Analyses of Generic Dairy Advertising, 1984-97. By Noel Blisard, Don Blayney, Ram Chandran, and Jane Allshouse. Food and Rural Economics Division, and Market and Trade Economics Division, Economic Research Service, U.S. Department of Agriculture. Technical Bulletin No 1873.

Abstract

Generic advertising raised fluid milk sales about 6.0 percent, or 18.1 billion pounds, between September 1984 and September 1997. Sales of cheese rose by about 6.8 billion pounds (milk equivalent) 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 advertising. Activities of the National Fluid Milk Processor Promotion Board also contributed to increased milk sales over the past year. Gross returns to dairy farmers between September 1984 and September 1997 were estimated to increase by $3.44 for each dollar spent on generic advertising.

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

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1800 M Street, NW
Washington, DC 20036-5831

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Summary

Generic advertising raised fluid milk sales an estimated 1.1 billion pounds, or 4.9 percent, during September 1996-August 1997. Assessments of 15 and 20 cents per hundredweight of milk sold commercially by producers and processors, respectively, provided 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 Dairy Production Stabilization Act of 1983, fluid milk sales are estimated to be 6.0 percent (almost 18.1 billion pounds) above what they would have been without the advertising. Fluid milk advertising expenditures for September 1984-September 1997 equaled $481.6 million, of which $239.6 million is attributed to the act. The gain for each act-increased advertising dollar is about 75 pounds of milk.

Advertising expenditures due to the act are estimated to have increased cheese sales by 6.8 billion pounds (1.0 percent) during September 1984-September 1997.

Blacks, rural households, single-person 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. Single-member families may routinely consume other nondairy beverages. Education may 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 1997 increased fluid milk sales by 814 million pounds. Increasing real incomes raised fluid milk sales by 8.1 billion pounds.

It is important to assess how the Dairy Act has affected producers' returns from the increased generic advertising. This is a particularly complex evaluation because one must account for the economic link between the consumers at the retail level, to the processors, manufacturers, and producers. One must also account for the myriad other market factors that continue to change and influence decisions at each market level. Some factors will directly affect one market level, while other levels are affected only indirectly.

A model developed at Cornell University was the first attempt to explicitly model government price support and simultaneously examine the issue of

generic advertising effectiveness. It includes supply and demand equations for wholesale and retail fluid and manufactured milk products (cheese, butter, and frozen products) and farm-level supply. The model also provides information on advertising effects at three market levels: retail, wholesale, and farm.

The U.S. Department of Agriculture’s Economic Research Service carefully examined, updated, and re-estimated the Cornell model. The results of the estimation were similar to model parameters reported earlier by Cornell using data through 1993. The stability of the parameter estimates lend credibility to using the model for simulating the effectiveness of advertising. Model estimates were used to simulate dairy industry conditions with and without the additional advertising attributed to the dairy and fluid acts.

Generic advertising under the acts boosted demand for fluid milk and cheese, but demand for butter and frozen products remained about the same. The advertising also caused higher farm-level milk prices. Over the simulation period, farm prices averaged 2.3 percent higher than they would have in the absence of the programs. A gross rate of return of approximately $3.44 per additional advertising dollar was found.

Analyses of Generic Dairy Advertising, 1984-97

Noel Blisard
Don Blayney
Ram Chandran
Jane Allshouse

Introduction

This report is an updated analysis of the effectiveness of generic advertising on fluid milk and cheese. As stipulated in The Dairy and Tobacco Adjustment Act of 1983, this annual report fulfills one requirement that the USDA evaluate the effectiveness of the dairy promotion program. To do this, the Agricultural Marketing Service (AMS) contracts with USDA's Economic Research Service (ERS) to conduct an econometric evaluation of the effectiveness of the dairy promotion programs. The last report covered 1978-96 (Blisard, Blayney, Chandran, Smallwood, and Blaylock, 1997).

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. 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 for commercial use. 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. Producers fund the program and the commercial marketing. The program is administered by Dairy Management Incorporated (formed in 1995 by the management staff for National Dairy Promotion and Research Board and the United Dairy Industry Association).

The Fluid Milk Promotion Act of 1990 authorized the establishment of a national processor program for fluid milk promotion, similar to the 1983 Act's producer program. The Processor program is carried out by the National Fluid Milk Processor Promotion Board (Fluid Milk Board) whose mission is to establish a fluid milk promotion and consumer education program funded by fluid milk processors. Those who process and market more than 500,000 pounds of milk per month in the United States are subject to a 20-cent-per-hundredweight assessment to fund the program. 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 through consumer education and promotion. The consumer education aspect of the program uses public relations, advertising, or other means to educate consumers about the desirable characteristics of fluid milk products. They are intended to increase the general demand for milk. The advertising campaign of the Fluid Milk Board was launched in early 1995. The combined effect of both the Dairy Board and the Fluid Milk Board are presented in this report.

Specifically, the objectives of this study were to determine what, if any, effect generic advertising had on the demand for fluid milk and natural and processed cheese. In addition, we wanted to determine the gross returns to producers from generic dairy advertising.

This year, the cheese results were estimated from the industry model, which is used to calculate the returns to producers from generic advertising. In the past, ERS has been supplied with data for two cheese models (natural and processed cheeses), but ERS did not receive data this year.

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) then modified by Blisard, Chandran, and Smallwood. The 12-region sales database enables the fluid milk model to encompass variations of price and quantity among various regions. 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 and intercept shift) structural changes after the 1983 Act. Advertising is also allowed to interact with the variable that represents the U.S. population 18 years old and under, the primary target group of generic dairy advertising, and the group which consumes the most fluid milk. Accounting for time-series autocorrelation within each region and missing variables correlated across regions in their effect 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 1997.

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. To examine the dynamics of the advertising effect, we separated the period after the act into 13 time intervals. Gains in sales due to the act are fairly constant from year to year and fluctuate with changes in aggregate spending on generic dairy advertising.

The total increase in advertising expenditures since the act is $481.6 million. If we assume that real advertising expenditures were fixed at the level of the 12-month interval immediately preceding the act and compare this simulated result with the result from actual advertising expenditures, the increase in milk consumption resulting from the act for September 1984-September 1997 is 18.1 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 814 million pounds of fluid milk, and gains because of higher income are 8.1 billion pounds. These simulations are based on the 12 regions, which represent 43 percent of U.S. fluid milk consumption.

To assess how the act, with its increased advertising, has affected producer returns, one must account for the economic link between the consumers at the retail level, to the processors, manufacturers, and producers, as well as control for the myriad other market factors that continue to change and influence decisions at each market level. Some factors will directly affect one market level, while others may be affected only indirectly. A model developed at Cornell University was the first attempt to explicitly model government price support and simultaneously examine the effectiveness of generic advertising. The model includes supply and demand equations for wholesale and retail fluid and manufactured milk products (cheese, butter, and frozen products) and farm-level supply. It also provides information on advertising effects at three market levels: retail, wholesale, and farm.

ERS examined, updated, and re-estimated the Cornell model. The results of the estimation were similar to model parameters reported earlier by Cornell using data through 1993. The stability of the parameter estimates lends credibility to using the model for simulating the effectiveness of advertising. Model estimates were used to simulate dairy industry conditions with and without the additional advertising attributed to the dairy and fluid acts.

Generic advertising under the acts boosted demand for fluid milk and cheese, although demand for butter and frozen products remained relatively flat. The advertising programs under the acts also caused higher farm-level milk prices. Over the simulation period, farm prices averaged 2.3 percent higher than they would have in the absence of the programs. Our analysis found a gross rate of return of approximately $3.44 for each additional advertising dollar. In addition, we simulated the cheese equation in order to determine the effect of generic cheese advertising on national cheese disappearance. We found that, over the study period, generic cheese advertising increased cheese disappearance (sales) by 1.0 percent, or approximately 6.8 billion pounds (milk equivalent).

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 consumers' 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, while persuasion and reinforcement are generally associated with maintaining or increasing market shares.

Evidence 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 helps increase 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 is generally expected by consumers to be less persuasive (and less deceptive) than branded messages.

(3) It likely has more factual information than branded advertising, but it is still oriented to high recall, unlike 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 may force 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 prices they must pay. The result of this process is a set of demand relations, one for each commodity, that 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 multiple-stage utility maximization hypothesis is that the demand functions for individual commodities within a branch can be specified as a function of the prices of the goods in that branch and total expenditures for goods in the branch. Such demand functions are called conditional to highlight the fact that the effects of total income and prices of goods outside the branch enter the group demand functions through the budget allocation for goods in the branch. An advantage of the conditional demand function formulation is that, once the budget allocation to goods within the branch is known, prices of goods outside the branch can be ignored.

The above theory of consumer demand does not explain the consumption behavior of individuals when their preferences are changed, either autonomously or by advertising and other sales efforts. Two approaches for incorporating advertising into the neoclassical theory of demand have dominated economic literature: one that sees advertising as a way to alter utility and one that views advertising as a way to disseminate information. 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 provides information, it plays the role of an exogenous shift variable in the household's production functions for information and 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.

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 persuading more consumers to enter the market, and convincing 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 enter and others to exit the market.

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

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

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

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

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

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

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

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

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 components 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 sum 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 dependent 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 43 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.

Recently, the demographic variables were updated to reflect values contained in the 1990 census data. In addition, the structure of the milk model was respecified. There were individual slope shifters for generic dairy advertising for each year since the creation of the National Dairy Promotion and Research Board (NDB), but they have been eliminated because they were highly collinear. The model now has a slope variable for advertising (lagged), and a slope shifter (lagged) that begins with the first month of advertising of the NDB and continues through the most recent month of data. In addition, the advertising variables and the variable representing the proportion of the population 18 years old and under were allowed to interact. This last variable acknowledges the fact that those 18 years old and under are the largest consumers of fluid milk and are a primary target for generic advertising. This year, dummy variables were added to account for a large increase in advertising expenditures by the Fluid Dairy Board. This dummy variable for the last year of data interacted with the advertising variable and with the variable that represents the interaction of advertising with the proportion of the population 18 years old and younger.

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 depreciates over time. The probable factors that cause 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 advertisement 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 about the lag's distribution. 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 embodied in the product.

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

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

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

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

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

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

or

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

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

$W_0 = W_{11} = 0.071007$; $W_1 = W_{10} = 0.130178$; $W_2 = W_9 = 0.177515$;
$W_3 = W_8 = 0.213018$; $W_4 = W_7 = 0.236686$; $W_5 = W_6 = 0.248521$.

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 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.

The milk model allows the intercept term to shift up or down over the life of the producer and processor advertising boards. Given the nature of the fluid milk market and the results of research conducted by ERS, we expect the intercept term to shift upward over the life of the producer and processor advertising boards, because we hypothesize that the advertising campaigns have been particularly successful in persuading drinkers of fluid milk to consume more milk or slow the well-known decline in milk consumption as consumers get older. This outcome may be partially reflected by an increase in the intercept term.

Data

Fluid milk data encompass December 1978 - September 1997. The period before the act is December 1978-August 1984. The period after the act is September 1984-September 1997. The United Dairy Industry Association (UDIA), California Milk Marketing Board, and National Dairy Research and Promotion Board provided the regional consumption, income, advertising, and related deflators. USDA's Agricultural Marketing Service provided regional prices. Given that the milk model is based on pooling regional data, it is useful to have an understanding of both the average and regional differences in these data. In the following discussion, reference is made to the 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 Upper Midwest area ranks the highest in per capita fluid milk consumption (about 10.6 daily ounces), and California ranks sixth (8.1 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 was 8.1 ounces in 1997.

Fluid Milk Prices

Fluid milk prices are from representative cities within the 12 regions. Before 1993, prices were reported in both gallon and half-gallon units, and the prices selected for the fluid milk model were in cents for each 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 1996 was projected from historical price data. Regionally, Georgia has the highest average price, and New England the lowest. Comparisons of milk price and average per capita consumption present mixed results. For instance, California has a low price (32.0 cents per half gallon) but also a low average consumption (8.1 ounces). Conversely, the upper Midwest has a high price (37.2 cents per half gallon) and also a high average consumption (10.6 ounces). On the average, the real fluid milk price for the 12 regions demonstrated a declining trend before 1989. It increased in 1990 but later decreased slightly. The average milk price for all regions increased to 36.1 cents per half gallon in 1997.

Income

The New England region has the highest average per capita real income (1975 = 100), followed by Kansas and the Middle Atlantic region. Average real income for the 12 regions increased from December 1978 to September 1997. 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 1996-August 1997, average annual real income increased by 1.9 percent.

Fluid Milk Advertising

Advertising is measured in terms of expenditures for each month. These expenditures take several forms depending on the controlling agent, types of media used, and 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 expenditures for calcium advertising is added to fluid milk advertising. Thus, in the model, real 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 the NDB and UDIA have merged their operations for national advertising in 1994. The new entity is known as Dairy Management Incorporated (DMI). Hence, from September 1994 onward, DMI is responsible for national dairy advertising. In addition, the Fluid Milk Board has funded its own advertising campaign with a 20-cent-per-hundredweight checkoff program on fluid milk processors (completely separate from the producer checkoff).

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 1997, total advertising increased from $55.1 million to about $70.5 million, due mainly to an increase in spending by the Fluid Milk Processor Board. There were substantial increases in advertising expenditures in the early months following establishment of the Dairy Board. 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 probably remain in the $60-$70 million range due to a major campaign by the Fluid Milk Processor Board.

Demographic Variables

The demographic variables used to account for different noneconomic characteristics in the various regions include: (1) the percentage of a region's population 18 years of age or under; (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, 1980-April 1, 1990).

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, seasonality, and time trend:

$$
\begin{aligned}
Lnpcads_{it} = \; & B_0 + B_1\ Ta + B_2\ Lnmapr_{it} + B_3\ Lndpcin_{it} \\
& + B_4\ Lnnu18_{it} + B_5\ Lnfem_{it} + B_6\ Lnblk_{it} + B_7\ Lnrur_{it} + B_8\ Lnhous_{it} \\
& + B_9\ Lnschl_{it} + B_9\ Lnadver_{it} + B_{10}\ Lnad97_{it} + B_{11} Adv_{it} + B_{12}\ Lnnu18_{it} * Lnadver \\
& + B_{13}\ Nu18d97_{it} + B_{13}\ Lntime_{it} + B_{14}\ Djan_{it} + B_{15}\ Dfeb_{it} + B_{16}\ Dmar_{it} \\
& + B_{17}\ Dapr_{it} + B_{18}\ Dmay_{it} + B_{19}\ Djun_{it} + B_{20}\ Djly_{it} \\
& + B_{21}\ Daug_{it} + B_{22}\ Dsep_{it} + B_{23}\ Doct_{it} + B_{24}\ Dnov_{it} + e_{it}
\end{aligned} \tag{10}
$$

where

Lnpcads = Log of the average daily ounces consumed per capita by region.
Ta = Intercept shifter for September 1984-September 1996.
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.
Lnad97 = Advertising slope shifter for October 1996-September 1997.
Adv = Advertising slope shifter for September 1984-September 1996.
Lnadver*
Lnnu18 = Log of advertising multiplied by the log of the percentage of a region's population under 18 years of age.
Nu18d97= Advertising slope shifter for October 1996-September 1997 for the log of advertising multiplied by the log of the percentage of a region's population under 18 years of age.
Lntime = Log of the variable Time (Time=48-273 for December 1978-September 1997).
Djan = Seasonal dummy variable for January.
Dfeb = Seasonal dummy variable for February.
Dmar = Seasonal dummy variable for March.
Dapr = Seasonal dummy variable for April.
Dmay = Seasonal dummy variable for May.
Djun = Seasonal dummy variable for June.
Djly = Seasonal dummy variable for July.
Daug = Seasonal dummy variable for August.
Dsep = Seasonal dummy variable for September.
Doct = Seasonal dummy variable for October.
Dnov = Seasonal dummy variable for November.
e_{it} = Equation error for region I (I=1-12) and time t (t=48-273).

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 that affect 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 ($R^2 = 0.8$). Most 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 0.07 percent. A 1-percent increase in income increases milk consumption by about 0.26 percent. Milk consumption also changes with the season, declining most in June and July and increasing in the fall.

Of the demographic effects, younger consumers (lnnu18) and women (lnfem) are expected to consume less milk than men do. In addition, clinical studies show that blacks (lnblk) have a higher level of intolerance to lactose (Goodhart and Shils, 1980); thus, a negative effect is expected for all three variables. Rural consumers (lnrur) may have milk supply sources other than commercial channels, which may also produce negative effects on commercial sales. The estimated effects of the above variables consistently confirm these hypotheses, except for the women and young children variables, which have the opposite 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 0.05 and 0.16 percent, respectively.

The expected effects of family size (lnhous) and schooling (lnschl) 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-member families may view milk as a convenience food and consume more per-person than larger households. 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 single-member families have a negative coefficient of -0.31, while schooling has a negative coefficient of -0.68.

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, 0.034, reflects an average effect for the 12-month cumulative advertising expenditures (the α_1 in equation 9b). The advertising coefficients for adv (0.003) measure changes in the average advertising effect following the act. This coefficient is rather small but is statistically significant at the 1-percent level. In addition, this same variable, interacted with a dummy variable for the last 12 months of the data set (Lnad98), when the Processor Board came fully online with its advertising campaign, is relatively large, 0.04, and statistically significant at the 1-percent level. Also, the interaction term between advertising and the proportion of the population under 18 years old (Lnadver*Lnnu18) is positive (0.027) and statistically significant at the 1-percent level, whereas this same variable, interacted with a dummy variable for the last 12 months of the data set (Nu18d98), is statistically significant at the 1-percent level.

Table 1--Summary of fluid milk model estimates, December 1978-September 1997

Variable	Coefficient	Standard error	T-test
Intercept	5.410731	0.301966	17.918317
Ta	.063618	.026599	2.391728
Prices, income, and demographics:			
Lnmapr	-.071295	.009429	-7.560833
Lndpcin	.257757	.018513	13.922706
Lnnu18	1.044577	.119787	8.720308
Lnfem	4.260371	.298994	14.249003
Lnblk	-.159283	.002359	-67.520186
Lnrur	-.050425	.004540	11.106643
Lnhous	-.309945	.036184	-8.565773
Lnschl	-.675266	.059715	-11.308226
Advertising:			
Lnadver	.033892	.012039	2.815108
Lnad98	.044459	.006871	6.470489
Adv	.003240	.001989	1.628633
Lnadver*Lnnu18	.027048	.009526	2.839373
Nu18d98	.030563	.004795	6.374511
Trend and monthly shifters:			
Lntime	-.030173	.010760	-2.804278
Djan	.030290	.004171	7.261388
Dfeb	.018940	.005110	3.706173
Dmar	.028718	.005521	5.201165
Dapr	.000214	.005717	.037346
Dmay	-.012193	.005813	-2.097567
Djun	-.061419	.005852	-10.494521
Djly	-.070039	.005843	-11.986098
Daug	-.024279	.005769	-4.208689
Dsep	.029427	.005577	5.275950
Doct	.028142	.005193	5.419195
Dnov	.028446	.004257	6.681673

Estimated values of rho:

Cal	0.8334	Mic	0.9135	No. of cross sections = 12
Col	.5322	Eng	.7351	No. of time series = 226
Fla	.8349	Atl	.7488	Total observations = 2,712
Gbs	.7148	Tex	.6654	R^2 MSE
Geo	.4672	Umw	.7732	0.8105 1.0011
Kan	.5121	Vir	.8022	

Source: U.S. Department of Agriculture, Economic Research Service.

Milk consumption had a distinctly declining trend before the act, and this trend continues. The coefficient of the time trend variable for 1978-97 is -0.03. However, the intercept shifter is positive (0.06) and statistically significant at the 5-percent level, indicating that average daily consumption has increased over the life of the dairy and processor boards.

Simulation of Fluid Milk Advertising Effects

Analysis of the simulation of advertising on fluid milk consumption examines the marginal changes in advertising effects.

Table 2--Generic advertising expenditures for fluid milk, December 1978-September 1996

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-August 1995	28,348,027	28,057,136	56,405,162	64,856,900
September 1995-August 1996	24,086,603	30,981,019	55,067,622	71,845,500
September 1996-August 1997	23,879,521	46,596,508	70,476,029	106,521,600
September 1997	2,760,737	4,139,515	6,900,252	9,431,300
September 1984-September 1997	262,931,046	218,650,142	481,581,187	509,994,681
December 1978-September 1997	353,373,894	218,650,142	572,024,035	509,994,681

Source: U.S. Department of Agriculture, Economic Research Service.

Gains from Advertising

We simulated the gain due to generic dairy advertising with the following assumptions. 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 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.

Tables 2 and 3 provide the fluid milk advertising expenditures and the bootstrap simulation results for the advertising scenario. In table 2, columns 2 and 5 give total expenditures for the regions and the NDB and the FMB. Column 3 is the NDB and the FMB 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 $481.6 million in the 12 regions.

Table 3, column 2 shows actual sales, and column 3 shows predicted sales using the observed data. Column 4 reports the gains due to advertising under the above assumptions. Column 5 shows the gains in column 4 as percentages of actual sales (column 2).

Column 4 shows that the simulated sales gain due to the acts is 18.1 billion pounds, about 6.0 percent of actual total sales. If yearly advertising expenditures had stayed at the 12-month (September 1983-August 1984) level before the act ($18.5 million), total advertising expenditures after the act would have been only $242.0 million, $239.6 million less than actual post-act expenditures. The comparison of the sales gains due to the act (18.1 billion pounds) with the gains in advertising expenditures ($239.6 million), indicate that the gain for each act-increased advertising dollar is about 75.5 pounds.

Table 3--Actual fluid milk sales and simulated sales gains from generic advertising, December 1978-September 1996

Monthly intervals	Fluid milk sales		Advertising gains due to act	
	Actual	Simulated	Amount	Percent of actual
(1)	(2)	(3)	(4)	(5)
	---------------------*Million pounds*------------------			*Percent*
Before the act:				
December 1978-August 1979	16,321.2	16,128.2	0	0
September 1979-August 1980	21,861.6	21,406.3	0	0
September 1980-August 1981	21,754.7	21,273.7	0	0
September 1981-August 1982	21,411.6	21,213.9	0	0
September 1982-August 1983	21,431.1	21,173.2	0	0
September 1983-August 1984	21,808.5	21,558.1	0	0
September 1978-August 1984	124,588.7	122,753.4	0	0
After the act:				
September 1984-August 1985	22,152.1	22,248.2	1,354.3	6.11
September 1985-August 1986	22,406.4	22,363.8	1,379.9	6.16
September 1986-August 1987	22,619.0	22,475.3	1,370.5	6.06
September 1987-August 1988	22,944.9	22,793.2	1,400.3	6.10
September 1988-August 1989	23,340.6	22,794.6	1,405.9	6.02
September 1989-August 1990	23,569.3	22,861.7	1,405.8	5.96
September 1990-August 1991	23,747.8	22,692.2	1,398.3	5.89
September 1991-August 1992	24,008.4	22,965.2	1,420.0	5.91
September 1992-August 1993	23,380.1	22,978.6	1,425.4	5.10
September 1993-August 1994	23,331.5	23,058.1	1,423.3	6.10
September 1994-August 1995	23,267.2	23,167.9	1,453.7	6.25
September 1995-August 1996	23,528.2	23,211.6	1,411.9	6.00
September 1996-August 1997	23,338.0	23,264.8	1,136.0	4.86
September 1997	1,997.6	1,977.4	96.2	4.82
September 1984-September 1997	303,681.1	298,852.6	18,081.6	6.00

Source: U.S. Department of Agriculture, Economic Research Service.

Simulation of Fluid Milk Price and Income Effects

Table 4 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 but rose to 36.1 cents in 1997. Declining prices caused consumption to increase. The simulated total gain from price decreases from September 1984 to September 1997 is 814 million pounds, about 0.3 percent of actual sales.

Income has an increasing trend. In September 1996-August 1997, per capita real income was 38 percent higher than that of the corresponding 1983/84 period, resulting in a simulated consumption increase of 8.1 billion pounds, or 2.7 percent of actual sales.

Specification of the Cheese Models

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

(1) Purchases of natural cheese vary significantly by month and season, with a peak in December and a trough in July. Purchases of processed cheese vary much less by season.

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

(3) Natural cheese costs more 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, we entered branded and generic advertising as a single variable since branded advertising may have generic advertising characteristics. Advertising effects in the cheese equations are modeled with a logarithmic inverse functional form with carryover effects following a gamma distribution.

Table 4--Simulated gains in fluid milk sales attributed to price and income changes after passage of the act, 1984-97

Monthly intervals (1)	Fluid milk sales: Price fixed[1] (2)	Fluid milk sales: Income fixed[1] (3)	Price and income gains: Price (4)	Price and income gains: Income (5)	Gains due to--: Price (6)	Gains due to--: Income (7)
	Million pounds				*Percent*	
September 1984-August 1985	22,218.4	22,029.0	29.8	219.2	0.13	1.00
September 1985-August 1986	22,283.5	22,028.0	80.4	335.8	.36	1.52
September 1986-August 1987	22,377.6	22,048.1	97.7	427.2	.44	1.94
September 1987-August 1988	22,666.3	22,264.9	126.9	528.2	.56	2.37
September 1988-August 1989	22,696.7	22,193.8	97.9	600.8	.43	2.71
September 1989-August 1990	22,876.6	22,224.2	-14.9	637.5	-.07	2.87
September 1990-August 1991	22,650.2	22,141.3	42.0	551.0	.19	2.49
September 1991-August 1992	22,898.6	22,475.8	66.6	489.4	.29	2.18
September 1992-August 1993	22,925.1	22,335.3	53.5	643.3	.23	2.88
September 1993-August 1994	23,021.1	22,334.9	37.0	723.2	.16	3.24
September 1994-August 1995	23,118.8	22,360.0	49.2	808.0	.21	3.61
September 1995-August 1996	23,136.8	22,229.7	74.8	981.9	.32	4.42
September 1996-August 1997	23,205.3	22,170.1	59.5	1094.7	.26	4.94
September 1997	1,963.6	1,870.3	13.7	107.1	.69	5.73
September 1984-September 1997	298,038.6	290,705.4	814.0	8147.2	.27	2.80

[1]Gains measured when price or income were fixed at the September 1983-August 1984 level.
Source: U.S. Department of Agriculture, Economic Research Service.

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 for 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

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

where:

LnQ^n_t	=	Log of per capita quantity of natural cheese purchases by U.S. households, in pounds for each month t (t = 1...189 for January 1982-September 1997).
Lnq^n_t	=	Log of average per capita quantity of natural cheese purchases by U.S. households purchasing natural cheese, in pounds for each month t (t = 1...189 for January 1982-September 1997).
LnP^n_r	=	Log of proportion of all U.S. households that purchased natural cheese during month t (t = 1...189 for January 1982-September 1997).
LnQ^p_t	=	Log of per capita quantity of processed cheese purchases by U.S. households, in pounds for each month t (t = 1...189 for January 1982-September 1997).
Lnq^p_t	=	Log of average per capita quantity of processed cheese purchases by U.S. households, in pounds for each month t (t = 1...189 for January 1982-September 1997).
LnP^p_r	=	Log of proportion of all U.S. households that purchased processed cheese during month t (t = 1...189 for January 1982-September 1997).
LnP^n_t	=	Log of price of natural cheese in dollars for each 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 for each 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 for each pound, deflated by the CPI.
LnY_t	=	Log of U.S. per capita disposable income in month t, deflated by the CPI.
D_t	=	Monthly dummy variable, $D_t = 1$ if cheese was distributed under the Temporary Emergency Food Assistance Program.
T_t	=	Time trend, T = 1...189 for January 1982-September 1997.
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 the logarithm of current and past per capita (deflated) generic advertising expenditures, and 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.

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.

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. The advertising multiplier effect changes 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.

Data

ERS received no data this year for the cheese analysis since DMI did not purchase Market Research Corporation of America (MRCA) data because of the expense. Hence, the above hypothesized models were not run. We hope to receive data for next year’s analysis that is comparable with data we received in the past. In the Report to Congress which corresponds to this bulletin, we reported simulation results from the industry model that is stated below. In summary, we found that advertising expenditures under the Dairy Act increased total national cheese disappearance by the milk equivalent of approximately 6.8 billion pounds or about 1.0 percent during the period from the fourth quarter 1984 through the third quarter 1997. During the most recent 1-year period, from the fourth quarter of 1996 through the third quarter of 1997, generic advertising increased the national sales of cheese by approximately 500 million pounds (milk equivalent) or 0.9 percent of total sales. Since another model was used this year for the cheese analysis, the results are not comparable with past reported results.

Estimating Returns to Producers

The July 1, 1996, *USDA Report to Congress on the National Dairy Promotion and Research Program and the National Fluid Milk Processor Promotion Program* was the first study to include an estimate of the returns to milk producers from generic advertising administered by the National Dairy and Fluid Milk Processor Boards. In this section, we present an overview of how that estimate was obtained, along with discussions of key technical elements of the analysis.

First, the conceptual industry model is described. Second, a statistical model is specified and estimated to quantify the relationships in the conceptual model. This estimated model is important since it is used as the basis of simulations of the dairy industry under two situations: with and without generic advertising activities by the two boards. The simulation results provide the information used to calculate a return to producers from the generic dairy advertising.

The Dairy Industry Model

The industry model in this study is an extension of a model initially developed by several researchers at Cornell University and has been refined over time (Liu and others, 1989; Kaiser and others, 1993; Kaiser, 1995). The selection of this model was made after considerations of other analytical approaches and methodological issues had been made (Wohlgenant and Clary, 1993; Cornick and Cox, 1994). Through its many incarnations, the model has exhibited certain features. It is a structural model of the dairy industry at the national level, not a model of individual firms or any subgroup of firms. Three industry levels are identified: farm, wholesale, and retail. The wholesale and retail markets have been disaggregated into various product submarkets, which are the same at each level. These features and others are highlighted in the following discussion.

The farm level of the model is represented by a supply relationship written in general as:

$$Q_{milk} = g(P_{mf} , S_{mf}) \qquad (13)$$

where:

P_{mf} is the price the producer receives,
S_{mf} is a vector of milk supply shifters, and
Q_{milk} is the quantity of milk produced.

In equation 13, the price is an expected price and the quantity is milk produced.

The price the producer receives is a weighted average of milk prices used in final products. In simplest terms, the price can be written as:

$$P_{mf} = h(P_{fl} , P_{man}) \qquad (14)$$

where P_{fl} is the price paid for fluid grade milk and P_{man} is the manufacturing grade milk price. There is a relatively small share of manufacturing grade milk (grade B) produced in the United States. Therefore, a large proportion of the milk in manufactured products is of fluid grade.

It is important to consider economic relationships at the wholesale dairy market level, where raw farm milk is transformed into various consumer milk and dairy products, for at least two reasons. It reflects the derived demand of consumers for milk in its various forms and is the point in the marketing chain for milk and dairy products where public dairy policy has its major effects.

Public dairy policymakers in the United States have used prices in the past as the tool to direct the industry toward desired objectives. The Dairy Price Support Program and the Federal Milk Marketing Orders are two major policy programs. The U.S. Government supports the farm price of milk at an announced level through purchases of specific manufactured products, mainly American cheese, butter, and nonfat dry milk, at announced product purchase prices. The Federal Milk Marketing Orders, originally designed to move fluid milk to major population centers, establish a classified pricing structure. The institutional structure of classified prices has been modified over time to incorporate milk pricing in manufactured product uses and ultimately to affect the price milk producers receive. The support price program and the Federal Milk Marketing Orders are linked by the basic formula price, which recently replaced the Minnesota-Wisconsin price as the price mover in the marketing orders.

The wholesale dairy market is disaggregated into four submarkets: fluid milk, frozen products (mainly ice cream), butter, and cheese. Supply and demand relationships for each submarket are defined so that the effects of government programs are included where appropriate. The fluid milk and frozen products submarkets are defined generally as:

$$Q_{whs} = e(P_{wh} , S_{wh}) \tag{15}$$

$$Q_{whd} = Q_r \tag{16}$$

where:

Q_{whs} is the wholesale supply,
P_{wh} is the own-price of the product at the wholesale level,
S_{wh} is a vector of wholesale supply shifters,
Q_{whd} is the wholesale demand, and
Q_r is the retail equilibrium quantity of the product(s).

The wholesale supplies and demands for cheese and butter differ from those of fluid milk and frozen products and require further attention. Unlike fluid milk and frozen products, cheese and butter can be stored for relatively long periods. The possibilities for storage make inventory and inventory changes relevant variables for consideration in models of these two submarket models. Purchases of cheese and butter through the Commodity Credit Corporation (CCC) for price support imply that the wholesale product prices are not the only prices that might be in play. When cheese and butter markets are “at support,” announced CCC purchase prices are applicable. These are prices at which the government will buy all American cheese and butter that meet a set of specific criteria. By removing the product from the commercial marketing channels, the government supports milk prices at the announced level. The wholesale cheese and butter submarkets are specified thus:

$$Q_{whs} = d(P_{wh}, P_{ccc}, S_{wh}, INV) \tag{17}$$

$$Q_{wsd} = Q_r \tag{18}$$

where:

Q_{whs}, P_{wh}, S_{wh}, Q_{wsd}, and Q_r are defined as in equations 15 and 16 (for butter and cheese in this case), P_{ccc} is the CCC purchase price for cheese or butter, and INV is a vector of inventory-related variables.

The retail market for each of the four product categories is defined by a supply function, a demand function, and an equilibrium condition requiring that retail supply equals retail demand. These three relationships are written as:

$$Q_{rs} = m(P_r , S_{rs}) \tag{19}$$

$$Q_{rd} = n(P_r , D_{rs}) \tag{20}$$

$$Q_{rs} = Q_{rd} = Q_r \tag{21}$$

where:

P_r is the retail price of the product,
S_{rs} is a vector of retail supply shifters, and
D_{rs} is a vector of retail demand shifters.

Q_{rs}, Q_{rd}, and Q_r are the retail supply, the retail demand, and the equilibrium retail quantity of the product(s).

There is likely some limited generic dairy advertising or promotion at the wholesale level, but the vast majority is aimed at retail product consumers and, in many cases, very specific groups of those consumers. Thus, generic dairy advertising and promotion programs are viewed as elements of the vector of retail demand shifters, D_{rs}.

The econometric model is derived from the dairy industry model as presented in equations 13-17. The relevant farm level price for production decisions is an expected price. As in previous work (Kaiser, 1995), milk producers are assumed to hold what are called "naive price expectations"; the price received tomorrow will be the same as the price received today, in symbols, $E\ (P_{mf(t+1)}) = P_{mf(t)}$. The farm milk supply is therefore predetermined and the model of the dairy industry is recursive, with the system of wholesale and retail market relationships independent of the farm milk supply function.

Each of the retail product markets contains a market equilibrium condition that retail supply equals retail demand that results in the variable Q_r. Each wholesale product market also includes an equilibrium condition that wholesale supply equals wholesale demand, but wholesale demand is set equal to Q_r. This condition implies that a fixed-proportions production technology characterizes the firms providing retail dairy products to consumers. Some research has suggested that this may be unrealistic (Wohlgenant, 1989), but the data used to estimate the econometric model in part support the assumption. National demand data is proxied by commercial disappearance data that do not differentiate between wholesale and retail uses.

The Econometric Model and Its Estimates

The dairy industry model to be estimated comprises 13 equations: 4 retail demand equations, 4 retail supply equations, 4 wholesale supply equations, and the farm milk supply equation.

Each equation is specified in double logarithmic form. The double-log form provides estimated model coefficients that can be directly interpreted as elasticities. All of the equations were estimated using two-stage least square s (TSLS) with quarterly data for the period of first quarter 1975, to fourth quarter 1997.

It has been argued (Jastram, 1976) that promotion campaigns have large initial effects and then begin to have declining influence or wear out. Advertising expenditures are included in the retail demand equations with a distributed-lag structure. Second-order polynomial distributed lags of four quarters were used with end-point restrictions imposed on both ends (Pindyck and Rubinfeld, 1981). This specification is analogous to that used for the fluid milk demand model presented earlier in this report. Advertising expenditure data were obtained from various issues of *Leading National Advertisers*. These data have been criticized as possibly underestimating actual expenditures, which in turn may bias downward estimates of advertising coefficients in models. However, they are the best data available for analytical use.

The estimated equations with their associated measures of significance and fit are shown in table 5. The large majority of estimated coefficients are statistically significant and are of the correct sign as expected in economic theory. Many coefficients with the incorrect sign are statistically insignificant. The magnitudes of the estimated coefficients appear plausible and are consistent with other empirical estimates. While they appear in several equations, the insignificant coefficients seem to be more prevalent in the retail-level equations, particularly the butter and frozen product demands.

The adjusted R-squared is a measure of fit that shows how well the specified right-hand-side variables explain variation in the respective endogenous (left-hand side) variables. Ten of the equations have adjusted R-squared values of 0.80 or greater, one has a value just below (0.78). The two equations that are not as good by this measure are the retail butter and the retail frozen product demand equations, with adjusted R-squared values of 0.54 and 0.29, respectively.

An Estimate of Producer Returns

The model structure allows one to focus on the industry, on one of the market levels, or on any one of the four product submarkets. Since producer returns from generic advertising and promotion by the NDB (and the recent processor program) are the specific interest here, the farm-level relationships are of primary interest. Highlights from the retail level, in particular the demand relationships, are a secondary topic. The retail demand relationships are important because they show the first-round effects from promotion and advertising expenditures.

Simulations of the dairy industry using the estimated econometric model were made for cases with and without the boards. The simulations are for the period beginning with the third quarter of 1984 and ending with the fourth quarter of 1997. The with-boards simulation essentially provides the industry baseline for comparison of the without-boards estimates. The without-boards case is what the industry would have been like in the absence of NDB and processor actions. How the without-boards case is simulated plays a major role in the calculation of differences between the two situations.

The simulation of the dairy industry without the boards' generic advertising expenditures is based on the assumption that the level of funding for generic advertising and promotion that existed prior to the implementation of the mandatory assessment would continue. That funding had been provided voluntarily in some States, or by mandatory assessments in others (Forker, 1996). The expenditures for media buys in the third quarter of 1983 through the second quarter of 1984 were used as the basis for estimating an implied national assessment for generic advertising and promotion in the without-boards case. The implied without-boards assessment was estimated to be about 6.3 cents per hundredweight (cwt).

Table 5--Econometric estimation of the dairy industry model

Farm level:

Farm milk supply--

$$LMILK = \underset{(5.68)}{1.2286} + \underset{(2.78)}{0.1122}LAMPFEED - \underset{(-1.59)}{0.0817}LFWAGEFEED + \underset{(10.04)}{0.6582}LMILK(-1) + \underset{(8.25)}{0.0581}DUMQ1 + \underset{(15.73)}{0.1007}DUMQ2 + \underset{(4.29)}{0.0018}T$$

Adjusted R-squared 0.96 DW 1.70

Wholesale level:

Wholesale fluid milk supply--

$$LWFLS = \underset{(15.27)}{2.5205} + \underset{(0.94)}{0.0927}LWFPP1 - \underset{(-2.38)}{0.0855}LPFEP1 - \underset{(-5.42)}{0.0143}DUMQ1 - \underset{(-17.57)}{0.0593}DUMQ2 - \underset{(-16.71)}{0.0512}DUMQ3 + \underset{(2.36)}{0.0012}T + \underset{(10.28)}{0.7905}AR(1)$$

Adjusted R-squared 0.93

Wholesale cheese supply--

$$LWCHS = \underset{(75.84)}{1.8884} + \underset{(1.41)}{0.1028}LWPCH + \underset{(2.04)}{0.0175}DUMQ1 + \underset{(12.01)}{0.09961}DUMQ2 + \underset{(20.39)}{0.0089}T + \underset{(7.65)}{0.6155}AR(1)$$

Adjusted R-squared 0.98

Notes to table 5

Values in parentheses are t-values

LMILK = Milk production, billion pounds.
LAMPFEED = Ratio of all milk price to ration value.
LFWAGEFEED= Ratio of farm wage rate to ration value.
DUMQ1 = Intercept dummy variable equal to 1 for first quarter of a year, 0 otherwise.
DUMQ2 = Intercept dummy variable equal to 1 for second quarter of a year, 0 otherwise.
DUMQ3 = Intercept dummy variable equal to 1 for third quarter of a year, 0 otherwise.
LWFLS = Wholesale fluid supply measured in billion pounds, milkfat equivalent.
LWFPP1 = Ratio of wholesale fluid price index to class 1 milk price.
LPFEP1 = Ratio of energy price index to class 1 milk price.
LWCHS = Wholesale cheese supply measured in billion pounds, milkfat equivalent.
LWPCH = Wholesale cheese price.
LWBS = Wholesale butter supply measured in billion pounds, milkfat equivalent.
LWPB = Wholesale butter price
T = Time trend variable equal to 1 for first quarter 1975, 2 for second quarter 1975, 3 for third quarter 1975, and so forth.
LWFZS = Wholesale frozen products supply measured in billion pounds, milkfat equivalent.
LWPFZ = Wholesale frozen product price index.
LRFLS = Retail fluid supply measured in billion pounds, milkfat equivalent.
RFLPWFLP= Ratio of retail price index for fresh milk and cream to wholesale fluid milk price index.

Table 5--Econometric estimation of the dairy industry model -- continued

Wholesale butter supply--

LWBS = 0.5288 + 0.0473LWPB + 0.0006T + 0.0525DUMQ1 - 0.1973DUMQ2 -
(4.95) (1.61) (1.84) (2.27) (-5.94)
0.4193DUMQ3 + 0.7730LWBS(-1)
(-15.31) (10.93)

Adjusted R-squared 0.89

Wholesale frozen product supply--

LWFZS = 0.3634 + 0.1238LWPFZ + 0.0701DUMQ1 + 0.3279DUMQ2 + 0.3499DUMQ3 +
(1.40) (2.22) (8.90) (36.73) (45.14)
+ 0.6967AR(1)
(8.77)

Adjusted R-squared 0.95

Retail level:
Retail fluid milk supply--

LRFLS = 2.5922 + 0.2391RFLPWFLP - 0.1156PFEWPF - 0.0166DUMQ1 - 0.0614DUMQ2
(99.01) (1.10) (-1.62) (-5.25) (-18.15)
- 0.0520DUMQ3 + 0.9198AR(1)
(-19.74) (24.96)

Adjusted R-squared

Notes to table 5 (continued)

Continued--

PFEWPF = Ratio of energy price index to wholesale fluid milk price index.
LRCHS = Retail cheese supply measured in billion pounds, milkfat equivalent.
RCPWCP= Ratio of retail cheese price index to wholesale cheese price.
LTREND= Natural logarithm of the trend variable, T.
LRBS = Retail butter supply measured in billion pounds, milkfat equivalent.
RBPWPB= Ratio of retail butter price index to wholesale butter price.
LRFZS = Retail frozen products supply measured in billion pounds, milkfat equivalent.
RFZPWFZP= Ratio of retail frozen products price index to wholesale frozen products price index.
LRFLDEM= Per capita retail fluid demand measured in billion pounds, milkfat equivalent.
RFPBEV = Ratio of retail fluid milk and cream price index to the price index for nonalcoholic beverages.
INCBEV = Ratio of personal disposable income to the consumer price index for nonalcoholic beverages.
LRCHSDEM= Per capita retail cheese demand measured in billion pounds, milkfat equivalent.
RCPMEA= Ratio of retail cheese price index to retail meat price index.
INCMEA= Ratio of personal disposable income to retail meat price index.
TSQ = Time trend variable squared.
LRBDEM= Per capita retail butter demand measured in billion pounds, milkfat equivalent.
RPBFAT = Ratio of retail butter price index to retail fats and oils price index.
INCFAT = Ratio of personal disposable income to retail fats and oils price index.
LRFZDEM= Per capita retail frozen products demand measured in billion pounds, milkfat equivalent.
RFZPFOO= Ratio of retail frozen products price index to retail price index for food.
INCFOO = Ratio of personal disposable income to retail price index for food.

Table 5--Econometric estimation of the dairy industry model -- continued

Retail cheese supply--

LRCHS = 0.7052 + 0.3380RCPWCP +0.0547DUMQ2 + 0.1329LTREND + 0.3035AR(1)
(2.98) (5.35) (5.15) (8.58) (3.62)

Adjusted R-squared 0.93

Retail butter supply--

LRBS = 0.7213 + 0.2829RBPWPB + 0.1339DUMQ1 + 0.0877DUMQ2 - 0.1270DUMQ3 +
(1.53) (2.65) (9.09) (5.65) (-9.47)
0.7819AR(1)
(12.06)

Adjusted R-squared 0.83

Retail frozen product supply--

LRFZS = 0.9337 + 0.3856RFZPWFZP + 0.0708DUMQ1 +0.3284DUMQ2 + 0.3503DUMQ3 +
(52.48) (1.00) (9.16) (37.34) (45.85)
0.7551AR(1)
(10.49)

Adjusted R-squared 0.95

Retail fluid milk demand--

LRFLDEM = 2.6598 - 0.1202RFPBEV + 0.2079INCBEV - 0.0030T - 0.0128DUMQ1 -
(2.66) (-2.05) (2.98) (-4.85) (-3.01)
0.0566DUMQ2 - 0.0503DUMQ3 - 0.0504BST + 0.0092LGFAD +
(-9.96) (-11.89) (-3.66) (5.63)
0.0147LGFAD(-1) + 0.0166LGFAD(-2) + 0.0147LGFAD(-3) +0.0092LGFAD(-4) +
(5.63) (5.63) (5.63) (5.63)
0.6239MA(1)
(6.97)

Adjusted R-squared 0.87

Notes to table 5 (continued)

BST = Intercept dummy variable equal to 1 for the quarters when bST is commercially available, 0 otherwise.
LGFAD = Generic fluid milk advertising expenditures deflated by the media price index, measured in $1,000.
LGBAD = Generic butter advertising expenditures deflated by the media price index, measured in $1,000.
LGCAD = Generic cheese advertising expenditures deflated by the media price index, measured in $1,000.
LGICAD = Generic ice cream advertising expenditures deflated by the media price index, measured $1,000.

“L” preceding variable names indicates the natural logarithm of the variable.

Table 5--Econometric estimation of the dairy industry model – continued

Retail cheese demand--

LRCHSDEM = 2.3609 - 0.6175RCPMEA + 0.2353INCMEA - 0.0924DUMQ1 - 0.0536DUMQ2 -
(4.11) (-3.40) (1.765 (-12.24) (-6.35)
0.0550DUMQ3 - 0.0743BST+ 0.00006TSQ + 0.0035LGCAD +
(-7.22) (-3.26) (8.45) (2.70)
0.0056LGCAD(-1) + 0.0064LGCAD(-2) + 0.0056LGCAD(-3) +
(2.70) (2.70) (2.70)
0.0035LGCAD(-4) + 0.4184AR(1)
(2.70) (3.93)

Adjusted R-squared 0.98

Retail butter demand--

LRBDEM = 0.0683 - 0.3741RPBFAT + 0.7065INCFAT - 0.1640DUMQ1 - 0.2151DUMQ2 -
(0.30) (-1.72) (1.24) (-6.04) (-7.88)
0.1334DUMQ3 + 0.1721BST -0.0074T -0.0004LGBAD -0.0006LGBAD(-1) -
(-4.95) (4.63) (-1.69) (-0.87) (-0.87)
0.0007LGBAD(-2) - 0.0006LGBAD(-3) - 0.0004LGBAD(-4)
(-0.87) (-0.87) (-0.87)

Adjusted R-squared 0.53 DW 2.18

Retail frozen product demand--

LRFZDEM = -0.0984 - 0.2934RFZPFOO + 0.5448INCFOO - 0.00004TSQ + 0.0130DUMQ1 +
-0.23) (-1.37) (6.19) (-10.19) (1.48)
0.2873DUMQ2 + 0.3174DUMQ3 - 0.0002LGICAD - 0.0003LGICAD(-1) -
(32.90) (36.23) (-1.67) (-1.67)
0.0004LGICAD(-2) - 0.0003LGICAD(-3) - 0.0002LGICAD(-4)
(-1.67) (-1.67) (-1.67)

Adjusted R-squared 0.97 DW 1.25

Simulated average quarterly values of selected price and aggregate quantity variables under the two scenarios, with and without the boards' activities, are presented in table 6. A rough measure of the returns to producers from generic advertising can be obtained using the estimates of the farm milk price and the board assessments in the with and without simulations. The difference in the assessments is 8.7 cents per cwt. The difference in simulated average farm milk prices is 30 cents per cwt, 2.3 percent above the price in the without-boards scenario, for a return of $3.44 for each dollar of advertising.

The simulated retail demand quantities reported in table 6 support the contention that generic advertising and promotion is achieving one of its main objectives: increasing the demand for milk and dairy products. The clearest positive effects of generic advertising are seen for fluid milk and cheese, the product groups that receive most of the advertising monies. The quarterly average increase in aggregate retail demand is estimated to be 5.5 percent for fluid milk and 1 percent for cheese. Both the frozen product and the butter demands appear to be essentially unchanged in the with-boards case. Recall that the retail demand equation for butter exhibits statistical shortcomings so the simulation results must be interpreted with caution. The frozen product demand equation is more difficult to assess. It has a good fit, but other statistical properties, for instance the Durbin-Watson statistic, suggest that one needs to be careful in interpreting this equation and its simulated results.

Future Work

The empirical results presented here indicate that milk producers receive a positive return from generic advertising on the order of $3.44 for each dollar assessed to fund the activities. These results are consistent with previous estimates that ranged from $2.00 to near $7.00 in the literature.

The variation among estimates of producers' returns from generic advertising points to several key elements of this and other analyses. First, and not surprising, is that the models used to generate empirical estimates of economic variables for the analyses condition the results. The empirical estimates presented here are based on an aggregate industry model developed at Cornell University over several years, with data updated and coefficients re-estimated. This model has been widely used and continues to be evaluated and improved (Kaiser, 1996).

There is clearly room for improvement in the model presented here, given sufficient time and resources. The retail butter supply and demand relationships need to be revisited. There have been few attempts to estimate butter supply and demand that have given what might be called reasonable results. The assumption of fixed-proportions technology between the wholesale and the retail levels also needs to be examined further. There has been work in this area focused on other products that can offer suggestions as to how to proceed (Kinnucan, Nelson, and Xiao, 1995). A third item to consider is inclusion of variables for branded advertising efforts in the retail product markets.

Having suggested there is more work to do to improve the analytical base for evaluating generic dairy advertising and promotion programs, it is important to take stock of recent actions in the agricultural policy arena and in the courts. Generic advertising and promotion programs have both ardent critics and supporters. In the new environment of reduced roles for public policy in the agricultural sector, supporters of the generic dairy promotion and research programs will likely be under increasing pressure to show why the programs are needed and what benefits they provide to various groups, including the milk producers and processors who fund them.

Table 6--Simulated values of selected market variables with and without the boards, 1984:3-1997

Variable	Unit	Without boards	With boards	Percent difference
Farm milk supply	Bil. lbs. me.[1]	34.7	35.6	2.6
Farm milk price	Dol./cwt.	12.91	13.21	2.3
Advertising assessment	Cents/cwt.	6.3	15.0	
Fluid demand	Bil. lbs. me.	12.90	13.62	5.5
Cheese demand	Bil. lbs. me.	12.76	12.89	1.0
Butter demand	Bil. lbs. me.	5.35	5.35	0.0
Frozen product demand	Bil. lbs. me.	3.20	3.20	0.0

[1] The abbreviation "me." is milk equivalent milkfat basis.
Source: U.S. Department of Agriculture, Economic Research Service

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. Kaiser and others (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 effects 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 assumed 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 43 percent of national milk consumption. For the cheese analysis, the Market Research Corporation of America (MRCA) data measure only household purchases of cheese at retail establishments for off-premises 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 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, types of media used, and 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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