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An Evaluation of Fluid Milk and Cheese Advertising, 1978-93

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An Evaluation of Fluid Milk and Cheese Advertising, 1978-93. By Theresa Y. Sun, Noel Blisard, and James R. Blaylock. Food and Consumer Economics Division, Economic Research Service, U.S. Department of Agriculture. Technical Bulletin No. 1839.

Abstract

Generic advertising expenditures raised fluid milk sales about 3.8 percent, or 8.1 billion pounds, between September 1984 and September 1993. Sales of natural and processed cheese consumed at home rose by about 38.9 million pounds and 316 million pounds in the same period because of increased generic advertising. An assessment of 15 cents per hundredweight of milk sold commercially, mandated by the Dairy and Tobacco Adjustment Act of 1983, funded the increase in advertising. The authors use econometric demand models to control for variables that influence the demand for milk and cheese. These variables include generic and branded advertising, market prices, income, and demographic characteristics.

Keywords: Cheese, fluid milk, advertising, demand, entry, exit, distributed lag, econometrics, simulation, elasticities.

Acknowledgments

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Contents

Summary

Generic advertising raised fluid milk sales an estimated 749 million pounds, or 3 percent, during September 1992-August 1993. An assessment of 15 cents per hundredweight of milk sold commercially, mandated by the Dairy and Tobacco Adjustment Act of 1983, provides funds for such advertising, as well as for research and nutrition education for fluid milk and milk products.

This report presents the results of econometric demand models that examined the effect of advertising and other factors (market prices, income, and demographic characteristics) on milk and cheese sales.

Since passage of the act (September 1984-September 1993), fluid milk sales are estimated to be 3.8 percent (almost 8.1 billion pounds) above what they would have been without the advertising. Fluid milk advertising expenditures for September 1984-September 1993 equal $236 million, of which $67.5 million is attributed to the act. The gain per act-increased advertising dollar is about 119 pounds.

Advertising expenditures due to the act are estimated to have increased natural cheese sales by 38.9 million pounds (0.4 percent) during September 1984-June 1993. Act-increased generic advertising boosted processed cheese sales an estimated 4.3 percent (315.6 million pounds).

Women, households with children under 18 years of age, and single-person households drink more milk per person than the national average. Black and rural households drink less. Younger consumers and women are expected to demand more dairy products because of calcium requirements, while studies have shown blacks to have a higher level of intolerance to lactose. Rural consumers may have milk supply sources other than commercial channels, which may also have negative effects on commercial sales. Higher educational levels correspond with lower milk consumption. Education may also be linked to a concern about fat, thus limiting consumption among more educated consumers.

The study's advertising simulations indicated that declining real fluid milk prices during September 1984-September 1993 increased fluid milk sales by 1 billion pounds. Increasing real incomes raised fluid milk sales by 5.7 billion pounds.

The cheese study decomposed the advertising effects on: (1) the share of households in the market buying cheese, and (2) the average purchase of cheese per buying household. Results indicate that generic advertising for natural cheese may not induce existing consuming households to increase their purchases, but it may attract newcomers to the natural cheese market. On the other hand, advertising for processed cheese may induce processed cheese-consuming households to increase their purchases, but it may not be effective enough to add new consumers to the processed cheese market.

Falling real prices for natural cheese, down 11.2 percent on average from September 1983-August 1984 to September 1984-June 1993, increased natural cheese sales by about 1.7 billion pounds, according to the cheese model. An

8.7-percent decline in real processed cheese prices between these periods increased processed cheese sales by 491.7 million pounds. A 2.4-percent drop in real prices of meat, poultry, and fish reduced natural cheese sales by 51.0 million pounds and processed cheese sales by 42.1 million pounds. Rising real consumer income, up about 16.2 percent, is estimated to have increased natural cheese sales approximately 69.2 million pounds and increased processed cheese sales by 17.3 million pounds.

An Evaluation of Fluid Milk and Cheese Advertising

Theresa Y. Sun
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James R. Blaylock

Introduction

This report is an updated analysis of the effectiveness of generic advertising on fluid milk and cheese sales. An assessment of 15 cents per hundredweight of milk sold commercially, mandated by the Dairy and Tobacco Adjustment Act of 1983, provides funds for research, promotion, and nutrition education for fluid milk and milk products. This annual report satisfies one requirement of the Act: yearly evaluation of the effectiveness of the dairy promotion program.

The advertising analysis for fluid milk is based on a 12-region, pooled, cross-sectional time-series model originated by Ward and Dixon (1989a and 1989b). The 12-region sales database enables the fluid milk model to encompass variations of price and quantity among various regions. The analysis of cheese advertising effects is an update of the cheese model by Blaylock and Blisard (1988). The cheese model provides not only an approximation of national advertising effects, but also an examination of the entry and exit of consumers in the cheese market.

This report evaluates advertising effects by examining:

- Current, lagged and cumulative effects of advertising on fluid milk and cheese consumption.
- Structural changes in advertising effects over time.
- Advertising influences on consumers entering and exiting the cheese market.
- Model simulations of changes in milk and cheese consumption since 1983 related to changes in advertising, price, and income.

The fluid milk model incorporates a second-order polynomial distributed-lag structure for the carryover effects of advertising. The model also hypothesizes primary (advertising) and secondary (time-trend) structural changes after the 1983 act. Accounting for time series autocorrelation within each region, and missing variables that are correlated across regions in their effect on the dependent variable, we estimated the model with Parks' generalized least-squares procedure. Data for the analysis extends from December 1978 through September 1993.

Results indicate that current and lagged effects of advertising are distributed over a 12-month period for fluid milk. The shortrun advertising effect is highest after a 6-month period. The shape of the shortrun advertising effect is flatter before the act than after the act. To examine the dynamics of the advertising effect, we separated the period after the act into nine time intervals. The advertising multiplier (a 12-month cumulative advertising effect) is highest during September 1984-July 1985, the period immediately after the act. Afterwards, the cumulative effect generally declines until 1993, when advertising expenditures begin to surge.

The total increase in advertising spending since the act is $203.3 million. If we assume that real advertising expenditures are fixed at the level of the 12-month interval immediately preceding the act and compare the simulated results with those obtained from the passage of the act, the simulated increase in milk consumption resulting from the act for September 1984-September 1993 is 8 billion pounds. If deflated per capita price or income is the same as that in the 12-month interval immediately before the act, simulated gains because of lower prices are 1 billion pounds of fluid milk, and gains because of higher income are 5.7 billion pounds. These simulations are based on the 12 regions, which represent 40 percent of U.S. fluid milk consumption.

We specified three equations for both natural and processed cheese: market demand, demand in terms of proportion of purchasing consumers, and average purchase per purchasing household. Data include at-home consumption from January 1982 to June 1993. We assumed a gamma-distributed lag with no length restriction for the carryover effects of both generic and branded advertising expenditures.

Results for natural cheese demand indicate that branded advertising was not a statistically significant factor to increase the demand for natural cheese. Generic advertising has a two-period weighted carryover effect on natural cheese purchases, and most of the weight occurs in the current period.

For processed cheese, branded and generic advertising separately are not important demand-shifting factors. However, the combined effect of both types of advertising for processed cheese cannot be ignored. The advertising effect was largest in the second month and declined slowly, with the first 9 months having about 50 percent of the total advertising effect.

The most influential economic factors affecting the proportion of households buying natural cheese were its own price, the price of substitutes such as meat and processed cheese, and generic advertising. Generic advertising increased the proportion of consumers buying natural cheese, but it did not induce those who already bought natural cheese to increase their purchases. For processed cheese, combined generic and branded advertising evidently increased the proportion of consumers buying processed cheese and induced those already using processed cheese to increase their purchases.

Background on Advertising

Advertising is directed toward existing and potential consumers of a product with the objective of increasing sales. Branded advertising promotes the particular characteristics of a given brand of the commodity. Generic advertising promotes consumption of the general commodity by a cooperative effort of producers.

Sheth (1974) identifies four separate mechanisms through which advertising produces potential changes in consumer demand: precipitation, persuasion, reinforcement, and reminder. Precipitation encourages consumers to become buyers of a product. Persuasion encourages consumers to choose among alternative brands within a product category. Reinforcement continually directs the consumer's attention to a particular brand or product. A reminder encourages consumers to become repeat purchasers of the product. Ward, Chang, and Thompson (1985) note that generic advertising is intended to precipitate and remind, and branded advertising is intended to persuade and reinforce. The reminder and precipitation functions are more likely to increase total industry sales, and persuasion and reinforcement are generally associated with maintaining or increasing market shares.

Some evidence, at least for a few commodity groups, suggests that generic advertising increases aggregate demand or at least reduces the rate of decline in consumption (Ward and Myers, 1979;

Thompson, 1975; Ward, 1984). The empirical evidence that branded advertising is effective in increasing aggregate demand is less persuasive. Generic advertising, in theory, is brand-neutral, but this neutrality may not exist if generic promotion emphasizes the common characteristics of a product group, and a concurrent branded advertising campaign stresses differences. Also, if one firm dominates the branded advertising for a particular product (such as in the processed cheese market), branded advertising may be serving both as a form of branded and generic promotion. Concurrent generic and branded advertising campaigns can have both complementary and competitive aspects, depending on the commodity and the nature of the promotion activities.

Ward, Chang, and Thompson (1985, p. 275) attribute the following traits to generic advertising:

(1) It encourages consumption and repeat purchases of a product category.
(2) It provides information about product groups and would generally be expected to be less persuasive (and less deceptive) than branded messages.
(3) It probably has more factual information than branded advertising, but it is still oriented to high recall versus the kinds of messages one would expect from promoting infrequently purchased goods.
(4) It may have a negative effect on product differentiation, thus reducing barriers to entry and excessive profits (and margins) among first handlers beyond the farmgate.
(5) It probably forces brand advertisers to concentrate on product attributes (whether real or fancied) that are more difficult for the consumer to verify.
(6) It may provide producers and smaller firms with a mechanism for benefiting from any economies of scale.

The Theory of Demand With Advertising

The classical theory of consumer demand is based on the assumption that individual consumers allocate expenditures on commodities as if they had a fixed, ordered set of preferences described by an indifference map or by an ordinal utility function. Consumers maximize this utility function subject to restraints imposed by the money income they receive and the prices they must pay. The result of this process is a set of demand relations, one for each commodity, which are functions of all prices, income, and other demand factors. Few empirical analyses have attempted to estimate a complete system of consumer demand functions for food. Notable exceptions include Brandow (1961), George and King (1971), and Huang (1985). Most analyses use weakly separable utility and multiple-stage maximization, where the utility function is partitioned into separate subsets or branches for the commodity product groups (Pollak, 1971). The empirical implication of the multistage utility maximization hypothesis is that the demand functions for individual commodities within a branch can be specified as a function of the prices of the goods in that branch and total expenditures for goods in the branch. Such demand functions are called conditional to highlight the fact that the effects of total income and prices of goods outside the branch enter the group demand functions through the budget allocation for goods in the branch. An advantage of the conditional demand function formulation is that, once the budget allocation to goods within the branch is known, prices of goods outside the branch can be ignored.

The above theory of consumer demand does not explain the consumption behavior of individuals when their preferences are changed, either autonomously or by advertising and other sales efforts. Two approaches for incorporating advertising into the neoclassical theory of demand have dominated the economic literature: the "advertising as utility altering" approach and the "advertising as information" approach. Neither of these approaches has reached a refined state of theoretical or empirical development. To the extent that advertising enters into and alters the utility function, the issue revolves around how to treat that entry. In other words, should advertising itself be an object of preferences

(thus a direct generator of utility) or does it shift preferences? Tintner (1952) and Ichimura (1950-51) defined a change in preferences by a change in the form of the ordinal utility function. Basmann (1956) chose to treat advertising as not entering the utility function directly, but rather as uniquely controlling a set of parameters that determine the form of the utility function. Dixit and Norman (1978) envision utility functions with goods and any advertising of these goods as arguments. As Rosen (1980) pointed out, because no economic theory exists that systematically explains the process by which advertising affects consumers' tastes and preferences, modeling the effects of advertising via the utility function lacks theoretical objectivity.

The "advertising as information" approach, refined by Verma (1980) and summarized by Rosen (1980), is grounded in the household production theory, where utility is a function of product characteristics rather than the products directly. Under such a theoretical concept, the demand for observed goods (market products) is derived from the demand for commodity attributes. Efficient matching of desired attribute bundles to market products requires information about attributes embodied in various products and about the corresponding prices. The process of gathering, analyzing, and producing information relevant to the household production function means that information and time are supplied in the same manner as product attributes in the household production function. Because advertising to which consumers are exposed conditions information, advertising plays the role of an exogenous shift variable in the household's production functions for information and hence ultimately for commodities (product attributes).

The outcome of this line of reasoning is that advertising variables, in addition to the usual price and income variables, are arguments of the consumer's demand functions for market goods. The appealing aspect of this approach is that it views advertising as increasing the endowment of a productive factor, which makes purchased market goods and time more productive in generating ultimate commodities (product attributes). Thus, consumers are logically more prepared to sacrifice some income or are willing to pay higher prices for advertised goods, a basis for normative welfare that is vastly different from the position one is led to if advertising directly and capriciously alters underlying preferences.

Entry and Exit in Commodity Demand

Entry and exit theory deals with the effects of individual consumers or households beginning or ceasing to purchase a given commodity. Not all consumers will purchase a given commodity at all prices. Rather, some consumers will choose not to purchase any of a given good at certain relative prices. Advertisers may try to increase consumption by getting more consumers to enter the market, by getting those already in the market to increase their purchases, or both. The influence of other variables in the demand function, such as prices and income, may also change over time, thus inducing some individuals to decide to enter, and others to decide to exit, the market.

Haidacher (1964) developed a technique for analyzing the effects on the demand for a given good due to consumers entering and exiting the market. The method focuses on decomposing the conventional aggregate market demand Q with respect to the entry-exit phenomenon. Let the maximum number of potential consumers in the market be fixed as N. At prices above some minimum level, there may be r (less than N) consumers actually purchasing the product. The proportion, Pr, of consumers purchasing at a given price is r/N. If q_i is the purchase of individual i, the average quantity, q, purchased by individuals in the market is then:

$$q = 1/r \sum q_i \tag{1}$$

The summation of q_i over all consumers in the market is the aggregate market demand Q:

$$Q = q*r \tag{2}$$

Substitute r = Pr*N into the above equation, and we have:

$$Q = q*Pr*N \tag{3}$$

Let the market price elasticity of demand for good i with price P_i be:

$$E_Q = \delta Q/\delta P_i*P/Q \tag{4}$$

Using equation 3 for Q and applying the product differentiation rule, the price elasticity of demand for good i expressed in terms of the entry-exit phenomenon is:

$$E_Q = (\delta q/\delta P_i) * P/q + (\delta PrN)/\delta P_i * P/(PrN) \tag{5}$$

Because N is constant, the equation may also be written as:

$$E_Q = \delta q/\delta P_i * P/q + \delta Pr/\delta P_i * P/Pr \tag{6a}$$

or

$$E_Q = E_q + E_{Pr} \tag{6b}$$

Equation 6b indicates that the own-price elasticity of demand for a good consists of two components: the price elasticity of average quantity purchased by consumers in the market, and the price elasticity of the proportion of total consumers in the market.

Thus, to examine consumer behavior with respect to market entry and exit for a good, two additional demand schedules need to be examined: an average quantity demand equation where the average quantity bought by consumers is related to price and other demand factors, and a demand equation relating the percentage of consumers in the market to demand determinants. As demonstrated, these two equations are a breakdown of the ordinary demand curve. The same variables that enter into the ordinary demand curve are expected to enter into the curves representing the average quantity purchased and the proportion of consumers in the market. In a log-linear demand framework, the summation of the estimated coefficients for a given variable from the two curves should equal the corresponding estimated coefficient in the ordinary demand curve.

The empirical application of theoretical demand models is conditioned on data and other empirical restrictions. In the demand analysis for cheese, the data include both information on the average quantity of cheese purchased by consuming households and the proportion of households buying cheese. Thus, we can examine the entry and exit relations for cheese demand by the proportion of consumers entering the market, and the average quantity purchased by those already in the market. Data for the fluid milk market model, on the other hand, are obtained from selected regional time-series data. A cross-sectional time-series model is thus used for fluid milk, and entry/exit cannot be examined.

Empirical Fluid Milk Demand Model

The pooled cross-sectional time-series model for fluid milk uses data from 12 different regions that encompass over 40 percent of U.S. consumption. Because of the wide range of regional demographic characteristics, in addition to price, income, and advertising, we specify demand for fluid milk to depend also on seasonality, demographic characteristics, and a time trend.

Lagged Distribution of Advertising Expenditures

One may regard advertising expenditures as affecting demand with some sort of distributed lag. To a certain extent, advertising is viewed as a capital investment in goodwill, which has a cumulative effect on sales and which depreciates over time. The probable factors causing a distributed lag in the effect of advertising in one period on the sales over a succession of periods are (Palda, 1965; Jastram, 1976):

(1) The type of advertising copy and the media used. Not all advertising and media choices by an advertising agency are designed to produce immediate purchases. Some are meant to build up favorable impressions upon which to capitalize later (a capital investment in goodwill).

(2) The germination period for a purchase decision. Several advertisements may be necessary before a buyer finally purchases. Even if potential customers are persuaded by an ad, they may not immediately be in the market for the product. The longer the germination period, the longer a specific advertising will take to show its result in increased sales.

(3) The marketing level where advertising is initiated. If a wholesale firm's advertising is aimed at ultimate consumers, an increased sales effect will be delayed in reaching back to the wholesale firm.

However reasonable the assumption of lagged effect, it gives us no clue as to the form (or time shape) of the distribution of the lags. The form of the lag structure depends on the duration (or longrun multiplier) and the shortrun time coefficients of the lag distribution. These characteristics empirically depend on the price policies, promotion policies, and competitive environment that are embodied in the product.

For fluid milk advertising, a reasonable lag structure is the 12-month, second-degree polynomial distributed lag used by Ward and Dixon (1989a). The log of current and lagged advertising for region i at time t, $Lnadver_{it}$, has the form:

$$Lnadver_{it} = \sum \{[\log(adverg_{i(t-j)} + advbrd_{(t-j)} + K)] * W_j\} \tag{7}$$

where j = 0,1,..11, adverg is deflated per capita regional radio and television milk advertising expenditures, advbrd is deflated per capita national television milk expenditures (including 75 percent of calcium advertising expenditures before October 1991), and K is a goodwill constant of 0.0015. The W are weights based on a second-order polynomial of the form:

$$\delta_j = \alpha_0 + \alpha_1 ((j+1)/13) + \alpha_2 ((j+1)/13)^2 \tag{8}$$

Substituting the end points j = -1 and j = 12 in the above equation, one obtains the condition $\alpha_0 = 0$ and $\alpha_2 = -\alpha_1$, and:

$$\delta_j = \alpha_1[(j+1)/13][(12-j)/13] \tag{9a}$$

or

$$\delta_j = \alpha_1 \; W_j \tag{9b}$$

The coefficient α_1 is the model estimate of the advertising expenditure variable Lnadver. If we let j = 0,1,2,...11, the W's can be directly estimated to be:

$W_0 = W_{11} = .071007$; $W_1 = W_{10} = .130178$; $W_2 = W_9 = .177515$;
$W_3 = W_8 = .213018$; $W_4 = W_7 = .236686$; $W_5 = W_6 = .248521$.

Structural Change Over Time

A major hypothesis of the fluid milk demand analysis is that changes in advertising expenditures have also led to structural changes in consumption habits. As stated by Jastram (1976), through a distributed lag formulation, the effect of each new advertising expenditure builds on the residual contributions of advertising outlays in preceding periods. Thus, additional consumption generated over time may not be due to advertising expenditures in a single period, but it may be the cumulative effect of advertising due to continuous increments of advertising outlays. The effect from a continuous increment of advertising outlay is also called the multiplier effect of advertising. After enough time and continuing advertising effort, the multiplier effect may change. Such a phenomenon may be due to increased advertising outlays and more efficient advertising or, conversely, decreased advertising outlays. The structural change in the multiplier effect is usually represented by a change in the distributed advertising coefficients. A change in the system of advertising coefficients over time is the most direct effect, but the increased advertising activities may also have affected the coefficients of the other explanatory variables through change in consumption trends. In the empirical fluid milk model, the direct measure of structural change from advertising assumes that, after the act, the distributed advertising effects change their magnitudes every 12 months, albeit with the same type of polynomial distribution. The secondary effect of structural change in the time coefficient is hypothesized to occur only once after the act.

Data

Fluid milk data encompass December 1978-September 1993. The period before the act is December 1978-August 1984. The period after the act is September 1984-September 1993. The United Dairy Industry Association (UDIA), the California Milk Marketing Board, and the National Dairy Research and Promotion Board provided the regional consumption, income, advertising, and related deflators. The U.S. Department of Agriculture's (USDA's) Agricultural Marketing Service provided regional prices. Given that the milk model is based on pooling regional data, it is useful to have an understanding of both the average and regional differences in these data. In the following discussion, reference is made to the periods before and after the act.

Fluid Milk Consumption

Total fluid milk sale was recorded in pounds of milk sold per month within each of the 12 regions. California had the highest share of the 12-region total sale, about 28 percent. The Great Basin had almost the lowest share, about 3 percent (see app. table 2 for descriptions of regions). However, after adjusted for differences in population and monthly calendar days, the Great Basin area ranked the

highest in per capita fluid milk consumption (about 12 daily ounces), and California ranked fifth (9 ounces) (fig. 1). Per capita fluid milk consumption generally demonstrates significant seasonal cycles with peaks in the early fall months and troughs in June and July (Ward and Dixon, 1989b; Sun Blaylock, and Blisard, 1993). Average consumption in the 12 regions show a declining trend before August 1984 (fig. 2). Following the dairy promotion act, consumption tended to stay higher than the 1983/84 level until 1991/92.

Fluid Milk Prices

Fluid milk prices are from representative cities within the 12 regions. Before 1993, prices were reported in both gallon and half-gallon units, and the price selected for the fluid milk model was in cents per half-gallon unit, deflated by regional consumer price indexes (base = 1975). Beginning in 1993, the half-gallon fluid milk price was discontinued. Thus the price series for 1993 was projected from historical price data. Regionally, Georgia had the highest average price, and California the lowest (fig. 3). Most of the high-price regions had low per capita fluid milk consumption (figs. 1 and 3). For instance, the Great Basin, Upper Midwest, and New England regions had above-average per capita consumptions and corresponding prices lower than the regional average (fig. 3). The real fluid milk price for the 12 regions demonstrated a declining trend before 1989. It increased in the 1989/90 period, but later decreased at a level higher than the 1988/89 level (fig. 4).

Income

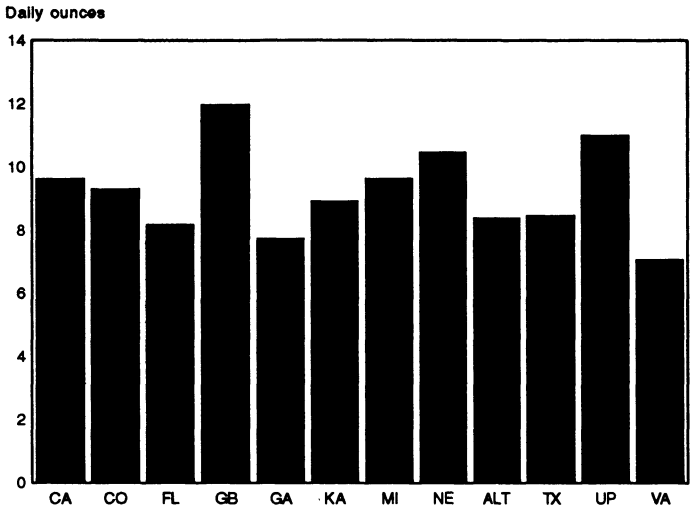
New England had the highest average per capita real income (1975 = 100), followed by the Middle Atlantic and Florida (fig. 5). Average real income for the 12 regions increased from December 1978-September 1993 (fig. 6). The rate of increase was slower before 1984. During December 1978-August 1984, the average annual real income for the 12 regions increased by 2.38 percent. For September 1984-August 1993, the average annual real income increased by 20.4 percent.

Fluid Milk Advertising

Advertising is measured in terms of expenditures per month. These expenditures take several forms depending on the controlling agent, the types of media used, and the message content. Before the start of the National Dairy Board (NDB) programs in September 1984, all fluid milk advertising was the responsibility of separate regional organizations. With the establishment of the NDB, a checkoff from dairy farmers of 15 cents per hundredweight of commercial milk sales has funded the NDB promotional programs. NDB reverts 10 cents of the checkoff to qualified regional programs and uses the remaining 5 cents for national research, promotion, and educational programs. Thus, beginning in 1984, generic fluid milk advertising has included both regional and national promotional expenditures. In addition, because calcium promotion indirectly increases fluid milk consumption, on advice from the NDB staff, 75 percent of calcium advertising is added to fluid milk advertising. Thus, in the model, advertising expenditures are composed of regional radio and television expenditures before September 1984, and additional national television advertising expenditures with 75 percent of national calcium advertising (when applicable) after September 1984.

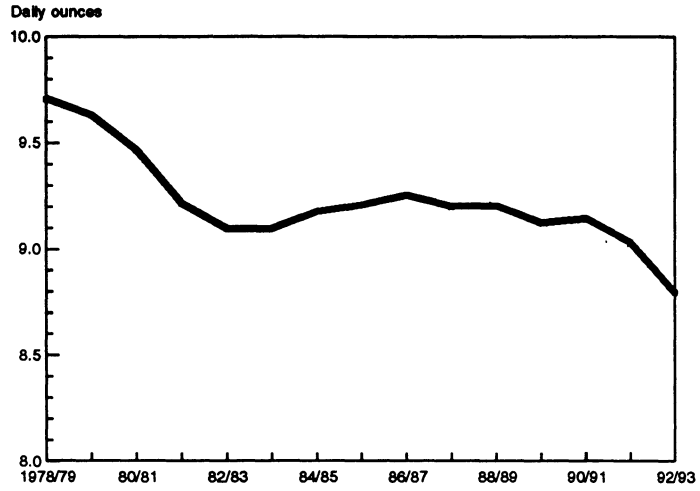
To prorate the national advertising expenditures to each region, the national expenditures are expressed on a per-capita basis and multiplied by the regional populations. Thus the prorated national expenditures at the regional level differ across regions, because of differences in regional populations. The total 12-region advertising expenditures increased considerably in the 1984/85 period. Later, advertising expenditures declined because regional shares declined. In 1993, total advertising increased to a level higher than the 1984/85 period, about 31.8 million (fig. 7). The deflated 12-region average per capita media expenditures during 1978-93 convey similar changes (fig. 8). There were

Figure 1
Regional per capita fluid milk consumption 1/



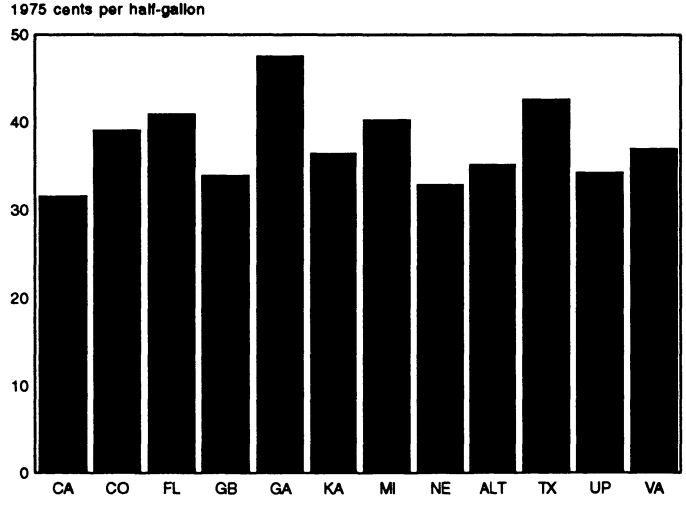
1/ Average daily ounces for 12/78-9/93. See appendix for list of regions.

Figure 2
Average per capita fluid milk consumption 1/



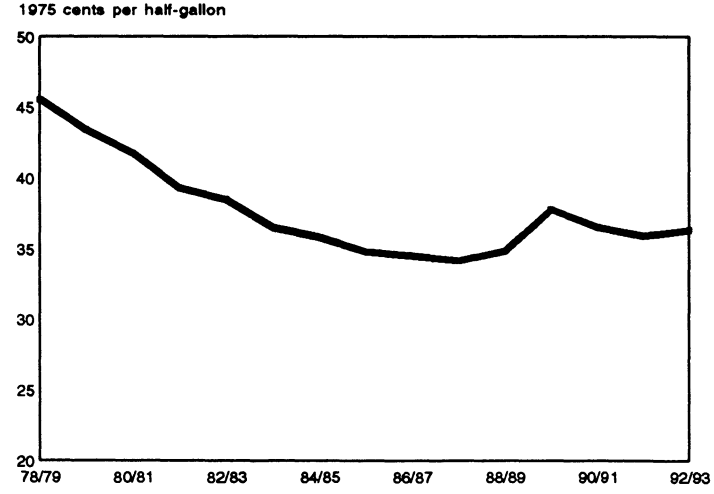
1/ Average of 12 regions. First period=12/78-8/79. Remaining periods are September 1 to August 31 of the following year.

Figure 3
Regional fluid milk price 1/



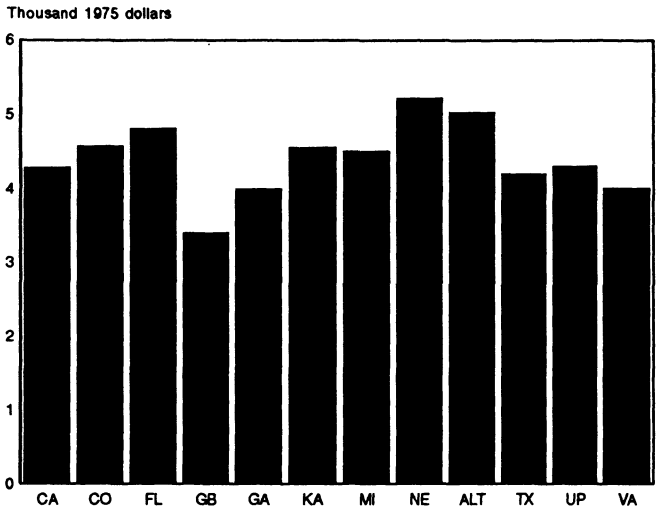
1/ Average for 12/78-9/93. See appendix for list of regions.

Figure 4
Average fluid milk price 1/



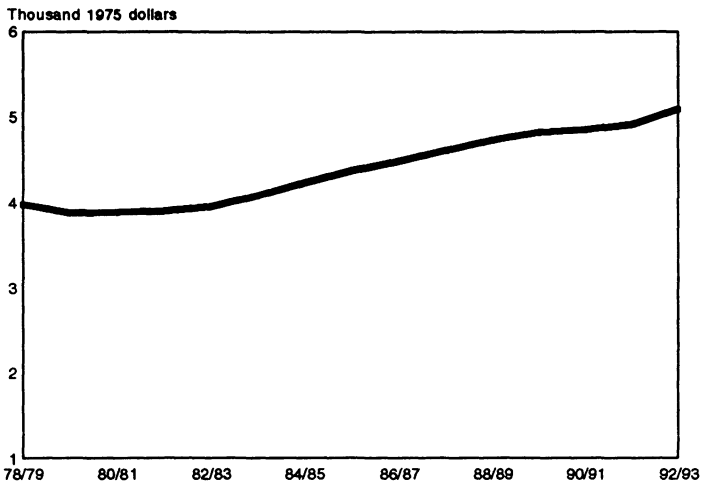
1/ Average of 12 regions. First period=12/78-8/79. Remaining periods are September 1 to August 31 of the following year.

Figure 5
Regional per capita income 1/



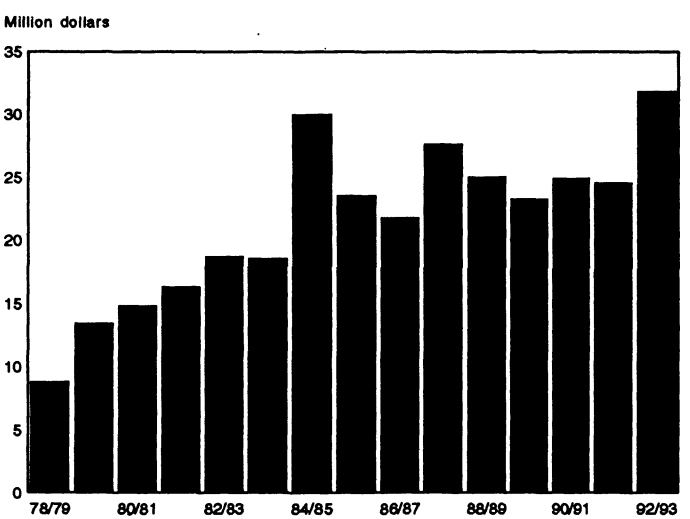
1/ Average for 12/78-9/93. See appendix for list of regions.

Figure 6
Average per capita income 1/



1/ Average of 12 regions. First period=12/78-8/79. Remaining periods are September 1 to August 31 of the following year.

Figure 7
Total advertising expenditures 1/



1/ First period=12/78-8/79. Remaining periods are September 1 to August 31 of the following year.

Figure 8
Per capita fluid milk advertising expenditures, deflated 1/

1/ Average of deflated regional and nationally prorated expenditures in 12 regions. First period is 12/78-8/79. Remaining periods are September 1 to August 31 of the following year.

substantial increases in advertising expenditures in the early months following passage of the act. The 12-region average of per capita real advertising expenditures increased from 4.3 cents in August 1984 to 7.6 cents in August 1985, a 78-percent increase. In recent years, however, real per capita advertising expenditures for the 12 regions have declined. In August 1993, the average regional real per capita advertising expenditure increased to 5.3 cents, still less than in the initial period following passage of the act.

Demographic Variables

The demographic variables that are used to account for different noneconomic characteristics in the various regions include: (1) the percentage of a region's population that is under 18 years of age; (2) the percentage that is female; (3) the percentage that is black; (4) the percentage that is rural; (5) the percentage of households that contain only one person; and (6) the median number of years of schooling among people over 25 years of age. The monthly observations were generated by interpolation and extrapolation using the growth rate and data observations from Bureau of the Census data (April 1, 1970-April 1, 1980).

The observations of economic factors, demographic characteristics, and assumptions of structural change in consumption habits enable us to estimate the per capita demand for fluid milk as a function of income, prices, demographics, advertising, shifts in advertising,[1] seasonality, and time trend:

$$\begin{aligned} Lnpcads_{it} = {} & B_0 + B_1\, Lnmapr_{it} + B_2\, Lndpcin_{it} + B_3\, Lnnu18_{it} \\ & + B_4\, Lnfem_{it} + B_5\, Lnblk_{it} + B_6\, Lnrur_{it} + B_7\, Lnhous_{it} \\ & + B_8\, Lnschl_{it} + B_9\, Lnadver_{it} + B_{10}\, Adv1_{it} + B_{11}\, Adv2_{it} \\ & + B_{12}\, Adv3_{it} + B_{13}\, Adv4_{it} + B_{14}\, Adv5_{it} + B_{15}\, Adv6_{it} \\ & + B_{16}\, Adv7_{it} + B_{17}\, Adv8_{it} + B_{18}\, Adv9_{it} + B_{19}\, Lntime_{it} \\ & + B_{20}\, Ta1_{it} + B_{21}\, Djan_{it} + B_{22}\, Dfeb_{it} + B_{23}\, Dmar_{it} \\ & + B_{24}\, Dapr_{it} + B_{25}\, Dmay_{it} + B_{26}\, Djun_{it} + B_{27}\, Djly_{it} \\ & + B_{28}\, Daug_{it} + B_{29}\, Dsep_{it} + B_{30}\, Doct_{it} + B_{31}\, Dnov_{it} + e_{it} \end{aligned} \tag{10}$$

where

Lnpcads=	Log of the average daily ounces consumed per capita by region.
Lnmapr =	Log of the deflated fluid milk price per half gallon with price reported by the market administrator for selected U.S. cities.
Lndpcin=	Log of deflated per capita income across regions and over time.
Lnnu18 =	Log of the percentage of a region's population under 18 years of age.
Lnfem =	Log of the percentage of a region's population that is female.
Lnblk =	Log of the percentage of a region's population that is black.
Lnrur =	Log of the percentage of a region's population that lives in rural areas within each region.
Lnhous =	Log of the percentage of a region's households that are single-member families.
Lnschl =	Log of the median number of years of education for individuals over 25 years of age.
Lnadver=	The advertising variable expressed as a restricted polynomial lagged model with advertising measured in real per capita advertising expenditures.
Adv1 =	Lnadver*T1, and T1=1 for September 1984 through July 1985.
Adv2 =	Lnadver*T2, and T2=1 for August 1985 through September 1986.

[1]Structural change in advertising can be expressed either as advertising coefficient changes from a zero advertising base (as in the text), or from a minimum advertising goodwill. The later estimates are presented in appendix table 1.

Adv3	=	Lnadver*T3, and T3=1 for October 1986 through September 1987.
Adv4	=	Lnadver*T4, and T4=1 for October 1987 through September 1988.
Adv5	=	Lnadver*T5, and T5=1 for October 1988 through September 1989.
Adv6	=	Lnadver*T6, and T6=1 for October 1989 through September 1990.
Adv7	=	Lnadver*T7, and T7=1 for October 1990 through September 1991.
Adv8	=	Lnadver*T8, and T8=1 for October 1991 through September 1992.
Adv9	=	Lnadver*T9, and T8=1 for October 1992 through September 1993.
Lntime	=	Log of the variable Time (Time=48-225 for December 1978 through September 1993).
Ta1	=	Lntime*Ta, and Ta=1 for September 1984 through September 1993.
Djan	=	Seasonal dummy variable for January.
Dfeb	=	Seasonal dummy variable for February.
Dmar	=	Seasonal dummy variable for March.
Dapr	=	Seasonal dummy variable for April.
Dmay	=	Seasonal dummy variable for May.
Djun	=	Seasonal dummy variable for June.
Djly	=	Seasonal dummy variable for July.
Daug	=	Seasonal dummy variable for August.
Dsep	=	Seasonal dummy variable for September.
Doct	=	Seasonal dummy variable for October.
Dnov	=	Seasonal dummy variable for November.
e_{it}	=	Equation error for region i (i=1-12) and time t (t=48-225).

Estimation and Empirical Results

The pooled cross-sectional time-series econometric model for fluid milk sales is specified in a log-linear form. Because of the distributed-lag advertising assumption, the error term in each cross section is assumed to be characterized by a first-order autocorrelation. In addition, factors omitted from the model are assumed to generate correlated contemporaneous errors across the regions. Parks' method for the generalized least squares procedure is used in the estimation (Parks, 1967). Table 1 provides the estimation results.

The double-log equation provides a reasonably good fit to the data (R^2 = 0.9). Most of the parameters possess theoretically correct signs and are statistically significant at the 5-percent probability level. Fluid milk demand is inelastic with respect to milk price and income changes. A 1-percent increase in the price reduces milk consumption by 0.13 percent. A 1-percent increase in income increases milk consumption by about 0.3 percent. Milk consumption also changes with the season, declining the most in June and July, and increasing in the fall.

Of the demographic effects, younger consumers and women are expected to have a stronger demand for dairy products because of calcium requirements. On the other hand, studies show that blacks have a higher level of intolerance to lactose (Goodhart and Shils, 1980); thus, a negative effect is expected for blacks. Rural consumers may have milk supply sources other than commercial channels, which may also have negative effects on commercial sales. The estimated effects of these variables consistently confirm these hypotheses, with only small differences in magnitude from previous empirical examination (Sun, Blaylock, and Blisard, 1993). Milk consumption is lower among rural and black consumers. A 1-percent increase in the proportion of either of these groups reduces total milk consumption by 0.01 - 0.1 percent. Young consumers and females have positive effects on consumption. A 1-percent increase in the proportion of younger people in the population increases milk consumption by about 0.5 percent. A 1-percent increase in the proportion of females in the population

Table 1--Summary of fluid milk model estimates, December 1987-September 1992[1]

Variable	Coefficient	Standard error	T-test
Intercept	4.033982	0.282702	14.269359
Lnmapr	-.128041	.015525	-8.247597
Lndpcin	.325546	.022991	14.159928
Lnnu18	.516759	.038878	13.291866
Lnfem	1.320208	.279147	4.729413
Lnblk	-.101389	.002189	-46.321001
Lnrur	-.006858	.004304	-1.593265
Lnhous	.249402	.033311	7.487111
Lnschl	-.744381	.084771	-8.781044
Lnadver	.008867	.003137	2.826178
Adv1	.019844	.004994	3.973656
Adv2	.018864	.005126	3.680302
Adv3	.017079	.005103	3.346626
Adv4	.017264	.005198	3.321321
Adv5	.017400	.005303	2.281074
Adv6	.015739	.005343	2.945840
Adv7	.015389	.005398	2.850907
Adv8	.015650	.005423	2.885931
Adv9	.017060	.005514	3.093981
Lntime	-.096666	.017095	-5.654591
TA1	.047909	.011912	4.021888
Djan	.025579	.003631	7.044174
Dfeb	.021230	.004665	4.550638
Dmar	.028458	.005222	5.449176
Dapr	.007980	.005544	1.439454
Dmay	-.012323	.005724	-2.152635
Djun	-.061153	.005804	-10.537174
Djly	-.066562	.005792	-11.492059
Daug	-.034096	.005676	-6.007050
Dsep	.028965	.005347	5.417140
Doct	.034281	.004770	7.187546
Dnov	.026222	.003734	7.023102

Estimated values of rho:

Cal	0.7780	Mic	0.8117
Col	.4498	Eng	.7901
Fla	.5788	Atl	.7787
Gbs	.6170	Tex	.7249
Geo	.8167	Umw	.7649
Kan	.6698	Vir	.8636

Number of cross sections = 12
Number of time series = 178
Total observations = 2,136

R^2	MSE	PRMSE	MABSER
0.8979	0.0025	2.2946	0.0198

[1]See appendix table 2 for the list of regions.

increases milk consumption by 1.3 percent (versus 2.2 percent estimated previously) (Sun, Blaylock, and Blisard, 1993).

The expected effects of family size and schooling are ambiguous. Larger families with young children may view milk as a low-cost protein source and may use it more often. On the other hand, single-person households may view milk as a convenience food and may consume more per person than do larger households. Education may increase nutritional awareness, and thus milk consumption. However, education may also be linked to a concern about fat, thus lowering consumption levels among more educated consumers. Estimated coefficients indicate that the single-person household has a positive coefficient of 0.25, while the schooling coefficient has a negative value of -0.74. In comparison with the previous estimation (Sun, Blaylock, and Blisard, 1993), family size has about the same positive influence, and schooling has a less negative influence in fluid milk consumption.

Because the advertising variable, Lnadver, in the equation represents a 12-month weighted sum of current and lagged per capita advertising expenditures, the coefficient of this variable, 0.009, reflects an average effect for the 12-month cumulative advertising expenditures (the α_1 in equation 9b). The advertising coefficients for Adv1 (0.0198) through Adv9 (0.0171) measure changes in the average advertising effect following the act (table 1). As with previous empirical examinations, the advertising effect was largest during September 1984-July 1985, 0.03 (average coefficient + the first measure of slope change). Later on, the advertising effect declines with different rates at every 12-month period. For the last time interval, the effect is 0.026 (average coefficient + the last shift coefficient), slightly larger than in the previous time interval.

To examine the distribution of advertising effects, the current and lagged shortrun advertising coefficients are graphed for four time periods: the period before the act (December 1978-August 1984), the period immediately after the act (September 1984-July 1985), the last period in the previous analysis (October 1991-September 1992), and the most recent period (October 1992-September 1993) (fig. 9). For all periods, the shortrun advertising effects demonstrate a peak after 6 months. However, the level and rate of change (the time shape) that the shortrun advertising coefficients trace are different for the different time intervals. The time-shape of the lagged effects is flatter before the act than in the periods after the act, indicating that advertising effects were smaller before the act. The largest shortrun advertising effects are registered in the months immediately following the act. In other words, higher advertising expenditures immediately after the act increased both current and lagged advertising effects. Subsequently, advertising efforts, and thus shortrun effects, declined. In the last period, the per capita advertising expenditures trended upward, causing increases in the lagged advertising effects, as shown in the second and third curves in figure 9.

To find the total advertising effect for each period, we used the cumulative advertising effects (advertising multipliers). The multiplier effect indicates that a 10-percent increase in advertising expenditures would eventually increase consumption by 1.9 percent in 1978-84 (fig. 10). Immediately after the act, a 10-percent increase in advertising expenditures would eventually increase consumption by 6.2 percent. For the later periods, the cumulative advertising effect has declined except for the last period. In the last period (October 1992-September 1993), a 10-percent increase in advertising expenditures would induce a cumulative increase in consumption of about 5.6 percent.

Milk consumption had a distinctly declining trend before the act. The coefficient of the time trend variable for 1978-84 is -0.095. Ward and Dixon (1989b) hypothesized that increased awareness of the importance of calcium in the diet may lead to changes in consumption habits that are captured through the time trend. The coefficient of the time trend variable after the act, 0.047, seems to bear witness to this hypothesis. However, milk consumption actually declined during the past period. A different estimation, using a minimum goodwill as base to measure the structural change in advertising, captured the negative trend in consumption but it was statistically insignificant (see appendix table 1).

Figure 9
Distribution of advertising effects for fluid milk

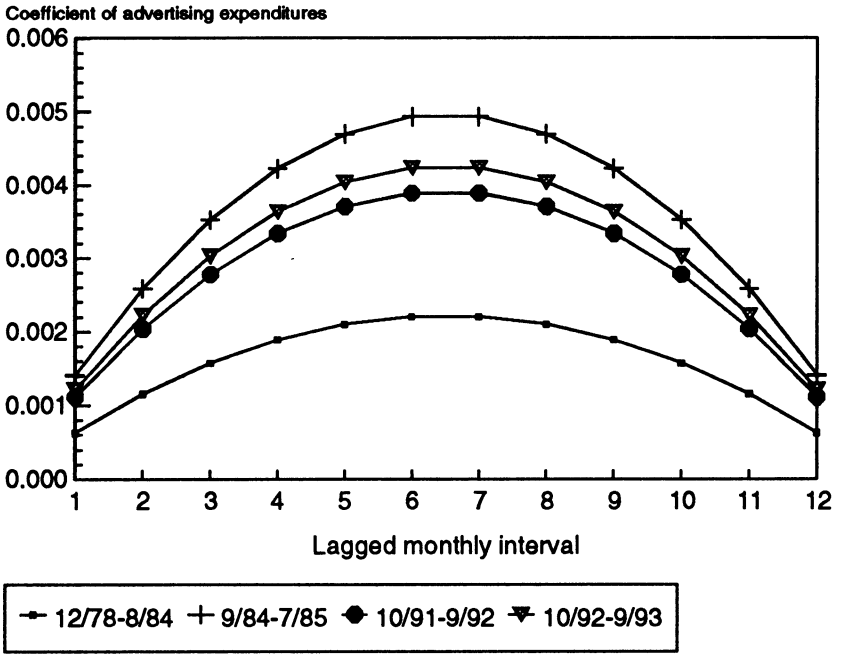
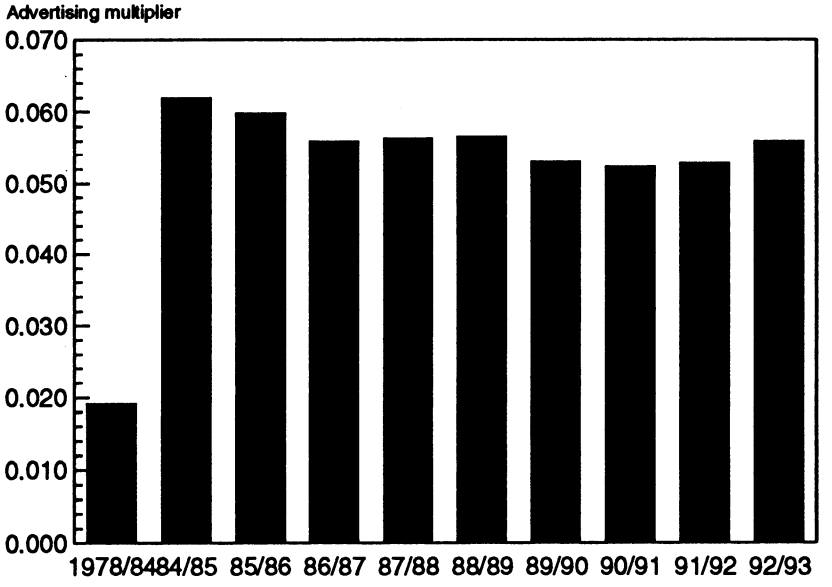


Figure 10
Dynamic shifts of advertising multiplier for fluid milk 1/



1/ Time intervals same as in figure 5. Advertising multiplier = total of current and lagged advertising effects for indicated time interval.

Simulation of Fluid Milk Advertising Effects

Analysis of the simulation effects of advertising on fluid milk consumption includes two parts: examining the influence of advertising under different scenarios of advertising expenditures and examining marginal changes in advertising effects.

Gains from Advertising Under Different Scenarios

We simulated three types of advertising effects on the consumption of fluid milk:

(1) Gains due to advertising. The gains are computed by simulating sales with and without advertising and reporting the difference.

(2) Gains due to the act. First, we assumed that regional advertising expenditures remained at the September 1983-August 1984 level (undeflated yearly total of about $18.5 million for the 12 regions). We then compared simulated sales under this advertising scenario with sales simulated from the model using actual data. The difference is the gain in sales from the act, assuming that regional programs would have continued to advertise at the levels before the act. Since the simulation is performed in real terms, per capita advertising expenditures in the assumed scenario are deflated, and real per capita advertising expenditure levels are the same as in September 1983-August 1984.

(3) Gains due to structural changes after the national program went into effect. The structural changes are measured through both the dynamics of the advertising multipliers and cyclical consumption changes in the period following passage of the act.

Tables 2 and 3 provide the fluid milk advertising expenditures and the bootstrap simulation results for the three scenarios of advertising and structural effects on fluid milk sales. In table 2, columns 2 and 5 give total expenditures for the regions and the NDB. Column 3 shows NDB expenditures prorated to the 12 regions. Column 4 shows the total of regional and prorated national advertising efforts for the 12 regions. Estimated total fluid milk advertising after the act equaled $236 million in the 12 regions.

In table 3, column 2 shows actual sales, and column 3 shows predicted sales using the observed data. Columns 4, 5, and 6 report the gains due to advertising under the three different scenarios. Columns 7 and 8 show the gains in columns 4 and 5 as percentages of actual sales (column 2).

Column 4 represents gains in sales with advertising as opposed to sales without advertising. Simulated gains in fluid milk sales due to advertising for December 1978-August 1984 were about 3.2 billion pounds (about 46.4 million pounds per month). The gains after the act reached 21.9 billion pounds (about 201.2 million pounds per month).

Column 5 shows that the simulated sales gains due to the act is 8.06 billion pounds, about 3.8 percent of actual total sales. If yearly advertising expenditures stayed at the 12-month (September 1983-August 1984) level before the act ($18.5 million), total advertising expenditures after the act would be only $168.5 million, $67.5 million less than actual after-act expenditures. Comparing the sales gains due to the act (8.06 billion pounds) with the gains in advertising expenditures ($67.5 million), the gain per act-increased advertising dollar is about 119.4 pounds.

Column 6 is the simulated structural change due to advertising and the accompanying changes in consumption trends. The total effect of structural changes after the act is a 10.5-billion-pound consumption increase (column 6).

Table 2--Generic advertising expenditures for fluid milk, December 1978-September 1993

Monthly intervals (1)	Regional programs (2)	National prorated (3)	Total regions (4)	Total national (5)
		Dollars		
Before the act:				
December 1978-August 1979	8,814,681	0	8,814,681	0
September 1979-August 1980	13,380,032	0	13,380,032	0
September 1980-August 1981	14,769,237	0	14,769,237	0
September 1981-August 1982	16,267,178	0	16,267,178	0
September 1982-August 1983	18,664,497	0	18,664,497	0
September 1983-August 1984	18,547,223	0	18,547,223	0
December 1978-August 1984	90,442,848	0	90,442,848	0
After the act:				
September 1984-August 1985	18,583,198	11,403,812	29,987,010	27,553,015
September 1985-August 1986	12,820,909	10,661,764	23,482,673	25,658,104
September 1986-August 1987	11,229,605	10,535,187	21,764,792	25,281,812
September 1987-August 1988	14,921,175	12,668,785	27,589,960	30,195,400
September 1988-August 1989	16,056,224	8,912,924	24,969,148	21,102,400
September 1989-August 1990	15,591,570	7,660,962	23,252,532	18,155,425
September 1990-August 1991	16,735,898	8,152,273	24,888,171	19,131,375
September 1991-August 1992	17,598,292	6,942,465	24,540,757	16,115,050
September 1992-August 1993	20,349,277	11,490,440	31,839,717	26,725,400
September 1993	2,131,737	1,570,847	3,702,584	3,646,700
September 1984-September 1993	146,017,885	89,999,459	236,017,344	213,564,681
December 1978-September 1993	236,460,733	89,999,459	326,460,192	213,564,681

Table 3--Actual fluid milk sales and simulated sales gains from generic advertising, December 1978-September 1993

Monthly intervals	Fluid milk sales		Advertising gains			Gain due to—	
	Actual	Estimated	Total advertising	Postact advertising[1]	Structural change	Total advertising	Postact advertising[1]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Million pounds					*Percent*	
Before the act:							
December 1978-August 1979	16,321.2	16,248.2	443.8	0	0	2.72	0
September 1979-August 1980	21,861.6	21,507.0	559.0	0	0	2.74	0
September 1980-August 1981	21,754.7	21,310.4	557.7	0	0	2.56	0
September 1981-August 1982	21,411.6	21,210.3	547.7	0	0	2.56	0
September 1982-August 1983	21,431.1	21,097.3	531.1	0	0	2.48	0
September 1983-August 1984	21,808.5	21,421.6	522.0	0	0	2.39	0
September 1978-August 1984	124,588.7	122,794.8	3,201.3	0	0	2.57	0
After the act:							
September 1984-August 1985	22,152.1	21,874.5	1,890.6	377.7	290.0	8.53	1.71
September 1985-August 1986	22,406.4	22,380.1	2,304.2	786.4	734.3	10.28	3.51
September 1986-August 1987	22,619.0	22,570.8	2,402.6	878.3	1,016.8	10.62	3.88
September 1987-August 1988	22,944.9	22,910.7	2,477.9	934.7	1,122.5	10.80	4.07
September 1988-August 1989	23,340.6	22,780.4	2,406.5	869.9	1,130.5	10.31	3.73
September 1989-August 1990	23,531.7	22,971.3	2,658.1	1,127.3	1,499.3	11.30	4.79
September 1990-August 1991	23,680.9	22,808.2	2,674.0	1,157.7	1,614.1	11.29	4.89
September 1991-August 1992	23,843.8	22,965.0	2,641.1	1,109.0	1,641.4	11.08	4.65
September 1992-August 1993	23,360.1	22,591.0	2,273.6	748.7	1,317.2	9.73	3.21
September 1993	1,958.3	1,919.8	205.3	75.2	121.5	10.48	3.84
September 1984-September 1993	209,837.8	205,771.8	21,933.9	8,064.9	10,487.6	10.45	3.84
December 1978-September 1993	334,426.5	328,566.6	25,135.2	8,064.9	10,487.6	7.52	2.41

[1]Gains measured when advertising expenditures were fixed at September 1983-August 1984 regional levels.

Table 4--Estimated marginal fluid milk gains at different advertising levels

Percent change in advertising expenditure (1)	Advertising expenditures (2)	Estimated sales (3)	Marginal changes (4)	Pounds per dollar (5)
Percent	*Million dollars*	*Billion pounds*	*Million pounds*	*Pounds/ dollar*
80	188.81	203.98	491.41	41.64
85	200.61	204.45	471.44	39.95
90	212.42	204.90	453.11	38.40
95	224.22	205.34	436.21	36.96
100	236.02	205.76	420.59	35.64
105	247.82	206.16	406.10	34.41
110	259.62	206.56	392.63	33.27
115	271.42	206.94	380.06	32.21
120	283.22	207.31	368.30	31.21

Marginal Advertising Gains

Marginal advertising gains measure how different rates of advertising expenditures affect fluid milk sales. To study the marginal gains from advertising, simulations are performed with 10 different levels of advertising expenditures. These different advertising levels are calculated as percentage decreases and increases from actual advertising expenditures after the act ($236 million). Table 4 provides the simulated total sales for the different advertising expenditure levels and the corresponding marginal changes at these expenditure levels. A 20-percent reduction in actual expenditures would have a marginal gain of 41.6 pounds per dollar, while a 20-percent increase in the actual expenditure level would have a lower marginal gain of 31.2 pounds per dollar. Marginal gains are declining over the years. Comparing with our last year's estimation, the rate of gain is about 2 to 3 percent less for a similar percentage change in advertising expenditures (Sun, Blaylock, and Blisard, 1993).

Simulation of Fluid Milk Price and Income Effects

Table 5 presents simulations of consumption changes when price or income is assumed to remain at the September 1983-August 1984 level. For the 12 regions, the average real fluid milk price during September 1983-August 1984 was 36.5 cents per half-gallon. It decreased to 34.2 cents per half-gallon during 1987/88, and rose to 37.8 cents per half-gallon during 1989/90. Prices declined again to about 36 cents per half-gallon in 1991/92 and 1992/93. Declining price caused consumption to increase. The simulated total gain from price decreases during the September 1984-September 1993 period is 1 billion pounds, about 0.5 percent of actual sales.

Income has an increasing trend. In September 1992-August 1993, per capita real income was 25 percent higher than that of the corresponding 1983/84 period, resulting in a simulated consumption increase of 5.7 billion pounds, or 2.7 percent of actual sales.

Table 5--Simulated gains in fluid milk sales attributed to price and income changes after passage of the act, September 1984-September 1993

Monthly intervals	Fluid milk sales		Price and income gains		Gains due to--	
	Actual	Estimated	Price fixed[1]	Income fixed[1]	Price	Income
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Million pounds				*Percent*	
September 1984-August 1985	22,152.1	21,876.3	53.1	270.3	0.24	1.22
September 1985-August 1986	22,406.4	22,330.2	144.8	421.2	.65	1.88
September 1986-August 1987	22,619.0	22,552.8	176.4	539.0	.78	2.38
September 1987-August 1988	22,944.9	22,925.4	229.0	667.5	1.00	2.91
September 1988-August 1989	23,340.6	22,811.9	175.4	757.0	.75	3.24
September 1989-August 1990	23,531.7	22,980.8	-30.7	814.9	-.13	3.46
September 1990-August 1991	23,680.9	22,817.8	72.0	716.7	.30	3.03
September 1991-August 1992	23,843.8	22,921.4	116.4	647.2	.49	2.71
September 1992-August 1993	23,360.1	22,609.7	92.2	835.7	.39	3.58
September 1993	1,958.3	1,921.0	10.2	87.4	.52	4.46
September 1984-September 1993	209,837.8	205,747.2	1,038.8	5,756.9	.50	2.74
December 1978-September 1993	334,426.5	328,444.9	1,038.8	5,756.9	.31	1.72

[1]Gains measured when price or income was fixed at the September 1983-August 1984 level.

Specification of the Cheese Models

Branded and generic advertising, the price of cheese, prices of substitutes (such as meat, poultry, and fish), income, seasonality, trends, and government donations influence the demand for cheese. To isolate and measure the effects of advertising, we must control for the effects of these variables on quantities demanded. Processed and natural cheese purchase patterns, prices, and product characteristics are sufficiently different to warrant separate analyses of each. Among these differences are the following:

(1) Natural cheese purchases vary significantly by month and season, with a peak in December and a trough in July. Processed cheese purchases vary much less from season to season.

(2) Government donations of cheese under the Temporary Emergency Food Assistance Program were predominantly processed cheese. Hence, donations probably have a greater effect on processed cheese purchases than on purchases of natural cheese.

(3) Natural cheese is a higher priced product than processed cheese. Hence, it should have larger price and income effects.

The cheese advertising data include both generic and branded advertising. In the natural cheese equation, generic and branded advertising expenditures were entered separately. For processed cheese, a single company usually dominates the product promotion, with a high percentage of the advertising expenditures allocated to a few products (*Leading National Advertisers*). Thus, for processed cheese, branded advertising may have generic advertising characteristics, and they are entered as a single variable in the processed cheese model. Advertising effects in the cheese equations are modeled with a logarithmic or an inverse functional form with carryover effects following a gamma distribution.

Because we are interested in examining the entry and exit effects of advertising in the consumer demand for cheese, we estimated three demand equations for each type of cheese. These equations are the market demand for cheese, the average quantity demanded, and demand in terms of the proportion of purchasing consumers in the market. Aside from advertising expenditures, seasonal dummies, and a trend term, other variables are in logarithmic form. The two sets of mathematical demand equations, for natural and processed cheese, are as follows:

$$\begin{aligned} LnQ_t^n,\ Lnq_t^n,\ LnP_r^n = {} & \beta_0 + \beta_1\ LnP_t^n + \beta_2\ LnP_t^p + \beta_3\ LnP_t^m \\ & + \beta_4\ D_t + \beta_5\ LnY_t + \beta_6\ T_t + \sum_{j=1}^{11} d_j\ M_j \\ & + \alpha_1 \sum_{i=0}^{t-1} (i+1)^{d(1-c)} L^i [1/(K_1 + A_{t-i}^g)] \\ & + \alpha_2 \sum_{i=0}^{t-1} (i+1)^{s(1-s)} H^i [Ln(K_2 + A_{t-i}^b)] + e_t \end{aligned} \tag{11}$$

and

$$
\begin{aligned}
LnQ_t^p,\ Lnq_t^p,\ LnP_r^p = {} & \beta_0 + \beta_1\ LnP_t^p + \beta_2\ LnP_t^n + \beta_3\ LnP_t^I \\
& + \beta_4\ LnP_t^m + \beta_5\ LnY_t + \beta_6\ LnD_t \\
& + \alpha_1 \sum_{i=0}^{t-1} (i+1)^{g/(1-g)} G^i [1/(K_1 + Adv_{t-i})] + e_t
\end{aligned}
\tag{12}
$$

where:

LnQ_t^n = Log of per capita quantity of natural cheese purchases by U.S. households, in pounds per month t (t = 1...138 for January 1982 through June 1993).

Lnq_t^n = Log of average per capita quantity of natural cheese purchases by U.S. households purchasing natural cheese, in pounds per month t (t = 1...138 for January 1982 through June 1993).

LnP_r^n = Log of proportion of all U.S. households that purchased natural cheese during month t (t = 1...138 for January 1982 through June 1993).

LnQ_t^p = Log of per capita quantity of processed cheese purchases by U.S. households, in pounds per month t (t = 1...138 for January 1982 through June 1993).

Lnq_t^p = Log of average per capita quantity of processed cheese purchases by U.S. households, in pounds per month t (t = 1...138 for January 1982 through June 1993).

LnP_r^p = Log of proportion of all U.S. households that purchased processed cheese during month t (t = 1...138 for January 1982 through June 1993).

LnP_t^n = Log of price of natural cheese in dollars per pound, deflated by the Consumer Price Index (CPI, 1977 = 100 for all urban consumers).

LnP_t^p = Log of price of processed cheese in dollars per pound, deflated by the CPI.

LnP_t^m = Log of price index for meat, poultry, and fish, deflated by the CPI.

LnP_t^I = Log of price of imitation cheese in dollars per pound, deflated by the CPI.

LnY_t = Log of U.S. per capita disposable income in month t, deflated by the CPI.

LnD_t = Log of per capita domestic donations of cheese in pounds under the Temporary Emergency Food Assistance Program.

T_t = Time trend, T = 1...138 for January 1982 through June 1993.

M_j = Monthly dummy variables, M_1 = 1 if j = January, zero otherwise; M_2 = 1 if j = February, zero otherwise; and so forth. December is omitted to avoid perfect multicollinearity.

A_{t-i}^g = Current and past per capita generic advertising expenditures for cheese, deflated by media cost index (i = 0 for the current period and i = t-1 for the beginning period).

A_{t-i}^b = Current and past per capita branded advertising expenditures for cheese, deflated by media cost index (i = 0 for current period and i = t-1 for the beginning period).

Adv_{t-i} = Deflated current and past per capita advertising expenditures (branded and generic) for processed cheese (i = 0 for current period and i = t-1 for the beginning period).

K_1, K_2 = Goodwill indexes for generic and branded cheese advertising. This value is small (0.0001), intended to capture the word-of-mouth or other goodwill effect at any given time even if no advertising took place.

The weights $(i+1)^{c/(1-c)}L^i$ and $(i+1)^{s/(1-s)}H^i$ in equation 11 represent gamma lag structures for the inverse of current and past per capita (deflated) generic advertising expenditures, and logarithm of per capita branded advertising expenditures. The time shapes of these gamma lags are determined by parameters c, L, s, and H. The gamma lag structure for the inverse of both generic and branded advertising expenditures and goodwill in equation 12 is $(i+1)^{g/(1-g)}G^i$. The time shapes of these gamma lags are determined by parameters g and G.

Time-Varying Parameter Estimation

As with the fluid milk model, the structure of current and lagged advertising effects in the cheese model is hypothesized to change over time. Such change in the advertising multiplier effect is because, as the public continues to see and read cheese advertisements, the quality of the ad changes, or the overall advertising strategy is refined. By allowing the advertising parameter to change over time, the model hypothesizes that there is a structure change in the distribution of advertising effects on sales. In the fluid milk demand model, such structural change in the advertising effects is captured through the estimates of the interaction of weighted advertising expenditures and time. In the cheese model, the time-varying parameter models (tvpm) procedure tests this dynamic multiplier effect. The tvpm estimation procedure of the cheese model specifically allows the coefficients of advertising to have a time-varying process in the form of a random walk. In other words, let the advertising coefficients be $\alpha_t = \alpha_{t-1} + \upsilon_t$. With this specification, parameter α_t will drift over the course of the data, usually with an obvious trend reflecting continuing change of the parameter if it does change over the sample period.

Because of the carryover and time-varying advertising parameter assumptions, the error terms of the equations are assumed to follow a first-order autocorrelation scheme. Direct estimation of the parameters of the gamma distribution is not practical. The estimation strategy was to set the parameters to fixed values and to estimate the remaining parameters in a given equation by ordinary least squares. The procedure was repeated for a wide range of values for c, L, s, H, g, and G, and the equation yielding the best statistical fit with plausible parameter estimates was selected. Thus, the standard errors for the parameters c, L, s, H, g, and G are not available. This estimation procedure will also bias downward the standard errors of other parameters in the model.

Data

Data on retail prices and quantities for natural, imitation, and processed cheese are obtained from the National Dairy Board (NDB) as reported by the Market Research Corporation of America (MRCA). The time-series data on household cheese purchases reflect aggregate national purchase data estimated from a continuing consumer panel. The data include only cheese purchased for direct consumption at home. Cheese consumed in restaurants, away-from-home establishments, or consumed in connection with purchased foods (such as pizzas and macaroni-and-cheese mixtures) is not included.

Because MRCA reports prices and quantities in 4-week intervals, these data have to be converted to a calendar-month basis. The method was to allocate to each month the prices or quantities in a week that overlapped 2 calendar months according to the number of days in the overlapping months. Total number of buying households in a month is divided by the total number of households to calculate the proportion of buying households in a given month. To remove any artificial month-to-month fluctuations caused strictly by the uneven number of days in a month, data for quantity, income, and advertising expenditures are adjusted for each calendar month to reflect the same number of days.

The Bureau of Labor Statistics, U.S. Department of Commerce provided the price indexes for meat, poultry, fish, and all items. Personal disposable income is obtained from the Bureau of Economic Analysis, U.S. Department of Commerce. U.S. civilian population data are from the Bureau of the Census, U.S. Department of Commerce.

Government cheese donations are expected to displace retail sales. A time trend is assumed to capture the downward trend in natural cheese consumption (Blaylock and Blisard, 1988). Monthly dummy variables in the natural cheese model capture seasonal variation in consumption.

Monthly branded cheese advertising expenditures were supplied by the United Dairy Industry Association (UDIA). UDIA, together with NDB, the Wisconsin Milk Marketing Board, and the California

Table 6--Estimated generic and branded cheese advertising expenditures, 1982-1993

Period	Generic advertising	Branded advertising
	Million dollars	
1982	5.8	56.4
1983	6.0	57.8
1984	21.7	83.3
1985	56.5	78.9
1986	58.0	73.2
1987	49.7	51.3
1988	42.2	89.5
1989	37.5	85.8
1990	37.3	104.0
1991	33.1	87.7
1992	31.3	70.5
1993, January-June	14.9	43.5

Milk Advisory Board, supplied monthly cheese generic promotion expenditures. Twenty-five percent of NDB's calcium advertising expenditures were included in the advertising variable. Promotion expenditures include only the media cost of advertising, and do not include such items as talent and production costs. Media expenditures include radio, television, outdoor, and print costs.

Table 6 provides generic and branded cheese advertising expenditures for 1982-93. Generic advertising peaked in 1986 at $58 million, and declined to $31.3 million in 1992. Still, the increase from 1982 to 1992 was over 439 percent. Branded advertising expenditures fluctuated between 1982 and 1992, with a high of $104 million in 1990 before declining 15.7 percent to $70.5 million in 1992.

Separate media cost indexes deflated both generic and branded advertising expenditures, allowing advertising expenditures to be interpreted as a measure of the quantity of advertising taking place in each time period. We constructed the divisia advertising cost indexes using information on the share of total advertising expenditures spent for each type of media and price indexes for each media type. Divisia cost indexes are exact for an underlying translogarithmic unit cost function. (For details in constructing this type of index, see Diewert, 1976, p. 121.) Monthly advertising expenditures by media type (for both branded and generic advertising) and monthly price indexes by media type were not available. Thus, we constructed quarterly divisia indexes. We obtained the budget shares devoted to each media type for cheese advertising by quarter from various issues of *Leading National Advertisers* (LNA). In the case of generic advertising, some judgments were required in constructing media shares because LNA did not always separate UDIA advertising expenditures for cheese from other dairy products. Yearly media price indexes by media type were taken from *Media Insights*, published by the advertising firm of D'Arcy, MacManus, and Masuis. We used that firm's adjustment factors to convert the yearly price indexes to a quarterly basis.

Empirical Results of Demand for Cheese

The empirical results provided two different aspects of demand for cheese: the total market demand and the proportion of households entering and exiting the cheese market. Although the cheese demand equations were tested with the dynamic advertising multiplier hypothesis, the time-varying parameter estimations yielded almost constant coefficients over time for the advertising variables in each equation. Thus, the results are of a fixed parameter estimation with the assumption of first-order autocorrelation.

Market Demand for Cheese

Tables 7 and 8 present parameter estimates of the natural and processed cheese market demand equations. Both equations provide a reasonably good statistical fit to the data. Most parameter estimates have the expected signs and are generally of reasonable magnitudes.

Demand is more elastic for natural than for processed cheese. In the market demand equations, the own-price elasticity for natural cheese is about -1.4, and that for processed cheese is about -0.79. Thus, a 10-percent decrease in the price of natural cheese would increase consumption by 14 percent. A 10-percent decrease in the price of processed cheese would increase consumption by only 8 percent. Both price elasticities are statistically significant at the 5-percent probability level.

Table 7--Summary of natural cheese model estimates, January 1982-June 1993

Source	Estimated b values	T for H:b=0	Prob T	Standard error of estimate
Intercept	0.765	0.508	0.6126	1.506
$\log(p^n)$	-1.399	-5.849	.0001	.239
$\log(p^p)$	.675	3.411	.0009	.198
$\log(p^m)$	.713	4.490	.0001	.159
log(Y)	-.068	-.409	.6831	.166
d	-.002	-2.306	.0229	.001
t	-.003	-5.424	.0001	.001
Djan	-.125	-8.072	.0001	.016
Dfeb	-.132	-6.504	.0001	.020
Dmar	-.159	-9.736	.0001	.016
Dapr	-.185	-12.104	.0001	.015
Dmay	-.220	-12.535	.0001	.018
Djun	-.238	-14.011	.0001	.017
Djul	-.267	-14.717	.0001	.018
Daug	-.235	-12.070	.0001	.020
Dsep	-.194	-11.423	.0001	.017
Doct	-.173	-10.482	.0001	.017
Dnov	-.104	-10.567	.0001	.010
advb	.003	0.938	.350	.003
advg	*	-1.615	.1091	*
rho	-.499	-6.228	.0001	.080
c	.7			
L	.001			
s	.7			
H	.3			

Note: rho is the first-order autocorrelation coefficient.
Adjusted R^2 = 0.93.
Number of observations = 138.
Degrees of freedom = 117.
* The b value for advg is -0.0004, its standard error 0.0002.

Table 8--Summary of processed cheese estimates, January 1982-June 1993

Source	Estimated b values	T for H:b=0	Prob T	Standard error of estimate
Intercept	-1.070	-1.441	0.1521	0.743
$\log(p^n)$	.098	.704	.4825	.139
$\log(p^p)$	-.792	-4.299	.0001	.184
$\log(p^i)$	.337	4.372	.0001	.084
$\log(p^m)$	.717	2.792	.0060	.257
log(Y)	.024	.324	.7465	.073
d	-.002	-2.766	.0065	.001
adv	-.155	-2.473	.0147	.063
rho	-.602	-8.571	.0001	.070
g	.2			
G	.9			

Note: rho is the first-order autocorrelation coefficient.
Adjusted R^2 = 0.71.
Number of observations = 138.
Degrees of freedom = 130.

Demand for both natural and processed cheese seems insensitive to income changes. The estimated income elasticity for processed cheese is about 0.02. The estimated income elasticity for natural cheese is also small and has a wrong sign. Both estimates are not statistically significant.

The cross-price elasticities measure the extent to which the demand for a good is influenced by the price changes of its substitutes or complements. A positive cross-price elasticity suggests that two commodities are substitutes. A negative cross-price elasticity suggests that the two commodities are complements. Natural and processed cheeses are substitutes. However, the estimated substitution effects between them are not symmetric. The cross-price elasticity between purchase of natural cheese and the price of processed cheese is close to 0.7. Conversely, the cross-price elasticity between processed cheese purchase and natural cheese price is only 0.1 and not statistically significant. For the other substitution effects, meat price positively influences the purchases of either type of cheese with a cross-price elasticity close to 0.7, while imitation cheese price influences processed cheese purchases with a cross-price elasticity of 0.3. All of these estimates are statistically significant.

Government donations have negative influences on consumption of both natural and processed cheese. The estimated donation coefficients indicate that a 10-percent increase in cheese donations may result in a 0.02-percent reduction in the purchase of either natural or processed cheese.

Demand for processed cheese did not demonstrate seasonal fluctuations. Measurement of seasonal demand for natural cheese indicates that the natural cheese purchase demand has a seasonal high in December. Its lowest consumption month is July, when the seasonal coefficient is about -0.27. Aside from seasonal fluctuations, natural cheese purchase share also declined over the years. The estimated trend effect is -0.003 and statistically significant.

Generic advertising influences natural cheese purchases but branded advertising does not. The coefficient of the sum of weighted branded advertising expenditures is not statistically significant. The estimated generic gamma distribution (c = 0.7, L = 0.001) provides the carryover effect with weights the highest in the current period and declining immediately to nil in the third period. The coefficent of the

weighted inverse of generic advertising expenditures is -0.0004 and statistically significant at the 10-percent probability level.

Advertising is more effective in increasing demand for processed than for natural cheese. The estimated coefficient for the weighted inverse of branded and generic advertising in the processed cheese equation is -0.155 and significant at the 5-percent probability level. Of the carryover weights obtained from the gamma distribution (g = 0.2, G = 0.9), the highest weight occurred in the first lagged period, with the previous 9 months' advertising inducing about 50 percent of the total advertising effect.

Cheese Entry and Exit Demand

Examining the proportion of all households purchasing cheese and the average amount of cheese they purchased provides analysis of entry and exit in demand. Table 9 presents estimates of the proportion of households in the natural cheese market. All variable coefficients have the expected signs, and most are significant at the 10-percent probability level. A 10-percent increase in the price of natural cheese reduces the proportion of households in the natural cheese market by about 5 percent. A 10-percent increase in the price of substitute goods, either processed cheese or meats, increases the proportion of households in the natural cheese market by 4 percent.

The current and lagged generic advertising (from Gamma distribution estimation) also induces entry in the natural cheese market. A 10-percent increase in the Gamma weighted generic advertising expenditures is associated with a 0.003-percent increase in the proportion of households in the natural cheese market.

The average purchase per purchasing household for a product provides us with another source to examine the increase (decrease) in total market demand through entry (exit) in the cheese market. Table 10 indicates how the various factors influence the average natural cheese purchase per purchasing household. Income, branded, and generic advertising are not significant enough to influence the magnitude of average quantity purchased. All other variables are statistically significant and have the expected signs.

The entry or exit demand estimation for processed cheese is presented in tables 11 and 12. In table 11, changes in price of processed cheese do not induce any significant changes in the number of households purchasing processed cheese. However, a 10-percent rise in prices of substitutes such as natural cheese, imitation cheese, and meat increases the proportion of households likely to purchase processed cheese by 2, 3, and 7 percent, respectively. Increased consumer income also affects household entry into the cheese market. A 10-percent increase in income is associated with an 8-percent increase in the percentage of households in the processed cheese market. Advertising also has limited pull for more households buying processed cheese. A 10-percent increase in the weighted sum of generic and branded advertisings increases the proportion of households in the processed cheese market by less than 1 percent.

A 10-percent increase in processed cheese price reduces average consumption by about 5 percent. Likewise, a 10-percent increase in the price of imitation cheese will increase the average amount purchased by about 1.3 percent, while a 10-percent increase in the price of meats will increase the average amount purchased by about 2 percent. Income and natural cheese price are not statistically significant factors that influence the average consumption of processed cheese per purchasing household.

Table 9--Estimates of the proportion of households purchasing natural cheese, January 1982-June 1993

Source	Estimated b values	T for H:b=0	Prob T	Standard error of estimate
Intercept	5.997	6.423	0.0001	0.9337
$\log(p^n)$	-.501	-3.300	.0013	.1518
$\log(p^p)$	.374	3.008	.0032	.1243
$\log(p^m)$	.358	3.726	.0003	.0961
log(Y)	-.181	-1.750	.0827	.1031
d	-.001	-1.861	.0653	.0005
t	-.001	-3.415	.0009	.0004
Djan	-.076	-7.670	.0001	.0099
Dfeb	.040	3.200	.0018	.0126
Dmar	-.080	-7.744	.0001	.0103
Dapr	-.046	-4.797	.0001	.0096
Dmay	-.118	-10.657	.0001	.0111
Djun	-.091	-8.483	.0001	.0107
Djul	-.143	-12.488	.0001	.0115
Daug	-.122	-9.863	.0001	.0124
Dsep	-.055	-5.162	.0001	.0107
Doct	-.086	-8.129	.0001	.0106
Dnov	.005	.844	.4003	.0064
advb	-.0001	-.061	.9511	.0017
advg	*	-1.899	.0600	.0002
rho	-.460	-5.613	.0001	.0821
c	.7			
L	.001			
s	.7			
H	.3			

Adjusted R^2 = 0.94.
Number of observations = 138.
Degrees of freedom = 118.
* The b value for advb and advg are .0001 and -.0003, respectively.

Table 10--Estimates of the average quantity of natural cheese bought by purchasing households, January 1982-June 1993

Source	Estimated b values	T for H:b=0	Prob T	Standard error of estimate
Intercept	-0.610	-0.597	0.5516	1.0217
$\log(p^n)$	-.897	-5.332	.0001	.1683
$\log(p^p)$	.301	2.200	.0297	.1370
$\log(p^m)$	.344	3.312	.0012	.1038
log(Y)	.108	.959	.3396	.1130
d	-.001	-1.743	.0840	.0005
t	-.002	-4.709	.0001	.0004
Djan	-.049	-4.437	.0001	.0111
Dfeb	-.070	-5.064	.0001	.0138
Dmar	-.079	-6.855	.0001	.0115
Dapr	-.106	-9.997	.0001	.0106
Dmay	-.102	-8.281	.0001	.0123
Djun	-.115	-9.721	.0001	.0118
Djul	-.123	-9.687	.0001	.0127
Daug	-.113	-8.235	.0001	.0137
Dsep	-.105	-8.862	.0001	.0119
Doct	-.088	-7.450	.0001	.0118
Dnov	-.087	-10.899	.0001	.0071
advb	.003	1.549	.1241	.0019
advg	*	-.426	.6709	.0002
rho	-.439	-5.278	.0001	.0831
c	.7			
L	.001			
s	.7			
H	.3			

Adjusted R^2 = 0.85.
Number of observations = 138.
Degrees of freedom = 118.
* The b value for advg is -0.0001.

Table 11--Estimates of the proportion of households purchasing processed cheese, January 1982-June 1993

Source	Estimated b values	T for H:b=0	Prob T	Standard error of estimate
Intercept	-4.497	-6.154	0.0001	0.7300
$\log(p^n)$	.231	1.771	.0790	.1304
$\log(p^p)$	.008	.045	.9642	.1700
$\log(p^i)$	.275	3.425	.0008	.0802
$\log(p^m)$	.736	3.570	.0005	.2061
log(Y)	.848	11.665	.0001	.0727
d	.000	.135	.8927	.0007
advb	-.060	-1.256	.2114	.0478
rho	-.475	-6.128	.0001	.0775
g	.2			
G	.9			

Adjusted R^2 = 0.52.
Number of observations = 138.
Degrees of freedom = 129.

Table 12--Estimates of the average quantity of processed cheese bought by purchasing households, January 1982-June 1993

Source	Estimated b values	T for H:b=0	Prob T	Standard error of estimate
Intercept	-0.444	-0.991	0.3233	0.4476
$\log(p^n)$	.052	.666	.5063	.1000
$\log(p^p)$	-.533	-5.332	.0001	.0773
$\log(p^i)$	.134	2.782	.0062	.0481
$\log(p^m)$	.197	1.760	.0807	.1121
log(Y)	.038	.852	.3958	.0447
d	-.002	-3.827	.0002	.0004
advb	-.045	-1.759	.0809	.0253
rho	-.387	-4.800	.0001	.0811
g	.2			
G	.9			

Adjusted R^2 = 0.80.
Number of observations = 138.
Degrees of freedom = 130.

Simulations of the Cheese Demand Equations

The purposes of our simulations are to: (1) examine the effects on cheese purchases of increased generic advertising after passage of the 1983 act, (2) examine changes in cheese consumption at different levels of advertising expenditures, and (3) examine the effects on cheese purchases of changes in cheese prices, substitute prices, and income.

The statistical error associated with each estimate of the natural and processed cheese demand equations is small enough to permit a statistically founded conclusion that advertising increases the demand for cheese. Thus, we can use these estimated-demand equations for generic advertising with sufficient confidence to simulate the total effect of advertising on cheese purchases. We used the following procedures to simulate the effect on cheese purchases of increased generic advertising after passage of the act. First, we simulated per capita consumption from the natural and processed cheese equations using the actual levels of generic advertising. Next, we simulated per capita consumption by assuming that generic advertising remained at the monthly per capita levels of the year before passage of the act, September 1983-August 1984. For this procedure, we assumed that, in the absence of the act, generic advertising dollars spent would have increased over time at the same rate as inflation in media costs. We then estimated per capita consumption of natural and processed cheese on a monthly basis during September 1984-June 1993. The only factor that differed between the simulations was the level of generic advertising expenditures. We kept all other factors at actual levels observed during the period.[2] The difference in per capita consumption between the simulations is an estimate of the effects of the act. We then obtained the national effects of the act by expanding the per capita effect by total population.

Table 13 presents the advertising simulations. The table indicates that increased generic advertising expenditures due to the act increased national consumption of natural cheese at home by 38.9 million pounds during September 1984-June 1993. Total national consumption of natural cheese at home during the same period was 10.2 billion pounds. Similar estimates from the processed cheese model indicate that increased generic advertising caused by the act increased national consumption of processed cheese at home by 315.6 million pounds. Total national consumption of processed cheese at home was 7.3 billion pounds. Because of the sustained effect of past advertising on current consumption, generic advertising appears to be much more effective in increasing total consumption of processed than natural cheese.

To examine consumption changes at different levels of advertising expenditures, we simulated the effect of increasing (decreasing) real generic advertising expenditures by 10 percent above (below) the actual amount spent during September 1984-June 1993. Results indicate that a 10-percent increase or decrease in generic advertising expenditures for cheese would have virtually no effect on natural cheese consumption. A 10-percent increase (decrease) in advertising expenditures, however, would have increased (decreased) processed cheese consumption by 28.5 (30.8) million pounds.

We used similar procedures to simulate the effects on cheese purchases of changes in other model variables. First, we simulated per capita consumption from the natural and processed cheese equations using the actual levels of all variables. Next, we simulated per capita consumption assuming that the variable of interest, say natural cheese price, remained at the monthly levels of the year before the act, September 1983-August 1984. The only factor that differed between simulations was the level of the variable under study. We kept all other factors at actual levels observed during the period. The

[2]This control implies that the behavior of branded cheese advertisers did not change in response to the expanded generic programs. In reality, branded advertising dollars increased dramatically when the act became effective. If branded advertising increased as a result of the act, then our simulation underestimates the effect of the legislation.

difference in per capita consumption between the simulations is an estimate of the effect of changes in an individual variable. We then obtained the national effects by multiplying the per capita effects by the total population (table 14).

Falling real natural cheese prices, down 11.2 percent on average from September 1983-August 1984 to September 1984-June 1993, increased natural cheese sales by about 1.7 billion pounds. All other variables were constant. This change in natural cheese prices reduced processed cheese sales by about 99.8 million pounds because natural and processed cheeses are substitutes. An 8.7-percent decline in real processed cheese prices between these periods increased processed cheese sales by 491.7 million pounds. A 2.4-percent drop in real prices of meat, poultry, and fish reduced natural cheese sales by 51.0 million pounds and processed cheese sales by 42.1 million pounds. Rising real consumer income, up 16.2 percent, increased natural cheese sales by approximately 69.2 million pounds and processed cheese sales by 17.3 million pounds.

Table 13--Summary of model simulation results on the effect of regional and national generic cheese advertising on national at-home consumption, September 1984-June 1993

Item	Unit	Sales/advertising results
Total sales of natural cheese	Million pounds	10,184.7
Total sales of processed cheese	Million pounds	7,295.0
Estimated increase in national and regional advertising expenditures due to act	Million dollars[1]	311.0
Natural cheese:		
Sales gain due to advertising	Million pounds	38.9
As a share of total sales	Percent	.4
Per advertising dollar	Pounds	.1
Processed cheese:		
Sales gain due to advertising	Million pounds	315.6
As a share of total sales	Percent	4.3
Per advertising dollar	Pounds	1.0

[1] Includes 25 percent of the calcium advertising of the National Dairy Promotion and Research Board.

Table 14--Summary of model simulation results on the effects of changes in selected variables on consumption of natural and processed cheese at home, September 1984-June 1992

Item	Sales results
	Million pounds
Sales gain or loss due to changes in selected variables:	
Natural cheese--	
Decreasing price of natural cheese	1,691.9
Decreasing price of processed cheese	-620.9
Decreasing price of meat, poultry, and fish	-51.0
Increasing income	69.2
Processed cheese--	
Decreasing price of natural cheese	-99.8
Decreasing price of processed cheese	491.7
Decreasing price of meat, poultry, and fish	-42.1
Increasing income	17.3

Study Limitations

In their comparative static analysis of optimal advertising policy, Nerlove and Waugh (1961) noted that without supply control, the elasticities of supply, demand, and longrun marginal revenue of advertising jointly determine the optimal advertising expenditures. If the model is cast in a dynamic framework, optimal advertising policy also depends on the expected rates of change in demand and supply shifters, the temporal distribution of advertising effects, and the discounting rate of investment (Nerlove and Arrow, 1962). Both of the comparative static and dynamic optimization studies, however, deal with generalized aggregate supply and demand markets. Recently, Kaiser et al. (1993) examined a disaggregated industry model at the retail, wholesale, and farm levels with markets for fluid products, frozen products, cheese, and butter. The multi-product, multi-market level model could simultaneously account for the direct and cross-product impacts of concurrent advertising programs for fluid and manufactured products. Wohlgenant and Clary (1993), on the other hand, examined a farm-to-retail price linkage model using an industry-derived demand equation for milk linking advertising and Government purchases to farm price. Because we use a single-equation retail demand, supply is implicitly fixed. Thus, advertising effects from this study could be larger than if we assume a flexible supply that responds to increased demand.

The other limitations of this study are related to the data. First, the fluid milk model encompasses only 40 percent of national milk consumption. For the cheese analysis, MRCA data measure only household purchases of cheese at retail establishments for off-premise consumption. MRCA did not measure cheese consumed away from home or as a component of a food product. USDA per capita disappearance data suggest that cheese use has increased over time, but the MRCA data show that it is generally declining. Such data differences suggest that growth in eating away from home and the consumption of cheese in food mixtures more than offset the downward trend in purchases for consumption at home. Generic advertising may affect consumption of cheese away from home and food mixtures containing cheese that are not measured with the MRCA data. Thus, our estimates may understate the total effects of generic advertising.

Another area that requires attention is the data for the advertising variable. Advertising expenditure in dollars and cents are a convenient measure of the theoretical concept of an advertising variable. However, these expenditures take several forms depending on the controlling agent, the types of media

used, and the message content. In other words, the quality of advertising is not evident from an expenditure measurement.

The issue of how best to model the effects of past advertising on current consumption should also receive more attention. This critical issue can significantly affect the simulated effects of advertising expenditures on consumption.

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Appendix

Appendix table 1 lists results using the minimum goodwill expenditure (per capita advertising expenditure $0.0015) as a base for measuring changes in advertising the multiplier at a different time interval. Comparing with the text table 1, advertising has smaller cumulative effects in the second and third postact periods, but larger multipliers afterwards. The measured time trend for milk consumption is negative, albeit statistically insignificant, in the postact period. Other economic, demographic, and seasonal effects are about the same as those obtained in the text. Appendix table 2 lists definitions of the 12 regions included in the fluid milk study.

Appendix table 1. Fluid milk estimation using minimum advertising for slope change, December 1987-September 1993[1]

Variable	Coefficient	Standard error	T-test
Intercept	6.875477	0.766027	8.975498
Lnmapr	-.139662	.015254	-9.155913
Lndpcin	.323994	.022888	14.155814
Lnnu18	.501246	.037691	13.298958
Lnfem	1.189795	.273559	4.349317
Lnblk	-.100031	.002121	-47.152863
Lnrur	-.006452	.004045	-1.595237
Lnhous	.247271	.034380	7.192203
Lnschl	-.796732	.081891	-9.729218
Lnadver	.009120	.003125	2.918340
Adv1	.005126	.005444	0.941723
Adv2	.011090	.005308	2.089426
Adv3	.018184	.005801	3.134637
Adv4	.019509	.005777	3.376734
Adv5	.020688	.005831	3.547909
Adv6	.029283	.006278	4.664749
Adv7	.032435	.006544	4.956717
Adv8	.032556	.006839	4.760274
Adv9	.027447	.006937	3.956489
Lntime	-.098173	.016428	-5.975801
TA1	-.002164	.003472	-0.623314
Djan	.026377	.003640	7.245795
Dfeb	.022520	.004678	4.813546
Dmar	.030018	.005237	5.731728
Dapr	.009345	.005557	1.681817
Dmay	-.011382	.005731	-1.985970
Djun	-.060271	.005802	-10.387265
Djly	-.065674	.005783	-11.356048
Daug	-.033351	.005665	-5.887130
Dsep	.029529	.005331	5.539580
Doct	.033370	.004783	6.977297
Dnov	.025537	.003742	6.824045

Estimated values of rho:

Cal	0.7512	Mic	0.8207
Col	.4758	Eng	.7821
Fla	.5609	Atl	.7937
Gbs	.6312	Tex	.7360
Geo	.7998	Umw	.7368
Kan	.6672	Vir	.8660

Number of cross sections = 12
Number of time series = 178
Total observations = 2,136

R^2	MSE	PRMSE	MABSER
0.8977	0.0025	2.3037	0.0198

[1]See appendix table 2 for the list of regions.

Appendix table 2. Definition of regions

Region	Federal marketing order number	Marketing area	
		States	Minor civil divisions
California (CA)	Not available	California	Entire State.
Eastern Colorado (CO)	137	Colorado	Adams, Arapahoe, Boulder, Cheyenne, Clear Creek, Crowley, Custer, Denver, Douglas, Elbert, El Paso, Gilpin, Huerfano, Jefferson, Kiowa, Kit Carson, Larimer, Las Animas, Lincoln, Logan, Morgan, Otero, Park, Phillips, Pueblo, Sedgwick, Teller, Washington, Weld, and Yuma Counties.
		Kansas	Cheyenne, Logan, Sherman, and Wallace Counties.
Georgia (GA)	7	Georgia	Entire State except Catoosa, Chattooga, Dade, Fannin, Murray, Rabun, Walker, and Whitfield Counties.
Great Basin (GB)	139	Idaho	Bannock, Bear Lake, Bingham, Bonneville, Caribou, Franklin, Jefferson, Madison, Oneida, and Power Counties.
		Nevada	Clark, Elko, Lincoln, and White Pine Counties.
		Utah	Beaver, Box Elder, Cache, Carbon, Daggett, Davis, Duchesne, Emery, Garfield, Grand, Iron, Jaub, Kane, Millard, Morgan, Piute, Rich, Salt Lake, San Juan, Sanpete, Sevier, Summit, Tooele, Uintah, Utah, Wasatch, Washington, Wayne, and Weber Counties.
		Wyoming	Lincoln and Uinta Counties.
Greater Kansas City (KA)	64	Kansas	Atchison, Brown, Clay, Cloud, Dickinson, Doniphan, Douglas, Geary, Jackson, Jefferson, Johnson, Leavenworth, Lyon, Marshall, Miami, Morris, Nemaha, Ottawa, Pottawatomie, Republic, Riley, Saline, Shawnee, Wabaunsee, Washington, and Wyandotte Counties.
		Missouri	Andrew, Atchison, Bates, Buchanan, Cass, Clay, Clinton, Daviess, De Kalb, Gentry, Henry, Holt, Jackson, Johnson, Lafayette, Nodaway, Pettis, Platte, St. Clair, and Worth Counties.

Continued--

Appendix table 2. Definition of regions–Continued

Region	Federal marketing order number	Marketing area: States	Marketing area: Minor civil divisions
Middle Atlantic (ALT)	4	Delaware	Entire State.
		District of Columbia	Entire District.
		Maryland	Anne Arundel, Baltimore, Calvert, Caroline, Carroll, Cecil, Charles, Dorchester, Frederick, Harford, Howard, Kent, Montgomery, Prince Georges, Queen Annes, St. Marys, Somerset, Talbot, Washington, Wicomico, and Worcester Counties; and the city of Baltimore.
		New Jersey	Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Mercer, and Salem Counties; the boroughs of Barnegat Light, Beach Haven, Harvey Cedars, Ship Bottom, and Tuckerton; and the townships of Eagleswood, Lacey, Little Egg Harbor, Long Beach, Ocean, Stafford, and Union in Ocean County.
		Pennsylvania	Adams, Bucks, Chester, Cumberland, Dauphin, Delaware, Franklin, Fulton, Juniata, Lancaster, Lebanon, Montgomery, Perry, Philadelphia, and York Counties.
		Virginia	Arlington, Fairfax, Loudoun, and Prince William Counties and the cities of Alexandria, Fairfax, and Falls Church.
New England (NE)	1	Connecticut	Entire State.
		Massachusetts	Barnstable, Bristol, Essex, Franklin (except the towns of New Salem, Orange, and Warwick), Hampden (except the towns of Brimfield, Monson, Palmer, and Wales), Hampshire (except the town of Ware), Middlesex, Norfolk, Plymouth, Suffolk, and Worcester (except the towns of Athol, Barre, Douglas, East Brookfield, Hardwick, New Braintree, Northbridge, North Brookfield, Petersham, Phillipston, Royalston, Templeton, Uxbridge, Warren, West Brookfield, and Winchendon) Counties.
		New Hampshire	Belknap, Cheshire, Grafton (the towns of Ashland, Bridgewater, Bristol, Holderness, and Plymouth),Hillsborough, Merrimack, Rockingham, Strafford, and Sullivan (except the town of Plainfield) Counties.
		Rhode Island	Entire State except the town of New Shoreham (Block Island) in Washington County.
		Vermont	Bennington (the towns of Landgrove, Peru, and Winhall), Windham (except Somerset), and Windsor (the towns of Andover, Baltimore, Cavendish, Chester, Ludlow, Plymouth, Reading, Springfield, Weathersfield, Weston, West Windsor, and Windsor) Counties.

Continued--

Appendix table 2. Definition of regions—Continued

Region	Federal marketing order number	Marketing area	
		States	Minor civil divisions
Southeastern Florida (FL)	13	Florida	Broward, Dade, Glades, Hendry, Indian River, Martin, Monroe, Okeechobee, Palm Beach, and St. Lucie Counties.
Southern Michigan (MI)	40	Michigan	Alcona, Alpena, Antrim, Arenac, Barry, Bay, Benzie, Calhoun, Charlevoix, Cheboygan, Clare, Clinton, Crawford, Eaton, Emmet, Genesee, Gladwin, Grand Traverse, Gratiot, Huron, Ingham, Ionia, Iosco, Isabella, Jackson, Kalamazoo, Kalkaska, Kent, Lake, Lapeer, Leelanau, Livingston, Macomb, Manistee, Mason, Mecosta, Midland, Missaukee, Montcalm, Montmorency, Muskegon, Newaygo, Oakland, Oceana, Ogemaw, Osceola, Oscoda, Otsego, Ottawa, Presque Isle, Roscommon, Saginaw, St. Clair, Sanilac, Shiawassee, Tuscola, Washtenaw, Wayne, and Wexford Counties; the townships of Dorr, Gunplain, Hopkins, Leighton, Martin, Otsego, Watson, and Wayland in Allegan County; the townships of Ash and Berlin in Monroe County.
Texas (TX)	126	Texas	Anderson, Andrews, Angelina, Aransas, Archer, Austin, Bastrop, Baylor, Bee, Bell, Bexar, Borden, Bosque, Brazoria, Brazos, Brooks, Brown, Burleson, Burnet, Caldwell, Calhoun, Callahan, Cameron, Camp, Chambers, Cherokee, Clay, Coke, Coleman, Collin, Colorado, Comal, Comanche, Cooke, Coryell, Dallas, Dawson, Delta, Denton, De Witt, Duval, Eastland, Ector, Ellis, Erath, Falls, Fannin, Fayette, Fisher, Foard, Fort Bend, Franklin, Freestone, Galveston, Glasscock, Goliad, Gonzales, Grayson, Gregg, Grimes, Guadalupe, Hamilton, Hardeman, Hardin, Harris, Harrison, Haskell, Hays, Henderson, Hidalgo, Hill, Hood, Hopkins, Houston, Howard, Hunt, Jack, Jackson, Jasper, Jefferson, Jim Wells, Jonson, Jones, Karnes, Kaufman, Kenedy, Kent, King, Kleberg, Knox, Lamar, Lampasas, Lavaca, Lee, Leon, Liberty, Limestone, Live Oak, Madison, Marion, Martin, Matagorda, McLennan, Midland, Milam, Mills, Mitchell, Montague, Montgomery, Morris, Nacogdoches, Navarro, Newton, Nolan, Nueces, Orange, Palo Pinto, Panola, Parker, Polk, Rains, Red River, Refugio, Robertson, Rockwall, Runnels, Rusk, Sabine, San Augustine, San Jacinto, San Patricio, Scurry, Shackelford, Shelby, Smith, Somervell, Stephens, Sterling, Stonewall, Tarrant, Taylor, Throckmorton, Titus, Tom Green, Travis, Trinity, Tyler, Upshur, Van Zandt, Victoria, Walker, Waller, Washington, Wharton, Wichita, Wilbarger, Willacy, Williamson, Wilson, Wise, Wood, and Young Counties.

Continued--

Appendix table 2. Definition of regions–Continued

Region	Federal marketing order number	Marketing area	
		States	Minor civil divisions
Upper Midwest (UP)	68	Iowa	Howard, Kossuth, Mitchell (except the city of Osage), Winnebago, Winneshiek, and Worth Counties.
		Minnesota	Entire State except Lincoln, Nobles, Pipestone, and Rock Counties.
		North Dakota	Barnes, Cass, Cavalier, Dickey, Grand Forks, Griggs, La Moure, Nelson, Pembina, Ramsey, Ranson, Richland, Sargent, Steele, Traill, and Walsh Counties.
		South Dakota	Brown, Day, Edmunds, Grant, McPherson, Marshall, Roberts, and Walworth Counties.
		Wisconsin	Ashland, Barron, Bayfield, Buffalo, Burnett, Chippewa, Clark, Douglas, Dunn, Eau Claire, Pepin, Pierce, Polk, Price, Rusk, St. Croix, Sawyer, Taylor, Trempealeau, and Washburn Counties.
Virginia (VA)	Not available	Virginia	Entire State except that area regulated under the Middle Atlantic order.

U.S. Department of Agriculture
Economic Research Service

SUMMARY OF REPORT #AIB-705

Consumer Interest in Nutrition Grows, and the Food Sector Responds

October 1994

Contact: Elizabeth Frazao, 202/219-0911

As evidence of the link between diet and health grows in the United States, many consumers are changing their diets. Food consumption patterns have changed dramatically in the last 20 years. Eating patterns are slowly shifting toward healthier diets, although there is still considerable room for improvement in meeting Federal food guidance recommendations. The food sector is clearly aware that nutrition is important to many consumers, and has been active in responding to consumer demand for foods with improved nutrient profiles. Meats, for example, are much leaner now than even 10 years ago, due to improved breeding practices and changes in meat trimming practices.

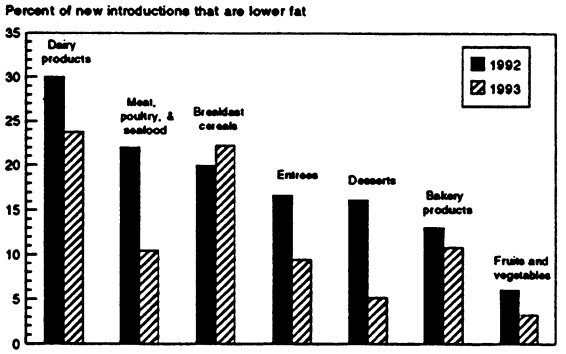
Consumer Concerns About Nutrition: Opportunities for the Food Sector, a recent report from USDA's Economic Research Service, reveals that many consumers want to improve their diets, but claim they lack the information to do so. Research has shown that many of the changes Americans have made in their food choices end up canceling each other out. To assist consumers in choosing a healthier diet, the Federal Government has overhauled its nutrition labeling regulations. In mid-1994, new nutrition labels became mandatory for most processed foods. Although nutrition labeling remains voluntary for fresh produce, meats, and seafood, the regulations contain strong incentives for the information to be made available to consumers.

New or reformulated products have also abounded. More than 4,500 claims were made about the high nutrient content of new foods in 1992--nearly four times the number made in 1988, and a 5-percent increase above the number filed in 1991. The number of nutrient content claims on new products fell significantly in 1993, possibly related to the new mandatory nutrition labeling regulations. These regulations may push manufacturers to reformulate their products to further improve their nutrient content to meet the new definitions and requirements for health claims and nutrient descriptors.

Although Americans are making some dietary changes, they enjoy the taste of high-fat foods and do not seem willing to give them all up. If food companies can develop lower-fat products that taste like traditional high-fat foods, and provide consumers with acceptable low-fat substitutes, the food industry can help consumers to eat less fat without having to greatly change their eating habits.

1992 and 1993 product introductions that are low, reduced, or nonfat, by product category

Dairy products and breakfast cereals were the main food groups introducing lower fat products in 1993.



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SUMMARY OF REPORT #SB-888

Americans Spending Smaller Share of Income on Food

October 1994

Contact: David Smallwood, (202) 219-1265

Urban Americans increased their food expenditures by 59 percent, from $985 per person in 1980 to $1,567 in 1992, according to a new report by USDA's Economic Research Service. During this same period, per person household income rose 94 percent from $6,916 to $13,398. As a result, the percent of income spent on food declined from 14.2 to 11.7 percent. Annual spending per person for food consumed at home increased 55 percent from $667 to $1,036, compared with an increase of nearly 69 percent for food consumed away from home, which rose from $318 to $536. Rural Americans spent about the same on food at home as urban Americans but somewhat less on food away from home. During this period, prices for total food rose 58.9 percent, prices for food at home rose 54.8 percent, and prices for food consumed away from home rose 68.7 percent. After adjusting for prices, urban Americans were buying about the same amount of food in 1992 as they were in 1980.

Food Spending in American Households, 1980-92 presents information on trends in household food expenditures for major food groups by selected demographic factors for 1980-92. Information is also presented on food price trends. Detailed tabulations are presented for 133 food categories by 10 household socioeconomic characteristics for 1992, the most recent year of data available. Several measures of food expenditures and prices are presented. The data are from the 1980-92 Consumer Expenditures Diary Surveys prepared by the Bureau of Labor Statistics, U.S. Department of Labor. (These surveys are described in detail in the report.)

Using the per person food spending information in this report, one can determine the similarities and disparities in spending habits of households of differing sizes, races, incomes, geographic areas, and other socioeconomic and demographic features. This information is valuable for assessing existing market conditions, product distribution patterns, consumer buying habits, and consumer living conditions. Combined with demographic and income projections, this information may be used to anticipate consumption trends. The information may also be used to develop typical market baskets of foods for special population groups, such as the elderly. These market baskets may, in turn, be used to develop price indices tailored to the consumption patterns of these population groups.

Highlights of the report include:

- Household size--One-person households spent more than twice as much per person on food as households of six or more persons. In 1992, one-person households spent $2,146 per year compared with $878 per person per year for households of six or more persons. One-person households also spent a much larger share of their food budget on food consumed away from home: 42 percent versus 20 percent. Married couples without children spent about the same per person as single persons, while single mothers with children spent about half as much. Married couples with children spend more per person as their children get older, but expenditures tend to be less than for married couples without children.

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