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Impact of Generic Fluid Milk and Cheese Advertising on Dairy Markets 1984-99

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- Facilitate the development of new theory and research methodology.

Impact of Generic Fluid Milk and Cheese Advertising on Dairy Markets, 1984-99

Abstract

The purpose of this study was to analyze the impacts of generic milk and cheese advertising on dairy markets. The results indicated that generic milk and cheese advertising by dairy farmers and fluid milk processors had major market impacts for the dairy industry. The main conclusion of the study is that farmers and processors are receiving a high return on their investment in generic dairy advertising.

The impacts of advertising tend to be more profound in increasing price than quantity, which is due to the inelastic nature of demand for milk and cheese. These estimated impacts need to be compared with the other options producers and processors have for marketing their product (e.g., non-advertising promotion, research, new product development, etc.) in order to determine the optimality of the current investment of advertising. Consequently, these results should be viewed as a first step in the evaluation process.

Impact of Generic Fluid Milk and Cheese Advertising on Dairy Markets, 1984-99

Dairy farmers pay a mandatory assessment of 15 cents per hundred pounds of milk marketed in the continental United States to fund a national demand expansion program. The aims of this program are to increase consumer demand for fluid milk and dairy products, enhance dairy farm revenue, and reduce the amount of surplus milk purchased by the government under the Dairy Price Support Program. Legislative authority for these assessments is contained in the *Dairy and Tobacco Adjustment Act* of 1983. To increase fluid milk and dairy product consumption, the National Dairy Promotion and Research Board (NDPRB) was established to invest in generic dairy advertising and promotion, nutrition research, education, and new product development. More recently, fluid milk processors began their own generic fluid milk advertising program (the Milk Mustache print media campaign), which is funded by a mandatory $0.20 per hundredweight processor checkoff on fluid milk sales.

Each year, the Cornell Commodity Promotion Research Program (CCPRP) estimates the impact of the generic advertising effort on the U.S. dairy industry. For the past two years, this research has been used by the U.S. Department of Agriculture as the evaluation basis for their report to Congress on the economic impacts of generic milk and cheese advertising. U.S. dairy industry data are updated each year and used with a dairy industry model to measure the impact of generic advertising milk and cheese on prices and quantities for fluid milk and dairy products. The model used is based on a dynamic econometric model of the U.S. dairy industry estimated using quarterly data from 1975 through 1999, and is unique from previous models of the U.S. dairy sector in its level of disaggregation. For instance, the dairy industry is divided into retail, wholesale, and farm markets, and the retail and wholesale markets include fluid milk and cheese as separate markets. Markets for butter and frozen products are included in the model, but are treated as being exogenous since the focus is on fluid milk and cheese advertising. Econometric results are used to simulate market conditions with and without the national programs.

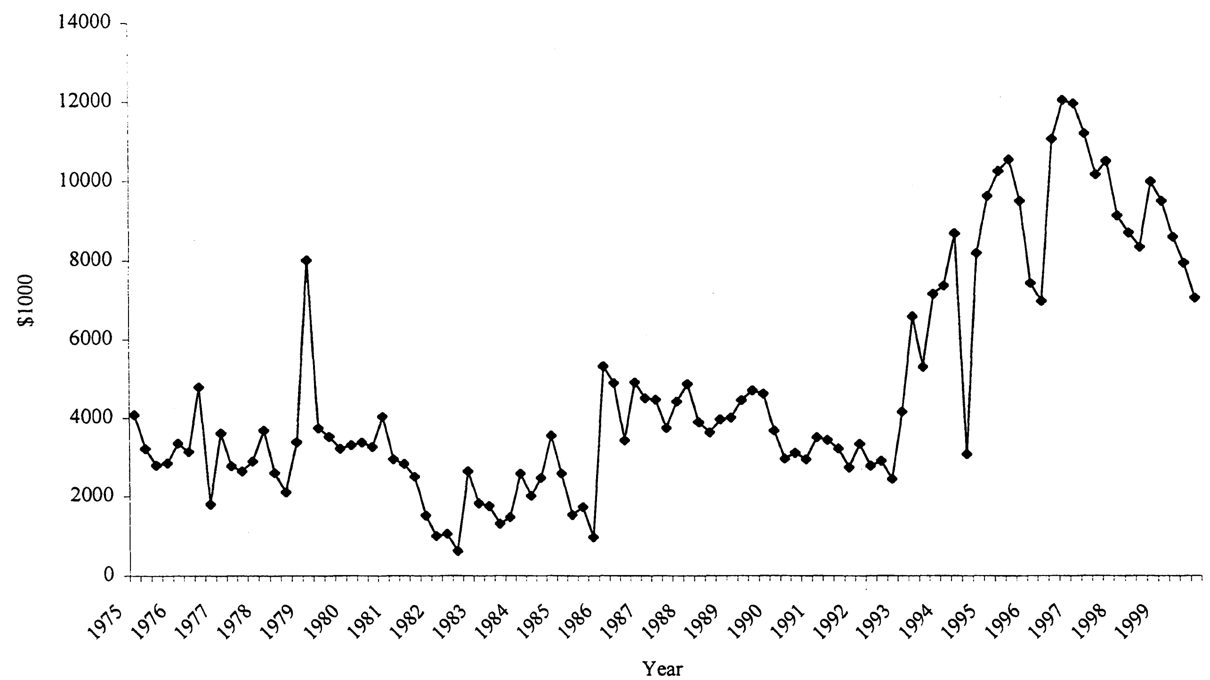
The results of this study are important for dairy farmers, fluid milk processors, and policy makers given that the dairy industry has the largest generic promotion program of all U.S. agricultural commodities. Over $200 million is raised annually by the checkoff on dairy farmers, and the majority of this is invested in media advertising of fluid milk and cheese. In addition, over $100 million is raised annually by the checkoff on fluid milk processors. Farmers and processors certainly want to know whether their advertising investment is paying off. Consequently, the annual measurement of generic dairy advertising is an important objective of the CCPRP.

Background

Prior to 1984, there was no national mandatory checkoff for dairy advertising and promotion. However, many states had their own checkoff programs, which were primarily used for promoting and advertising fluid milk. Because of the huge surplus milk problem beginning in the early 1980s, Congress passed the *Dairy and Tobacco Adjustment Act* in 1983. This Act was designed to reduce the milk surplus by implementing a voluntary supply control program (Milk Diversion Program) and authorizing a mandatory checkoff for demand expansion. The mandatory checkoff program, which was subsequently approved by dairy farmers in a national referendum, resulted in the creation of the NDPRB.

The generic advertising effort under the mandatory checkoff program initially emphasized manufactured dairy products, since 10 of the 15 cents of the checkoff went to state promotion programs, which were primarily fluid programs. The initial emphasis on

Figure 1. Quarterly deflated generic fluid milk advertising, 1975-99.



manufactured advertising is evident from Figure 1, which shows quarterly generic fluid advertising expenditures in the United States from 1975-99, deflated by the Media Cost Index. At the national level, generic fluid advertising expenditures did not significantly change immediately following the creation of this mandatory program. In fact, it was not until the mid-1990s that there was a significant increase in generic fluid milk advertising expenditures, which occurred after the NDPRB merged with the United Dairy Industry Association (UDIA). Subsequently, the amount of fluid advertising has increased significantly. With the inception of the MilkPEP program (the Milk Mustache print media campaign) in 1995, generic fluid milk advertising increased substantially. However, deflated generic fluid milk advertising has been decreasing over the past three years.

Figure 2. Quarterly deflated generic cheese advertising, 1975-99.

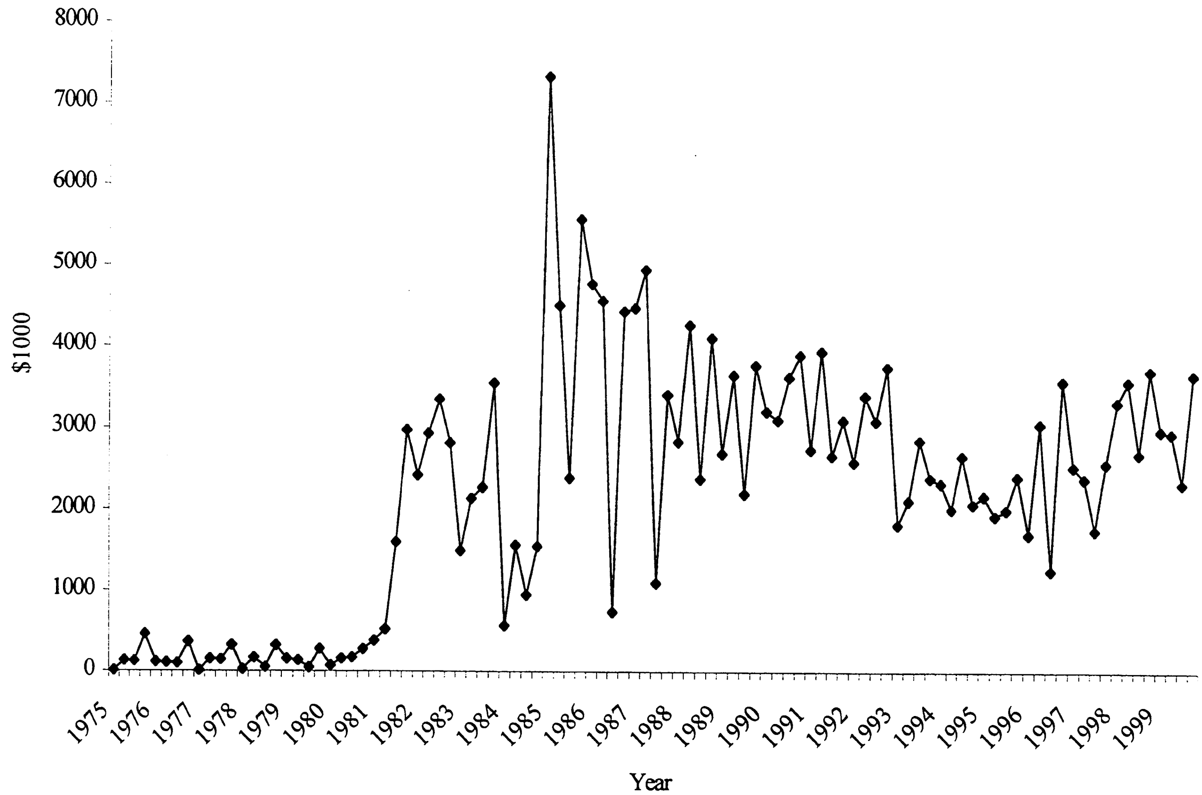


Figure 2 shows quarterly generic cheese advertising in the United States from 1975-99. It is clear from this figure that the initial focus was on generic cheese (and other manufactured products) advertising of manufactured dairy products. Generic cheese advertising, as well as generic butter and ice cream advertising (not shown) increased substantially after the mandatory checkoff program was introduced. However, since the mid-1980s, generic advertising of cheese steadily declined in favor of generic fluid advertising until very recently, where it has shown a slight increase.

Conceptual Model

Much research has been conducted on the impacts of generic dairy advertising. For example, in an annotated bibliography of generic commodity promotion research, Ferrero et al. listed 29 economic studies on dairy over the period, 1992-96. Some of this research has been at the state level with New York state being studied extensively (e.g., Kinnucan, Chang, and Venkateswaran, Kaiser and Reberte, Reberte et al., Lenz, Kaiser, and Chung). These studies have used single equation techniques to estimate demand equations (usually for fluid milk) as functions of own price, substitute price, income, population demographics, and advertising. There have been several recent national studies done as well (e.g., Blisard and Blaylock, Liu et al., 1990, Cornick and Cox, Suzuki et al., Wohlgenant and Clary). Of these, the most disaggregated in terms of markets and products is the study by Liu et al (1990), who developed a multiple market, multiple product dairy industry model to measure the impacts of fluid milk and manufactured dairy product generic advertising.

The econometric model presented here is similar in structure to the industry model developed by Liu et al. (1990, 1991). Both Liu et al. (1990, 1991) and the current model are partial equilibrium models of the domestic dairy sector (with no trade) that divides the dairy industry into retail, wholesale, and farm markets. However, while Liu et al. (1990, 1991) classified all manufactured products into one category (Class III), the present model focuses on cheeses rather than on other manufactured dairy products. Cheese is the most important manufactured dairy product in terms of market value as well as in amount of advertising. Since there is no longer much dairy farmer money invested in advertising butter and ice cream, these two products are treated as being exogenous in the industry model.

In the farm market, Grade A (fluid eligible) milk is produced by farmers and sold to wholesalers. The wholesale market is disaggregated into two sub-markets: fluid (beverage) milk and cheese.[1] Wholesalers process the milk into these products and sell them to retailers, who then sell the products to consumers. The model assumes that farmers, wholesalers, and retailers behave competitively in the market. This assumption is supported empirically by two recent studies. Liu, Sun, and Kaiser estimated the market power of fluid milk and manufacturing milk processors, concluding that both behaved quite competitively over the period 1982-1992. Suzuki et al. measured the degree of market imperfection in the fluid milk industry and found the degree of imperfection to be relatively small and declining over time.

It is assumed that the two major federal programs that regulate the dairy industry (Federal milk marketing orders and the Dairy Price Support Program) are in effect. Since this is a national model, it is assumed that there is one Federal milk marketing order regulating all milk marketed in the nation. The Federal milk marketing order program is incorporated by restricting the prices wholesalers pay for raw milk to be the minimum class prices. For example, fluid milk wholesalers pay the higher Class I price, while cheese wholesalers pay the lower Class III price. The Dairy Price Support Program is incorporated into the model by restricting the wholesale cheese price to be greater than or equal to the government purchase prices for cheese. With the government offering to buy unlimited quantities of storable manufactured dairy products at announced purchase prices, the program indirectly supports the farm milk price by increasing farm-level milk demand.

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[1] All quantities in the model (except fluid milk) are expressed on a milkfat equivalent (me) basis. Fluid milk is expressed in product form in pounds.

Retail markets are defined by sets of supply and demand functions, in addition to equilibrium conditions that require supply and demand to be equal. Since the market is disaggregated into fluid milk and cheese, there are two sets of these equations. Each set has the following general specification:

(1.1) $RiD = f(RiP|Si^{rd})$,

(1.2) $RiS = f(RiP|Si^{rs})$,

(1.3) $RiD = RiS \equiv Ri^*$, i = fluid milk (F), cheese (C),

where: RiD and RiS are retail demand and supply for fluid milk and cheese, respectively, RiP is the retail own price for fluid milk and cheese, respectively, Si^{rd} is a vector of retail demand shifters including generic advertising for fluid milk and cheese, respectively, Si^{rs} is a vector of retail supply shifters including the wholesale own price for fluid milk and cheese, respectively, and Ri* is the equilibrium retail quantity for fluid milk and cheese, respectively.

The wholesale market is also defined by two sets of supply and demand functions, and two sets of equilibrium conditions. The wholesale fluid milk market has the following general specification:

(2.1) $WFD = RF^*$,

(2.2) $WFS = f(WFP|SF^{ws})$,

(2.3) $WFS = WFD \equiv WF^* \equiv RF^*$,

where: WFD and WFS are wholesale fluid milk demand and supply, respectively, WFP is the wholesale fluid milk price, and SF^{ws} is a vector of wholesale fluid milk supply shifters, including the Class I price, which is equal to the Class III milk price (i.e., the Basic Formula price) plus a fixed fluid milk differential. Note that the wholesale level demand functions do not have to be estimated since the equilibrium conditions constrain wholesale demand to be equal to the equilibrium retail quantity. The assumption that wholesale demand equals retail quantity implies a fixed-proportions production technology.

The direct impacts of the Dairy Price Support Program occur at the wholesale cheese market level. It is at this level that the Commodity Credit Corporation (CCC) provides an alternative source of demand at announced purchase prices. In addition, cheese can be stored as inventories, which represent another source of demand not present with fluid milk. Consequently, the equilibrium conditions for the cheese wholesale market differs from those for the fluid milk market. The wholesale cheese market has the following general specification:

(3.1) $WCD = RC^*$,

(3.2) $WCS = f(WCP|SC^{WS})$,

(3.3) $WCS = WCD + \Delta INVC + QSPC \equiv QC^W$,

where: WCD and WCS are wholesale cheese demand and supply, respectively, WCP is the wholesale cheese price, SC^{WS} is a vector of wholesale cheese supply shifters including the Class III milk price, $\Delta INVC$ is change in commercial cheese inventories, QSPC is quantity of cheese sold by specialty plants to the government, and QC^W is the equilibrium wholesale cheese quantity. The variables ΔINVC and QSPC represent a small proportion of total milk production and are assumed to be exogenous in this model.[2]

The Dairy Price Support Program is incorporated in the model by constraining the wholesale cheese price to be not less than their respective government purchase prices, i.e.:

(4.1) $WCP \geq GCP$,

where: WCP and GCP are the wholesale cheese price and government purchase price for cheese.

Because of the Dairy Price Support Program, two regimes are possible: (1) WCP > GCP, and (2) WCP = GCP. In the first case, where the market is competitive, equilibrium condition (3.3) applies. However, in the second case, where the market is being supported by the Dairy Price Support Program, equilibrium condition (3.3) is changed to:

(3.3a) $WCS = WCD + \Delta INVC + QSPC + GC \equiv WC$,

where: GC is government purchases of cheese, which becomes the new endogenous variable, replacing the wholesale cheese price.

The farm raw milk market is represented by the following milk supply equation:

(5.1) $FMS = f(E[AMP]|S^{fm})$,

where: FMS is commercial milk marketings in the United States, E[AMP] is the expected all

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[2] Certain cheese plants sell products to the government only, regardless of the relationship between the wholesale market price and the purchase price. These are general balancing plants that remove excess milk from the market when supply is greater than demand, and process the milk into cheese which is then sold to the government. Because of this, the quantity of milk purchased by the government was disaggregated into purchases from these specialized plants and other purchases. In a competitive regime, the "other purchases" are expected to be zero, while the purchases from specialty plants may be positive. The QSPC variable was determined by computing the average amount of government purchases of cheese during competitive periods, i.e., when the wholesale price was greater than the purchase price.

milk price, and S^{fm} is a vector of milk supply shifters. As in the model developed by LaFrance and de Gorter and by Kaiser, a perfect foresight specification is used for the expected farm milk price.

The farm milk price is a weighted average of the Class prices for milk, with the weights equal to the utilization of milk among products:

$$(5.2) \quad AMP = \frac{(P3 + d)\ WFS + P3\ WCS + P3\ (OTHER)}{WFS + WCS + OTHER}$$

where: P3 is the Class III price, d is the Class I fixed fluid milk differential (therefore the Class I price is equal to P3 + d), WFS is wholesale fluid milk supply, WCS is wholesale cheese supply, and OTHER is wholesale supply of other manufactured dairy products (principally butter and frozen dairy products), which are treated as exogenous in the model.

Finally, the model is closed by the following equilibrium condition:

$$(5.3) \quad FMS = WFS + WCS + FUSE + OTHER,$$

where FUSE is on-farm use of milk, which is treated as exogenous.

Econometric Estimation

The equations were estimated simultaneously using an instrumental variable approach for all prices and quarterly data from 1975 through 1999. Specifically, all prices were regressed using ordinary least squares on the exogenous variables in the model, and the resulting fitted values were used as instrumental price variables in the structural equations. The econometric package used was EViews (Hall, Lilien, and Johnston). All equations in the model were specified in double-logarithm functional form. Variable definitions, data sources and estimation results are presented in the appendix. In terms of statistical fit, the estimated equations were found to be reasonable with respect to R^2. The lowest adjusted coefficient of determination for any equation was 0.92, which is quite respectable.

The retail market demand functions were estimated on a per capita basis, and the following variables were included as demand determinants: Consumer Price Index (CPI) for fluid milk; CPI for non-alcoholic beverages, which was used as a proxy for fluid milk substitutes; per capita disposable income; consumer expenditures on food consumed away from home, which has a negative impact on fluid milk demand; percent of U.S. population five years old or younger, which has a positive effect on fluid milk demand; an indicator variable for when bovine somatotropin was approved for commercial use, which may have a negative impact on fluid milk demand; quarterly indicator variables to capture seasonality in fluid milk demand; brand fluid milk advertising and generic fluid milk advertising.[3] To account for the impact of inflation, the CPI for fluid milk and income were deflated by the CPI for non-alcoholic beverages. This specification was followed because there was strong correlation between prices. To measure the generic advertising by the dairy industry, generic fluid milk advertising expenditures were included as explanatory variables in the demand equation. Since 1995, fluid milk processors have funded their own generic fluid milk advertising program. In the econometric estimation, the fluid milk processors' generic advertising expenditures were added to dairy farmer advertising expenditures. Brand and generic fluid milk advertising was measured as the amount of expenditures per quarter deflated by the Media Cost Index. To capture the dynamics of advertising in the demand model, generic and brand advertising expenditures were specified as a second-order polynomial distributed lag. The length of the lag was initially varied between one and six quarters and the final specification was chosen based on goodness of fit.

Finally, a first-order moving average error structure was imposed on the retail fluid milk demand equation to correct for autocorrelation.

The following variables were included as determinants of per capita cheese demand: CPI for cheese; CPI for meat, which was used as a proxy for cheese substitutes; per capita disposable income; consumer expenditures on food consumed away from home, which, unlike fluid milk, has a positive impact on cheese demand; quarterly indicator variables to capture seasonality in cheese demand; brand cheese advertising and generic cheese advertising. Similar estimation procedures were used to estimate cheese demand as were used to estimate fluid milk demand. Generic and brand advertising expenditures were specified as a second-order polynomial distributed lag, and the length of the lag was initially varied between one and six quarters and the final specification was chosen based on goodness of fit. Finally, a first- and second-order autoregressive error structure was imposed on the retail cheese demand equation to correct for autocorrelation.

[3] All generic and brand advertising expenditures come from various issues of *Leading National Advertisers*.

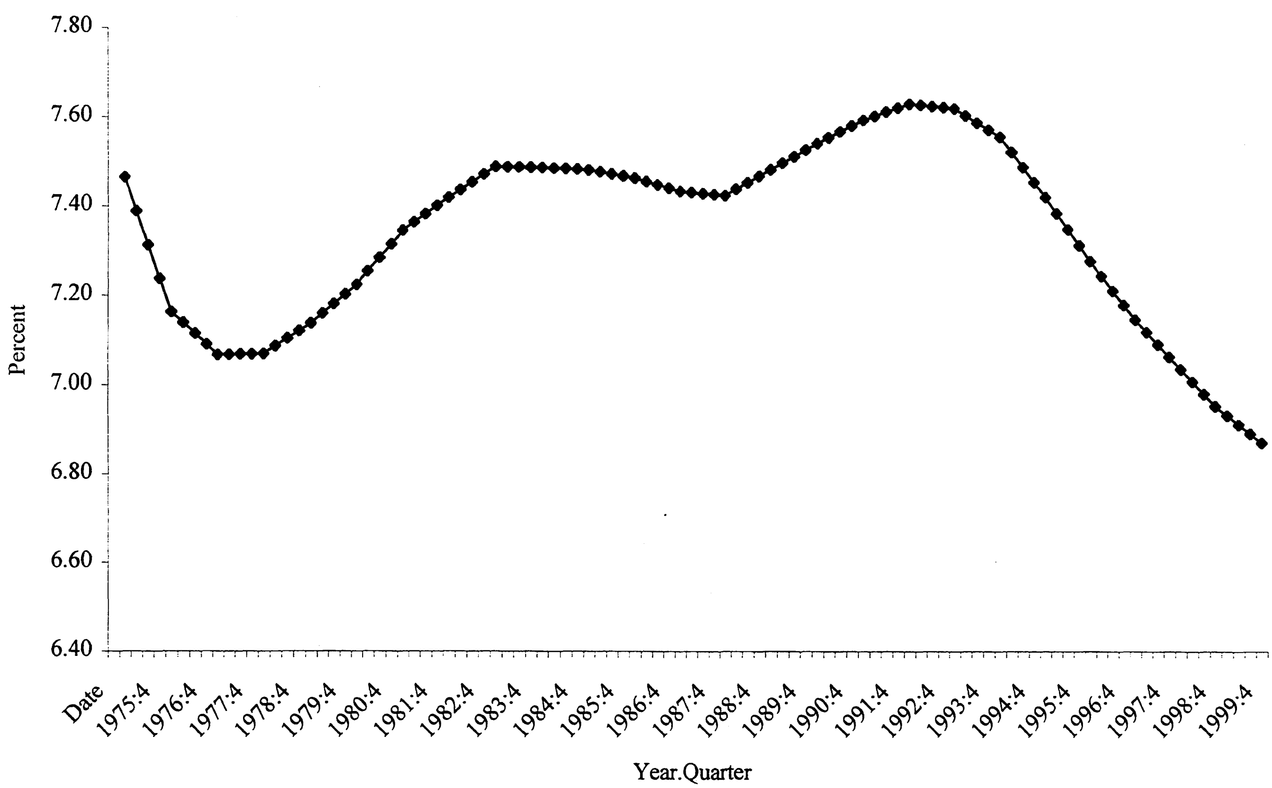
Table 1. Estimated elasticity values for factors affecting the retail demand for fluid milk and cheese.[a]

Factors affecting demand	Fluid Milk	Cheese
Retail price	-0.170	-0.320
Per capita income	0.180	0.305
Food away from home	-0.180	0.495
Brand advertising	0.015	0.032
Generic advertising	0.051	0.015
Percent of population younger than six years old	0.610	n.a.

[a]Example: a 10 percent increase in the retail price of fluid milk is estimated to reduce per capita sales of fluid milk by 1.7 percent. n.a. means "not applicable." For more information on the data used to estimate these elasticities, see the appendix of this chapter.

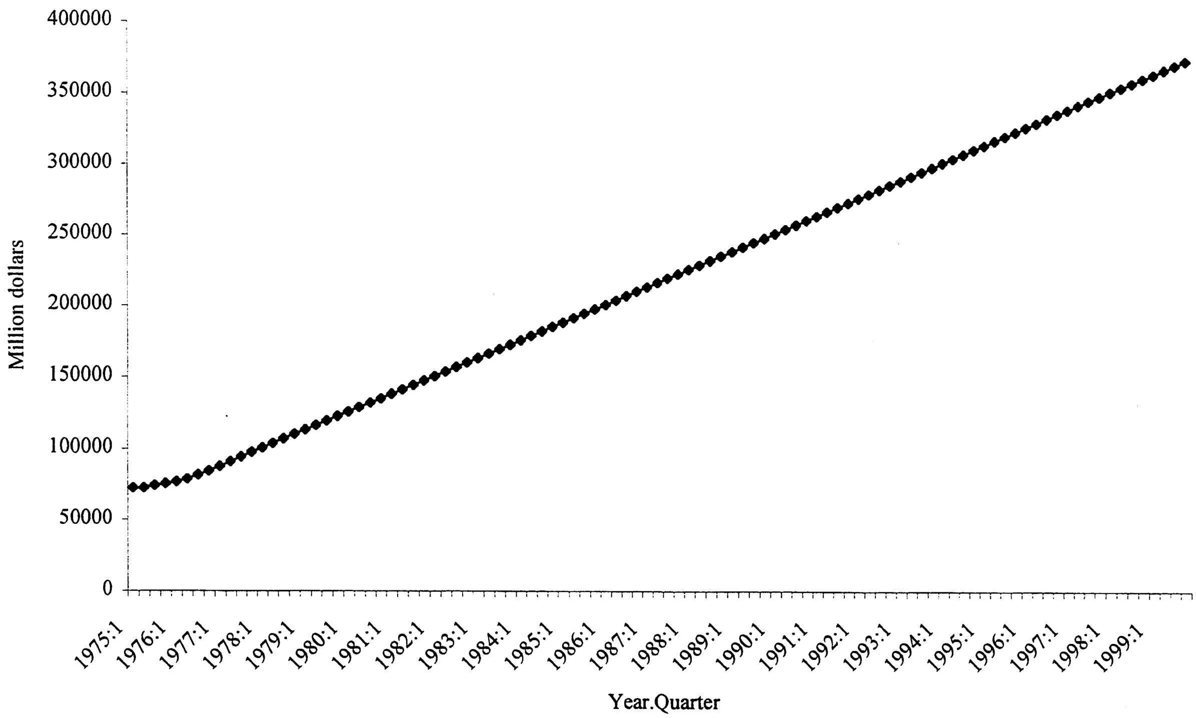
The relative impacts of variables affecting demand can be represented with "elasticities," which measure the percentage change in per capita demand given a one percent change in one of the identified demand factors. Table 1 presents the estimated elasticity values for selected demand factors for fluid milk and cheese. For example, the income elasticity of demand for fluid milk equal to 0.18 means that a 10 percent increase in per capita income increases per capita fluid milk demand by 1.8 percent.

Figure 3. Percentage of U.S. population six years old and younger, 1975-99.



The most important factor affecting per capita fluid milk demand is the percentage of population under six years old. As Figure 3 illustrates, after peaking in 1993, the percentage of population under six years old has steadily declined, which has had a very large negative effect on per capita fluid milk demand since younger children consume a larger share of fluid milk than older segments of the population.

Figure 4. Expenditures on food consumed away-from-home in the U.S., 1975-99.



The most important factor affecting per capita cheese demand is expenditures on food consumed away from home. Figure 4 displays expenditures on away-from-home food consumption, which has consistently increased over time. This trend has had an important impact on increasing per capita cheese demand, presumably since people often consume cheese at meals away from home, e.g., pizza and Mexican restaurants. It is interesting that while the trend in eating away-from-home has been beneficial to cheese demand, it has had a negative impact on fluid milk consumption. This is due to the reduced demand for fluid milk products away-from-home, which in turn limits the variety of products available.

The elasticity of generic advertising for fluid milk was 0.051. This means that for each 10 percent increase in expenditures for generic fluid milk advertising, fluid milk consumption would be expected to increase 0.51 percent. Other studies have found comparable estimates, e.g., Kinnucan estimated a long-run fluid milk advertising elasticity of 0.051 for New York City; and Kinnucan, Chang, and Venkateswaran estimated a long-run fluid milk advertising elasticity of 0.016 for New York City. The elasticity of generic advertising for cheese was also positive, but at 0.015, was almost 3.5 times smaller in magnitude than the generic elasticity for advertising of fluid milk. One reason why generic fluid milk advertising may be more effective in increasing demand than generic cheese advertising is that fluid milk is a much more homogeneous product than cheese. On the other hand, branded cheese advertising was positive, and had a long run advertising elasticity of 0.032. Therefore, it appears that branded cheese advertising is an effective marketing tool for increasing total market cheese demand.

It is hypothesized that advertising of pizza and cheeseburgers has a positive effect on the consumption of cheese. Such variables were not included in the model due to a lack of data. Assuming pizza and cheeseburger advertising has a significantly positive effect on cheese consumption, omission of these variables would result in the impact of generic cheese advertising being overstated.

The retail supply for each product was estimated as a function of the following variables: 1) retail price, 2) wholesale price, which represents the major variable cost to retailers, 3) producer price index for fuel and energy, 4) lagged retail supply, 5) time trend variable, and 6) quarterly dummy variables. The producer price index for fuel and energy was used as a proxy for variable energy costs. All prices and costs were deflated by the wholesale product price associated with each equation. The quarterly dummy variables were included to capture seasonality in retail supply, while the lagged supply variables were incorporated to represent capacity constraints. The time trend variable was included as a proxy for technological change in retailing. Finally, a first-order autoregressive error structure was imposed on the retail fluid milk supply equation.

The wholesale supply for each product was estimated as a function of the following variables: 1) wholesale price, 2) the appropriate Class price for milk, which represents the main variable cost to wholesalers, 3) producer price index for fuel and energy, 4) lagged wholesale supply, 5) time trend variable, and 6) quarterly dummy variables. The producer price index for fuel and energy was included because energy costs are important variable costs to wholesalers. All prices and costs were deflated by the price of farm milk, i.e., Class price. The quarterly dummy variables were used to capture seasonality in wholesale supply, lagged wholesale supply was included to reflect capacity constraints, and the trend variable was incorporated as a measure of technological change in dairy product processing.

For the farm milk market, the farm milk supply was estimated as a function of the following variables: 1) ratio of the farm milk price to feed ration costs, 2) ratio of the price of slaughter cows to feed ration costs, 3) lagged milk supply, 4) intercept dummy variables to account for the quarters that the Milk Diversion and Dairy Termination Programs were in effect, 5) quarterly dummy variables, and 6) time trend variable. Feed ration costs represent the most important variable costs in milk production, while the price of slaughtered cows represents an important opportunity cost to dairy farmers. Lagged milk supply was included as biological capacity constraints to current milk supply.

Average Market Impacts of Farmer and Fluid Milk Processor Advertising

The market impacts of the Dairy Program and the Fluid Milk Program were examined over the time period 1996-99. These two programs are complementary in that they both share a common objective to increase fluid milk sales. To do this, both programs invest in generic fluid milk advertising, which is different from brand advertising in that the goal is to increase the total market for fluid milk rather than a specific brand's market share. In the evaluation of the programs, it is assumed that a dollar spent on fluid milk advertising by dairy farmers has the same effect on demand as a dollar spent by processors on fluid milk advertising, since both programs have an identical objective. The Dairy Program additionally has an objective to expand the market for cheese. Accordingly, part of its budget is directed to generic cheese advertising.

To examine the impacts that the two programs had on the markets for fluid milk and cheese over this period, the economic model was simulated under two scenarios based on the level of generic advertising expenditures: (1) a baseline scenario, where generic advertising levels were equal to actual generic advertising expenditures under the two programs, and (2) a no-national program scenario, where there was no fluid milk processor nor dairy farmer advertising program. A comparison of these two scenarios provides a measure of the combined impacts of the two programs.

Table 2 presents the annual averages for supply, demand, and price variables over the period 1996-99 for the two scenarios. Generic advertising resulting from the Dairy and Fluid Milk Acts has had a positive impact on fluid milk consumption over this period. Specifically, fluid milk consumption would have been 1.4 percent lower had the two programs not been enacted. Likewise, generic cheese advertising under the Dairy Act had a positive impact on cheese consumption, i.e., consumption would have been 1.2 percent lower without generic advertising. Consumption of milk used in all dairy products would have been 1.0 percent lower had these two programs not been in effect during 1996-99.

Table 2. Simulated impacts of the Dairy and Fluid Milk Programs on selected market variables, 1996-99.

Market variable	Unit	Baseline Scenario[a]	No-national-Program scenario[b]	Percent Difference
Fluid milk demand	bil lbs	55.4	54.6	-1.4
Cheese demand	bil lbs milk fat equivalent	60.7	60.0	-1.2
Total dairy demand	bil lbs	154.0	152.5	-1.0
Basic formula price	$/cwt	12.88	12.04	-7.0
All milk price	$/cwt	13.83	12.98	-6.5
Milk marketings	bil lbs	158.2	157.3	-0.6
Benefit-cost ratio[c]	$ per $1	4.29	---	---

[a] The baseline scenario reflects the operation of the Dairy and Fluid Milk Programs.

[b] The no-national-program scenario assumes there is no generic advertising for fluid milk and cheese.

[c] The BCR is for the Dairy Program only.

In general, these results are comparable to those in last year's report. However, one exception to this is the impact of generic cheese advertising on cheese consumption, which was found to be larger in this year's analysis (1.2 percent) compared with last year's study (0.3 percent). This is likely due to two factors. First, the average amount of generic cheese advertising over the period 1996-99 was higher than over the period 1996-98 (last year's simulation period). Therefore, the simulation results between the baseline and the no-generic advertising scenarios should be larger. Second, the estimated retail own price elasticity of supply was slightly more elastic in the current model than last year, which leads to marginally higher quantity impacts due to an increase in demand. This allows the additional cheese production to occur with a smaller price increase. Again, it should be noted that the omission of pizza and cheeseburger advertising from the cheese demand model has the potential to overstate the impact of cheese advertising on demand.

Generic advertising also had an effect on farm milk prices and milk marketings. The simulation results indicate that the Basic Formula Price and the all-milk price would have been, respectively, \$0.84 and \$0.85 per hundredweight lower without the generic advertising provided under the two programs. The farm milk price impacts resulted in a slight increase in farm milk marketings. That is, had there not been the two advertising programs, farm milk marketings would have been 0.6 percent lower over the 1996-99 period due to the lower milk price.

One way to measure whether the benefits of a program outweigh the cost is to compute a benefit-cost ratio (BCR). A BCR can be computed as the change in net revenue due to advertising divided by the cost of advertising. While a BCR can be estimated for the Dairy Program, it cannot be computed at this time for the Fluid Milk Program because data on packaged fluid milk wholesale prices, which is necessary in calculating processor net revenue, are proprietary information and not available.

The BCR for the Dairy Program was calculated as the change in dairy farmer net revenue due to the existence of the Dairy Act divided by the costs of the Dairy Program. The cost of the Dairy Program was measured as the 15 cents per hundredweight assessment. The results show that the average BCR for the Dairy Program was 4.29 from 1996 through 1999. This means that each dollar invested in generic fluid milk and cheese advertising by dairy farmers during the period returned $4.29, on average, in net revenue to farmers. This figure is slightly lower than the one computed in last year's report (average of 4.61 for 1996-98). The somewhat smaller BCR is due to the estimated generic fluid milk advertising elasticity being slightly lower in the current model (i.e., 0.051 as opposed to 0.057 in last year's study). However, the results are quite similar to those reported last year.

Conclusion

The purpose of this study was to analyze the impacts of generic milk and cheese advertising on dairy markets. The results indicated that generic milk and cheese advertising by dairy farmers and fluid milk processors had major market impacts for the dairy industry. The main conclusion of the study is that farmers and processors are receiving a high return on their investment in generic dairy advertising.

The impacts of advertising tend to be more profound in increasing price than quantity, which is due to the inelastic nature of demand for milk and cheese. These estimated impacts need to be compared with the other options producers and processors have for marketing their product (e.g., non-advertising promotion, research, new product development, etc.) in order to determine the optimality of the current investment of advertising. Consequently, these results should be viewed as a first step in the evaluation process.

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Appendix

This appendix contains the estimated econometric model of the U.S. dairy industry. Appendix table 1 provides the variable definitions and data sources. This is followed by the estimated equations.

Appendix Table 1. Variable definitions and sources.*

RFD = per capita retail fluid milk demand (milkfat equivalent basis), from Dairy Situation and Outlook,

RFPBEV = consumer retail price index for fresh milk and cream (1982-84 = 100), divided by consumer retail price index for nonalcoholic beverages, both indices from Consumer Price Index,

INCBEV = per capita disposable personal income (in $1,000), from Employment and Earnings, divided by consumer retail price index for nonalcoholic beverages,

FOODAWAY = consumer expenditures on food consumed away from home in bil $, from USDA

BST = intercept dummy variable for bovine somatotropin, equal to 1 for 1994.1 through 1998.4; equal to 0 otherwise,

A5 = percent of U.S. population 5 years old or younger, from Current Population Report,

DUMQ1 = intercept dummy variable for first quarter of year,

DUMQ2 = intercept dummy variable for second quarter of year,

DUMQ3 = intercept dummy variable for third quarter of year,

GFAD = generic fluid milk advertising expenditures (in $1,000), deflated by the media price index, from Leading National Advertisers,

BFAD = branded fluid milk advertising expenditures (in $1,000), deflated by the media price index, from Leading National Advertisers,

MA(1) = moving average 1 error correction term,

RCD = per capita retail cheese demand (milkfat equivalent basis), computed as commercial cheese production minus government cheese purchases by the Commodity Credit Corporation minus changes in commercial cheese inventories (from Cold Storage),

RCPMEA = consumer retail price index for cheese (1982-84 = 100), divided by consumer retail price index for fat (1982-84 = 100), both indices from Consumer Price Index,

GCAD = = generic cheese advertising expenditures (in $1,000), deflated by the media price index, from Leading National Advertisers,

BCAD = branded cheese advertising expenditures (in $1,000), deflated by the media price index, from Leading National Advertisers,

AR(1) = AR 1 error correction term,

AR(2) = AR 2 error correction term,

RFS = retail fluid milk supply (bil. lbs. of milkfat equivalent), RFS=RFD*POP (where POP = U.S. civilian population),

RFPWFP = consumer retail price index for fresh milk and cream, divided by wholesale fluid milk price index (1982 = 100) from Producer Price Index,

T = time trend, equal to 1 for 1975.1,....,

RCS = retail cheese supply (bil. lbs. of milkfat equivalent), RCS=RCD*POP,

RCPWCP = consumer retail price index for cheese, divided by wholesale cheese price ($/lb.) from Dairy Situation and Outlook,

PFEWCP = producer price index for fuel and energy (1967 = 100), from Producer Price Index, divided by wholesale cheese price,

WFS = wholesale fluid milk supply (bil. lbs. of milkfat equivalent), WFS = RFS = RFD*POP,

WFPP1 = wholesale fluid milk price index, divided by Class I price for raw milk ($/cwt.), from Federal Milk Order Market Statistics,

WCS = wholesale cheese production (bil. lbs. of milkfat equivalent), from Dairy Products Annual Summary,

WCPP3 = wholesale cheese price, divided by Class III price for raw milk ($/cwt.) from Federal Milk Order Market Statistics,

PFEP3 = = producer price index for fuel and energy (1967 = 100), from Producer Price Index, divided by Class III milk price,

FMS = U.S. milk production (bil. lbs.), from Dairy Situation and Outlook,

AMPPFEED = U.S. average all milk price ($/cwt.), divided by the U.S. average dairy ration cost ($/cwt.), both from Dairy Situation and Outlook,

PCOWPFEED = U.S. average slaughter cow price ($/cwt.) from Dairy Situation and Outlook, divided by U.S. average dairy ration cost.

MDP = intercept dummy variable for the Milk Diversion Program equal to 1 for 1984.1 through 1985.2; equal to 0 otherwise,

DTP = intercept dummy variable for the Dairy Termination Program equal to 1 for 1986.2 through 1987.3; equal to 0 otherwise,

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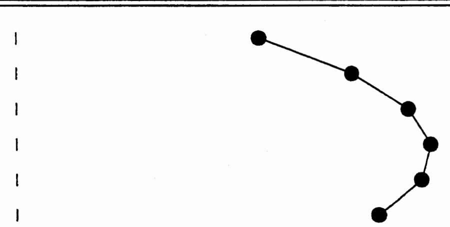
*An "L" in front of a variable means the variable has been transformed into natural logarithm.

LS // Dependent Variable is LRFD
Date: 07/18/00 Time: 10:46
Sample(adjusted): 1976:2 1999:4
Included observations: 95 after adjusting endpoints
Convergence achieved after 9 iterations

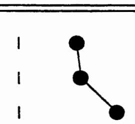
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.980189	0.580058	1.689813	0.0950
LRFPBEV	-0.163697	0.059922	-2.731819	0.0078
LINCBEV	0.181655	0.067315	2.698590	0.0085
LOG(FOODAWAY)	-0.169360	0.032134	-5.270471	0.0000
DUMQ1	-0.011988	0.003464	-3.460910	0.0009
DUMQ2	-0.056158	0.004287	-13.10102	0.0000
DUMQ3	-0.048061	0.003222	-14.91652	0.0000
BST	-0.035618	0.009115	-3.907567	0.0002
LOG(A5)	0.596645	0.134962	4.420848	0.0000
PDL01	0.009217	0.002431	3.791393	0.0003
PDL02	0.000952	0.001253	0.759681	0.4497
PDL03	-0.000396	0.000748	-0.529409	0.5980
PDL04	0.001339	0.001883	0.711205	0.4791
PDL05	0.000729	0.000904	0.806008	0.4227
PDL06	0.000229	0.000576	0.396961	0.6925
MA(1)	0.465947	0.101509	4.590223	0.0000

R-squared	0.933016	Mean dependent var	-2.913396
Adjusted R-squared	0.920297	S.D. dependent var	0.044934
S.E. of regression	0.012686	Akaike info criterion	-8.582153
Sum squared resid	0.012713	Schwarz criterion	-8.152027
Log likelihood	288.8531	F-statistic	73.35850
Durbin-Watson stat	1.816718	Prob(F-statistic)	0.000000

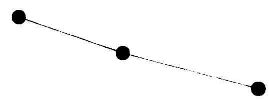
Inverted MA Roots -.47



Lag Distribution of LOG(GFAD/ i	Coefficient	Std. Error	T-Statistic
0	0.00573	0.00381	1.50239
1	0.00787	0.00207	3.80843
2	0.00922	0.00243	3.79139
3	0.00977	0.00244	4.00914
4	0.00954	0.00207	4.60551
5	0.00851	0.00378	2.24941
Sum of Lags	0.05063	0.00808	6.26677



Lag Distribution of LOG(BFAD/ i	Coefficient	Std. Error	T-Statistic
0	0.00080	0.00292	0.27213
1	0.00084	0.00161	0.52201
2	0.00134	0.00188	0.71121



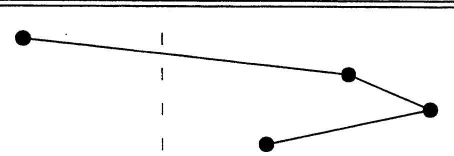
3	0.00230	0.00187	1.22780
4	0.00371	0.00157	2.36859
5	0.00558	0.00290	1.92789
Sum of Lags	0.01456	0.00697	2.08823

LS // Dependent Variable is LRCD
Date: 07/18/00 Time: 10:46
Sample(adjusted): 1976:2 1999:4
Included observations: 95 after adjusting endpoints
Convergence achieved after 10 iterations

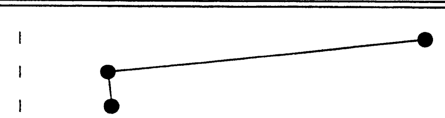
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.628125	2.746728	-3.141238	0.0024
LRCPMEA	-0.316912	0.196155	-1.615615	0.1101
LINCMEA	0.304551	0.193530	1.573665	0.1195
LOG(FOODAWAY)	0.494709	0.208618	2.371364	0.0201
DUMQ1	-0.103320	0.007607	-13.58197	0.0000
DUMQ2	-0.058252	0.006365	-9.151834	0.0000
DUMQ3	-0.058329	0.007508	-7.769449	0.0000
PDL01	0.006518	0.004043	1.612376	0.1108
PDL02	0.007067	0.002651	2.666242	0.0093
PDL03	-0.004255	0.001888	-2.253465	0.0270
PDL04	0.004778	0.008995	0.531206	0.5967
PDL05	-0.008514	0.005524	-1.541216	0.1272
PDL06	0.008640	0.011397	0.758129	0.4506
AR(1)	0.507932	0.099721	5.093520	0.0000
AR(2)	0.413166	0.098861	4.179262	0.0001

R-squared	0.984813	Mean dependent var	-3.087822
Adjusted R-squared	0.982156	S.D. dependent var	0.208503
S.E. of regression	0.027852	Akaike info criterion	-7.017731
Sum squared resid	0.062061	Schwarz criterion	-6.614487
Log likelihood	213.5430	F-statistic	370.5558
Durbin-Watson stat	2.192362	Prob(F-statistic)	0.000000

Inverted AR Roots	.95	-.44



Lag Distribution of LOG(GCAD/	i	Coefficient	Std. Error	T-Statistic
	0	-0.00480	0.00458	-1.04969
	1	0.00652	0.00404	1.61238
	2	0.00933	0.00404	2.31202
	3	0.00363	0.00449	0.80825
Sum of Lags		0.01468	0.01307	1.12323



Lag Distribution of LOG(BCAD/	i	Coefficient	Std. Error	T-Statistic
	0	0.02193	0.00949	2.31079
	1	0.00478	0.00900	0.53121
	2	0.00490	0.00939	0.52239
Sum of Lags		0.03162	0.01829	1.72849

LS // Dependent Variable is LRFS
Date: 07/18/00 Time: 10:46
Sample: 1976:1 1999:4
Included observations: 96
Convergence achieved after 5 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.306048	0.092934	3.293163	0.0014
LRFPWFP	0.107258	0.048916	2.192698	0.0310
LRFS(-1)	0.894009	0.038113	23.45683	0.0000
LT	0.004271	0.001936	2.205850	0.0300
DUMQ1	-0.057809	0.004358	-13.26423	0.0000
DUMQ2	-0.093601	0.003636	-25.74342	0.0000
DUMQ3	-0.043579	0.004136	-10.53572	0.0000
AR(1)	-0.266735	0.107224	-2.487641	0.0147

R-squared	0.948113	Mean dependent var	2.587574
Adjusted R-squared	0.943985	S.D. dependent var	0.049619
S.E. of regression	0.011743	Akaike info criterion	-8.809266
Sum squared resid	0.012136	Schwarz criterion	-8.595571
Log likelihood	294.6267	F-statistic	229.7118
Durbin-Watson stat	2.144849	Prob(F-statistic)	0.000000

Inverted AR Roots -.27

LS // Dependent Variable is LWFS
Date: 07/18/00 Time: 10:46
Sample: 1976:1 1999:4
Included observations: 96

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.474536	0.139246	3.407891	0.0010
LWFPP1	0.072873	0.026425	2.757726	0.0071
LWFS(-1)	0.780524	0.069866	11.17168	0.0000
DUMQ1	-0.050655	0.004984	-10.16418	0.0000
DUMQ2	-0.087199	0.004156	-20.98179	0.0000
DUMQ3	-0.044103	0.003648	-12.08959	0.0000
LPFEP1	-0.005453	0.008268	-0.659573	0.5112

R-squared	0.943520	Mean dependent var	2.587574
Adjusted R-squared	0.939712	S.D. dependent var	0.049619
S.E. of regression	0.012183	Akaike info criterion	-8.745280
Sum squared resid	0.013210	Schwarz criterion	-8.558297
Log likelihood	290.5554	F-statistic	247.7947
Durbin-Watson stat	2.388775	Prob(F-statistic)	0.000000

LS // Dependent Variable is LRCS
Date: 07/18/00 Time: 10:46
Sample: 1976:1 1999:4
Included observations: 96

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.220147	0.182284	1.207716	0.2304
LRCPWCP	0.262121	0.066687	3.930646	0.0002
LPFEWCP	-0.184094	0.040972	-4.493183	0.0000
LRCS(-1)	0.579263	0.086253	6.715864	0.0000
LT	0.119523	0.026811	4.458038	0.0000
DUMQ1	-0.124123	0.009311	-13.33118	0.0000
DUMQ2	-0.030720	0.009759	-3.147958	0.0022
DUMQ3	-0.048968	0.008598	-5.694983	0.0000

R-squared	0.989438	Mean dependent var	2.407922
Adjusted R-squared	0.988598	S.D. dependent var	0.277047
S.E. of regression	0.029583	Akaike info criterion	-6.961451
Sum squared resid	0.077014	Schwarz criterion	-6.747756
Log likelihood	205.9316	F-statistic	1177.700
Durbin-Watson stat	2.358671	Prob(F-statistic)	0.000000

LS // Dependent Variable is LWCS
Date: 07/18/00 Time: 10:46
Sample: 1976:1 1999:4
Included observations: 96

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.452544	0.512775	0.882538	0.3799
LWCPP3	0.159932	0.238112	0.671665	0.5035
LPFEP3	-0.013294	0.028550	-0.465640	0.6426
LWCS(-1)	0.977508	0.020185	48.42636	0.0000
DUMQ1	-0.001267	0.011971	-0.105870	0.9159
DUMQ2	0.063223	0.011669	5.418109	0.0000
DUMQ3	-0.104503	0.012132	-8.613836	0.0000

R-squared	0.976544	Mean dependent var	2.410331
Adjusted R-squared	0.974963	S.D. dependent var	0.253757
S.E. of regression	0.040152	Akaike info criterion	-6.360041
Sum squared resid	0.143485	Schwarz criterion	-6.173057
Log likelihood	176.0639	F-statistic	617.5697
Durbin-Watson stat	1.856197	Prob(F-statistic)	0.000000

LS // Dependent Variable is LFMS
Date: 07/18/00 Time: 10:46
Sample(adjusted): 1976:1 1999:4
Included observations: 96 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.493859	0.375156	3.981963	0.0001
LAMPPFEED	0.089711	0.034396	2.608174	0.0107
LPCOWPFEED	-0.044886	0.020020	-2.242080	0.0275
LFMS(-1)	0.561312	0.104429	5.375071	0.0000
DTP	-0.023246	0.009401	-2.472663	0.0154
MDP	-0.020630	0.009648	-2.138141	0.0353
DUMQ1	0.048539	0.006138	7.908069	0.0000
DUMQ2	0.092146	0.006442	14.30315	0.0000
DUMQ3	0.000625	0.008894	0.070307	0.9441
LT	0.056314	0.014743	3.819744	0.0003

R-squared	0.962878	Mean dependent var	3.566465
Adjusted R-squared	0.958993	S.D. dependent var	0.093696
S.E. of regression	0.018974	Akaike info criterion	-7.831083
Sum squared resid	0.030960	Schwarz criterion	-7.563964
Log likelihood	249.6739	F-statistic	247.8537
Durbin-Watson stat	1.566874	Prob(F-statistic)	0.000000

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99-11	Dairy Farm Management, Business Summary, New York State, 1998	($12 ea.)	Knoblauch, W.A., L.D. Putnam and J. Karszes
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99-05	Impact of Generic Milk Advertising on New York State Markets		Kaiser, H.M. and C. Chung
99-04	Optimal Temporal Policies in Fluid Milk Advertising		Vande Kamp, P.R. and H.M. Kaiser
99-03	Commodity Promotion Programs in the United States		Vande Kamp, P.R. and H.M. Kaiser
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