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Fluid Milk and Cheese Advertising

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Abstract

Generic advertising expenditures raised fluid milk sales about 5.6 percent, or 12.8 billion pounds, between September 1984 and September 1994. Sales of natural and processed cheese consumed at home rose by about 46.8 million pounds and 367.0 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. Activities of the recently established National Fluid Milk Processor Promotion Board are also analyzed.

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

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Summary

Generic advertising raised fluid milk sales an estimated 1.0 billion pounds, or 4.4 percent, during September 1993-August 1994. 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 1994), fluid milk sales are estimated to be 5.6 percent (almost 12.8 billion pounds) above what they would have been without the advertising. Fluid milk advertising expenditures for September 1984-September 1994 equal $296 million, of which $109.5 million is attributed to the act. The gain per act-increased advertising dollar is about 117 pounds.

Advertising expenditures due to the act are estimated to have increased natural cheese sales by 46.8 million pounds (0.4 percent) during September 1984-September 1994. Act-increased generic advertising boosted processed cheese sales an estimated 4.4 percent (367.0 million pounds).

Blacks, rural households, and people with higher education levels drink less milk than the national average. Studies have shown blacks to have a higher level of intolerance to lactose, which may account for their consuming less milk than average. 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 1994 increased fluid milk sales by 1 billion pounds. Increasing real incomes raised fluid milk sales by 6.6 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 natural cheese generic advertising may not induce existing consuming households to increase their purchase, but it may attract newcomers to the natural cheese market. On the other hand, processed cheese advertising may induce processed cheese consuming households to increase their purchase, but it may not be effective enough to add new consumers to the processed cheese market.

Falling real natural cheese prices, down 25 percent on average from September 1983-August 1984 to September 1993-August 1994, increased natural cheese sales by about 1.9 billion pounds, according to the cheese model. A 17-percent decline in real processed cheese prices between these periods increased processed cheese sales by 585.4 million pounds. A 3-percent drop in real prices of meat, poultry, and fish reduced natural cheese sales by 72.4 million pounds and processed cheese sales by 72.5 million pounds. Rising real consumer income, up about 15 percent, is estimated to have reduced natural cheese sales approximately 176.5 million pounds but increased processed cheese sales by 34.3 million pounds.

In July 1994, the National Fluid Milk Processor Promotion Board (Fluid Board) was created with the objective of strengthening the position of the dairy industry in the marketplace and maintaining and expanding markets and uses for fluid milk products produced in the United States. In January 1995, the Fluid Board initiated a national media campaign designed to educate women between the ages of 25 and 44 about the nutritional qualities of milk and its importance in a healthy diet. The largest portion of the campaign (about $37 million) will be directed toward a national magazine and supplemental local media advertising campaign. The campaign is designed to change attitudes about milk while generating both awareness and interest in dairy products. The Fluid Board's advertising is expected to have a major impact on milk consumption over the coming year.

Fluid Milk and Cheese Advertising

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Introduction

This report is an updated analysis of the effectiveness of generic advertising on fluid milk and cheese sales. Two dairy boards are responsible for national generic dairy advertising. The Dairy and Tobacco Adjustment Act of 1983 (Dairy Act) authorized a national producer program for dairy product promotion, research, and nutrition education as part of a comprehensive strategy to increase human consumption of milk and dairy products and reduce milk surpluses. This self-help program is funded by a mandatory 15-cent per hundredweight assessment on all milk produced in the contiguous 48 States and marketed commercially by dairy farmers and is administered by the National Dairy Promotion and Research Board (NDB). The Dairy Act provides that dairy farmers can direct up to 10 cents per hundredweight of the assessment for contributions to qualified regional, State, or local dairy product promotion, research, or nutrition education programs. This annual report satisfies one of the requirements of the Act--yearly evaluation of the effectiveness of the dairy promotion program.

The Fluid Milk Promotion Act of 1990 authorized the establishment of a national processor program for fluid milk promotion. This program is carried out by the National Fluid Milk Processor Promotion Board (Fluid Board). This program is financed through a 20-cent per hundredweight assessment on fluid milk processed and marketed in the United States by processors who marketed more than 500,000 pounds of fluid milk per month. The mission of the fluid milk board is to establish a fluid milk promotion and consumer education program that is funded by fluid milk processors. The program is designed to strengthen the position of the dairy industry in the marketplace and to maintain and expand markets and uses for fluid milk products in the United States. Consumer education is a program that uses public relations, advertising, or other means to educate consumers about the desirable characteristics of fluid milk products. Advertising is a program that involves only fluid milk products and is to inform consumers about the positive attributes of fluid milk. Both areas of promotion are intended to increase the general demand for milk. The advertising campaign of the fluid milk board was launched in early 1995. Hence, the impact of this campaign will not be known until USDA's next evaluation in 1996.

The advertising analysis for fluid milk is based on a 12-region, pooled, cross-sectional time-series model originated by Ward and Dixon (1989a, 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 impact on the dependent variable, we estimated the model with Parks' (1967) generalized least-squares procedure. Data for the analysis extends from December 1978 through September 1994.

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 10 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 1994, when advertising expenditures begin to surge.

The total increase in advertising spending since the act is $295.9 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 1994 is 9.2 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 6.6 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 September 1994. 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 statistically a significant factor in increasing the demand for natural cheese. Generic advertising has a two-period weighted carryover effect on natural cheese purchases, with most of the weight occurring in the current period.

For processed cheese, branded and generic advertising separately are not important demand-shifting factors. However, the combined effects 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 entering the natural cheese market were its own price, the price of substitutes such as meat and processed cheese, and generic advertising. Generic advertising increased the proportion of consumers entering the natural cheese market, but it did not induce those already in the market to increase their purchases. For processed cheese, combined generic and branded advertising had no effect on the proportion of consumers in the market but it 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 predominated in 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 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:

$$q = 1/r \sum q_i \qquad (1)$$

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:

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

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:

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

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

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

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 average quantity purchased curve and the proportion of consumers in the market curve. 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 firm's advertising is aimed at ultimate consumers, while it sells in an intermediate market, an increased sales effect will be delayed in reaching the 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:

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

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:

$$\delta_j = \alpha_0 + \alpha_1\,((j+1)/13) + \alpha_2\,((j+1)/13)^2 \qquad (8)$$

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

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

or

$$\delta_j = \alpha_1\, W_j \qquad (9b)$$

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 through September 1994. The period before the act is December 1978-August 1984. The period after the act is September 1984-September 1994. 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 USDA's Agricultural Marketing Service (AMS) 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 pre- and post-act periods.

Fluid Milk Consumption

Total fluid milk sales are recorded in pounds of milk sold per month within each of the 12 regions. California has the highest share of the 12-region total sales, about 29 percent. Kansas has the lowest share, about 2 percent. However, after adjusting for differences in population and monthly calendar days, the Great Basin area ranks the highest in per capita fluid milk consumption (about 12.1 daily ounces), and California ranks seventh (8.5 ounces). Generally, per capita fluid milk consumption 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 of the 12 regions showed a declining trend before August 1984; following the dairy promotion act, however, consumption tended to stay higher than the 1984 level until 1992. Average daily consumption for the 12 regions declined to 8.7 ounces in 1994.

Fluid Milk Prices

Fluid milk prices are from representative cities within the 12 regions. Before 1993, prices were reported in both whole and half-gallon units, and the prices selected for the fluid milk model were in cents per half-gallon unit, deflated by regional consumer price indexes (base = 1975). Beginning in 1993, the half-gallon fluid milk prices were discontinued. Thus, the price series for 1994 was projected from historical price

data. Regionally, Georgia has the highest average price, and New England the lowest. It is worth noting that comparisons of milk price and average per capita consumption present mixed results. For instance, California has a low price (32.9 cents per half gallon) but also a low average consumption (8.5 ounces). Conversely, the upper Midwest has a high price (38.7 cents per half gallon) and also a high average consumption (10.7 ounces) On the average, real fluid milk price for the 12 regions demonstrated a declining trend before 1989. It increased in 1990, but later decreased at a level higher than the 1989 level. Average milk price for all regions declined to 35.7 cents per half gallon.

Income

New England has the highest average per capita real income (1975 = 100), followed by the Middle Atlantic region and Florida. Average real income for the 12 regions increased from December 1978 to September 1994. The rate of increase was slower before 1984. During December 1978-August 1984, average annual real income for the 12 regions increased by 2.38 percent. For September 1993-August 1994, average annual real income increased by over 3 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 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. Note, that over the past year the NDB and UDIA have merged their operations for national advertising. The new entity is known as Dairy Management Incorporated (DMI). Hence, starting with the year September 1994-August 1995, DMI will be responsible for national dairy advertising.

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. Total 12-region advertising expenditures increased considerably in 1984-85. Later, advertising expenditures declined because regional shares declined. In 1994, total advertising increased from $31.8 million to about $56.7 million, due mainly to a large campaign by the California milk processors. There were substantial increases in advertising expenditures in the early months following passage of the act. Total milk advertising has ranged from about $30.0 million just after passage of the act to about $24.5 million in 1992. Advertising expenditures will increase for the next few years due to a major campaign by the national dairy processors.

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:

$$
\begin{aligned}
Lnpcads_R = {} & B_0 + B_1\, Lnmapr_R + B_2\, Lndpcin_R + B_3\, Lnnu18_R \\
& + B_4\, Lnfem_R + B_5\, Lnblk_R + B_6\, Lnrur_R + B_7\, Lnhous_R \\
& + B_8\, Lnschl_R + B_9\, Lnadver_R + B_{10}\, Adv1_R + B_{11}\, Adv2_R \\
& + B_{12}\, Adv3_R + B_{13}\, Adv4_R + B_{14}\, Adv5_R + B_{15}\, Adv6_R \\
& + B_{16}\, Adv7_R + B_{17}\, Adv8_R + B_{18}\, Adv9_R + B_{19}\, Adv10_R \\
& + B_{20}\, Lntime_R + B_{21}\, Ta1_R + B_{22}\, Djan_R + B_{23}\, Dfeb_R \\
& + B_{24}\, Dmar_R + B_{25}\, Dapr_R + B_{26}\, Dmay_R + B_{27}\, Djun_R \\
& + B_{28}\, Djly_R + B_{29}\, Daug_R + B_{30}\, Dsep_R + B_{31}\, Doct_R \\
& + B_{32}\, Dnov_R + e_R
\end{aligned}
\tag{10}
$$

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.

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 T9=1 for October 1992 through September 1993.

Adv10 = Lnadver*T10, and T10=1 for October 1993 through September 1994.

Lntime = Log of the variable Time (Time=48-225 for December 1978 through September 1994).

Ta1 = Lntime*Ta, and Ta=1 for September 1984 through September 1994.

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_R = Equation error for region i (I=1-12) and time t (t=48-237).

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[1]Structural change in advertising can be expressed either as advertising coefficient changes from zero advertising base (as in the text), or from a minimum advertising goodwill.

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 first-order autocorrelation. In addition, there can be factors omitted from the model affecting all regions (contemporaneous errors across the regions are assumed to be correlated). 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 0.12 percent. A 1-percent increase in income increases milk consumption by about 0.3 percent. Milk consumption also changes with season, declining most in June and July, and increasing in the fall.

Of the demographic effects, younger consumers and women are expected to consume less milk than men do. In addition, studies show that Blacks have a higher level of intolerance to lactose (Goodhart and Shils, 1980); thus, a negative effect is expected for all three variables. 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, except for the women and young children variables, which have the wrong sign. However, milk consumption is lower among rural and Black consumers. A 1-percent increase in the proportion of each of those groups reduces total milk consumption by 0.003 and 0.1 percent, respectively.

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 of it than larger households do on a per-person basis. Education may increase nutritional awareness, and thus milk consumption. However, education may 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 0.20, while the schooling coefficient has a negative value of -0.73.

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 (0.022) through adv10 (0.022) measure changes in the average advertising effect following the act. Estimation indicates the effect is about the same for any of the 10 time periods after creation of the NDB, 0.03 (average coefficient + the measure of slope change). Since the slope shifters are so similar in value, it may be possible to drop them from the model and allow the main advertising variable, lnadver, to capture the total effect.

Milk consumption had a distinctly declining trend before the act. The coefficient of the time trend variable for 1978-94 is -0.102. 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 post-act time trend variable Ta1. The coefficient of this time trend variable after the act, 0.054, seems to bear witness to this hypothesis. However, milk consumption actually declined during the latest period.

Table 1--Summary of fluid milk model estimates (December 1978-September 1994)[1]

Variable	Coefficient	Standard error	T-test
Intercept	3.814970	0.270126	14.122951
Lnmapr	-.117526	.015023	-7.822851
Lndpcin	.319907	.021870	14.627984
Lnnu18	.459166	.037494	12.246486
Lnfem	1.182599	.268847	4.398785
Lnblk	-.102841	.002082	-49.398235
Lnrur	-.003053	.004286	-.712329
Lnhous	.204860	.030850	6.640457
Lnschl	-.734443	.081262	-9.037957
Lnadver	.009204	.003306	3.008703
Adv1	.022109	.004812	4.594263
Adv2	.021509	.004930	4.363087
Adv3	.019429	.004904	3.961754
Adv4	.019855	.004998	3.972544
Adv5	.020204	.005099	3.962715
Adv6	.018584	.005139	3.616240
Adv7	.018318	.005197	3.524693
Adv8	.018521	.005223	3.545883
Adv9	.019856	.005334	3.722279
Adv10	.022169	.005570	3.980287
Lntime	-.101807	.017758	-5.733104
TA1	.053625	.011475	4.673202
Djan	.024520	.003758	6.523899
Dfeb	.018528	.004821	3.843168
Dmar	.026521	.005390	4.919656
Dapr	.004937	.005719	.863274
Dmay	-.013858	.005902	-2.348326
Djun	-.062893	.005981	-10.514929
Djly	-.070183	.005967	-11.762209
Daug	-.035059	.005844	-5.999184
Dsep	.027959	.005508	5.075809
Doct	.032000	.004921	6.501388
Dnov	.027568	.003858	7.145198

Estimated values of rho:

Cal	0.7759	Mic	0.8233
Col	.4489	Eng	.7779
Fla	.5858	Atl	.7552
Gbs	.6409	Tex	.7117
Geo	.8180	Umw	.7714
Kan	.6460	Vir	.8665

No. of cross sections = 12
No. of time series = 190
Total observations = 2,280

R^2	MSE	PRMSE	MABSER
0.8987	0.0025	2.3099	0.0201

[1]See appendix for list of regions.

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 kept 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 postact period.

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 is the 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 $296 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 25.1 billion pounds (about 207.6 million pounds per month).

Column 5 shows that the simulated sales gain due to the act is 12.77 billion pounds, about 5.6 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 $186.5 million, $109.5 million less than actual after-act expenditures. Comparing the sales gains due to the act (12.77 billion pounds) with the gains in advertising expenditures ($109.5 million), the gain per act-increased advertising dollar is about 116.6 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 12.4-billion-pound consumption increase (column 6).

Table 2--Generic advertising expenditures for fluid milk, December 1978-September 1994

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-August 1994	39,970,010	20,447,352	60,417,362	47,421,400
September 1994	2,698,309	545,372	3,243,681	1,263,200
September 1984-September 1994	186,554,467	109,421,336	295,975,803	258,602,581
December 1978-September 1994	276,997,315	109,421,336	386,418,651	258,602,581

Table 3--Actual fluid milk sales and simulated sales gains from generic advertising, December 1978-September 1994

Monthly intervals	Fluid milk sales		Advertising gains			Gain due to	
	Actual	Simulated	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	16,273.6	440.5	0	0	2.71	0
September 1979-August 1980	21,861.6	21,529.0	594.3	0	0	2.72	0
September 1980-August 1981	21,754.7	21,312.9	552.9	0	0	2.54	0
September 1981-August 1982	21,411.6	21,192.1	542.5	0	0	2.53	0
September 1982-August 1983	21,431.1	21,072.5	525.8	0	0	2.45	0
September 1983-August 1984	21,808.5	21,383.8	516.5	0	0	2.36	0
September 1978-August 1984	124,588.7	122,763.9	3,172.6	0	0	2.55	0
After the act:							
September 1984-August 1985	22,152.1	21,924.8	2,047.3	458.6	381.3	9.24	2.07
September 1985-August 1986	22,406.4	22,372.0	2,391.5	1,075.4	769.4	10.67	4.80
September 1986-August 1987	22,619.0	22,607.2	2,517.3	1,515.5	1,089.5	11.13	6.70
September 1987-August 1988	22,944.9	22,932.6	2,563.0	1,442.2	1,176.1	11.17	6.29
September 1988-August 1989	23,340.6	22,859.6	2,522.8	1,380.9	1,224.6	10.81	5.92
September 1989-August 1990	23,531.7	23,045.5	2,729.1	1,530.0	1,555.6	11.59	6.50
September 1990-August 1991	23,680.9	22,852.9	2,701.6	1,579.5	1,635.8	11.41	6.67
September 1991-August 1992	23,843.8	22,994.0	2,633.6	1,502.3	1,635.8	11.05	6.30
September 1992-August 1993	23,360.1	22,727.0	2,351.3	1,194.4	1,404.3	10.07	5.11
September 1993-August 1994	23,331.5	22,914.6	2,461.5	1,007.4	1,376.7	10.74	4.40
September 1994	2,006.7	1,936.4	203.5	78.9	114.6	10.51	4.07
September 1984-September 1994	233,217.7	229,166.6	25,122.4	12,765.5	12,363.7	10.96	5.57
December 1978-September 1994	357,806.4	351,930.5	28,294.9	12,765.8	12,363.7	8.04	3.63

[1]Gains measured when advertising expenditures were fixed at September 1983-August 1984 regional levels.
[2]Gains due to changes in advertising effects and consumption trends after the act.

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

Percent change in advertising expenditure	Advertising expenditures	Estimated sales	Marginal changes	Pounds per dollar
(1)	(2)	(3)	(4)	(5)
Percent	*Million dollars*	*Billion pounds*	*Million pounds*	*Pounds/ dollar*
80	236.78	226.97	622.98	42.09
85	251.58	227.56	597.52	40.37
90	266.38	228.14	574.17	38.80
95	281.18	228.69	552.66	37.34
100	295.98	229.22	532.80	36.00
105	310.77	229.74	514.39	34.76
110	325.57	230.23	497.27	33.60
115	340.37	230.72	481.31	32.52
120	355.17	231.18	466.38	31.51

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 ($296 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 42.1 pounds per dollar, while a 20-percent increase in the actual expenditure level would have a lower marginal gain of 31.5 pounds per dollar. Given the estimated model, marginal gains decline as advertising expenditures increase.

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 1988, and rose to 37.8 cents per half-gallon during 1990. Prices declined again to about 36 cents per half-gallon in 1993 and 35.7 cents in 1994. Declining price caused consumption to increase. The simulated total gain from price decreases from September 1984 to September 1994 is 1 billion pounds, about 0.5 percent of actual sales.

Income has an increasing trend. In September 1993-August 1994, per capita real income is 28 percent higher than that of the corresponding 1983/84 period, resulting in a simulated consumption increase of 6.6 billion pounds, or 2.8 percent of actual sales.

Specification of the Cheese Models

Branded and generic advertising, 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 had 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 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:

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

and

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

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

Monthly intervals (1)	Fluid milk sales: Actual (2)	Fluid milk sales: Estimated (3)	Price and income gains: Price fixed[1] (4)	Price and income gains: Income fixed[1] (5)	Gains due to--: Price (6)	Gains due to--: Income (7)
	Million pounds				*Percent*	
September 1984-August 1985	22,152.1	21,924.8	49.8	265.0	0.22	1.20
September 1985-August 1986	22,406.4	22,372.0	135.4	412.0	.60	1.84
September 1986-August 1987	22,619.0	22,607.2	165.0	527.8	.73	2.33
September 1987-August 1988	22,944.9	22,932.6	214.2	653.0	.93	2.85
September 1988-August 1989	23,340.6	22,859.6	164.1	739.1	.70	3.17
September 1989-August 1990	23,531.7	23,045.5	-28.4	797.4	-.12	3.39
September 1990-August 1991	23,680.9	22,852.9	67.4	700.0	.29	2.90
September 1991-August 1992	23,843.8	22,994.0	109.1	633.1	.46	2.66
September 1992-August 1993	23,360.1	22,727.0	86.5	818.9	.37	3.51
September 1993-August 1994	21,443.7	22,914.6	63.3	911.7	.30	4.25
September 1994	2,108.9	1,936.4	13.3	94.6	.63	4.49
September 1984-September 1993	233,300.4	229,166.6	1,039.9	6,552.7	.45	2.81
December 1978-September 1993	357,889.1	351,930.5	1,039.9	6,552.7	.29	1.83

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

where:

LnQ^n_t = 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 September 1994).

Lnq^n_t = 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 September 1994).

LnP^n_t = Log of proportion of all U.S. households that purchased natural cheese during month t (t = 1...138 for January 1982 through September 1994).

LnQ^p_t = 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 September 1994).

Lnq^p_t = 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 September 1994).

LnP^p_t = Log of proportion of all U.S. households that purchased processed cheese during month t (t = 1...138 for January 1982 through September 1994).

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

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

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

LnP^I_t = 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 September 1994.

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^g_{t-I} = 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^b_{t-I} = 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 (BLS) 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 Milk Advisory Board, supplied monthly generic cheese 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 1982-94. Generic advertising peaked in 1986 at $58 million, and declined to $31.3 million in 1993. Still, the increase from 1982 to 1993 is over 540 percent. Branded advertising expenditures fluctuated between 1982 and 1993, with a high of $104 million in 1990 before declining 15.7 percent to $70.5 million in 1992. However, in 1993 branded advertising rose 36.7 percent to $96.4 million

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.

Table 6--Estimated generic and branded cheese advertising expenditures

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	33.5	70.5
1993	31.3	96.4
1994, January-September	22.1	76.6

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 -1.2, and that for processed cheese about -0.89. Thus, a 10-percent decrease in the price of natural cheese would increase consumption by 12 percent. A 10-percent decrease in the price of processed cheese would increase consumption by only 9 percent. Both price elasticities are statistically significant at the 5-percent probability level.

Demand for both natural and processed cheese seems insensitive to income changes. The estimated income elasticity for processed cheese is about 0.04. 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

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	1.380	0.913	0.3630	1.512
log(p^n)	-1.246	-5.034	.0001	.248
log(p^p)	.636	3.112	.0023	.204
log(p^m)	.617	3.634	.0004	.170
log(Y)	-.143	-.863	.3900	.166
d	-.002	-2.040	.0433	.001
t	-.003	-4.767	.0001	.001
Djan	-.119	-7.314	.0001	.016
Dfeb	-.118	-5.521	.0001	.022
Dmar	-.156	-9.104	.0001	.017
Dapr	-.177	-11.119	.0001	.016
Dmay	-.215	-11.739	.0001	.018
Djun	-.232	-12.818	.0001	.018
Djul	-.257	-13.623	.0001	.019
Daug	-.227	-11.314	.0001	.020
Dsep	-.186	-10.340	.0001	.018
Doct	-.172	-9.855	.0001	.017
Dnov	-.100	-9.465	.0001	.011
advb	-.031	-0.885	.3780	.035
advg	*	-1.556	.1221	*
rho	-.481	-6.310	.0001	.076
c	.7			
L	.001			
s	.7			
H	.3			

Note: rho is the first-order autocorrelation coefficient.
Adjusted R^2 = 0.93.
Number of observations = 153.
Degrees of freedom = 133.
* The b value for advg is -0.0004, its standard error 0.0003.

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

Source	Estimated b values	T for H:b=0	Prob T	Standard error of estimate
Intercept	-1.281	-1.822	0.0710	0.703
log(p^m)	.273	2.033	.0440	.134
log(p^p)	-.889	-5.045	.0001	.176
log(p^i)	.339	4.437	.0001	.076
log(p^m)	.774	2.662	.0086	.291
log(Y)	.039	.564	.5738	.069
d	-.002	-2.699	.0078	.001
adv	-.153	-2.088	.0385	.073
rho	-.681	-11.147	.0001	.061
g	.2			
G	.9			

Note: rho is the first-order autocorrelation coefficient.
Adjusted R^2 = 0.81.
Number of observations = 153.
Degrees of freedom = 144.

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 about 0.6. Reversely, the cross-price elasticity between processed cheese purchases and natural cheese price is only 0.3 but is statistically significant. For the other substitution effects, meat price positively influences the purchase of either type of cheese with a cross-price elasticity close to 0.6 in the natural equation and 0.8 in the processed equation. 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 both natural and processed cheese consumptions. 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 -0.26. Aside from seasonal fluctuations, natural cheese purchase also declines over the years. The estimated trend effect is -0.003 and statistically significant.

Generic advertising has some influence on natural cheese purchases but not branded advertising. 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 highest in the current period and declining immediately to nil in the third period. The coefficient of the weighted inverse of generic advertising expenditures is -0.0004 and statistically significant at the 12-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 -0.153 and significant at the 5-percent probability level. The weights for the carryover effect, as obtained from the gamma distribution (g = 0.2, G = 0.9), are highest in the first lagged period and dwindle thereafter, with advertising expenditures 9 months previous having 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 (donation) of natural cheese reduces the proportion of households in the natural cheese market by about 4 (.01) 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 and 3 percent respectively.

The current and lagged generic advertising (from Gamma distribution estimation) also induces entry in the natural cheese market, and is significant at the 4 percent level. A 10-percent increase in the Gamma weighted generic advertising expenditures is associated with a 0.004-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 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.

Table 9--Estimates of the proportion of households purchasing natural cheese, January 1982-September 1994

Source	Estimated b values	T for H:b=0	Prob T	Standard error of estimate
Intercept	5.687	6.113	0.0001	0.9303
log(p^n)	-.444	-2.856	.0050	.1550
log(p^p)	.386	3.027	.0030	.1275
log(p^m)	.330	3.186	.0018	.1035
log(Y)	-.1551	-1.520	.1309	.1019
d	-.001	-1.984	.0493	.0005
t	-.001	-3.418	.0008	.0004
Djan	-.069	-6.760	.0001	.0103
Dfeb	.042	3.175	.0019	.0133
Dmar	-.077	-7.148	.0001	.0107
Dapr	-.042	-4.184	.0001	.0099
Dmay	-.114	-9.910	.0001	.0115
Djun	-.087	-7.687	.0001	.0113
Djul	-.136	-11.467	.0001	.0118
Daug	-.115	-9.112	.0001	.0126
Dsep	-.054	-4.761	.0001	.0114
Doct	-.085	-7.782	.0001	.0109
Dnov	.003	.511	.6105	.0017
advb	.014	.650	.5165	.0217
advg	*	-2.130	.0350	.0002
rho	-.458	-5.922	.0001	.0774
c	.7			
L	.001			
s	.7			
H	.3			

Adjusted R^2 = 0.95.
Number of observations = 153.
Degrees of freedom = 143.
* The b value for advg is -.0004.

The entry and exit demand estimations for processed cheese are presented in Tables 11 and 12. In Table 11, changes in the 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 entering the processed cheese market by 3 percent, 2 percent and 8 percent, respectively. Increased consumer income also affects houshold entry into the cheese market. A 10-percent increase in income is associated with a 9-percent increase in the percentage of households in the processed cheese market. Advertising has an insignificant effect on households buying processed cheese.

A 10-percent increase in processed cheese price reduces average consumption by about 6 percent in Table 12. Likewise, a 10-percent increase in the price of imitation cheese will increase the average amount of processed cheese 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. However, advertising does have a statistically significant effect on inducing households to increase their average purchases of processed cheese. A 10-percent increase in advertising will induce households to increase their processed cheese purchases by about 5 percent.

Table 10--Estimates of the average quantity of natural cheese bought by purchasing households, January 1982-September 1994

Source	Estimated b values	T for H:b=0	Prob T	Standard error of estimate
Intercept	0.264	0.275	0.7839	0.9596
$\log(p^n)$	-.788	-4.764	.0001	.1654
$\log(p^p)$	.243	1.803	.0737	.1347
$\log(p^m)$	.283	2.686	.0082	.1054
log(Y)	.013	.122	.9032	.1053
d	-.001	-1.276	.2041	.0005
t	-.002	-4.001	.0001	.0004
Djan	-.050	-4.561	.0001	.0110
Dfeb	-.059	-4.274	.0001	.0139
Dmar	-.079	-6.933	.0001	.0114
Dapr	-.103	-9.782	.0001	.0105
Dmay	-.102	-8.347	.0001	.0122
Djun	-.113	-9.433	.0001	.0120
Djul	-.122	-9.688	.0001	.0126
Daug	-.113	-8.403	.0001	.0134
Dsep	-.099	-8.211	.0001	.0121
Doct	-.087	-7.398	.0001	.0118
Dnov	-.071	-9.811	.0001	.0072
advb	-.046	2.067	.0407	.0222
advg	*	-.143	.8865	.0002
rho	-.419	-5.295	.0001	.0790
c	.7			
L	.001			
s	.7			
H	.3			

Adjusted $R^2 = 0.85$.
Number of observations = 153.
Degrees of freedom = 133.
* The b value for advg is -0.00003.

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 the 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 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 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-

September 1994. 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 11--Estimates of the proportion of households purchasing processed cheese, January 1982-September 1994

Source	Estimated b values	T for H:b=0	Prob T	Standard error of estimate
Intercept	-5.448	-8.638	0.0001	0.6308
$\log(p^n)$	.337	2.874	.0047	.1173
$\log(p^p)$	.029	.190	.8492	.1532
$\log(p^i)$	.209	3.079	.0025	.0680
$\log(p^m)$	.809	3.493	.0006	.2317
log(Y)	.943	15.107	.0001	.0625
d	-.000	.154	.8775	.0007
advb	-.072	-1.287	.2002	.0562
rho	-.614	-9.342	.0001	.0658
g	.2			
G	.9			

Adjusted R^2 = 0.75.
Number of observations = 153.
Degrees of freedom = 145.

Table 12--Estimates of the average quantity of processed cheese bought by purchasing households, January 1982-September 1994

Source	Estimated b values	T for H:b=0	Prob T	Standard error of estimate
Intercept	-0.402	-0.945	0.3462	0.4258
$\log(p^n)$	.089	1.350	.1790	.0736
$\log(p^p)$	-.593	-6.265	.0001	.0946
$\log(p^i)$	.125	2.814	.0056	.0445
$\log(p^m)$	.214	1.861	.0648	.1148
log(Y)	.035	.822	.4126	.0426
d	-.002	-4.028	.0001	.0001
advb	-.052	-2.029	.0443	.0258
rho	-.419	-5.531	.0001	.0757
g	.2			
G	.9			

Adjusted R^2 = 0.84.
Number of observations = 153.
Degrees of freedom = 145.

[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.

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 46.8 million pounds during September 1984-September 1994. Total national consumption of natural cheese at home during the same period was 11.6 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 367.0 million pounds. Total national consumption of processed cheese at home was 8.3 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-September 1994. 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 34.1 (36.6) 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 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 1993-August 1994, increased natural cheese sales by about 2.0 billion pounds, all other variables constant. This change in natural cheese prices reduced processed cheese sales by about 366.4 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 585.4 million pounds. A 2.4-percent drop in real prices of meat, poultry, and fish reduced natural cheese sales by 72.4 million pounds and processed cheese sales by 72.5 million pounds. Rising real consumer income, up 16.2 percent, increased natural cheese sales approximately 176.5 million pounds and processed cheese sales by 34.3 million pounds.

National Fluid Milk Processor Promotion Board

In July 1994, the Fluid Board was seated with the objective of strengthening the position of the dairy industry in the marketplace and maintaining and expanding markets and uses for fluid milk products produced in the United States. The Fluid Board contracted with Bozell Worldwide, Inc., to develop and carry out an integrated advertising campaign. In January 1995, the National Fluid Milk Processor Promotion Board initiated MilkPep (**Milk** Processor Education Program), a national media campaign designed to educate women between the ages of 25-44 about the nutritional qualities of milk and its importance in a healthy diet. The Board will spend about $46 million on the campaign. The largest portion (nearly $37 million) will be directed toward a national magazine and supplemental local media advertising

Table 13--Summary of model simulation results on the effect of regional and national generic cheese advertising on national at-home consumption, September 1984-94

Item	Unit	Sales/advertising results
Total sales of natural cheese	Million pounds	11,572.6
Total sales of processed cheese	Million pounds	8,348.5
Estimated increase in national and regional advertising expenditures due to act	Million dollars[1]	336.8
Natural cheese:		
Sales gain due to advertising	Million pounds	46.8
As a share of total sales	Percent	.4
Per advertising dollar	Pounds	.1
Processed cheese:		
Sales gain due to advertising	Million pounds	367.0
As a share of total sales	Percent	4.4
Per advertising dollar	Pounds	1.1

[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	1,955.4
Decreasing price of processed cheese	-767.6
Decreasing price of meat, poultry, and fish	-72.4
Increasing income	-176.5
Processed cheese--	
Decreasing price of natural cheese	-366.4
Decreasing price of processed cheese	585.4
Decreasing price of meat, poultry, and fish	-72.5
Increasing income	34.3

campaign. The advertising features celebrities with a milk moustache and a brief text containing a nutrition message. The advertisements are slated to appear in 47 national magazines. Other portions of the campaign include a medical advisory board to provide medical and scientific advice as well as serve as expert spokesmen for the program, consumer tie-in promotions, a consumer hotline about the benefits of milk, and a series of informational brochures on milk-related topics. The campaign was devised to change attitudes about milk while generating both awareness and interest in dairy products.

Educational programs of this type are designed for long-term results. They usually attempt to change a basic attitude or awareness level about a product so that the commodity becomes an integral and continuing part of the diet. It is generally believed that this approach, if successful, has a long-term positive impact in changing fundamental attitudes, knowledge, and awareness about a commodity.

The Fluid Board commissioned Roper Starch, a research firm, to conduct door-to-door surveys of 2,406 adults and 502 teenagers (age 13-17) to provide a baseline for assessing the effects of the milk processor's promotional program and to identify groups to be targeted. The surveys were designed to gauge the respondents' attitudes, knowledge, and awareness of nutritional issues surrounding fluid milk. Roper Starch will also conduct a follow-up survey in late 1995 to examine if there have been any changes.

As part of its role in conducting independent evaluations of the dairy promotion programs and to gain insight into the MilkPep strategy and potential impacts, the Economic Research Service analyzed recent USDA consumption surveys and examined the Roper Starch survey instrument and responses.

Fluid Milk Consumption by Women

MilkPep is targeted at women 25-44 years old. ERS used the 1989-91 USDA Continuing Survey of Food Intakes by Individuals (CSFII) to examine the fluid milk consumption patterns of this targeted group. The CSFII measures consumption over a 3-day period. The target group's consumption is examined relative to that of other age groups, differences in consumption patterns by demographic characteristics within the targeted group, and total calcium intake relative to recommended daily allowances (RDA). As part of the CSFII, meal planners/preparers were questioned about their attitudes, knowledge, and awareness concerning various dietary issues and practices. This part of the survey is used to analyze concerns about calcium, fat, and other dietary issues. There are 2,713 women aged 25-44 in the CSFII.

Women aged 25-44 consume, on average, 13-percent less fluid milk than women aged 18-24 years and about the same as women aged 45-60 years. In the target group, ages 25-44 years, 33 percent of total milk consumed was whole. This compares with 50 percent whole milk for the 18-24 year old group and 27 percent whole milk for the 45-60 year old group. About 35-percent of the target group reported not consuming any milk during the 3-day sample period--about the same as the 18-24 and 45-60 age groups.

Percent of Women Meeting Calcium Requirements

Calcium intake tends to decline steadily with age. The target group's calcium intake was 7-percent below the 18-24 age group but 3-percent above the 45-60 age group. On average, only about 25-percent of the target group met or exceeded the Recommended Dietary Allowance (RDA) for calcium. Taking into account the possibility of underreporting of food consumption, still only 51 percent of the target group met or exceeded two-thirds of the calcium RDA. These are population averages and may not accurately represent any particular population subgroup. For example, Black women tend to ingest less calcium than Whites--perhaps because of lactose intolerance associated with some dairy products.

Fluid Milk Consumption, Women Ages 25-44

Within the target group, poorer women (annual household income under $15,000) tended to consume less fluid milk than their wealthier counterparts--about 10 percent less--and a much different mix of low-fat and whole milk. Poorer women consumed 65 percent more whole milk than wealthier women but 39 percent less low-fat milks. The percent-age of women reporting zero milk consumption also varies significantly by income. Thirty-six, 64, and 72 percent of poorer households report zero consumption of fluid milk, whole milk, and low-fat milk, respectively. The comparable percentages for higher income women are 34, 77, and 53. Note the markedly higher percentage of low-income women not consuming low-fat milks.

White women in the target group consumed twice as much fluid milk as did Black women and about the same as Hispanics. However, Black women consume 32 percent more whole milk than Whites do, but Whites consume almost 7 times as much low-fat milks. Hispanics have a clear preference for whole milk--

about 75 percent of their milk consumption is whole. Hispanics consume over 2.5 times as much whole milk as Whites do and a little over twice as much as Blacks do. About one-third of both Whites and Hispanics and about half the Blacks reported zero milk consumption during their 3-day survey period.

Targeted women residing in the Northeast and Midwest consumed more milk than targeted women in other regions. Northeastern and Southern women consumed the most whole milk, and Western and Midwest women the most low-fat milks.

The CSFII revealed that more highly educated 25-44 year old women consume more milk than their less educated counterparts. Women with some college training drink 7-percent more milk than women with a high school education and 25-percent more than women with less than a high school education. Those women in the target group with less than a high school education drink twice as much whole milk as those with some college and 50-percent more than those with a high school education. Conversely, women with some college drink almost 3 times more low-fat milks than their counterparts with less than a high school education and 25-percent more than those with a high school education.

Attitudes About Dairy Products

Since MilkPep is primarily a print campaign, it may not be reaching lower income and less educated women who tend to buy fewer magazines and read less than their counterparts who have higher incomes and are better educated.

Regardless of age group, virtually everyone knew that skim milk has less cholesterol than whole milk. In addition, a relatively constant 80 percent of the 18-24, 25-44, and 45-60 year old age groups knew that low calcium intake was related to bone problems.

It appears that as women age, a substantial number try to avoid whole milk. Approximately 46 percent of the target group said they try to avoid consuming whole milk, and 11 percent said they try to avoid all types of milk. Thirty-one percent of the 18-24 age group said they try to avoid whole milk, compared with 57 percent of the 45-60 age group.

The USDA Food Guide Pyramid recommends 2-3 servings per day of dairy products. Women's perception/attitude about the importance that their diets contain at least the minimum servings declines with age. Thirty-six percent of the 25-44 age group reported that it is very important that their diets contain at least two daily servings of dairy products. This percentage was less than for the 18-24 age group, 38 percent, but higher than for the 45-60 age group, about 33 percent. Thirty percent of both the target group and the 18-24 age group thought their diets should contain more dairy products. This compares with only 22 percent for women 45-60 years old. About 58 percent of the target group felt that their diets contain about the right amount of diary products, while 67 percent of the 45-60 age group felt this way.

Forty-four percent of the target group, versus 47 percent for the 18-24 group, felt their diets should contain more calcium. Only 34 percent of the 45-60 age group thought their diets should have more calcium. Although most women have diets that are deficient in this vital nutrient, almost half the target group thought that their diets contained the right amount of calcium. This compares with 57 percent for the 45-60 age group and 45 percent for the 18-24 age group.

Evidence from the CSFII clearly indicates that women of virtually all ages consume too little calcium, consume too few dairy products, and unaware of these problems. MilkPep is clearly targeting an important problem.

Roper Starch Benchmark Study

The results from the Roper Starch survey, taken August 6 - September 15, 1994, appear to accurately reflect the knowledge, attitudes, and perceptions of the respondents and do not appear to have been adversely affected or biased by current events or controversies while the interviewers were in the field.

During this time frame, relatively little media attention was focused on fat and rBsT and no food safety incidents occurred involving milk.

Some of the key Roper Starch findings are:

- Fat content was the top reason that women aged 25-44 are drinking less milk (38 percent of the respondents). This is consistent with the 1989-91 USDA CSFII that indicated about 42 percent of the 25-44 age group say it is very important to avoid too much fat in their diet. Milk drinkers who have cut back gave the following reasons: fat content of milk (38 percent), calories (8 percent), and taste (11 percent). The CSFII reveals that about 33-percent of total milk consumed by the target group was whole. Those women drinking less milk because of its fat content may not be aware of the lower-fat content of 2-percent, 1-percent, and skim milks.

- Thirty-two percent of women in the Roper Starch survey were non-milk drinkers. The primary reasons given were taste (63 percent), don't think about milk (32 percent), and too high in fat (18 percent). This compares favorably to the finding in the CSFII that about 35 percent of women do not drink milk.

- Consumers do not understand that lower fat and skim milks are nutritionally comparable, except for fat, with whole milk. About 75-percent of the target group thought that whole milk was high in calcium, 45 percent thought that 2% or 1% milk was high in calcium, while only 33 percent thought that skim milk was high in calcium. Conversely, the CSFII reveals that consumers overwhelming know that skim and whole milk have different cholesterol levels.

- Forty-two percent of the target group felt that milk is an extremely important part of a woman's diet. On the other hand, 16 percent felt that milk was somewhat unimportant or not important at all in a woman's diet. In the CSFII, 36 percent of the target group felt that it is extremely important to eat at least two servings of dairy products daily. Although addressing slightly different questions, the Roper and CSFII are consistent in the percentage of women that believe it is important to have milk and/or dairy products as part of their diet.

- About 57-percent of the 25-44 age group in the Roper survey thought that milk consumption was an extremely important part of preventing bone disease. Seventy-five percent thought it was extremely or very important. In the CSFII, about 80 percent of the target group knew that low calcium intake was related to bone disease.

- A majority of women strongly agreed that milk builds strong bones (61 percent) and is important for preventing bone disease (57 percent). Fewer than half the target group strongly agreed that milk is needed for strong bones at every stage of life and helps build bone mass. Less than 40 percent strongly agree that milk is a socially acceptable drink and is a good source of most nutrients. Only 52 percent strongly agreed that milk is a good source of calcium.

In general, the Roper findings are quite consistent with the results from the 1989-91 CSFII. This consistency is encouraging for several reasons. First, it implies that the Roper Starch survey is probably an accurate measure of the attitudes, awareness, and behavior of the target group. Second, the consistency means that the Roper Starch survey provides an accurate and reliable benchmark for gauging the results from the post-MilkPep survey to be done later this year.

Major Conclusions of Roper Starch and CSFII Surveys

Together the Roper Starch and CSFII surveys point to several important findings related to the target group of 25-44 year old women. These are:

- Calcium intake is significantly below recommendations.
- A high percentage are not aware of the nutritional characteristics of low-fat milk products.

- A minority say that milk is an extremely important part of their diet or it's extremely important to eat at least two daily servings of dairy products.
- Only about half strongly agree that milk is a good source of calcium while less than half think their diet should contain more calcium. Almost 50 percent think their diet contains about the right amount of calcium.
- Less than 40 percent strongly agree that milk is a socially acceptable drink.

Future Work

The existence of the Fluid Board presents some unique challenges to USDA's generic advertising evaluation program. First, the expenditures of the MilkPep program will have to be integrated into the milk model in order to accurately evaluate the impact of generic dairy advertising on the consumption of milk. The expenditures of this board will be substantial: funding for the initial 30 months is approximately $53 million. Much thought will have to be given to the correct technique of incorporating these expenditures into the model in a meaningful and unbiased way.

Second, as previously noted in this report, the Fluid Board commissioned Roper Starch, a research firm, to conduct a door-to-door survey of 2,406 adults and 502 teenagers (ages 13-17) to provide a baseline for assessing the effects of the milk processors' promotional program and to identify groups to be targeted. Roper will also conduct a followup survey in late 1995 to examine if there have been any changes. The USDA evaluation committee will analyze the followup survey and the 1994 Continuing Survey of Food Intakes by Individuals (CSFII) to examine the fluid milk consumption patterns of the targeted group (women age 25-44). This will be a followup to the work reported on in this report.

Finally, the evaluation committee will attempt to implement a sector dairy model. Currently, the committee is evaluating two different models that attempt to determine what return producers realize from their advertising expenditures. These models were built by Harry Kaiser at Cornell University and Mike Wohlgenant at North Carolina State University. While the aim of both models is the same, the techniques and methodologies are different. Hence, the committee has been evaluating the performance of both models and seeking the opinions of experts in the area of econometrics.

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 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 multiproduct, multimarket 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 it

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 expenditures in dollars and cents is 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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