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NICPRE 99-4

National Institute for Commodity Promotion Research & Evaluation

August 1999
NICPRE 99-04
R.B. 99-06

Impact of Generic Fluid Milk and Cheese Advertising on Dairy Markets 1984-98

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- Enhance both public and private policy maker's understanding of the economics of commodity promotion programs.
- Facilitate the development of new theory and research methodology.

Preface

Harry M. Kaiser is a professor and Chris Chiambalero is an undergraduate student in the Department of Agricultural, Resource, and Managerial Economics at Cornell University. Kaiser is also the director of the National Institute for Commodity Promotion Research and Evaluation (NICPRE). The author thanks Don Blayney, Madlyn Daley, and John Mengel for providing current data for this research. Funding for this project came from the USDA.

This report is published as a NICPRE research bulletin. The mission of NICPRE is to enhance the overall understanding of economic and policy issues associated with commodity promotion programs. An understanding of these issues is crucial to ensuring continued authorization for domestic checkoff programs and to fund export promotion programs.

Each year, NICPRE provides an updated analysis of the national dairy advertising program. This year, the report serves as the independent evaluation for the required report to Congress. This bulletin summarizes the independent evaluation of advertising under the national dairy and fluid milk checkoff programs. This report should help farmers, fluid milk processors, and policy makers in understanding the economic impacts of generic dairy advertising on the national markets for milk and dairy products.

Executive Summary

The Dairy Production and Stabilization Act of 1983 (Dairy Act 7 U.S.C. 4514) and the Fluid Milk Promotion Act of 1990 (Fluid Milk Act 7 U.S.C. 6407) require an independent analysis of the effectiveness of these programs as they operate in conjunction to increase the sale of fluid milk and dairy products. The U.S. Department of Agriculture carried out this independent evaluation in the past, and annually issued a report to Congress on the effectiveness of the two Acts. This year's evaluation was conducted NICPRE. Unlike past evaluations which have relied on a 12 market model for the fluid milk evaluation, and two cheese models for the cheese evaluation, this year's evaluation is based on a detailed economic model of the U.S. dairy industry. This model is unique in its level of disaggregation. For instance, the dairy industry is divided into retail, wholesale (processing), and farm markets, and the retail and wholesale markets include fluid milk and cheese separately. The model simulates market conditions with and without the Dairy Act and the Fluid Milk Act. The following summarizes the findings of this analysis.

Generic fluid milk and dairy product advertising conducted under the Dairy and Fluid Milk Acts had a major impact on dairy market conditions. Over the period 1995-98, on average, following market impacts would have occurred if the two programs had not been in effect:

- Fluid milk consumption would have been 1.7 percent lower.
- Cheese consumption would have been 0.3 percent lower.
- Total consumption of milk in all dairy products would have been 0.8 percent lower.
- The average price received by dairy farmers would have been almost 5 percent lower.
- Commercial milk marketings by farmers would have been 0.7 percent lower.

These market impacts translated into an average benefit-cost ratio for the two programs of 4.43, i.e., a dollar invested in generic (fluid milk and cheese) advertising by farmers and processors resulted in a return of $4.43 in net revenue to both groups combined, on average, over this period. Further, the average benefit-cost ratio for the two programs ranged from a low of 3.5 in 1995 to a high of 5.2 in 1998. This ratio has consecutively increased each year since 1995.

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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. 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 1998, 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 manufactured advertising is evident from appendix figure 1, which shows quarterly generic fluid advertising expenditures in the United States from 1975-98, 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.

Appendix figure 2 shows quarterly generic cheese advertising in the United States from 1975-98. 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. This trend is most likely due to the fact that dairy farmers received a higher price for milk going into fluid products. Hence, increasing the utilization of fluid milk into fluid products is an effective way to increase the average farm price.

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

[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.

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.

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 $\Delta INVC$ 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.

[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.

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

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) $FMS = WFS + WCS + FUSE + OTHER$,

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 1998. 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, most of 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

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

autoregressive error structure was imposed on the retail cheese demand equation to correct for autocorrelation.

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 0.215 means that a one percent increase in per capita income has the impact of increasing per capita fluid milk demand by 0.215 percent. The most important factor effecting per capita fluid milk demand is the percentage of population under 6 years old. After peaking in 1993, the percentage of population under 6 years old declined which has had a large negative effect on per capita fluid milk demand. The most important factor effecting per capita cheese demand is expenditures on food consumed away from home. There has been consistent increases in food consumed away from home over time and this has had an important impact on increasing per capita cheese demand.

Based on the econometric estimation, generic fluid milk advertising had the largest long-run advertising elasticity of 0.057 and was statistically different from zero at the one percent significance level. This means a one percent increase in generic fluid advertising expenditures resulted in a 0.057 percent increase in fluid demand on average over this period, which is higher than previous results. For example, based on a similar model with data from 1975-97, Kaiser estimated a long-run elasticity of 0.029 for generic fluid milk advertising. 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 had a t-value of 1.2 which is not statistically significant from zero at the 10 percent significance level. The generic cheese advertising elasticity was almost four 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. The long run generic cheese advertising elasticity was 0.015, which is slightly higher than the previous estimate of 0.011 by Kaiser. Branded cheese advertising was positive, and had a long run advertising elasticity of 0.024. Therefore, it appears that branded cheese advertising is an effective marketing tool for increasing total market cheese demand. However, its t-value of 1.3 was only marginally significant.

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 generic fluid milk and cheese advertising by dairy farmers and fluid milk processors were examined over the time period, 1995-98, which coincides with the life of the fluid milk processor program. The generic fluid milk advertising programs by dairy farmers (herein called the "Farmer Program") and fluid milk processors (herein called the "Processor Program") are complimentary since 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 since the goal is to increase the total market for fluid milk rather than to increase a specific brand's market share. In the evaluation of the two 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 identical objectives. The Farmer Program has an additional objective to expand the market for cheese. Accordingly, part of its budget is directed to generic cheese advertising.

To examine the impacts that the Farmer and Processor Programs had on the markets for fluid milk and cheese over this period, the economic model was simulated under two scenarios based on the volume of generic advertising expenditures: 1) a baseline scenario, where advertising levels were equal to actual generic advertising expenditures under the two programs, and 2) a no-national program scenario, where there was no Processor Program and quarterly values of generic advertising expenditures by dairy farmers were based on a national average assessment of 6.3 cents per hundredweight, which was the average assessment the year prior to the enactment of the Dairy Program. A comparison of these two scenarios provides a measure of the impacts of the two programs.

Table 2 presents the annual averages for selected variables over the period, 1995-98 for the two scenarios. The fifth column in this table is the percentage change in each market variable had the two programs not existed over this period of time. Generic advertising resulting from the Farmer and Processor Programs has had a substantially larger impact on fluid milk consumption than on cheese consumption. Specifically, fluid milk and cheese consumption would have been 1.7 percent and 0.3 percent lower had the two programs not been enacted. This larger impact on fluid milk consumption than on cheese consumption is a result of two factors: (1) more money was spent on generic fluid milk advertising than generic cheese advertising, and (2) generic fluid milk advertising had a larger elasticity than generic cheese advertising (i.e., a one percent change in generic fluid milk advertising had a larger percentage impact on fluid milk consumption than the percentage impact on cheese consumption from a one percent change in generic cheese advertising). Consumption of milk used in all dairy products would have been 0.8 percent lower had these two programs not been in effect during 1995-98.

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 5 percent and 4.8 percent lower without the generic advertising provided under the two programs. The farm milk price impacts resulted in a marginal increase in farm milk marketings. That is, had there not been the two advertising programs, farm milk marketings would have been 0.7 percent lower over the 1995-98 period due to the lower milk price.

The bottom-line question to farmers and fluid milk processors is: do the benefits of these programs outweigh the costs? One way to measure the net benefits to farmers and processors is by an average benefit-cost ratio (BCR), which gives the ratio of benefits to costs of the two programs. Specifically, the BCR was calculated as the change in producer and fluid milk processor net revenue[4], due to the existence of the Farmer and Processor Programs, divided by the costs of the two programs. The cost of the Processor Program was measured as the 20 cents per hundredweight assessment multiplied by fluid milk demand. The cost of the Farmer Program was measured as the 15 cents per hundredweight assessment minus the 6.3 cents per hundredweight voluntarily contributed by farmers and multiplied by milk marketings. The results showed that the average BCR for the two programs was 4.43 over this period. This means that

[4] Producer net revenue is defined as milk marketings multiplied by the difference between the all milk price and feed ration costs per hundredweight. Fluid milk processor net revenue is defined as fluid milk demand multiplied by the difference between the 2% wholesale milk price per hundredweight and Class I price per hundredweight, adjusted to a 2% fat content.

each dollar invested in generic advertising returned $4.43, on average, in combined net revenue to processors and farmers.

While it is important to measure the overall effectiveness of the two programs over the past four years, it is also useful to compare how the impacts of the program have varied over time. Rather than focusing on all market variables, consider how the average BCR has changed. Figure 1 shows the annual BCR from 1995-98. It is clear from this figure that the effectiveness of the two programs has steadily increased from 1995, when it was 3.5, to 1998, when it was 5.2. One explanation for this is that the managers of these programs have become more efficient over time in improving the overall effectiveness of their programs. Another explanation is that the accumulative affect of advertising over time has had a positive impact on changing consumer attitudes and consumption patterns of fluid milk.

Caveat on Fluid Milk Processor Price Impacts

The wholesale fluid milk supply equation was estimated as a function of several variables, including the wholesale fluid milk price index. While the own price elasticity computed with this data was positive and statistically significant, it was very inelastic (0.049). This very inelastic price estimate has a major implication for the simulation in that even very small increases in demand lead to huge simulated increases in the processor price. Indeed, when the baseline and no-national program scenarios were simulated, the results indicated that the two programs had the impact of increasing the processor price by more than 20 percent, an implausible result.

Several attempts were made to try to remedy this problem. The best solution was to increase the own price elasticity of wholesale fluid milk supply and farm milk supply to the upper bound of 90 percent confidence intervals for the two respective estimated own price coefficients. This solution, in fact, is what was done for the scenarios reported in Table 2 of the text. However, even after this was done, the simulated increases for the fluid milk processor price due to the two programs was still rather high, at 14.5 percent. While the author found this estimate to be plausible, several dairy experts considered this to be too large. Various attempts were made to re-estimate the econometric equation for the wholesale milk supply, but none resulted in a higher own price elasticity.

Two factors may be causing this inelastic own price coefficient. First, the estimated elasticity may in fact be highly inelastic in the neighborhood of very small price changes, but the same may not be true for larger price changes. This result may in turn be due to the fact that consumers have a very inelastic price elasticity of demand for fluid milk. If the retail price of milk changes, for example, by 3 percent, the change in per capita quantity of fluid milk demand is hardly noticeable. Since processors base their supply on market demand, this will make the own supply elasticity very small, which is precisely the case here. The highly inelastic price is not a problem when simulating alternative scenarios that are fairly close to one another, e.g., baseline advertising vs. 5 percent higher advertising. However, the inelastic price is a problem in the present study where the baseline scenario is very different from the no-national program scenario. The problem lies in the fact that the econometric equations were estimated under a policy regime where there were two programs. Consequently, when the no-national program scenario is simulated, the model coefficients that are used are based on a regime where these actually were two programs in placed. This is the famous Lucas critique of econometric policy models.

Second, the quality of the wholesale fluid milk price data is suspect. Fluid milk processor price data is hard to come by, and the only source that was available for the time period used in the econometric estimation was the wholesale fluid milk price index. If these data are not accurate, it is possible that this could be causing the low elasticity.

In any event, based on the expert judgement of several dairy economists, it was decided that the 14.5 percent increase in the processor price was unrealistically high, and consequently not reported in Table 2. In the future, it is recommended that rather than simulating a baseline and no-national program scenario, that closer scenarios be simulated to compute a marginal benefit cost ratio. Specifically, a baseline scenario can be compared to a scenario where advertising expenditures are increased or decreased by 1 percent. A comparison of these two scenarios would measure the marginal impact of the program and would not result in an unrealistically high processor price impact.

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. Furthermore, the impacts over the most recent three years tend to be larger than in earlier years. One explanation for this is that managers of these programs have become more efficient over time in improving the overall effectiveness of the programs. Another explanation is that the accumulative affect of advertising over time has had a positive impact on changing consumer attitudes and consumption patterns of fluid milk.

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

Factors affecting demand	Fluid Milk	Cheese
Retail price	-0.202	-0.400
Per capita income	0.215	0.295
Food away from home	-0.198	0.426
Brand advertising	0.011	0.024
Generic advertising	0.057	0.015
Percent of population younger than 6 years old	0.744	

[1] Example: a one percent increase in the retail price of fluid milk is estimated to reduce per capita sales of fluid milk by 0.202 percent.

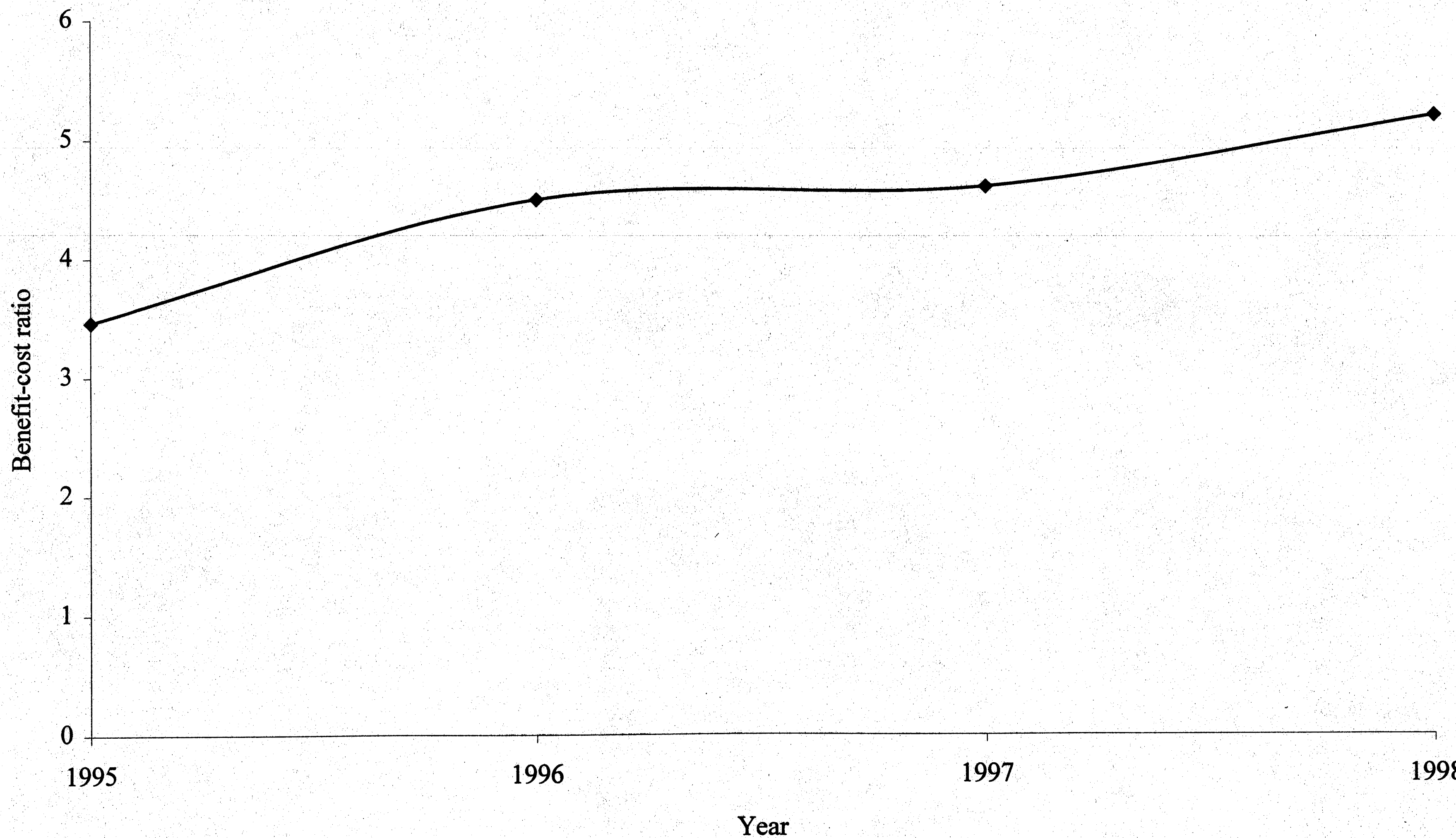
Table 2. Simulated impacts of the Farmer and Processor Programs on selected market variables, 1995-98.

Market variable	Unit	Baseline scenario[1]	No-national program scenario[2]	Percent difference
Fluid milk demand	bil lbs	59.6	58.6	-1.7
Cheese demand	bil lbs milk fat	58.8	58.6	-0.3
Total dairy demand	bil lbs	155.9	154.7	-0.8
Basic formula price	$/cwt	13.30	12.63	-5.0
All milk price	$/cwt	14.18	13.51	-4.8
Milk marketings	bil lbs	160.2	159.0	-0.7
Benefit-cost ratio	$ per $1	4.43		

[1] The baseline scenario reflects the operation of the Farmer and Processor Programs.

[2] The no-national program scenario reflects the operation of voluntary generic advertising in the absence of the Farmer and Processor Programs.

Figure 1. Benefit-cost ratio, 1995-96



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. Finally, several appendix figures are included to show how several key variables have varied over time.

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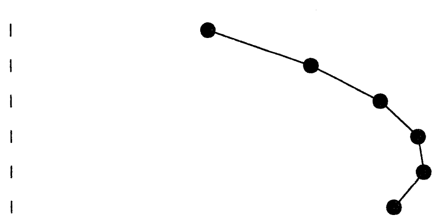
*An "L" in front of a variable means the variable has been transformed into natural logarithm.

LS // Dependent Variable is LRFD
Date: 06/16/99 Time: 14:26
Sample(adjusted): 1976:2 1998:4
Included observations: 91 after adjusting endpoints
Convergence achieved after 11 iterations

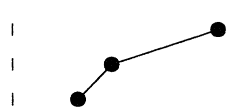
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.765960	0.646511	2.731526	0.0079
LRFPBEV	-0.201534	0.054587	-3.691964	0.0004
LINCBEV	0.214830	0.062908	3.415005	0.0010
LOG(FOODAWAY)	-0.197623	0.030892	-6.397151	0.0000
DUMQ1	-0.012820	0.003476	-3.687764	0.0004
DUMQ2	-0.059744	0.004317	-13.83988	0.0000
DUMQ3	-0.050260	0.003298	-15.24097	0.0000
BST	-0.027794	0.009483	-2.930788	0.0045
LOG(A5)	0.743883	0.175160	4.246867	0.0001
PDL01	0.010246	0.002480	4.132112	0.0001
PDL02	0.001483	0.001261	1.175885	0.2434
PDL03	-0.000454	0.000747	-0.607369	0.5454
PDL04	0.000626	0.001953	0.320319	0.7496
PDL05	3.42E-05	0.000957	0.035723	0.9716
PDL06	0.000351	0.000592	0.593221	0.5548
MA(1)	0.480322	0.106958	4.490765	0.0000

R-squared	0.931276	Mean dependent var	-2.910832
Adjusted R-squared	0.917531	S.D. dependent var	0.043956
S.E. of regression	0.012623	Akaike info criterion	-8.586166
Sum squared resid	0.011951	Schwarz criterion	-8.144696
Log likelihood	277.5472	F-statistic	67.75432
Durbin-Watson stat	1.821403	Prob(F-statistic)	0.000000

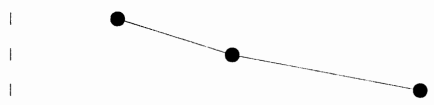
Inverted MA Roots -.48



Lag Distribution of LOG(GFAD/	i	Coefficient	Std. Error	T-Statistic
	0	0.00547	0.00385	1.41964
	1	0.00831	0.00213	3.90465
	2	0.01025	0.00248	4.13211
	3	0.01127	0.00250	4.50630
	4	0.01140	0.00220	5.18258
	5	0.01061	0.00390	2.71791
Sum of Lags		0.05730	0.00884	6.47991



Lag Distribution of LOG(BFAD/	i	Coefficient	Std. Error	T-Statistic
	0	0.00196	0.00306	0.64166
	1	0.00094	0.00170	0.55606
	2	0.00063	0.00195	0.32032



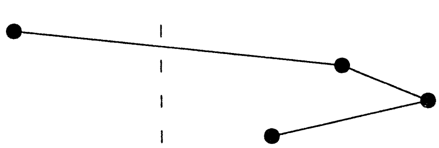
3	0.00101	0.00194	0.52079
4	0.00210	0.00166	1.26384
5	0.00389	0.00304	1.28114
Sum of Lags	0.01053	0.00725	1.45389

LS // Dependent Variable is LRCD
Date: 06/16/99 Time: 14:26
Sample(adjusted): 1976:2 1998:4
Included observations: 91 after adjusting endpoints
Convergence achieved after 9 iterations

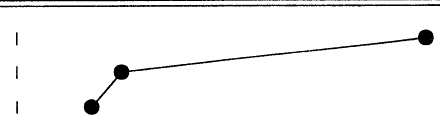
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-7.766499	1.971030	-3.940326	0.0002
LRCPMEA	-0.395191	0.198968	-1.986207	0.0506
LINCMEA	0.295066	0.190201	1.551332	0.1250
LOG(FOODAWAY)	0.426230	0.143406	2.972195	0.0040
DUMQ1	-0.103344	0.007847	-13.16987	0.0000
DUMQ2	-0.058559	0.006493	-9.018366	0.0000
DUMQ3	-0.060578	0.007937	-7.632567	0.0000
PDL01	0.006486	0.003932	1.649673	0.1031
PDL02	0.007323	0.002648	2.765935	0.0071
PDL03	-0.004296	0.001874	-2.292488	0.0246
PDL04	0.004261	0.009205	0.462954	0.6447
PDL05	-0.006828	0.005833	-1.170563	0.2454
PDL06	0.005630	0.011431	0.492485	0.6238
AR(1)	0.477442	0.100752	4.738777	0.0000
AR(2)	0.430302	0.100621	4.276449	0.0001

R-squared	0.984161	Mean dependent var	-3.101376
Adjusted R-squared	0.981243	S.D. dependent var	0.202132
S.E. of regression	0.027683	Akaike info criterion	-7.024324
Sum squared resid	0.058243	Schwarz criterion	-6.610446
Log likelihood	205.4833	F-statistic	337.3045
Durbin-Watson stat	2.199660	Prob(F-statistic)	0.000000

Inverted AR Roots .94 -.46



Lag Distribution of LOG(GCAD/	i	Coefficient	Std. Error	T-Statistic
	0	-0.00513	0.00452	-1.13622
	1	0.00649	0.00393	1.64967
	2	0.00951	0.00394	2.41193
	3	0.00395	0.00446	0.88508
Sum of Lags		0.01481	0.01272	1.16445



Lag Distribution of LOG(BCAD/	i	Coefficient	Std. Error	T-Statistic
	0	0.01672	0.00967	1.72874
	1	0.00426	0.00920	0.46295
	2	0.00306	0.00987	0.31029
Sum of Lags		0.02404	0.01901	1.26456

LS // Dependent Variable is LRFS
Date: 06/16/99 Time: 14:26
Sample(adjusted): 1975:3 1998:4
Included observations: 94 after adjusting endpoints
Convergence achieved after 6 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.311762	0.108066	2.884934	0.0049
LRFPWFP	0.137012	0.071023	1.929112	0.0570
LRFS(-1)	0.892559	0.044166	20.20921	0.0000
LT	0.003524	0.001824	1.932428	0.0566
DUMQ1	-0.057737	0.004485	-12.87422	0.0000
DUMQ2	-0.092715	0.003638	-25.48465	0.0000
DUMQ3	-0.043120	0.004157	-10.37350	0.0000
AR(1)	-0.268378	0.120333	-2.230300	0.0283

R-squared	0.944608	Mean dependent var	2.584847
Adjusted R-squared	0.940099	S.D. dependent var	0.049119
S.E. of regression	0.012022	Akaike info criterion	-8.760812
Sum squared resid	0.012429	Schwarz criterion	-8.544362
Log likelihood	286.3780	F-statistic	209.5091
Durbin-Watson stat	2.027512	Prob(F-statistic)	0.000000

Inverted AR Roots	-.27

LS // Dependent Variable is LRCS
Date: 06/16/99 Time: 14:27
Sample(adjusted): 1975:2 1998:4
Included observations: 95 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.144816	0.160143	-0.904296	0.3683
LRCPWCP	0.256821	0.063652	4.034782	0.0001
LPFEWCP	-0.106381	0.035502	-2.996510	0.0036
LRCS(-1)	0.700840	0.070633	9.922308	0.0000
LT	0.059994	0.018454	3.251035	0.0016
DUMQ1	-0.133057	0.009246	-14.39111	0.0000
DUMQ2	-0.025954	0.009742	-2.664117	0.0092
DUMQ3	-0.050490	0.008788	-5.745399	0.0000

R-squared	0.988920	Mean dependent var	2.373719
Adjusted R-squared	0.988028	S.D. dependent var	0.277811
S.E. of regression	0.030397	Akaike info criterion	-6.906368
Sum squared resid	0.080386	Schwarz criterion	-6.691304
Log likelihood	201.2533	F-statistic	1109.244
Durbin-Watson stat	2.554606	Prob(F-statistic)	0.000000

LS // Dependent Variable is LWFS
Date: 06/16/99 Time: 14:27
Sample(adjusted): 1975:2 1998:4
Included observations: 95 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.382666	0.140090	2.731572	0.0076
LWFPP1	0.049023	0.028096	1.744806	0.0845
LWFS(-1)	0.833165	0.071290	11.68697	0.0000
DUMQ1	-0.053734	0.005209	-10.31524	0.0000
DUMQ2	-0.089497	0.004337	-20.63797	0.0000
DUMQ3	-0.044346	0.003796	-11.68327	0.0000
LOG(PFE/P1)	-0.002163	0.008071	-0.268059	0.7893

R-squared	0.937346	Mean dependent var	2.584276
Adjusted R-squared	0.933074	S.D. dependent var	0.049173
S.E. of regression	0.012721	Akaike info criterion	-8.658160
Sum squared resid	0.014241	Schwarz criterion	-8.469980
Log likelihood	283.4634	F-statistic	219.4215
Durbin-Watson stat	2.409300	Prob(F-statistic)	0.000000

LS // Dependent Variable is LWCS
Date: 06/22/99 Time: 10:19
Sample(adjusted): 1975:2 1998:4
Included observations: 95 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.304751	0.424518	0.717876	0.4748
LWCPP3	0.024607	0.186603	0.131870	0.8954
LPFEP3	-0.038860	0.034121	-1.138875	0.2579
LWCS(-1)	0.870725	0.059395	14.65997	0.0000
LT	0.039668	0.021320	1.860543	0.0662
DUMQ1	0.002817	0.012361	0.227932	0.8202
DUMQ2	0.077148	0.012180	6.334041	0.0000
DUMQ3	-0.091843	0.013577	-6.764768	0.0000

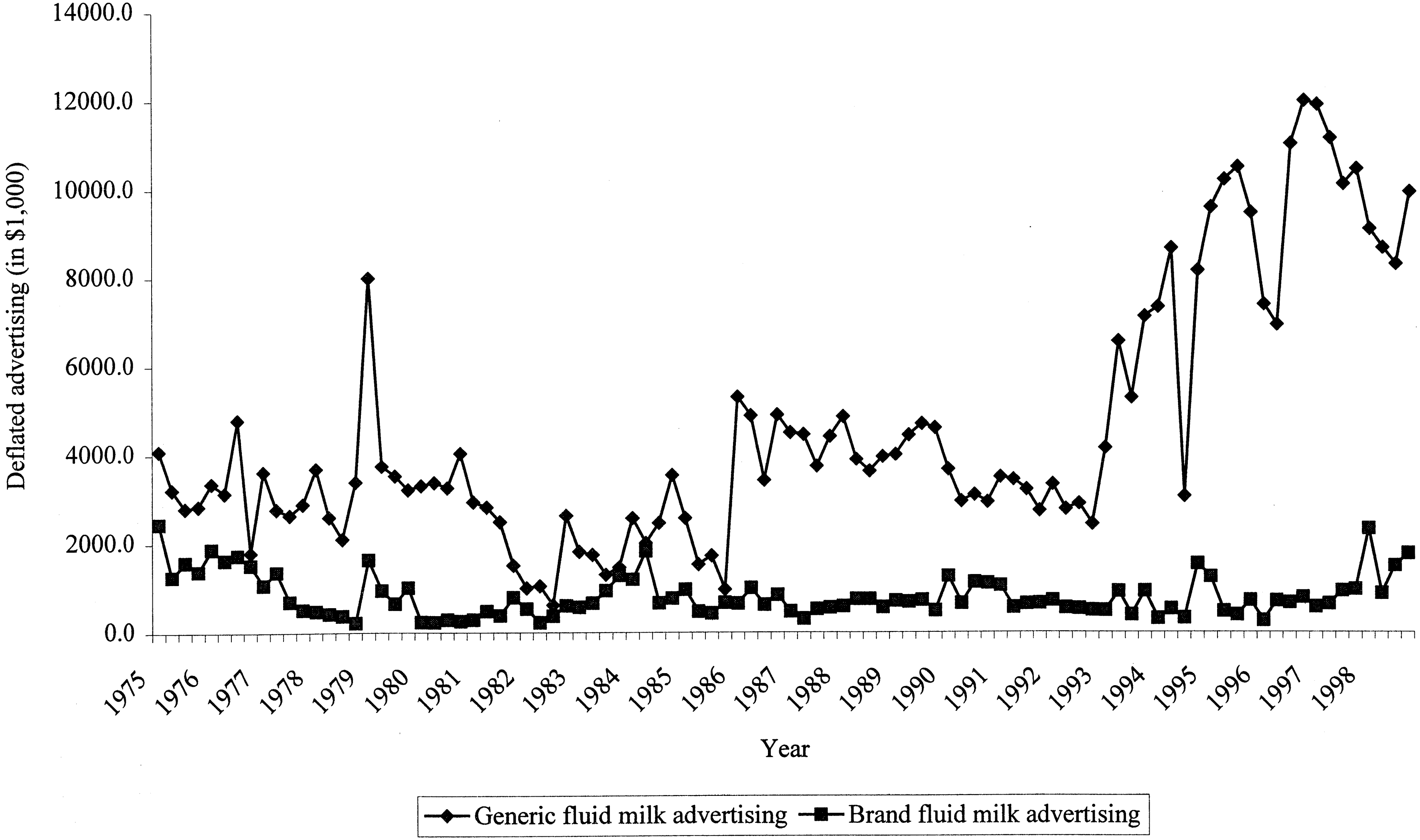
R-squared	0.977121	Mean dependent var	2.374993
Adjusted R-squared	0.975280	S.D. dependent var	0.263186
S.E. of regression	0.041380	Akaike info criterion	-6.289481
Sum squared resid	0.148968	Schwarz criterion	-6.074417
Log likelihood	171.9512	F-statistic	530.7975
Durbin-Watson stat	1.868900	Prob(F-statistic)	0.000000

LS // Dependent Variable is LFMS
Date: 06/16/99 Time: 14:22
Sample(adjusted): 1976:2 1998:4
Included observations: 91 after adjusting endpoints

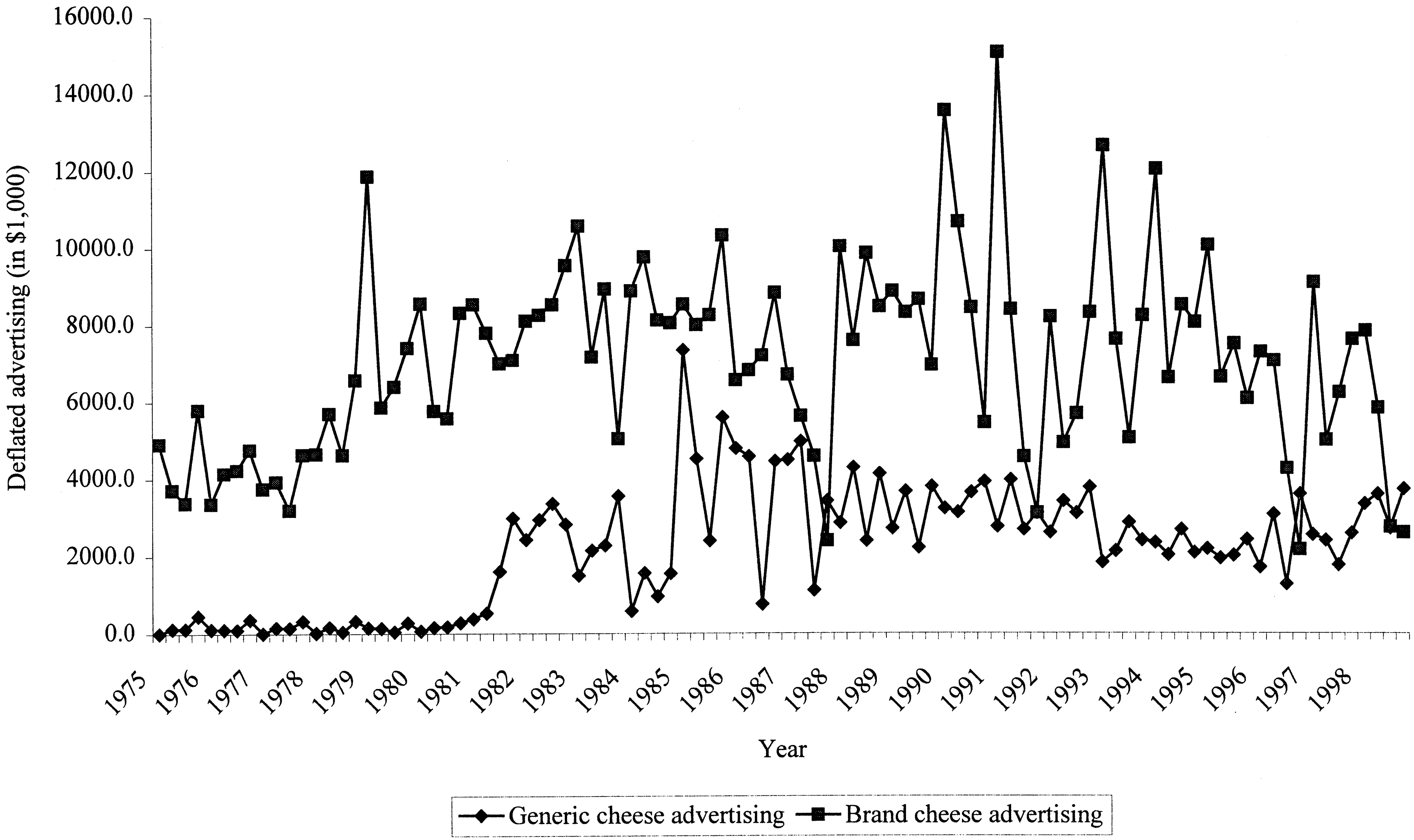
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.707399	0.380978	4.481620	0.0000
LAMPPFEED	0.073429	0.034671	2.117857	0.0373
LPCOWPFEED	-0.047608	0.018761	-2.537556	0.0131
LFMS(-1)	0.497661	0.106548	4.670756	0.0000
DTP	-0.021922	0.008913	-2.459458	0.0160
MDP	-0.021147	0.009174	-2.305252	0.0237
DUMQ1	0.046013	0.006357	7.238343	0.0000
DUMQ2	0.093134	0.006317	14.74287	0.0000
DUMQ3	0.005559	0.008666	0.641414	0.5231
LT	0.065113	0.014640	4.447546	0.0000

R-squared	0.962656	Mean dependent var	3.562554
Adjusted R-squared	0.958507	S.D. dependent var	0.089333
S.E. of regression	0.018197	Akaike info criterion	-7.909621
Sum squared resid	0.026822	Schwarz criterion	-7.633702
Log likelihood	240.7643	F-statistic	232.0018
Durbin-Watson stat	1.577875	Prob(F-statistic)	0.000000

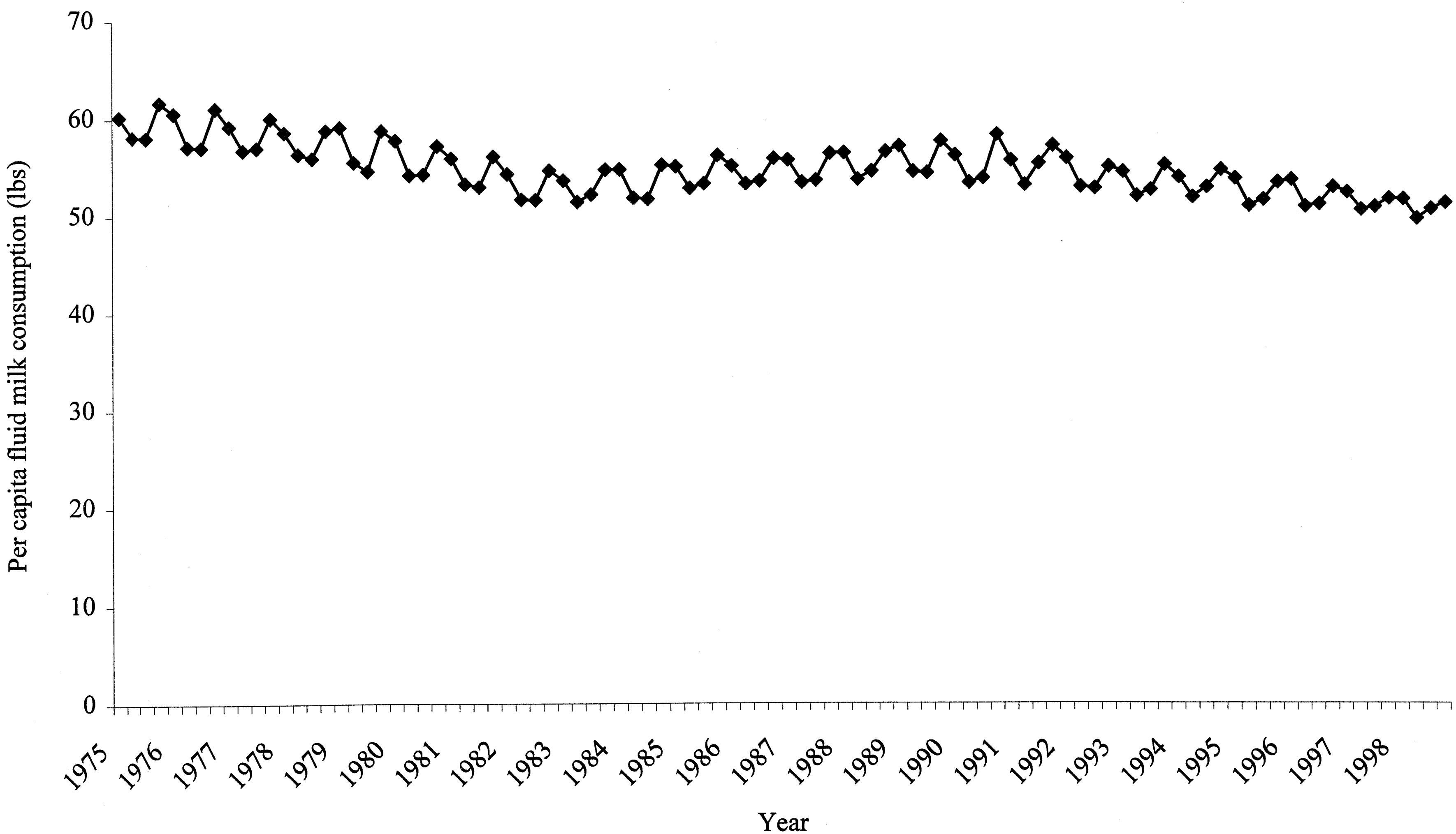
Appendix Figure 1. Deflated generic and brand fluid milk advertising, 1975-98.



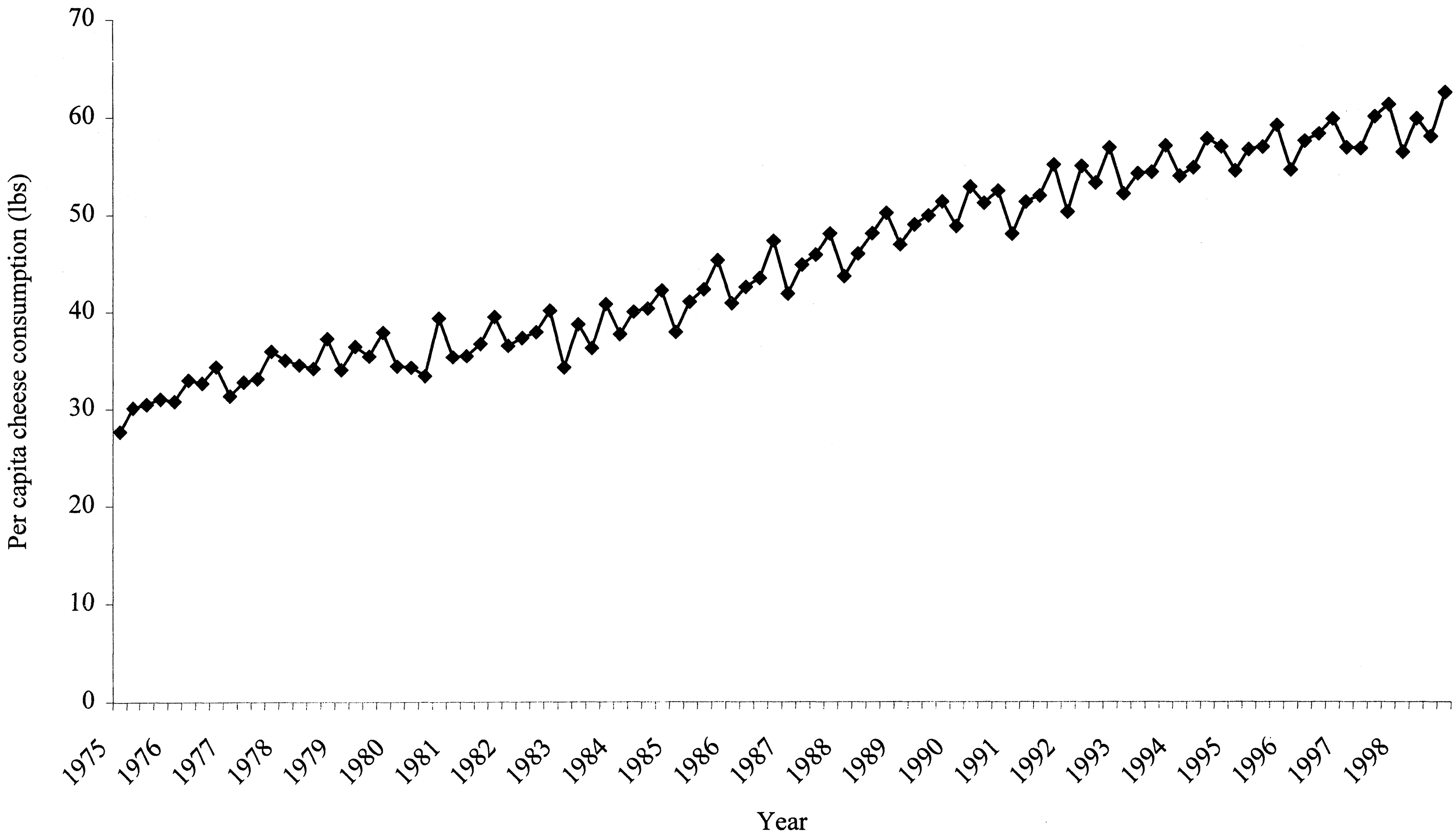
Appendix Figure 2. Deflated generic and brand cheese advertising, 1975-98.



Appendix Figure 3. Per capita fluid milk consumption, 1975-98.



Appendix Figure 4. Per capita cheese consumption, 1975-98.



OTHER A.R.M.E. RESEARCH BULLETINS

RB No	Title	Fee (if applicable)	Author(s)
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
99-02	Employee Compensation and Satisfaction on Dairy Farms in the Northeast	($10 ea.)	Fogleman, S.L., R.A. Milligan, T.R. Maloney and W.A. Knoblauch
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