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Impact of National Generic Dairy Advertising on Dairy Markets, 1984-97

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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.

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Preface

Harry M. Kaiser is an associate professor in the Department of Agricultural, Resource, and Managerial Economics at Cornell University, and director of the National Institute for Commodity Promotion Research and Evaluation (NICPRE). The author thanks Don Blayney, Jane Allshouse, and Noel Blisard, for providing current data, and Una Moneypenny, for technical editing. Funding for this project came from the New York State Milk Promotion Order and from NICPRE.

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 bulletin summarizes the independent evaluation of advertising under the national dairy checkoff program. This report should help farmers, policy makers, and program managers in understanding the economic impacts of generic dairy advertising on the national markets for milk and dairy products.

Executive Summary

The purpose of this study was to analyze the impacts of generic dairy advertising paid by the mandatory 15 cent per hundredweight dairy checkoff program on retail, wholesale, and farm dairy markets. A disaggregated industry model of the retail, wholesale, and farm levels with markets for fluid milk and cheese was developed to conduct the analysis. An econometric model of the dairy industry was estimated using quarterly data from 1975 through 1997. The econometric results were then used to simulate market conditions with and without the mandatory checkoff program.

The results indicate that generic dairy advertising had a major impact on market conditions at all levels of the dairy industry, particularly the fluid market. For example, over the period 1984-97, on average, advertising had the following market impacts compared to what would have occurred in the absence of this national program:

☞ An increase in the national farm milk price of 2.5 percent and an increase in milk production of 0.4 percent.

☞ An increase in dairy producer revenue of almost 3 percent.

☞ An average rate of return of 4, i.e., each dollar invested in generic advertising resulted in an average return of $4.00 in dairy producer profits.

☞ A marginal rate of return of 8.30, i.e., an additional dollar invested in generic advertising over this period would have increased dairy farm profit by $8.30.

☞ An increase in overall demand for milk of 0.5 percent, including a 1 percent increase in fluid milk demand, and a 0.3 percent increase in cheese demand.

☞ An overall increase in retail prices for milk and dairy products. The national advertising program had the largest effect on increasing retail fluid milk prices (8.4 percent). The retail cheese price averaged 1.1 percent higher due to the dairy checkoff advertising efforts.

☞ An increase in all wholesale prices for milk and cheese. The national advertising program had the largest effect on increasing wholesale fluid milk prices (7.3 percent). The wholesale cheese price averaged 1.6 percent higher due to generic advertising.

☞ A decrease in government purchases of dairy products under the Dairy Price Support Program of 1.8 percent.

Consequently, it is clear that dairy farmers benefitted from the presence of the mandatory checkoff program since farm prices and producer revenues were positively impacted. Dairy wholesalers and retailers

also benefitted from this program since prices and demand were positively effected by the advertising effort. Tax payers also benefitted because government purchases and costs of the Dairy Price Support Program were lower.

Introduction

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 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 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.

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 on prices and quantities for 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 1997, 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 separately. 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 program. In addition, several reallocation scenarios between fluid milk and cheese advertising expenditures are simulated. The results of the reallocation scenarios are especially timely given the current national debate regarding the relative effectiveness of milk vs. cheese advertising.

The results of this study are important for dairy farmers 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 milk and cheese. Farmers 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. This is evident from appendix figure 1, which shows quarterly generic fluid advertising expenditures in the United States from 1975-97, 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. Note that generic milk advertising expenditures increased dramatically in 1995 with the inception of the MilkPEP program (Milk Mustache print media campaign), which is funded by fluid milk processors paying $0.20 per hundredweight on fluid milk sales.

Appendix figure 2 shows quarterly generic cheese advertising in the United States from 1975-97.

It is clear from this figure that the initial focus was on generic cheese (and other manufactured dairy products) advertising. 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 likely due to the fact that dairy farmers receive a higher price for milk going into fluid products. Hence, increasing the utilization of milk into fluid products is an effective way to increase the average farm price.

Conceptual Model

There has been a lot of research 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.). 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 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 cheese rather than 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.

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, with each set having the following general specification:

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[1]All quantities in the model are expressed on a milkfat equivalent (me) basis.

(1.1) $RD = f(RP|Srd)$,
(1.2) $RS = f(RP|Srs)$,
(1.3) $RD = RS \circ \equiv R^*$,

where: RD and RS are retail demand and supply, respectively, RP is the retail own price, Srd is a vector of retail demand shifters including generic advertising, Srs is a vector of retail supply shifters including the wholesale own price, and R* is the equilibrium retail quantity.

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

(2.1) $WD = R^*$,
(2.2) $WS = f(WP|Sws)$,
(2.3) $WS = WD \circ W^* \circ \equiv R^*$,

where: WD and WS are wholesale milk demand and supply, respectively, WP is the wholesale milk price, and Sws is a vector of wholesale 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 are different than those for the fluid milk market. The wholesale cheese market has the following general specification:

(3.1) $WD = R^*$,
(3.2) $WS = f(WP|Sws)$,
(3.3) $WS = WD + DINV + QSP \circ\equiv Qw$,

where: WD and WS are wholesale cheese demand and supply, respectively, WP is the wholesale cheese price, Sws is a vector of wholesale cheese supply shifters including the Class III milk price, DINV is change in commercial cheese inventories, QSP is quantity of cheese sold by specialty plants to the government, and Qw is the equilibrium wholesale cheese quantity. The variables DINV and QSP 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 its respective government purchase price, i.e.:

(4.1) $WCP > GCP$,

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) $WCS = WCD + DINV + QSP + GC \circ WC$,

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) $FMS = f(E[AMP]|Sfm)$,

where: FMS is commercial milk marketings in the United States, E[AMP] is the expected all milk price, Sfm is a vector of milk supply shifters. As in the model

[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 QSP 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.

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:

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

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:

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

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

Econometric Estimation

The equations were estimated simultaneously using an instrumental variable approach for all prices and quarterly data from 1975 through 1997. 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 R2. The lowest adjusted coefficient of determination for any equation was 0.89, which is quite respectable.

The retail market demand functions were estimated on a per capita basis. Retail demand for each product was specified to be a function of the following variables: 1) retail product price, 2) price of substitutes, 3) per capita disposable income, 4) quarterly dummy variables to account for seasonal demand, 5) a time trend variable to capture changes in consumer tastes and preferences over time,[3] 6) a dummy variable for the quarters that bovine somatotropin has been approved, and 7) generic advertising expenditures to measure the impact of advertising on retail demand. In all demand functions, own prices and income were deflated by a substitute product price index. This specification was followed because there was strong correlation between the substitute price and own price for each dairy product. The consumer price index for nonalcoholic beverages was used as the substitute price in the fluid milk demand equation, while the consumer price index for meat was used as the substitute price in the cheese demand equation. To measure the generic advertising by the dairy industry, generic advertising expenditures for fluid milk and cheese were included as explanatory variables in the two respective demand equations. Since 1995, fluid milk processors have funded their own generic milk advertising program. In the econometric estimation, the fluid milk processors' generic advertising expenditures were added to dairy farmer advertising expenditures. Branded advertising expenditures were also included in the fluid milk and cheese demand equations, but were eventually omitted from the milk demand equation due to lack of statistical significance.[4]

To capture the dynamics of advertising, generic 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, and a first-order autoregressive error structure was imposed on the retail cheese demand equation to correct for autocorrelation.

Based on the econometric estimation, generic fluid milk advertising had the largest long-run

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[3]Several functional forms were specified for the time trend, including linear, log linear, and exponential forms. The form yielding the best statistical results was chosen for each equation.

[4]All generic and branded advertising expenditures came from various issues of *Leading National Advertisers*.

advertising elasticity of 0.02941 and was statistically different from zero at the 1 percent significance level. This means a 1 percent increase in generic fluid advertising expenditures resulted in a 0.02941 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 1975-95, Kaiser estimated a long-run elasticity of 0.021 for generic 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. Generic cheese advertising was also positive and statistically significant from zero at the 10 percent significance level and had a long run advertising elasticity of 0.01075, which is slightly lower than the previous estimate of 0.016 by Kaiser. Branded cheese advertising was positive, statistically significant, and had a long run advertising elasticity of 0.03604. Hence, it appears that branded cheese advertising is also an effective marketing tool for increasing total market cheese demand.

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 cheese supply equation, and a third-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. Finally, a third-order autoregressive error structure was imposed on the wholesale fluid milk supply equation, and a second-order autoregressive error structure was imposed on the wholesale cheese supply equation.

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. The Milk Diversion and Dairy Termination Programs were voluntary supply control programs implemented in the mid-to-late 1980s, and milk supply was reduced when these two programs were in effect.

Average Market Impacts of the Mandatory Farmer Checkoff Program

To examine the impacts that the mandatory 15 cent checkoff program had on the market over the period 1984.3-1997.4, the model was simulated under two scenarios based on generic advertising expenditures: 1) historic (checkoff) scenario, where advertising levels were equal to actual generic advertising expenditures under the mandatory checkoff program[5], and 2) no-mandatory 15 cent checkoff program scenario, where

[5]In the simulations, generic milk advertising expenditures by fluid milk processors is omitted. As a result, all simulated market impacts are by dairy farmer invested advertising expenditures only.

quarterly values of generic advertising expenditures were equal to 42 percent of their historical quarterly levels. In the year prior to the enactment of the national checkoff program, the national average assessment was 6.3 cents per hundredweight, which was increased to 15 cents with the creation of the 15 cent program. The 42 percent factor for the second scenario is derived from the ratio of 6.3 to 15. A comparison of these two scenarios provides a measure of the impacts of the checkoff program on dairy markets. Table 1 presents the quarterly averages of price and quantity variables for the period, 1984.3-97.4.

It is clear from these results that the mandatory checkoff program had an impact on the dairy market for the period 1984.3-97.4. The generic advertising effort under the 15 cent checkoff program resulted in a 1 percent increase in fluid sales and a 8.4 percent increase in retail fluid price compared to what would have occurred in the absence of this national program. Note that since the own price elasticity of fluid milk demand was estimated to be quite inelastic (-0.18), the modest increase in fluid sales due to advertising caused a sizable increase in price. The increase in fluid sales also caused the wholesale fluid price to increase by 7.3 percent, on average.

Generic advertising under the dairy checkoff resulted in a 0.5 percent increase in the overall demand for milk used in all dairy products compared to what would have occurred in the absence of this national program. It is interesting that most of the increase in dairy consumption from generic dairy advertising was due to increases in fluid milk demand. While milk demand was 1 percent higher due to the mandatory checkoff, the demand for cheese averaged 0.3 percent higher in the checkoff scenario. The modest increase in retail cheese demand due the dairy checkoff caused retail and wholesale cheese prices to be 1.1 percent and 1.6 percent higher, respectively, compared to what they would have been in the absence of the mandatory dairy checkoff program.

Cheese supply was slightly higher (0.10 percent, on average) due to advertising under the checkoff program. The checkoff also had an impact on purchases of cheese by the government. The increase in cheese demand due to checkoff advertising was larger than the increase in cheese supply resulting in a 11.5 percent decrease in cheese purchases by the government, on average, over this period. While this increase is significant in percentage terms, it is relatively small in actual magnitude averaging 30 million pounds (milk-fat equivalent) per quarter. The 11.5 percent reduction in cheese purchases by the government resulted in an overall decrease in total CCC purchases of 1.8 percent. Note that since dairy products are measured on a milk-fat equivalent basis, and most of the dairy products purchases over this period by the government was butter, the large percentage reduction in cheese purchases caused by the generic advertising under the checkoff program did not translate into a large reduction in total government dairy product purchases.

The introduction of the mandatory checkoff also had an impact on the farm market over this period. The Class III and all milk prices increased by an average of 2.6 percent and 2.5 percent under the checkoff due to an increase of 0.5 percent in total milk demand. Farm supply, in turn, increased by 0.4 percent. Farmers were better off under the checkoff since producer surplus averaged 2.9 percent higher with the program.[6] One bottom-line measure of the net benefits of the checkoff to farmers is an average benefit-cost ratio (BCR), which gives the ratio of benefits to costs of the national program. Specifically, the BCR was calculated as the change in producer surplus, due to the existence of the mandatory 15 cent checkoff program, divided by the costs of the mandatory checkoff program. The cost of the program was measured as the 15 cents per hundredweight assessment times total milk marketings. In the year prior to the program, farmers voluntarily contributed 6.3 cents per hundredweight. Therefore, the difference in cost due to the national 15 cent checkoff was the difference between 0.0015 times milk marketings (in billion pounds) under the checkoff scenario minus 0.00063 times milk marketings in the no-checkoff scenario. The results showed that the average BCR for the national mandatory checkoff program was 4.00 over this period. This means that each dollar invested in generic advertising returned $4.00 in profits to farmers, on average, over the period.

Because there is some error associated with any statistical estimation, a 90 percent confidence interval was calculated for these impacts. The 90 percent confidence interval provides lower and upper bounds where each of these random variables should be 90

[6]Producer surplus is similar to profit.

percent of the time. The lower and upper bounds for each market variable were estimated by re-simulating the two scenarios through setting the fluid milk and cheese advertising coefficients in the retail demand equations to the lower and upper bounds of a 90 percent confidence interval. The estimated lower and upper limits of the 90 percent confidence interval for all variables are presented in the last two columns of table 1. For example, consider the impact of the checkoff program on fluid demand. As mentioned above, the average impact of the mandatory 15 cent program was a 1 percent increase in fluid milk demand. The 90 percent confidence interval demonstrates that one could be "confident" 90 percent of the time that the impact of mandatory program on fluid milk demand lies between 0.1 percent, on the low side, and 1.9 percent, on the high side. The lower and upper limits of the 90 percent confidence interval for the BCR to dairy farmers were 0.31 and 10.41, respectively.

To determine whether generic advertising had a larger impact on dairy markets in more recent years, the simulation was repeated for the most recent period, 1995.1-97.4. The results are presented in table 2. Over the past three years, the mandatory checkoff program has had a slightly larger impact on the market compared with the longer period, 1984.3-97.4, especially in terms of the farm milk market. For example, the 1995-97 average Class III and all milk price was 2.8 and 2.7 percent higher, respectively, in the checkoff scenario compared to the no-checkoff scenario. Recall that the average Class III and all milk price were 2.6 and 2.5 percent higher, respectively, when averaged over the entire 13 year period. Moreover, the BCR to dairy farmers averaged 4.68 over the past three years compared with 4.00 over the past 13 years.

Marginal Impacts of the Mandatory Farmer Checkoff Program

The BCR figure calculated above was on an average basis, i.e., average BCR due to the existence of the mandatory checkoff program. Another way to examine benefits and costs of generic advertising is to compute a marginal BCR. The marginal BCR is defined as the ratio of the change in producer surplus due to a one percent increase in generic advertising divided by the change in advertising costs due to a one percent increase in advertising. A marginal BCR provides useful information on whether too much or too little is being invested in an activity. Specifically, if a marginal BCR is above 1.0, then the change in benefits exceeds the change in costs associated with increasing advertising. This situation implies that the current allocation is under-invested. Alternatively, a marginal BCR below 1.0 implies that the current allocation of advertising is over-funded since an small increase in advertising results in the incremental costs being larger than the incremental benefits.

For the entire period 1984.3-97.4, the marginal BCR of the mandatory checkoff program averaged 8.3. This means that, on average for this period, if farmers would have invested an additional dollar into generic advertising, producer surplus (profit) would have increased by $8.30. Since this estimate is well above 1.0, this implies that the current level of generic advertising is too low since it is obviously profitable for farmers to increase this investment. The marginal BCR was also calculated for a more recent period, 1995-97. Interestingly, the marginal BCR is still well above 1.0, but it is slightly lower (5.30) than for the entire period. This may mean that the dairy farmer program, while still under-investing in advertising, is moving closer to the optimal level.

Fluid Milk-Cheese Reallocation Simulations

The final set of simulations conducted with the model involve reallocating advertising between fluid milk and cheese advertising, while not changing the total advertising budget.[7] The model was simulated from 1984.3-1997.4 for nine re-allocation scenarios. In the first scenario, the advertising budget (sum of fluid milk and cheese advertising expenditures) was reallocated so that fluid milk advertising received 90 percent and cheese advertising received 10 percent. In the second

[7]There was some generic butter and ice cream advertising expenditures over this period. This is ignored in the analysis. Consequently, when the term "total advertising budget" is used, it means the summation of fluid milk and cheese advertising expenditures.

scenario, fluid milk advertising received 80 percent and cheese advertising received 20 percent of the advertising budget. These reallocations were repeated in the remaining scenarios in 10 percent increments with the ninth and last scenario investing 10 percent of the advertising budget in fluid milk and 90 percent in cheese advertising. As was the case in the previous simulations, the recent fluid milk advertising by milk processors is netted out and ignored in this analysis.

In examining the market impacts of these reallocations, we will focus on the impact on producer surplus since this is the dairy farmer profitability variable in the analysis. Figure 1 shows simulated average quarterly producer surplus (1984.3-97.4) for the nine reallocation scenarios (note that in the horizontal axis of this figure, the percentage refers to the percent of the total budget allocated to fluid milk advertising and the remaining percentage is allocated to cheese advertising). Of the nine scenarios considered, producer surplus is highest in the 80 percent fluid milk advertising 20 percent cheese advertising scenario. However, the difference between the optimal 80 percent milk advertising scenario and the two adjacent scenarios (90 percent fluid and 70 percent fluid) is not that large (only 0.2 percent difference). On the other hand, the percentage difference between the optimal 80 percent fluid milk advertising scenario and the scenario involving only 10 percent fluid milk advertising is fairly large, i.e., 4 percent. Therefore, since the mandatory program was initiated in 1984, the results indicate that investing the majority of advertising in fluid milk advertising is a good strategy. This is not surprising since: (1) farmers receive a price premium for milk going into Class I products, and (2) the estimated demand response to milk advertising is more elastic than the estimated cheese demand response to cheese advertising.

Conclusion

The purpose of this study was to analyze the impacts of generic dairy advertising on retail, wholesale, and farm dairy markets. The results indicated that the 15 cent checkoff had a major impact on retail, wholesale, and farm markets for the dairy industry. The main conclusion of the study is that farmers are receiving a high return on their investment in generic dairy advertising. Furthermore, the impacts over the most recent three years tend to be somewhat larger than over the entire life of the program. This may reflect improvements in management associated with gains in experience over the life of the program. 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 other options producers 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.

In addition, simulations were conducted on reallocating the advertising budget between fluid milk and cheese advertising. The results indicated that the optimal level of advertising between products is about 80 percent for fluid milk and 20 percent for cheese advertising. Therefore, a continued strategy of putting most advertising into milk would be optimal.

There are two directions that could be useful for future research. Obviously, inclusion of other marketing activities by the NDPRB would be useful because then the model could be used to determine the optimal allocation of dairy farmer checkoff funds across marketing activities. In addition, spatial disaggregation of the model into several regions of the United States, particularly for fluid milk, would be valuable. Although manufactured dairy products are well- represented as a national market, fluid milk markets tend to be regional in scope, and fluid milk marketing orders cause different price surfaces for fluid milk. Regional disaggregation of fluid milk markets would also make the model a valuable tool in examining dairy policy questions on such issues as federal milk marketing order consolidation.

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Table 1. Simulated quarterly values for market variables with and without advertising under the Mandatory 15 cent checkoff program, averaged over 1984.3-97.4.

					Confidence interval	
		1984.3-97.4 Average			High	Low
		with	without	Percent	bound	bound
Variable	Unit	NDPRB	NDPRB	change	(percent)	(percent)
Fluid demand/supply	bil lbs me[a]	13.55	13.42	1.0	1.9	0.1
Cheese demand	bil lbs me	12.80	12.76	0.3	0.5	0.1
Cheese supply	bil lbs me	13.06	13.05	0.1	0.3	0.0
Total demand	bil lbs me	34.94	34.77	0.5	1.0	0.1
Retail fluid price	1982-84=100	123.35	113.02	8.4	15.4	0.8
Retail cheese price	1982-84=100	127.08	125.69	1.1	2.1	0.2
Wholesale fluid price	1982=100	115.66	107.24	7.3	13.5	0.7
Wholesale cheese price	$/lb	1.46	1.44	1.6	3.4	0.2
Class III price	$/cwt	12.18	11.87	2.6	5.4	0.2
All milk price	$/cwt	13.11	12.79	2.5	5.1	0.2
CCC cheese purchases	bil lbs me	0.25	0.28	-11.5	-16.8	-1.2
CCC purchases	bil lbs me	1.63	1.66	-1.8	-1.6	-0.3
Milk supply	bil lbs	37.32	37.18	0.4	0.8	0.0
Producer surplus	bil $	4.55	4.42	2.9	5.9	0.3
Benefit-cost ratio	$	4.00	10.41	0.31		

[a] The notation "me" stands for milk equivalent.

Table 2. Simulated quarterly values for market variables with and without advertising under the Mandatory 15 cent checkoff program, averaged over 1995.1-97.4.

Variable	Unit	1995.1-97.4 Average with NDPRB	without NDPRB	Percent change
Fluid demand/supply	bil lbs me[a]	13.86	13.71	1.0
Cheese demand	bil lbs me	15.04	15.00	0.3
Cheese supply	bil lbs me	15.24	15.20	0.2
Total demand	bil lbs me	38.30	38.12	0.5
Retail fluid price	1982-84=100	135.39	124.15	8.3
Retail cheese price	1982-84=100	152.79	151.02	1.2
Wholesale fluid price	1982=100	126.60	117.43	7.2
Wholesale cheese price	$/lb	1.68	1.65	1.7
Class III price	$/cwt	13.33	12.96	2.8
All milk price	$/cwt	14.23	13.85	2.7
CCC cheese purchases	bil lbs me	0.16	0.17	-6.0
CCC purchases	bil lbs me	0.38	0.39	-2.6
Milk supply	bil lbs	39.41	39.24	0.4
Producer surplus	bil $	5.20	5.04	3.1
Benefit-cost ratio	$	4.68		

[a] The notation "me" stands for milk equivalent.

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 six estimated equations. There are also appendix figures which provide graphical representations of changes in some of the key variables over time.

Appendix table 1. Variable definitions and sources.*

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

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 <u>Consumer Price Index</u>,

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

T = time trend variable for the retail and wholesale-level equations, equal to 1 for 1975.1,....,

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,

BST = intercept dummy variable for bovine somatotropin, equal to 1 for 1994.1 through 1996.4; equal to 0 otherwise,

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

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 <u>Cold Storage</u>),

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

INCMEA = per capita disposable personal income (in $1,000), from <u>Employment and Earnings</u>, divided by consumer retail price index for meat,

TSQ = time trend squared,

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

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

AR(1) = AR 1 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 <u>Producer Price Index</u>,

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

AR(3) = AR 3 error correction term,

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,

PFEP1 = producer price index for fuel and energy, divided by Class I price for raw milk,

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,

AR(2) = AR 2 error correction term,

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.

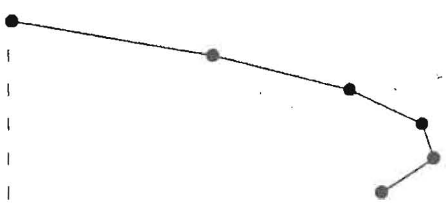
LS // Dependent Variable is LRFD
Date: 04/21/98 Time: 10:18
Sample: 1976:2 1997:4
Included observations: 87 after adjusting endpoints
Convergence achieved after 6 iterations

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	-2.522123	0.168795	-14.94195	0.0000
LRFPBEV	-0.174951	0.053800	-3.251863	0.0017
LINCBEV	0.162679	0.045591	3.568205	0.0006
LT	-0.078835	0.012836	-6.141747	0.0000
DUMQ1	0.051512	0.003699	13.92702	0.0000
DUMQ2	0.040640	0.004904	8.286807	0.0000
DUMQ3	-0.006953	0.003821	-1.819396	0.0728
BST	-0.056736	0.009171	-6.186261	0.0000
PDL01	0.005680	0.002632	2.158248	0.0341
PDL02	0.001753	0.001379	1.270899	0.2077
PDL03	-0.000523	0.000821	-0.636148	0.5266
MA(1)	0.508278	0.102606	4.953700	0.0000

R-squared	0.907449	Mean dependent var	-2.908218
Adjusted R-squared	0.893875	S.D. dependent var	0.043105
S.E. of regression	0.014042	Akaike info criterion	-8.403936
Sum squared resid	0.014789	Schwartz criterion	-8.063811
Log likelihood	254.1236	F-statistic	66.85159
Durbin-Watson stat	1.623567	Prob(F-statistic)	0.000000

Inverted MA Roots -.51

Lag Distribution of LGFAD



i	Coefficient	Std. Error	T-Statistic
0	8.3E-05	0.00410	0.02033
1	0.00340	0.00220	1.54929
2	0.00568	0.00263	2.15825
3	0.00691	0.00261	2.64267
4	0.00710	0.00213	3.33715
5	0.00624	0.00402	1.55277
Sum of Lags	0.02941	0.00754	3.90267

LS // Dependent Variable is LRCD
Date: 04/21/98 Time: 14:26
Sample: 1976:1 1997:4
Included observations: 88 after adjusting endpoints
Convergence achieved after 5 iterations

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	-3.014558	0.292055	-10.32188	0.0000
LRCPMEA	-0.570932	0.145131	-3.933919	0.0002
LINCMEA	0.317914	0.100231	3.171802	0.0022
TSQ	6.07E-05	6.33E-06	9.585083	0.0000
DUMQ1	0.055111	0.008847	6.229199	0.0000
DUMQ2	-0.036248	0.009703	-3.735770	0.0004
DUMQ3	-0.003849	0.009542	-0.403410	0.6878
BST	-0.072178	0.021023	-3.433347	0.0010
PDL01	0.002600	0.004668	0.556914	0.5793
PDL02	0.004868	0.003707	1.313183	0.1932
PDL03	0.001473	0.005515	0.267196	0.7901
PDL04	0.012108	0.010776	1.123633	0.2649
PDL05	-0.004358	0.007741	-0.563015	0.5751
PDL06	-0.000140	0.012526	-0.011193	0.9911
AR(1)	0.334968	0.106779	3.137024	0.0025

R-squared	0.982665	Mean dependent var	-3.118185
Adjusted R-squared	0.979341	S.D. dependent var	0.200206
S.E. of regression	0.028776	Akaike info criterion	-6.942377
Sum squared resid	0.060449	Schwartz criterion	-6.520104
Log likelihood	195.5980	F-statistic	295.5843
Durbin-Watson stat	2.018437	Prob(F-statistic)	0.000000

Inverted AR Roots .33

Lag Distribution of LGCAD	i	Coefficient	Std. Error	T-Statistic
	0	-0.00079	0.00476	-0.16693
	1	0.00260	0.00467	0.55691
	2	0.00894	0.00459	1.94715
Sum of Lags		0.01075	0.00730	1.47103

Lag Distribution of LBCAD	i	Coefficient	Std. Error	T-Statistic
	0	0.01633	0.01068	1.52901
	1	0.01211	0.01078	1.12363
	2	0.00761	0.01068	0.71257
Sum of Lags		0.03604	0.01895	1.90183

LS // Dependent Variable is LRFS
Date: 05/11/98 Time: 08:52
Sample: 1976:1 1997:4
Included observations: 88 after adjusting endpoints
Convergence achieved after 5 iterations

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	0.715475	0.208147	3.437356	0.0009
LRFPWFP	0.121029	0.087027	1.390714	0.1682
LPFEWFP	-0.024831	0.017605	-1.410430	0.1623
LRFS(-1)	0.699410	0.089588	7.806959	0.0000
LT	0.014068	0.005926	2.374025	0.0200
DUMQ1	0.046949	0.003138	14.95997	0.0000
DUMQ2	-0.003399	0.006317	-0.538101	0.5920
DUMQ3	-0.040034	0.005118	-7.822543	0.0000
AR(3)	0.312007	0.109063	2.860787	0.0054

R-squared	0.949745	Mean dependent var	2.583224
Adjusted R-squared	0.944655	S.D. dependent var	0.049468
S.E. of regression	0.011637	Akaike info criterion	-8.810397
Sum squared resid	0.010699	Schwartz criterion	-8.557033
Log likelihood	271.7909	F-statistic	186.6211
Durbin-Watson stat	2.244476	Prob(F-statistic)	0.000000

Inverted AR Roots	.68	-.34+.59i	-.34 -.59i

LS // Dependent Variable is LRCS
Date: 05/11/98 Time: 08:53
Sample: 1976:1 1997:4
Included observations: 88
Convergence achieved after 4 iterations

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	-0.035881	0.157811	-0.227363	0.8207
LRCPWCP	0.165714	0.057680	2.872984	0.0052
LPFEWCP	-0.085511	0.034668	-2.466565	0.0158
LRCS(-1)	0.777144	0.072738	10.68416	0.0000
LT	0.053082	0.021737	2.442027	0.0168
DUMQ1	0.051005	0.011575	4.406331	0.0000
DUMQ2	-0.082037	0.008577	-9.564356	0.0000
DUMQ3	0.027701	0.012313	2.249811	0.0272
AR(1)	-0.400844	0.114559	-3.499012	0.0008

R-squared	0.989227	Mean dependent var	2.372075
Adjusted R-squared	0.988136	S.D. dependent var	0.260577
S.E. of regression	0.028383	Akaike info criterion	-7.027276
Sum squared resid	0.063642	Schwartz criterion	-6.773912
Log likelihood	193.3336	F-statistic	906.7356
Durbin-Watson stat	2.012141	Prob(F-statistic)	0.000000

Inverted AR Roots -.40

LS // Dependent Variable is LWFS
Date: 05/11/98 Time: 08:55
Sample: 1976:1 1997:4
Included observations: 88 after adjusting endpoints
Convergence achieved after 6 iterations

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	0.698308	0.205509	3.397947	0.0011
LWFPP1	0.042344	0.032851	1.288955	0.2012
LPFEP1	-0.032084	0.016811	-1.908503	0.0600
LWFS(-1)	0.696669	0.090511	7.697052	0.0000
LT	0.014962	0.007039	2.125708	0.0367
DUMQ1	0.046463	0.003270	14.20743	0.0000
DUMQ2	-0.002533	0.006515	-0.388789	0.6985
DUMQ3	-0.039381	0.005199	-7.574986	0.0000
AR(3)	0.268365	0.108260	2.478892	0.0153

R-squared	0.948653	Mean dependent var	2.583224
Adjusted R-squared	0.943453	S.D. dependent var	0.049468
S.E. of regression	0.011763	Akaike info criterion	-8.788906
Sum squared resid	0.010931	Schwartz criterion	-8.535542
Log likelihood	270.8453	F-statistic	182.4432
Durbin-Watson stat	2.302259	Prob(F-statistic)	0.000000

Inverted AR Roots	.65	-.32+.56i	-.32 -.56i

LS // Dependent Variable is LWCS
Date: 05/11/98 Time: 08:59
Sample: 1976:1 1997:4
Included observations: 88
Convergence achieved after 4 iterations

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	0.104714	0.313821	0.333674	0.7395
LWCPP3	0.036740	0.135464	0.271216	0.7869
LPFEP3	-0.015234	0.021483	-0.709108	0.4803
LWCS(-1)	0.946764	0.040801	23.20440	0.0000
LT	0.015576	0.015981	0.974653	0.3327
DUMQ1	0.093957	0.016460	5.708200	0.0000
DUMQ2	0.083226	0.022220	3.745584	0.0003
DUMQ3	0.159874	0.016006	9.988284	0.0000
AR(2)	-0.574244	0.076753	-7.481710	0.0000

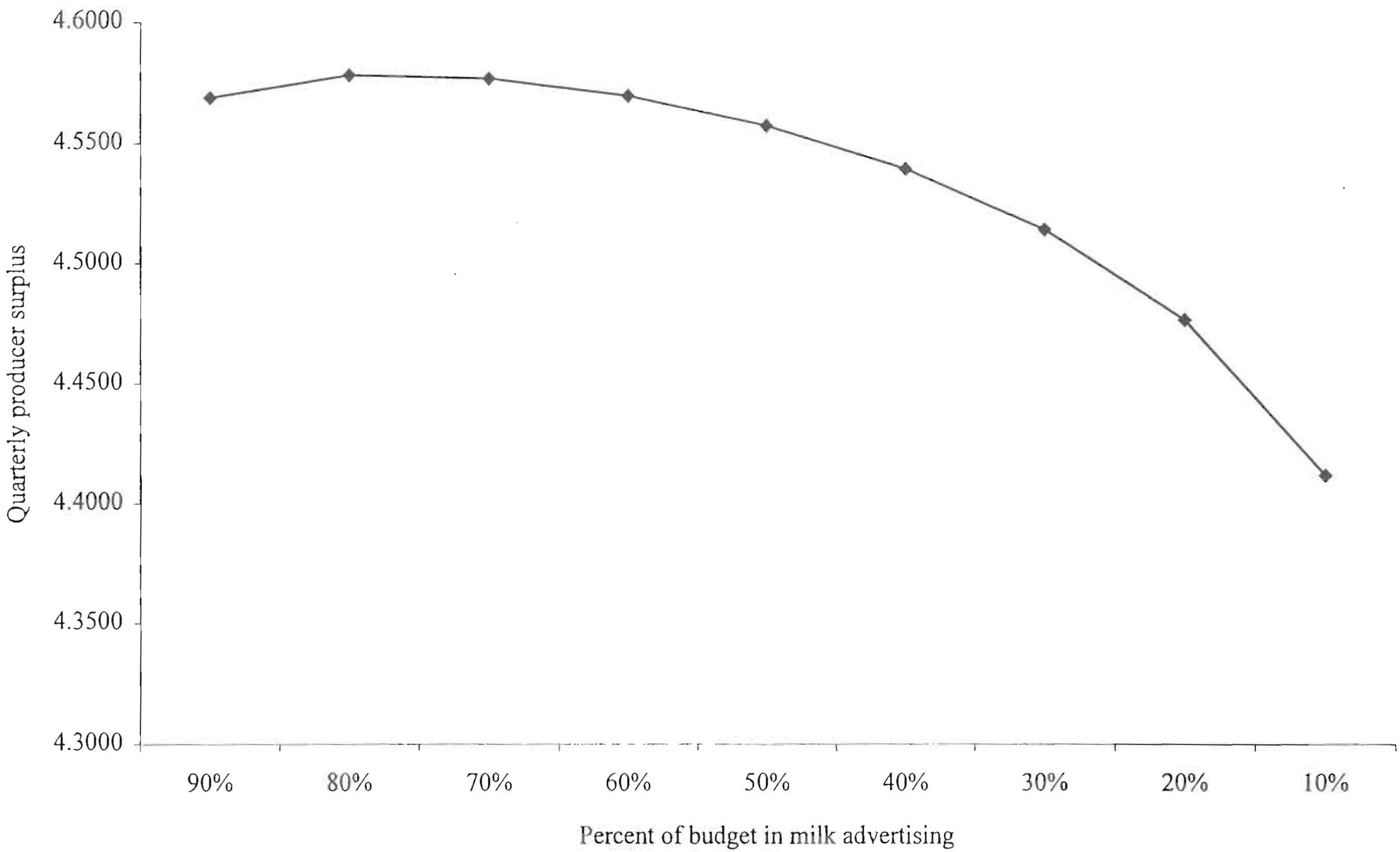
R-squared	0.985000	Mean dependent var	2.377781
Adjusted R-squared	0.983481	S.D. dependent var	0.239338
S.E. of regression	0.030761	Akaike info criterion	-6.866337
Sum squared resid	0.074755	Schwartz criterion	-6.612973
Log likelihood	186.2522	F-statistic	648.4541
Durbin-Watson stat	2.221407	Prob(F-statistic)	0.000000

LS // Dependent Variable is LFMS
Date: 05/11/98 Time: 09:01
Sample: 1976:3 1997:4
Included observations: 86 after adjusting endpoints

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	1.609890	0.485520	3.315807	0.0014
LAMPPFEED	0.077976	0.039148	1.991812	0.0501
LPCOWPFEED	-0.045344	0.019228	-2.358277	0.0210
LFMS(-1)	0.695687	0.108106	6.435256	0.0000
LFMS(-2)	-0.491020	0.118918	-4.129076	0.0001
LFMS(-3)	0.319076	0.108960	2.928381	0.0045
LT	0.064493	0.018846	3.422199	0.0010
DTP	-0.024894	0.008335	-2.986756	0.0038
MDP	-0.021894	0.008102	-2.702478	0.0085
DUMQ1	0.021551	0.011526	1.869851	0.0655
DUMQ2	0.028787	0.011923	2.414482	0.0182
DUMQ3	0.071326	0.007589	9.398015	0.0000

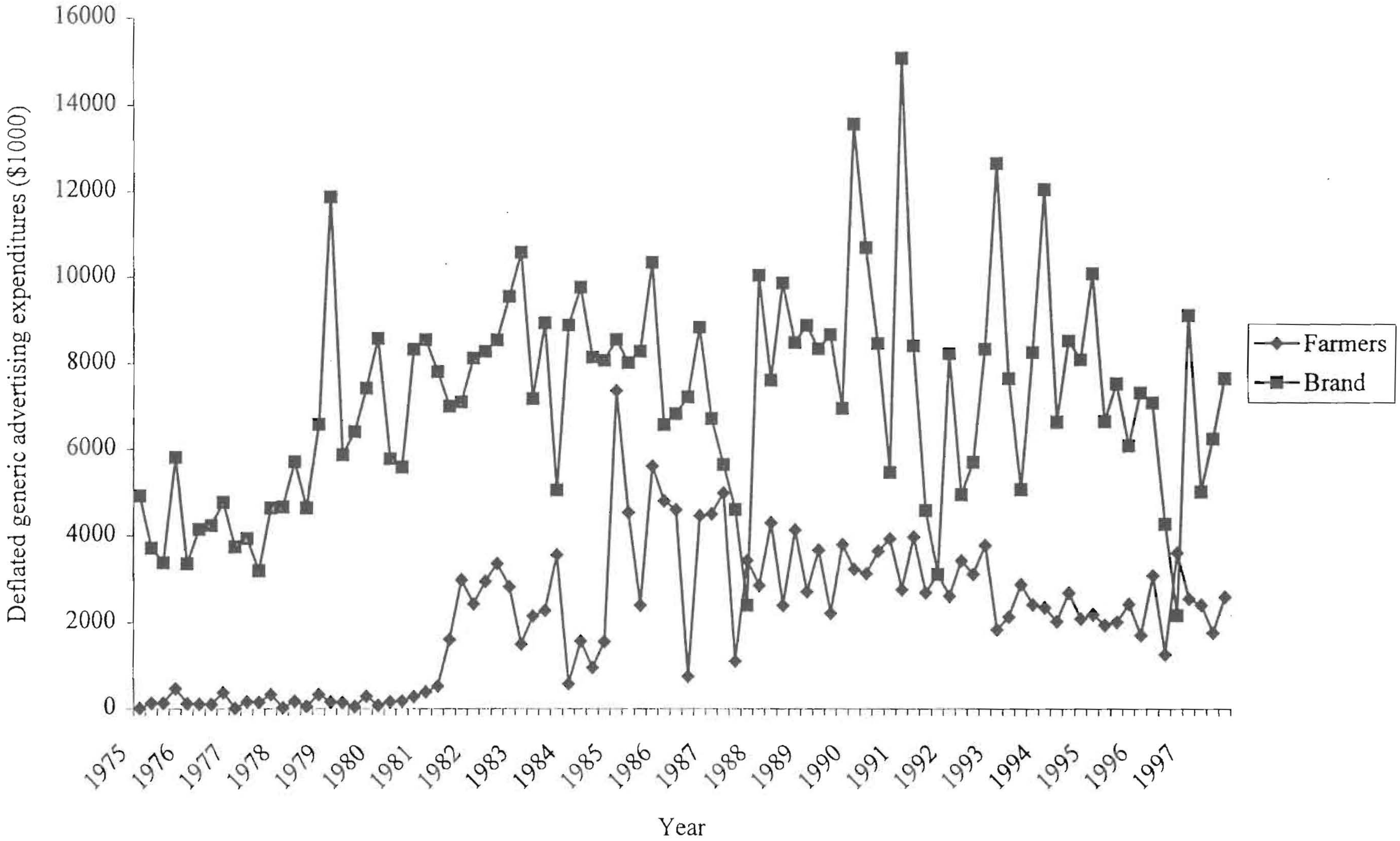
R-squared	0.973537	Mean dependent var	3.558574
Adjusted R-squared	0.969603	S.D. dependent var	0.088196
S.E. of regression	0.015377	Akaike info criterion	-8.221019
Sum squared resid	0.017497	Schwartz criterion	-7.878552
Log likelihood	243.4751	F-statistic	247.4874
Durbin-Watson stat	1.925401	Prob(F-statistic)	0.000000

Figure 1. Average quarterly producer surplus by percent of advertisng allocated to fluid milk.

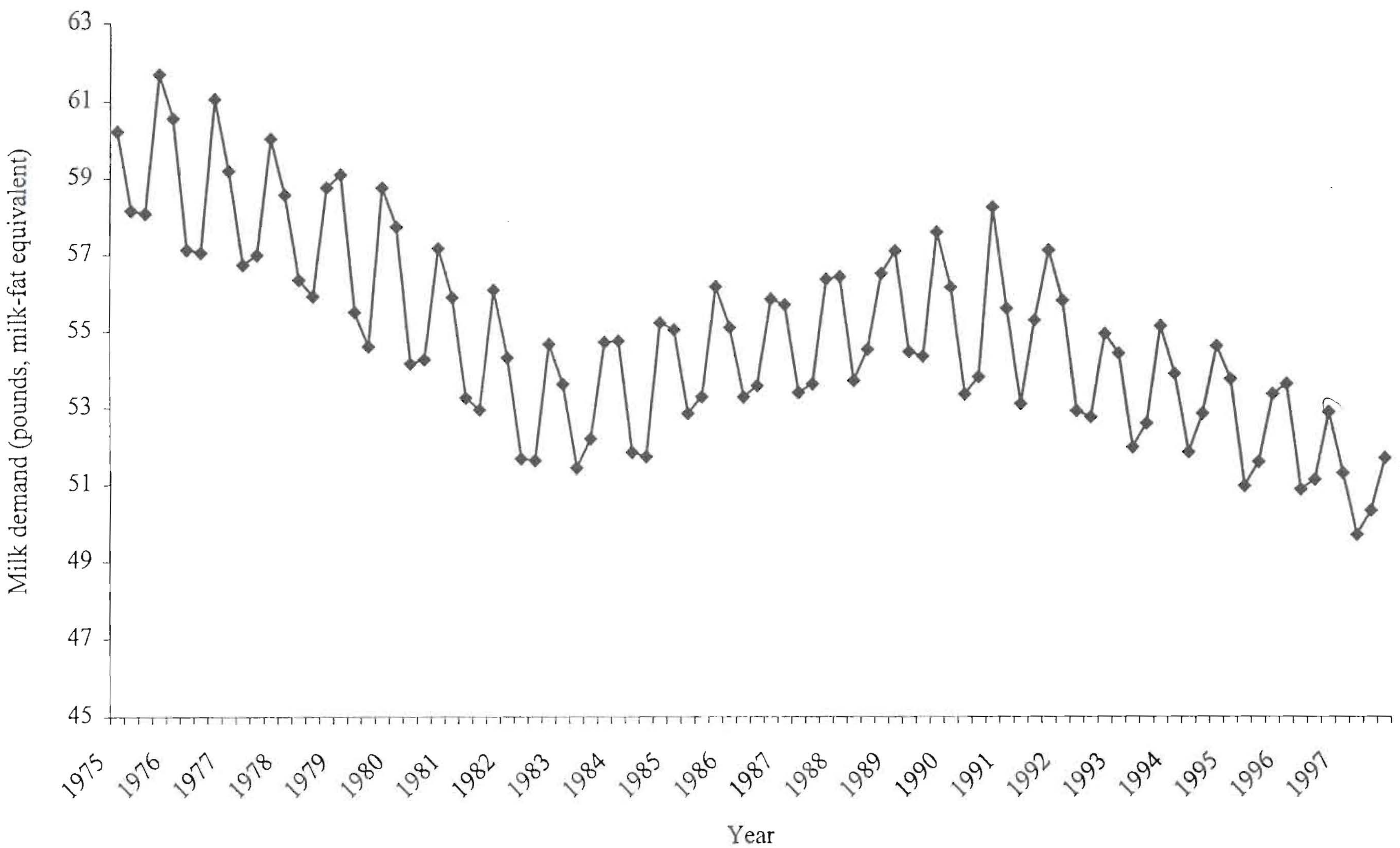


Appendix figure 1. Deflated generic fluid milk advertising expenditures by dairy farmers and milk processors, 1975-97.

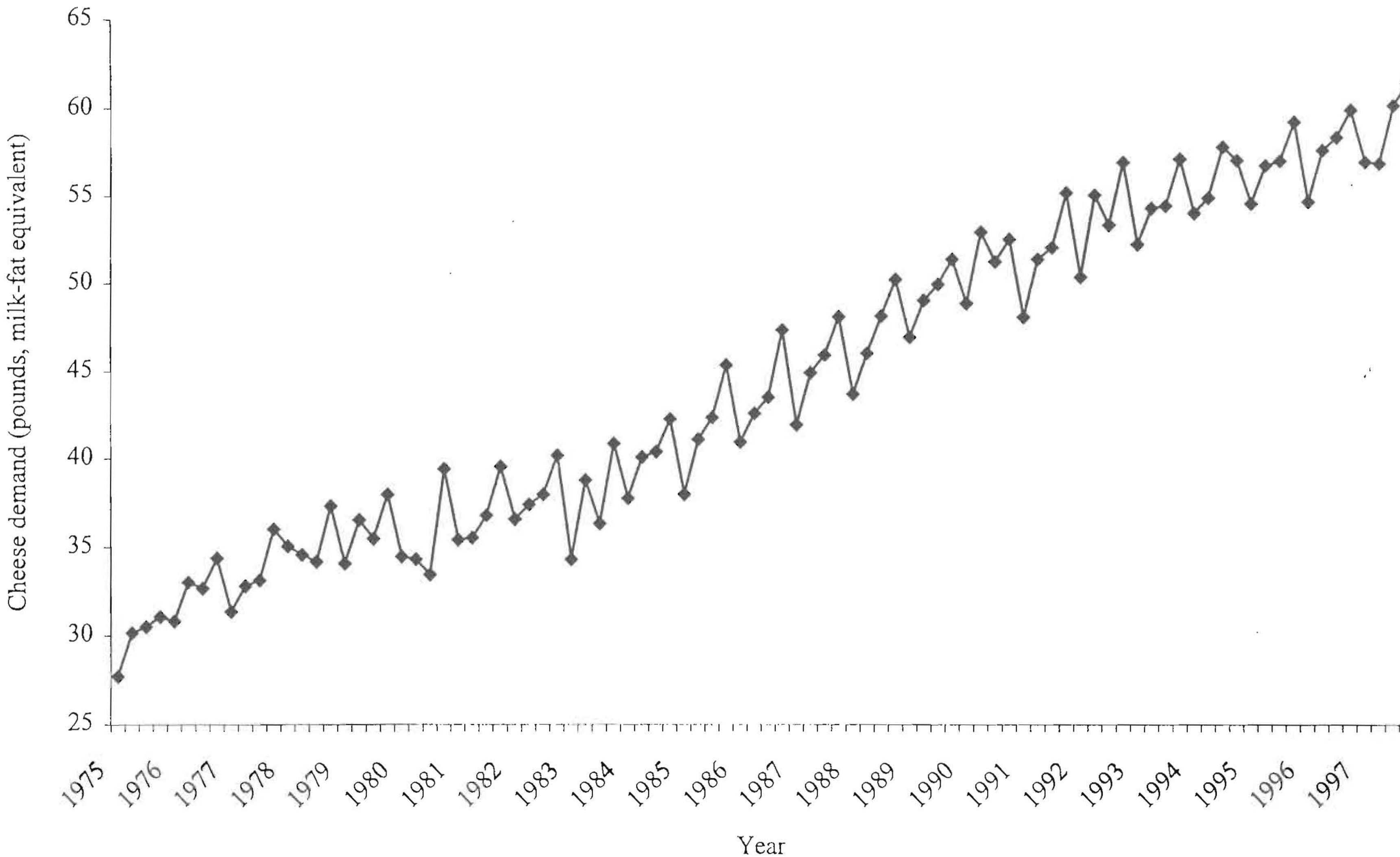
Appendix figure 2. Deflated generic and brand cheese advertising expenditures, 1975-97.



Appendix figure 3. Per capita fluid milk demand, 1975-97.



Appendix figure 4. Per capita cheese demand, 1975-97.



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