
NOTES. * Average calories per day in 1977 in parentheses. Mean without drinks (wo/Dr) excludes soft drinks, and fruit-flavored and alcoholic beverages.

off-seasons also falls between 1987/88 and 1989/90 (t=-0.8 for women in summer and t=-3.9 for men in spring).

These percentages with and without the calories from drinks are illustrated in Figures 3-3 and 3-4. For both sexes, the impact of drink calories is greater in summer and has grown since 1977 (as indicated by the distance between the graphs for the with and without drink measures after 1977). For men, the effect of drink calories is largest in 1985 and falls somewhat in later years, though it is always considerably larger than for women during this period.

Overall, the data indicate that both fat and the percentage of calories from fat fell between 1977 and 1985 for men and women, as expected if consumers were absorbing diet-health information, but calories increased for both, contrary to expectations. The percentage of calories from fat fell faster than fat itself, but this is due to an increase in calories rather than a relatively greater reduction in fat versus nonfat calories. During 1985-1989/90, the data indicate that fat consumption fell at a faster rate than in the earlier period and that calories fell significantly as well, as expected if consumers were responding to diet-health information. The 1989/90 data also show a significant drop in the percentage of calories from fat compared to 1985 but the 1987/88 data show this density measure remaining stable for both sexes, introducing some uncertainty on the relative rate of reduction in fat and calories.[63,64]

[63] Restricting the sample to heads of households and to those who consumed more than 300 calories did not change the pattern of results. For instance, for the health claims years of 1985, 1987/88, and 1989/90, average fat consumption for women 19-50 years of age in spring is 68.9, 62.1, and 61.1 grams, respectively, for the entire sample, compared to 69.6, 63.9, and 62.1 grams in the sample used for this study. Differences are comparable for the other items reported in Table 3-1.

[64] Some of the improvements in diet observed in the USDA data during the period of (continued...)

Saturated Fat Consumption

Table 3-1 and Figures 3-1 and 3-2 also show that movements in saturated fat consumption over time generally parallel changes in total fat consumption. As with fat, the reduction in saturated fat consumption is larger in the 1985-1989/90 years than in the pre-1985 period. For women, saturated fat consumption drops by 1.0 gram between 1977 and 1985 (t=-1.8), and by an additional 2.3 grams between 1985 and 1987/88 (t=-3.7), and by 3.5 grams between 1985 and 1989/90 (t=-4.7), with

(...continued)
this study are also supported in new results from the latest NHANES data, which show a significant drop in the percentage of calories consumed from fat and in measured serum cholesterol levels between the late 1970s and the late 1980s (Johnson *et al.* 1993 and McDowell *et al.* 1994).

Other results in this survey are not entirely consistent with the USDA data analyzed here. Reported calories in the NHANES III data (1988-91) are 14-17 percent higher for women in our age groups compared to the NHANES II survey (1977-80). For males reported calories do not change for young adults, but are approximately 5 percent higher for the older adults in our age range. Reported fat consumption also rises in the latest NHANES survey, especially for women (Life Sciences Research Office, in press). Data from NHANES III also show an increase in the prevalence of overweight adults in most age groups, compared to NHANES II which would suggest that caloric intake has indeed increased during this time period (Kuczmarski *et al.* 1994). This is contrary to the findings from the USDA data analyzed here, where caloric intake in 1989/90 is at the same level as 1977 for women and 5 percent lower for men in our age group.

The NHANES survey design was changed significantly between the NHANES II survey and the NHANES III survey, however, in an effort to more accurately capture food consumption. For instance, the NHANES III survey includes weekend data (as does the USDA data), but the NHANES II survey does not (Carroll *et al.* 1983), and as we show below, consumption on weekends differs considerably on the dimensions of interest. Also, more extensive probes were added in NHANES III to attempt to get more accurate consumption reporting (McDowell et al. 1994). These changes make it difficult to assess whether observed dietary changes (but not serum cholesterol levels or weight measures) reflect changing behavior or the changes in survey methodology. We will have to wait for further analyses of these new data to gauge the impact of the survey changes and the consistency of the different data sources.

approximately one-third of the 1985-87/88 reduction occurring by 1986. For men, average saturated fat consumption declines insignificantly by 1.0 gram between 1977 and 1985 (t=-.8), and falls an additional 5.7 grams between 1985 and 1987/88 (t=-3.6), or by 6.7 grams between 1985 and 1989/90 (t=-4.5).

Recall that saturated fat information is not included in the USDA nutrition database in 1977 and that saturated fat consumption for 1977 is based on nutrition data from 1985 matched to 1977 food codes. The use of matched 1985 data for 1977 saturated fat consumption may lead us to underestimate the reductions in the early period, but our test of this issue suggests that this potential bias is small and would not alter the qualitative nature of the results for saturated fat.[65]

As with fat consumption, Table 3-1 also presents the percentage of calories from saturated fat with and without soft drinks, fruit-flavored drinks, and alcoholic beverages. For both women and men, the percentage of calories from saturated fat fell significantly between 1977 and 1985 (t=-7.8 and -6.7, respectively), though this reduction is smaller without drinks and its magnitude is largely determined by the reported increase in calories during this period. The change in the percentage of calories from saturated fat during the post-1985 period depends on whether the 1989/90 or 1987/88 data are used. In the spring data for women, the drop is insignificant using the 1987/88 data but significant

[65] To test this potential bias in the matched data, we linked the 1985 values to the 1977 food items and compared the matched fat content data with the actual 1977 fat content. This provides some sense of the potential bias in the matched saturated fat and cholesterol numbers. As hypothesized, the matched fat content is lower than the actual 1977 fat content, though the difference is only 3% for both men and women. If saturated fat and cholesterol changes followed a similar pattern, this difference is too small to affect the overall results. Thus, the linked data does not appear to introduce significant problems in interpreting the saturated fat and cholesterol data for 1977.

using the 1989/90 data (t=-0.5 and t=-3.9, respectively). In the summer data for men, the percentage of calories from saturated fat follows the same pattern, with a significant movement by 1989/90 (t=-0.2 and t=-2.5 in 1987/88 and 1989/90, respectively). These effects are illustrated in Figures 3-7 and 3-8 and are stronger without drink calories.

Thus, for both men and women, saturated fat consumption falls at a greater rate during the post-1985 period than in the earlier period. The 1989/90 data indicate that the percentage of calories from saturated fat also falls significantly for both sexes, but these findings are not supported by the 1987/88 data, thus leaving some uncertainty about the relative rate at which saturated fat consumption and calories fall in the post-1985 period.

Cholesterol Consumption

Average cholesterol consumption for our primary seasons is given in Table 3-1, and off-season estimates are shown in Table 3-2. For women these data show the same pattern of accelerated decline during the health claims period as found for fat and saturated fat. In fact, the acceleration is more pronounced for cholesterol than for fats, though a change in the cholesterol data used for eggs beginning in 1987 could bias this result towards overstatement. For example, daily cholesterol consumption for women declines significantly by 11.7% during the 8 years prior to 1985 (t=-4.4). From 1985 to 1987/88 dietary cholesterol declines by 19.6% (t=-6.3) and from 1985 to 1989/90 by 27.5% (t=-7.9). This decline is not observed in the 1986 data, however. If the 1987 data are adjusted to remove the effect of the change in the cholesterol data for eggs, 1987 cholesterol consumption would have been approximately 266.5 mg for

Figure 3-7 Percentage of Calories From Saturated Fat Women, 19-50 Years, Spring and Summer

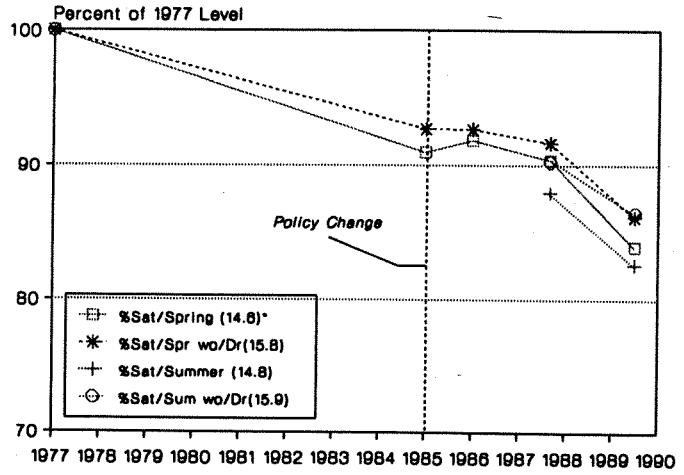
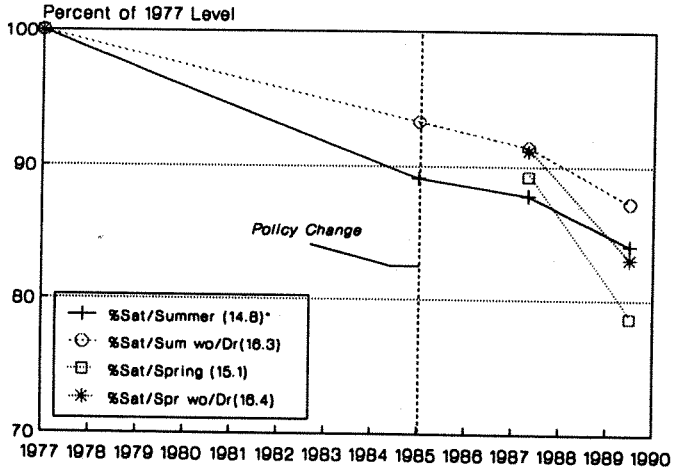


Figure 3-8 Percentage of Calories From Saturated Fat Men, 19-50 Years, Spring and Summer



DATA. USDA NFCS & CSFII surveys, 1977, 1985, 1986, 1987/88, and 1989/90.
NOTES. * Percentage of calories from saturated fat in 1977 in parentheses. Mean without drinks (wo/Dr) excludes soft drinks, fruit-flavored and alcoholic beverages.

women based on USDA estimates.[66] Thus, even with an adjustment for the change in egg nutrition data, the decline in cholesterol consumption was greater on a per-year basis during the post-1985 period, though the 1986 data do not confirm this finding. The decline continued in the 1989/90 data for women. These results are illustrated in Figure 3-9.

Average cholesterol consumption during the post-1985 period is more variable for men. In our primary summer data, daily cholesterol consumption declines 10.5% (t=-2.9) during the 1977-1985 period, and an additional 17.8% between 1985 and 1987/88 (t=-3.8). The 1989/90 data show a decline of 13% (t=-2.4), compared to 1985. If the cholesterol data are adjusted as above, the cholesterol consumption level for men would have been approximately 399 mg in 1987/88 and 423 mg in 1989/90, and thus, would indicate a significant decline during the post-1985 period using the 1987/88 data and a more moderate decline using the 1989/90 data. The spring data for men, shown in Figure 3-10, follow the pattern of accelerated decline found for women in the spring data.

Summary

The data examined above indicate that the average consumption of fat, saturated fat, and cholesterol declined significantly during the years 1977 to 1989/90. The evidence also indicates that the rate of decline was generally greater during the period when the policies towards diet-disease claims were relaxed. Thus, at this aggregate level, the data on average fat, saturated fat, and cholesterol consumption are consistent with the hypothesis that the change in policy towards explicit diet-

[66] This adjustment is made based on the USDA estimate that the change would have reduced 1985 cholesterol consumption by 8 percent. Thus, if the change had not been made, 1987 cholesterol consumption would have been approximately 245.2/.92=266.5 mg.

Figure 3-9 Cholesterol Consumption Women, 19-50 Years, Spring and Summer

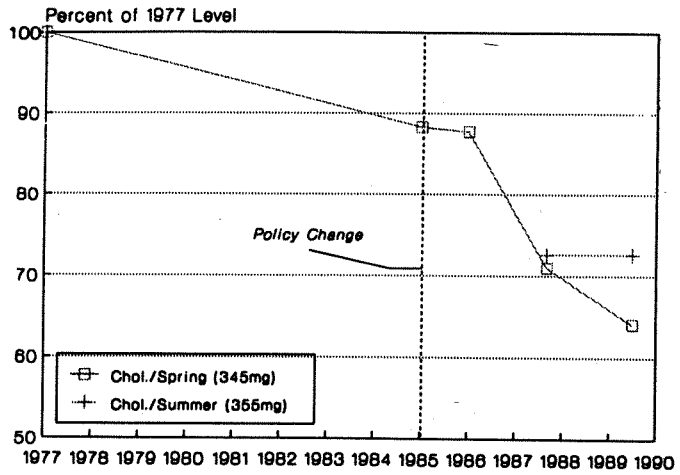
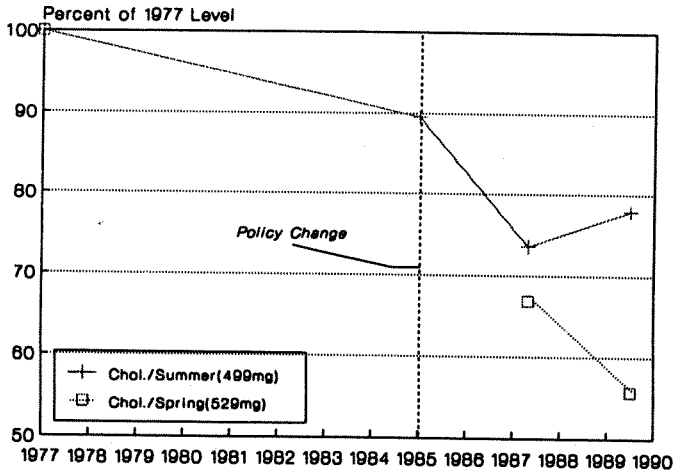


Figure 3-10 Cholesterol Consumption Men, 19-50 Years, Spring and Summer



DATA. USDA NFCS & CSFII surveys, 1977, 1985, 1986, 1987/88, 1989/90.
NOTES. * Average cholesterol consumption in 1977 in parentheses.

disease claims in advertising and labeling added information to the market and led to a faster rate of improvement in consumers' diets. The evidence is inconsistent with the hypothesis that these producer claims led to an absolute deterioration in consumers' diets, or even to a deterioration in the rate of dietary improvement.

The percentage of calories from fat and from saturated fat follow a different pattern. These measures decline between 1977 and 1985, due in part to an increase in (nonfat) calories. During the post-1985 period, the results depend on whether the 1987/88 or 1989/90 data best reflect behavior, with the 1989/90 data indicating a more rapid rate of decline and the 1987/88 data indicating that fat and saturated fat declined at approximately the same rate as calories. We explore these differences further when we examine food group evidence below.

Obviously, this type of data cannot establish that advertising and labeling claims are responsible for the increased rate of dietary improvement, since, for instance, government and other public and private organizations continued their efforts to inform the public during this period and could have found more effective ways to accomplish their goals. Nonetheless, these data provide no support for the view that the relaxation of the policies governing producer health claims adversely affected consumer food choices overall or led consumers to reverse dietary improvements that were underway. Moreover, the data are consistent with the hypothesis that these claims, and the competition they spurred among producers, helped consumers to improve their diets more rapidly during the period when producers were freer to explain why dietary choices are important.

IV

TRENDS IN CONSUMER KNOWLEDGE OF FAT-DISEASE ISSUES

INTRODUCTION

In Chapter III changes in the average consumption of fats and cholesterol over time were analyzed to test the hypothesis that information relating these dietary factors to disease risks reached consumers and had an effect on their food choices. In this chapter, these issues are examined using independent survey data that directly attempt to measure consumers' knowledge of the relationship between fats and cholesterol and disease risks.

Knowledge data, in addition to consumption data, are useful for several reasons. First, as with any self-reported data, there is reason to be cautious about the USDA consumption data. Consistent findings from independent data sources provide more assurance that results are not a survey artifact. Second, our hypotheses about behavioral changes are premised on changes in information flowing to consumers. Knowledge data provide a more direct assessment of the information hypothesis in its simplest form. Also, direct analysis of knowledge data is not as affected by simultaneity issues that could color conclusions based on consumption data. For example, new information about the potential relationship between calcium and osteoporosis might cause

individuals to increase dairy consumption, and thus fat consumption, even when consumers' knowledge of fat issues is improving. In this example, examination of consumption data could lead to inappropriate conclusions about consumers' success in absorbing fat information, if we cannot appropriately control for the simultaneous effect of the calcium information. Direct measures of consumer knowledge of fat-disease issues should not be affected by consumers' acquisition of the calcium-osteoporosis information.

This chapter analyzes some available consumer survey data on reported knowledge of the relationships between fats and cholesterol and two diseases, heart disease and cancer. As in the analysis in Chapter III, we are primarily interested in two periods: years before 1985, when government and general sources were the primary sources of explicit diet-disease information, and years following 1985, when the policies towards explicit health claims in advertising and labeling were relaxed. Unfortunately, the limited data available for the pre-1985 period constrain our ability to analyze the early period.

CONSUMER KNOWLEDGE DATA

Consumer knowledge data are taken from the *Health and Diet Surveys*, a series of national telephone surveys directed by the Food and Drug Administration in collaboration with the National Heart, Lung and Blood Institute (NHLBI).[67] These surveys, which were conducted in 1978, 1982, 1984, 1986, 1988, and 1990, deal with a variety of diet and health issues. The 1978 survey data are no longer available, however, and the 1982 survey focuses primarily on sodium issues. The 1990 survey does not contain questions comparable to the earlier years on the

[67] See Levy, Fein, and Stephenson (1993) or Schucker *et al.* (1987) for a more detailed description of the surveys and independent analyses of some of these data.

relationships between fats, cholesterol, and disease risks. For these reasons, we examine only the available questions dealing with these relationships that are consistently specified in the 1984, 1986, and 1988 surveys.

The surveys use a split-sample design, in which some questions are asked of all respondents but others are asked only of a randomly chosen 20-25 percent of the sample. This allows the FDA to examine various issues using several approaches without overburdening respondents or otherwise coloring responses of individual respondents. Most questions examined here are asked of subsamples of the overall sample. The size of the subsample for each question will be noted when results are given.

To better match the sample for which we have consumption data, we analyze data collected from men and women, 19-50 years of age. The overall completion rate, computed as the number of completed interviews divided by the number of eligible households, was 56 percent for the 1984 survey, 67 percent for the 1986 survey, and 65 percent for the 1988 survey. The 1984 survey was conducted before the policy changes towards health claims, and the 1986 and 1988 surveys were conducted after the health claim restrictions were effectively relaxed. Thus, the 1984 data give us a measure of how well consumers had absorbed the information provided by government and general sources, and the 1986 and 1988 data measure whether changes occurred once the policies towards explicit diet-disease claims in advertising and labeling were relaxed.

The *Health and Diet Surveys* also contain demographic information, including many of the variables contained in the food consumption surveys, which are examined in Chapter VIII. Education, income, the presence of two adults in the household, age, sex, whether the

respondent smokes, and race are contained in both the consumption and knowledge surveys.

KNOWLEDGE MEASURES AND RESULTS

Table 4-1 describes the basic survey questions from the *Health and Diet Surveys* that deal with the relationship between fats, cholesterol, and disease issues in the years of interest. Variable names used in the discussion of results are also given. Some of the questions focus on the *disease* and ask consumers what foods or drinks are related to this disease (HEARD_HEART, HEART_FAT, HEART_AFAT, HEARD_CANCER, CANCER_FAT). Other questions focus on a *food characteristic* (fat) and ask whether the consumer has heard about any diseases related to the characteristic (FAT_HEART, FAT_CANCER). Other questions ask for the *major* causes of the disease, and thus, give a measure of how often dietary factors are viewed as a major cause compared to nondietary factors (MAJOR_HEART, MAJOR_BCHOL). These are all open-ended questions, and responses are coded by category by the FDA. Finally, we include one multiple-choice question, which deals directly with the *type* of fat likely to raise serum cholesterol (SAT_KIND).

Table 4-2 gives the proportion of the population giving the correct response to the survey question, as described in Table 4-1. Thus, for instance, when asked whether they had heard about heart disease being related to what people eat or drink (HEARD_HEART), 45 percent of women and 33 percent of men, aged 19-50 years, responded "yes" in 1984. When asked to name the foods related to this disease, 30 percent of women and 18 percent of men gave answers related to fat or cholesterol in at least one of their first 4 responses, as described by the variable HEART_FAT. The size of the sample for each question in each year is given in parentheses in the table, except for the secondary

TABLE 4-1 Definitions of Consumer Knowledge Variables for Fat and Cholesterol Disease Issues

Variable	Survey Question and Variable Definition
HEARD_HEART	"Have you heard about heart disease or heart attacks being related to things people eat or drink?"[1] = 1 if yes = 0 if no/not sure.
HEART_FAT	If answer yes: "What things people eat or drink make them more likely to get heart disease or heart attack?"[2] = 1 if answer fat, saturated fat, fried, greasy, oily foods, animal fat, cholesterol, eggs, dairy, or meats (in up to 4 responses). = 0 otherwise.
HEART_AFAT	(Same question) = 1 if answer saturated fat, animal fat, meat, or dairy (in up to 4 responses). = 0 otherwise.
SAT_KIND	"What kind of fat is more likely to raise people's blood cholesterol? Saturated fats, polyunsaturated fats, both of them, or neither of them?" = 1 if answer saturated fat. = 0 otherwise.

(Table continued on next page.)

TABLE 4-1 (Continued)

Variable	Survey Question and Definition
FAT_HEART	"Another thing found in foods is fat. Have you heard about any health problems that might be related to how much fat people consume?" If yes: "What health problems?" = 1 if answer heart disease, heart problems, fat build-up in arteries, or high blood cholesterol (in up to 4 responses). = 0 otherwise.
MAJOR_HEART	"As you understand it, what are the major causes of heart disease or heart attack?" = 1 if answer foods high in fat, greasy foods, saturated or animal fats, or cholesterol (in up to 4 responses). = 0 otherwise.
MAJOR_BCHOL	"As you understand it, what are the major causes of high blood cholesterol?" = 1 if answer foods high in fats, saturated fats, cholesterol, meats, dairy products, or eggs (in up to 4 responses). = 0 otherwise.

(Table continued on next page.)

TABLE 4-1 (Continued)

Variable	Survey Question and Definition
HEARD_CANCER	"Have you heard about cancer being related to things people eat or drink?" = 1 if yes = 0 otherwise.
CANCER_FAT	If yes: "What things people eat or drink make them more likely to get cancer?" = 1 if answer fats, polyunsaturated or saturated fat, or meat (up to 4 responses). = 0 otherwise.
FAT_CANCER	"Another thing found in foods is fat. Have you heard about any health problems that might be related to how much fat people consume?" If yes: "What health problems?" = 1 if answer cancer, cancer of the colon, bowel, intestines, prostate, or breast (in up to 4 responses). = 0 otherwise.

SOURCE. *Health and Diet Survey* 1984, 1986, 1988, Food & Drug Administration and National Heart, Lung, and Blood Institute.

NOTES. [1] Wording differed slightly in 1984: "Have you heard about heart disease or heart problems other than high blood pressure being related to things people eat or drink?"

[2] Prompt was worded differently in each year. Question above is from the 1986 survey. In 1984: "What things people eat or drink?" and in 1988: "What things people eat or drink might be related to heart disease or heart attack?"

TABLE 4-2 Proportion Reporting Fat and Cholesterol Disease Knowledge

Variable (N)	Women, 19-50 Years			Men, 19-50 Years		
	1984	1986	1988	1984	1986	1988
HEARD_HEART	.45 (357)	.76* (395)	.84* (332)	.33 (279)	.80* (252)	.84 (194)
HEART_FAT	.30	.66*	.76*	.18	.69*	.70
HEART_AFAT	.15	.27*	.22	.09	.33*	.26
SAT_KIND	.61 (1,306)	.60 (1,337)	.62 (1,170)	.53 (910)	.59* (830)	.62 (684)
FAT_HEART	.70 (371)	.80* (385)	.78 (300)	.61 (277)	.64 (253)	.72* (206)
MAJOR_HEART	.41 (359)	.41 (364)	.50* (322)	.33 (280)	.41* (275)	.52* (211)
MAJOR_BCHOL	.58 (1,460)	.62* (1,534)	.67 (320)	.59 (1,073)	.64* (1,046)	.66 (211)
HEARD_CANCER	.80 (358)	.73* (395)	.66* (332)	.76 (280)	.71 (252)	.65 (194)
CANCER_FAT	.15	.22*	.22	.10	.19*	.20
FAT_CANCER	.04 (371)	.09* (385)	.06* (300)	.03 (277)	.07* (253)	.02* (206)

SOURCE. *Health and Diet Survey* 1984, 1986, 1988, Food & Drug Administration and National Heart, Lung, and Blood Institute.
NOTES. N = Sample size for the question. * indicates that the change from the previous year is significant at the 95 percent confidence level.

questions (HEART_FAT, HEART_AFAT, CANCER_FAT), which have the same sample sizes as the corresponding primary question (HEARD_HEART or HEARD_CANCER).

The first set of results concern the question about whether consumers had heard that heart disease was related to what people ate or drank (HEARD_HEART). In 1984, one-third of the men and nearly one-half of the women reported knowledge of this fact, but by 1986, these proportions had increased significantly to more than 75 percent of the population in both cases, and they increased again in 1988 (though in this case the increase is significant only for women). Responses that indicate knowledge about fat and cholesterol, as reflected in the variable HEART_FAT, followed the same pattern. In 1984, 30 percent of women and 18 percent of men reported that fat, cholesterol, or related responses were associated with heart disease, and these responses increased significantly by 1986 to 66 percent for women and 69 percent for men. In 1988, reported knowledge of this link increased significantly to 73 percent for women and remained constant for men.

If we focus specifically on those responses that relate directly to saturated fat and animal products, as reflected in the variable HEART_AFAT, we again find a similar pattern of change.[68] Reported knowledge of this relationship increases from 15 percent of women in 1984 to 27 percent in 1986 and from 9 percent of men in 1984 to 33 percent in 1986. Knowledge fell insignificantly for both sexes in the 1988 survey.

Thus, when asked about *heart disease* being related to food and drink, the data suggest that consumers had considerably less knowledge

[68] Recall that the scientific evidence relating diet to heart disease is strongest for saturated fat.

in 1984 than in 1986 or 1988. Moreover, women reported greater knowledge of the issue than men, though this difference had disappeared by 1988.

When questioned directly about health problems related to *fat consumption*, as described in the variable FAT_HEART, however, we find relatively high levels of knowledge in 1984, though again the data indicate significant increases for both sexes during the post-1984 period. In 1984, 70 percent of women gave heart disease responses to the question about fat consumption, and this proportion increased significantly to 80 percent in 1986. The response rate fell insignificantly to 76 percent in 1988. For men, the proportion mentioning heart disease increased insignificantly from 61 percent in 1984 to 64 percent in 1986, and then increased significantly to 72 percent by 1988. In 1984, women had significantly higher knowledge levels than men, but by 1988 this difference was no longer significant.

When asked about major causes of heart disease, as reflected in the variable MAJOR_HEART, the data show significant increases in fat and cholesterol-related responses for both men and women during the health claim years, with women increasing from 41 percent in 1984 to 48 percent in 1988, and men increasing from 33 percent in 1984 to 47 percent in 1988. Again, the data show that men began with less knowledge than women but that the differences had faded by 1988.

The responses to the question about the major causes of high blood cholesterol, MAJOR_BCHOL, show higher levels of knowledge that increased significantly during the health claim years. In this case, men and women reported approximately the same levels of knowledge across the period.

Finally, women's responses to the multiple choice question about the *type* of fat likely to raise blood cholesterol, as reflected in SAT_KIND, show relatively high and stable levels of knowledge over the period. Men had lower levels of knowledge in 1984, but this knowledge increased significantly during the post-1984 period, so that by 1988 their knowledge level is equal to that for women.

The questions relating to the role of fat in the development of cancer generally show a much lower level of knowledge than those for heart disease. First, the evidence indicates that the proportion of the population responding that cancer is related to the things people eat and drink, as reflected in the variable HEARD_CAN, fell throughout the period. However, the data indicate that this reduction is due to changes in the responses relating to other aspects of diet, specifically to sweeteners, preservatives, and artificial ingredients. In contrast, the proportion of the population giving fat and cholesterol-related responses rose for both sexes, as reflected in the results for CANCER_FAT in Table 4-2. For women, 15 percent of the population reported knowledge of this issue in 1984, and this proportion rose significantly to 22 percent of the population in 1986 and remained stable in 1988. For men, 10 percent of the population reported this knowledge in 1984, and this percentage increased to 19 percent in 1986 and remained stable in 1988.

Thus, when asked about cancer and diet, the proportion of the population mentioning fat-related responses grew during the period after 1984, but remained relatively low compared to the parallel heart disease question.

The finding that the relationship between fat and cancer is not well established with most consumers is supported by the results for FAT_CANCER, the question about health conditions related to how much fat people consume. In 1984 only 4 percent of women and 3

percent of men mentioned cancer in up to 4 responses to this open-ended question. The proportions had increased significantly to 9 percent for women and 7 percent for men by 1986, but these increases had dropped considerably by 1988.

CONCLUSION

Taken as a whole, the results from the consumer knowledge surveys indicate that consumers had considerable knowledge of the fat-heart disease issue in 1984, but significantly less knowledge of the fat-cancer issue. Knowledge of both issues increased significantly during the post-1984 period. The evidence also indicates that in 1984 men reported lower levels of knowledge for many of the questions, but that these differences were largely eliminated during the post-1984 period. Thus, the knowledge data indicate improvements in consumer information during the post-1984 period that are consistent with the movements in the fat and cholesterol consumption data. Unfortunately, we do not have data from the 1970s to test whether significant improvements in knowledge occurred during the earlier period prior to 1984. The relatively high levels of knowledge on heart disease issues in 1984 suggest that information had been absorbed during this time period, but there is no way to assess the relative rate of improvement with these data.

V

TRENDS IN PER CAPITA FOOD PRODUCTION

INTRODUCTION

In this chapter, the effects of information about fats and cholesterol consumption are examined using a third type of data, that for annual food production of various food categories used for U.S. consumption. These *food production data*, or *disappearance data*, measure basic food supplies moving through trade channels towards domestic consumption, and thus, measure the amount of food available for human consumption in the U.S. For most commodity categories, this available food supply is measured as the sum of annual production, beginning inventories, and imports, minus exports, industrial nonfood uses, farm uses (seed and feed), and end-of-year inventories. Whenever possible, we use data reflecting retail level production, which reduces the amount of waste reflected in the data.[69] Throughout, we refer to the disappearance data for a food category as simply *production* data, though it is important to emphasize that these data include only food destined for U.S. consumption.

[69] For instance, more of the bone and other inedible parts of the animal are removed in the retail level meat data, compared to the carcass-weight meat data, which reflect slaughter plant output.

These data are collected by USDA directly from producers and distributors using techniques that vary by commodity.[70] Because these data are not collected from individual consumers, they provide an independent basis for examining food consumption changes that does not have the potential problems implicit in consumer survey data. If waste and other losses in the system are relatively constant over time, these data provide an independent measure of changes in food consumption patterns.[71] Thus, trends in these production data can also be used to test the hypotheses that government and general sources of diet-health information affected consumers' food choices prior to 1985 and that the change in the regulations governing health claims in the mid-1980s provided an additional source of this information, with a corresponding incremental effect on consumption.

These production or disappearance data exist for various food types. This study uses two approaches to examine information effects on dietary choices during the years of interest. First, trends in broad food categories that comprise a sizable portion of the overall diet are examined to determine if consumption shifted away from higher-fat and cholesterol food categories towards lower-fat and cholesterol categories.

[70] See Putnam and Allshouse (1993) for a detailed description.

[71] It is important to note that these data include food that spoils prior to consumer purchase, as well as other waste in the system. If this spoilage and waste are not changing over time, estimates of the changes in trend will be unbiased. However, if this waste is changing for some categories, bias may be introduced into the analysis. For instance, USDA highlights the fats and oils category as one where waste may be changing. Fast food outlets and other restaurants generate significant amounts of waste grease, which is not consumed as food but which is included in the fats and oils data. As food consumed away from home has increased in the U.S., this waste grease has grown, and thus, the production data may overstate fat and oil consumption by a larger margin over time. A 1987 study estimated waste grease at approximately 6 pounds per capita, or approximately 9 percent of the 1992 data for this category (Putnam and Allshouse 1993, 3).

In particular, trends in red meat, poultry, fish, fats and oils, and dairy products are examined, as are those in the lowest-fat categories, such as flour and cereals, fruit, and vegetables.[72]

The second approach uses more refined tests of the information hypotheses by focusing on particular food substitutions for which other factors that could affect food choices are not likely to play an important role and where advertising and labeling may have played a more central role. In particular, pairs of foods are chosen that first satisfy the condition that the information hypotheses have clear *a priori* predictions on how the relative trends of the two foods should move in response to the dissemination of the diet-health information on fats and cholesterol. This depends crucially on the direct substitutability of the two foods. For example, dissemination of information on the health benefits of reducing fat consumption leads to a clear prediction that production of a lower-fat version of a product should gain relative to its otherwise identical regular version.

Second, the foods must be similar enough that potential confounding factors (factors other than information) are common to both products. Under these conditions, movements in input prices and other changes in demand factors are likely to affect the demand and supply of both products similarly, eliminating the importance of controlling for these factors. For example, creamed cottage cheese and lowfat cottage cheese are likely to be affected equally by cost shifts in the basic inputs to

[72] Recall that during the entire period of this study, health claims were not allowed on meat and poultry labels, which are regulated by USDA. Thus, any effects in these categories due to the change in health claims policy would be the result of general improvements in information from health claims for other foods, and any resulting increase in competitive pressure on the nutritional features of meat and poultry products (reflected in the greater use of allowed nutrient content claims, for instance), rather than the direct result of health claims for lean meats and poultry.

production and distribution and by underlying changes in demand for cottage cheese overall. The *relative* trend in these products, however, is likely to be influenced by changes in consumers' understanding of the health effects of fat consumption.

Finally, time series data for the pair of food products must span the period of analysis. Since the USDA production data are often collected at relatively aggregated levels, the requirement that the foods be close substitutes is a stringent requirement that sharply limits the number of products that can be analyzed with this second approach. The substitute foods identified in the USDA data that meet these conditions are ice cream and ice milk, butter and margarine products, creamed cottage cheese and lowfat cottage cheese. Movements in the sales of whole versus lower-fat milks are also reported.

As seen below, the data for both types of tests reveal a highly consistent set of results. In the first part of the analysis, which examines production trends for major food categories, the analysis shows relatively consistent movements away from higher-fat food categories and toward the lower-fat food categories, though some important exceptions are found. Moreover, the trends show no tendency to deteriorate during the post-1985 period. In fact, in most cases, the movements toward better dietary patterns increased significantly during the period when the policy towards health claims was relaxed. The second part of the analysis, which focuses on specific food substitutions, gives similar findings. In all four of these cases, consumers appeared to increase the rate at which they substitute lower-fat to higher-fat products during the post-1985 period.

DATA AND METHODOLOGY

Annual per capita production data for red meat, poultry, fish, eggs, milk and cream products, cheese, fats and oils, flour and cereal products, vegetables, fruit, butter, margarine, ice cream, ice milk, and other frozen dairy products used in the U.S. market are obtained from the USDA's *Food Consumption, Prices, and Expenditures, 1970-92* (Putnam and Allshouse 1993). Data for cottage cheese, by type, and for the fat content of frozen dairy products are obtained from *Dairy Products Annual Summary* for the years 1977 through 1990 (USDA, annual). Data for the fat content of margarines and spreads are taken from *Current Industrial Reports, Fats and Oils, Production, Consumption and Stocks* (U.S. Department of Commerce, annual).

For each food group the changes in per capita production are analyzed between the years 1977 and 1990. In addition to graphical presentations of time trends for per capita production during these years, simple spline, or piecewise linear, regression analyses are used to determine whether statistically significant changes in trend occurred in the mid-1980s. The model specification allows the new flow of advertising and labeling claims to increase the rate of dietary improvement after 1985 if the advertising is acting to spread diet-disease information and related food information, or to decrease the rate of improvement if the new advertising claims deceive or otherwise mislead consumers about desirable dietary changes.[73] The regression model is given by:

[73] Thus, the model can be viewed as an intervention analysis in which the full effects of the regulatory change will not be determined immediately but will affect the rate at which information spreads. See, for instance, Hanssens, Parsons, and Schultz (1990) 147, for a discussion of these issues.

(1) $Prod_{it} = a_{0i} + a_{1i}YEAR_t + a_{2i} YEAR_t*D8590 + e_{it}$,

where

$Prod_{it}$ = Per capita production of food i for the U.S. market in year t, for t = 77,..,90,

$YEAR_t$ = time index based in 1985, that is, t - 85, for t = 77,...,90,

D8590 = 1 during the health claims period, that is, for t = 85,...,90,

= 0 otherwise,

a_{0i}, a_{1i}, a_{2i} = coefficients to be estimated for each food i, and

e_{it} = normally distributed error term for food i in year t.

For a few dairy products, the model is also estimated with a control for USDA food donations in the category, because these donations are a substantial portion of total production used in the U.S. market during the 1980s.[74]

The coefficient on the variable YEAR reflects the underlying trend in the data during the 1977-1990 period. If government and general information sources of diet-health information had an ongoing effect in informing consumers, we expect higher-fat food categories to exhibit a downward trend relative to lower-fat categories across the various foods analyzed, that is, the coefficient a_{1i} should be significantly negative in the regressions for the higher-fat food categories. The interaction of the YEAR variable with the dummy variable D8590 for the health-claims

[74] Tests for first-order autocorrelation were conducted for all regressions but were not significant. The OLS regression results provide comparable estimates of the coefficients and significance levels for all commodities, and we present these here. A more general specification, which allowed an immediate level change for the health claims period as well as the change in trend, also gave comparable results.

period allows a direct test of whether the trend changed significantly once the policies governing heart-health claims changed.[75] If the change in policy added to the available flow of information, the decline in higher-fat and higher-cholesterol foods relative to their lower-fat alternatives should accelerate during the period; that is, the coefficient a_{2i} should be significantly negative in the higher-fat food equations. In contrast, if health claims were deceptive or sufficiently confusing to consumers to affect their behavior adversely, favorable trends should deteriorate in the post-1985 period, which would be indicated by a significant positive coefficient for a_{2i} in the higher-fat food equations.

This simple trend model does not attempt to assess demand and supply conditions for each food in question, and in particular, does not attempt to control for input price changes, weather, and the many other factors that affect the price and quantity of a particular food category sold in any year. Consequently, as with any event analysis of this type, the change in any one production trend is not necessarily a reliable indicator of the effects of the regulatory change. A systematic pattern of movement across the 22 food trends considered, however, is likely to reflect the effects of the policy change.

We begin with an assessment of the trends in major food categories, followed by the comparisons of foods that are direct substitutes.

[75] We specify the spline break in 1985, with the change in the rate of information dissemination possibly beginning to show effects in 1986 and later years, because we are able to document major advertisement campaigns beginning in 1986 and because this parallels our previous consumption analysis. Tests of alternative break points in 1984 and 1986 showed slightly weaker but comparable results.

CHANGES IN PER CAPITA PRODUCTION FOR MAJOR FOOD CATEGORIES

Meat, Poultry, Fish, and Egg Production

Per capita production data for red meat, poultry, fish, and eggs are given in Table 5-1 for the years 1977-1990.[76] These data indicate that per capita red meat use declined during the years 1977-1985. By 1985 red meat production was more than seven pounds less than the 132.2 pounds per capita available in 1977. Production fell an additional 12.5 pounds per capita in the five years after 1985.

Table 5-1 also provides regression results for these red meat data, which indicate a significantly declining trend in per capita red meat production throughout the period (a significant negative coefficient on the variable YEAR) and an increase in the rate of decline during the health claims period (as reflected by the negative coefficient on the variable YEAR*D8590). This incremental change is significant only at the 15 percent level, however.

Per capita production of poultry is shown in Table 5-1 to be increasing over time throughout the years 1977 to 1990. Regression results reveal a significant positive underlying trend in per capita poultry production and a significant increase in this production trend during the health claims period. Since many poultry products are lower in fat than red meat products, these results are consistent with the added information hypothesis and inconsistent with the alternative hypothesis that the change in policy led to a deterioration in these aspects of diet.

Per capita fish production showed a tendency to increase during the entire period. Regression analysis shows that the underlying trend

[76] Data from Table 1 in Putnam and Allshouse (1993), 27.

Table 5-1 Per Capita Production and Trend Estimates[1] for Red Meat, Poultry, Fish, and Eggs (Pounds per Year)

Year	Red Meat	Poultry	Fish	Eggs
1977	132.2	35.9	12.6	34.3
1978	127.5	37.3	13.4	34.9
1979	124.4	40.0	13.0	35.5
1980	126.4	40.6	12.4	34.8
1981	125.1	41.9	12.6	34.0
1982	119.8	42.0	12.4	33.9
1983	123.9	42.6	13.3	33.5
1984	123.7	43.7	14.1	33.5
1985	124.9	45.2	15.0	32.9
1986	122.2	47.1	15.4	32.6
1987	117.4	50.7	16.1	32.7
1988	119.5	51.7	15.1	31.6
1989	115.9	53.6	15.6	30.4
1990	112.4	55.9	15.0	30.1
Coefficient Estimates				
Intercept	122.53 (96.10)*	45.33 (121.29)*	14.48 (35.70)*	33.29 (134.62)*
YEAR	-0.73 (-2.61)*	1.07 (12.98)*	0.29 (3.21)*	-0.22 (-4.08)*
YEAR*D8590	-1.03 (-1.52)	1.07 (5.36)*	-0.05 (-0.23)	-0.41 (-3.08)*
Adj. R-square	.78	.99	.67	.92

DATA. *Food Consumption, Prices and Expenditures, 1970-1992*, Putnam and Allshouse (1993), 27. Boneless, trimmed equivalent for meat; retail weight for eggs.
NOTE. * indicates significance at the 5 percent level; t-statistics in parentheses.
[1] Estimates based on a spline, or piecewise linear, model with an underlying linear trend (reflected in the intercept and YEAR coefficients) and allowing a possible shift in trend after 1985 (reflected in the YEAR*D8590 coefficient).

toward fish production was positive and significant, with no significant change in trend during the health claims period.

Finally, Table 5-1 indicates that per capita egg consumption fell during the entire period of our study, and the decline is more rapid during the 1985-1990 period. Regression results show a significant negative underlying trend during the period and a significant incremental negative trend during the health claims period.

In summary, per capita production for these products indicates that during the entire period, when government and other general sources of information provided diet-health information, red meat and egg production declined, and chicken and fish production increased. The favorable trends in these production series clearly were not adversely affected by the change in policy towards health claims. In fact, the evidence indicates that the shift of production towards the lower-fat animal products (poultry and fish) and away from red meat and eggs continued or accelerated during the 1985-1990 period. Figure 5-1 graphically represents the meat, poultry, and fish series, expressed as a percentage of 1977 values, with the underlying trend indicated by the dashed line.[77] Figure 5-2 illustrates the comparable egg data.

Milk Production

Effective dissemination of information about fat should result in movements away from whole milk and toward lower-fat and skim milk products, other things equal. Table 5-2 and Figure 5-2 show that per capita milk production declined during the period under analysis, but at

[77] That is, the trend from the regression model without the post-1985 term YEAR*D8590.

Figure 5-1 Per Capita Meat, Poultry, and Fish Production As a Proportion of 1977 Level

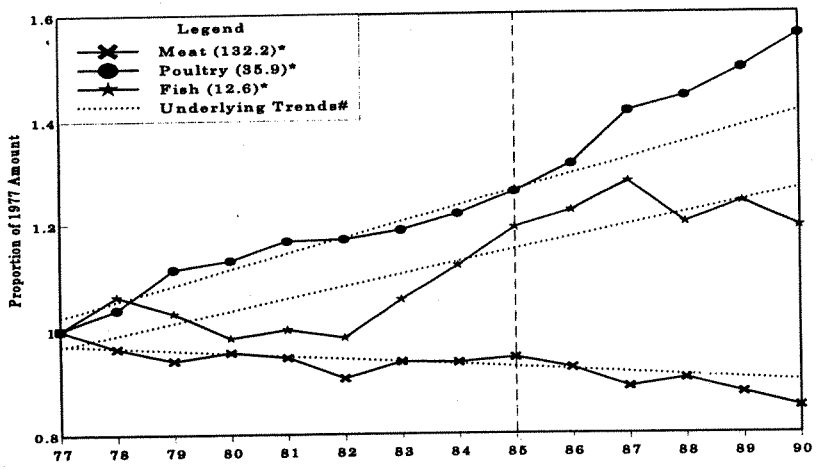
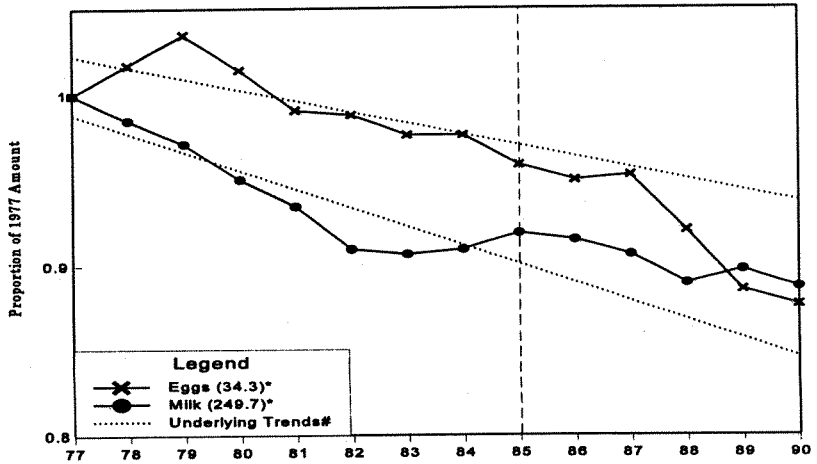


Figure 5-2 Per Capita Egg and Milk Production As a Proportion of 1977 Level



SOURCE. Data from Putnam and Allshouse (1993).
NOTES. * Per capita pounds in 1977.
Estimated underlying trend in per capita production for each food (without structural shift in 1985), as described in text.

Table 5-2 Per Capita Production and Trend Estimates[1] for Milk (Pounds per Year)

Year	All Milk	Whole Milk	2% Lowfat Milk[2]	1% Lowfat Milk[2]	Skim Milk
1977	249.7	167.3	47.4	13.7	11.9
1978	246.0	161.0	49.6	14.6	11.5
1979	242.6	154.8	52.4	14.6	11.6
1980	237.4	146.4	54.7	15.3	11.6
1981	233.5	140.0	57.0	15.6	11.3
1982	227.2	133.4	58.3	15.3	10.6
1983	226.5	130.3	60.7	14.8	10.6
1984	227.2	126.8	64.2	14.3	11.6
1985	229.6	123.3	68.5	14.7	12.6
1986	228.6	116.5	71.8	16.3	13.5
1987	226.5	111.9	74.0	15.6	14.0
1988	222.3	105.7	74.6	15.3	16.1
1989	224.3	97.6	79.1	17.2	20.2
1990	221.7	90.4	78.4	19.9	22.9
Coefficient Estimates					
Intercept	225.1 (128.4)*	121.0 (96.7)*	67.7 (101.5)*	14.8 (31.1)*	11.1 (23.2)*
YEAR	-2.7 (-7.1)*	-5.5 (-19.8)*	2.6 (17.8)*	0.0 (0.2)	-0.1 (-0.7)
YEAR*D8590	2.3 (2.5)*	-0.3 (-0.4)	-0.1 (-0.4)	0.7 (2.8)*	2.2 (8.8)*
Adj. R-square	.86	.99	.99	.66	.94

DATA. *Food Consumption, Prices and Expenditures, 1970-1992*, Putnam and Allshouse (1993), Table 12, 39.

NOTES. * indicates significance at the 5 percent level; t-statistics in parentheses.

[1] Estimates based on a spline, or piecewise linear, model with an underlying linear trend (reflected in the intercept and YEAR coefficients) and allowing a possible shift in trend after 1985 (reflected in the YEAR*D8590 coefficient).

[2] Does not include flavored milk.

a slower rate in the post-1985 period.[78] However, the decline in the overall production of milk masks dramatic trends in the production of whole, lowfat, and skim milk. For example, while per capita annual milk production fell 20.1 pounds between 1977 and 1985, whole milk production fell 44 pounds, and lowfat/skim milk production increased by approximately 24 pounds.

During the 1985-1990 period, overall milk production per capita decreased less rapidly.[79] Again, however, the decline in overall milk production masks very different trends in the production of whole and lower-fat milk. Per capita whole milk production fell an additional 32.9 pounds during these five years, while lowfat milk increased by about 15 pounds and skim milk production experienced an 82 percent increase, rising almost 10.3 pounds by 1990. Figure 5.3 graphically presents the data and underlying trends in the production of whole, 2% lowfat, 1% lowfat, and skim milk as a percent of their 1977 values.

The regression results, also provided in Table 5-2, indicate that during the period, the underlying downward trend in whole milk production was statistically significant, as was the upward trend in 2% lowfat milk. One-percent lowfat milk and skim milk production showed no significant underlying trend during the period. The downward trend in whole milk production and the upward trend in 2% lowfat milk production continue at essentially the same pace during the post-1985

[78] Data from Table 13, Putnam and Allshouse (1993), 39. One- and two-percent lowfat milk data do not include flavored milks, and thus the sum of the various milk categories listed do not equal the All Milk totals listed in the first column of the table.

[79] This may reflect information about the role of calcium in preventing osteoporosis, which became more prominent in the mid 1980s. See, for instance, the 1984 National Consensus Conference on Osteoporosis (NIH, 1984), which is discussed in more detail in Chapter 7.

Figure 5-3 Per Capita Milk Production, By Type As a Proportion of 1977 Level

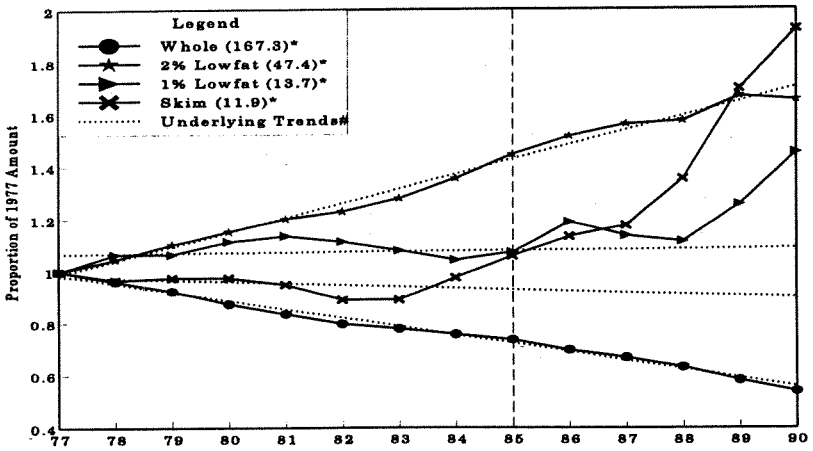
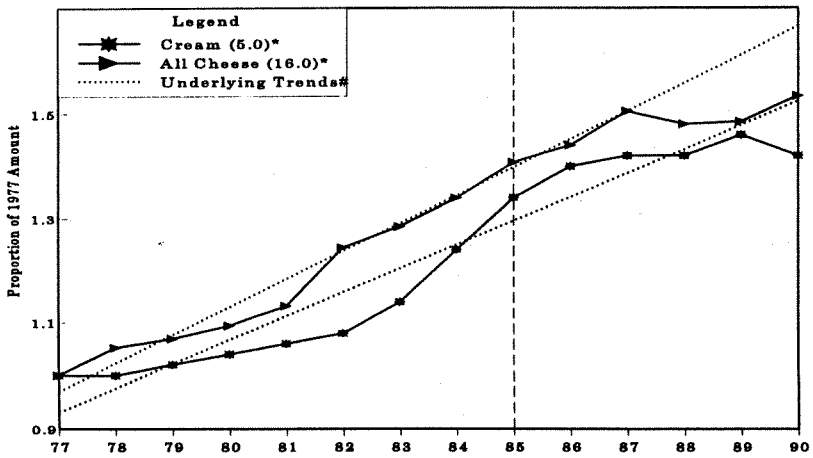


Figure 5-4 Per Capita Cream and Cheese Production As a Proportion of 1977 Level



SOURCE. Data from Putnam and Allshouse (1993).
NOTES. * Per capita pounds in 1977.
Estimated underlying trend in per capita production for each food (without structural shift in 1985), as described in text.

period (as indicated by the insignificant coefficients on YEAR*D8590), while 1% lowfat milk and skim milk production show marked increases (as indicated by the significant positive coefficients on YEAR*D8590). Overall milk consumption increased significantly during 1985-90, relative to the underlying trend,[80] as shown in the all milk regression. This increase, however, was largely limited to the 1% lowfat and skim milk category.

Thus, the evidence from the milk production data is consistent with the hypotheses that information about the health implications of fat consumption was spreading throughout the period, leading to significant shifts toward lowfat milk, and that these trends continued once health claims were allowed, with a significant increase in the movements to the lowest fat milk products.

Cream and Cheese Production

Table 5-3 gives per capita cream and cheese production for the years 1977-90. The cheese data are also broken out for Italian cheeses and all other cheeses. Because USDA cheese donation programs are a substantial factor affecting consumption during this period, USDA donations are also listed on a per capita basis.[81]

The evidence on cream production does not follow the expected pattern for a high-fat product. During the 1977-1985 period, per capita production of cream products increased substantially, from 5 pounds per year in 1977 to 6.7 pounds in 1985, contrary to expectation if

[80] As discussed below in more detail, information on calcium and osteoporosis was released in the mid-1980s.

[81] Data for cream production are from Table 12, 39, for cheese production from Table 13, 40, for USDA cheese donations from Table 55, 84, and population on July 1 from Table 111, Putnam and Allshouse (1993), 145.

Table 5-3 Per Capita Production and Trend Estimates[1] for Cream and Cheese (Pounds per Year)

Year	Cream	Total Cheese	Italian Cheese	All Other Cheese	All Other/ USDA Don.[2]
1977	5.0	16.0	3.7	12.3	.5
1978	5.0	16.8	4.1	12.8	.3
1979	5.1	17.1	4.2	12.9	.2
1980	5.2	17.5	4.4	13.1	.8
1981	5.3	18.2	4.5	13.7	.9
1982	5.4	19.9	4.8	15.1	2.0
1983	5.7	20.6	5.3	15.3	2.7
1984	6.2	21.5	5.8	15.7	2.4
1985	6.7	22.5	6.5	16.1	2.7
1986	7.0	23.1	7.0	16.1	2.3
1987	7.1	24.1	7.6	16.5	2.5
1988	7.1	23.7	8.1	15.6	1.1
1989	7.3	23.8	8.5	15.3	.3
1990	7.1	24.7	9.0	15.6	.1
Coefficient Estimates					
Intercept	6.5 (44.9)*	22.4 (92.6)*	6.2 (46.8)*	16.2 (91.4)*	14.4 (34.2)*
YEAR	0.2 (7.2)*	0.9 (16.1)*	0.3 (11.4)*	0.5 (13.5)*	0.3 (5.2)*
YEAR*D8590	-0.0 (-0.6)	-0.4 (-3.2)*	0.3 (3.8)*	-0.7 (-7.1)*	-0.1 (-0.6)
USDA-CHES[1]	—	—	--	--	0.6 (4.4)*
Adj. R-square	.91	.98	.98	.95	.98

DATA. *Food Consumption, Prices and Expenditures, 1970-1992*, Putnam and Allshouse (1993), 40 and 84.

NOTES. * indicates significance at the 5 percent level; t-statistics in parentheses.

[1] Estimates based on a spline, or piecewise linear, model with an underlying linear trend (reflected in the intercept and YEAR coefficients) and allowing a possible shift in trend after 1985 (reflected in the YEAR*D8590 coefficient).

[2] USDA cheese donations through various welfare programs.

government and other sources were spreading fat-related information. Consumption continued to increase during the health claims period to 7.1 pounds in 1990. The regression results shown in Table 5-3 indicate that the underlying rate of increase during the period was significant and that the trend did not change positively or negatively during the post-1985 period.

Total cheese production also grew substantially during the period. Total cheese production increased from 16 pounds in 1977 to 22.5 pounds in 1985 and to 24.7 pounds in 1990, again contrary to expectations for a relatively high-fat product, if information was spreading during the period. The regression results, shown in the second column of Table 5-3, indicate that the underlying trend is a significant growth of 0.9 pounds per year, but that this growth is significantly reduced by 0.4 pounds during the post-1985 period. Thus, as with the cream data, the underlying trend is contrary to expectation, but the change in trend during the health claims period is consistent with the hypothesis that the change in policy added to the flow of information. The cream and cheese data, together with their underlying trends, are depicted in Figure 5-4 above.

In an effort to better understand the dramatic trends in cheese production, Table 5-3 also breaks out Italian cheese production from that of all other cheeses, and lists USDA cheese donations on a per capita basis during the years of interest. The growth in Italian cheese production has been quite substantial over the entire period, rising from under 4 pounds in 1977 to 9 pounds in 1990.[82] For all other (non-Italian) cheeses, the growth pattern is different. Like Italian cheeses, the

[82] The growth in Italian cheeses probably reflects the growth in prepared foods during this time period, such as pizza.

underlying trend in per capita production of these other cheeses is one of rapid increase (from approximately 12 pounds in 1977 to 16.1 pounds per person in 1985), but production of non-Italian cheese stabilizes and then declines during the post-1985 period (to 15.6 pounds in 1990).

Figure 5.5 illustrates the per capita production of Italian cheese and other cheese as a percent of their 1977 values. This figure clearly shows the dramatic increase in Italian cheese production and the change in the trend for non-Italian cheeses.

The regression results, provided in Table 5-3, indicate that the underlying growth in per capita Italian cheese production is statistically significant during the period, as is the increase in the trend during the post-1985 period. For non-Italian cheese, the regression results indicate a statistically significant underlying growth in production of 0.5 pounds per year during the period but a highly significant decline of 0.7 pounds per year in the trend during the advertising period. Thus, both Italian and non-Italian cheese exhibited a strong underlying positive trend during the period. This growth in cheese production was reversed for non-Italian cheeses during the health claims period, but increased further for Italian cheese.

In interpreting these results, a note of caution is warranted. USDA policy to stabilize dairy prices generated substantial government cheese stockpiles in the 1980s, and these non-Italian cheese products were donated to consumers through food welfare programs.[83] As shown in the fifth column of Table 5-3, these cheese donations amounted to over 2.7 pounds per person, or nearly 18 percent of the consumption of non-Italian cheese at their peak in 1983 and 1985. Presumably, these surpluses, in part, reflect consumers' reduced demand for the fat content

[83] See, for instance, Putnam and Allshouse (1993), 17 and 84.

Figure 5-5 Per Capita Cheese Production, By Type As a Proportion of 1977 Level

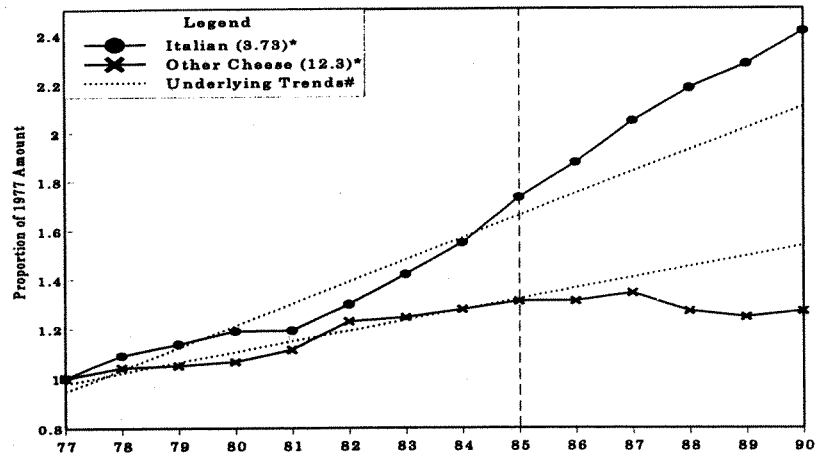
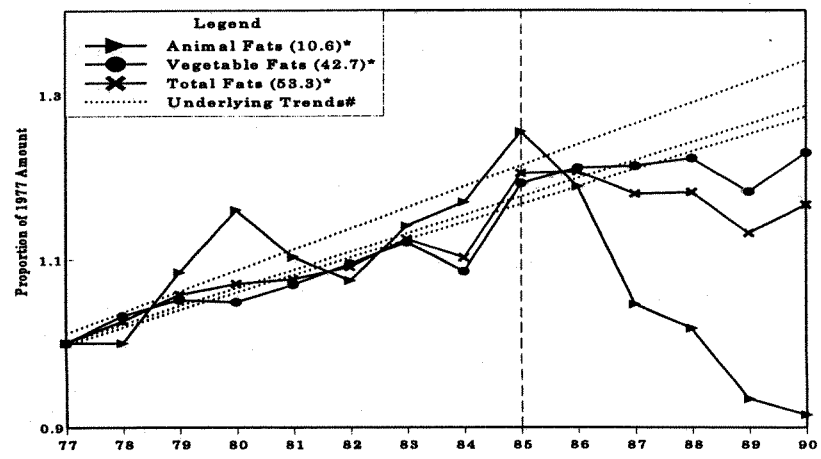


Figure 5-6 Per Capita Fats and Oils Production, By Type As a Proportion of 1977 Level



SOURCE. Data from Putnam and Allshouse (1993).
NOTES. * Per capita pounds in 1977.
Estimated underlying trend in per capita production for each food (without structural shift in 1985), as described in the text.

of standard dairy products, and the government programs, which are designed to stabilize prices, may mask the full impact of consumers' reactions to information about fats and disease.

As one simple test of the potential confounding effect of these stabilization programs, Table 5-3 also reports the trend model for all other cheeses with a control for USDA donations.[84] In this adjusted model, the magnitude of the underlying increase in cheese consumption falls, as does the negative increment to this growth in the post-1985 period, but the signs remain the same for each.

Thus, the cheese data indicate that the consumption of cheese products increases significantly during the period when government and other sources were providing diet-health information, contrary to expectations for a relatively high-fat food if information was effectively reaching consumers. During the post-1985 period, consumption of Italian cheeses increased further, again inconsistent with expectations if information is reaching consumers. The evidence for non-Italian cheese, however, suggests that the pattern of increasing consumption is reversed during the post-1985 period, though an estimate of the strength of this reversal depends on an assessment of the role of government cheese donation programs in consumption.

Fats and Oils Production

Table 5-4 indicates that per capita production of animal-based and vegetable-based fats and oils increased during the 1977-1985 period.[85] Per capita production of total fats increased from 53.3 pounds in 1977 to

[84] In a more detailed examination of dairy markets, it would be important to recognize the endogeneity of government purchases of dairy commodities and to attempt to model them directly.

[85] Data on fats and oils are from Table 1, Putnam and Allshouse (1993), 27.

Table 5-4 Per Capita Production and Trend Estimates[1] for Fats and Oils (Pounds per Year)

Year	Animal Fats	Vegetable Fats & Oils	Total Fats & Oils
1977	10.6	42.7	53.3
1978	10.6	44.1	54.7
1979	11.5	44.9	56.4
1980	12.3	44.8	57.1
1981	11.7	45.7	57.4
1982	11.4	46.8	58.2
1983	12.1	47.9	60.0
1984	12.4	46.4	58.8
1985	13.3	50.9	64.2
1986	12.6	51.7	64.3
1987	11.1	51.8	62.9
1988	10.8	52.2	63.0
1989	9.9	50.5	60.4
1990	9.7	52.5	62.2
Intercept	12.87 (58.59)*	49.83 (82.96)*	62.70 (90.56)*
YEAR	0.27 (5.54)*	0.91 (6.84)*	1.17 (7.69)*
YEAR*D8590	-0.95 (-8.15)*	-0.38 (-1.18)	-1.33 (-3.61)*
Adj. R-square	.84	.89	.86

DATA. *Food Consumption, Prices and Expenditures, 1970-1992*, Putnam and Allshouse (1993), 27.

NOTES. * indicates significance at the 5 percent level; t-statistics in parentheses.

[1] Estimates based on a spline, or piecewise linear, model with an underlying linear trend (reflected in the intercept and YEAR coefficients) and allowing a possible shift in trend after 1985 (reflected in the YEAR*D8590 coefficient).

64.2 pounds in 1985. In contrast, during the health claims period, the production of these fats declined to 62.2 pounds in 1990. Moreover, the decline in fats during this period is due to reduced production of animal-based fats, which fell from 13.3 pounds in 1985 to 9.7 pounds in 1990, exceeding the overall fat reduction. Figure 5-6 above graphically portrays per capita production as a percentage of the 1977 value and demonstrates the dramatic change in per capita production of animal-based fats and the leveling off of the production of vegetable-based fats.

The regression results in Table 5-4 indicate that both vegetable- and animal-based fats exhibit a statistically significant underlying positive trend during the period, contrary to expectations if government and general information sources were effectively informing consumers. The results also show that the animal-based fat decline during the health claims period is larger and more significant than that for vegetable-based fats. Thus, in addition to the significant shifting from animal- to vegetable-based fats, the evidence shows that total fat began to fall significantly relative to trend once the policy on health claims was changed, reversing an underlying positive trend in the data during the period.[86]

[86] In drawing these conclusions we should note that the data on fat and oil production may overstate consumption by a growing amount during the period of this study, because of the growth of fast food restaurants in the U.S. (Putnam and Allshouse 1993, 3, and Hunter and Applewhite 1993). Restaurants that deep fry foods generate a substantial amount of waste grease, which is included in this production data but is not consumed by individuals, and the proportion of food eaten away from home has been increasing during the period of this study. If this difference is substantial and growing, consumption may not be growing as fast as the underlying trend in production would indicate and consumption may be falling faster than indicated by the change in trend in the 1985-90 period.

Flour and Cereal, Fruit, and Vegetable Production

Table 5-5 displays per capita production of flour and cereal products,[87] and selected vegetables and fruits available from USDA.[88] These product categories are among those recommended for increased consumption as a replacement for fats in the U.S. diet. The data show that per capita production in all three categories increases during the years under analysis. Figures 5.7 and 5.8 graphically portray the data and the underlying trends.

The regression results confirm that the underlying upward trend in production during these years is statistically significant and substantial in magnitude, increasing at nearly 2 pounds per year for flour and cereal products, 1.3 pounds per year for vegetables, and 0.8 pounds per year for fruits. Moreover, for the grain and vegetable categories, the trend increases significantly during the post-1985 period, by 4.0 pounds per year for grains and 3.4 pounds for vegetables. The change in the fruit production trend is also positive, but not significant.

These results are again consistent with the information hypotheses, suggesting that government and other general sources of information had an effect throughout the period and that the changes in advertising and labeling policy also had a positive effect on consumer choices. The evidence from these three food categories is inconsistent with the alternative hypothesis that the change in policy led to a deterioration in consumer choices in these categories.

[87] Data from Table 31, Putnam and Allshouse (1993), 58.

[88] Data on fruit are obtained from Tables 17, 18, and 20, Putnam and Allshouse (1993), 44, 45, and 47, respectively. Production is the sum of fresh fruits, canned and chilled fruits, and frozen fruits. Data on vegetables are obtained from Tables 27 and 28, 54 and 55, respectively, and represent available fresh and processed vegetables.

Table 5-5 Per Capita Production and Trend Estimates[1] for Flour and Cereal, Vegetables, and Fruit (Pounds per Year)

Year	Flour & Cereal Products	Vegetables[2]	Fruit[3]
1977	140.7	200.5	96.1
1978	138.8	192.8	99.0
1979	144.8	199.4	96.5
1980	144.6	201.4	102.0
1981	145.4	194.7	97.3
1982	147.8	196.8	99.2
1983	147.5	196.4	103.0
1984	148.8	211.1	100.9
1985	156.1	210.8	99.5
1986	162.1	208.2	106.2
1987	170.8	214.0	111.4
1988	173.7	216.1	110.7
1989	175.4	227.2	111.0
1990	183.5	228.5	106.6
Coefficient Estimates			
Intercept	154.31 (113.24)*	205.25 (81.50)*	103.23 (65.18)*
YEAR	1.95 (6.48)*	1.27 (2.29)*	0.84 (2.42)*
YEAR*D8590	4.04 (5.57)*	3.41 (2.54)*	0.78 (0.93)
Adj. R-square	.97	.83	.70

DATA. *Food Consumption, Prices and Expenditures, 1970-1992*, Putnam and Allshouse (1993), 27, 44-45, 47, and 54-55.

* indicates significance at the 5 percent level; t-statistics in parentheses.

[1] Estimates based on a spline, or piecewise linear, model with an underlying linear trend (reflected in the intercept and YEAR coefficients) and allowing a possible shift in trend after 1985 (reflected in the YEAR*D8590 coefficient).

[2] Includes fresh and processed vegetables currently reported by USDA.

[3] Includes select fresh, canned/chilled, and frozen fruit.

Figure 5-7 Per Capita Flour and Cereal Production As a Proportion of 1977 Level

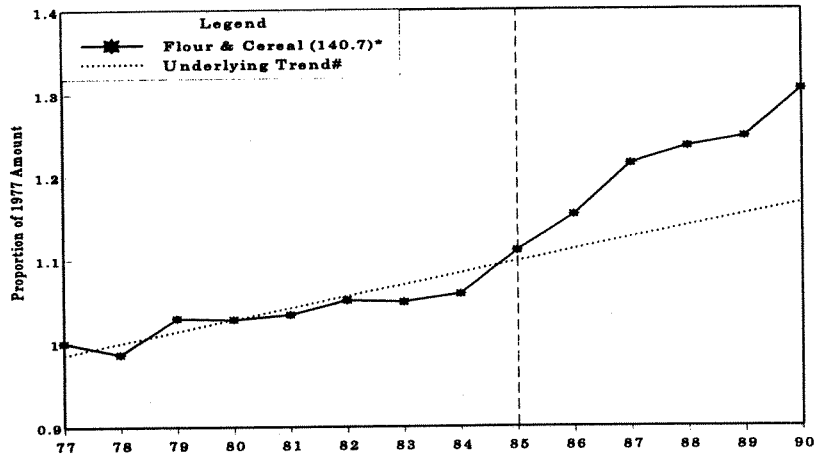
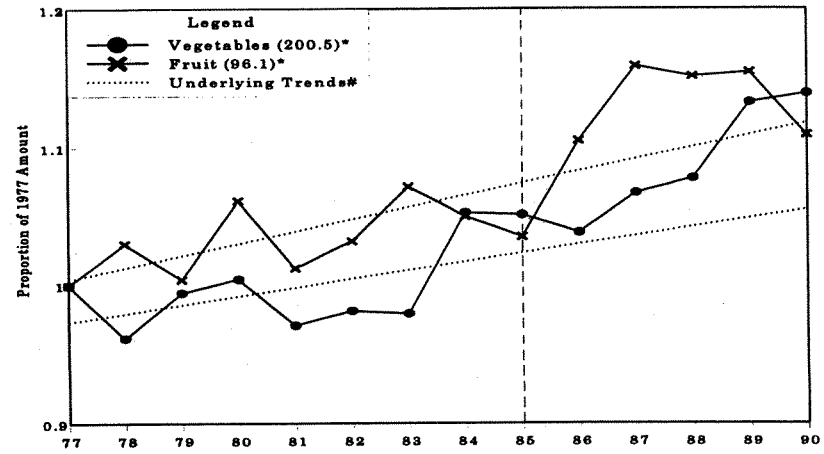


Figure 5-8 Per Capita Vegetable and Fruit Production As a Proportion of 1977 Level



SOURCE. Data from Putnam and Allshouse (1993).

NOTES. * Per capita pounds in 1977.

\# Estimated underlying trend in per capita production for each food (without structural shift in 1985), as described in text.

Summary of Trends in Major Food Categories

Examination of per capita production data for major food categories of interest during the years 1977-1985, when government and other general sources were the primary information sources on diet and health, provides some substantial evidence that information about fats, cholesterol, and disease was spreading to consumers, leading to improvements in some important aspects of diet. The evidence for this period is not entirely consistent, however. As expected, per capita production of red meat, eggs, and whole milk all show significant reductions during the period, and the lower-fat categories of poultry, fish, lowfat milk, flour and cereals, and fruit all showed significantly increasing trends. Per capita production of some higher-fat dairy products (cheese and cream products) and fats and oils also increased significantly during the period, however, contrary to expectations.

The production evidence for major food groups provides a more consistent picture during the 1985-1990 period of analysis, when the policy towards producer health claims was changed. During this period, with the exception of Italian cheese, per capita production of food in categories with the highest fat levels either stayed on the underlying trend or experienced a decline in the trend. With the exceptions of Italian cheese and an insignificant coefficient for fish, none of the increments to the trends had signs contrary to expectations under our information hypotheses, and thus, the production data for broad food categories provide no evidence consistent with the view that the addition of health claim advertising had adverse effects on the rate of dietary improvement. The evidence indicates statistically significant incremental declines in the trends for eggs, non-Italian cheese, animal fats, and total fats, and incremental but insignificant declines in red meat, whole milk, 2% lowfat milk, cream, and vegetable fats.

Similarly, the production data show a consistent pattern during the post-1985 period of additional movements towards lower-fat food categories. Significant increases in trend occurred in the per capita production of poultry, 1% lowfat milk, skim milk, flour and cereal products, and vegetables. Fruit production also increased relative to the underlying trends, though not significantly so.

Thus, the per capita production data for these broad food categories are consistent with the view that government and other sources of dietary information had an effect on some key food choices and that health claims advertising and labeling added to the information flow, resulting in significant additional increments to the rate of improvement in food choices. The evidence is not consistent with the hypothesis that the change in health claims policy had an adverse effect on the dietary choices using these measures of dietary choices.

RESULTS FOR SELECTED FOOD SUBSTITUTIONS

This section analyzes three pairs of specific food substitutes for which production data are available and for which costs and other noninformation issues are likely to affect the products relatively equally. In particular, we examine production trends in ice cream and ice milk, butter and margarine products, and creamed and lowfat cottage cheese. This evidence, together with the movements in the type of milk chosen, will provide a second type of evidence on the potential effects of diet-health information in these markets.

Butter and Margarine

Though butter and traditional margarine products contain approximately the same amount of total fat, assimilation of diet-health information should lead to shifts in consumption from butter to

margarine because of butter's higher saturated fat content, other things equal.[89] Similarly, consumption would be expected to shift among margarine products towards margarine spreads, which are reduced-fat margarine products.[90]

Table 5-6 gives per capita production of butter and margarine products for the periods under analysis.[91] The per capita amount of fat used in the production of margarine products is also given, which reflects changes in the average type of margarine product over time.[92] Finally, Table 5-6 also lists USDA annual donations of butter on a per capita basis. As a result of price support programs for dairy products, the government sometimes accumulates stockpiles of longer-lived dairy products, such as butter, which are given to consumers through various social welfare programs. Since these butter donations vary substantially during the period of our study (reaching nearly 25 percent of total production in 1983), we consider their potential to affect observed trends in butter and margarine consumption.

[89] This assessment of the relative healthfulness of butter and traditional margarine products has been challenged recently, as evidence develops on the role of transfatty acids and heart disease. This evidence is relatively new, however, and was not available to scientists or consumers during the period of this study.

[90] Traditional margarine and butter both contain approximately 80 percent fat by weight. Most margarine spreads have between 40 percent and 79 percent fat content (Statistics from National Association of Margarine Manufacturers 1991). New margarine spread products have even lower fat content.

[91] Data on butter and margarine are obtained from Table 14, Putnam and Allshouse (1993), 41.

[92] Data for the amount of fat and oil used in the production of margarine products are taken from *Current Industrial Reports, Fats and Oils, Production, Consumption and Stocks*, M20K-13, U.S. Department of Commerce, Bureau of the Census, Annual, Table 3A. The monthly data are aggregated to a calendar year basis.

Table 5-6 Per Capita Production and Trend Estimates[1] for Butter and Margarine (Pounds per Year)

Year	USDA Butter Donations	Butter	Margarine Products[2]	Fat In Margarines
1977	.4	4.3	11.4	9.2
1978	.3	4.4	11.3	9.0
1979	.4	4.5	11.2	9.0
1980	.5	4.5	11.3	9.0
1981	.5	4.2	11.1	8.8
1982	.6	4.3	11.0	8.6
1983	1.1	4.9	10.4	7.9
1984	1.1	4.9	10.4	7.8
1985	1.0	4.9	10.8	8.2
1986	.8	4.6	11.4	8.5
1987	1.0	4.7	10.5	8.0
1988	.8	4.5	10.3	7.7
1989	.9	4.4	10.2	7.6
1990	.7	4.4	10.9	8.6

Coefficient Estimates

Intercept	4.82 (52.2)*	3.81 (15.9)*	10.66 (57.9)*	12.18 (19.0)*	7.96 (43.9)*	9.44 (14.8)*
YEAR	0.07 (3.4)*	-0.03 (-1.0)	-0.09 (-2.3)*	0.05 (0.8)	-0.16 (-4.0)*	-0.02 (-0.3)
YEAR*D8590	-0.16 (-3.3)*	-0.01 (-0.1)	0.07 (0.7)	-0.17 (-1.3)	0.19 (2.0)*	-0.04 (-0.3)
USDA-Butter	---	0.96 (4.3)*	---	-1.46 (-2.5)*	---	-1.41 (-2.4)*
Adj. R-square	.45	.79	.37	.56	.60	.72

DATA. *Food Consumption, Prices and Expenditures, 1970-1992*, Putnam and Allshouse (1993), 41, 89; *Fats and Oils*, U.S. Dept. Commerce, Annual, Table 3A.
NOTES. * denotes significance at 5 percent level; t-statistics in parentheses.
[1] Estimates based on a spline, or piecewise linear, model with an underlying linear trend (reflected in the intercept and YEAR coefficients) and allowing a possible shift in trend after 1985 (reflected in the YEAR*D8590 coefficient).
[2] Margarine-type products are 40-80 percent fat.

Surprisingly, per capita butter production increased during the pre-1985 period, rising from 4.3 pounds in 1977 to 4.9 pounds in 1985. USDA donations of butter also rose substantially during this period, however, suggesting that the increase in butter consumption may be the result of government support programs, and the resulting butter donations, rather than a lack of information. As one test of this view, trend regressions, which control for USDA butter donations, are also reported in Table 5-6. Controlling for USDA donations, the butter regression indicates that the underlying trend in butter consumption is negative (but insignificant) during the period, as expected.

By 1990, per capita butter production falls back almost to its 1977 level of 4.3 pounds. In part, this reduction again reflects government donations, which fall by 0.1 pounds per year on average. As shown in the regression controlling for USDA butter donations, the underlying negative trend towards lower butter consumption continues unchanged during the advertising period (as indicated by the insignificant coefficient on YEAR*D8590).

Per capita production of margarine products declines during both periods of analysis, from 11.4 pounds in 1977 to 10.8 pounds in 1985, to 10.2 pounds in 1989, though 1990 data show an increase. The per capita fat content of margarine products declines even more as consumption shifts to lower-fat products, from 9.2 pounds in 1977, to 8.2 pounds in 1985, to 7.6 pounds in 1989, though again the 1990 data show a substantial increase. The effect of the butter donations is also clear in the margarine data, with the government butter donations reducing the sales of margarine products. Figure 5.9 graphically portrays these trends.

For both margarine products and for fat in margarine products, the regression results indicate a negative underlying trend in per capita

Figure 5-9 Per Capita Butter and Margarine Production As a Proportion of 1977 Level

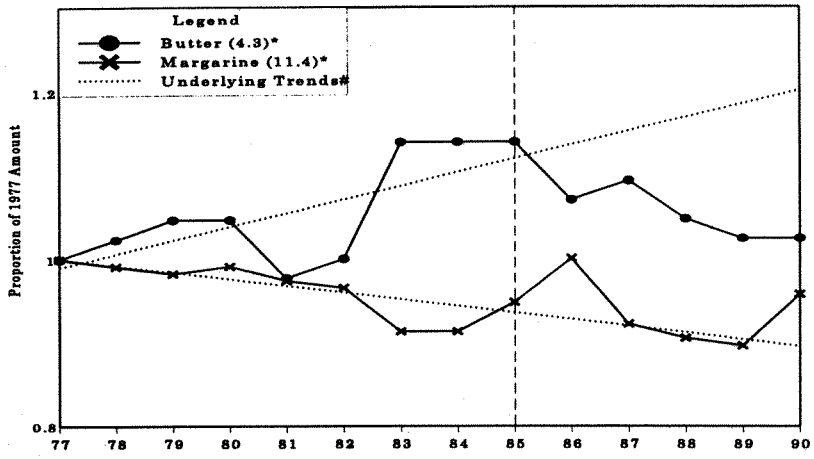
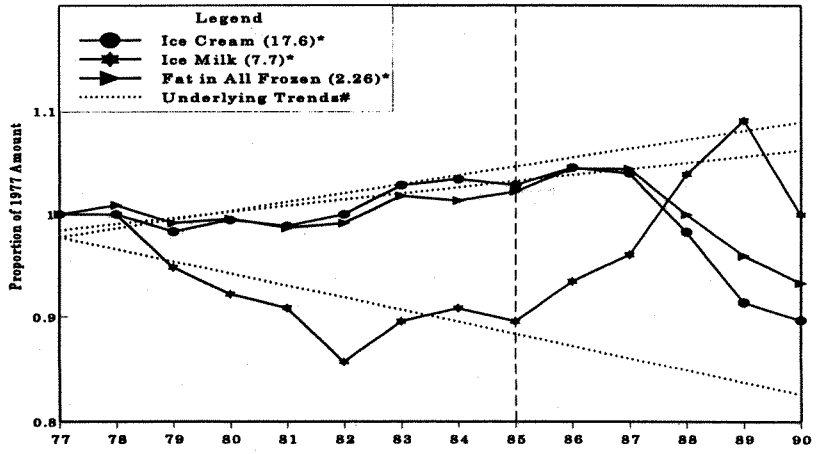


Figure 5-10 Per Capita Frozen Dessert Production, By Type As a Proportion of 1977 Level



SOURCE. Data from Putnam and Allshouse (1993).
NOTES. * Per capita pounds in 1977.
Estimated underlying trend in per capita production for each food (without structural shift in 1985), as described in text.

production during the period, though these trends are insignificant if the regression controls for USDA donations. These results also indicate an added negative but insignificant change in the negative trend for both during the advertising period, controlling for USDA donations. Note also that the coefficient on the USDA butter donations indicates a loss of approximately 1.5 pounds of margarine for every pound of butter given away.[93]

Taken together, these results are consistent with the hypothesis that, controlling for government butter donations, government and general information had some effect in lowering butter sales and increasing margarine sales, other things equal, though these results are statistically insignificant for both. The results are also consistent with the hypothesis that margarine consumption did not change significantly once the policy towards producer health claims was relaxed. Finally, controlling for government butter donations, these results do not support the hypothesis that the dissemination of information about the health benefits of the lower saturated fat content of high-fat margarine products lead to an increase in the total demand for margarine products.

Ice Cream and Ice Milk

Since ice milk is a lower-fat alternative to ice cream, assimilation of health information should move consumption towards ice milk and away from ice cream. Table 5-7 gives per capita production of ice cream and ice milk.[94] These data indicate that, contrary to expectation, per capita

[93] The fact that the coefficient on the USDA butter donations is approximately 1 in the butter equation and -1.5 in the margarine equation suggests that the primary effect of the butter donations was to shift consumption from margarine to butter for those receiving the donations.

[94] Data on ice cream and ice milk are obtained from Table 11 of Putnam and (continued...)

Table 5-7 Per Capita Production and Trend Estimates[1] for Ice Cream and Ice Milk (Pounds per Year)

Year	Ice Cream	Ice Milk	Other Frozen	Fat in Frozen Desserts[2]
1977	17.6	7.7	0.3	2.26
1978	17.6	7.7	0.3	2.28
1979	17.3	7.3	0.3	2.24
1980	17.5	7.1	0.3	2.25
1981	17.4	7.0	0.6	2.23
1982	17.6	6.6	0.6	2.24
1983	18.1	6.9	0.6	2.30
1984	18.2	7.0	0.6	2.29
1985	18.1	6.9	1.3	2.31
1986	18.4	7.2	0.9	2.36
1987	18.3	7.4	1.0	2.36
1988	17.3	8.0	1.0	2.26
1989	16.1	8.4	2.9	2.17
1990	15.8	7.7	3.7	2.11
Coefficient Estimates				
Intercept	18.42 (83.13)*	6.81 (42.14)*	0.60 (2.34)*	2.33 (89.66)*
YEAR	0.15 (3.10)*	-0.09 (-2.52)*	0.04 (0.68)	.01 (2.36)*
YEAR*D8590	-0.62 (-5.28)*	0.38 (4.42)*	0.45 (3.28)*	-0.05 (-3.46)*
Adj. R-square	.75	.62	.77	.45

DATA. *Food Consumption, Prices and Expenditures, 1970-1992*, Putnam and Allshouse (1993) at 38 and *Dairy Products Annual Summary*, Table 47.

NOTES. * indicates significance at 5 percent level; t-statistics in parentheses.

[1] Estimates based on a spline, or piecewise linear, model with an underlying linear trend (reflected in the intercept and YEAR coefficients) and allowing a possible shift in trend after 1985 (reflected in the YEAR*D8590 coefficient).

[2] Fat content based on whole milk equivalent in ice cream, ice milk, frozen yogurt, and other frozen dairy products.

ice cream production actually increases during the 1977-1985 period, from 17.6 pounds to 18.1 pounds. Moreover, also contrary to prediction, ice milk production falls during this period, from 7.7 pounds in 1977 to 6.9 pounds in 1985.

During the post-1985 period, the production of ice milk increases substantially and the production of ice cream levels off and then begins to decline. Per capita ice cream production falls by more than 2 pounds, from 18.1 pounds in 1985 to 15.8 pounds in 1990. The production of ice milk rises from 6.9 pounds in 1985 to 8.4 pounds in 1989 and then falls to 7.7 pounds in 1990. Frozen yogurt is included in the category "other frozen desserts," which increases markedly in 1989 and 1990. These results for ice cream and ice milk are graphically portrayed in Figure 5.10 above and illustrate the movements towards lower-fat desserts during the post-1985 period.

The regression results provided in Table 5-7 indicate that the underlying trend in ice cream production is positive and significant, growing at 0.15 pounds per capita per year, contrary to expectations. This trend shows a significant and large reversal during the post-1985 period. Similarly, the results for ice milk show a significant negative underlying trend in ice milk production and a significant reversal of this trend during the post-1985 period.

Table 5-7 also presents the per capita fat content of all frozen dairy products,[95] and the regression model for these data. These results reflect

(...continued)
Allshouse (1993), 38, and for the whole milk equivalence used in the production of frozen dessert from Table 47, *Dairy Products Annual Summary* (USDA, annual).

[95] The per capita fat content of frozen dairy products is computed by multiplying the USDA data on the whole milk equivalent used in the manufacture of ice cream and other (continued...)

the combined effects of shifting among types of frozen dairy products, primarily between ice cream and ice milk, as well as the overall changes in consumption levels. This regression indicates that the underlying trend in the fat from frozen dairy products is positive and significant but becomes negative once the policy towards producer health claims is relaxed.

These results are consistent with the hypothesis that the addition of health claims in advertising and labeling provided information to consumers, but they are not consistent with the hypothesis that information was reaching consumers during the pre-1985 period.

Creamed and Lowfat Cottage Cheese

Creamed cottage cheese has at least 4 percent milkfat, while lowfat cottage cheese has less, usually 0.5 percent or 2.0 percent milkfat. As with the hypotheses for ice cream and ice milk, the production of creamed cottage cheese is expected to decline relative to its lower fat alternative as information spreads to consumers.[96] Table 5-8 shows that per capita creamed cottage cheese production declined during both the pre-1985 period and the post-1985 period. The data also indicate an increase in lowfat cottage cheese production during both periods. Figure 5.11 graphically portrays these production data relative to their 1977 levels and shows the underlying trends in these data.

(...continued)
frozen dairy products (*Dairy Products Annual Summary*, Table 47) with data on the average fat content of whole milk by year (provided by USDA, National Agricultural Statistics Service) and dividing by population on July 1, from Table 111, Putnam and Allshouse (1993), 145.

[96] Data on cottage cheese production by type are derived from *Dairy Products Annual Summary* (USDA, annual).

Table 5-8 Per Capita Production and Trend Estimates[1] for Cottage Cheese (Pounds per Year)

Year	Creamed Cottage Cheese[2]	Lowfat Cottage Cheese[3]	Total
1977	3.99	0.63	4.62
1978	3.82	0.69	4.51
1979	3.73	0.70	4.44
1980	3.62	0.79	4.41
1981	3.36	0.91	4.27
1982	3.23	0.94	4.16
1983	3.17	0.92	4.09
1984	3.11	0.97	4.08
1985	3.00	1.02	4.03
1986	2.93	1.10	4.03
1987	2.78	1.11	3.89
1988	2.64	1.19	3.83
1989	2.31	1.22	3.53
1990	2.12	1.21	3.33
Coefficient Estimates			
Intercept	3.00 (68.24)*	1.05 (62.08)*	4.05 (93.60)*
YEAR	-0.12 (-11.93)*	0.05 (13.81)*	-0.06 (-6.74)*
YEAR*D8590	-0.04 (-1.86)	-0.01 (-1.56)	-0.06 (-2.50)*
Adj. R-square	.98	.97	.95

DATA. *Dairy Products, Annual Summary*, USDA, Annual.

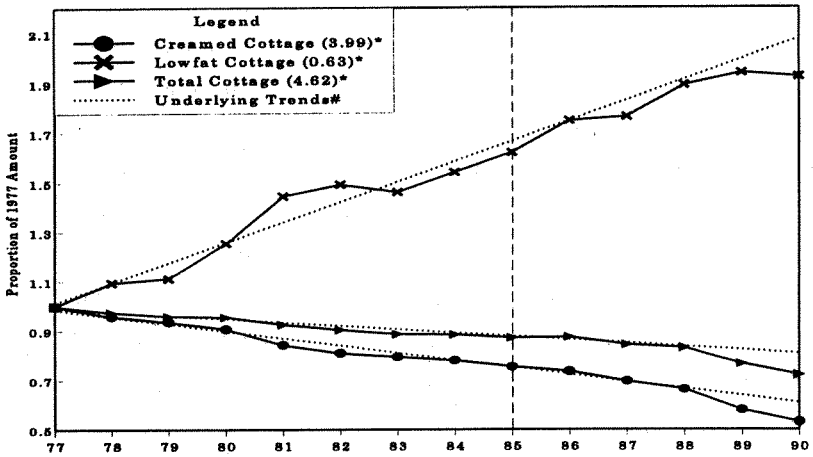
NOTES. * indicates significance at 5 percent level; t-statistics in parentheses.

[1] Estimates based on a spline, or piecewise linear, model with an underlying linear trend (reflected in the intercept and YEAR coefficients) and allowing a possible shift in trend after 1985 (reflected in the YEAR*D8590 coefficient).

[2] At least 4.0 percent milkfat.

[3] Less than 4.0 percent milkfat, mostly 0.5 and 2.0 percent.

Figure 5-11 Per Capita Cottage Cheese Production As a Proportion of 1977 Level



SOURCE. Data from Putnam and Allshouse (1993).

NOTES. * Per capita pounds in 1977.

Estimated underlying trend in per capita production for each food (without structural shift in 1985), as described in text.

The regression results in Table 5-8 indicate that the production of creamed cottage cheese was declining significantly at an average rate of 0.12 pounds per year and experiences an added decline of 0.04 pounds per year during the post-1985 period. The results for lowfat cottage cheese show a significantly positive underlying trend in production and a negative, but insignificant, change in the trend during the post-1985 period. Available USDA data do not allow us to assess changes in the fat content of total cottage cheese production directly. As shown by the regression for total cottage cheese production in Table 5-8, however, per capita cottage cheese production declined significantly during the entire period and decline significantly faster during the post-1985 period. Since the evidence above indicates that production shifts toward the lower-fat product during both periods, together these results imply that the total fat consumed in cottage cheese products falls even more rapidly than total production in both periods.

Thus, the evidence on cottage cheese production again indicates a shift from the higher-fat product to the lower-fat product, and a reduction in the total fat consumed in cottage cheese products, which begins prior to the changes in policy and increases during the post-1985 period.

Summary and Conclusion

Examination of these three specific food substitutions, together with the evidence on movements in milk types, gives results consistent with the hypothesis that during the post-1985 period movements towards lower-fat substitutes accelerated compared to the underlying trends, though the strength of the effects depends on an assessment of the nutritional effects of government dairy price support programs during the 1980s. These results, combined with the evidence from the examination of broad food categories, provide no evidence that the use

Table 5-9 Summary of Trends Before and After Policy Change

Food	Underlying Trend	Trend Change 1985-90
High-Fat/Chol. Groups	*Expect (-)*	*Expect (-)*
Red Meat	(-)*	(-)
Eggs	(-)*	(-)*
Cream Products	(+)*	(-)
Cheese	(+)*	(-)
Italian Cheese	(+)*	(+)*
All Other Cheese	(+)*	(-)*[1]
Total Fats & Oils	(+)*	(-)*
Animal Fats	(+)*	(-)*
Vegetable Fats	(+)*	(-)
Lower-Fat Groups	*Expect (+)*	*Expect (+)*
Poultry	(+)*	(+)*
Fish	(+)*	(-)[2]
Flour & Cereal	(+)*	(+)*
Vegetables	(+)*	(+)*
Fruit	(+)*	(+)
Higher-Fat Products	*Expect (-)*	*Expect (-)*
Whole Milk	(-)*	(-)[2]
Butter	(+)*[1]	(-)*[1]
Ice Cream	(+)*	(-)*
Creamed Cottage Cheese	(-)*	(-)
Lower-Fat Substitutes	*Expect (+)/smaller (-)*[5]	*Expect (+)/smaller (-)*[5]
2% Lowfat Milk	(+)*	(-)
1% Lowfat Milk	(+)[2]	(+)*
Skim Milk	(-)	(+)*
Margarine Products[4]	(-)*[3]	(+)[1]
Ice Milk	(-)*	(+)*
Lowfat Cottage Cheese	(+)*	(-)

NOTES. * indicates significance at the 5 percent level.
[1] Insignificant negative coefficient if control for USDA donations.
[2] Insignificant coefficient with t-statistic less than 0.5.
[3] Insignificant positive coefficient if control for USDA donations.
[4] Margarine products can have the same amount of fat as butter, but often a better fat type.
[5] Relative to higher fat substitute.

of health claims in advertising and labeling has adverse effects on diet. On the contrary, as shown in the summary in Table 5-9, the evidence suggests that the rate of improvement increases during this time period, leading to a more rapid and more consistent rate of improvement. During the health claims period, 19 of the 20 trend coefficients in the major food and specific substitute regressions have the expected sign (11/19 were significant) and the one inconsistent sign is insignificant. For the underlying trends, 12 of the 20 coefficients have the expected sign (11/12 significant), and 7 of the 8 inconsistent signs are significant. Whether tested on sign differences or only on significant sign differences, this relationship is statistically significant in a standard chi-square test, suggesting that information spread more consistently during the post-1985 period compared with the earlier period. If we control for USDA donations in dairy products, the results are somewhat less skewed, but qualitatively similar. Thus, the evidence from food production trends is consistent with the hypotheses that diet-health information from government and other sources affected consumers' food choices, as expected, in many but not all food categories, and that consumers were better able to improve dietary choices during the period when, in addition to these other sources, producers were also allowed to make more explicit diet-health claims.

These results are generally consistent with the overall findings in both Chapters III and IV. In Chapter III, data from USDA food consumption surveys indicate that the average consumption of fats and cholesterol declined during the pre-1985 period, with an increase in the rate of decline during the post-1985 period. The FDA knowledge data, analyzed in Chapter IV, indicate that knowledge of diet-disease relationships increases significantly from 1984 to 1988. The production data presented here also indicate that shifts in food consumption towards lower-fat and lower-cholesterol foods were occurring in many food

groups, though not all, during the government and general information period, and that these trends generally improve faster and for more food groups during the post-1985 period.

Together these results present a substantial body of evidence indicating that diet-disease information from all sources led to significant improvements in the intake of fats and cholesterol consumption in the United States. Moreover, contrary to public perception, these improvements accelerate during the 1985-90 period, when the policies toward producer health claims were relaxed and producers were able to join government and other general sources in spreading this information. We now turn to more detailed analyses of the USDA individual consumption data and the FDA knowledge data to better understand where changes in diets were made and what types of individuals react to the different information environments.

VI

FOOD SOURCES OF FAT AND CHOLESTEROL CONSUMPTION

INTRODUCTION

As in Chapter V, we now examine changes in diet at the food group level, but here using the USDA food consumption data for individuals. This analysis serves two purposes. First, examination of consumption by food categories over time is a useful descriptive exercise that allows a better understanding of where changes in food choices occur over the period of this study. More importantly for our purposes, an assessment of changing consumption patterns may help us to better understand how various sources of information affect consumer choices, and in particular, to test one of the key hypotheses about *why* producer claims may be important to consumer behavior. Specifically, we examine the hypothesis that, compared with government and general sources, producer-provided information is better able to provide more detailed information in ways that help more consumers make changes across a broader range of food choices. Finally, this analysis allows us to judge whether the more consistent pattern of improvement found in the production data in Chapter V is also found in the individual consumption data.

INFORMATION DISSEMINATION AND FOOD CHOICES

Government and General Sources of Information

Government and general sources of information typically provide generic information about the effects of diet on disease risks and about the importance of eliminating or reducing foods that contain high levels of nutrients linked to the disease risk. For example, in providing information about saturated fat or cholesterol and heart disease, these sources typically stress the importance of reducing meat consumption and increasing foods that are very low in saturated fat and cholesterol, such as fruits and vegetables.[97] This type of generic information provides a broad perspective on major dietary changes to reduce disease risks. These information sources are unlikely to focus on particular brands of food, but rather on broad food categories for which general statements can be made. Thus, food categories that have midrange levels of the nutrients at issue, or for which simple generalizations are inappropriate, are unlikely to be the focus of these information sources.

For these reasons, during the 1977-1985 period, government and general sources of information would be expected to have their greatest effects in reducing fat, saturated fat, and cholesterol consumption from those food categories for which this type of generic information can be given, and thus, from the easily identified high-fat or high-cholesterol food categories, such as meat, dairy, and eggs. Similarly, the generic information should cause increases in the consumption of food categories that are quite "good" in these dimensions, specifically leading to increased consumption of simple grain products, fruits, and

[97] For example, the recommendations specifically mentioning foods in the *Dietary Goals for Americans* (U.S. Senate 1977) were for consumers to reduce meats, increase poultry and fish, substitute nonfat milk for whole milk, increase consumption of fruits and vegetables, and reduce butterfat, eggs, sugar, and salt.

vegetables. We would expect reductions to be relatively limited in the mid-range and higher-fat food categories that have considerable variation within the category, because these food categories are not likely to be the focus of information from government and general sources.

Information Provided By Producers

In contrast to information from government and general sources, producer-provided information is less likely to contain generic information about food categories and is less likely to provide broad guidance on dietary choices. Instead, producer-provided information typically focuses on a particular brand of a particular food, identifying where the brand is superior to its competitors and why the consumer should consider this difference important enough to buy the product. Thus, producer-provided information is usually more specific than information from government and other general sources but more narrow in scope, though the competitive process itself fills in some of the information missing in individual claims.[98] Also, producer-provided information may be more prominent to many consumers because of the increased quantity and greater creativity of claims, as well as the different mix of media used for making claims.

If the added specificity and prominence of producer-provided information are important in helping consumers to make dietary improvements, and if context and broad dietary information are gathered

[98] For example, if a producer focuses on the low cholesterol content of its product and is gaining market share from the claims, a competing producer that has a low cholesterol *and* low saturated fat product has the incentive to spread this information to regain the lost sales. This competitive process should provide a fuller picture of the range of products available in the market than is provided by any individual claim in isolation (Grossman 1981).

from either the competitive process or government and general sources, the change in policy towards producer health claims would be expected to increase the rate of improvement across a broader range of product categories, compared with the period when government and general information sources are the primary providers of this information. This would occur not only in food categories for which explicit health claims are made, but also in other food categories in which the incentive to compete on nutrition is increased because of the greater prominence of the diet-health issue created by the added claims. In contrast, if many producer-provided claims are deceptive or sufficiently incomplete to mislead consumers, the rate of dietary improvement would be expected to slow across food categories as consumers respond to the misleading information. We now turn to an assessment of the USDA consumption data to judge which of these hypotheses is most consistent with the available data.

DATA AND METHODOLOGY

This chapter analyzes the USDA food consumption data for individuals, described in Chapter III. The standard USDA food categories basically reflect commodity classifications. The major classification groups in the USDA data are dairy products; meat, poultry, and fish products; eggs; legumes, nuts, and seeds; grain products; fruits; vegetables; fats; and sweets and beverages. Because our primary interest is in examining how information affects consumer choices, we use a somewhat different set of product categories to reflect the choices consumers actually make. For example, in the standard USDA classification scheme, typical consumer dessert choices are scattered across a variety of product categories, including ice cream and puddings in dairy products; cakes, cookies, and pies in the grain category; fruit desserts in the fruit category; and candy and gelatin desserts in the

sweets category. In creating our own product categories, we put these types of alternative choices together in a single product category or in parallel product categories to allow us to judge better where consumers are making changes.

Table 6-1 provides a list of the food categories used in our analysis and a description of the major types of foods included in each category. Table 6-1A in the appendix gives a detailed listing of the USDA food codes included in each category for 1989. Other years are comparable.

As shown in Table 6-1, the first five product categories are Meat/Mixtures, Poultry/Mixtures, Fish/Mixtures, Grain/Mixtures, and Eggs/Mixtures, which typically include the main components of meals in the United States. Note that these categories include both single-ingredient items, such as steak in the meat category or a boiled egg in the egg category, and mixed foods classified by USDA as having the main ingredient from the category. Thus, for example, meatballs with tomato sauce is in the meat category (because meat is the main ingredient), but lasagna is in the grain category (because pasta is the dominant ingredient).

The next six categories include items typically consumed as accompaniments to meals. These are Breads, Sweet Breads, Fats and Oils, Dressings/Sauces/Gravies, Milk, and Cheese/Cream/Yogurt. These categories include only items recorded individually; items used as ingredients in mixed foods are typically recorded by the USDA as part of the mixed food. Thus, for example, bread eaten as toast that is spread with margarine would typically be recorded in the Bread and Fats and Oils categories, but bread and margarine used in a ham and cheese sandwich would often be recorded as part of the mixed food, ham and

Table 6-1 Description of Food Categories[1]

Food Category	Description
Meat/Mixtures	Beef, pork, lamb, veal, game, bacon, sausage, franks, lunchmeats, and substitutes; mixed foods with these meats as the major ingredient, including sandwiches, stews, meat in sauces, frozen dinners, etc.
Poultry/Mixtures	Chicken, turkey, and other poultry; mixed foods with poultry as the major ingredient.
Fish/Mixtures	Fish and seafood; mixed foods with fish or seafood as the major ingredient.
Grain/Mixtures	Rice and pasta; mixed foods with grain as the major ingredient; includes Italian, Oriental, Puerto Rican, Mexican food, etc. Bean dishes and soups.
Eggs/Mixtures	Eggs; mixed foods with eggs as the major ingredient.
Breads	Breads, rolls, croissants, bagels, English muffins, etc., if entered as single-ingredients. Does not include bread used in sandwiches, etc., if entered as a mixed food. Also pancakes and waffles.
Sweet Breads	Sweet breads, muffins, coffee cakes, donuts, nut breads, danish, etc.

(Table continued on next page.)

Table 6-1 (Continued)

Food Category	Description
Fats & Oils	Butter, margarine, spreads, lard, shortening, oils, if entered separately. Does not include fats & oils used as ingredients in other foods (*e.g.*, the oil absorbed by french fries).
Dressing/Sauce/Gravy	Salad dressings, meat sauces, white sauces, gravies, etc., if entered as a separate item.
Milk	Milk, milk-based drinks, and powdered milk, if entered as a separate item.
Cheese/Cream/Yogurt	Cheese, cream, sour cream, yogurt and substitutes, if entered separately. Does not include these items in mixed foods, as in lasagna or cheeseburgers.
Desserts	Ice cream, ice milk, and substitutes; pudding, jello; cakes, cookies, pies, and related baked goods; sweet sauces, jelly, candy, etc.
Snacks	Nuts, seeds, and peanut butter; crackers, salty snacks, chips, popcorn, etc.
Fruits/Vegetables	Fruits, vegetables, juices, dried fruit, beans, potatoes (includes french fries), etc.
Cereals	Ready-to-eat and cooked cereals.
Drinks/Other	Coffee, tea, soft drinks, fruit drinks (not juice), alcoholic drinks, sugar & substitutes.

NOTES. [1] A listing of USDA food codes included in each category for 1989 is provided in appendix Table 6-1A. Listings for others years are comparable.

cheese sandwich, in the Meat category.[99] Similarly, cheese used in pizza would be recorded in the nutrition data for pizza in the Grains/Mixtures category, not in the Cheese/Cream/Yogurt category.

The distinction between items in the Desserts and Snacks categories is somewhat arbitrary, but generally we include sweet items in the Desserts category and salty, nonsweet items in the Snacks category. Fruit is not included in the Dessert category so that we can better isolate movements in this important category, but fruit desserts, such as apple cobbler, are included in the Desserts category.

Fruits/Vegetables and Cereals are relatively straightforward categories, though it is important to note that fats or other ingredients used in the preparation of fruits and vegetables are recorded in that category. Thus, for example, the fat in french fries, or fat added to vegetables in cooking, is reflected in the Fruits/Vegetables category.

Drinks/Other includes all nonjuice and nonmilk drinks, primarily soft drinks and alcoholic beverages, together with sugar and artificial sweeteners used during the day. The category also includes liquid meal replacements and food supplements, such as liquid protein, though these are not important sources of fats or cholesterol in the aggregate.

The samples are specified as in Chapter III and are designed to provide comparable samples across the years of the study. Specifically, our analysis focuses on 1-day data for women, 19-50 years of age, who

[99] Fats and oils are recorded separately only if they are added *after* preparation of a food. For example, margarine used in baking and frying is coded in the nutritional value of the prepared food. For primary meal preparers, this information is solicited from the consumer and incorporated into the data for the food. For all others, USDA makes an assumption based on general practices. Thus, changes in behavior may be incorporated with some lag. Margarine used on a slice of bread, however, is included in the Fats and Oils category.

are heads of households, in spring 1977, 1985, 1986, 1987/88, and 1989/90. Comparable data for men are used from summer 1977, 1985, 1987/88, and 1989/90.

Finally, we should note that the nutrition database is continually modified by the USDA in an attempt to reflect accurately the nutritional characteristics of food in the market over time. As in any effort of this type, adjustments to the nutrition database often take place in discrete increments that do not necessarily reflect the incremental changes that occur in the market.[100] Because we examine consumption changes over time, significant modifications in the nutrition database that could affect our results are examined when we report results. Also, as in any database of this type, the changes in the nutritional characteristics of products reported in the database may lag behind movements in the market. This potential problem may be more severe in periods of rapid change. Trade press reports indicate a high rate of new product introductions in the late 1980s, and a sizable fraction of these new products were "light" or otherwise nutritionally reformulated products.[101] For this reason, the results based on the USDA data may understate changes in the type of food consumed in some food categories, especially in periods of rapid change, though we have no way to assess the size of this potential problem.

[100] For instance, in 1977 many USDA recipes assumed that butter was used in preparation. In 1985 this was changed to margarine reflecting changes that had been occurring in the market.

[101] More than 12,000 new food products were reported to have been introduced in 1989, for instance (*New York Times*, May 29, 1990, D-1) and approximately one third of these had nutrition-related claims on the package (*Food Engineering*, March 1992, 104). See also, *Food Review*, USDA, January-April 1994, 35.

RESULTS

Sources of Fat in the U.S. Diet

Table 6-2 gives the average amount of fat consumed by women from each of our product categories in the available years. Table 6-3 gives comparable data for men. We begin by focusing on the changes that occurred during the period of 1977-1985, when diet-health information was provided primarily by government and general sources. We then examine changes in the post-1985 period, when the policies towards producer claims is changed.

Changes in Fat Sources Between 1977 and 1985

In 1977, foods from the Meat/Mixtures category account for approximately 37% of the fat consumed per day by women and 42% for men.[102] Clearly, consumption from the Meat category is the dominant source of fat for both women and men in 1977. Foods from the Fruits/Vegetables category are the next largest source of fat for both sexes in 1977, contributing nearly 9% of the fat for women and 8% for men.[103] Other substantial sources of fat are Poultry, Eggs, Fats and Oils, Dressings/Sauces/Gravies, Milk, Cheese/Cream/Yogurt, and Desserts,

[102] Note that the sum of the fat from individual foods recorded in the data for 1977 is slightly less that the daily fat total reported by USDA for these individuals, as shown in Table 3-1. A small percentage of the food records in the 1977 data did not have valid USDA codes, leading to the observed differences. The sums of the individual foods for 1977, reported at the bottom of Tables 6-2 and 6-3, are 0.6 grams of fat less per day for women and 1.1 grams less for men. These differences are too small to change the conclusions of any of the analysis in this chapter, even if the missing foods are relatively concentrated by food category. The totals for food data for all other years match the USDA daily totals on all the nutritional dimensions examined in this report.

[103] Recall that fat used in preparing foods is recorded in the nutritional contributions of the food. Thus, for example, the data for french fries or other vegetables with fat added in cooking reflect the resulting fat content.

Table 6-2 Average Fat Consumption, By Food Category Women, 19-50 Years,[1] Spring (Grams)

	Food Category (N)	1977 (1704)	1985 (1259)	1986 (1293)	1987/8 (889)	1989/0 (365)
#	Meat/Mixtures	27.15	16.81+	15.56	15.18*	11.99*
	Poultry/Mixtures	3.64	3.51	3.46	3.42	4.34*
	Fish/Mixtures	1.83	2.27+	1.31*	1.51*	2.21
	Grain/Mixtures/Soups	2.74	5.74+	6.28	4.90	7.50*
#	Egg/Mixtures	3.18	2.54+	2.67	2.33	1.81*
	Breads	2.74	2.88	2.61	3.08	2.81
#	Sweet Breads	1.01	1.03	1.30	.91	1.26
#	Fats & Oils	4.35	3.58+	3.77	4.23	3.49
#	Dressings/Sauces/Gravy	4.44	5.39+	4.73	4.24*	5.39
#	Milk	4.05	3.57+	3.73	3.67	2.83*
#	Cheese/Cream/Yogurt	3.88	4.48+	4.95	3.79*	4.30
#	Desserts	4.70	7.23+	6.48	5.35*	3.87*
#	Snacks	2.15	4.18+	3.97	4.54	3.98
	Fruit/Vegetables	6.53	5.72+	5.18	6.27	5.87
	Cereals	.20	.32+	.45	.41	.39
	Drinks/Other	.11	.32+	.42	.04*	.08*
	Totals	72.70	69.57+	66.80	63.86*	62.14*

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and Continuing Survey of Food Intakes by Individuals, 1985, 1986, and 1989/90. All means weighted.

NOTES. + indicates difference from 1977 mean is significant at 5 percent level.
* indicates significant difference from 1985 mean. N is sample size.
# denotes higher-fat categories used for grouped statistical tests.
[1] Heads of households only.

Table 6-3 Average Fat Consumption, By Food Category Men, 19-50 Years,[1] Summer

Food Category (N)	1977 (720)	1985 (578)	1987/8 (230)	1989/0 (306)
# Meat/Mixtures	46.82	31.31+	26.82	23.06*
Poultry/Mixtures	4.41	4.91	5.58	6.17
Fish/Mixtures	2.24	2.89	1.23*	.86*
Grain/Mixtures/Soups	4.28	7.93+	6.83	8.45
# Egg/Mixtures	4.55	3.70+	3.40	5.09*
Breads	4.56	4.53	4.13	5.20
# Sweet Breads	1.96	1.90	1.67	1.71
# Fats & Oils	6.53	5.78	5.14	7.36
# Dressings/Sauces/Gravy	5.06	5.54	5.48	5.74
# Milk	6.12	5.77	4.59	3.28*
# Cheese/Cream/Yogurt	4.80	5.46	5.31	5.16
# Desserts	6.83	9.07+	6.91*	6.27*
# Snacks	4.00	7.75+	6.45	5.51*
Fruit/Vegetables	9.31	10.22	10.26	8.15*
Cereals	.24	.44	.27	.63
Drinks/Other	.07	.28+	.05*	.03*
Totals	111.74	107.48	94.12*	92.65*

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and Continuing Survey of Food Intakes by Individuals, 1985 and 1989/90. All means weighted.

NOTES. + indicates difference from 1977 mean is significant at 5 percent level.
* indicates significant difference from 1985 mean. N is sample size.
# denotes higher-fat categories used for grouped statistical tests.
[1] Heads of households only.

though together these sources contribute less fat than the Meat category for either sex.

Thus, in 1977, foods in the Meat category are the most identifiable, concentrated source of fat for both men and women. Most public education messages from this period reflect this concentration, advising consumers to reduce meat consumption. For example, in the *Dietary Goals for the United States* (U.S. Senate 1977), meat, along with butterfat and eggs, are the only specific foods singled out for reduced consumption for cardiovascular disease reasons.

Perhaps not surprisingly, given the focus of public health messages at the time and the significance of the category as a source of fat in 1977, the most striking change in fat consumption between 1977 and 1985 occurs for the Meat/Mixtures category. Fat consumption from this category declines by more than any other food category in both percentage and absolute terms. Fat consumed from the Meat category falls 10.3 grams per day for women and 15.5 grams per day for men between 1977 and 1985.[104] Fat falls in only 5 other food categories for both sexes, and 3 of these are specifically mentioned in public health messages from the period.[105] Fat consumption declines for Eggs, Fats and Oils, and Milk by approximately 1.9 grams per day for both sexes. Fat consumption also declines for Poultry and Fruits/Vegetables for women and trivially for Breads and Sweet Breads for men.

[104] This reduction in meat consumption has been reported by many others. See for instance, Peterkin (1986) and Putler and Frazao (1994).

[105] The category that stands out as the exception to the effectiveness of specific dietary advice is Cheese/Cream/Yogurt, which contributed more fat to the diet in 1985 than in 1977. This result is consistent with trends in cheese and cream production data, as reported in Chapter V.

In assessing the nature of the changes in consumption from the Meat category, note that the reduction in fat is not simply the result of consumers avoiding foods in the category. The fat reduction appears to be a mixed reaction, in which consumers reduced the frequency of consumption, changed the type of meat or preparation method when they consumed such foods, and consumed less per day. For example, as shown in Tables 6-4 and 6-5, the proportion of adults consuming from the Meat category per day falls 10% for women and 9% for men, far less than the 38% and 33% reductions in fat from the category observed in Tables 6-2 and 6-3. This evidence indicates that adults who continue to consume from the category also cut fat consumption from Meat. In fact, the proportion of total Meat calories coming from fat falls from 66% to 57% for women, and from 66% to 59% for men during this period, indicating that the type of meat or the preparation method changes for those who continue to consume from the category.

Despite the large declines in fat from the Meat category and the modest declines in the other identified categories, overall fat consumption from all foods declines by just 3.1 grams per day for women and 4.3 grams for men. Thus, much of the gain achieved in the Meat category is offset by increased fat consumption in other food categories.[106] Some of this is expected, of course, as individuals who cut meat consumption increase their intake of poultry, fish, and grain-based mixed dishes. This expected shift does not fully explain the overall compensation observed, however. Women increase fat consumption by only 3.3 grams per day from the Poultry, Fish, and Grain/Mixtures categories combined; men increase fat by only 4.8 grams from these

[106] The compensation observed during this period was the central result in Putler and Frazao (1991).

Table 6-4 Percent Consuming from Food Category per Day, Women, 19-50 Years,[1] Spring

Food Category (N)	1977 (1704)	1985 (1259)	1986 (1293)	1987/8 (889)	1989/0 (365)
# Meat/Mixtures	78.9	71.0+	68.3	70.1	63.1*
Poultry/Mixtures	20.8	26.0+	26.2	25.5	34.6*
Fish/Mixtures	14.6	18.1+	13.9*	17.3	16.0
Grain/Mixtures/Soups	34.0	43.5+	44.0	39.5	45.2
# Egg/Mixtures	29.7	23.9+	27.1	21.6	18.0*
Breads	77.0	74.2+	72.8	73.1	79.9*
# Sweet Breads	9.2	10.2	11.4	7.5*	11.4
# Fats & Oils	27.6	40.9+	42.6	36.4*	41.0
# Dressings/Sauces/Gravy	36.0	43.6+	41.7	34.9*	41.5
# Milk	56.0	53.2	55.6	52.3	49.9
# Cheese/Cream/Yogurt	39.5	48.8+	48.2	38.3*	39.7*
# Desserts	42.1	50.1+	47.3	39.2*	43.5*
# Snacks	24.9	38.1+	35.1	33.3*	31.3*
Fruit/Vegetables	90.7	90.2	89.4	91.7	90.1
Cereals	21.2	20.6	22.9	22.0	22.2
Drinks/Other	91.7	94.8+	90.6*	89.6*	95.7

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and Continuing Survey of Food Intakes by Individuals, 1985, 1986 and 1989/90. All means weighted.

NOTES. + indicates difference from 1977 proportion is significant at 5 percent level. * indicates significant difference from 1985. N is sample size.
# denotes higher-fat categories used for grouped statistical tests.
[1] Heads of households only.

Table 6-5 Percent Consuming from Food Category per Day, Men, 19-50 Years,[1] Summer

	Food Category (N)	1977 (720)	1985 (578)	1987/8 (230)	1989/0 (306)
#	Meat/Mixtures	88.6	80.4+	71.6*	82.8
	Poultry/Mixtures	18.1	24.7+	29.3	32.2*
	Fish/Mixtures	12.6	16.8+	15.0	8.9*
	Grain/Mixtures/Soups	36.0	39.5	40.8	43.8
#	Egg/Mixtures	35.2	28.8+	28.0	30.2
	Breads	85.7	80.9+	78.4	77.0
#	Sweet Breads	13.7	12.4	10.4	13.4
#	Fats & Oils	45.3	41.8	41.3	40.5
#	Dressings/Sauces/Gravy	34.7	40.5+	35.4	42.5
#	Milk	56.8	50.4+	49.0	44.8
#	Cheese/Cream/Yogurt	36.1	42.0+	37.4	44.7
#	Desserts	44.5	46.4	43.9	44.2
#	Snacks	26.9	35.3+	25.5*	32.0
	Fruit/Vegetables	92.0	92.8	89.6	93.4
	Cereals	19.5	16.1	18.6	12.0*
	Drinks/Other	93.7	93.7	94.0	93.6

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and Continuing Survey of Food Intakes by Individuals, 1985 and 1989/90. All means weighted.

NOTES. + indicates difference from 1977 proportion is significant at 5 percent level. * indicates significant difference from 1985. N is sample size.
# denotes higher-fat categories used for grouped statistical tests.
[1] Heads of households only.

foods. Thus, much of the compensating increase in fat comes from other changes in diet during this period.

As shown in Tables 6-2 and 6-3, the most substantial increases in fat consumption come from increases in Desserts and Snacks. Between 1977 and 1985, women consume an average of 4.6 grams more fat per day from these two categories combined, and men consume 6 grams more on average. In part, as shown in Tables 6-4 and 6-5, this reflects a substantial increase in the number of adults reporting consumption from these categories.[107] The increase in fat consumption also reflects an increase in the fat content of the items chosen in Desserts. As shown in Tables 6-6 and 6-7, the percentage of calories from fat for those who consume something in the Dessert category rises from 31% to 34% for women and from 32% to 35% for men during this period. The average

[107] One potential explanation for this result is a modification of the survey technique used for the 1985 and later surveys, in which interviewers are specifically trained to ask respondents whether they forgot to mention any food items. This added probing might be especially important for categories such as desserts and snacks, if these items might be forgotten in responding to the survey. In 1988 the USDA conducted a detailed test of the two survey methodologies, as well as changes in the nutrition database (USDA 1990). In this *Bridging Study*, food items added as a result of the added probing are noted by surveyors. The study finds that the added probing has no effect on the average number of food items reported by respondents or on total energy intakes. Moreover, no significant differences are found in fat intake between the two survey methods (in fact, average fat intake is insignificantly lower with the new technique). Thus, the available evidence does not support this potential explanation for the added consumption from these categories. Finally, in later years when the survey used the same technique as in 1985, fat consumption from these categories falls, suggesting that behavior, rather than a change in the survey method, is responsible for movement in the categories.

As an additional check on this change, we examined available industry sales data for a number of snack food categories (*Snack Foods* June 1986). These data also indicate that sales increase substantially between 1977 and 1985. For instance, between 1977 and 1985, sales of potato chips increase 15 percent (in 1990 dollars), sales of corn chips increase 76 percent, and sales of crackers and cookies increase 11 percent, rates of growth that substantially exceed population growth during the period.

Table 6-6 Average Food Type and Amount Eaten in Category, for Those Eating from the Category Women, 19-50 Years,[1] Spring

Food Category	Percent Calories from Fat			Food Amount (g/day)		
	1977	1985	1989/90	1977	1985	1989/90
# Meat/Mixtures	66	58+	55*	163.6	153.2+	130.4*
Poultry/Mixtures	47	42+	39	149.3	138.6	127.1
Fish/Mixtures	43	40+	34*	128.6	149.2+	158.9
Grain/Mixtures/Soups	25	28+	33*	245.9	280.5+	308.1
# Egg/Mixtures	68	68	67*	84.6	72.8+	81.0
Breads	14	15+	16*	73.5	74.5	68.5*
# Sweet Breads	36	37	36	73.3	69.3	73.5
# Fats & Oils	100	100	100	19.8	11.9+	11.4
# Dressings/Sauces/Gravy	90	83+	86*	36.9	36.1	41.2
# Milk	41	37+	32*	271.9	290.4	303.4
# Cheese/Cream/Yogurt	66	66	65	62.6	61.7	62.3
# Desserts	31	34+	25*	116.7	122.9	98.3*
# Snacks	49	49	50	28.9	38.0+	45.6*
Fruit/Vegetables	23	21+	21	346.7	331.9	311.8
Cereals	07	08+	09	65.0	78.1+	56.5*
Drinks/Other	00	09+	01*	773.4	990.0+	1004.4

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, and Continuing Survey of Food Intakes by Individuals, 1985, and 1989/90. All means weighted.

NOTES. + indicates difference from 1977 mean is significant at 5 percent level.
* indicates significant difference from 1985 mean.
# denotes higher fat categories used for grouped statistical tests.
[1] Heads of households only. Computed from data for those who ate something from the category on the survey day.

Table 6-7 Average Food Type and Amount Eaten in Category, for Those Eating from the Category Men, 19-50 Years,[1] Summer

Food Category[2]	Percent Calories from Fat			Food Amount (g/day)		
	1977	1985	1989/90	1977	1985	1989/90
# Meat/Mixtures	66	59+	55*	254.0	229.1+	206.9
Poultry/Mixtures	48	43+	43	195.5	204.5	195.1
Fish/Mixtures	47	39+	36	163.6	198.7	113.7*
Grain/Mixtures/Soups	24	28+	29	346.4	379.2	370.9
# Egg/Mixtures	68	68	67	101.0	92.9+	122.4*
Breads	14	14	16*	111.3	107.0	117.0
# Sweet Breads	40	36+	44*	88.8	106.4	69.6*
# Fats & Oils	100	100	100	18.0	17.8	25.9*
# Dressings/Sauces/Gravy	87	82+	84	52.2	49.8	48.0
# Milk	43	39+	36*	375.5	436.2+	391.4
# Cheese/Cream/Yogurt	71	70	67	59.4	60.6	59.8
# Desserts	32	35+	28*	148.0	158.0	133.2*
# Snacks	54	54	50*	43.2	64.5+	55.5
Fruit/Vegetables	25	24	22	425.8	466.0+	365.4*
Cereals	06	08+	10	90.3	110.4	154.8*
Drinks/Other	01	05+	00*	1076.4	1537.6+	1300.7*

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, and Continuing Survey of Food Intakes by Individuals, 1985 and 1989/90. All means weighted.

NOTES. + indicates difference from 1977 mean is significant at 5 percent level.
* indicates significant difference from 1985 mean.
# denotes higher fat categories used for grouped statistical tests.
[1] Heads of households only. Computed from data for those who ate something from the category on the survey day.

type of snack changes little, remaining at 49% of calories from fat for women and 54% for men.

More generally, both women and men increase fat consumption in 10 of the 16 food categories listed (5 of the 10 for women and 8 of the 10 for men increase by 0.5 grams or more), indicating that increases in fat came from a broad range of food choices.

Overall, the results indicate that during the 1977-1985 period fat decreases are concentrated in the Meat category. Increases in fat consumption from other foods are sufficient to eliminate approximately 70% of the fat reductions in the Meat category, however, resulting in moderate overall fat reductions between 1977 and 1985 for both women and men. We now turn to a discussion of changes between 1985 and 1989/90, before more formal tests of our hypotheses.

Changes in Fat Sources Between 1985 and 1989/90

The decline in average daily fat consumption is considerably larger between 1985 and 1989/90 than the decline between 1977 and 1985; average daily fat consumption falls by 7 grams for women and 15 grams for men between 1985 and 1989/90. In contrast to the changes that occur between 1977 and 1985, no single food category is responsible for the decline in fat consumption in the post-1985 period. Instead, the overall decline in fat consumption occurs across a larger number of food categories. For example, the largest decline in fat consumption again occurs in the Meat category for both men and women. Compared with the earlier period, the rate of improvement in meat consumption is unchanged for men, but the reductions occur at a somewhat slower rate for women; fat from Meat falls by 4.8 grams for women and 8.3 grams for men between 1985 and 1989/90. If Meat, Poultry, Fish, and

Grain/Mixtures are considered together, fat from the categories falls by 2.3 grams for women and 8.5 grams for men.

In evaluating changes during this period, note that fat reduction in the Dessert category is the second largest for both men and women, approximately 3 grams per day in each case. Also this reduction is again far larger in percentage terms than the change in the proportion of the population consuming from the category; the proportion consuming at least one Dessert item falls 13% for women and 5% for men, but fat from Desserts falls 46% and 31%, respectively. Thus, again consumers appear to be making substantial changes, not simply by avoiding the category, but by making better choices within the category and by eating less from the category. Other evidence supporting this conclusion is shown in Tables 6-6 and 6-7, indicating that the reduction in the percentage of Dessert calories due to fat falls from 34% to 25% for women who eat dessert items and from 35% to 28% for men between 1985 and 1989/90. The amount of dessert consumed also falls for those who eat desserts -- by 20% for women and 16% for men.

More broadly, fat falls in 10 of the 16 categories for women and 9 of 16 for men.[108] Only 2 food categories increase by more than 0.5 grams for women and only 5 categories increase by more than 0.5 grams for men.

Thus, in contrast to the 1977-85 period, fat reductions during the post-1985 period occur across a broader range of food categories, including food categories that are a substantial but not a primary source

[108] Note that fat from Cheese/Cream/Yogurt falls in the post-1985 period, while the production data for cheese discussed in Chapter V shows a slower rate of increase. Recall that the Cheese/Cream/Yogurt category does not include any cheese used as an ingredient in mixed dishes, and the fat from the Grain/Mixed category continues to rise during this period, which may explain the discrepancy.

of fat, and fat increases in fewer categories, leading to a more rapid rate of decrease in fat consumption overall. The results are essentially the same if the 1987/88 data are used as the basis for comparison in the post-1985 period.

To evaluate our hypothesis more formally, we focus on the pattern of change in the higher-fat food groups between the periods, where our hypothesis is most clear.[109] Note from Tables 6-6 and 6-7 that the average percentage of calories from fat is substantially higher in the Meat and Egg categories than that in the Poultry, Fish, or Grain categories. Similarly, Sweet Breads, Fats and Oils, Dressings/Sauces/Gravies, Milk, Cheese/Cream/Yogurt, Desserts, and Snacks are all substantially more dense fat sources than the remaining food categories, all averaging more than 30 percent of calories from fat. Thus, our formal hypothesis tests focus on patterns of change across these 9 higher-fat food categories, in which we expect informed consumers to cut fat consumption systematically by shifting away from the category, reducing the amount of food consumed from the category, or reducing the fat content of foods chosen within the category. These 9 food categories are noted with a pound sign (#) in the tables.

Our primary interest is in testing the hypothesis that the change in advertising and labeling policy around 1985 increases consumers' ability to improve their diets across a broader range of the higher-fat food categories. For these purposes, movements in these 9 food categories are treated as independent observations on consumers' successful

[109] Predictions are less clear in the lower-fat categories, because, for example, the average type of product chosen may deteriorate as consumers substitute away from the highest-fat categories. Thus, for example, if information causes more consumers to shift from meat-based entrees to grain-based entrees, the percentage of calories from fat in the Grain category might increase, though not to the level of the meat entrees they replace, or might decrease if the within-category change dominates the substitution effect.

absorption of the diet-health information necessary to implement dietary changes.

Several versions of our hypothesis are tested -- in each case the null hypothesis is one of equality between the two periods, against the one-sided alternative hypothesis that improvements are larger in the post-1985 period.[110] Our first test is a proportions test that focuses solely on the direction of the movements in the categories by testing whether the proportion of negative trends is the same in both periods for each of the dimensions of interest. Thus, for example, fat consumed by women falls in 4 of the 9 higher-fat categories in the 1977-85 period; it falls in 7 of the 9 categories in the post-1985 period, which is a significant difference at the 8% level.

Our second test considers relative rates of change between the two periods, using a sign test for matched data to compare the annualized rate of change in each category between the two periods.[111] Thus, for example, for women the rate of change in fat consumption is better in 6 of the 9 higher-fat food categories in the post-1985 period compared with the 1977-1985 period, which is significant at the 25% level.

The third test assesses whether the mean of the standardized movements in the measures across the food categories is the same in the two periods. This t-test accounts for the magnitude of the movements (relative to variance) as well as the sign of the change.[112] For women,

[110] Tests against the opposite alternative hypothesis, that improvements are smaller in the post-1985 period, are given by the reciprocal p statistics and are discussed as we summarize the results of the tests.

[111] Note that there are 8 years in the 1977-85 period and only 4.67 years in the post-1985 period. We annualize the data to correct for this difference.

[112] Specifically, the test statistic is

(continued...)

this t-statistic for fat consumption is -1.4, which is significant at the 9% level.

The final test is a Wilcoxon signed-rank test of the matched standardized movements in the two periods. This is a nonparametric test assessing whether the movements in the two periods are drawn from the same distribution based on both the rank magnitude and sign of the movements.[113] For women, the Wilcoxon statistic W^+ for changes in fat consumption in the 9 categories across the two periods is 10, which is significant at the 8% level.

The results from these tests for the fat dimensions are reported in summary form in Table 6-8. For fat itself, three of the four tests are significant at the 10% level for women, leading us to reject the null hypothesis that movements are drawn from the same distribution in the two periods, in favor of the alternative hypothesis that improvements in these higher-fat categories increase in the post-1985 period. For men, the results are in the same direction but the test statistics are not significant.[114]

(...continued)

$$(t_1 - t_2)/\text{sqrt}(s_{t_2}^2 + s_{t_1}^2)$$

where $t_1 = (F_{85} - F_{77})/8$, $t_2 = (F_{89/90} - F_{85})/4.67$, F_t is the standardized mean fat content for the 9 higher-fat food categories in year t, and s_{t_i} is the standard deviation for t_i.

[113] Specifically, the difference statistic for each food group, described in the previous footnote, is ranked by absolute magnitude and the sign is attached to the rank. The test statistic W^+ is the sum of the positive ranks.

[114] Note that if we test against the alternative deception/confusion hypothesis that trends deteriorated in the post-1985 period, the p values for fat for women are .92, .75, .91, and .92, respectively, which provides no empirical support for this alternative hypothesis. For men these p values are .68, .75, .84, and .88, again providing no empirical support for the alternative hypothesis.

Table 6-8 Tests for Changes Across Higher-Fat Food Groups[1] 1985-89/90 Versus 1977-85

	Sign Tests				
	Negative Trends[2] 77-85	85-90 (p)	Relative Trends[3] (p) (#Better/Total)	t-Test for Mean Change in Trends[4] (p)	Wilcoxon Test for Matched Samples[5] (p)
Women, 19-50 Years, Spring					
Fat	4/9	7/9 (.08)*	6/9 (.25)	-1.4 (.09)*	10 (.08)*
Percent Eating	3/9	7/9 (.03)**	8/9 (.02)**	-3.6 (.00)**	1 (.01)**
% Cal. Fat	4/9	6/9 (.18)	5/9 (.50)	-.5 (.32)	18 (.30)
Food Amount	6/9	3/9 (.91)	2/9 (.98)	.7 (.75)	31 (.85)
Men, 19-50 Years, Summer					
Fat	5/9	6/9 (.32)	6/9 (.25)	-1.1 (.16)	12 (.12)
Percent Eating	5/9	4/9 (.68)	5/9 (.50)	.1 (.55)	23 (.52)
% Cal. Fat	7/9	7/9 (.50)	7/9 (.09)*	-.7 (.25)	14 (.17)
Food Amount	4/9	7/9 (.08)*	7/9 (.09)*	-.8 (.22)	15 (.20)

NOTES. * indicates significance at 10 percent level; ** at 5 percent level.

[1] The nine higher-fat food groups used for these tests are meat, eggs, sweet breads, fats & oils, dressings/sauces/gravy, milk, cheese, desserts, and snacks. Tests are described in text.

[2] Test of hypothesis that the proportion of negative trends in the two periods are equal against the alternative that proportion is larger in 1985-89/90.

[3] Sign test of hypothesis that annualized trends for the two periods are drawn from the same distribution against alternative that 1985-90 trends are better than 1977-85 trends.

[4] t-test of hypothesis that standardized trends for higher-fat food groups in 1977-85 and 1985-89/90 are drawn from distributions with equal means, against the alternative that the mean in 1985-89/90 is more negative than that in 1977-85.

[5] Wilcoxon test for matched samples based on standardized trends for the periods.

When we consider why more categories improve in the post-1985 period, the evidence suggests somewhat different explanations for women and men. For women, the evidence indicates that a larger percentage of women systematically moved away from the higher-fat categories in the post-1985 period, as indicated by the significant test results for the percentage eating from the categories in Table 6-8. In the 1977-85 period, the percentage of women consuming from the higher-fat categories fall in only 3 of the 9 categories; it falls in 7 of the 9 in the post-1985 period. In 7 of the 9 cases, the relative rate of change in the percentage of women consuming from the higher-fat categories is better in the post-1985 period. Both the t-test and the Wilcoxon test are also significant at the 1% and 3% levels, respectively.

The evidence does not suggest that women who continue to eat from the higher-fat categories make systematically better choices or reduce the amount of food eaten from the category in the post-1985 period, as indicated in Table 6-8 by the test results for food type and amount (*Percent Calories From Fat* and *Food Amount*).[115] The finding that the choice of food within the higher-fat categories is not systematically better for women is somewhat surprising given the apparently increased focus on lower-fat products in the late 1980s, especially in new product development.[116]

[115] In fact, for those who continued to eat from these categories the amount of food eaten actually tended to increase (p = .02 to .25).

[116] We have no way to assess whether this result is real, a reflection of limitations in the incorporation of newer products in the database, or a reflection of strong selection effects in which the higher-fat categories increasingly reflect the choices of uninformed consumers. More detailed data, such as scanner data, could possibly resolve the issue. We should note, however, that improvements in food type *are* found in several food categories, notably meat, milk, and desserts. The tests reported here indicate that the *increase* in the rate of improvement in fat consumption is not the result

(continued...)

Thus, regardless of the test used, the evidence indicates that for women, fat falls faster in the post-1985 period because more women systematically shift away from a broader range of the higher-fat food categories (to the lower-fat categories), suggesting that more women are effectively reached by information useful for making dietary change in the post-1985 period.

For men, fat consumption falls in the higher-fat categories due to a combined reaction of more men systematically making better choices within the higher-fat food categories (p = .09 to .50) and a systematic reduction in the amount of food consumed from these categories for those who continued to consume from them (p = .08 to .20).

Summary of Results on Fat Sources

The pattern of decline in fat consumption across food categories changes during the post-1985 period. Between 1977 and 1985, reductions in fat are highly concentrated in the Meat category and to a modest extent in Eggs, Fats and Oils, and Milk for both women and men. These results are consistent with the hypothesis that government and other sources of information would have their greatest effect in those food categories for which general statements could be made. Also, as expected, these sources of information do not do well in the less concentrated food categories or in those that include a broad mix of foods; fat actually increases in 10 of the 16 food categories during this period, so that approximately 70% of the reduction in fat from Meat is lost due to this compensation.

(...continued)
of systematic *increases* in the rate of improvement in type of food chosen across these higher-fat categories.

In contrast, the reductions in fat during the post-1985 period occur across a broader range of food categories. Fat continues to fall in the Meat category, but fat also falls in other categories, such as Desserts or Cheese/Cream/Yogurt. In fact, fat consumption falls in 10 of the 16 food categories for both sexes during this period. For women statistical tests across the 9 higher-fat food categories generally show these results to be significant and to result primarily from more individuals systematically avoiding more of these higher-fat food categories in the post-1985 period. The results for men are statistically weaker but suggest that the overall reductions in fat reflect systematic improvements in the type of food chosen and reductions in the amount of food eaten from the higher-fat categories.

Sources of Saturated Fat in the U.S. Diet

Table 6-9 details the average consumption of saturated fat by food category for women in spring for the years available. Table 6-10 gives comparable results for men in summer.

Changes in Saturated Fat Sources Between 1977 and 1985

As found for fat, saturated fat consumption was highly concentrated in the Meat category in 1977; foods from the Meat category contributed 38% of total saturated fat per day for women and 42% for men, percentage levels that are essentially the same as for total fat. In contrast to the fat results, however, the dairy categories of Milk and Cheese/Cream/Yogurt are the next largest sources of saturated fat for both sexes (as opposed to Fruits/Vegetables for fat). Other food categories contributing more than 1 gram of saturated fat in 1977 are Poultry, Grain, Eggs, Fats and Oils, Desserts, and Fruits/Vegetables. Thus, in 1977 foods from the Meat category and the dairy categories

Table 6-9 Saturated Fat Consumption, By Food Category Women, 19-50 Years[1], Spring (Grams)

	Food Category (N)	1977 (1704)	1985 (1259)	1986 (1293)	1987/8 (889)	1989/0 (365)
#	Meat/Mixtures	10.02	6.46+	6.01	5.70*	4.47*
	Poultry/Mixtures	1.00	.95	.95	.93	1.16
	Fish/Mixtures	.43	.56+	.32*	.36*	.49
	Grain/Mixtures/Soups	1.23	2.16+	2.37	1.86	2.82*
#	Egg/Mixtures	1.00	.74+	.79	.72	.53*
	Breads	.72	.72	.66	.86*	.71
#	Sweet Breads	.31	.33	.42	.29	.52*
#	Fats & Oils	1.68	1.32+	1.29	1.52	1.00*
#	Dressings/Sauces/Gravy	.75	.95+	.86	.74*	.97
#	Milk	2.52	2.22+	2.32	2.29	1.77*
#	Cheese/Cream/Yogurt	2.47	2.86+	3.17	2.40*	2.81
#	Desserts	1.94	2.96+	2.71	2.23*	1.63*
#	Snacks	.51	.99+	.95	1.14	.95
	Fruit/Vegetables	1.46	1.70+	1.55	1.74	1.70
	Cereals	.07	.10	.11	.12	.15
	Drinks/Other	.07	.15+	.18	.02*	.06*
	Totals	26.18	25.18	24.64	22.92*	21.74*

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and Continuing Survey of Food Intakes by Individuals, 1985, 1986, and 1989/90. All means weighted.

NOTES. + indicates difference from 1977 mean is significant at 5 percent level.
* indicates significant difference from 1985 mean. N is sample size.
# denotes higher-fat categories used for grouped statistical tests.
[1] Heads of households only.

Table 6-10 Saturated Fat Consumption, By Food Category Men, 19-50 Years,[1] Summer (Grams)

Food Category (N)	1977 (720)	1985 (578)	1987/8 (230)	1989/0 (306)
# Meat/Mixtures	17.10	12.15+	9.96*	8.46*
Poultry/Mixtures	1.19	1.32	1.59	1.66
Fish/Mixtures	.48	.71+	.28*	.18*
Grain/Mixtures/Soups	2.00	2.93+	2.53	3.12
# Egg/Mixtures	1.46	1.08+	1.02	1.50*
Breads	1.14	1.09	1.07	1.29
# Sweet Breads	.62	.61	.57	.61
# Fats & Oils	2.38	2.52	1.74*	2.29
# Dressings/Sauces/Gravy	.94	1.03	1.07	1.14
# Milk	3.81	3.59	2.86	2.04*
# Cheese/Cream/Yogurt	3.05	3.48	3.38	3.30
# Desserts	2.72	3.78+	2.97	2.71*
# Snacks	.91	1.58+	1.38	1.27
Fruit/Vegetables	2.30	2.96+	2.86	2.38*
Cereals	.09	.13	.62	.38
Drinks/Other	.04	.11+	.02*	.02*
Totals	40.23	39.06	33.36*	32.35*

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and Continuing Survey of Food Intakes by Individuals, 1985 and 1989/90. All means weighted.

NOTES. + indicates difference from 1977 mean is significant at 5 percent level.
* indicates significant difference from 1985 mean. N is sample size.
# denotes higher-fat categories used for grouped statistical tests.
[1] Heads of households only.

were the major sources of saturated fat in the U.S. diet for both women and men.

As with fat consumption, the largest change in saturated fat consumption between 1977 and 1985 comes in the Meat category. Saturated fat from Meat falls by 3.6 grams for women and 5.0 grams for men, reductions that substantially exceed those observed in any other food category for either sex during this period. In fact, the second largest reduction of saturated fat for a food category between 1977 and 1985 is the loss of 0.4 grams from Fats and Oils for women and the loss of 0.4 grams from Eggs for men. Saturated fat from Milk declines modestly by 0.3 grams for women and 0.2 grams for men, but these reductions are more than offset for both sexes by the increased saturated fat consumption from the other dairy category, Cheese/Cream/Yogurt.

Overall, between 1977 and 1985 saturated fat consumption falls for only 5 of the 16 food categories for both women and men. Of these, only 4 of the reductions for women (Meat, Eggs, Fats and Oils, and Milk) and 3 of the reductions for men (Meats, Eggs, and Milk) are larger than 0.2 grams of saturated fat. Moreover, saturated fat consumption increases by more than 0.2 grams in 6 of the 16 categories for both women and men. Thus, despite the relatively large reductions in saturated fat consumption from the Meat category, saturated fat from all food categories falls by only 1.0 gram per day for women and 1.2 grams for men between 1977 and 1985. The increases in saturated fat consumption from other foods are sufficient to eliminate approximately 72% of the reduction achieved by women in the Meat category and approximately 76% of the reduction by men, resulting in moderate overall saturated fat reductions between 1977 and 1985 for both sexes.

Changes in Saturated Fat Sources Between 1985 and 1989/90

The declines in average saturated fat consumption per day are considerably larger between 1985 and 1989/90 than between 1977 and 1985; saturated fat falls by 3.4 grams for women and 6.7 grams for men between 1985 and 1989/90, compared with 1.0 and 1.2 grams per day, respectively, between 1977 and 1985. In contrast to the changes in the pre-1985 period, no single food category is responsible for the decline in fat consumption in the post-1985 period. Instead, the overall decline in saturated fat consumption occurs across a larger number of food categories. For example, the largest decline in saturated fat consumption again occurs in the Meat category for both men and women. Compared with the earlier period, the rate of improvement is unchanged for women, but the reductions occur at a somewhat faster rate for men; saturated fat from Meat falls by 2.0 grams for women and 3.7 grams for men between 1985 and 1989/90.

More broadly, saturated fat consumption falls in 10 of the 16 categories for women and 9 of 16 for men and by more than 0.2 grams per day in 5 of the 16 categories for women and in 7 of the 16 categories for men. In contrast, only 2 food categories increase by more than 0.2 grams for women and only 3 categories increase by more than 0.2 grams for men.

In most cases, saturated fat movements parallel fat changes quite closely, but there are a few exceptions. For example, in the Fats and Oils category saturated fat declines by 24% for women and 9% for men between 1985 and 1989/90, compared to a decline in fat of 2.5% for women and an increase of 27% for men. This evidence indicates that saturated fat is the relative focus of change within the category in the

post-1985 period. This is not true of the earlier period.[117] As illustrated in Chapter II, advertising for fat and oil products is one of the major areas with explicit health claim advertising, and that advertising focused on the health implications of saturated fat consumption during the post-1985 period.

Thus, in contrast to the 1977-1985 period, saturated fat reductions occur across a broader range of food categories, after the regulations on producer claims are relaxed, leading to a more rapid rate of decrease in saturated fat consumption overall. With a few exceptions, this pattern of change closely mirrors that observed for overall fat consumption, though the results for men are stronger for saturated fat than they are for fat. More formal tests of the pattern of change (summarized below) indicate that these results are statistically significant in a majority of comparisons. For women these results again reflect primarily a larger percentage of the population systematically moving away from the higher-fat categories, toward the lower-fat categories; for men, they reflect systematic reductions in the amount of food eaten from the higher-fat categories.

Sources of Cholesterol in the U.S. Diet

Tables 6-11 and 6-12 give the average amounts of cholesterol consumed from the different food categories by women and men, respectively, for the years available.

[117] Between 1977 and 1985, saturated fat consumption from the category declined by 21% for women and increased by 6% for men, compared with fat declines of 18 and 11.5%, respectively.

Table 6-11 Cholesterol Consumption, By Food Category Women, 19-50 Years[1], Spring (Milligrams)

Food Category (N)	1977 (1704)	1985 (1259)	1986 (1293)	1987/8[2] (889)	1989/0 (365)
# Meat/Mixtures	96.2	71.1+	69.4	62.9*	52.9*
Poultry/Mixtures	24.2	26.1	28.2	24.9	33.5*
Fish/Mixtures	14.4	20.1+	12.9*	14.0*	11.7*
Grain/Mixtures/Soups	14.0	21.3+	21.6	15.2*	20.6
# Egg/Mixtures	123.4	87.1+	97.7	67.0*	51.1*
Breads	7.4	8.7	7.0	7.8	3.6*
# Sweet Breads	3.2	3.6	4.4	2.6	2.9
# Fats & Oils	5.4	4.5	3.8	4.7	2.3*
# Dressings/Sauces/Gravy	2.9	3.1	3.5	1.9*	2.5
# Milk	16.5	14.4+	15.1	14.8	11.7*
# Cheese/Cream/Yogurt	11.6	13.1+	14.5	11.1*	11.5
# Desserts	15.5	21.4+	17.6*	12.6*	10.9*
# Snacks	.8	1.4+	1.2	.9	.6*
Fruit/Vegetables	8.5	8.7	6.0*	4.7*	5.1*
Cereals	.0	.2+	.0*	.0*	.2
Drinks/Other	.3	.1	.4	.0	.2
Totals	344.4	304.9+	303.0	245.1*	221.2*

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and Continuing Survey of Food Intakes by Individuals 1985, 1986, 1989/90. All means weighted.

NOTES. + indicates difference from 1977 mean is significant at 5 percent level.
* indicates significant difference from 1985 mean. N is sample size.
# denotes higher-fat categories used for grouped statistical tests.
[1] Heads of households only.
[2] Recall that cholesterol data for eggs was changed beginning in 1987.

Table 6-12 Cholesterol Consumption, By Food Category Men, 19-50 Years,[1] Summer (Milligrams)

Food Category (N)	1977 (720)	1985 (578)	1987/8[2] (230)	1989/0 (306)
# Meat/Mixtures	159.3	122.7+	104.0*	94.5*
Poultry/Mixtures	31.7	34.9	45.8	41.6
Fish/Mixtures	16.0	22.2+	15.5	8.4*
Grain/Mixtures/Soups	20.0	25.2	19.6	25.7
# Egg/Mixtures	176.4	136.4+	104.8*	146.7
Breads	10.2	10.2	7.6	11.5
# Sweet Breads	4.9	6.1	3.3*	3.8*
# Fats & Oils	7.2	9.0	4.8*	7.7
# Dressings/Sauces/Gravy	4.0	3.9	2.9	3.3
# Milk	24.8	23.4	18.7	13.1*
# Cheese/Cream/Yogurt	14.1	16.4	16.0	15.2
# Desserts	18.7	23.9+	16.5*	11.6*
# Snacks	.7	1.2+	.8	.6*
Fruit/Vegetables	11.9	11.0	6.8	5.1*
Cereals	.0	.0	.0	.0
Drinks/Other	.1	.1	.0	.2
Totals	500.0	446.6+	367.0*	389.0*

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and Continuing Survey of Food Intakes by Individuals, 1985 and 1989/90. All means weighted.

NOTES. + indicates difference from 1977 mean is significant at 5 percent level.
* indicates significant difference from 1985 mean. N is sample size.
# denotes higher fat categories used for grouped statistical tests.
[1] Heads of households only.
[2] Recall that cholesterol data for eggs was changed beginning in 1987.

Changes in Sources of Cholesterol Between 1977 and 1985

In 1977 cholesterol consumption is highly concentrated in two product categories, Eggs and Meat. Approximately 64% of total cholesterol consumption for women and 67% for men comes from these two food groups. The only other food groups that contributes more than 20 mg of cholesterol to the total are Poultry for both sexes and Milk for men.

Between 1977 and 1985 cholesterol consumption from Eggs and Meat falls significantly for both sexes. Jointly, cholesterol consumption from these two categories falls by 61 mg for women and 77 mg for men during this period, so that by 1985 the two categories account for 52% of total cholesterol consumption for women and 58% for men. No other category loses more than 3 mg of cholesterol for either sex. Thus, reductions in cholesterol are essentially confined to these two food categories during this period.

Cholesterol consumption increases in several food categories between 1977 and 1985, but especially in the categories that include substitutes for foods from the Meat category and in Desserts. Unlike the results for total fat and saturated fat consumption, however, these increases are not large enough to offset most of the gains achieved in Eggs and Meats. Overall cholesterol consumption from all food categories falls by nearly 40 mg for women and 53 mg for men between 1977 and 1985.

Thus, between 1977 and 1985, cholesterol reductions are limited to the two concentrated sources of cholesterol, Meat and Eggs, consistent with our expectations about where government and general sources of information would be most effective.

Changes in Sources of Cholesterol Between 1985 and 1989/90

Between 1985 and 1989/90 average cholesterol consumption declines by 84 mg for women and 58 mg for men. Although cholesterol consumption from the Eggs category continues to decline during this period for women, this is not true for men. Meat, Fish, Desserts, and several other categories also make substantial contributions to the reduction in cholesterol consumption overall during this period. In fact, cholesterol consumption declines in 13 of the 16 categories for women and 10 of the 16 categories for men between 1985 and 1989/90, again indicating a broader basis for reductions in the post-1985 period.

One important caveat in interpreting this evidence concerns the change in USDA's nutrition data for eggs, which is reflected in the 1987/88 and 1989/90 data. Beginning in 1987, the reported cholesterol content of eggs is reduced by 22%, from 274 mg per egg to 213 mg per egg. This change reflects changes that occurred over time in poultry feeding practices and measurement techniques for assessing the amount of cholesterol in foods.[118] The USDA reports that the change in egg data would have reduced cholesterol consumption for women by approximately 8% in 1985 if the new data had been used.

For our purposes this change in nutrition data is most relevant to the Egg category. If we assume that all cholesterol in this category comes from eggs and adjust the 1989 data to reflect the old nutrition data for eggs, cholesterol for the category would be 22% higher than that reported in 1989/90. Under these assumptions, cholesterol from Eggs would fall by 25 mg for women (instead of 36 mg) between 1985 and 1989/90, and cholesterol would increase by 42 mg for men (instead of

[118] Press information release, USDA, Human Nutrition Information Service, 1991.

the 10 mg increase).[119] Categories, such as Breads or Desserts, which include eggs as an ingredient in some foods, would also fall less, though these changes would be small. Other categories, such as Meat, Poultry, Fish, Milk, and Cheese/Cream/Yogurt, would be largely unaffected, and the cholesterol reductions observed in these categories would not change. More generally, if the USDA estimate for the effect on total cholesterol (8%) holds for 1989/90, total cholesterol would be approximately 240 mg per day for women and 423 mg for men using the old egg data, which is primarily accounted for by the projected change in the Egg category.

Thus, the change in egg data suggests that the major reduction in cholesterol between 1985 and 1989/90 comes from Meat, though reductions from Eggs are still important for women, so that by 1989/90 these two categories contribute only 47% of total cholesterol for women and 62% for men (compared with 64 and 67% in 1977). More broadly, the change in egg data does not appear to alter our finding that cholesterol reductions occur across a broad range of food categories during this period, leading to substantial reductions in overall cholesterol consumption. As shown in Table 6-13, statistical tests of the pattern of change for cholesterol are significant for both women and men.

CONCLUSION

This chapter examines the distribution of total fat, saturated fat, and cholesterol across food categories between 1977 and 1985, and between 1985 and 1989/90. Our earlier analysis of overall changes in these

[119] This is likely to be an overstatement. For example, any butter used in cooking or any cheese or meat added to egg mixtures, such as omelettes, would also be reflected in the cholesterol total for the category and should not be increased because of the change in egg data.

Table 6-13 Tests for Changes Across Higher-Fat Food Groups[1] 1985-89/90 Versus 1977-85

	Sign Tests				
	Negative Trends[2] 77-85	85-90 (p)	Relative Trends[3] (p) (#Better/Total)	t-Test for Mean Change in Trends[4] (p)	Wilcoxon Test for Matched Samples[5] (p)
Women, 19-50 Years, Spring					
Fat	4/9	7/9 (.08)*	6/9 (.25)	-1.4 (.09)*	10 (.08)*
Percent Eating	3/9	7/9 (.03)**	8/9 (.02)**	-3.6 (.00)**	1 (.01)**
% Cal. Fat	4/9	6/9 (.18)	5/9 (.50)	-.5 (.32)	18 (.30)
Food Amount	6/9	3/9 (.91)	2/9 (.98)	.7 (.75)	31 (.85)
Saturated Fat	4/9	7/9 (.08)*	5/9 (.50)	-1.6 (.07)*	8 (.05)**
% Cal. Sat	7/9	7/9 (.50)	5/9 (.50)	-1.2 (.13)	17 (.25)
Cholesterol	4/9	9/9 (.00)**	7/9 (.09)*	-3.9 (.00)**	0 (.00)**
Calories	4/9	8/9 (.02)**	5/9 (.50)	-1.8 (.05)**	7 (.04)**
Men, 19-50 Years, Summer					
Fat	5/9	6/9 (.32)	6/9 (.25)	-1.1 (.16)	12 (.12)
Percent Eating	5/9	4/9 (.68)	5/9 (.50)	.1 (.55)	23 (.52)
% Cal. Fat	7/9	7/9 (.50)	7/9 (.09)*	-.7 (.25)	14 (.17)
Food Amount	4/9	7/9 (.08)*	7/9 (.09)*	-.8 (.22)	15 (.20)
Saturated Fat	4/9	6/9 (.18)	6/9 (.25)	-1.4 (.09)*	10 (.09)*
% Cal. Sat	7/9	5/9 (.84)	5/9 (.50)	-.6 (.27)	17 (.27)
Cholesterol	4/9	8/9 (.02)**	8/9 (.02)**	-2.8 (.00)**	5 (.01)**
Calories	3/9	5/9 (.18)	7/9 (.09)*	-1.0 (.18)	12 (.12)

NOTES. * indicates significance at 10 percent level; ** at 5 percent level.

[1] The nine higher-fat food groups used for these tests are meat, eggs, sweet breads, fats & oils, dressings/sauces/gravy, milk, cheese, desserts, and snacks.

[2] Test of hypothesis that the proportion of negative trends in the two periods are equal against the alternative that proportion is larger in 1985-89/90.

[3] Sign test of hypothesis that annualized trends for the two periods are drawn from the same distribution against the alternative that 1985-90 trends are better than 1977-85 trends.

[4] t-test of hypothesis that standardized trends for higher-fat food groups in 1977-85 and 1985-89/90 are drawn from distributions with equal means, against the alternative that the mean in 1985-89/90 is more negative than that in 1977-85.

[5] Wilcoxon test for matched samples based on standardized trends for the periods.

nutrients in the diet masks the interesting movements that occur within and across food categories.

During the 1977-1985 period, the amount of fat, saturated fat, and cholesterol derived from the Meat category falls substantially, producing the largest change by far in these nutrients of any of the identified food groups. The target nutrients also fell moderately in most cases in the Egg, Fats and Oils, and Milk categories. Presumably these reductions reflect the effectiveness of government and general sources of information in educating the public about the health implications of consumption from these relatively concentrated sources of the target nutrients. These reductions in the Meat and other categories are accompanied by increases in the amount of fat and saturated fat, and to a lesser degree cholesterol, derived from other food categories, so that total reductions in the consumption of these nutrients are considerably smaller than the reductions from Meat alone.

The changes that occur during the 1985-1989/90 are markedly different. Reductions in fat, saturated fat, and cholesterol are spread across many food categories rather than concentrated in only a few, leading to a more rapid rate of improvement than in the earlier period. For women, these results primarily reflect a more systematic movement away from higher-fat food categories by a larger percentage of the population; for men, they reflect a systematic reduction in the amount of food eaten from the higher-fat categories, as well as some improvement in the type of food chosen within these categories.

Overall the evidence is not consistent with the hypothesis that the policy change that allowed producer health claims under the general deception rules for advertising and labeling undermined public health efforts to provide information, and thus, slowed the rate of dietary improvement. The evidence is consistent with the hypothesis that

producer-provided information is likely to be effective across a broader range of food categories, so that in the presence of other sources of information, dietary improvements occur more rapidly.

Finally, we should note that the results from the consumption survey data closely parallel the pattern of movements observed in the production data, reported in Chapter V. In both cases, the movement away from higher-fat food categories is found to be mixed in the pre-1985 period and to be more systematic in the post-1985 period, providing additional confidence in these results.

VII

DIFFERENCES IN INDIVIDUALS' CONSUMPTION OF FATS AND CHOLESTEROL

INTRODUCTION

This chapter begins our examination of differences in consumers' reactions to information about diet and health. The analysis begins by focusing on differences in individuals' consumption of fat, saturated fat, and cholesterol in 1977, and then examines how these differences changed by 1985, and then in the following years through 1989/90, the periods of interest for this study.

A primary purpose of this analysis is to describe how differences in the consumption of fats and cholesterol are associated with individuals' characteristics, and which types of consumers changed their behavior during the years of interest. A secondary purpose is to examine economic theories of information acquisition and processing that predict how an individual's characteristics are associated with the costs and benefits of acquiring and processing diet-health information, and how the addition of producers as a source of more information changes these relative costs.

DIFFERENCES IN DAILY CONSUMPTION

The Model

In each year, differences in consumption across individuals are presumably the result of differences in taste for fats, in consumers' valuation of health, in the effectiveness of government and general sources of nutrition information in reaching individuals of each type, in the incremental effectiveness of producers in spreading relevant information in the years after the changes in policy, and in consumers' abilities to use the available information to alter their diets. Our empirical model[120] is designed to examine how these various factors affected consumption in each year. As in Chapters III and VI, this analysis uses the USDA individual consumption data for men and women, 19-50 years of age, who are heads of household, and who consumed at least 300 calories on the survey day. The empirical model is given by

$$
\begin{aligned}
(7\text{-}1)\quad \text{Nutrient}_i = {} & a_0 + a_1\,\text{LESS-THAN-HS}_i + a_2\,\text{HIGH-SCHOOL-GRAD}_i \\
& + a_3\,\text{SOME-COLLEGE}_i + a_4\,\text{INCOME}_i + a_5\,\text{MALE-HEAD}_i \\
& + a_6\,\text{BLACK}_i + a_7\,\text{OTHER}_i + a_8\,\text{HISPANIC}_i + a_9\,\text{AGE}_i \\
& + a_{10}\,\text{FULLTIME}_i + a_{11}\,\text{HH-SIZE}_i + a_{12}\,\text{PREGNANT}_i \\
& + a_{13}\,\text{VITAMINS}_i + a_{14}\,\text{NE}_i + a_{15}\,\text{MW}_i + a_{16}\,\text{WEST}_i \\
& + a_{17}\,\text{DIET}_i + a_{18}\,\text{VEGETARIAN}_i + a_{19}\,\text{MEALSOUT}_i \\
& + a_{20}\,\text{3MEALS}_i + a_{21}\,\text{WEEKEND}_i + a_{22}\,\text{SICK}_i \\
& + a_{23}\,\text{TRAVEL}_i + a_{24}\,\text{HOLIDAY}_i + a_{25}\,\text{HEIGHT}_i + e_i,
\end{aligned}
$$

where the subscript i denotes the particular individual, a_0 through a_{25} are coefficients to be estimated, the variables are defined in Tables 7-1 and 7-2, and e_i is an independent, normally distributed error term. This

[120] The assumptions embodied in this empirical model are discussed in detail later in this section.

Table 7-1 Variables Used in Regression Analyses and Means[1] Women, 19-50 Years, Spring

Variable	Definition	1977	1985	1986	1987/88	1989/9(
FAT	Fat consumption (g)	73.8	68.8	66.7	63.5	62.5
SATFAT	Sat. fat consumption (g)	26.4	25.1	24.6	22.9	21.9
CHOLESTEROL	Choles. consump. (mg)	346.9	295.8	301.9	242.7	221.5
CALCIUM	Calcium consump. (mg)	575.6	665.6	662.5	605.1	646.(
LESS THAN HS	1 if < 12 years school 0 otherwise	.19	.15	.13	.17	.11
HIGH GRAD	1 if 12 years school 0 otherwise	.42	.43	.42	.41	.38
SOME COLLEGE	1 if between 12-16 years 0 otherwise	.22	.23	.25	.24	.3(
COLLEGE GRAD	1 if 16 years or more 0 otherwise	.17	.19	.20	.17	.22
INCOME	Household income (1977 $1000)	16.3	15.3	15.8	16.9	16.9
MALE HEAD	1 if male head present 0 otherwise	.79	.80	.75	.78	.78
BLACK	1 if black 0 otherwise	.12	.06	.06	.11	.05
OTHER	1 if not white or black 0 otherwise	.04	.05	.05	.05	.05
HISPANIC	1 if Hispanic 0 otherwise	.07	.05	.05	.06	.09
AGE	Age (years)	34.0	34.6	34.8	35.1	36.1
FULLTIME	1 if works 35+ hrs/wk 0 otherwise	.35	.44	.44	.50	.54
HH SIZE	Number in household	3.7	3.5	3.4	3.3	3.3

Table continued on next page

Table 7-1 (Continued)

Variable	Definition	1977	1985	1986	1987/88	1989/90
PREGNANT	1 if pregnant or lactating 0 otherwise	.06	.07	.05	.05	.07
VITAMINS	1 if vitamin nearly daily 0 otherwise	.29	.41	.41	.39	.32
NORTHEAST	1 if live in Northeast 0 otherwise	.26	.20	.18	.23	.16
MIDWEST	1 if live in Midwest 0 otherwise	.24	.25	.25	.20	.25
WEST	1 if live in West 0 otherwise	.21	.22	.24	.21	.21
DIET	1 if special diet 0 otherwise	.18	.13	.16	.09	.13
VEGETARIAN	1 if vegetarian 0 otherwise	.02	.03	.03	.02	.02
MEALS OUT	Number of meals out on survey day	.43	.59	.58	.49	.52
3 MEALS	1 if 3 meals or more 0 otherwise	.62	.61	.54	.51	.60
WEEKEND	1 if weekend 0 otherwise	.22	.20	.22	.37	.19
SICK	1 if sick on survey day 0 otherwise	.01	.03	.04	.03	.01
TRAVEL	1 if traveled on survey day 0 otherwise	.01	.02	.01	.01	.00
HOLIDAY	1 if holiday/social occas. 0 otherwise	.07	.06	.04	.03	.06
HEIGHT	Height (inches)	64.1	64.2	64.4	64.5	64.3

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88; Continuing Survey of Food Intakes by Individuals, Spring 1985, 1986, 1989/90.
NOTES. [1] Weighted means for the data used in the regressions, which excludes observations with incomplete data for any of the listed variables.

Table 7-2 Variables Used in Regression Analyses and Means[1] Men, 19-50 Years, Summer

Variable	Definition	1977	1985	1987/88	1989/90
FAT	Fat consumption (g)	112.9	110.0	92.7	92.7
SATFAT	Saturated fat consumption (g)	40.0	40.0	32.7	32.4
CHOLESTEROL	Cholesterol consumption(mg)	508.3	452.5	362.4	391.0
CALCIUM	Calcium consumption (mg)	781.5	920.9	821.3	840.9
LESS THAN HS	1 if < 12 years school	.22	.13	.25	.17
HIGH GRAD	1 if 12 years school 0 otherwise	.34	.39	.30	.40
SOME COLLEGE	1 if between 12-16 years 0 otherwise	.21	.25	.22	.22
COLLEGE GRAD	1 if 16 years or more 0 otherwise	.23	.23	.23	.22
INCOME	Household income (1977 $1000)	17.1	14.4	19.2	17.2
FEMALE HEAD	1 if female head present 0 otherwise	.87	.76	.80	.85
BLACK	1 if black 0 otherwise	.09	.05	.11	.03
OTHER	1 if not white or black 0 otherwise	.03	.07	.05	.03
HISPANIC	1 if Hispanic 0 otherwise	.05	.07	.03	.08
AGE	Age (years)	35.0	33.9	35.7	36.1
FULLTIME	1 if works 35+ hrs/wk 0 otherwise	.82	.83	.81	.78
HH SIZE	Number in household	3.5	3.4	3.0	3.2

Table continued on next page.

Table 7-2 (Continued)

Variable	Definition	1977	1985	1987/88	1989/90
VITAMINS	1 if take vitamin nearly every day 0 otherwise	.22	.26	.24	.20
NORTHEAST	1 if live in Northeast 0 otherwise	.27	.18	.16	.21
MIDWEST	1 if live in Midwest 0 otherwise	.24	.25	.22	.27
WEST	1 if live in West 0 otherwise	.22	.22	.20	.19
DIET	1 if on special diet 0 otherwise	.09	.08	.07	.07
VEGETARIAN	1 if vegetarian 0 otherwise	.00	.01	.03	.00
MEALS OUT	Number of meals out on survey day	.54	.65	.82	.73
3 MEALS	1 if 3 meals or more 0 otherwise	.57	.49	.58	.52
WEEKEND	1 if weekend 0 otherwise	.24	.30	.23	.23
SICK	1 if sick on survey day 0 otherwise	.02	.02	.01	.01
TRAVEL	1 if traveled on survey day 0 otherwise	.02	.01	.00	.01
HOLIDAY	1 if holiday/social occasion 0 otherwise	.05	.04	.06	.03
HEIGHT	Height (inches)	70.1	70.3	70.3	70.3

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and Continuing Survey of Food Intakes by Individuals, 1985, and 1989/90.
NOTES. [1] Weighted means for the data used in the regressions, which excludes observations with incomplete data for any of the listed variables.

equation is estimated separately for women in spring in 1977, 1985, 1986, 1987/88, and 1989/90, and for men in summer in these years except 1986, for four dependent variables measuring the amounts of fat, saturated fat, cholesterol, and calcium consumed from foods on the survey day. Means for all variables are given in Table 7-1 for women in spring and in Table 7-2 for men in summer and are discussed below. Calcium consumption, which can be seen in Tables 7-1 and 7-2 to vary significantly over the period, is examined because of its potential to confound the fat and cholesterol equations of primary interest, as discussed below.

The dependent variable in equation (7-1) is the individual's total consumption of the relevant nutrient from all foods eaten on the survey day. The independent variables include factors that measure: i) information differences of two types, those related to the individual's efficiency in processing information, and those reflecting differences in the individual's cost of acquiring information, ii) the individual's underlying valuation of health, and iii) other available cultural, behavioral, and demographic factors that may affect fat, saturated fat, cholesterol, or calcium consumption. While these variables are classified into three groups, some variables may fit into more than one group. Our classification is based on what we consider to be the primary effect on an *a priori* basis, but secondary effects are discussed as the variables are reviewed.

Information Variables

Two types of variables are used to capture the individual's *efficiency* in processing information. First, three education dummy variables (LESS-THAN-HS, HIGH-SCHOOL-GRAD, and SOME-COLLEGE) reflect the effects of schooling on the individual's ability to process new information and incorporate it into dietary decision making

(Grossman 1972 and Schultz 1975). Coefficients on these variables measure the difference between individuals with the specified education level and college graduates, other things equal. Besides this efficiency effect, however, highly educated individuals are more likely to read print media, such as newspapers and magazines, and more likely to be exposed to news sources. Thus, education variables may also reflect access advantages, if government and general sources use these media disproportionately. Also, since education is an investment good, differences in education may reflect differences in individuals' discount rates, which alone would lead to different consumption patterns; those with high discount rates would not be as willing to sacrifice current consumption for future gains (Fuchs 1982). Consequently, those with more schooling would be expected to consume lower levels of fat, saturated fat, and cholesterol, and higher levels of calcium, and to react more to new information about these issues, other things equal.

Household INCOME is also included to capture efficiency in processing information. Income may indicate human capital beyond that given by schooling, and thus, may reflect greater efficiency in processing information. If INCOME functions primarily as a proxy for information processing efficiency, a negative relationship between income and consumption of fats and cholesterol is expected, other things equal. Depending on the implicit price of fats and cholesterol, however, foods containing these components may be a preferred option at particular income levels because of their relative prices (independent of health considerations).[121] If this effect is important, the sign on the income coefficient is more difficult to predict.

[121] For instance, individuals with high incomes might consume relatively expensive desserts or meats more frequently, compared to those in lower income households, and could consume more fat as a result, even if they had the same diet-disease information.

The presence of two adult heads in the household is used to capture information access advantages at the household level. For women. the presence of a male head of household is indicated by the dummy variable MALE-HEAD, and for men, the presence of a female head of household is indicated by the variable FEMALE-HEAD. Viewing the household as a productive unit, the presence of two adults doubles the access to information for the household. Moreover, other things equal, the value of time will be lower for each adult in a two-adult household compared with its single-adult counterpart (Becker 1965, 1977). This lowers the cost of acquiring information, again leading to access advantages for those in households with two adults. Thus, the sign on this coefficient is expected to be negative in the fat, saturated fat, and cholesterol equations, and positive in the calcium equation.

For the analysis of women's diets, a variable is included to indicate whether the woman is pregnant or lactating (PREGNANT). Most women in these cases are under medical supervision and presumably receive nutrition information directly from doctors and other related sources. Consequently, pregnant women would be expected to be better informed about the health consequences of their diets. Additionally, since many doctors directly instruct pregnant women to increase calcium consumption, a positive coefficient on PREGNANT would be expected in the calcium equation, and if calcium consumption is linked to fat and cholesterol consumption, in those equations as well. Also, pregnant women are generally advised to increase caloric intake somewhat, which also leads us to expect positive coefficients in all equations.

A variable is included to reflect whether the person works fulltime (FULLTIME). Since income and education are already accounted for, the work variable is included to reflect differential constraints that might affect the diet when the person works. Working may increase an

individual's access to information, because the person is likely to interact with a larger number of individuals. However, work may also affect the value of the individual's time, and thus, the cost of gathering information for the household and the cost of preparing foods. If FULLTIME primarily reflects the higher cost of gathering information and acting on it, the variable would be expected to be positively (negatively) associated with higher levels of fat and cholesterol (calcium); if it primarily reflects increased access to information, the opposite relationship is expected.

Other cultural/regional variables may also reflect differential access to information, as discussed below.

Valuation of Health Variables

Individuals who place a higher valuation on health are more likely to consume lower levels of fats and cholesterol and higher levels of calcium, other things equal. In the primary model, the variable VITAMINS, indicating whether the individual takes a vitamin or mineral supplement regularly, is included as a measure of the value individuals place on health. In the data from 1985 and later, information is also available on whether the individual smokes, indicated in a variable NOSMOKE, which is set to 1 if the individual does not smoke currently, 0 otherwise. Individuals who do not smoke or who take vitamin supplements regularly presumably place greater value on health, and therefore are likely to consume less fat, saturated fat, and cholesterol, and more calcium than smokers and those who do not take vitamins, other things equal.[122] In addition, those who value health highly should be willing to spend more to acquire information about

[122] See Hersh and Viscusi (1990), who consider the risk preferences of smokers in a job risk context.

diet, which itself leads to less fat and cholesterol consumption and more calcium consumption during this period.

Other Variables

Since individuals with different demographic characteristics may be reached differentially by each information source and may have different underlying "tastes" for foods, the model accounts for geographic regions (NE, MW, and WEST),[123] racial, cultural, and age characteristics (BLACK, OTHER, HISPANIC, and AGE).[124] To the extent that these variables measure differential access to nutrition information, any change between the 1977 and 1985 coefficients helps indicate which individuals are reached most successfully by government and general information sources available prior to 1985. Changes in these coefficients between 1985 and 1990 helps to identify whether the new information source is more successful in reaching particular types of individuals, other things equal. If the coefficients do not change over time, the evidence is consistent with the hypothesis that all share

[123] Beyond the different ethnic makeups of the regions of the country, these variables also capture weather differences, which could affect diets. These regional variables reflect differences relative to the south, which is the warmest region.

[124] "Tastes" include any differences driven by biological factors, as well as culturally determined or other preferences in diet. For instance, lactose intolerance, an inability to digest milk sugar easily, which causes abdominal discomfort, pain, and diarrhea, varies significantly across racial groups and would constitute a "taste" difference for dairy foods in our specification. High proportions of Asians (85 to 95 percent), Africans (50 to 99 percent), American Indians (85 to 95 percent), and American blacks (70 to 75 percent) have a genetic absence of lactase, the enzyme responsible for the breakdown of milk sugar (Surgeon General 1988). By contrast, lactose intolerance occurs in only about 10 percent of American whites (Linder 1985). Thus, individuals with a lactose intolerance would be expected to consume fewer dairy products, and as a result, less of the fat that normally accompanies those food choices, even if information and other things are equal.

approximately equally in the improvements observed in mean fat, saturated fat, and cholesterol consumption during the period.

The number of persons in the household (HH-SIZE) should increase the benefits of gathering health information for the household and would be expected to be negatively related to fat and cholesterol consumption for this reason. More people in the household may also increase the costs of gathering information, however, because the value of time for household adults may be higher, especially if children are involved. In this case, the expected sign would be positive.

A number of variables are also included to control for other factors that could influence diet; in particular, variables indicating whether the individual is on a special diet (DIET), is a vegetarian (VEGETARIAN), is sick on the survey day (SICK), is traveling (TRAVEL), is surveyed on a weekend (WEEKEND), holiday or social occasion (HOLIDAY), the number of meals consumed away from home (MEALSOUT), and eats three meals that day (3MEALS).[125] We expect negative coefficients for the first three variables and positive for the others.

Estimation Using Reduced-Form Models

Equation (7-1) is estimated independently for males and females in each year for which data are available for fat, saturated fat, cholesterol, and calcium consumption using weighted ordinary least squares.[126]

[125] Some of these variables may, in part, reflect a response to information. For instance, individuals may respond to nutrition information by eating out less often, by reducing the number of meals eaten, or by adopting a vegetarian diet. Our basic analysis assumes that these variables are generally unaffected by information about fat and cholesterol. We examine this assumption in our empirical work below.

[126] Seemingly unrelated regression (SUR) techniques are often utilized when estimating a system of equations, such as those specified in equation (7-1). SUR

(continued...)

These equations represent a reduced-form model of the determinants of food consumption; that is, fat, saturated fat, cholesterol, and calcium consumption are analyzed with respect to variables that are, for the most part, exogenously determined.

Ideally, the determinants of consumption should be specified in a system of equations in which these and other food components are determined simultaneously. Such a specification recognizes the possibility that information about one component (such as cholesterol or calcium) might affect the consumption of another component (such as fat or saturated fat), and vice versa.

The estimation of simultaneous equations requires that the parameters of each equation be identified. Identification, in turn, requires that each equation include variables that are unique to that equation. For example, to identify the direct role of the information variables on the fat and cholesterol equations separately, variables are required that affect an individual's intake of fat but not cholesterol, and vice versa. Unfortunately, the available food consumption data do not allow identification of such a system of equations. The available variables that have the potential to affect any of the major dietary components also relate to the other dietary components. As a result, reduced-form equations must be relied on in which other food components are not included as independent variables.

(...continued)
techniques account for the correlation in errors across equations. In our case, for instance, it is reasonable to expect that individuals with higher than predicted fat consumption will also have higher than predicted cholesterol consumption. However, because each of the four equations in our system is estimated from the same data matrix, use of SUR techniques would yield identical results to those from independent estimation of each equation (Kmenta 1971, 521).

Thus, the coefficients for the variables in the reduced-form equations represent the effects of information about *all* food components on consumption of the component under study, rather than the effect of the information about this component alone. For instance, the coefficients in the fat equation represent the effects of the variables on the absorption of fat information, as well as any secondary effects due to information about other dietary components that have indirect effects on fat consumption. Thus, if education helps consumers to absorb information about diet, the education coefficient in the fat equation will reflect any education advantages in reacting to fat information, as well as the indirect effects that greater reactions to (say) calcium information may have on fat consumption. If information about other food components has relatively small effects on fat consumption, the coefficients from the reduced-form and structural equations will be similar. If the indirect effects are large, the reduced-form equations could differ substantially from the underlying structural equations.

One potentially important diet-health relationship that could affect fat and cholesterol consumption during this period is that of calcium and osteoporosis. Beginning in the 1960s, scientific evidence linked calcium consumption to bone mass and to the risks of developing osteoporosis. This evidence is reflected, for instance, in recent Surgeon General's recommendations that women increase their consumption of calcium, because most women do not consume the recommended 800 mg of calcium. Since dairy products are major contributors to calcium intake,[127] the flow of information about calcium and osteoporosis is likely to increase the demand for dairy products, and thus potentially, the consumption of fats and cholesterol. In this case, consumers may

[127] *Diet and Health* reports that 50 percent of calcium came from dairy products in 1977 (National Research Council 1988, 69).

knowingly consume more fat, and to a lesser extent cholesterol, than they otherwise would because of knowledge of the benefits of calcium consumption. Consequently, focusing on fats and cholesterol intakes, without considering calcium knowledge, could lead to inappropriate conclusions about the effects of fat and cholesterol information.

In assessing changes in the equations over time, the possibility that new information about calcium consumption was publicized during the period is especially important. Of particular concern for this reason is the 1984 National Consensus Conference on Osteoporosis (NIH 1984), which released its findings in the year before our 1985 sample and which received considerable media attention. This report documents the growing scientific support linking calcium consumption with osteoporosis, highlights the value of calcium in the diet for all, but especially for women, and concludes that the RDA of 800 mg of calcium for women is too low. If this is substantially new information for the public, the potential confounding influence of calcium consumption for the fat and cholesterol equations may be especially problematic in 1985.[128]

For these reasons, calcium consumption is also examined in parallel with fat and cholesterol consumption in order to better assess whether

[128] Independent results from FDA knowledge surveys support the conclusion that by 1986, a majority of women knew the relationship between calcium and osteoporosis, and that knowledge varied by education level. In 1986, the FDA survey included the following question: "Have you heard about any health problems related to not consuming enough calcium." If we consider persons who responded to the question with either "osteoporosis" or "problems with bones" as knowing the relationship between calcium consumption and osteoporosis, the survey results indicate that 42 percent of those who did not graduate high school, 61 percent of high school graduates, 71 percent of those who attended some college, and 86 percent of college graduates knew the relationship. Differences in individuals' knowledge are discussed in more detail in the next chapter.

the reduced-form estimates for fats and cholesterol are affected by simultaneity problems due to calcium information.

RESULTS

Fat Consumption

The reduced-form regression results for fat consumption for women in spring 1977, 1985, 1986, 1987/88, and 1989/90 are presented Table 7-3, and for men in summer 1977, 1985, 1987/88, and 1989/90 in Table 7-4. Note that the sample size for women in 1989/90 is considerably smaller than that for other years, resulting in less precise coefficient estimates in 1989/90. Similarly, the sample sizes for men are considerably smaller than those for women in the relevant years. For these reasons we primarily focus on the results for women in the years 1977 through 1987/88, though we report and discuss the other equations throughout.

Regressions for women in summer and men in spring are given in appendix Tables 7-3A and 7-4A for 1977, 1987/88, and 1989/90, the years for which data are available. Due to the limited number of years covered, these other results are discussed only to the extent that seasonality issues affect our conclusions.

First, the estimates indicate that variables reflecting whether the person is on a special diet (DIET), eats more meals out on the survey day (MEALSOUT), is sick (SICK), traveling (TRAVEL), surveyed on the weekend (WEEKEND) or a special occasion (HOLIDAY), or eats three meals (3MEALS) on that day are nearly always significant determinants of fat consumption in the expected directions. The exceptions are MEALSOUT for men and TRAVEL for both sexes.

Table 7-3 Fat Regression Results for Women, Spring

Variable	1977	1985	1986	1987/88	1989/90
LESS THAN HS	7.99 (2.0)**	-5.14 (-1.1)	8.73 (1.9)*	12.23 (2.1)**	2.78 (0.3)
HIGH SCHOOL GRAD	3.42 (1.1)	.59 (0.2)	7.73 (2.3)**	5.48 (1.1)	2.92 (0.5)
SOME COLLEGE	7.44 (2.3)**	-1.12 (-0.3)	9.27 (2.7)**	8.02 (1.6)	4.63 (0.8)
INCOME	.28 (2.5)**	.10 (0.6)	-.15 (-1.0)	.20 (1.4)	.02 (0.1)
MALE HEAD	.03 (0.0)	-2.70 (-0.9)	3.15 (1.0)	2.79 (0.7)	.69 (0.1)
BLACK	3.04 (0.7)	-2.96 (-0.6)	-.87 (-0.2)	9.31 (1.9)*	34.74 (2.8)**
OTHER	-7.02 (-1.1)	-5.52 (-1.0)	-4.13 (-0.8)	-15.20 (-3.0)**	5.90 (0.5)
HISPANIC	-1.04 (-0.2)	-7.08 (-1.4)	-8.74 (-1.9)*	1.87 (0.5)	-2.15 (-0.3)
AGE	-.25 (-1.6)	.06 (0.4)	-.04 (-0.2)	-.19 (-1.1)	-0.07 (-0.2)
FULLTIME	-1.58 (-0.7)	-1.23 (-0.5)	.73 (0.3)	-5.78 (-2.2)**	-1.34 (-0.3)
HH SIZE	-1.30 (-1.8)*	.53 (0.6)	.76 (0.7)	-3.43 (-3.9)**	-2.41 (-1.5)
PREGNANT	1.76 (0.4)	15.05 (3.6)**	6.78 (1.3)	12.45 (2.4)**	13.78 (1.5)
VITAMINS	.52 (0.2)	5.50 (2.2)**	2.14 (0.9)	-1.39 (-0.4)	-8.83 (-1.9)*
DIET	-17.08 (-6.4)**	-12.64 (-4.2)**	-15.20 (-4.9)**	-21.03 (-4.2)**	-7.36 (-1.3)
MEALS OUT	3.20 (1.8)*	5.06 (3.1)**	7.51 (4.0)**	7.26 (3.3)**	5.39 (1.7)*
3 MEALS	10.57 (4.4)**	10.05 (4.2)**	14.24 (5.9)**	18.55 (6.5)**	12.75 (2.8)**
WEEKEND	11.96 (3.8)**	13.65 (4.3)**	6.17 (2.0)**	2.41 (0.7)	3.02 (0.5)
SICK	-9.69 (-1.4)	-23.18 (-5.0)**	-16.50 (-3.6)**	-10.59 (-2.0)**	-0.91 (-0.1)
TRAVEL	18.60 (1.5)	-8.40 (-1.0)	6.54 (0.6)	15.74 (1.0)	1.13 (0.1)
HOLIDAY	13.98 (2.8)**	8.39 (1.4)	4.79 (0.8)	25.21 (3.8)**	12.27 (1.7)*
Adj. R-squared	.08	.10	.11	.17	.16
N	1378	1087	1016	850	349
Mean Fat Consumption	73.8	68.8	66.7	63.5	62.5

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and Continuing Survey of Food Intakes by Individuals, 1985, 1986 and 1989/90.

NOTES. All regressions weighted, with White-corrected t-statistics in parentheses. * denotes significance at the 10 percent level and ** at the 5 percent level. The model also controls for region (NE, MW, and WEST), whether the woman is a vegetarian, and height. Of these, HEIGHT is significant (+) in 1977 and 1986, MW, NE, and WEST (+) in 1977 and 1989/90, and VEGET (-) in 1986 and (+) 1987/88.

Table 7-4 Fat Regression Results for Men, Summer

Variable	1977	1985	1987/88	1989/90
LESS THAN HS	10.36 (1.3)	12.19 (1.0)	3.64 (0.3)	27.07 (2.4)**
HIGH SCHOOL GRAD	8.49 (1.4)	13.07 (1.4)	-1.05 (-0.1)	.07 (0.0)
SOME COLLEGE	3.05 (0.5)	12.02 (1.2)	-3.05 (-0.3)	1.30 (0.1)
INCOME	-.43 (-1.5)	-.49 (-1.1)	-.00 (-0.0)	-0.34 (-1.1)
FEMALE HEAD	5.20 (0.7)	-11.79 (-1.0)	-0.26 (-0.0)	-.94 (-0.1)
BLACK	-22.06 (-3.4)**	3.02 (0.1)	-10.02 (-0.7)	-9.41 (-0.6)
OTHER	-9.02 (-0.6)	-29.41 (-2.8)**	-67.20 (-5.1)**	19.70 (1.6)
HISPANIC	20.68 (1.8)*	-6.19 (-0.5)	33.12 (2.3)**	-28.65 (-2.0)**
AGE	.10 (0.3)	-.14 (-0.3)	-1.38 (-2.5)**	-.78 (-1.9)*
FULLTIME	3.82 (0.7)	23.96 (2.9)**	7.03 (0.7)	1.75 (0.3)
HH SIZE	1.19 (0.7)	1.68 (0.6)	1.99 (0.6)	6.15 (1.8)*
VITAMINS	4.31 (0.8)	-0.60 (-.1)	9.07 (1.2)	.01 (0.0)
DIET	-17.42 (-2.6)**	-35.71 (-3.4)**	-27.00 (-1.9)*	-24.60 (-1.9)*
MEALS OUT	1.44 (0.5)	-1.54 (-0.4)	4.03 (0.7)	2.74 (0.5)
3 MEALS	14.59 (3.1)**	13.90 (2.1)**	24.08 (3.1)**	19.27 (2.6)**
WEEKEND	13.84 (2.2)**	-5.06 (-0.8)	32.14 (3.3)**	-2.57 (-0.3)
SICK	-53.73 (-4.8)**	-78.26 (-4.7)**	-74.01 (-4.5)**	3.41 (0.3)
TRAVEL	-10.62 (-0.8)	-23.94 (-1.8)*	---	16.03 (0.7)
HOLIDAY	33.96 (2.7)**	38.76 (2.3)**	5.46 (0.4)	55.22 (3.1)**
Adj. R-squared	.09	.12	.18	.21
N	557	475	221	294
Mean Fat Consumption	112.9	110.0	92.7	92.7

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and Continuing Survey of Food Intakes by Individuals, Summer 1985 and 1989/90, Men 19-50 Years.

NOTES. All regressions weighted, with White-corrected t-statistics in parentheses. * denotes significance at the 10 percent level and ** denotes significance at the 5 percent level. The model also controls for region (NE, MW, and WEST), whether the man is vegetarian, and height. Of these, HEIGHT is significant (+) in each year except 1987/88, where it is negative; WEST (+) in 1977, VEGETARIAN (-) in 1985, and NE and MW (+) in 1989/90 are also significant.

Turning to the variables hypothesized to relate to information acquisition, consider first the education coefficients. With the exception of the 1985 equation for women, the education coefficients in Tables 7-3 and 7-4 are generally positive and often significant, or nearly so, indicating that those with lower levels of education consume more fat than those with a college education, other things equal. The few negative coefficients are highly insignificant (t-statistics less than 0.5) except for the least educated women in 1985.[129]

In 1985, none of the education coefficients in the female equation are significant and two of them have signs opposite (negative) from those in other years. Thus, a direct comparison of the 1977 and 1985 fat results for women indicates that the advantages to education observed in 1977 were eliminated by 1985 (and actually reversed to a degree). These coefficient changes are significant at the 5 percent level for the lowest education category and at the 10 percent level for the some-college category. By 1986 advantages to education are again significant, however, and these continue into 1987/88 and to a lesser extent in 1989/90. Moreover, these differences are nutritionally significant. For instance, in 1986, college educated women consume approximately 8 grams less fat per day than less educated women, other things equal, an amount equal to 12 percent of the daily average of 66.7 grams in that year.

Thus, considered in isolation, these results suggest that during the period when only government and general information sources provided diet-health information, the advantages to education that existed in 1977 were eliminated by 1985, but once producers are added as a new source

[129] The off-season equations also have an exception; the education coefficients are negative and significant in summer 1977 for women. As discussed below, this appears to be related, at least in part, to consumption of calcium-containing foods in summer.

of information, individuals with higher levels of education are once again more successful than their less educated counterparts in processing the new fat-related information, other things equal. These education differences in the post-1985 equations are approximately the same size as those existing in 1977; none of the differences are significant.

In contrast, the results do not indicate that educational differences in fat consumption erode for men by 1985. In fact, the difference between college graduates and less educated men increases somewhat by 1985 and by more in 1989/90, though the changes themselves are not significant. The few negative coefficients in other years are all highly insignificant.[130] In assessing whether this different pattern is the result of confounding effects from other information, we turn to comparable regressions for calcium consumption, given in Table 7-5 for women in spring and in Table 7-6 for men in summer.[131]

In considering the interpretation of the education coefficients in the reduced-form fat equations, it is instructive to compare changes in these coefficients with the comparable changes in the calcium equations. In particular, note that for women, but not for men, the education coefficients in the 1977 calcium equations are negative and significant, or nearly so, at lower education levels, as would be expected if education helps women to understand the role of calcium in preventing

[130] In 1987/88 and 1989/90 the seasonal samples for men are quite small, but we have data for all seasons in these years. The coefficients on the three education variables for men in the all-year equations are generally positive and of approximately the same magnitude as in the 1985 equations. The education coefficients are 11.9, 4.1, and -2.1 in the 1987/88 equation and 13.3, 8.3, and 9.0 in the 1989/90 equation. All the 1989/90 coefficients are significant at the 10 percent level, as is the lowest level coefficient in the 1987/88 equation.

[131] Comparable results for women in summer and men in spring for available years are given in appendix Tables 7-5A and 7-6A.

Table 7-5 Calcium Regression Results for Women, Spring

Variable	1977	1985	1986	1987/88	1989/90
LESS THAN HS	-55.50 (-1.6)	-135.14 (-2.7)**	2.59 (0.0)	28.32 (0.4)	-104.73 (-0.9)
HIGH SCHOOL GRAD	-76.19 (-2.7)**	-42.43 (-1.0)	-37.92 (-0.9)	10.25 (0.2)	-6.61 (-0.1)
SOME COLLEGE	8.47 (0.3)	-43.97 (-1.0)	3.62 (0.1)	-7.77 (-0.1)	-14.96 (-0.2)
INCOME	-1.42 (-1.4)	.71 (0.4)	0.94 (0.5)	-.18 (-0.1)	1.89 (0.5)
MALE HEAD	-35.07 (-1.2)	22.65 (0.6)	23.30 (0.6)	11.09 (0.2)	25.69 (0.3)
BLACK	-54.34 (-1.7)*	-113.63 (-2.7)**	-155.94 (-3.4)**	-82.35 (-1.3)	248.91 (2.0)**
OTHER	-74.17 (-1.2)	-97.14 (-1.9)*	-91.22 (-1.4)	-133.51 (-2.3)**	9.04 (0.1)
HISPANIC	-4.22 (-0.1)	-76.48 (-1.4)	-82.71 (-1.4)	43.47 (0.6)	-70.99 (-0.7)
AGE	-4.40 (-3.5)**	-1.91 (-1.0)	-2.40 (-1.3)	-4.23 (-1.9)*	1.47 (0.4)
FULLTIME	.21 (0.0)	-37.34 (-1.3)	-71.67 (-2.3)**	-30.53 (-0.9)	-79.13 (-1.1)
HH SIZE	6.91 (1.1)	0.56 (0.1)	-9.53 (-0.9)	-16.42 (-1.3)*	1.53 (0.1)
PREGNANT	256.27 (4.7)**	360.51 (5.3)**	416.57 (5.1)**	370.52 (4.5)**	185.47 (1.6)
VITAMINS	54.82 (2.3)**	54.12 (1.9)*	12.58 (0.4)	49.03 (1.3)	-35.50 (-0.5)
DIET	-116.24 (-4.8)**	-41.49 (-1.0)	-81.49 (-2.1)**	-136.77 (-2.9)**	-48.66 (-0.5)
MEALS OUT	-14.90 (-1.0)	-10.54 (-0.6)	-5.47 (-0.3)	-12.52 (-0.5)	32.69 (0.7)
3 MEALS	189.47 (9.3)**	160.17 (5.2)**	181.05 (6.4)**	241.08 (6.5)**	353.76 (5.2)**
WEEKEND	41.22 (1.7)*	27.38 (0.8)	0.27 (0.0)	-2.30 (-0.1)	-73.42 (-0.9)
SICK	-16.66 (-0.2)	-48.06 (-0.4)	-154.92 (-2.3)**	125.92 (0.9)	226.03 (1.4)
TRAVEL	-22.83 (-0.3)	22.31 (0.2)	157.46 (1.4)	74.34 (0.4)	5.13 (0.0)
HOLIDAY	76.75 (1.8)*	0.49 (0.0)	1.03 (0.0)	184.76 (2.1)**	36.66 (0.5)
Adj. R-squared	.17	.13	.12	.16	.15
N	1378	1087	1016	850	349
Mean Calcium Consumption	575.6	665.6	662.5	605.1	646.0

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and Continuing Survey of Food Intakes by Individuals, 1985, 1986, 1989/90.

NOTES. All regressions weighted, with White-corrected t-statistics in parentheses. * denotes significance at the 10 percent level and ** denotes significance at the 5 percent level. The model also controls for region (NE, MW, and WEST), whether the woman is a vegetarian, and height. In 1977 all variables except vegetarian are significant (+); in 1985 and 1986 MW is significant (+).

Table 7-6 Calcium Regression Results for Men, Summer

Variable	1977	1985	1987/88	1989/90
LESS THAN HS	-50.24 (-0.8)	18.17 (0.2)	-301.18 (-2.2)**	407.74 (2.2)**
HIGH SCHOOL GRAD	17.75 (0.3)	145.78 (1.8)*	-253.09 (-2.1)**	81.79 (0.6)
SOME COLLEGE	-54.47 (-0.8)	144.45 (1.6)	-168.36 (-1.2)	210.55 (1.5)
INCOME	-2.45 (-0.8)	3.78 (1.0)	-3.34 (-1.2)	9.20 (0.9)
FEMALE HEAD	78.95 (1.2)	-7.38 (-0.1)	116.75 (0.8)	-16.86 (-0.1)
BLACK	-223.59 (-5.0)**	-222.16 (-2.0)**	-183.23 (-1.6)	163.53 (0.8)
OTHER	-86.26 (-0.7)	-176.64 (-1.5)	-751.16 (-4.5)**	52.04 (0.5)
HISPANIC	165.26 (1.3)	-51.24 (-0.4)	216.43 (1.9)*	-338.55 (-2.2)**
AGE	-2.29 (-0.9)	-11.30 (-2.7)**	-11.31 (-1.8)*	-13.56 (-2.1)**
FULLTIME	-36.51 (-0.6)	150.14 (2.2)**	-24.53 (-0.2)	59.96 (0.7)
HH SIZE	-8.98 (-0.7)	-9.97 (-0.5)	-22.92 (-0.5)	47.47 (1.4)
VITAMINS	83.21 (1.4)	-59.43 (-0.9)	341.72 (3.0)**	169.06 (1.5)
DIET	-102.31 (-1.4)	-172.51 (-1.9)*	-244.90 (-1.3)	106.62 (0.6)
MEALS OUT	-45.77 (-1.7)*	-80.96 (-2.2)**	117.58 (1.8)*	-62.33 (-1.2)
3 MEALS	104.87 (2.4)**	242.62 (3.9)**	132.69 (1.4)	245.17 (3.2)**
WEEKEND	-79.98 (-1.8)*	-34.49 (-0.5)	82.04 (0.8)	111.93 (1.0)
SICK	58.54 (0.3)	-711.97 (-4.7)**	768.17 (4.1)**	152.24 (0.7)
TRAVEL	134.83 (0.5)	-331.83 (-2.7)**	---	-190.73 (-1.0)
HOLIDAY	-30.35 (-0.5)	367.01 (2.1)**	-220.92 (-1.5)	327.77 (1.5)
Adj. R-squared	.11	.14	.21	.21
N	557	475	221	294
Mean Calcium Consumption	770.9	920.9	821.3	840.9

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and Continuing Survey of Food Intakes by Individuals, Summer 1985 and 1989/90, Men 19-50 Years.

NOTES. All regressions weighted, with White-corrected t-statistics in parentheses. * denotes significance at the 10 percent level and ** at the 5 percent level. The model also controls for region (NE, MW, and WEST), vegetarian and height. Of these, HEIGHT, NE, MW, and WEST (+) in 1977, MW, WEST, and HGT (+), and VEGETARIAN (-) in 1985, and HEIGHT, NE, and MW (+) in 1989/90 are significant.

osteoporosis.[132] These education differences increase in the 1985 equation for women, the year following the release of the *Consensus Development Conference Statement on Osteoporosis* that recommended increased calcium consumption for women (NIH 1984). In 1986 and later years, however, the education coefficients are not significant in the calcium equations for women. The substantial increase in mean calcium consumption for women between 1977 and 1985 thus appears to have been concentrated among women with more education, other things equal, but this concentration is much reduced or not present in the post-1985 equations for women. For men, the education coefficients in the calcium equations are of mixed signs and quite variable from year to year, though the small sample sizes in later years may be responsible for this variability.[133]

Together, this evidence suggests that educated women initially reacted more strongly than other women to the calcium/osteoporosis information released in 1984. The evidence also suggests that by 1986, the calcium reaction spread more evenly to women at all education levels or that a better balance was reached in the tradeoff between fat and calcium, so that once again higher education levels are associated with less fat consumption.

The potential magnitude of the interaction between calcium and fat consumption for women can also be illustrated using frequency statistics. Table 7-7 gives the average fat consumption by education level for the entire sample of women and for the sample of women who

[132] Summer results for women in Table 7-5A are even stronger.

[133] In 1987/88 and 1989/90 where we have data for the entire year, and thus larger samples, education coefficients are insignificant for men in the all-year equations, as for women.

Table 7-7 Average Fat Consumption per Day, Women, Spring (Grams)

For Whole Sample (N)	1977 (1704)	1985 (1259)	1986 (1293)	1987/8 (889)	1989/0 (365)
Not HS Graduate	70.9	62.0*	62.3	67.3	61.2
High School Graduate	72.4	70.2	67.7	61.2	60.9
Some College	77.1	69.5	69.3	67.0	65.8
College Graduate	73.9	74.7	65.5	64.2	61.0
For Women With At Least 500mg Calcium/Day (N)	(801)	(713)	(730)	(453)	(192)
Not HS Graduate	93.6*	77.1	82.0	88.2*	88.0*
High School Graduate	88.0	85.6	82.7	75.2	72.3
Some College	87.4	83.0	82.1	84.1	78.9
College Graduate	81.0	81.5	77.3	75.7	68.5
Percent of Women Consuming 500mg Calcium or More Per Day					
For Whole Sample (N)	(1704)	(1259)	(1293)	(889)	(365)
Not HS Graduate	40.9*	45.1*	47.8*	41.2*	29.9*
High School Graduate	43.0*	55.6*	52.9*	52.2*	56.1
Some College	54.9	57.5*	60.1	51.5*	58.2
College Graduate	57.3	68.0	64.4	61.9	55.3

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, Women 19-50 Years, 1977, 1985, 1986, 1987/88, and 1989/90.

NOTES. N indicates sample size. All means weighted. * indicates education group is significantly different from college graduates at the 5 percent level.

consume at least 500 mg of calcium.[134] At the bottom of the table, the proportion of women with consumption of at least 500 mg of calcium per day is also reported by education level.

First, these statistics clearly indicate that in each year, the percentage of women who consume at least 500 mg of calcium per day is positively correlated with education level (as shown at the bottom of the table). For instance, in 1977, 40.9 percent of women who did not graduate from high school consume at least 500 mg of calcium, but 57.3 percent of the college-educated group consume this level.

Second, higher calcium consumption is clearly correlated with higher fat consumption overall; for each group in each year, average fat consumption in the whole sample is much lower than the comparable figure in the 500 mg calcium group, as seen by comparing the top two portions of the table. For instance, in 1977 average fat consumption is 73.9 grams for college graduates, compared to 81.0 grams for college graduates who consume at least 500 mg of calcium. However, if we restrict our attention to those in the high-calcium group, the correlation between education and fat consumption is generally negative, in contrast to that in the entire sample. For instance, if only those with high calcium consumption are considered in 1977, college graduates consume 81.0 grams of fat per day compared to 93.6 grams for those who did not graduate from high school. Thus, if we condition on calcium consumption, education is again generally associated with lower levels of fat consumption.

Thus, the evidence on calcium consumption suggests that calcium consumption is linked to fat consumption throughout the period of

[134] Means for those consuming at least 700 mg of calcium on the survey day follow the same pattern.

study, though the strength of this relationship may have weakened over time. Also, education is associated with higher levels of calcium consumption for women in all years, but especially in 1985.[135] Thus, the potential for calcium consumption to mask the true relationship between education and the assimilation of fat information, as measured by the reduced-form equations, is problematic for women, especially in 1985, and the 1985 estimate for women is the one case where higher education is not associated with lower levels of fat consumption.[136]

Taken together, this evidence leads us to conclude that education is a determinant of consumers' ability to assimilate fat information and to act on it throughout the period of the study. Moreover, the evidence suggests that the advantages of education that accumulated by 1977 are not eliminated once producers are added as a source of diet-health information; education coefficients in both the 1987/88 and 1989/90

[135] In the summer 1977 equation for women, the calcium phenomenon is also found but is highly concentrated to college educated women. Unfortunately, we have no data from summer 1985 to assess the change in the consumption of calcium across education levels during this period. The education coefficients in the fat, saturated fat, and cholesterol equations for women in summer 1977 reflect this differential consumption of foods containing calcium. As in spring, the differences in calcium consumption fade substantially by 1987/88 and 1989/90 in the summer equations, reducing the potential confounding effects of calcium on the other equations.

[136] As an alternative test of the calcium issue in 1985, we separated foods into two groups, those which are substantial calcium sources (defined as all milk, cheese, milk desserts entries, and all other foods with more than 175 mg of calcium in the amount eaten), and "low" calcium foods (defined as all other food entries) and estimated the fat regressions separately for consumption from the two types of food. The education coefficients in the fat equation for calcium foods were -3.9, -1.7 and -0.8, respectively, for the LESS-THAN-HS, HIGH-SCHOOL-GRAD, and SOME-COLLEGE coefficients, with the first coefficient significant at the 90 percent level. The corresponding coefficients in the equation for "low" calcium foods were 0.4, 2.3 and 0.0, respectively. Thus, if the fat equations are estimated based on the portion of the diet that does not contribute significant amounts of calcium (as defined here), the education coefficients are positive, as in the other years, though none of these coefficients is significant at traditional levels.

equations are not significantly different from those in the 1977 equations. Thus, women at all education levels reduced fat consumption approximately equally over the period, other things equal. The evidence for men also indicates no significant movement in the advantages to education when producers are added as a source of this information, though the difference between the least educated and college graduates increases somewhat. Thus, for both sexes, the reductions observed in average fat consumption are not concentrated among adults at any particular education level but shared approximately equally by individuals at all education levels.

In contrast with education, INCOME does not appear primarily to reflect the ability to process information in the fat equations shown in Tables 7-3 and 7-4. The coefficient on INCOME is positive in 4 of the 5 years for women, significantly so in 1977, contrary to prediction if income were reflecting a superior ability to process information. For men, the coefficients are negative in the 4 years but not significant. The positive signs are consistent with price effects influencing the choice of fat-containing foods.[137] Moreover, the coefficient on INCOME does not change significantly over the period for either sex.[138]

The racial variables BLACK and OTHER (which primarily indicates Asian) show movement over time in the fat equation, but again

[137] This result is not surprising, since meat is a major source of fat in the diet and is a relatively expensive food product. Moreover, the movements in the income coefficient for women parallel those in meat prices in most years. For instance, the ratio of the consumer price index for meat relative to poultry (one measure of meat prices) is .84, .93, .89, .97, and .88 in 1977, 1985, 1986, 1987, and 1989, respectively (Putnam and Allshouse 1993). With the exception of the earliest regression, the coefficients on income have the same pattern, falling in 1986, rising in 1987, and again falling in 1989.

[138] We also tested nonlinear specifications for income, such as log and quadratic specifications, which gave comparable results.

these must be interpreted carefully because of the potential for calcium consumption to confound the interpretation of coefficients in the reduced-form fat equations. In the calcium equations given in Tables 7-5 and 7-6, the coefficients on BLACK and OTHER are negative in all years except 1989/90, and significant or nearly so in most years, consistent with the differences in lactose intolerance across racial groups (as discussed in footnote 124). Moreover, note that the negative coefficients, especially for black women, tend to increase in magnitude with increases in average calcium consumption in 1985 and 1986, suggesting that these increases in average calcium consumption are concentrated among white women, other things equal.[139]

Thus, the potential confounding effects of calcium consumption suggests that the coefficients on BLACK and OTHER in the fat equation may reflect lactose intolerance, as well as potential information effects, and thus, may overstate the extent to which these coefficients reflect the assimilation of information about fat consumption. That is, because lactose intolerance leads nonwhite women and men to consume significantly less calcium-containing dairy food, and this type of food contributes considerable amounts of fat to the U.S. diet, the coefficients on BLACK and OTHER would be expected to be negative in the fat equations, other things equal, if the fat information had been absorbed equally.

As shown in Tables 7-3 and 7-4 (and for the off-season in the appendix Tables 7-3A and 7-4A), the coefficients on BLACK and OTHER in the fat equations are usually negative, or positive and quite insignificant, with two notable exceptions; the coefficient for black

[139] The same pattern is found in the coefficients on HISPANIC, suggesting that Hispanics also did not increase consumption of calcium foods in the same amount as non-Hispanics.

women is positive and significant in spring 1987/88, and in spring and summer 1989/90.[140] Taken in isolation, this change in coefficients would suggest that black women's diets deteriorated relative to that of white women, either because they did not share in the improvements experienced by the overall population or because their diets worsened on average, other things equal.

Other evidence from the surveys indicates the need for caution in accepting this conclusion, however. The sample size in the 1989/90 survey is much smaller than other years, making these estimates less reliable when the sample is split by season, especially for small subpopulations.[141] When we examine the data for other seasons and for the entire year, the higher fat consumption by black women is not found consistently. For instance, the racial coefficients in comparable regressions for fat consumption in each season in 1987/88 and 1989/90, and for the entire year, are given below. Only the summer results in 1989/90 support the spring finding that women's diets differ significantly by racial characteristics, other things equal.[142]

[140] For women, these two spring coefficients on BLACK are significantly different from both the 1977 and 1985 coefficients. For men, the racial coefficients are not significantly worse in any of the comparisons.

[141] For instance, the spring 1989/90 sample contains only 26 black women and 22 women in the OTHER category.

[142] Also, this is one of the few cases where the unweighted results do not parallel the weighted results. Specifically, in contrast to the weighted results above, the coefficient on BLACK is not significant in either the summer or all-year unweighted equations in 1989. The coefficient in spring is significant in the unweighted regressions, but one-third smaller than in the weighted regressions. The sensitivity of these results may reflect the small sample sizes for minority groups in the 1989/90 samples.

Coefficients on Race in Fat Equations By Season, Women 19-50 Years

	1987/88					1989/90				
	Spring	Summer	Fall	Winter	All Year	Spring	Summer	Fall	Winter	All Year
Black	9.3 (1.9)*	2.5 (0.3)	1.6 (0.2)	-6.3 (-1.0)	1.4 (0.4)	34.7 (2.8)**	27.2 (2.1)**	-2.9 (-0.4)	2.6 (0.2)	17.1 (2.3)**
Other	-15.2 (-3.0)**	1.7 (0.1)	28.3 (1.8)*	9.5 (0.8)	2.6 (0.4)	5.9 (0.5)	-3.8 (-0.4)	-4.0 (-0.5)	2.4 (0.2)	-1.9 (-0.4)
N	850	316	312	617	2095	349	376	374	317	1416

Note. N is sample size. * denotes significance at the 10 percent level and ** at the 5 percent level.

For men, as for women, the racial coefficients are generally negative, or positive but quite insignificant, indicating that men in the identified racial groups consume the same or less fat than men in the base group. Compared to 1977, none of the changes in coefficients are significant except for the change between 1977 and 1987 for men in the other-race category, which showed significant improvement relative to the base group.

Also, Hispanic women are generally found to consume less fat than non-Hispanic women; these negative coefficients are significant only in 1985 and 1986, paralleling the increases in calcium consumption by the base group. The Hispanic coefficient is of mixed signs and quite variable from year to year for men.

Thus, with the exception of black women in spring, few systematic changes are found in the racial and ethnic coefficients during this period, suggesting that improvements in average fat consumption are not

concentrated in any particular racial group, other things equal. The spring evidence suggests that black women may not have shared equally in the average fat reductions experienced over this period, though this result is not found in other seasons.

The presence of two adults in the household (MALE-HEAD or FEMALE-HEAD), the regular use of vitamin supplements (VITAMINS),[143] and pregnancy or lactation (PREGNANT) do not have the significant coefficients in most years that would have been consistent with a primary role as information or health-valuation variables (the exception is for vitamin use in 1989/90 for women). In fact, the coefficient on PREGNANT is positive in all years and significant in every year but 1977 and 1989/90, presumably reflecting, in part, the higher calcium consumption of pregnant or lactating woman, and with it fat consumption, other things equal. Finally, the coefficient on HH-SIZE is negative and significant for women in 1977 and 1987/88, and almost significant in 1989/90, consistent with the prediction that a larger number of individuals in the household (presumably children) should increase the benefits of collecting and acting on diet-health information. This finding is not confirmed, however, by the equations in other years and is not found in the equations for men.

Thus, education and race are the primary variables associated with differences in fat consumption that potentially reflect differential

[143] In contrast, results on NOSMOKE are generally consistent with our hypotheses in 1985 and later years, when information on smoking behavior is available in the dataset. If NOSMOKE is included in the regressions in these years, its coefficient is negative in all of the 7 cases and significant in 3 of those cases and nearly so in a fourth, consistent with the hypothesis that individuals who value health more highly are more likely to respond to available information about fat. Other coefficients are stable if smoking behavior is included.

absorption of diet-health information.[144] The evidence indicates that education gives both men and women advantages in acquiring diet-health information and incorporating it into behavior. The differences due to education do not show any systematic tendency to fade or to increase during the health claims period, suggesting that adults at all education levels share approximately equally in reductions in fat consumption over this period.

In contrast, the results indicate that in 1977 and 1985 black women consumed approximately the same amount of fat as other women, other things equal, but lost ground relative to their counterparts as average fat consumption fell in our primary spring estimates, other things equal. This suggests that diet-health information did not reach black women as successfully as other women during the post-1985 years. Estimates for women in other seasons and for men do not show significant changes in racial coefficients during the post-1985 period, however, making this result somewhat uncertain.

Saturated Fat Consumption

Regression results for saturated fat consumption are shown in Table 7-8 for women and in Table 7-9 for men. As in the fat regressions, the variables reflecting whether the person is on a special diet (DIET), the number of times they eat out on the survey day (MEALSOUT), is sick

[144] We also tested regression specifications that excluded MEALSOUT and 3MEALS, because these variables are choice variables that may, in part, reflect information. In general, the results for men were quite robust to specification changes; but for women, education differences fade somewhat when coefficients are positive and increase in magnitude when they are negative, but are qualitatively unchanged. This is, in part, due to the fact that women with more education are more likely to consume 3 meals on the survey day. If instead of fat, we examined the percentage of calories from fat, the sign on 3MEALS is reversed; that is, the percentage of calories from fat is lower for those eating 3 meals on the survey day. With this exception, regression results using the percentage of calories from fat measure closely parallel those for fat reported here.

Table 7-8 Saturated Fat Regression Results for Women, Spring

Variable	1977	1985	1986	1987/88	1989/90
LESS THAN HS	2.67 (1.8)*	-2.54 (-1.4)	4.23 (2.4)**	4.93 (2.1)**	2.36 (0.6)
HIGH SCHOOL GRAD	1.50 (1.3)	.54 (0.4)	3.29 (2.4)**	2.90 (1.6)	3.04 (1.3)
SOME COLLEGE	3.17 (2.5)**	-.58 (-0.4)	3.85 (2.9)**	2.91 (1.6)	2.41 (1.0)
INCOME	.11 (2.3)**	.03 (0.4)	-.05 (-1.0)	.09 (1.2)	.10 (1.0)
MALE HEAD	-1.16 (-0.9)	-.21 (-0.2)	1.28 (1.0)	.64 (0.4)	1.36 (1.0)
BLACK	0.06 (0.0)	-1.86 (-1.0)	-1.65 (-0.9)	2.73 (1.2)	10.42 (2.6)**
OTHER	-1.84 (-0.8)	-2.08 (-1.0)	-2.44 (-1.2)	-5.36 (-2.8)**	3.19 (0.6)
HISPANIC	-.34 (-0.2)	-1.86 (-0.9)	-3.27 (-1.7)*	0.94 (0.6)	-1.86 (-0.7)
AGE	-.13 (-2.1)**	.02 (0.3)	-.04 (-0.5)	-.09 (-1.3)	-.08 (-0.7)
FULLTIME	-.71 (-0.8)	-1.37 (-1.4)	.04 (0.0)	-2.64 (-2.3)**	-1.25 (-0.8)
HH SIZE	-0.45 (-1.8)*	.15 (0.4)	.30 (0.7)	-1.36 (-3.6)**	-.97 (-1.5)
PREGNANT	1.46 (0.8)	6.83 (3.8)**	5.32 (2.5)**	4.85 (2.4)**	3.63 (1.0)
VITAMINS	.90 (1.0)	2.08 (2.1)**	.73 (0.7)	-.16 (-0.1)	-2.85 (-1.5)
DIET	-7.28 (-7.8)**	-5.36 (-4.7)**	-5.89 (-4.7)**	-8.17 (-4.6)**	-4.05 (-1.8)*
MEALS OUT	.49 (0.8)	1.74 (2.7)**	2.53 (3.3)**	2.35 (2.7)**	2.49 (1.9)*
3 MEALS	3.85 (4.1)**	4.22 (4.7)**	4.83 (5.0)**	6.42 (5.5)**	5.16 (2.8)**
WEEKEND	3.90 (3.5)**	3.95 (3.3)**	1.59 (1.3)	1.42 (1.0)	-1.48 (-0.7)
SICK	-3.17 (-1.2)	-8.67 (-5.2)**	-6.78 (-3.8)**	-2.85 (-1.3)	1.10 (0.5)
TRAVEL	4.52 (1.1)	-1.21 (-0.4)	5.91 (1.4)	3.90 (0.7)	-.55 (-0.1)
HOLIDAY	4.77 (2.5)**	2.93 (1.3)	1.95 (0.9)	11.02 (4.4)**	5.52 (1.6)
Adj. R-squared	.08	.10	.10	.15	.12
N	1352	1087	1016	850	349
Mean Sat. Fat Consumption	26.4	25.1	24.6	22.9	21.9

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and Continuing Survey of Food Intakes by Individuals, 1985, 1986, and 1989/90 Women 19-50 Years.

NOTES. All regressions weighted, with White-corrected t-statistics in parentheses. * denotes significance at the 10 percent level and ** denotes significance at the 5 percent level. The model also controls for region (NE, MW, and WEST), whether the woman is a vegetarian, and height. Of these, HEIGHT is significant (+) in 1977 and 1986, MW, NE, and WEST (+) in 1977, NE and WEST (+) in 1989/90, and VEGETARIAN (-) in 1977 and 1986.

does not differ by racial characteristics in either spring or summer, but black women consume 10 grams more saturated fat in the comparable 1989/90 estimate. This relative difference for black women is not found in the 1987/88 estimates or in the fall, winter, or all-year estimates for 1989/90, however. In contrast to fat consumption, this relative movement in saturated fat consumption is also found for black men, where a 10 gram advantage in saturated fat consumption in summer 1977 is nearly eliminated in the 1989/90 estimate (significant at the 10 percent level).

In contrast, the negative coefficient on OTHER tends to increase in magnitude by 1987/88, indicating that the lower level of saturated fat consumption by individuals of other races becomes more pronounced over time relative to whites. The coefficient on HISPANIC is generally negative but not significant for women and quite variable in the small sample years for men.

For women the coefficient on HH-SIZE, the number of people in the household, is negative and significant in 1977 and 1987/88, and nearly so in 1989/90, consistent with theoretical predictions that the greater benefits to diet-health information in households with more persons should lead to more information gathering. However, these results are not found in other years for women and are highly insignificant in 3 of the 4 male equations.

As in the fat equations, pregnancy or lactation (PREGNANT) is consistently associated with higher levels of saturated fat consumption. The presence of two adult heads (MALE-HEAD and FEMALE-HEAD),

regular vitamin use (VITAMINS), and fulltime work (FULLTIME) show no consistent sign patterns and are generally insignificant.[146]

Thus, as in the fat equations, the evidence indicates that education is the information variable most consistently related to saturated fat consumption, suggesting that education creates advantages in processing information (in this case about saturated fat consumption) and that these advantages are not eliminated or increased once producers are allowed to provide health information. Thus, the reductions observed in average saturated fat consumption are shared approximately equally across individuals at all education levels, other things equal. Also, the evidence suggests that black men and women may not have been as successfully reached by information about saturated fat consumption compared to whites, other things equal, though this result is not fully consistent across seasons and years.

Cholesterol Consumption

The regression results for cholesterol consumption are shown in Tables 7-10 for women and 7-11 for men. Again, the variables reflecting special diets (DIET), the number of meals eaten out on the survey day (MEALSOUT), sickness (SICK), travel (TRAVEL), weekend (WEEKEND), special occasion (HOLIDAY), and whether the person ate three meals on the survey day (3MEALS) are nearly always significant determinants of cholesterol consumption in the expected directions.

[146] As in the fat case, if we control for smoking behavior in the post-1985 equations, where these data are available, the coefficients on NOSMOKE are all negative and 6 of the 7 are significant, consistent with the hypothesis that those who value health more highly will react more to the information about saturated fat, other things equal. Other results are stable when smoking behavior is controlled.

Table 7-10 Cholesterol Regression Results for Women, Spring

Variable	1977	1985	1986	1987/88	1989/90
LESS THAN HS	50.90 (2.0)**	12.32 (0.5)	20.82 (0.7)	45.31 (1.5)	92.68 (1.6)
HIGH SCHOOL GRAD	7.19 (0.3)	33.22 (1.7)*	31.25 (1.6)	11.98 (0.6)	52.17 (2.2)**
SOME COLLEGE	12.63 (0.5)	-29.68 (-1.5)	41.83 (2.0)**	11.99 (0.5)	111.47 (4.1)**
INCOME	2.25 (2.5)**	-.05 (-0.0)	-1.30 (-1.6)	-.25 (-0.3)	.89 (1.0)
MALE HEAD	-29.52 (-1.3)	-13.84 (-0.7)	12.28 (0.5)	-6.32 (-0.3)	-54.22 (-1.7)*
BLACK	68.54 (2.7)**	69.77 (2.5)**	55.12 (1.3)	78.43 (2.3)**	86.20 (1.6)
OTHER	-1.71 (-0.0)	33.02 (0.8)	71.58 (2.0)**	-65.57 (-1.9)*	25.25 (0.5)
HISPANIC	64.92 (1.6)	15.36 (0.5)	-77.04 (-2.4)**	78.50 (1.9)*	-35.89 (-1.0)
AGE	-1.29 (-1.3)	.99 (1.0)	.19 (0.2)	.48 (0.4)	-.12 (-0.1)
FULLTIME	-35.65 (-2.3)**	-1.11 (-0.1)	-10.99 (-0.7)	-40.07 (-2.4)**	6.01 (0.3)
HH SIZE	-14.28 (-3.0)**	5.85 (1.1)	8.25 (1.3)	-5.05 (-0.9)	3.87 (0.5)
PREGNANT	-26.30 (-0.8)	71.86 (2.4)**	-6.16 (-0.2)	95.31 (2.9)**	123.95 (2.3)**
VITAMINS	24.66 (1.5)	31.94 (1.9)*	2.89 (0.2)	11.95 (0.7)	-9.22 (-0.4)
DIET	-28.24 (-1.5)	-55.96 (-2.8)**	6.42 (0.3)	-56.35 (-2.2)**	-44.27 (-1.5)
MEALS OUT	-2.29 (-0.2)	5.46 (0.5)	28.42 (2.3)**	52.34 (3.2)**	-8.96 (-0.6)
3 MEALS	59.31 (3.7)**	43.88 (2.7)**	50.44 (3.1)**	49.14 (2.7)**	53.76 (2.4)**
WEEKEND	91.47 (4.4)**	81.89 (4.4)**	70.68 (3.3)**	49.19 (2.3)**	61.41 (1.9)*
SICK	-125.44 (-3.5)**	-71.89 (-1.8)*	-86.08 (-2.4)**	-61.89 (-1.9)*	-50.96 (-1.3)
TRAVEL	129.41 (1.7)*	-81.80 (-2.2)**	-66.39 (-1.2)	90.03 (0.9)	15.24 (0.3)
HOLIDAY	92.45 (2.8)**	30.64 (1.0)	.05 (0.0)	48.30 (1.0)	29.36 (0.5)
Adj. R-squared	.06	.05	.04	.10	.12
N	1352	1087	1016	850	349
Mean Choles. Consumption	346.9	295.8	301.9	242.7	221.5

ATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and ontinuing Survey of Food Intakes by Individuals, Spring 1985, 1986, 1989/90.

OTES. All regressions weighted, with White-corrected t-statistics in parentheses. * denotes significance at e 10 percent level and ** at the 5 percent level. The model also controls for region (NE, MW, and WEST), ight and whether the woman is vegetarian. Of these, only WEST and HEIGHT are significant (+) in 1977 id VEGETARIAN (-) in 1986.

Table 7-11 Cholesterol Regression Results for Men, Summer

Variable	1977	1985	1987/88	1989/90
LESS THAN HS	68.62 (1.4)	120.85 (2.1)**	98.43 (1.8)*	236.33 (3.1)**
HIGH SCHOOL GRAD	46.01 (1.2)	86.49 (2.2)**	51.54 (1.0)	98.59 (1.8)*
SOME COLLEGE	25.17 (0.6)	113.71 (2.7)**	117.54 (1.7)*	68.08 (0.9)
INCOME	.19 (0.1)	-2.94 (-1.4)	.95 (0.7)	1.18 (0.5)
FEMALE HEAD	28.10 (0.6)	-69.72 (-1.5)	84.05 (1.3)	-10.56 (-0.1)
BLACK	.69 (0.0)	-2.07 (-0.0)	176.53 (2.9)**	236.54 (1.3)
OTHER	46.99 (0.4)	-53.91 (-1.0)	-206.06 (-2.5)**	249.09 (3.4)**
HISPANIC	77.98 (1.0)	12.66 (0.2)	321.48 (3.1)**	-15.05 (-0.2)
AGE	.04 (0.0)	.14 (0.1)	-3.01 (-1.3)	-4.96 (-1.8)*
FULLTIME	-21.96 (-0.6)	132.72 (3.0)**	84.40 (1.5)	-30.12 (-0.5)
HH SIZE	14.15 (1.2)	13.93 (1.1)	4.34 (0.2)	7.42 (0.4)
VITAMINS	4.07 (0.1)	-26.46 (-0.7)	6.08 (0.2)	47.13 (0.9)
DIET	-38.78 (-0.7)	-137.60 (-2.9)**	-171.13 (-4.2)**	-211.12 (-2.9)**
MEALS OUT	2.34 (0.1)	23.28 (1.1)	15.77 (0.5)	42.41 (0.8)
3 MEALS	122.06 (4.3)**	77.19 (2.4)**	79.80 (2.0)**	27.02 (0.6)
WEEKEND	109.13 (2.9)**	54.70 (1.5)	46.09 (1.1)	47.23 (0.7)
SICK	-312.55 (-5.8)**	-75.69 (-0.5)	-392.50 (-3.1)**	-26.50 (-0.2)
TRAVEL	-37.83 (-0.4)	-98.65 (-1.1)	---	103.74 (0.8)
HOLIDAY	150.29 (2.0)**	178.03 (3.0)**	12.18 (0.2)	90.41 (1.0)
Adj. R-squared	.05	.07	.20	.17
N	543	475	221	294
Mean Cholesterol Consumption	508.3	452.5	362.4	391.0

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and Continuing Survey of Food Intakes by Individuals, Summer 1985 and 1989/90.

NOTES. All regressions weighted, with White-corrected t-statistics in parentheses. * denotes significance at the 10 percent level and ** denotes significance at the 5 percent level. The model also controls for region (NE, MW, and WEST), whether the man is a vegetarian, and height. Of these, WEST (+) and VEGETARIAN (-) in 1985, WEST (+) in 1987/88, and NE, MW, WEST, and HEIGH (+) in 1989/90 are significant.

Also, higher education is again associated with lower levels of consumption throughout the period, and this relationship is stronger and more consistent than that found for fat and saturated fat. Twenty-six of the 27 coefficients on education are positive in the cholesterol equations. One noticeable difference in the cholesterol equations, compared to those for fat and saturated fat, is the presence of a negative education gradient for women in 1985. Since cholesterol consumption is more tangentially tied to dairy products,[147] this finding is generally consistent with the calcium explanation for the fading of the education coefficients in the fat and saturated fat equations in 1985.

With the exception of 1977, the coefficient on INCOME is generally quite weak in the cholesterol equations, thus again providing little support for the hypothesis that income primarily reflects human capital not captured in education. The coefficient on BLACK is again positive in 8 of the 9 equations and again shows some tendency to increase for men, though not for women in this case,[148] other things equal. The coefficients on OTHER and HISPANIC are of mixed signs and do not follow a consistent pattern in the cholesterol equations.

The coefficient on MALE-HEAD is negative in 4 of the 5 equations for women, as predicted, but it is generally insignificant. FEMALE-HEAD is positive in 3 of the 4 cases for men, contrary to expectation if FEMALE-HEAD is an information variable. FULLTIME is negative in 4 of the 5 equations for women and significant in 1977 and 1987/88, consistent with the view that working women have better access to information. This does not hold in the equations for men, however.

[147] Recall from Chapter VI that over 60 percent of cholesterol consumption in 1977 came from meat and eggs.

[148] This is not supported by the spring data for men, as shown in appendix table 7 -11A.

HH-SIZE and VITAMINS are of mixed signs for both males and females. PREGNANT is positive and significant in 1985, 1987/88, and 1989/90 and insignificant in other years.[149]

Thus, again the education variables and BLACK are the most important information variables that follow a consistent pattern over time. Educational advantages are found during the entire period and tend to increase marginally for men. Blacks have higher cholesterol consumption compared to whites, other things equal; this difference is constant for women and increases for men.

CONCLUSION

This examination of cross-sectional differences in individuals' consumption of fat, saturated fat, and cholesterol indicates that education and race are the two information-related variables associated with consistent differences in consumption. With the exception of spring 1985 for women,[150] higher education is generally associated with lower levels of consumption of these food components. The evidence suggests that the exception in 1985 may be the result of higher levels of calcium consumption (and with it fat) by more educated women in 1985, following a burst of publicity about the relationship between calcium consumption and osteoporosis, which acts to mask the information advantages of education in reduced-form estimates of fat and saturated fat consumption in that year. The advantages to education did not change significantly over the period of this study.

[149] When NOSMOKE is added to the specification in the post-1985 regressions, the coefficients are negative and significant in each year for women, as predicted, but insignificant and positive for men.

[150] A similar but more limited exception for college-educated women is also found in the summer 1977 equation for women, where calcium consumption is very highly concentrated to these women.

These results suggest that education gives individuals advantages in absorbing information from government and general sources or that differential discount rates are important in explaining diet. The introduction of producers as an additional source of information did not eliminate the existing difference due to education. Thus, the reductions observed in the average consumption levels of fat, saturated fat, and cholesterol are not the result of the less educated simply "catching up" to their more educated counterparts, but of a more complex process of information diffusion across all education levels, leading to reductions in consumption across all education levels at approximately equal rates.

Tables 7-12 and 7-13 give weighted means for the key nutrients by education group for women and men, respectively, for all years of available data. These data show that the education findings in the regressions are also observed in the basic group means. By 1989/90 mean fat, saturated fat, and cholesterol consumption are lower for all education groups compared to both 1985 and 1977 levels.

The other information-related result in the cross-section estimates indicates that, compared to their position in 1977, blacks of both sexes may not have experienced the same gains as the rest of the population during this period, other things equal. By 1989/90, being black was associated with greater consumption of fat and saturated fat for women, and the elimination of the lower levels of consumption that had existed for black men, other things equal. These results are especially notable, because higher lactose intolerance rates for American blacks leads to lower consumption levels of dairy products, a significant source of fats in the U.S. diet. These results suggest that neither government and general information sources nor producer advertising and labeling have been as effective in reaching black adults with information about the role of fats and cholesterol in cardiovascular risk, other things equal. As

Table 7-12 Means By Education, Women 19-50 Years[1]

	SPRING					SUMMER		
(N)	1977 (1704)	1985 (1259)	1986 (1293)	1987/8 (889)	1989/0 (365)	1977 (1097)	1987/8 (323)	1989/0 (391)
FAT (g)								
Less than HS	70.9	62.0**	62.3	67.3	61.2	74.5	54.8**	56.7**
High School	72.4	70.2	67.7	61.2++	60.9++	75.8	61.3**	60.9**
Some College	77.1	69.5**	69.3	67.0	65.8	76.5	76.0	72.2
College Graduate	73.9	74.8	65.5++	64.2++	61.0++	83.1	57.4**	68.1**
SATURATED FAT (g)								
Less than HS	24.7	21.8**	23.3	24.0	21.1	25.9	18.8**	19.5**
High School	25.8	25.8	24.8	22.4++	21.6++	27.3	22.5**	21.1**
Some College	28.0	24.8**	25.9	23.6	23.1	26.5	28.4	25.3
College Graduate	26.6	27.0	23.7++	22.7++	20.9++	30.2	19.9**	24.1**
CHOLESTEROL (mg)[2]								
Less than HS	355	320*	314	260++	247++	383	252**	267**
High School	333	317	310	235++	208++	325	259**	227**
Some College	351	279**	306	244+	273	348	293*	284**
College Graduate	357	298**	278	252++	170++	416	224**	284**
CALCIUM (mg)								
Less than HS	511	518	595+	555	479	522	385**	571
High School	530	656**	639	592++	648	543	595	615*
Some College	639	663	712	612	661	588	678	696**
College Graduate	647	756**	728	654++	687	731	648	671
CALORIES (kcal)								
Less than HS	1538	1518	1488	1638	1496	1622	1328**	1449*
High School	1549	1679**	1598++	1465++	1521++	1597	1579	1574
Some College	1629	1697	1676	1599+	1655	1628	1763	1763
College Graduate	1650	1782**	1630++	1523++	1609++	1768	1482**	1776

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and Continuing Survey of Food Intakes by Individuals, 1985, 1986 and 1989/90.

NOTES. N is sample size. * denotes significant difference from 1977 at the 10 percent level and ** denotes significance at 5 percent level. + and ++ denote comparable significant differences relative to 1985.

[1] Heads of households. [2] Recall egg data change begins in 1987 data.

Table 7-13 Means By Education, Men 19-50 Years[1]

	SUMMER				SPRING		
	1977	1985	1987/8	1989/0	1977	1987/8	1989/0
(N)	(720)	(578)	(230)	(306)	(1309)	(705)	(266)
FAT (g)							
Less than HS	114.6	105.9	102.8	92.0	114.5	101.4**	80.5**
High School	114.7	109.9	87.3 ++	88.3 ++	113.2	85.3**	85.1**
Some College	112.6	112.5	93.5 ++	102.7	120.4	89.1**	83.6**
College Graduate	109.3	99.8	94.8	90.8	107.8	89.2**	81.9**
SATURATED FAT (g)							
Less than HS	39.1	37.4	35.1	30.4 ++	39.8	35.2**	27.3**
High School	40.6	40.5	29.9 ++	31.0 ++	40.8	29.8**	30.4**
Some College	40.9	41.4	34.2 ++	37.8	44.0	33.0**	29.5**
College Graduate	39.8	35.5*	35.4	30.8 +	38.6	31.6**	27.3**
CHOLESTEROL (mg)[2]							
Less than HS	537	446**	408	401	588	379**	333**
High School	501	455	315 ++	387 +	546	346**	323**
Some College	494	488	439	457	542	397**	292**
College Graduate	469	391**	299 +	314 ++	457	302**	239**
CALCIUM (mg)							
Less than HS	702	709	766	794	787	812	702
High School	820	926*	672 ++	751 ++	773	647**	768
Some College	847	1015**	877	1053	893	851	708**
College Graduate	817	906	1028	799	801	812	825
CALORIES (kcal)							
Less than HS	2412	2655	2424	2116 ++	2468	2407	2234
High School	2451	2625*	2103 ++	2160 ++	2396	2010**	2162*
Some College	2437	2720**	2185 ++	2628	2525	2112**	2066**
College Graduate	2330	2377	2303	2254	2282	2152	2193

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, and Continuing Survey of Food Intakes by Individuals, 1985 and 1989/90.

NOTES. N is sample size. * denotes significant difference from 1977 at the 10 percent level and ** denotes significance at 5 percent level. + and ++ denote comparable significant differences relative to 1985.

[1] Heads of households. [2] Recall egg data change begins in 1987 data.

average consumption falls in the post-1985 period, black adults did not share equally in the gains experienced by the rest of the population, other things equal. In particular, this result conflicts with the finding in our study of the cereal market, where the introduction of producer claims reduced racial differences in the consumption of fiber from cereals.

VIII

DIFFERENCES IN DIET-DISEASE KNOWLEDGE

INTRODUCTION

Chapter IV examines average knowledge levels for various diet-disease issues related to fat and cholesterol consumption to test hypotheses about whether producer claims add to or interfere with the flow of information reaching consumers. These results from the FDA knowledge surveys indicate that the proportion of consumers with knowledge of the fat-heart disease issue is considerable in 1984, but knowledge of the fat-cancer issue is limited. Knowledge of these issues increases significantly during the post-1985 period, although cancer knowledge remains much lower than heart disease knowledge.

This chapter examines whether this knowledge is evenly distributed across the population, and if not, which individual characteristics are associated with higher knowledge levels in the years of interest. In particular, the analysis focuses on the distribution of knowledge in 1984, before the change in health claims policy, and then on changes in this distribution in 1986 and 1988, as advertising and labeling health claims increase. Changes in the importance of individual characteristics in explaining variation in knowledge should reflect how well producer-provided information reaches different types of individuals compared with government and general information sources, and thus, provide another test of the hypotheses described in Chapter VII.

Unlike the consumption equations in the previous chapter, analysis of knowledge data is not colored by the confounding effects of other diet-disease knowledge, such as the potential for calcium information to affect fat consumption. In particular, this analysis of knowledge differences will allow us to assess more directly whether the education and racial differences observed in the consumption analysis appear to be determined by differences in consumer understanding of the basic fat and cholesterol disease issues.

EMPIRICAL METHOD

This chapter analyzes the responses to survey questions dealing with fat and cholesterol disease issues from the FDA's *Health and Diet Surveys* for the years 1984, 1986, and 1988, which are described in Table 4-1.

In order to parallel our consumption analysis, this evaluation is limited to responses from adults 19-50 years old and uses available demographic information on education, income, race, ethnic heritage, age, smoking behavior, and number of adults in the household. Since the various knowledge measures, such as HEART_FAT and FAT_CANCER, are dummy variables, which take a value of 1 if the individual gives a specified response, and 0 otherwise, probit multiple regression analysis is used for estimation. The estimation equation is given by:

$$\begin{aligned}(8\text{-}1)\quad \text{Knowledge}_i = {} & a_0 + a_1\text{LESS-THAN-HS}_i + a_2\text{HIGH-SCHOOL-GRAD}_i \\ & + a_3\text{SOME-COLLEGE}_i + a_4\text{INCOME}_i + a_5\text{BLACK}_i \\ & + a_6\text{HISPANIC}_i + a_7\text{OTHER-RACE}_i + a_8\text{AGE}_i \\ & + a_9\text{SINGLE}_i + a_{10}\text{SMOKER}_i + e_i,\end{aligned}$$

where Knowledge_i is a dummy variable for the specified diet-disease issue, as indicated by the variables FAT_HEART, CANCER_FAT, etc., and where

LESS-THAN-HS_i = 1 if did not graduate from high school, 0 otherwise,
$\text{HIGH-SCHOOL-GRAD}_i$ = 1 if high school graduate, 0 otherwise,
SOME-COLLEGE_i = 1 if post high school education, but no college degree, 0 otherwise,
INCOME_i = Income in 1984 \$1000,[151]
BLACK_i = 1 if black, 0 otherwise,
OTHER-RACE_i = 1 if not black and not white, 0 otherwise,
HISPANIC_i = 1 if Hispanic, 0 otherwise,
AGE_i = Age in years,
SINGLE_i = 1 if only adult in household, 0 otherwise, and
SMOKER_i = 1 if currently smokes cigarettes, 0 otherwise.

The sample is restricted to observations with no missing values for these demographic variables. The means for the resulting samples are shown in Table 8-1 and are quite similar to overall sample means. Particular knowledge variables are usually available only for subsamples of the survey. Sample sizes for these subsamples are reported in the tables with the relevant regression results.

[151] Income data are coded in eight categories: Less than \$5000, \$5000-10,000, \$10,000-15,000, \$15,000-20,000, \$20,000-25,000, \$25,000-35,000, \$35,000-50,000, and more than \$50,000. INCOME is coded as the midpoint of the relevant range, deflated to 1984 dollars using the overall consumer price index (*Economic Report of the President* 1991, 351).

TABLE 8-1 Means for Knowledge Regression Variables

Variables	Women, 19-50 Years			Men, 19-50 Years		
	1984	1986	1988	1984	1986	1988
LESS THAN HS	.09	.08	.08	.10	.09	.05
HIGH SCHOOL GRAD	.41	.42	.36	.35	.32	.30
SOME COLLEGE	.28	.26	.28	.24	.28	.28
INCOME	25.4	26.7	27.9	27.0	28.7	30.9
BLACK	.10	.10	.10	.08	.08	.07
HISPANIC	.04	.03	.05	.04	.05	.06
OTHER RACE	.03	.06	.03	.04	.06	.07
AGE	34.1	34.8	35.6	34.4	33.7	34.1
SINGLE	.16	.18	.17	.17	.19	.19
SMOKER	.29	.29	.28	.36	.30	.29
N	1238	1373	1077	934	927	698

SOURCE. *Health & Diet Surveys*, Food and Drug Administration.
NOTES. N is sample size for the entire sample. Means are also for the entire sample. Sample size for individual regressions depends on the particular knowledge measure and isnoted when regressions are reported.

RESULTS

Heart Disease Knowledge

In this section, we present regression results for the five major fat-heart disease questions, namely HEART_FAT, FAT_HEART, MAJOR_HEART, MAJOR_BCHOL, and SAT_KIND, defined in Table 4-1. Discussions of the fat-cancer and calcium questions follow.

HEART_FAT

Table 8-2 gives probit regression results for the knowledge variable HEART_FAT, which is equal to 1 if an individual answers "yes" to the question "Have you heard about *heart disease* or heart attacks being related to the things people eat or drink?" and then gives a fat, saturated fat, or cholesterol response (as described in Table 4-1) to the follow-up question: "What things people eat or drink make them *more* likely to get heart disease or heart attacks?"

These regression results indicate that knowledge tends to vary positively with schooling in all years for both women and men. When measured against college graduates, as in these regressions, these differences are often significant, especially at lower education levels. To assess the magnitude of the relationship between education and the probability of HEART_FAT knowledge, we present estimated probabilities of knowledge from the regressions for each education level in each year, with all other variables fixed at the mean of the sample in the given year.[152] These estimated probabilities are:

[152] In a nonlinear model, such as the probit model used here, the estimated coefficients do not reflect directly the marginal effect of a given characteristic on the probability of interest. One standard way to assess this marginal effect in nonlinear models is to calculate the estimated probability at representative values. Thus, for

(continued...)

TABLE 8-2 Probit Knowledge Regressions: HEART_FAT[1]

(What foods make you more likely to get heart disease? Fat responses.)

	Women, 19-50 Years			Men, 19-50 Years		
	1984	1986	1988	1984	1986	1988
Constant	-1.41 (-3.1)**	-.33 (-0.9)	.79 (1.7)*	-.63 (-0.1)	.30 (0.7)	.92 (1.6)
LESS THAN HS	-.54 (-1.4)	-.44 (-1.4)	-1.03 (-2.6)**	-1.20 (-3.0)**	-.24 (-0.7)	-1.05 (-2.4)**
HIGH SCHOOL GRAD	-.76 (-3.2)**	-.31 (-1.6)	-.93 (-3.1)**	-1.15 (-4.0)**	-.23 (-0.9)	-.97 (-3.3)**
SOME COLLEGE	.11 (0.5)	.05 (0.3)	-.78 (-2.6)**	-.41 (-1.5)	-.25 (-1.0)	-.36 (-1.2)
INCOME	.01 (2.3)**	.01 (1.3)	.01 (0.7)	-.02 (-2.1)**	.01 (1.3)	.00 (0.2)
BLACK	-1.37 (-2.6)**	-.48 (-2.1)**	-.13 (-0.4)	-.36 (-1.0)	-.73 (-1.9)*	-.49 (-1.4)
HISPANIC	-.25 (-0.5)	-.31 (-0.8)	-.21 (-0.5)	.16 (0.4)	-.41 (-1.1)	-.57 (-1.4)
OTHER RACE	-.03 (-0.1)	.01 (0.0)	-.71 (-2.0)**	-.54 (-0.9)	-.15 (-0.3)	-1.08 (-2.7)**
AGE	.03 (2.5)**	.03 (2.9)**	.02 (1.7)*	.01 (0.6)	.01 (0.9)	.01 (0.6)
SINGLE	-.03 (-0.1)	-.06 (-0.3)	.16 (0.6)	-.30 (-1.1)	.15 (0.6)	.15 (0.5)
SMOKER	-.21 (-1.1)	-.22 (-1.4)	.05 (0.3)	-.02 (-0.1)	-.44 (-2.2)**	-.01 (-0.1)
Mean HEART_FAT	.302	.674	.779	.191	.707	.718
N	308	356	276	246	225	177

SOURCE. *Health & Diet Surveys*, Food and Drug Administration. NOTES. t-statistics are in parentheses: * indicates significance at 10 percent level; ** at 5 percent level. N is sample size.

[1] HEART_FAT is a dummy variable with a value of one for individuals giving fat-related answers to the open-ended question "What things people eat or drink make them *more* likely to get heart disease or heart attack?" as described in Table 4-1.

Predicted Percent with Knowledge, By Education

HEART_FAT	Women			Men		
	1984	1986	1988	1984	1986	1988
Less than High School	19	58	70**	07**	68	53**
High School Graduate	13**	62	73**	07**	69	56**
Some College	40	75	78**	24	68	78
College Graduate	36	73	94	38	76	87

The asterisks indicate the significance level of the underlying regression coefficients in Table 8-2 relative to college graduates. These estimates show quite clearly that higher education levels are associated with higher knowledge levels in all years. The estimates also indicate, however, that the large increase in knowledge reported between 1984 and 1986, and the additional increase in 1988, are not concentrated among the most educated, but are shared approximately equally by women and men at all education levels.

The coefficients on the race and ethnicity variables are also negative in almost all equations, though these are significant only for BLACK in 1984 and 1986 and for OTHER-RACE in 1988. To assess the magnitudes of racial and ethnic differences, we again present the estimated probability that individuals had HEART_FAT knowledge by

(...continued)
instance, to estimate the difference in the predicted probability of knowledge for college educated women compared to those with less than a high school education, other things equal, we calculate the predicted probability of knowledge for a college graduate, and compare it to the predicted probability if education is less than a high school education, with all other noneducation variables set equal to the sample means.

race and ethnic characteristics, with all other characteristics at the sample mean:

Predicted Percent with Knowledge, By Race & Ethnicity

HEART_FAT	Women			Men		
	1984	1986	1988	1984	1986	1988
Black	03**	52**	80	11	46*	63
Hispanic	22	59	77	24	59	59
Other Race	29	71	60**	08	69	39**
White	30	70	83	19	74	79

Again these estimates indicate that knowledge gains are experienced by women and men of all racial and ethnic types, and in particular, that the significantly lower level of knowledge reported by black women in 1984 is eliminated by 1988, other things equal. Thus, in contrast to the consumption evidence, this knowledge measure shows improvements across all racial and ethnic groups during the post-1984 period.

Income and age also tend to be associated with greater knowledge of this issue (with the 1984 equation for men the exception), but age is significant only for women and income only in 1984. In general, income differences faded in significance and estimated magnitude by 1988, but age differences remains for women. The coefficients on SINGLE and SMOKER are generally negative, as predicted, but these are not significant in most cases.

Thus, for this measure of knowledge, education, race, and to a lesser extent age, are the primary factors associated with differences in

knowledge. Increases in this knowledge measure in 1986 and 1988 are shared by individuals across all education, racial, and age characteristics.

FAT_HEART

Table 8-3 gives probit regression results for the knowledge variable FAT_HEART, which is equal to 1 if individuals give heart disease answers to the question "Another thing found in foods is *fat*. Have you heard about any health problems that might be related to how much *fat* people consume?" as described in Table 4-1.

These regression results again indicate that education is significantly related to knowledge in all years for both women and men. Six of the 9 coefficients for women and 8 of the 9 for men are negative. The exceptions are all quite statistically insignificant and 3 of the 4 occur for the SOME-COLLEGE coefficient. The estimated probabilities of knowledge for FAT_HEART at different education levels are given below (in Table 8-7) and show that women at all education levels increase their knowledge levels, with the largest effects for those at the lowest education level. Knowledge levels for men are generally lower than for women at all education levels, and in contrast to women, men at the lower education levels do not share in the knowledge increases experienced by the more educated in 1986 and 1988.

Racial differences in this knowledge measure are significant for black women in all years and for black men in 1984, and nearly so in 1986. Other racial coefficients are insignificant. Predicted probabilities of knowledge for FAT_HEART by racial and ethnic type, with other characteristics at the means of the sample, are given below (in Table 8-8). These estimates show that all racial and ethnic types increased their knowledge levels during the health claims period, other things equal,

TABLE 8-3 Probit Knowledge Regressions: FAT_HEART[1]
(Heard about health problems related to fat? Heart disease answers.)

	Women, 19-50 Years			Men, 19-50 Years		
	1984	1986	1988	1984	1986	1988
Constant	.32 (0.8)	-.15 (-0.4)	.20 (0.4)	.50 (1.2)	-.26 (-0.6)	.82 (1.5)
LESS THAN HS	-.95 (-2.7)**	-1.05 (-3.3)**	.13 (0.3)	-.49 (-1.4)	-.74 (-2.1)**	-1.08 (-2.0)**
HIGH SCHOOL GRAD	-.44 (-1.8)*	-.22 (-0.9)	-.46 (-1.8)*	-.24 (-1.1)	-.53 (-2.1)**	-.50 (-1.9)*
SOME COLLEGE	-.00 (-0.0)	.16 (0.6)	.08 (0.3)	-.46 (-1.9)*	-.42 (-1.7)*	.05 (0.2)
INCOME	.01 (1.2)	.01 (1.0)	.02 (2.1)**	.01 (0.8)	-.00 (-0.3)	.00 (0.6)
BLACK	-.80 (-3.4)**	-.78 (-2.7)**	-.61 (-2.0)**	-1.34 (-3.2)**	-.40 (-1.5)	-.11 (-0.2)
HISPANIC	-.19 (-0.5)	.49 (0.8)	-.29 (-0.7)	.02 (0.0)	.27 (0.6)	.10 (0.2)
OTHER RACE	-.39 (-0.8)	-.19 (-0.6)	-.36 (-0.5)	-.36 (-1.0)	-.38 (-0.8)	.17 (0.3)
AGE	.02 (1.6)	.03 (3.3)**	.01 (1.1)	.00 (0.2)	.03 (2.5)**	-.00 (-0.3)
SINGLE	-.05 (-0.2)	-.06 (-0.2)	.02 (0.1)	.33 (1.2)	.19 (0.8)	.39 (1.4)
SMOKER	-.39 (-2.3)**	.02 (0.1)	.04 (0.2)	-.20 (-1.1)	.29 (1.4)	-.48 (-2.0)**
Mean FAT_HEART	.687	.810	.789	.625	.652	.720
N	319	342	251	240	227	175

SOURCE. *Health & Diet Surveys*, Food and Drug Administration.
NOTES. t-statistics are in parentheses: * indicates significance at 10 percent level; ** at 5 percent level. N = sample size.
[1] FAT_HEART is a dummy variable with a value of one for those who gave a heart-disease-related answer to the open-ended question "Another thing found in foods is *fat*. Have you heard about any health problems that might be related to how much *fat* people consume?" as described in Table 4-1.

with black women and men experiencing larger improvements than others.

Again, income and age are positively associated with higher knowledge levels for women in all years, with income significant in 1988, and age in 1986 and nearly so in 1984. These relationships are weaker for men. The coefficients on SINGLE and SMOKER are usually insignificant.

Thus, education and BLACK are again the primary variables associated with differences in knowledge on this measure. Educational differences for women and racial differences for both sexes fade somewhat in the post-1984 period. Men with lower education levels do not share in these gains.

MAJOR_HEART

Table 8-4 gives probit regression results for the knowledge variable MAJOR_HEART, which is equal to 1 if individuals give fat-related answers to the question "As you understand it, what are the major causes of *heart disease* or heart attacks?" as described in Table 4-1.

Again the regression results indicate that education is significantly associated with higher knowledge levels in 1984 for both men and women. By 1988 these educational differences fade in significance. As shown in Table 8-7, conditional probabilities by education level for MAJOR_HEART indicate the sizable education differences for men and women in 1984, other things equal, and the extent of the equalization of knowledge across education levels by 1988.

In contrast to the previous two measures of knowledge, this measure shows no significant racial differences in knowledge for women. Black men are estimated to have less knowledge at almost significant levels in

TABLE 8-4 Probit Knowledge Regressions: MAJOR_HEART[1]

(What are the major causes of heart disease? Fat responses.)

	Women, 19-50 Years			Men, 19-50 Years		
	1984	1986	1988	1984	1986	1988
Constant	-.82 (-2.1)**	-.07 (-0.2)	.02 (0.1)	.27 (0.5)	.20 (0.4)	.19 (0.4)
LESS THAN HS	-.65 (-1.9)*	-1.01 (-2.9)**	.10 (0.3)	-1.23 (-3.1)**	-.80 (-2.1)**	-.17 (-0.3)
HIGH SCHOOL GRAD	-.18 (-0.8)	-.45 (-2.4)**	-.25 (-1.2)	-.80 (-3.1)**	-.31 (-1.4)	-.42 (-1.6)
SOME COLLEGE	-.06 (-0.3)	-.22 (-1.1)	-.06 (-0.3)	-.12 (-0.5)	-.36 (-1.6)*	-.26 (-1.0)
INCOME	.00 (0.6)	.01 (1.1)	-.00 (-0.7)	.01 (1.2)	.00 (0.2)	-.00 (-0.2)
BLACK	-.02 (-0.1)	.09 (0.4)	-.37 (-1.3)	-.55 (-1.6)	-.65 (-1.6)	-.00 (-0.0)
HISPANIC	.18 (0.4)	-.43 (-0.9)	.48 (1.3)	.30 (0.7)	-.34 (-0.8)	.07 (0.1)
OTHER RACE	.17 (0.3)	-.17 (-0.5)	.43 (0.9)	.34 (0.9)	-.97 (-1.8)*	-1.64 (-2.9)**
AGE	.02 (2.0)**	.00 (0.3)	.01 (0.7)	-.01 (-0.8)	-.00 (-0.3)	.01 (0.6)
SINGLE	.31 (1.3)	-.12 (-0.6)	-.13 (-0.6)	-.00 (-0.2)	.11 (0.5)	-.72 (-2.7)**
SMOKER	-.18 (-1.1)	-.13 (-0.8)	-.20 (-1.1)	-.40 (-2.0)**	-.20 (-0.9)	.19 (0.8)
Mean MAJOR_HEART	.429	.414	.498	.329	.409	.525
N	310	326	275	246	235	179

SOURCE. *Health & Diet Surveys*, Food and Drug Administration.

NOTES. t-statistics are in parentheses: * indicates significance at 10 percent level; ** at 5 percent level. N = sample size.

[1] MAJOR_HEART is a dummy variable taking a value of one for those who gave fat-related answers to the open-ended question "As you understand it, what are the major causes of *heart disease* or heart attack?" as described in Table 4-1.

1984 and 1986, though this difference does not exist in 1988. The coefficient on OTHER-RACE is negative and significant for men in 1986 and 1988, indicating significantly less knowledge for these men in these years. As shown in Table 8-8, the conditional probability estimates by racial and ethnic characteristics show little movement for women on this measure, but men, especially black men, show substantial knowledge increases, while men of other races show less knowledge.

Single and smoking status tend to have the predicted signs but are not generally significant. Similarly, income and age are less important than in the earlier measures, though age is positive and significant for women in 1984 as in the previous measures.

MAJOR_BCHOL

Table 8-5 gives probit regression results for the knowledge variable MAJOR_BCHOL, which is equal to 1 if individuals give fat-related answers to the question "As you understand it, what are the major causes of *high blood cholesterol*?" as described in Table 4-1. One of the advantages of examining this knowledge question is that it is asked of more of the sample in 1984 and 1986, resulting in much larger sample sizes in those years.

Again, education is found to be significantly associated with higher knowledge levels for both women and men in most years. These educational differences fade for men by 1988 but remain significant for women. As shown in Table 8-7, estimated conditional probabilities of knowledge for MAJOR_BCHOL by education level indicate that the educational differences in this knowledge measure in 1984 are substantial and vary systematically with education level, other things equal. For instance, women with less than a high school education are estimated to be 35 percentage points less likely than college graduates to

TABLE 8-5 Probit Knowledge Regressions: MAJOR_BCHOL[1]

(What are the major causes of high blood cholesterol? Fat responses.)

	Women, 19-50 Years			Men, 19-50 Years		
	1984	1986	1988	1984	1986	1988
Constant	.15 (0.8)	-.07 (-0.4)	.19 (0.4)	.35 (1.5)	.36 (1.6)	-.67 (-1.2)
LESS THAN HS	-.93 (-5.7)**	-.75 (-4.9)**	-.89 (-2.6)**	-.82 (-4.9)**	-.97 (-5.5)**	.46 (0.7)
HIGH SCHOOL GRAD	-.48 (-4.5)**	-.44 (-4.5)**	-.32 (-1.5)	-.49 (-4.3)**	-.50 (-4.2)**	.11 (0.4)
SOME COLLEGE	-.10 (-0.9)	-.10 (-0.9)	.55 (2.2)**	-.11 (-0.9)	-.28 (-2.3)**	.35 (1.3)
INCOME	.01 (3.7)**	.00 (1.9)*	-.00 (-0.1)	.01 (2.3)**	.00 (0.7)	.01 (1.5)
BLACK	-.39 (-3.1)**	-.40 (-3.4)**	-.77 (-2.7)**	-.67 (-4.2)**	-.45 (-2.8)**	-.59 (-1.3)
HISPANIC	-.42 (-2.2)**	-.27 (-1.4)	-.54 (-1.4)	.09 (0.4)	-.41 (-2.0)**	-.07 (-0.1)
OTHER RACE	.10 (0.5)	-.28 (-1.9)*	-.72 (-1.6)	-.17 (-0.8)	-.31 (-1.6)	.03 (0.1)
AGE	.01 (1.3)	.02 (4.2)**	.02 (1.5)	.00 (0.5)	.01 (2.1)**	.02 (1.6)*
SINGLE	.07 (0.7)	.10 (1.0)	-.11 (-0.5)	.09 (0.7)	-.06 (-0.6)	-.02 (-0.1)
SMOKER	.01 (0.1)	-.12 (-1.5)	-.09 (-0.5)	-.07 (-0.8)	.08 (0.8)	-.21 (-0.9)
Mean MAJOR_BCHOL	.604	.631	.689	.610	.659	.676
N	1238	1373	273	934	927	179

SOURCE. *Health & Diet Surveys*, Food and Drug Administration. NOTES. t-statistics are in parentheses: * indicates significance at 10 percent level; ** at 5 percent level. N = sample size.

[1] MAJOR_BCHOL is a dummy variable taking a value of one for those who gave a fat-related answer to the open-ended question "As you understand it, what are the major causes of *high blood cholesterol*?" as described in Table 4-1.

give a correct response to this question in 1984, other things equal, compared to a 18 percentage point difference for high school graduates and a 3 percentage point difference for those with some post-high school education. By 1988, knowledge for women with both the lowest and highest education levels is unchanged, but those with middle education levels show increases. For men, the knowledge distribution by education level is quite similar to that for women on this knowledge measure in 1984 and 1986, but is higher and more equal across education levels in 1988.

As with previous knowledge measures, both black women and men have significantly lower knowledge levels for MAJOR_BCHOL in 1984. These differences in knowledge remain for black women in 1986 and 1988, but are somewhat reduced for black men in these years. Hispanic women also exhibit significantly less knowledge of this issue in 1984, but this difference falls in 1986 and 1988. Estimated conditional probability estimates for these racial and ethnic characteristics are given for MAJOR_BCHOL in Table 8-8. In this case, black and other race women do not experience the increases in knowledge experienced by white women. For black men, however, the difference in knowledge is reduced.

For this measure of knowledge, income is estimated to be significantly and positively related to knowledge levels for both men and women in 1984, and in both cases these differences fade in 1986 and again in 1988, so that by 1988 income is not associated with any significant difference in knowledge. Age is also positively related to knowledge for both sexes in all years, though this is significant only in the later years. The coefficients on SINGLE and SMOKER are not significant in any of the years.

Thus, education and racial characteristics are again the primary variables associated with differences in knowledge. The differences in knowledge observed in 1984 are generally reduced by 1988, with the exception of differences between black and white women.

SAT_KIND

Finally, Table 8-6 presents probit regression results for the knowledge measure SAT_KIND, which is equal to 1 if the individual answered "saturated fats" to the multiple-choice question "What kind of fat is more likely to raise people's blood cholesterol? Saturated fats, polyunsaturated fats, both of them, or neither of them?" This question is asked of a larger portion of the sample, as noted in the table.

Again for both women and men, education is positively related to knowledge in all years. As shown in Table 8-7, knowledge increases for women with the lowest education level, reducing differences in knowledge across education levels. This is not true for men, however, where those with the lowest education level do not share in the overall knowledge increase experienced by the other education categories.

As in most of the previous knowledge measures, racial variables in the regression tend to be associated with lower levels of knowledge. For black women, this difference is not significant in 1984 but becomes so in 1986 and 1988. As shown in Table 8-8, this reflects a drop in reported knowledge levels for black women in the later years. Black men follow the pattern observed more frequently, in which a significant difference in 1984 fades by 1988, reflecting knowledge levels more like the rest of the population in the later years. Hispanic women and men also exhibit significantly less knowledge than whites in 1984, but this difference fades for both sexes over time. As shown in Table 8-8,

TABLE 8-6 Probit Knowledge Regressions: SAT_KIND[1]

(What kind of fat is likely to raise blood cholesterol? Saturated fat.)

	Women, 19-50 Years			Men, 19-50 Years		
	1984	1986	1988	1984	1986	1988
Constant	-.34 (-1.6)	-.29 (-1.5)	.09 (0.4)	-.20 (-0.8)	-.31 (-1.3)	.17 (0.6)
LESS THAN HS	-1.02 (-5.8)**	-.52 (-3.0)**	-.60 (-3.3)**	-.23 (-1.3)	-1.06 (-5.1)**	-.81 (-2.9)**
HIGH SCHOOL GRAD	-.69 (-5.9)**	-.57 (-5.5)**	-.55 (-4.8)**	-.31 (-2.6)**	-.65 (-5.0)**	-.44 (-3.1)**
SOME COLLEGE	-.45 (-3.8)**	-.26 (-2.4)**	-.27 (-2.3)**	-.04 (-0.3)	-.28 (-2.2)**	-.40 (-2.9)**
INCOME	.01 (2.3)**	.00 (1.0)	.00 (0.8)	.00 (0.6)	.00 (0.1)	.01 (1.9)*
BLACK	-.11 (-0.8)	-.42 (-3.3)**	-.43 (-3.0)**	-.33 (-1.9)*	-.37 (-2.1)**	-.12 (-0.6)
HISPANIC	-.54 (-2.5)**	.18 (0.9)	-.36 (-1.8)*	-.75 (-2.9)**	-.28 (-1.2)	.02 (0.1)
OTHER RACE	.10 (0.4)	-.37 (-2.2)**	-.38 (-1.5)	-.27 (-1.1)	-.54 (-2.5)**	-.22 (-0.9)
AGE	.03 (5.8)**	.03 (5.6)**	.02 (3.5)**	.01 (2.1)**	.03 (4.4)**	.01 (1.4)
SINGLE	-.10 (-0.9)	.07 (0.7)	-.16 (-1.3)	.18 (1.5)	-.10 (-0.8)	-.08 (-0.5)
SMOKER	.04 (0.5)	-.13 (-1.6)	-.11 (-1.2)	-.05 (-0.5)	.13 (1.2)	-.15 (-1.2)
Mean SAT_KIND	.622	.607	.634	.543	.597	.634
N	1116	1220	993	810	750	595

SOURCE. *Health & Diet Surveys*, Food and Drug Administration.
NOTES. t-statistics are in parentheses: * indicates significance at 10 percent level; ** at 5 percent level. N = sample size.
[1] SAT_KIND is a dummy variable which takes a value of one for those who answered "saturated fats" in response to the question "What kind of fat is more likely to raise people's blood cholesterol? Saturated fats, polyunsaturated fats, both of them, or neither of them?"

knowledge levels increase for Hispanics of both sexes, reducing the difference by 1988.

Income is also significantly related to knowledge for women in 1984, though this fades in both 1986 and 1988. Income is not significant for men until 1988. Age is again positive and significant for both women and men. SINGLE and SMOKER tend to have negative coefficients, as predicted, but these are not significant.

Summary of Results From Fat/Heart Disease Regressions

In reviewing the findings from these five measures of fat/heart disease knowledge over time, several patterns stand out. First, as shown in Table 8-7, education is one of the most consistent predictors of these knowledge measures. Education is especially important in 1984, prior to the introduction of health claims; all five of the equations for women and for men have at least one significant education coefficient in 1984. By 1988, the equations for women show a reduced number of significant education coefficients and education differences of smaller magnitudes, indicating a reduction in the strength of the education effect, though at least one education coefficient is still significant in 4 of 5 equations. Thus, women at all education levels shared in the reported increases in knowledge and those at lower education levels may have increased knowledge disproportionately compared to 1984. Thus, these information measures are generally consistent with our findings from the consumption data, which indicate that information gains are approximately equal across education groups, leading to consumption gains for women at all education levels during the post-1985 period, other things equal.

For men, the effect of education does not appear to be as consistent across these knowledge measures. For instance, in comparing the

TABLE 8-7 Estimated Probability of Knowledge of Heart-Related Questions, By Education[1]

Knowledge Variable[2]	Women, 19-50 Years			Men, 19-50 Years		
	1984	1986	1988	1984	1986	1988
HEART_FAT: What foods make you more likely to get *heart disease*? Fat responses.						
Less than High School	.19	.58	.70**	.07**	.68	.53**
High School Grad	.13**	.62	.73**	.07**	.69	.56**
Some College	.40	.75	.78**	.24	.68	.78
College Grad	.36	.73	.94	.38	.76	.87
FAT_HEART: Heard about health problem related to *fat*? Heart disease responses.						
Less than High School	.45**	.53**	.87	.53	.52**	.39**
High School Grad	.65*	.82	.71*	.62	.60**	.62**
Some College	.80	.90	.86	.54**	.65*	.80
College Grad	.80	.87	.84	.71	.79	.79
MAJOR_HEART: What are *major* causes of heart disease? Fat responses.						
Less than High School	.25*	.18**	.57	.10**	.21**	.54
High School Grad	.42	.36**	.44	.20**	.37	.44
Some College	.46	.45	.51	.43	.35*	.50
College Grad	.49	.53	.53	.48	.49	.60
MAJOR_BCHOL: What are *major* causes of high blood cholesterol? Fat responses.						
Less than High School	.37**	.45**	.38**	.41**	.42**	.78
High School Grad	.54**	.57**	.61	.54**	.60**	.66
Some College	.69	.70	.87**	.68	.69**	.74
College Grad	.72	.73	.72	.72	.78	.62
SAT_KIND: What *kind* of fat is likely to raise blood cholesterol? Saturated fat.						
Less than High School	.42**	.54**	.53**	.50	.32**	.43**
High School Grad	.56**	.52**	.55**	.47**	.48**	.58**
Some College	.64**	.64**	.66**	.58	.62**	.59**
College Grad	.80	.73	.75	.59	.73	.74

SOURCE. *Health & Diet Surveys*, Food and Drug Administration.
NOTES. * indicates underlying regression coefficient is significant relative to college graduates at the 10 percent level; ** indicates 5 percent level.
[1] Estimated probability based on probit regressions that individuals with specified schooling had knowledge, assuming other characteristics at sample mean.
[2] Knowledge variables are defined more precisely in Table 4-1.

estimated probabilities of knowledge by education level in Table 8-7, the difference between the lowest and highest education group grows in 3 of the 5 measures of knowledge for men in 1988 compared to 1984. Men with lower levels of schooling tend to show substantial increases in knowledge between 1984 and 1988, but not as consistently as do men with higher education levels. This result is again consistent with our findings with the consumption data, where the least educated men do not experience as consistent an improvement in fat and cholesterol consumption as the rest of the population.

As summarized in Table 8-8, racial characteristics, especially being black, are also predictors of knowledge across these fat/heart disease knowledge measures, other things equal. In 1984 the coefficient on BLACK is negative in all of the equations and significant in 3 of the 5 equations for each sex. For women, the pattern of change over time is not fully consistent; comparing projected knowledge levels in 1984 and 1988 indicates that knowledge levels for black women increase substantially in two equations but decrease moderately (but not significantly) in two other equations and remain essentially the same in the fifth equation. For men, the pattern is more consistent; knowledge levels increase substantially for black men for all 5 measures of knowledge, other things equal, which reduces the knowledge difference between black and white men in 4 of 5 measures. The coefficients for Hispanics and those of other race are also often negative, but the magnitude of the knowledge difference is generally smaller on these measures and less often significant.

These racial results on knowledge are not entirely consistent with those found in the consumption analysis. For black women, we find some improvement in knowledge, though other knowledge measures do not show improvements. This less consistent knowledge gain could

TABLE 8-8 Estimated Probability of Knowledge of Heart-Related Questions, By Racial and Ethnic Characteristics[1]

Knowledge Variable	Women, 19-50 Years			Men, 19-50 Years		
	1984	1986	1988	1984	1986	1988
HEART_FAT: What foods make you more likely to get *heart disease*? Fat responses.						
Black	.03**	.52**	.80	.11	.46*	.63
Hispanic[2]	.22	.59	.77	.24	.59	.59
Other Race	.29	.71	.60**	.08	.69	.39**
White	.30	.70	.83	.19	.74	.79
FAT_HEART: Heard about health problem related to *fat*? Heart disease responses.						
Black	.45**	.61**	.63**	.19**	.53	.68
Hispanic[2]	.68	.94	.74	.68	.78	.75
Other Race	.61	.81	.72	.53	.54	.78
White	.75	.86	.83	.67	.69	.72
MAJOR_HEART: What are *major* causes of heart disease? Fat responses.						
Black	.42	.45	.35	.16	.21*	.56
Hispanic[2]	.50	.26	.68	.44	.30	.59
Other Race	.49	.35	.66	.45	.13*	.07**
White	.42	.41	.49	.32	.43	.56
MAJOR_BCHOL: What are *major* causes of high blood cholesterol? Fat responses.						
Black	.48**	.51**	.46**	.38**	.52**	.47
Hispanic[2]	.47**	.56	.56	.67	.54**	.67
Other Race	.67	.56*	.48	.57	.58	.71
White	.63	.66	.75	.64	.69	.69
SAT_KIND: What *kind* of fat is likely to raise blood cholesterol? Saturated fat.						
Black	.60	.46**	.50**	.43*	.47**	.60
Hispanic[2]	.43**	.69	.53*	.28**	.50	.65
Other Race	.68	.48**	.52	.45	.40**	.56
White	.64	.63	.66	.56	.61	.64

SOURCE. *Health & Diet Surveys*, Food and Drug Administration.
NOTES. * indicates underlying regression coefficient is significant relative to whites at the 10 percent level; ** at the 5 percent level.
[1] Estimated probability based on probit regressions that individuals with given racial or ethnic characteristics had knowledge, with other characteristics at sample mean.
[2] Assumes white.

account for the smaller gains in consumption observed for black women, other things equal. For black men, however, we find consistent increases in knowledge, but our consumption evidence suggests that this knowledge does not generate the improvements in consumption experienced by the rest of the population.

Income is a significant predictor of knowledge in 3 of 5 equations for women in 1984 and for 2 of 5 equations for men; the coefficient on income is positive in all cases but one. Income fades as a predictor of knowledge over time, however, so that by 1988, income is significant in only one equation for women and one for men. Thus, these knowledge results suggest that income may be a proxy for human capital, as hypothesized in the previous chapter, but these effects are not large enough to overcome the income-price effects also captured in this variable in the consumption analysis.

Age is also a consistent predictor of better knowledge on these measures, especially for women. The coefficient on age is positive for all measures of knowledge in all years for women. In 1984, the coefficient on age is significant or nearly so in 4 of the 5 equations. The same is true in 1986 and for 2 of the 5 coefficients in 1988. Age is less important as a predictor of knowledge for men, though it is positive in most equations and significant in several. For men this relationship does not change systematically over time. Age is also significant in many of the consumption equations.

Finally, smoking tends to be associated with lower levels of knowledge, but this is significant in only a few cases. Thus, smoking behavior is more consistently significant in predicting consumption differences than in predicting knowledge differences. This finding supports the hypothesis that smokers have less healthful diets, because they place a lower value on health than nonsmokers, not simply because

they have less information. This evidence is consistent with the use of smoking behavior as a proxy for differences in individuals' valuation of health.

As found in the consumption analysis, living in a household with more than one adult does not have any systematic relationship to knowledge, contrary to our expectations.

Cancer Knowledge

As shown in Chapter IV, knowledge of the fat-cancer issue is much lower than of the fat-heart disease issue. Only 15 percent of women and 10 percent of men give a fat-related answer to the question about dietary causes of cancer (CANCER_FAT) in 1984, and these percentages rise to only 22 and 20 percent, respectively, by 1988. The proportion reporting cancer as a health issue associated with fat consumption (FAT_CANCER) never rises above 9 percent of the population. As a result, the fat-cancer knowledge data exhibit very little variation, especially in 1984. Thus, regression results for FAT_CANCER and for CANCER_FAT show few significant predictors of knowledge and are not reported in detail here. By 1988, the coefficients on INCOME (+) and BLACK (-) are significant in the equation for CANCER_FAT for women, as are all three education coefficients (-) in the comparable equation for men, but few other coefficients are significant in other years.

Calcium Knowledge

Finally, we focus briefly on the evidence available in the FDA surveys on consumer awareness of calcium as a nutrient important to diet/disease issues, in order to assess whether our findings in the 1985 fat and cholesterol consumption regressions could indeed reflect a change in the concern for calcium, as described in Chapter VII.

Unfortunately for our purposes, the FDA surveys do not ask any question about calcium consistently in the surveys for 1984, 1986, and 1988. Questions about calcium are asked in each of the surveys, however, as shown in Table 8-9. In 1984, questions are limited to open-ended questions about information on the nutrition label (CALC_LABEL) and about which nutrients are the particular focus of consumers' interest (CALC_FOCUS). One question also asks about desirable changes in diet, and answers reflecting consumers' interest in increasing milk and dairy consumption are coded, which presumably reflect a recognition of the need for consuming more calcium (CALC_MORE). In 1986, the CALC_FOCUS question is again asked, but in a multiple-choice format, which would be expected to increase positive responses substantially (CALC_USE), thus making a direct comparison of the two questions inappropriate. The 1986 and 1988 surveys include an open-ended question about the relationship between calcium and disease (CALC_OSTEO).

The proportion of the population that mentions calcium or dairy responses to the 1984 questions is shown in Table 8-10. The results suggest that calcium is not a primary nutrient of concern in 1984; knowledge and interest levels never rise above 10 percent for women or 7 percent for men and virtually no one in the sample mentions the need to increase dairy consumption in response to the CALC_MORE question.

In 1986 the frequency results for the multiple choice question, reflected in CALC_USE, show a substantial level of perceived usefulness of calcium information for both men and women, though women show a significantly higher level of potential use (chi-square=15.6). For instance, 61 percent of women and 41 percent of men responded that calcium information is "very useful." Similarly, the

TABLE 8-9 Definitions of Calcium Knowledge Variables

Variable	Survey Question and Definition
CALC_LABEL (1984)	"What are some of the kinds of information shown on the nutrition label?" (PROBE) "Anything else you can think of?" = 1 if mention calcium (up to 8 responses). = 0 otherwise.
CALC_FOCUS (1984)	"What kinds of nutrition information do you pay particular attention to?" (PROBE) "Anything else?" = 1 if mention calcium (up to 6 responses). = 0 otherwise.
CALC_MORE (1984)	"What changes, if any, do you think you could make in what you eat to have a healthier diet? That is, if you wanted to have the healthiest diet possible, and taste or convenience or money were no problem, what would you change in the way you eat?" (PROBE) "Are there any other changes you would make?" = 1 if would eat more milk/dairy products (up to 8 responses). = 0 otherwise.

(Table continued on next page.)

TABLE 8-9 (Continued)

Variable	Survey Question and Definition
CALC_USE (1986)	"I would like to know what kinds of *nutrition* information you pay particular attention to or would find helpful on food packages. I am going to name a few kinds of nutrition information. For each one, please tell me if it would be "very useful," "of some use," or "of little or no use" to you if you were interested in improving your diet or your family's diet. If you are not familiar with any of these, just tell me so." Responses for calcium coded by answer.
CALC_VERY (1986)	(Same question.) = 1 if "very useful." = 0 otherwise.
CALC_OSTEO (1986, 1988)	"Another thing found in foods is calcium. Have you heard about any health problems that might be related to how much calcium people consume?" If yes, "What health problems might be related to not consuming enough calcium?" (PROBE) "Are there any other problems that might be related to not consuming enough calcium?" = 1 if answer osteoporosis, problems with bones (not child's), weak bones, posture problems (up to 4 responses). = 0 otherwise.

SOURCE. *Health and Diet Survey* 1984, 1986, 1988, Food & Drug Administration, Department of Health & Human Services.

TABLE 8-10 Percentage With Calcium Knowledge

Variable	Women, 19-50 Years (N)	Men, 19-50 Years (N)
1984		
CALC_LABEL	10 (313)	7 (193)
CALC_FOCUS	3 (229)	4 (110)
CALC_MORE	2 (380)	1 (269)
1986		
CALC_USE		
"Very Useful"	61	41
"Of Some Use"	28	40
"Of Little or No Use"	10	19
"Not Sure"	1	0
	(202)	(132)
CALC_OSTEO	64 (385)	46 (252)
1988		
CALC_OSTEO	75 (179)	59 (102)

SOURCE. *Health & Diet Surveys*, Food and Drug Administration.
NOTES. N = Sample size.

results indicate a relatively high level of knowledge of the calcium-osteoporosis issue in 1986, again with women showing a higher level of knowledge, with 64 percent of women and 46 percent of men giving an osteoporosis-related answer. This knowledge increases further in 1988 to 75 percent for women and 59 percent for men.

Thus, while we have no direct test of the hypothesis that interest in calcium increases substantially between 1984 and 1986, because no survey question is directly comparable, the available evidence is certainly consistent with this hypothesis.

One final issue examined with the available data is the relationship between education and calcium knowledge, and especially whether the knowledge data suggest that the education-knowledge relationship is particularly strong for women in 1985/86 compared with earlier and later years, as suggested in the consumption analysis of Chapter VII.

Table 8-11 gives probit regression results for women for CALC_LABEL in 1984, CALC_VERY in 1986, and CALC_OSTEO in 1986 and 1988. First, in the 1984 equation for CALC_LABEL, which reflects mention of calcium as a nutrient listed on the nutrition panel, the relationship between education and knowledge is actually negative, as indicated by the positive signs and falling magnitudes on the education variables.[153] Thus, educated women mention calcium less often than less educated women in 1984.

In the 1986 CALC_VERY equation, analyzing whether women responded that calcium information is "very useful," the education results are quite strong and have the expected negative signs. Education

[153] The other 1984 questions also show no education relationship.

TABLE 8-11 Probit Regressions for Calcium Knowledge[1] Women, 19-50 Years

	CALC_LABEL	CALC_VERY	CALC_OSTEO	
	1984	1986	1986	1988
Constant	-.93 (-1.5)	-.19 (-0.3)	1.04 (2.7)**	-.89 (-1.4)
LESS THAN HS	.99 (2.0)**	-1.23 (-2.5)**	-1.59 (-5.0)**	-.93 (-1.6)
HIGH SCHOOL GRAD	.27 (0.8)	-.35 (-1.4)	-.82 (-3.7)**	-.95 (-2.7)**
SOME COLLEGE	.44 (1.3)	.11 (0.4)	-.52 (-2.2)**	-.08 (-0.2)
INCOME	.01 (1.4)	-.01 (-1.8)*	-.00 (-0.4)	.01 (1.5)
BLACK	-.51 (-1.0)	.40 (1.2)	-1.05 (-3.5)**	-.78 (-1.7)*
HISPANIC	-5.09 (-0.0)	.10 (0.2)	-.66 (-1.5)	-.56 (-0.9)
OTHER RACE	-5.00 (-0.0)	-.05 (-0.1)	-.18 (-0.6)	-1.48 (-1.4)
AGE	-.03 (-1.8)*	.03 (2.4)**	.01 (1.1)	.05 (3.0)**
SINGLE	-.10 (-0.3)	-.72 (-2.6)**	-.13 (-0.6)	.21 (0.5)
SMOKER	-.04 (-0.1)	.44 (1.8)*	-.38 (-2.4)**	.16 (0.5)
Mean Dep. Variable	.09	.61	.66	.77
N	257	187	342	149

SOURCE. *Health & Diet Surveys*, Food and Drug Administration.
NOTES. t-statistics are in parentheses: * indicates significance at 10 percent level; ** at 5 percent level. N = sample size.
[1] Calcium questions described in Table 8-9.

significantly increases the likelihood that a woman says that calcium information is "very useful" in 1986.[154]

Similarly, in the 1986 calcium-osteoporosis equation (CALC_OSTEO), education is a very strong influence on a woman's knowledge of the calcium-osteoporosis issue. By 1988 the education effect weakens considerably; education coefficients are still negative, but the magnitudes are smaller and only one of them is significant. To assess the magnitude of the marginal effects of education in these two equations, we calculate the predicted probability of knowledge from the regression, with all other characteristics evaluated at the mean of the sample:

Predicted Percent of Women with Knowledge, By Education

CALC_OSTEO	1986	1988
Less than High School	30**	63
High Grad	60**	62**
Some College	71**	88
College Grad	86	89

This evidence indicates that the weakening of the relationship between education and calcium/osteoporosis knowledge in 1988 reflects the fact that women with less education became more like their more educated counterparts in their knowledge of the calcium-osteoporosis

[154] We also examine the joint responses of "very useful" and "of some use." All women with some college training and all but one woman with a college degree give one of these answers. By contrast, 58 percent of the lowest education group and 83 percent of high school graduates give one of these responses, thus, also indicating a very strong education relationship.

issue. Unfortunately, we have no knowledge data from 1985 to verify that this education gradient is also strong in 1985, as suggested by the consumption data.

Comparable equations for men are presented in Table 8-12, which also show a substantial education relationship in 1986 and some closing of the gap in 1988, though not at the magnitude of that estimated for women in either case.[155]

Thus, overall this evidence supports our interpretation of the education-fat relationship in 1985 and 1986 as potentially distorted by the substantial increase in the focus on calcium in the mid-1980s, due to the release of information concerning calcium and osteoporosis for women. The evidence also suggests a reduction in this complication as the 1980s progressed, as this knowledge became more evenly distributed across the population.

Comparison of Knowledge And Consumption Results

Overall, these results parallel the results of our consumption analysis in the last chapter quite well. There, we found that education and race were the strongest demographic predictors of differences in fats and cholesterol consumption over time, results similar to our findings for the disease knowledge data. Age was also often significant in both analyses throughout the period, especially for women. Moreover, the calcium knowledge results suggest that the anomalous finding for women for education in 1985, where we found a positive relationship between education and fat and cholesterol consumption, may indeed reflect a

[155] In 1986 for CALC_VERY and in 1988 for CALC_OSTEO, no men with the lowest schooling level gave the correct answer.

TABLE 8-12 Probit Regressions for Calcium Knowledge[1] Men, 19-50 Years

	CALC_LABEL	CALC_VERY	CALC_OSTEO	
	1984	1986	1986	1988
Constant	-1.06 (-1.2)	.78 (1.1)	.33 (0.7)	.22 (0.3)
LESS THAN HS	.06 (0.1)	-5.82 (-0.1)	-1.53 (-3.7)**	-14.00 (-0.0)
HIGH SCHOOL GRAD	.02 (0.1)	.28 (0.7)	-.81 (-3.3)**	-.31 (-0.8)
SOME COLLEGE	-.23 (-0.5)	-.55 (-1.4)	-.52 (-2.2)**	-1.04 (-2.1)**
INCOME	.01 (0.7)	.01 (0.8)	.01 (1.0)	.03 (2.2)**
BLACK	-4.37 (-0.0)	1.86 (2.9)**	-.73 (-2.5)**	5.24 (0.0)
HISPANIC	.24 (0.4)	.69 (1.2)	-.61 (-1.2)	.11 (0.2)
OTHER RACE	-4.72 (-0.0)	.20 (0.4)	.37 (0.7)	.03 (0.0)
AGE	-.02 (-0.6)	-.04 (-2.4)**	.01 (0.5)	-.02 (-0.8)
SINGLE	.45 (1.3)	.55 (1.6)	-.41 (-1.7)*	2.16 (3.2)**
SMOKER	-.63 (-1.6)	.35 (1.2)	-.11 (-0.6)	-1.58 (3.5)**
Mean Dep. Variable	.08	.46	.49	.63
N	170	112	226	84

SOURCE. *Health & Diet Surveys*, Food and Drug Administration.
NOTES. t-statistics are in parentheses: * indicates significance at 10 percent level; ** at 5 percent level. N = sample size.
[1] Calcium questions described in Table 8-9.

strong education effect in the absorption of the calcium-osteoporosis information released in 1984, which was equalized with time.

As in the consumption analysis, education is significantly associated with knowledge in 1984, before the change in policy, and education is still associated with greater knowledge in 1988. In fact, as in the consumption analysis, the strength of the education effect for men may have increased somewhat by 1988, though this increase is not significant in either case. In contrast, both consumption and knowledge results suggest that women at all education levels improved approximately equally during the health claims period.

The fat and cholesterol consumption analysis indicates that black men and black women did not improve their diets as much as whites during the health claims period, other things equal. The knowledge analysis indicates substantial differences in knowledge in 1984 and a consistent improvement in knowledge for black men, but more mixed progress for black women. It is not clear why this improvement in knowledge by blacks, especially by men, did not lead to comparable dietary improvements. The knowledge results do not suggest that the lower fat and cholesterol intakes found in the consumption analysis for those of other races were due to superior knowledge of the nutrition-disease issues. Thus, since most individuals in this category are Asian, the observed consumption differences may reflect the underlying advantages of traditional Asian diets.

Finally, smoking behavior is more consistently significant in predicting consumption differences than in predicting knowledge differences. This finding suggests that smokers have less healthful diets because they place a lower value on health than nonsmokers, not simply because they have less information.

IX

CONCLUSION

This report examines key aspects of the American diet in order to better understand how health-related information affects food choices. The report uses three major federal data sources and a variety of tests to assess whether information about fat, saturated fat, and cholesterol changed diets during the years from 1977 to 1990. Throughout these years government, public health organizations, and other information sources attempted to spread information about diet and health. During the first part of this period, from 1977 to approximately 1985, manufacturers could advertise or label the nutrient contents of their products, but they faced considerable regulatory risk if they linked these nutrients to disease risks. During the latter part of the period, from 1985 to 1990, the policies towards producer health claims were relaxed. Health-related claims increased, and competition induced more producers to focus on the nutritional features of their products.

Producer health claims have been controversial. While always subject to the normal rules for all claims -- claims must be substantiated and nondeceptive -- some believe that this deception-based approach to diet-disease claims used during the 1985-1990 period is inadequate and that more stringent regulation is desirable. Advertising and labeling claims in a competitive setting are necessarily simplified. For instance, producer health claims tend to highlight the health advantages of a product compared to competing products, without a comparable focus on undesirable characteristics. On the other hand, the ability to highlight

the health consequences of food choices may have an important effect in informing and reminding consumers of the significance of the nutritional features of foods. The overall impact of health-related claims on consumer choices depends, in part, on whether these information and reminder effects are important, and whether competition among producers, nutrition labeling, and other sources of information create a sufficiently complete information environment that consumers' choices and producers' incentives to innovate are generally improved.

The results of this report suggest that information linking diet to disease risks had important beneficial effects on the U.S. diet. Between 1977 and 1990 the average amount of fat, saturated fat, and cholesterol in the diet has fallen substantially for both men and women. The available data do not allow us to determine conclusively how much of the improvement in diet is due to producer claims, continued government and public health organization dietary advice, or general media coverage of these issues. The available evidence is certainly consistent with the view that the relaxation of the rules governing producer health claims contributed to a better information environment, leading to improvements in consumers' food choices. The data do not support the alternative view that producer health claims in advertising and labeling had adverse effects on consumer food choices on average; adult diets improved faster in the years when health claims rules were relaxed.

Individual consumption data indicate that fat, saturated fat, and cholesterol declined at accelerated rates between 1985 and 1990, compared to the seven years prior to the policy change; all three nutrients dropped by at least 15 percent between 1977 and 1990, and most of the reduction occurred in the post-1985 period. Similarly, food production data and the consumption data indicate that during the health

claims period, high-fat food categories tend to show accelerated and more consistent declines, while low-fat food categories increased more rapidly, compared to the pre-1985 period. Finally, knowledge surveys indicate substantial increases in knowledge of diet-disease issues during the health claims period. Taken together, evidence from these three sources supports the view that consumers respond to diet-health information from all sources, and that these dietary improvements became more consistent and more rapid during the years when advertising and labeling joined government and other sources in spreading this information.

In considering potential reasons why the addition of advertising and labeling claims may be important, several differences between general information sources and advertising claims are worthy of mention as potential topics for further research. First, government and general sources of information typically provide generic information about the effects of diet on disease risk and about the importance of eliminating or reducing foods that contain high levels of nutrients linked to disease. These information sources are unlikely to focus on particular brands of food, but rather on broad food categories where general statements can be made, usually the "best" and "worst" food categories. In contrast, producer-provided information focuses on a particular brand of a particular food, identifying how that brand is superior to its competitors and who would benefit from its use. In the presence of broad dietary advice, this finer level of detailed information provided by many competing producers has the potential to affect choices across a broader spectrum of foods, since health messages can focus on all foods with any substantial nutrient advantages within or across food groups.

The results in this study suggest that this may be an important reason for the increased improvements in diets after 1985. Prior to

1985, reductions in fat and saturated fat are isolated to a few food categories, such as meat and milk, but much of the gain achieved in those categories is lost due to compensation elsewhere in the diet. After 1985, reductions come from a broad set of food categories, including modest but more systematic movements across a wide range of foods, resulting in larger overall reductions.

A second reason why producer claims may have significant effects on behavior is that these claims focus on those consumers most likely to respond to such claims, using a variety of marketing techniques designed to reach the target audience. Initially, we hypothesized that for a well established issue, like the connection between lipids and heart disease, the most educated men and women are likely to have been well reached by government and general information sources prior to 1985. We hypothesized that advertising claims would have a disproportionate effect on those less well reached, such as the less educated, as they caught up to their more educated counterparts. The evidence tends to support the hypothesis that the most educated had responded more to information by 1977, but contrary to our hypothesis, improvements occurred across all education levels in the post-1985 period; the least educated experienced substantial improvements in diet, but the most educated also made substantial further improvements in diet, so that individuals at all education levels improved their diets by approximately equal amounts over the period. This evidence suggests that even the best educated adults were not effectively reached by government and general information sources prior to 1985 or that dietary change is an incremental process that takes time and repeated reminding for even the well informed to react fully.

A third reason why the addition of producer health claims may have led to improvements in diet could simply be the substantial resources

firms devoted to disseminating diet-disease information. While we were unable to quantify these advertising expenditures in this study, it is clear that major promotional campaigns with a diet-disease focus increased during this period. These promotions may not only amplify the basic flow of diet-disease information but may also have secondary effects. As consumers are repeatedly exposed to advertising claims linking foods to disease risks, they may become more attentive to simple nutrition claims and to government and general sources of information as they attempt to assess the significance of the advertising claims.

In this sense, the improvements observed in diet raise the possibility that producer advertising may produce changes in behavior through a synergistic effect on the market for information. The simplified advertising claims, dictated by the limits of advertising media, may foster an enhanced demand for more complete government and general information on diet-disease issues, which, in turn, may enhance the demand for more nutritious products and the advertising that identifies them. Conversely, the advertising and labeling claims may have had a more positive effect because authoritative government and public health information sources were available to confirm the significance of the major diet-disease relationships advertised. Thus, in this model of the information market, each information source may amplify the effectiveness of the other information sources, leading to a fuller information environment in which consumer learning can progress more rapidly. These hypotheses about the relationship between advertising and labeling, and government and private nutrition education raise a number of interesting research questions that merit further study.

This study has examined changes in the U.S. diet during the years 1977 to 1990. At the end of this period, partly out of concern about the perceived effects of increased producer health-related claims, Congress

passed the Nutrition Labeling and Education Act (NLEA) of 1990, which directed the Food and Drug Administration to issue new regulations governing nutrition and health claims on food labels. These new rules clearly authorize some nutrition and health claims for labels, but they also place limits on the use of such claims. These labeling rules standardize nutrient claims to a limited list of terms and authorize health claims for a limited set of issues and for use only by the "best" foods on the market, thus precluding the health claims made by many of the products using them during the period examined here. The rules also require nutrition labels on virtually all packaged food products.

The hope implicit in these new labeling rules is that a more complete system of background nutrition information, together with the more restrictive rules for nutrition and health claims on labels, will facilitate more informed consumer dietary choices. Once the data become available, the evidence presented in this report can be used as a baseline against which to assess the effects of the new policy on the consumption of fats and cholesterol by U.S. adults.

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APPENDIX A

AVAILABLE EVIDENCE ON CHANGES IN FOOD ADVERTISING

As discussed in Chapter II, a study of changes in government policy towards advertising and labeling ideally should document that changes in the regulatory climate resulted in changes in the content of advertisin and labeling. Unfortunately for research purposes, we know of no systematic source of food product labels that could be used to study label claims over the period of interest. Similarly, we know of no systematic archive of television or radio advertising copy that could be used to assess the types of claims made in these media. Data on magazine advertising must be collected by assessing the content of a sample of advertisements in magazines over time, a costly and time-consuming process, but virtually the only systematic source of data available. Trade press for the food and advertising industries also reports significant events affecting these industries, and thus also provides information on changes in the regulatory environment.

The limits of the available data on advertising content make it difficult to document changes conclusively. Spending on food advertising is largest in television media, with spending in magazines a distant second. Table A-1 gives advertising spending for the Food and Food Products category as reported by BAR/LNA Multi-Media Service for the years of the study. We also list the percentage of these expenditures reported for television (network, spot, syndicated, or cable and for magazines in each year. With the exception of 1988, more than 80 percent of advertising spending reported for the category is for

Table A-1. Advertising Expenditures for Food Products By Media

Year	All Media ($1000)	TV (%)	Magazine[1] (%)
1977	1,310,543.2	86.9	10.7
1978	1,452,649.5	86.1	11.9
1979	1,638,292.0	86.4	11.4
1980	1,686,059.8	85.7	11.8
1981	1,810,332.3	85.7	11.7
1982	2,050,449.4	85.6	11.7
1983	2,211,752.5	85.9	11.9
1984	2,475,142.0	86.0	11.7
1985	2,760,816.0	84.6	12.4
1986	2,918,060.0	83.8	13.0
1987	3,045,408.0	84.4	12.4
1988	3,570,757.0	78.7	10.5
1989	3,551,050.0	83.4	12.2
1990	3,790,306.0	81.6	11.7

DATA. BAR/LNA Multi-Media Service, *Ad $ Summary*, Leading National Advertisers, New York, NY.

NOTES. [1] The magazine and TV spending percentages do not add to 100 percent. The omitted category includes radio, newspaper, and outdoor advertising.

television, with only 10 to 13 percent spent on magazine advertising. The remainder in each year is the combined spending in newspapers, including Sunday supplement advertising, radio, and outdoor advertising. Thus, the lack of data on television advertising copy suggests the need for caution in interpreting available research on food advertising content.

With this caveat in mind, we review the available research on the types of claims made in print food advertising during the period of interest. Hickman, Gates, and Dowdy (1993) collected information on nutrition claims in food and beverage advertising in four months of 1975, 1982, and 1990 in four magazines -- *Better Homes and Gardens, Good Housekeeping, Ladies Home Journal,* and *McCall's*. The key findings of interest for our purposes are shown in Table A-2.

Table A-2. Percentage of Food and Beverage Advertisements Containing Specific Claims by Year

Specific Claim	Year 1975 (n=337)	1982 (n=470)	1990 (n=502)
Prevents illness	0.6	0.0	3.0
Health professional recommends	2.7	0.4	3.4
Good for general health	7.1	9.2	17.9

Source. Hickman, Gates, and Dowdy (1993) using four issues each year from *Better Homes and Gardens, Good Housekeeping, Ladies Home Journal,* and *McCall's*.

First, note that few advertisements mention a specific disease in 1975 and none do in 1982, as would be expected if advertisers judged there to be significant legal risk in making such claims. In 1990, 3.0 percent of all food and beverage ads have explicit disease claims, a significant increase from either previous year. In 1975 more ads have general health claims[1] or claims that refer to health recommendations. The general health category also increases significantly by 1990.

More generally, this study finds that 27.3 percent of food ads contained some type of nutrition-related claim[2] in 1975, which rises significantly to 39.4 percent in 1982 and to 53.2 percent in 1990. Ads specifically referring to fat, saturated fat, or cholesterol rise insignificantly from 6.5 percent in 1975 to 10.4 percent in 1982, and then rise significantly to 25.3 percent in 1990. Thus, the evidence from the Hickman, Gates, and Dowdy study indicates that the use of specific disease claims increases between 1982 and 1990 (to 3% of all ads), as do nutrition-related advertising of all types, including ads making fat, saturated fat, and cholesterol claims. These results indicate that the amount of nutrition information included in magazine advertising grows substantially both in amount and explicitness between 1982 and 1990.

A second source of evidence on claims in food advertising is found in two papers by Lord, Eastlake, and Stanton (1987, 1988), which examine food advertising in 21 general readership magazines in 1985, 1986, and 1987. These studies find little increase in specific (disease) health claims over this short period, with 1.35, 2.07, and 1.29 percent of all

[1] The authors do not define this category clearly, but it appears to be a broad category that includes all nonspecific health and nutrition claims.

[2] This category is defined broadly to include all general and specific health-related claims, as well as claims that the food "contains specific nutrients or substances," "minimizes or eliminates specific substances," or "other nutrient claims."

claims falling into this category in 1985, 1986, and 1987, respectively. Unfortunately, this study does not report the percentage of *advertisements* using health claims and reports that the number of claims per ad increases over time. Thus, these results suggest that specific disease claims are used in the years 1985 to 1987, probably in a few percent of print food advertisements.[3] Specific nutrition claims grow somewhat during these 3 years rising from 6.14 percent of all claims in 1985 to 10.07 percent in 1986 and 10.19 percent in 1987.

Pratt and Pratt (1995) also report evidence on claims in food advertising. They study advertising in three magazines, *Ebony, Essence,* and *Ladies' Home Journal* for the years 1980-1982 and 1990-1992 in an effort to determine differences in advertising aimed at an African-American readership compared to a non-African-American readership. Unfortunately for our purposes, data from these years are combined when claims are reported by type. These authors report that 2.9%, 0.6%, and 1.3% of advertisements in their sample include claims categorized as "Health professional recommends/prevents illness" in *Ebony, Essence*, and *Ladies Home Journal*, respectively. Thus, again a small percentage of food advertising makes explicit health claims, though presumably this percentage is larger in the 1990-92 period than in the earlier period, if the other results are valid.

Pappalardo and Ringold (1995) examine nutrition-related claims made in margarine and cooking oil advertising over a longer period, the years 1950 to 1989. Their study examines a sample of advertising in

[3] To compute this percentage more precisely, we would have to know the average number of claims per advertisement in each year, given the authors' classification system for claims. These averages are not reported in the article. If we assume two claims per advertisement on average, approximately 2-4 percent of advertisements would have had health claims during these years.

two professional journals (*Journal of the American Dietetic Association* and *Journal of the American Medical Association*) as well as in two popular magazines, *McCall's* and *Readers' Digest*. For the popular magazines, these authors find that explicit heart disease claims occur briefly in the late 1950s, when the original research receives substantial publicity and before the regulatory agencies intervene, then again briefly in the early 1970s, before the start of the FTC's Food Rule proceeding, and then again in 1984, rising steadily from 1987 to 1989.

Taken together, these studies indicate that few specific health claims are made in the early part of the 1977-1990 period and that these claims become more common by the late 1980s. Since none of the published studies cover advertising for the breadth of food products over the years of interest, we independently collect information on a sample of advertising systematically covering our years of interest to confirm and refine the timing of these changes.[4] Specifically, we survey all food advertising in the March, June, and September issues of *Good Housekeeping* magazine in every year from 1977 to 1990. *Good Housekeeping* is chosen because it is one of the major women's magazines typical of those used in previous studies and available to us. Advertising for all foods and beverages, except for alcoholic beverages and baby food, is included.

[4] Claims are coded by the first author (Ippolito) with the assistance of a research analyst. Claims are coded as *health claims* if they explicitly mention a disease, such as heart disease or cancer; as *serum cholesterol claims* if they explicitly mention serum cholesterol or if they use phrases such as "lower your cholesterol level;" as *general health and dietary claims* if they contain the words "health," "smart," or "right" as describing dietary goals, discuss explicit references to health authorities, contain recommended dietary goals, such as the desirability of reducing fat and cholesterol consumption, or are body-function claims, such as "calcium to strengthen bones" but do not mention osteoporosis; and as *nutrient content claims* if they make claims about the level of a nutrient, such as "low fat" or "high in calcium."

Figure A-1 illustrates the percentage of advertising that includes disease claims by year. The category labeled *Disease Claims* includes any advertising that specifically mentions a disease, such as a claim that "lowering saturated fat in your diet reduces the risk of *heart disease*." The second category, labeled *Disease & Serum Cholesterol Claims*, adds any advertising that specifically discusses the goal of reducing serum cholesterol, which is closely tied to heart disease, but not a disease itself.

These data indicate that few advertisers use specific disease claims prior to the mid-1980s. Prior to 1983 the only specific disease claims in this sample are made by two lesser known brands: all but one are for Morningstar Farms products, a line of vegetable-based substitute products for breakfast meats and egg substitutes; and the one other ad is for Saffola margarine, a safflower oil margarine product emphasizing its highly polyunsaturated fat content and the role of saturated fat in heart disease risk. Advertising with specific health claims by major firms in this sample begins in the mid-1980s, with ads for Mazola corn oil in 1983 and for Fleischmanns light margarine in 1985. These ads increase most notably after 1987, following the publication of the FDA proposal for new labeling rules that would have allowed explicit health claims subject to a general deception standard.[5]

In assessing this evidence two issues are important to highlight. First, note that these data provide no evidence of Kellogg's bran cereal fiber-cancer advertising that began in 1984 and is widely viewed as a pivotal event in the regulatory history of health claims. This reflects the dominance of television advertising by food firms, which is particularly important in the fiber-cancer-cereal case. Table A-3 gives the percentage of Kellogg's advertising on television versus magazines for

[5] 52 *Federal Register*, August 4, 1987, 28843.

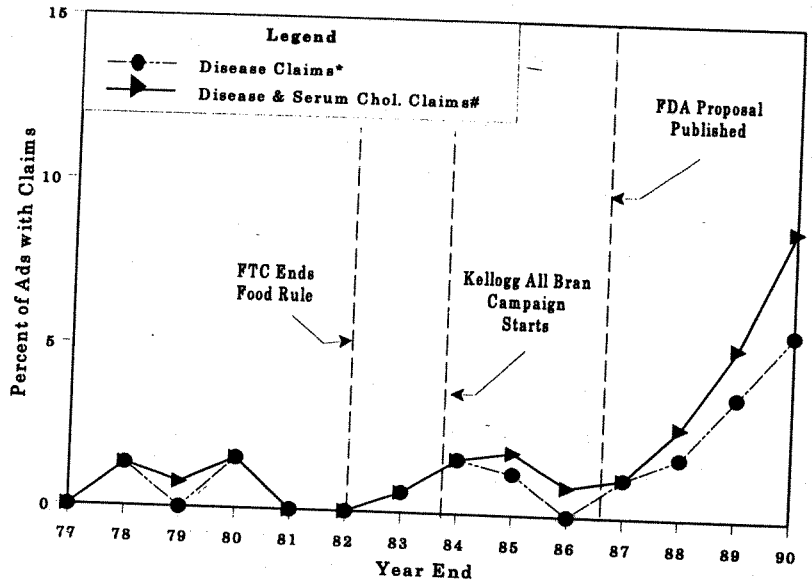

Figure A-1. Percentage of food and beverage advertisments with disease claims: *Good Housekeeping* magazine, March, June, and September of each year.

Notes. * The category labeled *Disease Claims* includes only those ads which explicitly mention a disease, such as heart disease.

The *Disease & Serum Cholesterol Claims* category also includes those ads that discuss the desire or need to reduce serum cholesterol levels.

Neither category includes ads that make only simple nutrition content claims, e.g. "low fat," or other more general nutrition-related claims, such as "wholesome."

Table A-3. Advertising Expenditures for Kellogg Company By Media

Year	All Media ($1000)	TV (%)	Magazine[1] (%)
1977	62,933.6	93.6	4.9
1978	68,162.8	96.0	2.9
1979	80,905.1	95.5	4.0
1980	83,819.6	94.0	5.3
1981	91,337.2	92.6	5.6
1982	100,973.6	90.2	9.3
1983	113,615.2	94.3	5.4
1984	170,947.3	98.7	1.1
1985	212,520.3	99.9	0.1
1986	219,217.3	99.5	0.5
1987	309,008.9	98.9	1.1
1988	401,816.3	94.2	1.5
1989	428,047.8	97.8	2.1
1990	404,392.6	97.6	2.1

DATA. BAR/LNA Multi-Media Service, *Ad $ Summary*, Leading National Advertisers, New York, NY.

NOTES. [1] The magazine and TV spending percentages do not add to 100 percent. The omitted category includes radio, newspaper, and outdoor advertising.

the years of interest. More that 90 percent of Kellogg's reported advertising in every year is on television, and more than 98 percent is on television in the years 1984-1987, when the fiber-cancer campaign ran.[6] This suggests that we may be missing an important part of the health claims phenomenon in the print data, especially in the early years, but as discussed above, the print advertising data are all that are available.[7]

The second issue to highlight in these data is the timing of the changes in advertising content compared to the regulatory events. Table A-4 lists key regulatory decisions that should have affected the perceived legal risks of making different types of health-related claims in advertising and on labels, as described in more detail in Chapter 2.

The advertising data suggest that in the 1977-1990 period major advertisers do not begin explicit disease claims until after December 1982, when the FTC officially ended its Food Rule proceeding which would have regulated such claims explicitly. Moreover, such claims increase markedly after the publication of the FDA's proposed regulation for health claims on labels in August 1987, which proposed an approach based more directly on likely deception, and thus presumably reduced the regulatory risk under the labeling rules created by truthful diet-

[6] The data for high fiber cereal advertising reported by LNA are even more pronounced in these years. For instance, if we consider the advertising reported for Kellogg's high fiber cereals, namely that for 40% Bran Flakes, All Bran, Fruitful Bran, and Raisin Bran, 99.9 percent and 100.0 percent of the advertising is on television in 1985 and 1986. See also, Julie Franz, "Kellogg bran-ching out with new cereal," *Advertising Age*, July 7, 1986, 40, which confirms that fiber-cancer campaign is still running in mid-1986 and that the company plans to continue it for the $7 million campaign introducing its new All Bran Fruit and Almonds; and Paula Schnorbus, "Brantastic," *Marketing and Media Decisions*, April 1987, 93, which reports that Kellogg "almost always" advertises its adult cereals on television.

[7] We have no way to assess whether this introduces any bias into analyses of food advertising based on print media.

disease claims in advertising. The increased use of health claims following both regulatory pronouncements is consistent with the hypothesis that the regulatory environment plays a significant role in determining the types of claims made by advertisers, and in this case, limited the explicit discussion of diet-disease issues in advertising in the early years of our sample.

Table A-4 Key Regulatory Events Regarding Health-Related Advertising and Labeling Claims, 1970-1990

January 1973	Fats and cholesterol content labels allowed; continue prohibition of disease claims on labels.
November 1974	FTC Staff proposes Food Rule that would prohibit all diet-disease claims, all general "health"claims, and would regulate nutrient content claims in ads.
May 1980	FTC votes to terminate portions of Food Rule, including ban of general "health" claims and emphatic nutrient claims; adopts deception approach on a case-by-case basis for these claims.
December 1982	FTC ends remaining portions of Food Rule in favor of deception approach towards all nutrition and diet-disease claims on a case-by case basis.
October 1984	Kellogg bran cereal campaign begins; explicit fiber-cancer claims.
August 1987	FDA proposes to allow diet-disease claims on labels as long as they meet deception standard.
November 1990	Nutrition Labeling and Education Act of 1990 enacted; requires FDA preclearance of diet-disease claims for labels. New rulemaking initiated.

As additional evidence on this point, we examine the use of more general health-related claims during this period, that is, claims that cite the desirability of improving diet in some way without reference to an explicit disease. These claims in advertising are covered by proposals in the FTC's Food Rule, but they do not trigger the FDA-related risk raised by disease claims. In this category we include any claim that refers to a health benefit, but stops short of naming a disease. Specifically, we include any claim that refers to "health," that discusses dietary goals with terms such as "smart" or "right" (as in "for those who want to eat right"), cites health authorities (as in "nutritionists recommend"), makes body-function claims (as in "calcium to build bones" -- but makes no mention of osteoporosis), or cites recommended dietary targets ("Just 3 servings a day gives you all you need" -- with RDA for calcium).

As shown in Figure A-2, general health-related claims are rarely used in our sample prior to 1980. As described in Chapter 2, the FTC terminated a number of inquiries in the Food Rule proceeding in 1980, including the proposal that would have prohibited any "health food" or other general health-related claim. The Commission also voted to terminate its proceedings that covered *emphatic claims*, that is, any claim that emphasizes the nutritional desirability of a food. Following 1980, the use of general health-related claims increases to approximately 5 percent of all advertising by 1985 and then stabilizes during 1985-1990. Note in particular, that this level changes little following the 1987 FDA proposal, consistent with expectations, since the FDA-related risks arise from disease claims, not from more general health-related claims.

Figure A-2 also shows the combined use of disease and general health-related claims, that is, the addition of the claims shown in Figure A-1 to the *General Health-Related Claims* category. The gap between the two curves reflects the use of explicit health claims, with the growth

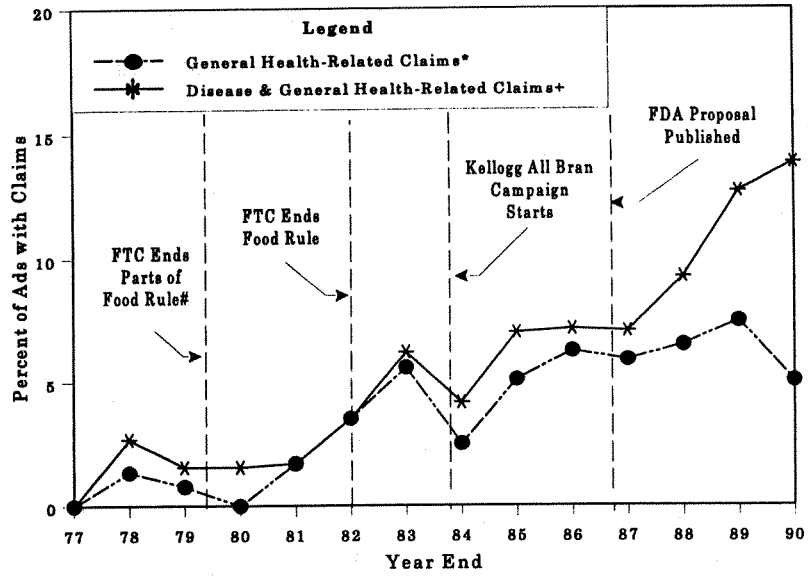

Figure A-2. Percentage of food and beverage advertisments with general health-related claims, and disease and general health-related claims: *Good Housekeeping* magazine, March, June, and September of each year.

Notes. * The *General Health-Related Claims* category does not include ads that refer to specific diseases or to serum cholesterol reduction directly, but only those ads making more general health-related claims. Specifically, this category include all advertisements that use phrases such as "healthy," "right," or "smart" in discussing dietary goals, cite authorities, as in "health professionals recommend," refer to dietary recommendations, such as the recommendation to consume less than 30 percent of calories from fat, or make body-function claims, as in "calcium to build bones" or fiber to "keep your digestive system functioning smoothly."

+ The *Disease & General Health-Related Claims* category adds the explicit disease anc serum cholesterol ads shown in Figure A-1.

Neither category includes ads that make only simple nutrient content claims, as in "low fat" or "high fiber," or other more general nutrition-related claims, such as "wholesome" or "natural."

Of particular relevance here, the FTC voted to drop the proposal that would have prohibited all "health food" or other general health-related claims.

in the size of the gap after the mid-1980s reflecting the growth in the use of explicit health claims. Note that by 1990 approximately 14 percent of all food and beverage advertisements in this sample contained these health-related claims, compared to less than 3 percent of all advertising during the pre-1980 period.

Figure A-3 illustrates the use of nutrient content claims in food advertising over the period. These data indicate that nutrient content claims of some type are made in approximately 10 percent of the food advertising in our sample in the early years of this 1977-1990 period, with lipid claims in approximately 5 percent of the ads, suggesting that consumer interest in nutrition issues and fat-related issues exists throughout these years. The use of nutrient content claims clearly rises over the period, but this rise does not follow the sharp change in trend observed in the health claims data. This different pattern of change thus reinforces the view that the change in the use of explicit health claims is due to the change in the perceived regulatory risk of using such diet-disease claims. Of course, if the use of general and specific health claims increases the competitive pressure on firms to focus on the nutritional features of their products, this added pressure increases the value of all types of nutrition-related claims, and thus, could have led to the increased use of nutrient content claims of all types.

More broadly, note that the data in our sample, as well as the other published work on nutrition-related claims in food advertising, clearly support the widely held view that the use of nutrition claims in advertising rises (for good or ill effect) during the period of our study. Moreover, the explicitness of advertising claims increases in the mid-1980s but most noticeably in the later 1980s, though the limits of the print media data may affect our assessment of the timing of these changes somewhat.

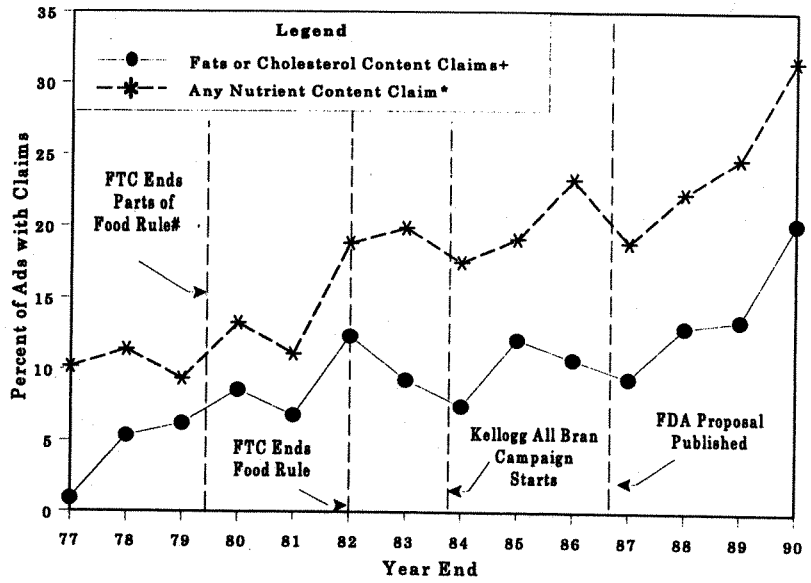

Figure A-3. Percentage of food and beverage advertisments with some nutrient content claim: *Good Housekeeping* magazine, March, June, and September of each year.

Notes. + The *Fats or Cholesterol Content Claims* category includes ads with any fat, type of fat, or cholesterol content claim, such as "low fat," "low saturated fat," or "no cholesterol."

* The category labeled *Any Nutrient Content Claim* includes ads from the previous category as well as any ad that explicitly mentions a fiber, protein, vitamin, or mineral claim, such as "a good source of fiber," or "high in calcium."

\# Of particular relevance for the claims presented here, the FTC voted to abandon the proposal to regulate positive nutrient content claims explicitly, such as "high in fiber."

As a final check of the advertising-health-claims issue, we surveyed the trade and business press to assess whether stories on food and health advertising issues generally agree with the available evidence from print advertising. Generally, this survey supports the print evidence, though there is some suggestion that health claims in television advertising and specialized print media may have been somewhat larger in the mid-1980s than is indicated by the print advertising evidence presented here. For instance, a *Wall Street Journal* story in April 1985 indicates that fiber-cancer and calcium-osteoporosis advertising is running on daytime television and in sports and women's magazines.[8] A 1985 year-end roundup article in *Advertising Age* lists health claim campaigns by several major food firms, including Kellogg's All Bran and General Mills' Fiber One for cancer, Quaker Oats for cholesterol reduction, Mazola corn oil for heart disease, as well as generic campaigns from the California Prune Council, the Florida Citrus Commission, and the National Dairy Research & Promotion Board for prevention of various illnesses.[9] On the other hand, early in 1985, the trade press reported that major firms were watching the health claims debate closely but were not rushing to enter with explicit disease claims.[10]

The trade press also notes an increase in health claims following the publication of the FDA labeling proposal in August 1987. For instance, a *Wall Street Journal* article in October 1987 cites consumer activists on this point and notes new television campaigns from Campbell's Soup for its bean soups and cancer, from Pepperidge Farm for its new line of

[8] See Betsy Morris, "Rise in Health Claims in Food Ads Can Help -- and Mislead -- Shoppers," *Wall Street Journal*, April 2, 1985, B2.

[9] See *Advertising Age*, December 30, 1985, 3 and 12.

[10] See Steven W. Colford, "Food marketers let health claims simmer," *Advertising Age*, March 18, 1985, 12.

multigrain breads tied to fiber health benefits, and for new Quaker Oatmeal advertising tied to cholesterol and heart disease benefits.[11] In 1987 Kellogg extends its health marketing approach with its "Project Nutrition," which adds a series of 2-page print advertisements in general readership magazines, such as *Time*, and in traditional women's and health magazines, such as *Better Homes and Gardens* and *Prevention*, to its ongoing television advertising. The company sponsored cholesterol screening for approximately 100,000 Americans as part of the campaign as well.[12] A number of advertisers are also running cholesterol reduction claims for oat bran and low saturated fat products by late 1987.[13]

Thus, taken together, the trade press, the findings in the literature, and the claims contained in our sample of print advertising indicate that general health-related claims begin to rise in the early 1980s and stabilize in the mid-1980s, and that explicit health claims from major firms begin in the mid-1980s, with substantial growth in the later 1980s.

[11] See Ronald Alsop, "More Food Advertising Plays on Cancer and Cardiac Fears," *Wall Street Journal*, October 8, 1987, B33.

[12] See Julie Liesse Erickson, "Kellogg exercises health claims," *Advertising Age*, January 25, 1988, 72.

[13] See, for instance, Judann Dagnoli, "Ads pump low-cholesterol claims," *Advertising Age*, November 2, 1987, 4.

APPENDIX B

AUXILIARY TABLES

This appendix contains auxiliary tables referenced in the report. These are numbered to parallel the report tables to which they correspond. Thus, for instance, the detailed USDA food codes that correspond to the food groups described in Table 6-1 are listed in Table 6-1A. The off-season regressions corresponding to the primary season regressions in Chapter 7 are included in Tables 7-3A to 7-11A.

Table 6-1A 1989 USDA Codes For Food Categories[1]

Food Category	USDA Food Codes
MEAT/MIXTURE Beef:	200-0000 --- 215-4010
	216-0200 --- 217-0102
	251-0010 --- 251-1034
	251-1080 --- 251-8111
	271-1100 --- 271-1818
	271-6001 --- 272-1831
	272-6001 --- 273-1901
	273-6000 --- 274-1841
	274-6001 --- 275-1601
	276-0010 --- 276-1073
Pork:	220-0010 --- 224-3100
	227-0100 --- 228-2000
	271-2002 --- 271-2141
	272-2001 --- 272-2111
	273-2002 --- 273-2050
	274-2001 --- 274-2201
	275-2011 --- 275-2054
	276-2010 --- 276-2012
Lamb:	230-0010 --- 231-3200
	271-3001 --- 271-3301
	272-3001 --- 272-3300
	273-3001 --- 273-3022
	274-3040 --- 274-3041
Veal/Other:	231-5010 --- 234-2002
	271-3501 --- 271-3610
	272-3500 --- 272-3600
	273-3115 --- 273-3631
	274-3050 --- 274-3061
	276-3010 --- 276-3012
Bacon:	216-0100 --- 216-0150
	225-0101 --- 226-2100
Sausage/Cold Cuts:	252-2001 --- 252-4032
	275-2031 --- 275-2039
	275-2054
	275-4011 --- 275-4012
	275-4031 --- 275-4032

(Table continued on next page.)

Table 6-1A (Continued)

Food Category	USDA Food Codes
MEAT (Cont.) Sausage/Cold Cuts:	275-6000 --- 275-6012
	275-6041 --- 275-7031
Franks:	252-1011 --- 252-1051
	275-6030 --- 275-6038
	275-4040
Frozen Meals: Beef:	281-0100 --- 281-1316
Pork:	281-2021 --- 281-2210
Veal:	281-3000 --- 281-3341
Other:	281-6030 --- 281-6071
	583-1011 --- 583-1031
POULTRY/MIXTURES Chicken:	241-0000 --- 241-9884
	247-0100 --- 247-0601
	271-4100 --- 271-4801
	272-4100 --- 272-4650
	273-4101 --- 273-4810
	274-4011 --- 274-4803
	276-4005 --- 276-4411
Turkey:	242-0100 --- 242-0800
Other:	243-0010 --- 244-0401
Liver, etc.:	251-1040 --- 251-1060
Sandwiches:	275-4011 --- 275-4033
Frozen Meals:	281-4010 --- 281-4581
	281-6081
FISH/MIXTURES Fish/Seafood:	261-0010 --- 263-2116
	271-5001 --- 271-5107
	272-5002 --- 272-5101
	273-5002 --- 273-5106
	274-5001 --- 274-5107
	276-5100
Sandwiches:	275-5000 --- 275-5075
Frozen Meals:	281-5000 --- 281-5401
GRAIN/MIXTURES Pasta:	561-0100 --- 561-3300
Rice:	562-0500 --- 562-0601
Italian:	581-0621 --- 581-0901
	581-3001 --- 581-3481
	581-4511 --- 581-4855

(Table continued on next page.)

Table 6-1A (Continued)

Food Category	USDA Food Codes
GRAIN/MIXTURES (Cont.) Oriental:	581-1011 --- 581-1311
	581-3511 --- 581-3613
	581-4921 --- 581-5116
Spanish:	581-0010 --- 581-0331
	581-0426 --- 581-0505
	581-1511 --- 581-1751
	581-4011 --- 581-4031
	581-5511 --- 581-5671
Other:	581-2011 --- 581-2825
	581-6011 --- 581-6411
	581-7511
	585-0300 --- 585-0902
Soups: Cheese:	147-1010 --- 147-1020
Meat/Poultry/Fish:	283-1011 --- 283-6021
Bean:	416-0101 --- 416-1010
Grain:	584-0000 --- 584-5030
Vegetable:	718-0100 --- 718-5102
	723-0200 --- 723-0700
	735-0101
	746-0100 --- 746-0602
	756-0010 --- 756-5700
	775-1301 --- 775-6301
Frozen Meals:	583-0101 --- 583-0701
	415-0100 --- 415-0200
EGGS/MIXTURES	311-0101 --- 341-0100
Frozen Meals:	350-0100 --- 350-0300
BREADS	510-0010 --- 511-5900
	511-6600 --- 522-0400
	522-0701 --- 522-2011
	523-0801 --- 523-1101
SWEET BREADS	511-6000 --- 511-6506
	522-0601 --- 522-0606
	523-0100 --- 524-0800
FATS & OILS	811-0000 --- 821-0900

(Table continued on next page.)

Table 6-1A (Continued)

Food Category	USDA Food Codes
DRESSING/SAUCE/GRAVY	
White sauce/gravy:	134-1100 --- 134-1200
Gravy:	285-0000 --- 285-2205
Other:	414-2005 --- 414-2045
	555-0200
Salad Dressing:	831-0010 --- 832-2000
MILK	110-0000 --- 113-4000
Flavored:	115-1100 --- 115-6101
Powdered:	118-1000 --- 118-3055
	118-4010 --- 119-4010
CHEESE/CREAM/YOGURT Yogurt:	114-1000 --- 114-4500
Cream:	121-0010 --- 122-2040
Sour Cream:	123-1010 --- 123-5010
Cheese:	141-0010 --- 146-6020
DESSERTS Frozen Yogurt:	114-6000 --- 114-6126
Ice Cream, etc.:	131-1000 --- 131-7000
Substitute:	414-8000 --- 414-8001
Puddings:	132-0011 --- 133-1210
	581-4911
	581-5711 --- 581-5721
Cakes:	531-0005 --- 531-2412
Cookies:	532-0010 --- 532-7010
Pie:	533-0010 --- 533-9120
Granola Bars:	535-4210 --- 535-4440
Other:	534-0020 --- 534-5317
	581-1811 --- 581-1821
	581-6421 611-1350
	634-0305 --- 634-0315
	634-2010 --- 634-3050
Sweet Sauces:	913-0001 --- 913-6105
Jelly, etc.:	914-0100 --- 914-0810
Gelatin, etc:	915-0020 --- 916-2100
Candy:	917-0001 --- 918-0200
SNACKS Chips:	712-0101 --- 712-1100
	719-0541 719-8020
Nuts/Seeds/Peanut Butter:	421-0010 --- 442-0200

(Table continued on next page.)

Table 6-1A (Continued)

Food Category	USDA Food Codes
SNACKS (Cont.) Crackers:	541-0100 --- 543-3900
Salty Snacks:	544-0101 --- 544-4001
	581-0408 --- 581-0416
FRUIT/VEGETABLES Fruit:	611-0101 --- 611-1301
	611-1601 --- 611-2501
	631-0010 --- 634-0304
	634-0801 --- 634-1510
	671-0010 --- 674-1620
Juice:	612-0050 --- 612-2560
	641-0010 --- 642-2101
Dried:	621-0100 --- 621-2600
Beans:	411-0100 --- 414-2501
Potatoes, etc.:	710-0010 --- 711-0607
	713-0100 --- 717-0304
	719-0010 --- 719-0521
	719-1011 --- 719-8010
Dark Green:	721-0110 --- 722-0203
Deep Yellow:	731-0101 --- 734-2100
Tomatoes:	741-0100 --- 745-0502
Other:	747-0100 --- 755-3500
	761-0200 --- 773-1651
CEREALS Cooked:	562-0300 --- 562-0354
	562-0700 --- 562-1000
R-T-E:	571-0010 --- 576-0410
DRINKS/OTHER Coffee:	921-0000 --- 922-9130
Tea:	923-0100 --- 923-0740
Soft Drink:	924-0000 --- 924-3300
Fruit Drink:	925-1011 --- 929-0030
Alcohol:	931-0100 --- 935-1200
Sugar/Substitutes:	911-0100 --- 912-0001
Meal Replacements/	116-1100 --- 116-5101
Supplements	118-3080 --- 118-3501
	284-0000 --- 284-1000
	414-3000 --- 414-6001

SOURCE. 1989/90 Continuing Survey of Food Intakes By Individuals, Documentation, USDA.

NOTES. [1] Codes for other years parallel these, but actual codes differ slightly.

Table 7-3A Fat Regression Results for Women, Summer

Variable	1977	1987/88	1989/90
LESS THAN HS	-10.40 (-1.8)*	-3.13 (-0.5)	.59 (0.1)
HIGH SCHOOL GRAD	-11.48 (-2.3)**	.28 (0.0)	-5.82 (-0.9)
SOME COLLEGE	-11.13 (-2.1)**	15.11 (2.0)**	3.89 (0.6)
INCOME	.16 (1.1)	-.18 (-1.4)	-.39 (-1.4)
MALE HEAD	1.47 (0.4)	3.63 (0.5)	10 85 (1.9)*
BLACK	2.35 (0.5)	2.46 (0.3)	27.25 (2.1)**
OTHER	1.57 (0.1)	1.72 (0.1)	-3.85 (-0.4)
HISPANIC	-2.87 (-0.4)	-2.26 (-0.1)	-10.73 (-1.1)
AGE	-.17 (-1.0)	-.12 (-0.4)	-.31 (-1.0)
FULLTIME	3.61 (1.0)	.60 (0.1)	2.43 (0.4)
HH SIZE	-.12 (-0.1)	1.74 (0.9)	.73 (0.4)
PREGNANT	-2.32 (-0.4)	-.76 (-0.1)	-5.79 (-0.5)
VITAMINS	1.36 (0.4)	-3.12 (-0.6)	.89 (0.2)
DIET	-13.24 (-3.8)**	-16.25 (-1.9)*	-20.24 (-2.7)**
MEALS OUT	1.33 (0.6)	7.56 (1.6)	7.71 (1.7)*
3 MEALS	13.02 (4.4)**	9.02 (1.8)*	20.47 (4.1)**
WEEKEND	9.34 (2.5)**	8.29 (1.5)	13.04 (2.2)**
SICK	-26.14 (-4.4)**	-15.01 (-1.6)	-12.61 (-2.4)**
TRAVEL	-7.58 (-1.0)	--	-17.30 (-0.8)
HOLIDAY	2.49 (0.4)	12.60 (0.8)	19.07 (1.9)*
Adj. R-squared	.08	.10	.23
N	821	316	376
Mean Fat Consumption	76.7	63.1	64.0

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, 1989/90, Women 19-50 Years.

NOTES. All regressions weighted, with White-corrected t-statistics in parentheses. * denotes significance at the 10 percent level and ** denotes significance at the 5 percent level. The model also controls for region (NE, MW, and WEST), whether the woman is a vegetarian, and height. Of these, HEIGHT, NE, and WEST are significant (+) in 1977, VEGETARIAN (-) in 1987/88, and MW (+) in 1989/90.

Table 7-4A Fat Regression Results for Men, Spring

Variable	1977	1987/88	1989/90
LESS THAN HS	18.56 (3.0)**	12.39 (1.6)	-3.89 (-0.4)
HIGH SCHOOL GRAD	7.34 (1.5)	-3.66 (-0.8)	2.96 (0.3)
SOME COLLEGE	15.37 (2.6)**	-2.75 (-0.5)	7.07 (0.7)
INCOME	.08 (0.4)	-.12 (-0.4)	-.29 (-0.8)
FEMALE HEAD	-9.05 (-1.2)	17.48 (2.5)**	20.16 (1.9)*
BLACK	.53 (0.1)	10.02 (1.2)	18.14 (1.0)
OTHER	-21.59 (-2.4)**	-7.15 (-0.9)	15.40 (0.9)
HISPANIC	.62 (0.1)	.20 (0.0)	-10.39 (-0.8)
AGE	-.53 (-2.3)**	-.57 (-2.0)**	-.20 (-0.4)
FULLTIME	13.70 (2.8)**	4.62 (1.0)	4.79 (0.5)
HH SIZE	.79 (0.7)	-3.24 (-2.1)**	.35 (0.1)
VITAMINS	-7.03 (-1.5)	-.43 (-0.1)	-15.35 (-1.8)*
DIET	-13.08 (-2.1)**	-3.75 (-0.5)	-2.09 (-0.2)
MEALS OUT	-1.02 (-0.4)	2.02 (0.7)	10.67 (2.1)**
3 MEALS	15.61 (3.9)**	15.64 (3.8)**	31.27 (4.6)**
WEEKEND	11.79 (2.4)**	10.30 (2.2)**	5.18 (0.6)
SICK	-40.88 (-4.1)**	-31.86 (-2.8)**	-2.27 (-0.2)
TRAVEL	20.46 (1.7)*	23.96 (1.0)	-46.31 (-2.4)**
HOLIDAY	17.85 (2.1)**	14.80 (1.0)	-3.10 (-0.2)
Adj. R-squared	.05	.06	.12
N	1067	673	258
Mean Fat Consumption	113.4	88.5	83.3

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88 and 1989/90, Men 19-50 Years.

NOTES. All regressions weighted, with White-corrected t-statistics in parentheses. * denotes significance at the 10 percent level and ** denotes significance at the 5 percent level. The model also controls for region (NE, MW, and WEST), whether the man is a vegetarian, and height. Of these, HEIGHT, MW, and WEST are significant (+) in 1977, MW (+) in 1987/88, and HEIGHT (+) in 1989/90.

Table 7-5A Calcium Regression Results for Women, Summer

Variable	1977	1987/88	1989/90
LESS THAN HS	-218.97 (-4.3)**	-134.76 (-2.0)**	-15.24 (-0.1)
HIGH SCHOOL GRAD	-213.26 (-4.6)**	30.76 (0.4)	-76.79 (-0.9)
SOME COLLEGE	-187.09 (-3.7)**	29.94 (0.4)	6.99 (0.1)
INCOME	-.49 (-0.4)	-0.16 (-0.1)	-7.22 (-1.9)*
MALE HEAD	-24.29 (-0.6)	-.98 (-0.0)	228.96 (2.9)**
BLACK	-79.05 (-1.9)*	-128.87 (-1.4)	-71.47 (-0.6)
OTHER	-55.39 (-0.9)	-71.49 (-0.5)	-142.57 (-1.1)
HISPANIC	-9.35 (-0.2)	-83.97 (-0.8)	-193.56 (-2.0)**
AGE	-3.11 (-2.0)**	-5.10 (-1.4)	.35 (0.1)
FULLTIME	10.02 (0.3)	-78.29 (-1.3)	25.33 (0.5)
HH SIZE	3.07 (0.4)	-33.22 (-1.5)	15.79 (0.7)
PREGNANT	196.16 (2.8)**	235.24 (1.8)*	-35.56 (-0.4)
VITAMINS	14.32 (0.5)	99.90 (1.6)	40.32 (0.6)
DIET	-84.95 (-2.6)**	-43.85 (-0.6)	-15.30 (-0.1)
MEALS OUT	-53.37 (-3.0)**	3.17 (0.1)	-63.46 (-1.5)
3 MEALS	112.74 (4.2)**	73.91 (1.3)	286.05 (4.5)**
WEEKEND	8.18 (0.3)	-41.32 (-0.7)	101.12 (1.3)
SICK	-15.56 (-0.2)	-52.95 (-0.6)	-174.80 (-1.9)*
TRAVEL	11.89 (0.1)	--	-335.87 (-1.7)*
HOLIDAY	-38.73 (-0.8)	44.79 (0.3)	107.08 (1.0)
Adj. R-squared	.12	.10	.16
N	821	316	376
Mean Calcium Consumption	581.7	588.4	636.8

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88, 1989/90, Summer, Women 19-50 Years.

NOTES. All regressions weighted, with White-corrected t-statistics in parentheses. * denotes significance at the 10 percent level and ** denotes significance at the 5 percent level. The model also controls for region (NE, MW, and WEST), whether the woman is a vegetarian, and height. Of these, NE, WEST, and HEIGHT are significant (+) in 1977, and MW (+) and VEGETARIAN (-) in 1989/90.

Table 7-6A Calcium Regression Results for Men, Spring

Variable	1977	1987/88	1989/90
LESS THAN HS	52.66 (1.0)	43.59 (0.5)	-91.04 (-0.8)
HIGH SCHOOL GRAD	1.17 (0.0)	-84.73 (-1.6)	56.02 (0.4)
SOME COLLEGE	75.57 (1.6)	-7.90 (-0.1)	-22.42 (-0.2)
INCOME	-2.06 (-1.2)	-1.32 (-0.5)	4.05 (0.6)
FEMALE HEAD	-91.87 (-1.5)	182.90 (2.3)**	94.96 (0.8)
BLACK	-85.04 (-1.4)	-39.41 (-0.6)	-37.13 (-0.3)
OTHER	-196.03 (-2.7)**	-81.61 (-0.7)	601.07 (1.7)*
HISPANIC	-35.10 (-0.5)	-206.31 (-1.6)*	-31.83 (-0.2)
AGE	-5.73 (-2.8)**	-11.97 (-4.3)**	-3.55 (-0.7)
FULLTIME	1.04 (0.0)	16.75 (0.3)	25.39 (0.2)
HH SIZE	16.67 (1.4)	-55.72 (-2.9)**	11.68 (0.3)
VITAMINS	64.72 (1.6)	-.74 (-0.0)	-46.47 (-0.4)
DIET	-36.36 (-0.7)	53.08 (0.5)	15.25 (0.1)
MEALS OUT	-62.70 (-3.1)**	-90.82 (-3.4)**	25.52 (0.4)
3 MEALS	196.02 (6.3)**	264.45 (6.4)**	281.46 (3.2)**
WEEKEND	61.46 (1.4)	102.92 (1.9)*	-6.67 (-0.1)
SICK	-195.77 (-1.4)	-125.73 (-1.2)	117.34 (0.8)
TRAVEL	158.86 (1.1)	36.22 (0.3)	-693.06 (-1.9)*
HOLIDAY	102.16 (1.7)*	232.25 (1.7)*	-131.30 (-0.7)
Adj. R-squared	.07	.15	.07
N	1067	673	258
Mean Calcium Consumption	802.3	745.9	751.2

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88 and 1989/90, Men 19-50 Years.

NOTES. All regressions weighted, with White-corrected t-statistics in parentheses. * denotes significance at the 10 percent level and ** denotes significance at the 5 percent level. The model also controls for region (NE, MW, and WEST), whether the man is a vegetarian, and height. Of these, HEIGHT, VEGETARIAN, MW, and WEST in 1977, WEST in 1987/88, and VEGET in 1989/90 are significant (+).

Table 7-8A Saturated Fat Regression Results for Women, Summer

Variable	1977	1987/88	1989/90
LESS THAN HS	-5.35 (-2.3)**	-.50 (-0.2)	-1.63 (-0.5)
HIGH SCHOOL GRAD	-4.35 (-2.2)**	2.29 (0.9)	-3.60 (-1.5)
SOME COLLEGE	-5.34 (-2.5)**	7.48 (2.4)**	.39 (0.2)
INCOME	.06 (1.1)	-.03 (-0.5)	-.15 (-1.5)
MALE HEAD	-.34 (-0.2)	-.68 (-0.2)	4.18 (2.1)**
BLACK	-1.02 (-0.5)	-.49 (-0.2)	10.32 (2.3)**
OTHER	-1.39 (-0.4)	.87 (0.2)	-1.71 (-0.5)
HISPANIC	-.47 (-0.2)	-3.37 (-0.6)	-5.51 (-2.0)**
AGE	-.12 (-1.8)*	-.02 (-0.2)	-.14 (-1.2)
FULLTIME	2.19 (1.6)	-1.13 (-0.6)	.91 (0.5)
HH SIZE	-.09 (-0.2)	.56 (0.8)	.51 (0.8)
PREGNANT	1.32 (0.5)	1.97 (0.5)	-.15 (-0.0)
VITAMINS	-.07 (-0.1)	.57 (0.3)	.71 (0.4)
DIET	-4.38 (-3.0)**	-5.53 (-1.8)*	-8.87 (-3.4)**
MEALS OUT	-.19 (-0.2)	2.03 (1.2)	1.88 (1.2)
3 MEALS	5.81 (5.0)**	2.53 (1.3)	6.14 (3.5)**
WEEKEND	3.22 (2.3)**	3.16 (1.4)	4.65 (2.1)**
SICK	-6.11 (-2.1)**	-6.66 (-1.6)	-6.49 (-2.5)**
TRAVEL	-2.67 (-1.0)	--	-9.31 (-1.0)
HOLIDAY	-.90 (-0.4)	8.26 (1.2)	5.70 (1.6)
Adj. R-squared	.07	.09	.21
N	804	316	376
Mean Saturated Fat Consumption	27.3	22.7	22.3

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987-88, 1989/90, Women 19-50 Years.

NOTES. All regressions weighted, with White-corrected t-statistics in parentheses. * denotes significance at the 10 percent level and ** denotes significance at the 5 percent level. The model also controls for region (NE, MW, and WEST), whether the woman is a vegetarian, and height. Of these, HEIGHT, NE, and WEST are significant (+) in 1977, VEGETARIAN (-) in 1987/88, and MW (+) in 1989/90.

Table 7-9A Saturated Fat Regression Results for Men, Spring

Variable	1977	1987/88	1989/90
LESS THAN HS	6.30 (2.7)**	3.96 (1.4)	.60 (0.2)
HIGH SCHOOL GRAD	3.71 (1.9)*	-1.29 (-0.8)	4.35 (1.1)
SOME COLLEGE	6.93 (3.0)**	-.36 (-0.2)	4.68 (1.3)
INCOME	.03 (0.3)	-.04 (-0.4)	.08 (0.5)
FEMALE HEAD	-5.81 (-1.9)*	7.39 (2.8)**	4.71 (1.1)
BLACK	-1.25 (-0.5)	1.18 (0.4)	3.45 (0.6)
OTHER	-7.06 (-2.1)**	-4.38 (-1.5)	10.34 (1.5)
HISPANIC	-1.59 (-0.4)	2.11 (0.9)	-7.31 (-1.7)*
AGE	-.20 (-2.3)**	-.34 (-3.2)**	-.16 (-0.8)
FULLTIME	3.59 (1.8)*	1.43 (0.8)	1.06 (0.3)
HH SIZE	.23 (0.5)	-1.60 (-2.8)**	.30 (0.3)
VITAMINS	-1.34 (-0.7)	-.30 (-0.2)	-3.51 (-1.1)
DIET	-4.15 (-1.8)*	-.07 (-0.0)	-3.37 (-0.7)
MEALS OUT	-.72 (-0.7)	.25 (0.2)	3.66 (1.9)*
3 MEALS	5.28 (3.4)**	6.06 (4.0)**	10.89 (4.1)**
WEEKEND	3.83 (2.0)**	4.83 (2.7)**	1.12 (0.4)
SICK	-12.94 (-3.0)**	-11.43 (-2.6)**	.74 (0.2)
TRAVEL	9.48 (2.4)**	6.25 (1.0)	-21.68 (-2.9)**
HOLIDAY	3.99 (1.2)	6.01 (1.1)	-4.05 (-0.5)
Adj. R-squared	.04	.08	.07
N	1049	673	258
Mean Saturated Fat Consumption	40.6	31.3	28.9

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88 and 1989/90, Men 19-50 Years.

NOTES. All regressions weighted, with White-corrected t-statistics in parentheses. * denotes significance at the 10 percent level and ** denotes significance at the 5 percent level. The model also controls for region (NE, MW, and WEST), whether the man is a vegetarian, and height. Of these, NE, MW, and WEST are significant (+) in 1977.

Table 7-10A Cholesterol Regression Results for Women, Summer

Variable	1977	1987/88	1989/90
LESS THAN HS	-18.43 (-0.4)	3.18 (0.1)	-47.71 (-1.0)
HIGH SCHOOL GRAD	-91.09 (-1.8)*	35.35 (0.9)	-68.36 (-1.7)*
SOME COLLEGE	-80.92 (-1.5)	75.45 (1.7)*	-25.54 (-0.6)
INCOME	2.14 (1.4)	-.24 (-0.3)	-2.08 (-1.5)
MALE HEAD	-72.38 (-2.4)**	-7.85 (-0.2)	43.56 (1.4)
BLACK	89.65 (2.5)**	33.34 (0.8)	237.64 (3.5)**
OTHER	26.65 (0.5)	124.12 (1.7)*	60.43 (0.8)
HISPANIC	14.69 (0.4)	83.59 (1.0)	-22.09 (-0.4)
AGE	-.25 (-0.2)	.98 (0.6)	-1.18 (-0.6)
FULLTIME	4.92 (0.2)	-24.73 (-0.9)	-3.85 (-0.1)
HH SIZE	10.86 (1.2)	-6.30 (-0.6)	11.77 (1.2)
PREGNANT	83.66 (1.3)	11.65 (0.2)	-38.49 (-0.7)
VITAMINS	8.02 (0.3)	-13.94 (-0.5)	4.55 (0.2)
DIET	-43.90 (-1.7)*	-57.34 (-1.2)	-83.86 (-2.1)**
MEALS OUT	11.48 (0.6)	27.80 (1.2)	-19.41 (-1.0)
3 MEALS	65.53 (2.4)**	67.30 (2.4)**	46.38 (1.6)
WEEKEND	115.67 (4.0)**	30.87 (0.9)	95.56 (2.5)**
SICK	-127.30 (-3.2)**	-63.60 (-0.8)	110.91 (1.3)
TRAVEL	22.57 (0.3)	--	63.32 (1.1)
HOLIDAY	9.69 (0.2)	111.84 (1.7)*	101.19 (1.8)*
Adj. R-squared	.06	.04	.20
N	804	316	376
Mean Cholesterol Consumption	349.9	260.8	256.3

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88 and 1989/90, Women 19-50 Years.

NOTES. All regressions weighted, with White-corrected t-statistics in parentheses. * denotes significance at the 10 percent level and ** denotes significance at the 5 percent level. The model also controls for region (NE, MW, and WEST), whether the woman is a vegetarian, and height. Of these, HEIGHT is significant (+) in 1977 and NE and WEST (+) in 1989/90 .

Table 7-11A Cholesterol Regression Results for Men, Spring

Variable	1977	1987/88	1989/90
LHS	135.70 (3.8)**	71.29 (2.2)**	135.81 (2.2)**
HIGHGRAD	76.13 (2.6)**	38.35 (1.5)	116.26 (2.8)**
SOMECOLL	89.11 (2.7)**	67.45 (2.0)**	97.52 (2.5)**
INCOME	-.27 (-0.2)	-.04 (-0.0)	0.96 (0.8)
FHEAD	-85.51 (-1.9)*	68.83 (1.9)*	40.14 (0.8)
BLACK	143.74 (3.3)**	55.06 (1.6)	136.75 (1.1)
OTHER	36.42 (0.5)	25.60 (0.4)	69.05 (1.1)
HISP	147.35 (3.3)**	274.05 (4.5)**	-52.79 (-1.1)
AGE	-1.50 (-1.0)	-.69 (-0.4)	-.97 (-0.4)
FULLTIME	33.06 (1.1)	20.59 (0.9)	6.43 (0.1)
NOPERS	14.90 (1.7)*	-17.41 (-2.2)**	-14.77 (-1.0)
VEVERY	-48.25 (-1.7)*	40.38 (1.4)	-63.66 (-1.5)
SPDIET	-61.01 (-1.7)*	-19.91 (-0.5)	54.21 (0.9)
MEALSOUT	-5.84 (-0.4)	12.51 (1.1)	27.91 (1.1)
MEALS3	97.74 (4.1)**	54.72 (2.6)**	128.72 (3.5)**
WEEKEND	152.33 (4.8)**	100.00 (3.5)**	66.28 (1.5)
SICK	-305.56 (-7.4)**	-161.18 (-4.8)**	15.69 (0.2)
TRAVEL	241.27 (2.6)**	-32.19 (-0.5)	10.08 (0.1)
HOLIDAY	73.43 (1.2)	51.87 (0.6)	9.00 (0.1)
Adj. R-squared	.09	.13	.08
N	1049	673	258
Mean Cholesterol Consumption	519.4	346.3	296.8

DATA. USDA National Food Consumption Surveys, Individual Intakes, 1-Day, 1977, 1987/88 and 1989/90, Spring, Men 19-50 Years.

NOTES. All regressions weighted, with White-corrected t-statistics in parentheses. * denotes significance at the 10 percent level and ** denotes significance at the 5 percent level. The model also controls for region (NE, MW, and WEST), whether the man is a vegetarian, and height. Of these, HEIGHT in 1977 and 1989/90 (+), and VEGETARIAN in 1987/88 and 1989/90 (-) are significant.