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Measuring the Impacts of Generic Fluid Milk and Dairy Marketing

by:

Harry M. Kaiser

Charles H. Dyson School of Applied Economics and Management
College of Agriculture and Life Sciences
Cornell University, Ithaca, New York 14853

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- Develop and maintain comprehensive databases relating to commodity promotion research and evaluation.

- Facilitate the coordination of multi-commodity and multi-country research and evaluation efforts.

- 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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Cornell University
Ithaca, NY 14853-7801

* Kaiser is the Gellert Family Professor of Applied Economics and Management in the Charles H. Dyson School of Applied Economics and Management at Cornell University, and the Director of the Cornell Commodity Promotion Research Program. The author thanks John Mengel, Jerry Cessna, and Howard McDowell for useful comments and suggestions on previous versions of the manuscript. Any possible remaining errors are the fault of the author.

Measuring the Impacts of Generic Fluid Milk and Dairy Marketing

Executive Summary

While per capita fluid milk consumption has been declining for decades in the United States at about 1% per year, generic fluid milk marketing activities sponsored by fluid milk processors and dairy farmers have helped mitigate at least some of this decline. We estimate that these marketing efforts have had a positive and statistically significant impact on per capita fluid milk consumption. Specifically, over the period 1995 through 2009, we estimate that a 1% increase in generic fluid milk advertising expenditures resulted in a 0.037% increase in per capita fluid milk consumption when holding all other demand factors constant. Over the same period, we estimate that a 1% increase in generic fluid milk non-advertising marketing expenditures resulted in a 0.028% increase in per capita fluid milk consumption when holding all other demand factors constant.

In terms of total consumption of fluid milk, generic fluid milk marketing activities increased fluid milk consumption by an average of 6.23 billion pounds per year on average. Stated differently, had there not been generic fluid milk marketing conducted by the two national programs, fluid milk consumption would have been 11.3% less than it actually was over this time period. Hence, the bottom line is that the fluid milk marketing efforts by fluid milk processors and dairy farmers combined have had a positive and statistically significant impact that is partially mitigating declines in fluid milk consumption.

An average benefit-cost ratio was computed for the fluid milk processor program based on the period, 1999-2009. The benefit-cost ratio was 8.88, implying that, on average over the period 1999-2009, the benefits of MilkPEP marketing programs have been 8.88 times greater than the costs, i.e., every dollar invested in MilkPEP marketing yielded an additional $8.88 in industry net revenue. To make allowance for the error inherent in any statistical estimation, a 90% confidence interval was calculated for the average BCR. The estimated lower bound for the average BCR was 1.79. Hence, it is reasonable to conclude that this confidence interval gives credence to the finding that the benefits of the Fluid Program’s marketing activities have been considerably greater than the cost of the programs.

In terms of the all-dairy product demand analysis, the average advertising elasticity for this period in terms of milk equivalents on a non-fat and fat basis was 0.036 and 0.056, respectively; a 1% increase in media advertising expenditures would increase per capita all-dairy product demand by 0.036% (non-fat basis) and 0.056% (fat basis). The average non-advertising marketing elasticity for this period was 0.016 (non-fat) and 0.017 (fat); a 1% increase in media advertising expenditures would increase per capita all-dairy product demand by 0.016% (non-fat) and 0.017% (fat). Thus, the total marketing (advertising and non-advertising) effort by dairy farmers and fluid milk processors has had a positive and statistically significant impact on dairy consumption.

We calculated a benefit-cost ratio (BCR) for the Dairy Program for the period 1999 through 2009**.** The benefits of the Dairy Program were calculated as the change in dairy farmers' net revenue (producer surplus) due to demand enhancement from all marketing activities under the Dairy Program by way of increased sales and higher prices. The costs of the Dairy Program were calculated as the differences in total assessment revenues before and after the national program was enacted. The results show that the average BCR for the Dairy Program was 6.20 (non-fat solids basis) and 9.85 (milk-fat basis) from 1999 through 2009. This means that each dollar invested in generic dairy marketing by dairy farmers during the period would return between $6.20 and $9.85, on average, in net revenue to farmers. These BCRs apply to all of the QP's marketing programs, but exclude the longer-term (programs that have no impact within a year) demand expansion programs operated by DMI. The level of the marketing BCR suggests that the combined marketing programs supported by dairy farmers have been a successful investment. The estimated lower bounds for a 90% confidence interval for the average BCR in the non-fat and fat models were 3.84 and 1.18, respectively. Hence, it is reasonable to conclude that these confidence intervals give credence to the finding that the benefits of the Dairy Program's marketing activities have been considerably greater than the cost of the programs.

In addition to computing a BCR for the overall marketing efforts of dairy farmers, an average BCR was also calculated for generic advertising and non-advertising activities by dairy farmers. The average BCR for generic advertising in the non-fat model was 8.56 compared with 6.60 for non-advertising marketing activities, and this difference was statistically significant at the 1% level. The average BCR for generic advertising in the fat model was 15.06 compared with 8.41 for non-advertising marketing activities, and this difference was statistically significant at the 1% level. Hence, dairy farmers are receiving a higher return from their generic advertising activities than the non-advertising marketing activities.

Measuring the Impacts of Generic Fluid Milk and Dairy Marketing

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The Dairy Production and Stabilization Act of 1983[1] and the Fluid Milk Promotion Act of 1990[2] require annual independent analyses of the advertising and promotion programs that operate to increase consumer awareness and sales of fluid milk and dairy products. In this bulletin, the 2009 evaluation results of the effectiveness of the Dairy and Fluid Milk Programs are presented. The economic evaluation focuses on generic marketing activities by dairy farmers and fluid milk processors that are designed to increase the demand for fluid milk and dairy products. The results of two separate models are presented, and each model is described in this report.

The first is a fluid milk-only demand model used to evaluate the economic impacts of all generic fluid milk marketing activities of both programs on fluid milk demand. The generic fluid milk marketing activities include fluid milk advertising and non-advertising marketing activities used to increase demand. Advertising includes all media activities such as television, print, radio, outdoor, and web advertising by dairy farmers and fluid milk processors. Non-advertising fluid milk marketing includes health and nutrition educational programs and affairs, public relations, promotion programs, school milk programs, food service programs, retail programs, child nutrition fitness initiative, single serve milk promotions, value added marketing (issues/crisis, trade service communications, strategic research, real seal), trade service communications. The advertising and non-advertising marketing variables represent all demand enhancing activities by fluid milk processors and dairy farmers that have an impact within one-year after being conducted. More recently, Dairy Management, Inc., which is the national association[3] implementing a significant part of the dairy farmer program, has conducted some marketing activities that require longer than one-year to have an impact on demand, and these activities are not included in this analysis. These activities include partnership programs with brand firms producing or selling dairy products, and the goal is to increase demand for fluid milk and dairy products. Several examples of such activities include: (1) $5 million invested by DMI in 2009 to supplement H.P. Hood’s $23.3 million investment in Creamy Milk (a new lowfat milk product that tastes like full fat) to evaluate the impact of this new product on fluid milk sales in a test market; (2) $8.3 million invested by DMI from 2006-2009 in a partnership with Dannon Company, Kraft Foods, Shamrock Farms, and Nestle who jointly contributed $46 million over this period in Dairy Aisle Reinvention, which is a category management project aimed at

[1] Dairy Act; 7 U.S.C. 4514.

[2] Fluid Milk Act; 7 U.S.C. 6407.

[3] Dairy farmers have two main organizations to promote fluid milk and dairy products: Dairy Management, Inc. (DMI) and the regional Qualified Programs (QPs). Dairy Management, Inc. operates at the national level and receives a minimum of $0.05 per hundredweight from the $0.15 assessment. There are 59 regional QPs operating at the state or regional level and receive a maximum of $0.10 per hundredweight of the $0.15 assessment. DMI actually receives more than the minimum $0.05 because some of the QPs send some of their $0.10 to DMI in collaborative marketing activities, i.e., the Unified Marketing Plan. Other QPs such as the Wisconsin Milk Marketing Board and the California Milk Advisory Board do not send any money to DMI and instead conduct their own promotion programs. The demand enhancing marketing expenditures of both DMI and the QPs are included in the model.

increasing overall sales of dairy products; and (3) $12 million invested in a Dominos Pizza partnership in 2008 and 2009 in American Legends® pizzas, a line of specialty pizzas inspired by regional American tastes, all featuring cheesy crusts and at least 40% more cheese (than their core pizzas) with Dominos spending more than $24 million in the campaign. Other non-demand enhancing activities are also not part of this analysis, including expenditures on overhead, research, technical support, industry relations, and corporate technology. While the dairy farmers' and fluid milk processors' programs utilize various types of marketing strategies to increase fluid milk consumption, the effects of fluid milk marketing under both programs are combined because the objectives of both programs are the same and data cannot be satisfactorily segregated to evaluate the two programs separately.

The second model is a combined fluid milk and dairy product demand model (measured in terms of domestic commercial disappearance) used to evaluate the economic impacts of all generic marketing activities for those products. This model, which is hereafter referred as the "all-dairy-products" model, is included because the dairy farmer programs now emphasize an "all-dairy" promotion strategy over product-specific campaigns. As in the first model, marketing activities in the second include generic advertising and non-advertising marketing activities. Advertising and non-advertising marketing strategies are included as two separate variables in the demand model. Unlike the first model, the marketing activities in the second model include activities for all dairy products (fluid and manufactured dairy products). This model provides a measure of the economic impact of all demand-enhancing, generic marketing activities by processors and farmers.

Analysis of Generic Fluid Milk Promotion

Per capita fluid milk consumption in the United States has been steadily declining for decades. Among the factors behind this decline are changes in U.S. demographics, changes in consumer preferences for fluid milk, how and where people consume food, changes in consumer income, changes in retail fluid milk prices, changes in advertising and marketing by producers of beverages that compete with fluid milk, and changes in generic fluid milk advertising and marketing. Figure 1 through 9 present a brief graphical overview of factors hypothesized to affect fluid milk consumption from 1995 through 2009. It is important to emphasize, however, that the decline in per capita fluid milk consumption has occurred over a significantly longer period of time than since 1995.

Figure 1 illustrates the declining trend in per capita fluid milk consumption[5] since 1995. From 1995 through 2009, annual per capita consumption declined by 13%. This translates into an average annual rate of decline of 0.9% per year. Annual per capita consumption actually increased slightly from 2005 to 2006, increasing from 183.8 pounds to 184.3 pounds, but declined from 184.3 to 180.2 from 2006 to 2009. From 2008 to 2009, the downward trend in per capita consumption stabilized somewhat with very little change from the previous year.

[5] All consumption data used in this study were adjusted for leap year.

Figure 1. Per capita fluid milk consumption.

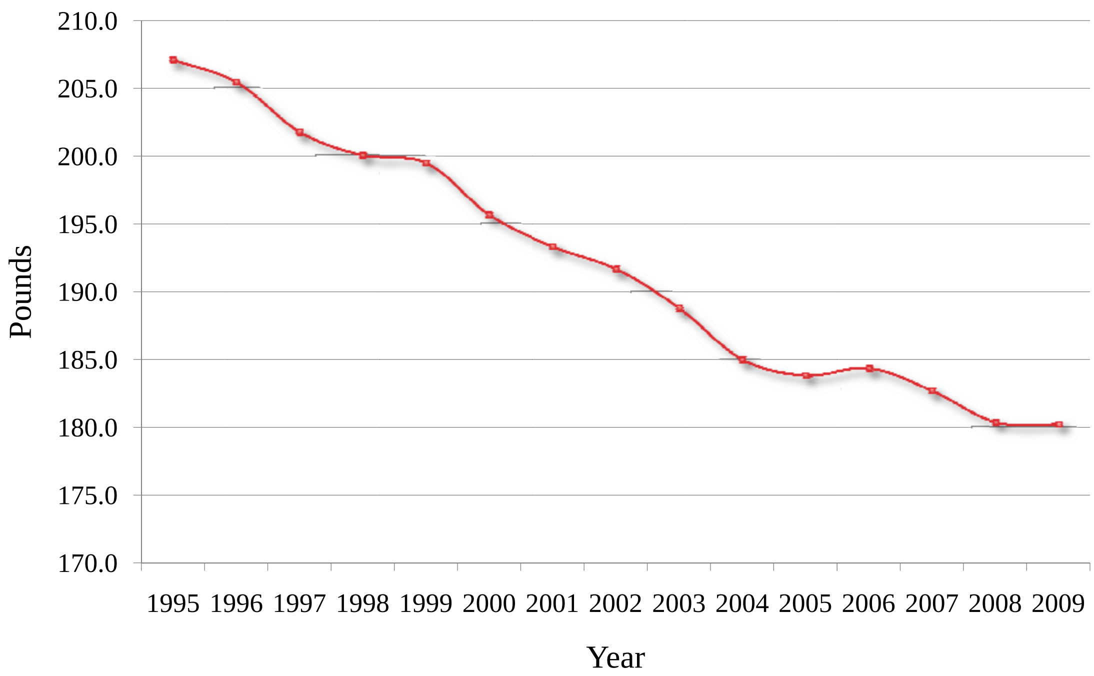
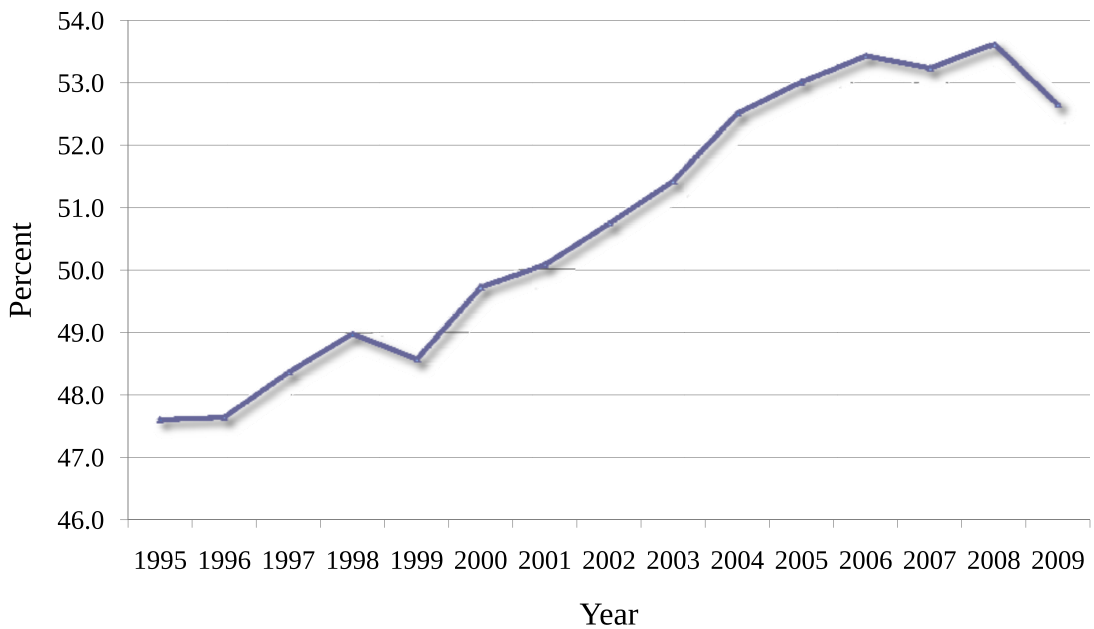


Figure 2. Food away from home expenditures as percent of total food expenditures.



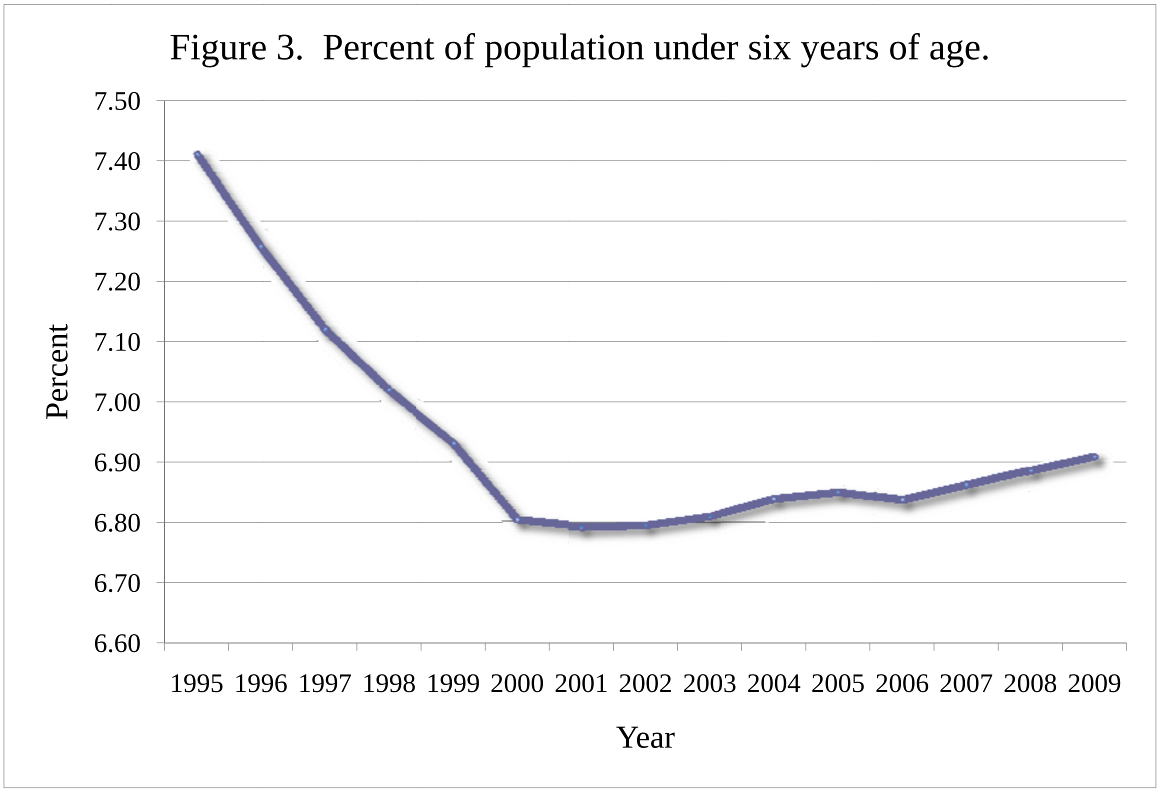


Figure 3. Percent of population under six years of age.
7.50
7.40
7.30
7.20
7.10
7.00
6.90
6.80
6.70
6.60
Percent
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Year

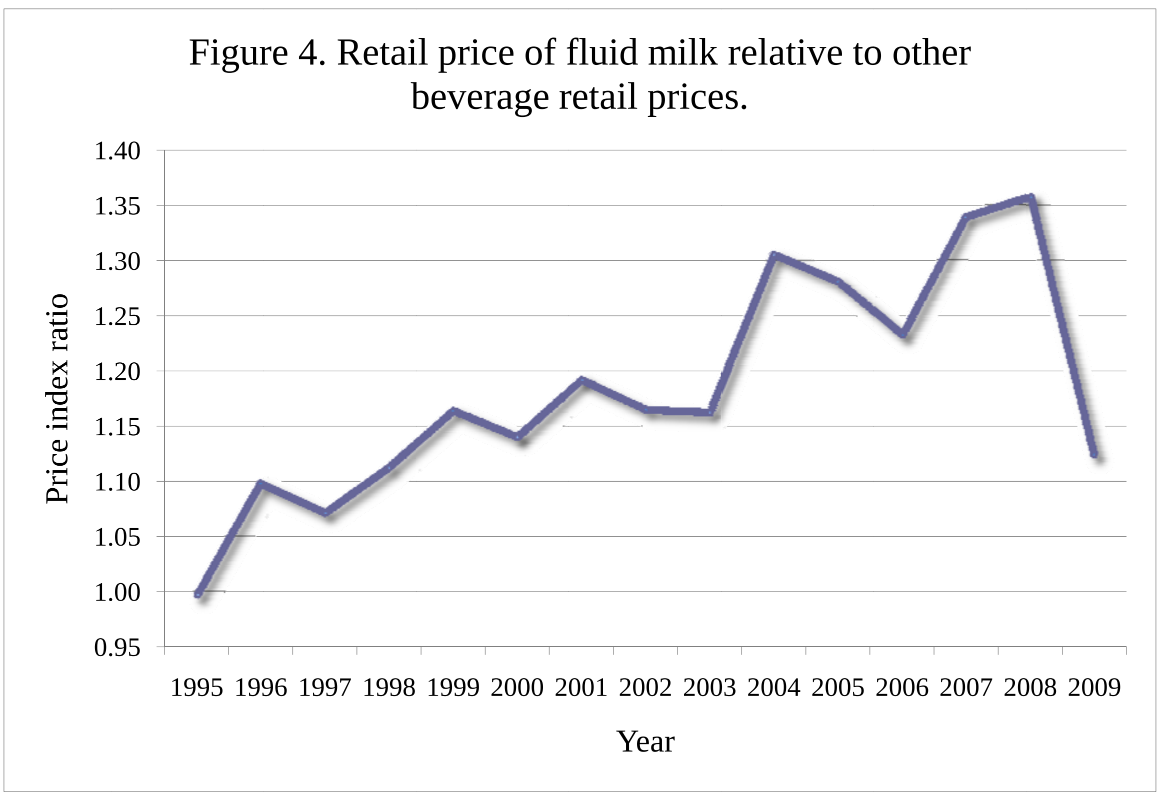


Figure 4. Retail price of fluid milk relative to other beverage retail prices.
1.40
1.35
1.30
1.25
1.20
1.15
1.10
1.05
1.00
0.95
Price index ratio
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Year

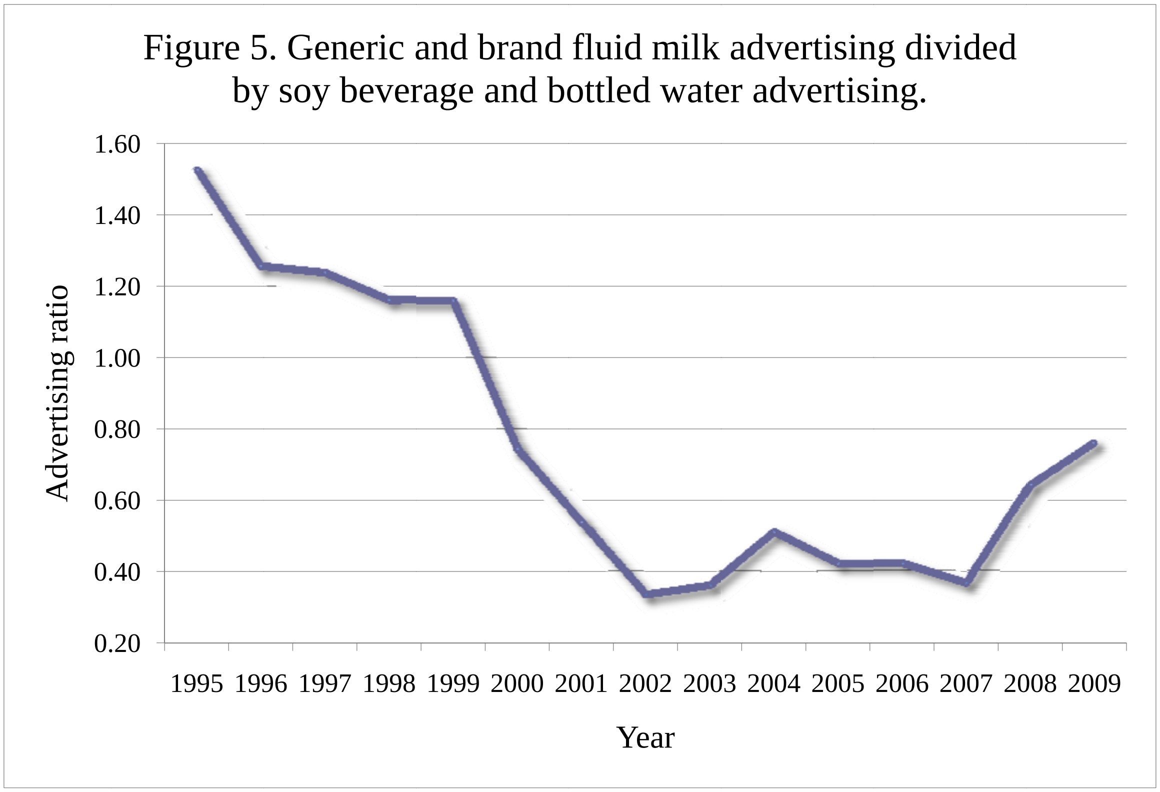


Figure 5. Generic and brand fluid milk advertising divided by soy beverage and bottled water advertising.
Advertising ratio
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Year

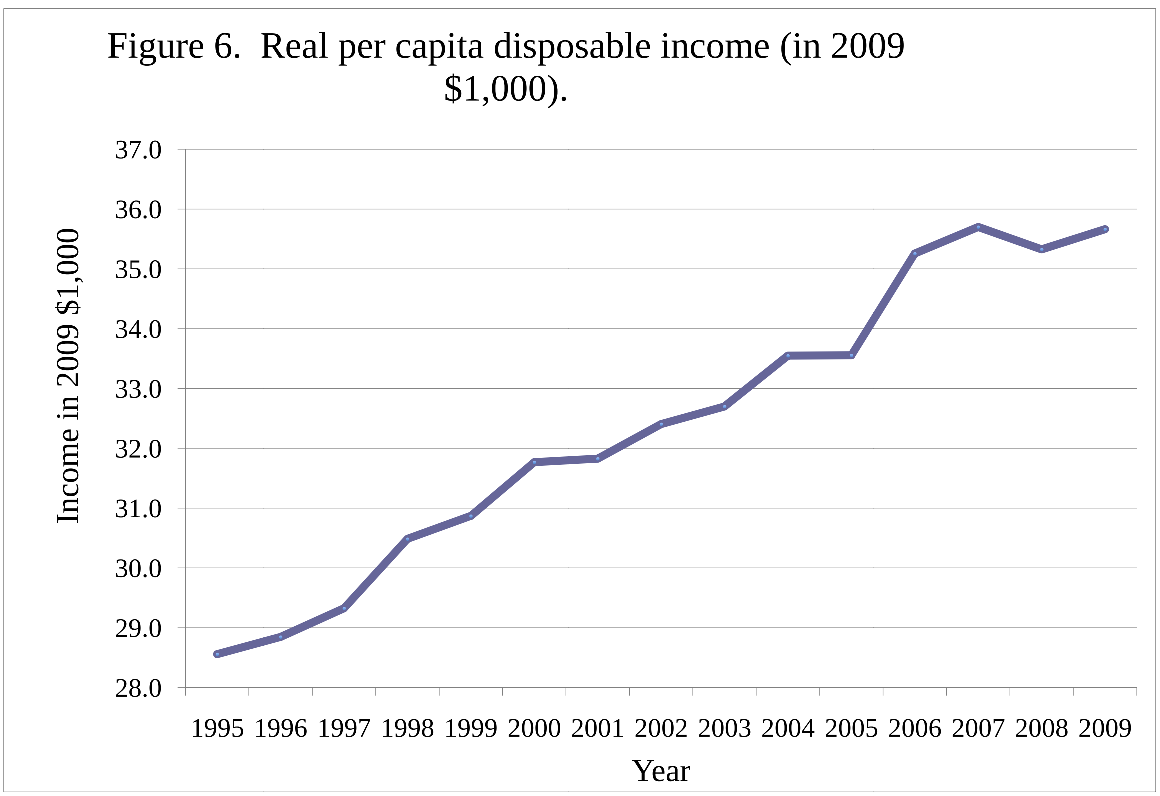


Figure 6. Real per capita disposable income (in 2009 $1,000).
Income in 2009 $1,000
37.0
36.0
35.0
34.0
33.0
32.0
31.0
30.0
29.0
28.0
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Year

Figure 7. Real fluid milk advertising expenditures (in 2009 $1,000) by Dairy Farmers and Milk Processors.

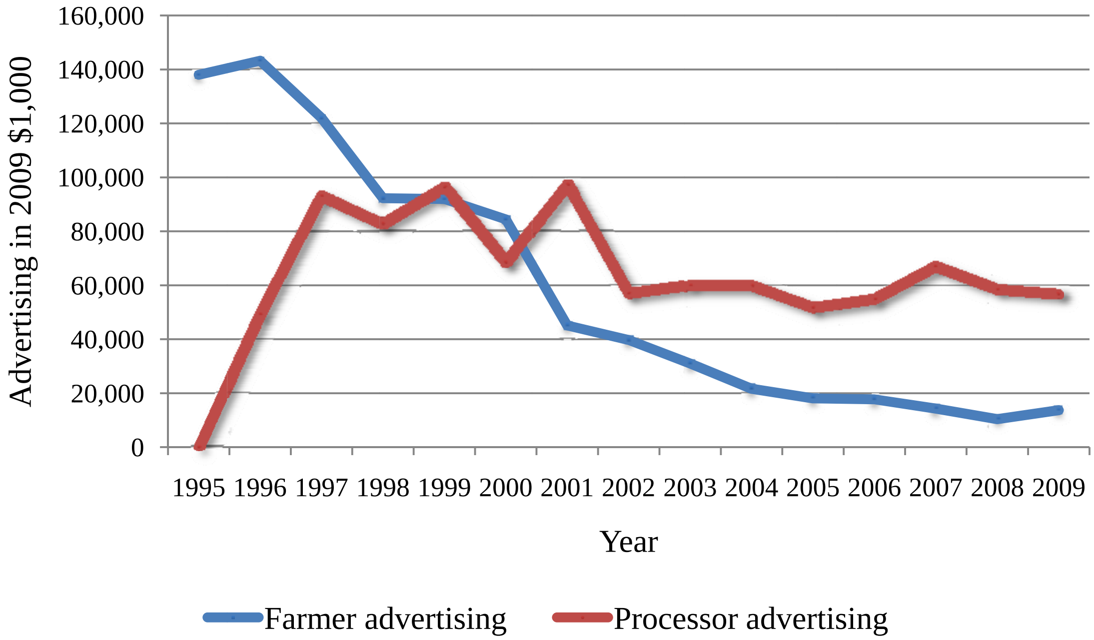
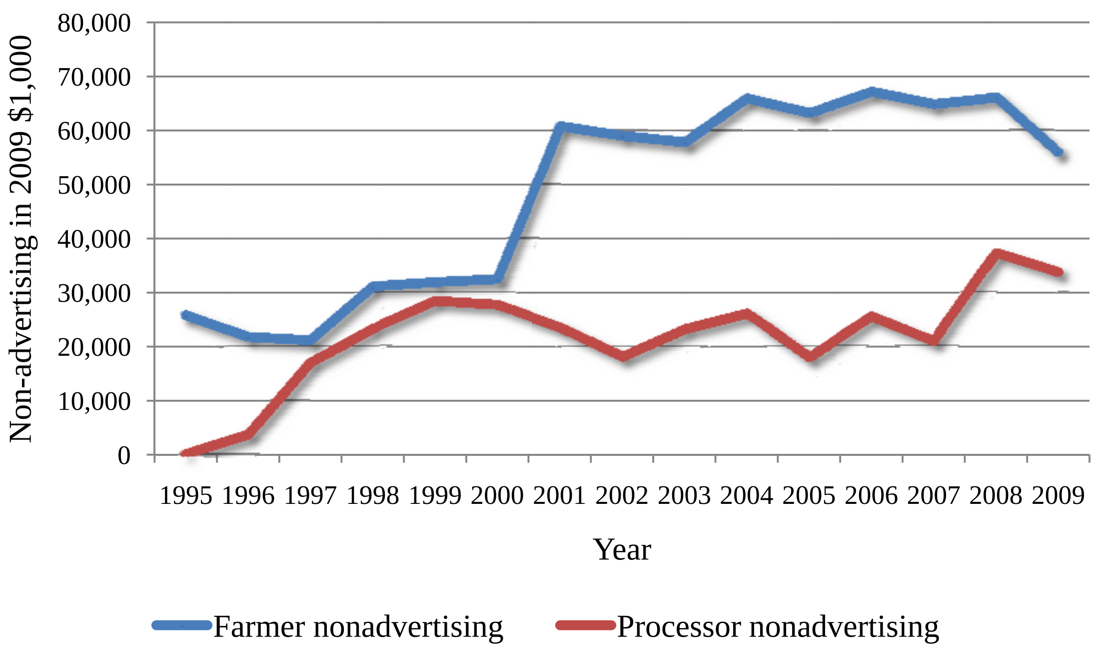
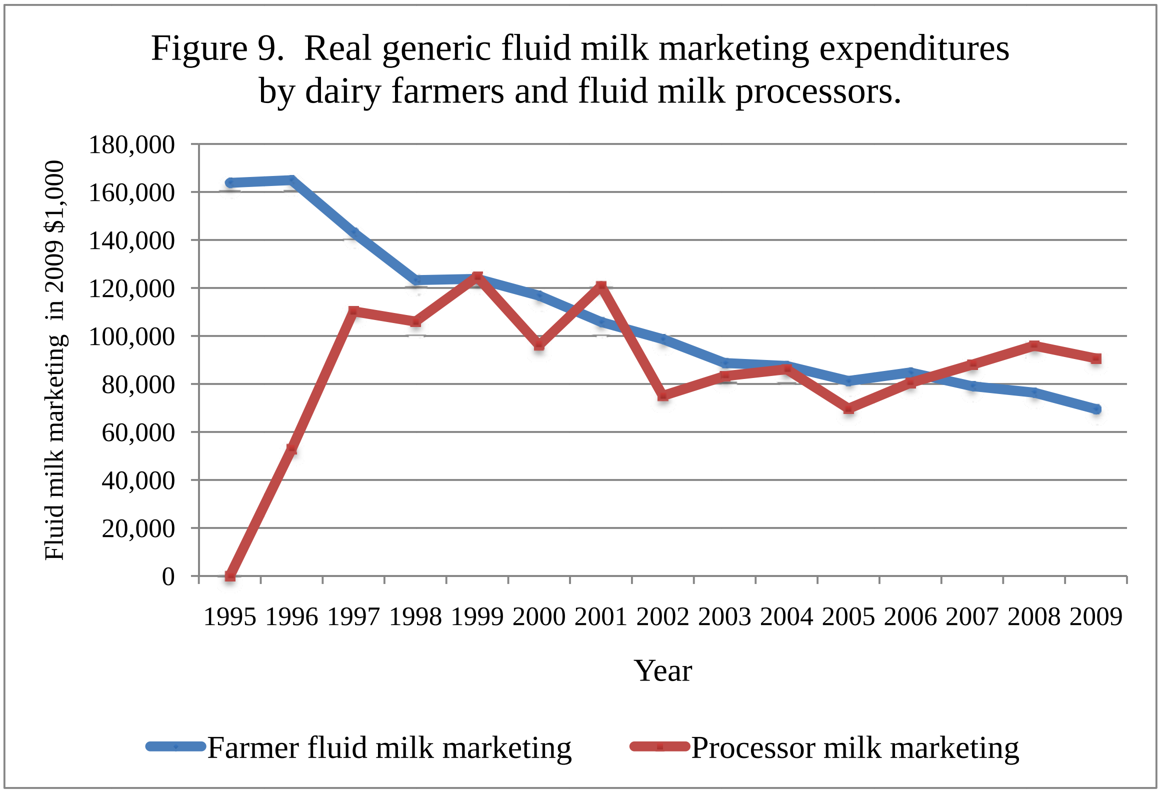


Figure 8. Real fluid milk non-advertising expenditures (in $1,000) by Dairy Farmers and Milk Processors





One potential cause of declining per capita fluid milk consumption over this time period may be the increasing trend in food consumed away from home. As people consume more food away from home, fluid milk consumption may be diminished by the lack of availability of many varieties of fluid milk products at the nation's eateries as well as the expanding availability of fluid milk substitutes. Many eating establishments carry only one type of fluid milk product, which causes some people who would normally drink fluid milk to consume a different beverage if the preferred fluid milk product is not available. Figure 2 illustrates the trend in expenditures on food consumed away from home as a percentage of total food expenditures. From 1995 through 2009, the annual average percentage of expenditures on food consumed away from home increased by 10.6%. While there were some ups and downs in the percentage of food consumed away from home over this period, the general trend is increasing from 1995 through 2006. From 1998-1999, there was a small dip in food away from home expenditures as a percent of total food expenditures and the decline in per capita fluid milk consumption lessoned considerably. From 2008 to 2009, food away from home expenditures as a percent of total food expenditures decreased by 1.9% due to the economic recession. It is evident from Figures 1 and 2 that per capita fluid milk consumption and eating away from home are negatively correlated. Thus the increase in food consumed away from home appears to be responsible for some of the decrease in per capita fluid milk consumption.

A second factor for declining per capita fluid milk consumption may be changes in U.S. demographics. One important change is the proportion of young children in the population, which is lower than it was in 1995. Since young children are one of the largest fluid milk-consuming cohorts, any decline in that cohort negatively impacts per capita fluid milk consumption. Figure 3 shows the percentage of the population that was under six years old from 1995 through 2009, a segment of the population that decreased 7.1% between 1995 and 2002. Therefore, there is a positive correlation between per capita fluid milk consumption and this age cohort—both have declined since 1995**.** Note that since 2000, there has actually been a marginal increase in this age cohort, but it is still below levels in the mid-1990s.

Between 1995 and 2008, the retail price of fluid milk products has generally been rising relative to the retail price of other nonalcoholic beverages. This pattern is displayed in Figure 4. While there have been some times over this period where retail fluid milk prices declined relative to other beverage prices, there is clearly an increasing trend over time making milk more expensive than other nonalcoholic beverages. However, this pattern significantly reversed itself in 2009, where the relative price ratio decreased 17.2%, which, by itself, had a positive effect on consumption. Over the entire period of 1995 through 2009, annual average fluid milk prices rose 12.7% relative to other beverages. These retail fluid milk price increases are likely responsible for some of the decline in per capita fluid milk consumption.

Fluid milk's loss of market share to other beverages also may be due to aggressive marketing by competing beverage producers. Indeed, both dairy farmers and fluid milk processors started generic marketing programs to combat competing marketing from other beverage producers. Figure 5 displays the combined real (i.e., inflation-adjusted) generic and brand fluid milk advertising expenditures divided by real bottled water plus soy beverage advertising, which are major competitors of fluid milk products. The general trend has been an erosion in the ratio of generic fluid milk advertising to competing beverage advertising. For example, in 1995, this ratio was 1.52, indicating that total generic and brand fluid milk advertising was 52 percent higher than the combined total advertising budgets for bottled water plus soy beverages. By 2009, this ratio fell 50 percent to 0.76. Hence, in terms of advertising, fluid milk has lost advertising market share to two of its main competitors, which likely had a negative impact on per capita milk consumption over this time period.

One factor that may have diminished some of the decline in per capita fluid milk consumption is the growth in real (inflation-adjusted) income over this period. Fluid milk is considered to be a "normal" good, which means that consumption increases as consumers' disposable incomes increase. Figure 6 illustrates the steady positive trend in real per capita income (in 2009 dollars) from 1995 through 2009. Since 1995, real per capita income has increased by 24.9%, however, there was no growth from 2007 to 2009.

Another factor that may have diminished some of the decline in per capita fluid milk consumption over part of this time period is generic marketing efforts by fluid milk processors and dairy farmers. The dairy-farmer checkoff program is the largest checkoff program in the United States in terms of revenue and the second largest program is the fluid milk processor program.

Figure 7 shows generic fluid milk advertising real expenditures (adjusted for inflation, in 2009 $1,000 dollars) by dairy farmers and fluid milk processors. Over this period, dairy farmers, primarily through their national organization Dairy Management, Inc., have significantly reduced their investment in generic fluid milk advertising, taking inflation into account. Real fluid milk advertising expenditures by dairy farmers have fallen from $138 million in 1995 to $13.7 million in 2009, a 90.1% decrease. Since the fluid milk processors had their first full year of MilkPEP in operation in 1997, their inflation-adjusted expenditures on fluid milk advertising have also declined from $93.3 million (1997) to $57.1 million in 2009, or 38.8 percent in real terms. Collectively, generic fluid milk advertising by both dairy farmers and fluid milk processors decreased by 69.4 percent in real terms.

Figure 8 shows generic fluid milk non-advertising marketing activities (in 2009 dollars) by dairy farmers and fluid milk processors. The trend in these expenditures have been the opposite of generic advertising. Dairy farmers have increased their annual expenditures of non-advertising marketing from almost $26 million in 1995 to $55.9 million in 2009, an increase of 116.4% in inflation-adjusted terms. Fluid milk processors increased their expenditures in this category from almost $17 million in 1997 to $33.6 million in 2009, a 119% increase in real terms. Collectively, generic fluid milk non-advertising marketing expenditures by both dairy farmers and fluid milk processors increased by 109.1% in real terms.

Figure 9 shows combined generic fluid milk marketing (advertising and non-advertising) activities (in 2009 dollars) by dairy farmers and fluid milk processors. The trend here has been negative for both farmers and processors. Dairy farmers have decreased their annual expenditures of combined fluid milk marketing from $163.8 million in 1995 to $69.6 million in 2009, a decrease of 57.5% in real (inflation-adjusted) terms. Some of this decline is due to inflation, which has eroded the purchasing power for marketing activities, and another reason for this decline has been a decision by dairy farmers to reduce expenditures on fluid milk marketing. Fluid milk processors decreased their combined generic marketing expenditures from $110.3 million in 1997 to $90.7 million in 2009, a 17.8% decrease in real terms. Almost all decline in fluid milk processor generic milk marketing has been due to inflation eroding the purchasing power of their marketing dollars. Collectively, generic fluid milk marketing expenditures by both dairy farmers and fluid milk processors decreased by 41.5% in real terms since 1995.

Fluid Milk Model Estimation

To more formally evaluate the relationship between per capita fluid milk consumption and factors hypothesized to influence that consumption, we used an econometric modeling approach. Because there are factors other than generic marketing by dairy farmers and fluid milk processors that influence the demand for fluid milk, we used this model to identify the effects of individual factors affecting demand. The following variables were included as factors influencing per capita fluid milk demand: the consumer price index (CPI) for fluid milk; the CPI for nonalcoholic beverages, which was used as a proxy for fluid milk substitutes; the percentage of the U.S. population less than six years old; per capita disposable income; variables to capture seasonality in fluid milk demand; expenditures on food consumed away from home as a percentage of total food expenditures; expenditures on competing beverage advertising (bottled-water and soy beverage advertising combined), expenditures on generic fluid milk advertising, and expenditures on generic fluid milk non-advertising marketing activities.[6] Since the goals of the farmer and processor marketing programs are the same with regards to fluid milk, all generic fluid milk advertising by both programs were aggregated into a single advertising variable, and all generic fluid milk non-advertising marketing by both programs were aggregated into a single non-advertising marketing variable.

The model was estimated with national quarterly data from 1995 through 2009. To account for the effects of inflation, prices and income were deflated by the CPI for all items. Generic fluid milk advertising and competing advertising expenditures were deflated by a media cost index computed from annual changes in advertising costs by media type. Generic fluid milk non-advertising marketing expenditures were deflated by the CPI for all items. Because advertising has a carry-over effect on demand, past fluid milk advertising expenditures also were included in the model as explanatory variables using a distributed-lag structure.[7] Similar procedures were used to capture this carry-over effect for competing advertising. The full estimation results of the fluid milk demand model are presented in Appendix Table A2.

The impacts of variables affecting demand can be represented with what economists call "elasticities." Elasticities measure the percentage change in per capita demand given a 1% change in one of the identified demand factors while holding all other factors constant. Table 1 provides average elasticities for the period 1995 through 2009 for model variables all of which have a statistically significant effect on consumption.[8] For example, a price elasticity of demand for fluid milk equal to –0.126 means that a 1% increase in the real (inflation-adjusted) retail fluid milk price decreases per capita fluid milk quantity demanded by 0.126%, holding all other demand factors constant.

The most important factors influencing per capita fluid milk demand are the proportion of food expenditures on food eaten away from home and demographic changes. While not as large in magnitude, retail fluid milk prices, income, expenditures on generic fluid milk advertising and non-advertising marketing efforts, and competing beverage advertising expenditures also impacted per capita fluid milk demand. Each factor is further discussed in detail.

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[6] As mentioned in the introduction, the advertising expenditures include media expenditures for television, radio, print, and outdoor advertising, while the non-advertising marketing expenditures included funds spent on fluid milk public relations, sales promotions, nutrition education, retail programs, and sponsorships by dairy farmers and fluid milk processors. Branded fluid milk advertising expenditures were also included in an earlier specification of the model, however, were subsequently omitted since they did not have a statistically significant impact on milk demand.

[7] Specifically, a second-degree polynomial lag structure was imposed. The demand model included current advertising expenditures and 11 quarters of lagged advertising expenditures to capture the carry-over effect of advertising. Similarly, competing advertising included current and nine quarters of lagged expenditures. Non-advertising marketing expenditures were lagged six quarters.

[8] The estimated model fit the data extremely well. Most variables were statistically significant at the 1% significance level or better. The adjusted goodness-of-fit measure indicated that the explanatory variables explained 98% of the variation in per capita fluid milk consumption. Various statistical diagnostics were performed and no statistical problems were found.

Table 1. Average Elasticity Values (1995-2009) for Factors Affecting the Per Capita Retail Demand for Fluid Milk.[a]

Demand factor	Elasticity
Percent of food away from home expenditures	-0.685**
Percent of population under six years of age	0.561**
Per capita income	0.130*
Retail fluid milk price	-0.126**
Bottled-water + soy beverage advertising expenditures	-0.013*
Generic fluid milk advertising expenditures	0.037**
Generic fluid milk non-advertising marketing expenditures	0.028*

[a] Example: A 1% increase in the retail price of fluid milk is estimated to reduce per capita sales of fluid milk by 0.126%. For more information on the data used, see Appendix Table A1.
* Statistically significant at the 10% significance level or less.
** Statistically significant at the 5% significance level or less.

The amount of food that is consumed away from home, measured in this model as per capita expenditures on food eaten away from home as a percentage of per capita expenditures on all food, has an elasticity of -0.685. This means that a 1% increase in the food consumed away from home would result in a 0.685% decrease in fluid milk demand when holding all other demand factors constant. As mentioned previously, this negative relationship may be due to the limited availability of fluid milk products and high availability of fluid milk substitutes at many eating establishments, which frequently offer only one or two types of fluid milk beverages. One can hypothesize that because of these limited choices, some people who would ordinarily choose fluid milk choose another beverage instead. This result suggests the need to target the retail food service industry in an effort to increase away from home consumption.

The percentage of the population under six years of age is also one of the most important factors affecting fluid milk consumption. This factor has an estimated elasticity of 0.561, which means that a 1% increase in this age cohort measure would result in a 0.561% increase in per capita fluid milk demand when holding all other demand factors constant. This result is consistent with previous studies, which show that one of the largest fluid milk-consuming segments of the population is young children. While this age cohort has declined since 1995, it has been slowly rising the last several years, which should have a mitigating influence on declining per capita fluid milk consumption.

Per capita disposable income has a positive and statistically significant impact on per capita fluid milk consumption. A 1% increase in real per capita income would result in a 0.13% increase in per capita fluid milk demand, holding all other demand factors constant. Similar to the price elasticity in magnitude, the income elasticity is consistent with the notion of fluid milk products as a staple commodity in the United States. With income up by 24.9% since 1995, this has lessened the decline in per capita fluid milk consumption. Holding all other factors constant, this 24.9% increase in real income increased per capita fluid milk consumption by 3.2% over this period.

Not surprisingly, the retail price of fluid milk has a negative and statistically significant impact on per capita demand. The results indicate that a 1% increase in the real retail price of fluid milk would result in a 0.126% decrease in per capita fluid milk quantity demanded. The magnitude of this elasticity is relatively small, which indicates that U.S. consumers' fluid milk purchasing behavior is relatively insensitive to changes in the retail price. This result, which is consistent with other studies, is likely due to the fact that fluid milk is generally regarded as a staple commodity in the United States.

Combined soy beverage and bottled water advertising also has a negative impact on fluid milk demand during the study period. The estimated fluid milk demand elasticity with respect to soy beverage and bottled-water advertising is -0.013, and statistically significant.

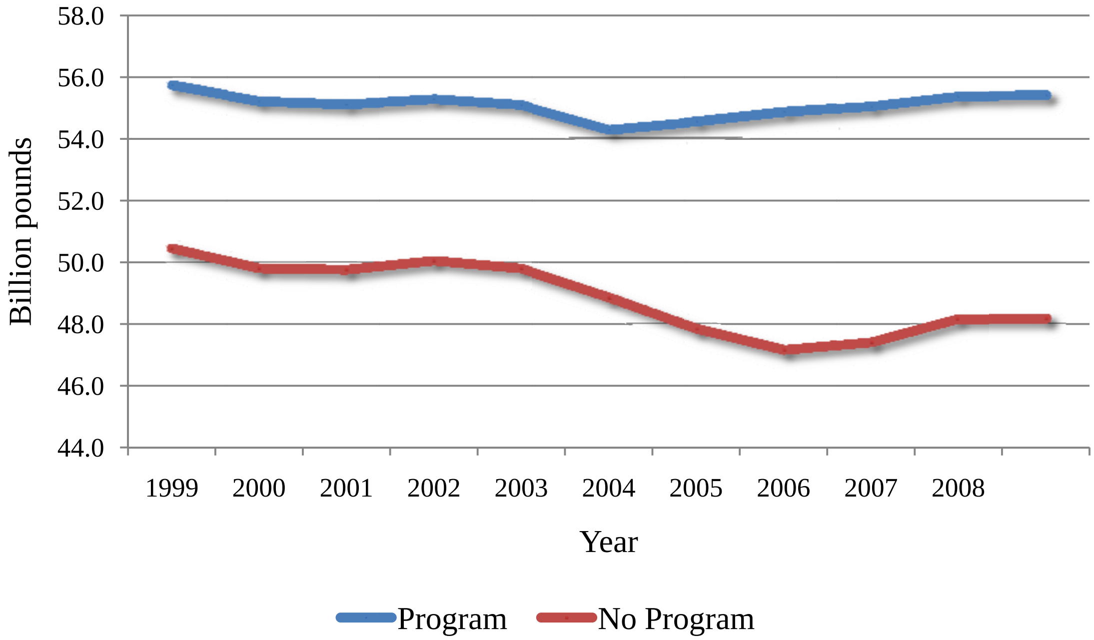
Finally, the generic fluid milk marketing activities conducted by fluid milk processors and dairy farmers have a positive and statistically significant impact on per capita fluid milk demand. The average advertising elasticity is computed to be 0.037 and is statistically significantly different from zero. Thus, a 1% increase in generic fluid milk advertising would increase per capita fluid milk consumption by 0.037% holding all other demand factors constant. The generic non-advertising marketing elasticity is computed to be 0.028 and is statistically significant. The advertising elasticity is found to be 1.3 times higher than the non-advertising elasticity and statistically different.

Fluid Milk Model Simulation and Benefit-Cost Analysis

To examine the impact of dairy farmer and fluid milk processor marketing on total consumption of fluid milk, the estimated demand equation was simulated for two scenarios for the period from 1999 through 2009: (1) a baseline scenario in which the combined fluid milk marketing (advertising and non-advertising) expenditures were equal to actual marketing expenditures under the two programs, and (2) a no-national-Dairy-Program, no-Fluid-Milk-Processor-Program scenario in which there was no fluid milk-processor-sponsored marketing and dairy-farmer-sponsored fluid milk marketing was reduced to 42% of actual levels to reflect the difference in assessment before the national program was enacted. A comparison of these two scenarios provided a measure of the impact of the national Dairy and Fluid Milk Programs.

Figure 10 displays the simulation results for annual fluid milk consumption for the two scenarios. These marketing activities were responsible for creating an additional 6.23 billion pounds more milk consumption each year on average. Put differently, had there not been generic fluid milk marketing conducted by the two national programs, fluid milk consumption would have been 11.3% less than it actually was over this time period. Hence, the bottom line is that the fluid milk marketing efforts by dairy farmers and fluid milk processors combined have had a positive and statistically significant impact that is partially mitigating declines in per capita fluid milk consumption.

Figure 10. Simulated milk consumption with and without generic fluid milk marketing.



One way to measure whether the benefits of a program outweigh the cost is to compute a benefit-cost ratio. A BCR can be computed as the change in net revenue[9] due to generic dairy marketing divided by the cost of the checkoff program. To compute the BCR for fluid milk processors' program,[10] the estimated demand equation was simulated for two scenarios for the period from 1999 through 2009: (1) a baseline scenario in which the combined fluid milk marketing (advertising and non-advertising) expenditures were equal to actual marketing expenditures under the two programs, and (2) a no-MilkPEP scenario, in which there was no fluid milk-processor-sponsored marketing, but dairy farmer fluid milk marketing expenditures were set at historical levels. A BCR for the fluid milk processor program can be computed on the basis of the difference in market conditions between these two scenarios.

To estimate the BCR, an estimate of the supply response by fluid milk processors and a retail-processor margin equation are necessary in addition to the fluid milk demand equation. Using quarterly data from 1995 through 2009, a supply function for fluid milk processors was as a function of fluid milk supply in the previous quarter, inflation-adjusted processor fluid price, inflation-adjusted Class I price, and a trend term. The econometric results for the processor

[9] "Net revenue" is defined as the aggregate gain in total fluid milk processor revenue from price and demand enhancements due to generic fluid milk advertising and non-advertising less the increase in supply costs for the additional milk marketed by fluid milk processors. Economists refer to this notion of net revenue as "producer surplus."

[10] A separate BCR is computed for the dairy farmers' program in the next section.

supply function and retail-processor margin equation are presented in Appendix Tables A3 and A4, respectively. The estimated long-run own price elasticity of supply was computed to be 0.12, i.e., a 1% increase in the processor price results in a 0.12% increase in quantity supplied of fluid milk. In addition, a retail-processor margin equation was estimated by regressing the retail price index on the wholesale processor price and a trend term. The three equations, retail demand equation, processor supply equation, and the margin equation were used to simulate the processor market impacts of the Fluid Milk Program.

Table 2 presents the average quarterly impacts and BCRs (from 1999 to 2009) for the fluid milk processor program. MilkPEP generic marketing had a positive impact on the price fluid milk processors received over this period. The average increase in price from 1999 to 2009 was 4.3%. In other words, had there not been any marketing by MilkPEP, the average fluid milk processors' price would have been 4.3% lower from 1999 to 2009 than it actually was. The increase in overall milk consumption due to MilkPEP (not the dairy farmers' marketing) was 4.8%.

Table 2. Average Market Impacts of Fluid Processor Generic Marketing Program, 1999-2009.

Item	
Change in processor price (percent)	4.3
Change in milk consumption	4.8
Change in producer surplus ($ million per year)	932
Change in marketing costs ($ million per year)	105
Benefit-cost ratio	8.88
Lower bound of 90% confidence interval for BCR	1.79

MilkPEP marketing efforts had a positive impact on producer surplus over this period as well. The average increase in producer surplus from 1999 to 2009 was $932 million per year. In other words, had there not been any MilkPEP marketing, average fluid milk processor net revenue would have been $932 million per year lower from 1999 to 2009 than it actually was.

How does the gain in producer surplus compare with the costs of the fluid milk processors' program? To answer the question, an average benefit-cost ratio was computed. A BCR greater than 1.0 implies that the total benefits of the Fluid Program exceed the costs. The average BCR from 1999 to 2009 was 8.88. This implies that, on average over the period 1999-2009, the benefits of MilkPEP marketing programs have been 8.88 times greater than the costs, i.e., every dollar invested in MilkPEP marketing yielded an additional $8.88 in industry net revenue.

To make allowance for the error inherent in any statistical estimation, a 90% confidence interval was calculated for the average BCR, providing a lower for the average BCR. One can be 90% "confident" that the true average BCR lies within those bounds. The estimated lower bound for the average BCR was 1.79. Since this lower bounds is above 1.0, it is reasonable to conclude that these confidence intervals give credence to the finding that the benefits of the Fluid Program's marketing activities have been greater than the cost of the programs

Questions often arise with respect to the accuracy of these BCR estimates. BCRs for commodity promotion programs are generally found to be large because marketing expenditures in relation to product value are small and, as such, only a small demand effect is needed to generate large positive returns. For example, generic milk marketing expenditures by fluid milk processors is a mere 0.8% of the recent average annual value of processor milk sales. The marketing activities resulted in modest gains in the quantity of milk products and a positive effect on processor prices, resulting in large positive net revenue from the marketing investment.

Analysis of All-Dairy Products Generic Marketing

Figures 11 through 16 provide a brief graphical overview of changes in per capita domestic commercial disappearance of all dairy products and factors hypothesized to affect it from 1995 through 2009. Figures 11 and 12 display the per capita domestic commercial disappearance of all dairy products since 1995 on a solids-not-fat and fat basis, respectively. The trends in per capita consumption are completely different for the fat basis measure compared with the solids-not-fat based measure. On a fat basis, per capita consumption has increased by 8.5% over this period, although it actually decreased for the first time in four years by 1.9% from 2008 to 2009. On a solids-not-fat basis, per capita consumption has actually decreased by 1.5% since 1995.

An important factor influencing per capita commercial disappearance of all dairy products is the retail price of dairy products. Figure 13 displays the Consumer Price Index for all dairy products relative to the Consumer Price Index for all items. This figure indicates that there have been both ups and downs for retail dairy prices relative to all prices in the economy. For instance, the price of all dairy products declined in the most recent year by 6%. However, the general trend since 1995 has been modestly upwards with dairy product prices increasing by 5.4%. The fact that dairy products have become more expensive relative to everything else consumers buy has had a negative impact on dairy consumption.

A factor that had a positive impact on per capita commercial disappearance of all dairy products is the growth in real (inflation-adjusted) income over this period. All dairy products are considered to be "normal goods, which means that consumption increases as consumers' disposable incomes increase. Figure 6 illustrates the steady positive trend in real per capita income (in 2009 dollars) from 1995 through 2009. Since 1995, real per capita income has increased by 24.9%, although it leveled off in 2007, fell in 2008, and showed only weak growth in 2009.

Another factor that may have contributed to increasing per capita domestic commercial disappearance of all dairy products over part of this time period is generic marketing efforts by fluid milk processors and dairy farmers. Figure 14 shows generic fluid milk and dairy product advertising real expenditures (in 2009 dollars) by dairy farmers and fluid milk processors. Real (inflation-adjusted) dairy farmer advertising expenditures have fallen from $251.4 million in 1995 to $69.2 million in 2009, a 68.7% decrease. Since the fluid milk processors had their first full year of MilkPEP in operation in 1997, their expenditures on fluid milk advertising have also

Figure 11. Domestic per capita commercial disappearance of fluid milk and dairy products (milk solids-not-fat basis).

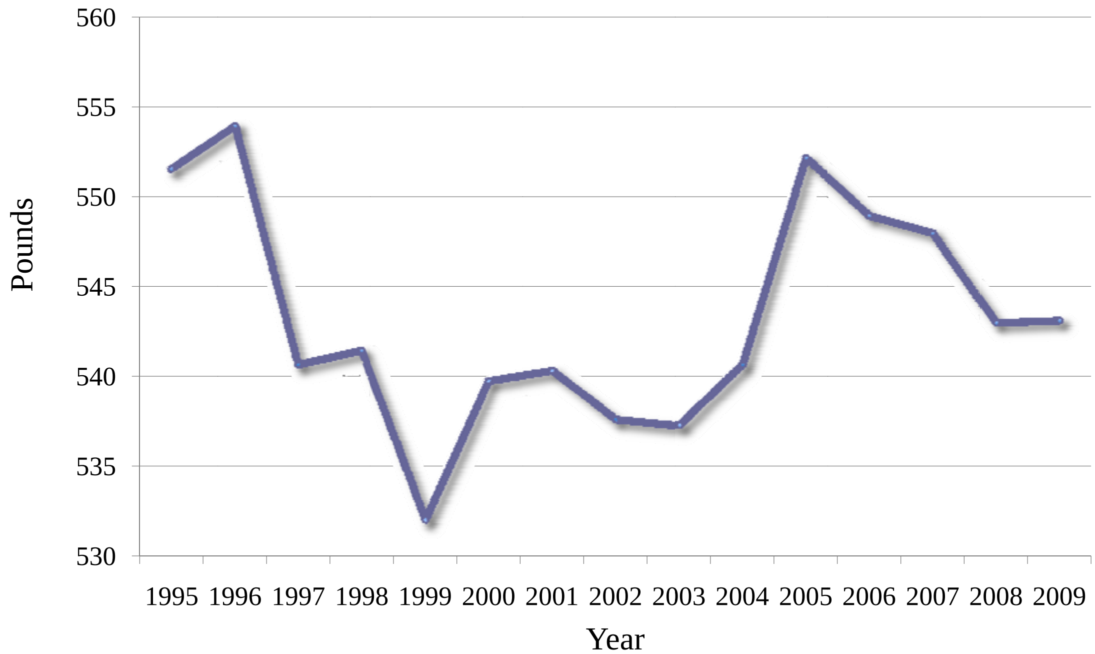


Figure 12. Domestic per capita commercial disappearance of fluid milk and dairy products (fat basis).

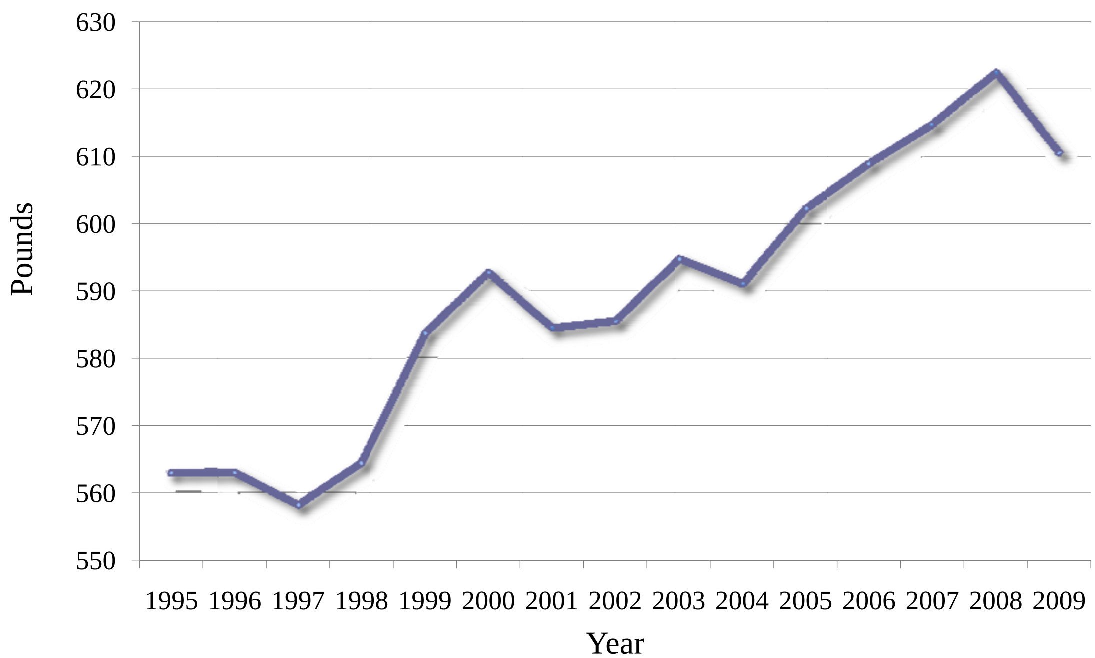


Figure 13. Retail price of dairy products relative to all other retail prices.

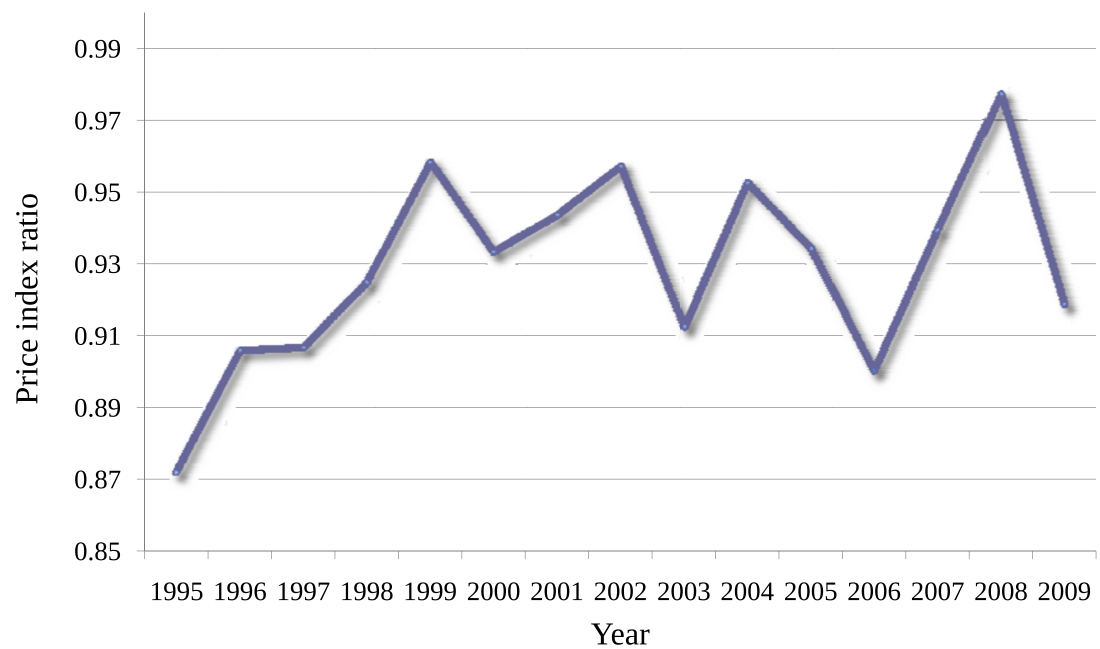


Figure 14. Real generic dairy advertising by dairy farmers and fluid milk processors.

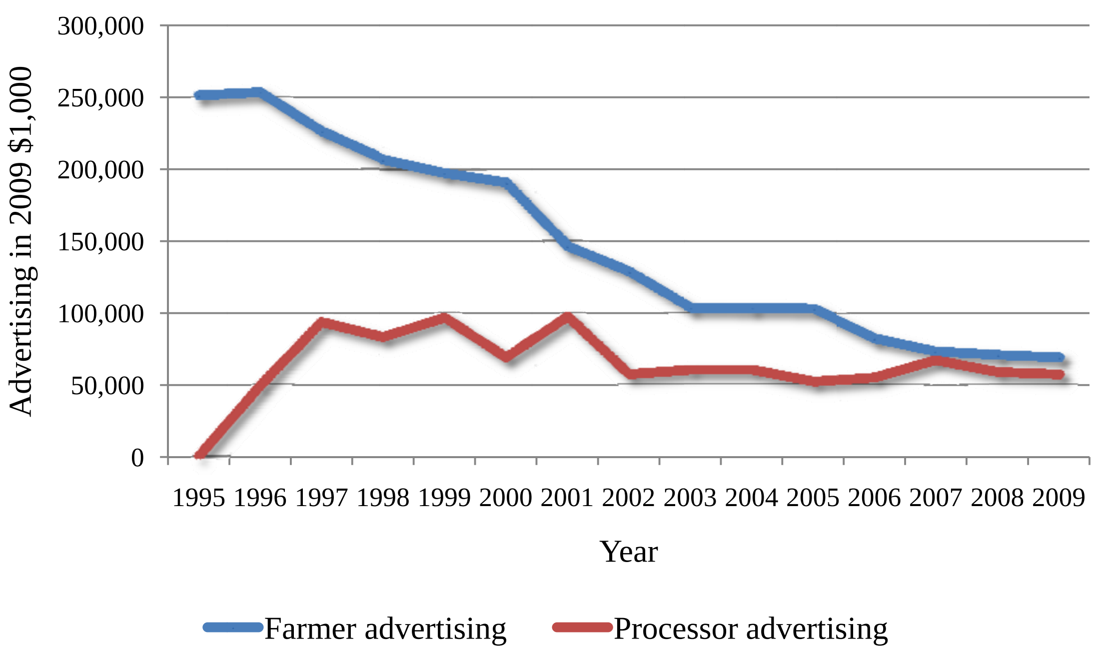


Figure 15. Real generic dairy non-advertising by dairy farmers and fluid milk processors.

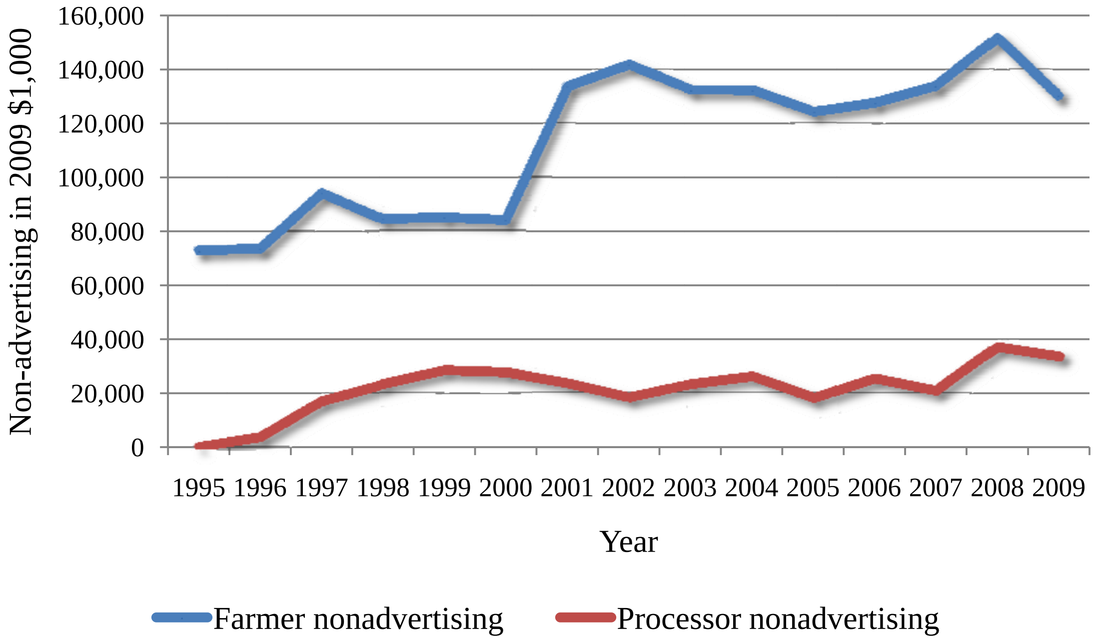
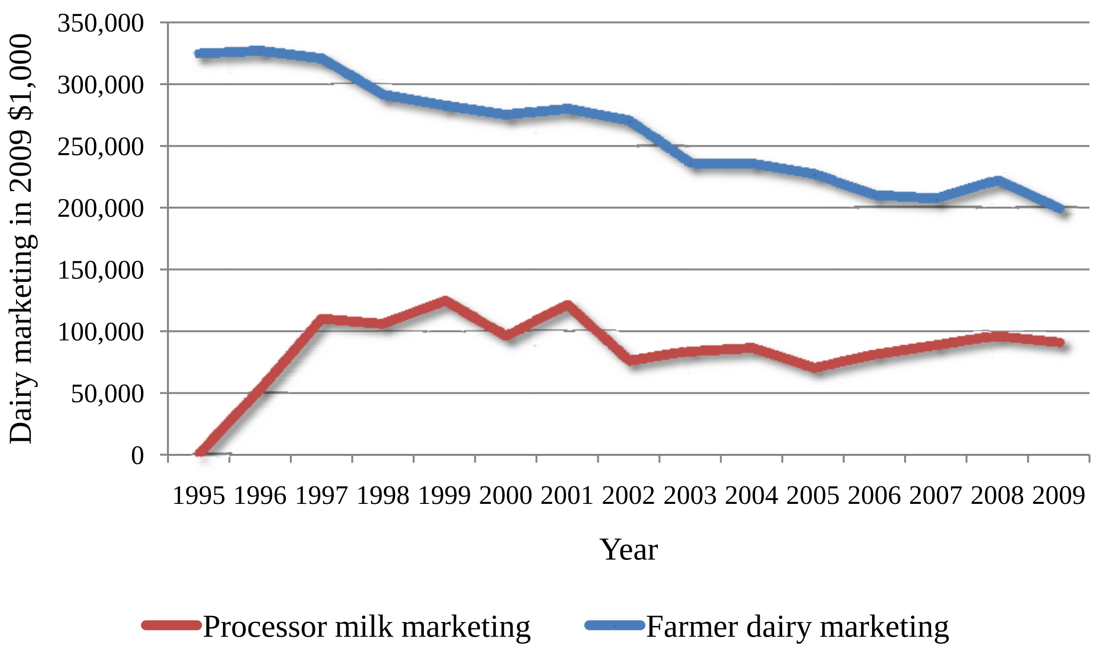


Figure 16. Real generic dairy marketing expenditures by dairy farmers and fluid milk processors.



declined from $93.3 million (1997) to $57.1 million in 2009, or 38.8 percent. However, since 2002, spending by fluid milk processors has been relatively stable, averaging $58.4 million per year. Collectively, generic dairy advertising by both dairy farmers and fluid milk processors decreased by 63.4%.

Figure 15 shows generic dairy non-advertising marketing activities (in 2009 dollars) by dairy farmers and fluid milk processors. The trend in these expenditures has been the opposite of generic advertising. Dairy farmers have increased their annual expenditures of non-advertising dairy marketing from $72.9 million in 1995 to $130 million in 2009, an increase of 78.3%. Fluid milk processors increased their expenditures in this category from almost $17 million in 1997 to $33.6 million in 2009, a 119% increase. Collectively, generic fluid milk non-advertising marketing expenditures by both dairy farmers and fluid milk processors increased by 82%.

Figure 16 shows combined generic dairy marketing (advertising and non-advertising) activities (in 2009 dollars) by dairy farmers and fluid milk processors. The trend here has been negative for both farmers and processors. Annual expenditures of combined dairy marketing by dairy farmers decreased from $324.3 million in 1995 to $199.1 million in 2009, a decrease of 37.9%. Annual combined generic marketing expenditures by fluid milk processors decreased from $110.3 million in 1997 to $90.7 million in 2009, a 17.8% decrease. Collectively, generic dairy and fluid milk marketing expenditures by both dairy farmers and fluid milk processors decreased by 41.5%.

Dairy Model Estimation

To examine the overall impact of the fluid-processor and dairy-farmer programs on overall dairy demand, we estimated a combined fluid milk/dairy product demand model that included all generic dairy advertising activities as one demand determinant, and all non-advertising dairy marketing activities as another demand determinant. Expenditures for the following advertising activities were aggregated into one variable assumed to impact the all-dairy product demand model: television, radio, print, and outdoor media advertising for fluid milk and manufactured dairy products by dairy farmers and fluid milk processors. Expenditures for the following non-advertising, marketing activities were aggregated into one variable: retail programs, school marketing, food service and manufacturing programs, integrated communications, public relations, sales promotions, nutrition education, retail programs, and sponsorships conducted by fluid milk processors and dairy farmers. In addition, the following variables were included as factors influencing per capita all-dairy products demand: the CPI for all-dairy products, per capita disposable income, and variables to capture seasonality in dairy product demand. Similar to the fluid milk demand model, the all-dairy products demand model was estimated on a per capita basis to control for the influence of population increases on demand.

The model was estimated with national quarterly data for 1995 through 2009. To account for the impact of inflation, all prices and income variables were deflated by the CPI for all items. Generic fluid milk and cheese advertising expenditures were deflated by a weighted average media cost index (television, radio, print, and outdoor. Generic fluid milk and cheese non-advertising marketing expenditures were deflated by the CPI for all items. Generic advertising expenditures were deflated by the media cost index. To correct for heterogeneity in the error term, a first difference procedure was used. The results for the fat and skim models are presented in Appendix Tables A5 and A6.

Table 3 provides elasticities for the all-dairy product demand models on a fat and non-fat solids basis.[12] All variables were statistically significant. The results indicate that a 1% increase in the real price for dairy products would result in a 0.288% and 0.218% decrease in per capita all-dairy product demand on a non-fat and fat basis, respectively, holding all other variables constant. The average income elasticity for 1995 through 2009 was 0.170 (non-fat basis) and 0.952 (fat basis); in other words, a 1% increase in real per capita income would result in a 0.17% (non-fat) and 0.952% (fat) increase in per capita demand for all-dairy products holding all other variables constant.

The major interest here is the advertising and non-advertising marketing elasticities. The average advertising elasticity for this period on a non-fat and fat basis was 0.036 and 0.056, respectively; a 1% increase in media advertising expenditures would increase per capita all-dairy product demand by 0.036% (non-fat basis) and 0.056% (fat basis). The average non-advertising marketing elasticity for this period was 0.016 (non-fat) and 0.017 (fat), respectively; a 1% increase in media advertising expenditures would increase per capita all-dairy product demand by 0.016% (non-fat) and 0.017% (fat). The advertising elasticity in both models was found to be statistically larger than the non-advertising elasticity in both models: 2.25 times higher on a non-fat basis, and 3.29 times higher on a fat basis.

Table 3. Average Elasticity Values (1995–2009) for Factors Affecting Per Capita All-dairy Products Demand.

Demand Factor	**Nonfat-solids basis Elasticity**	**Fat basis Elasticity**
CPI for all-dairy products	-0.288**	-0.218*
Per capita income	0.170*	0.952**
Generic dairy advertising expenditures	0.036**	0.056*
Generic dairy non-advertising marketing expendidtures	0.016**	0.017**

* Statistically significant at the 10% level or better.
** Statistically significant at the 1% level or better.

[12] The two models are for milk equivalent, calculated on a fat solids basis and non-fat solids basis. Not to be confused with models for nonfat solids and fat solids.

Dairy Farmer Benefit-Cost Analysis

It should be pointed out that Dairy Management, Inc. (DMI) has made a significant shift in their marketing programs in the past four years. Previously, the bulk of DMI's marketing expenditures were allocated primarily to media advertising and, to a lesser extent, non-advertising marketing activities. In 2009, these traditional marketing activities (advertising and non-advertising marketing) accounted for only $29 million of DMI's marketing budget. The same is not true for the Qualified Programs, which continue to spend the majority of their marketing budgets on advertising and shorter-term non-advertising marketing activities. The remaining marketing budget of DMI was spent on their new business plan of strategic business development with dairy processors and manufacturers, which is not included in the analysis that follows. DMI has stated that they do not expect any short-term benefits of these programs for 2009, but rather expect to see these benefits to accrue in the longer-term. Hence, it is important to note that the benefit-cost ratios that follow only include the advertising and shorter-term, non-advertising marketing activities by dairy farmers, and do not include DMI's newer business development plan.

We calculated BCRs on both a milk-fat and non-fat solids basis by simulating two scenarios: (1) a baseline scenario in which combined marketing (advertising and non-advertising marketing) levels were equal to actual marketing expenditures under the two programs, and (2) a no-national-Dairy-Program scenario in which there was fluid milk-processor-sponsored marketing, but dairy-farmer-sponsored marketing was reduced to 42% of actual levels to reflect the difference in assessment before and after the national program was enacted. A comparison of these two scenarios provided a measure of the impact of the Dairy Program. The benefits of the Dairy Program were calculated as the change in dairy farmer producer surplus (i.e., net revenue) due to demand enhancement from all marketing activities under the Dairy Program (i.e., the difference in producer surplus between scenarios 1 and 2). The demand enhancement reflects increases in quantity and price as a result of the dairy farmers' marketing program. The costs of the Dairy Program were calculated as the difference in total assessment revenue before and after the national program was enacted (after netting out the expenditures on the DMI's new business plan, which was not included in this analysis). These scenarios were run for the time period 1998 through 2009 for the two milk-equivalent models: milk-fat and non-fat.

As was the case for the Fluid Program, an own price elasticity of farm supply was necessary to compute the BCR and consequently a farm milk supply equation was estimated. Using quarterly data from 1995 through 2009, a supply function for dairy farmers was estimated and the long-run own price elasticity of supply was computed to be 1.01, i.e., a 1% increase in the all milk price results in a 1.3% increase in quantity supplied of farm milk. This estimate was used as the base case for computing the BCR. The full econometric results for the farm supply equation are presented in Appendix Table A7.

Table 4 presents the average quarterly impacts and BCR (from 1999 to 2009) for the dairy farmer program. The average all milk price from 1999 through 2009 was $14.60 per hundredweight. In the counter-factual no-national-Dairy-Program scenario for the nonfat-solids model, the average all milk price was $14.33 per hundredweight, which is 27 cents lower. Thus, had there been no national Dairy Program over this period, the price farmers receive for their milk would have been 1.86% lower than it actually was. The total quantity of milk demand was estimated to be 2.05% higher, on a nonfat-solids basis as a result of the Dairy Program. In the counter-factual no-national-Dairy-Program scenario for the milk-fat model, the average all milk price was $14.19 per hundredweight, which is 41 cents lower. Thus, had there been no national Dairy Program over this period, the price farmers receive for their milk would have been 2.81% lower than it actually was. The total quantity of milk demand was estimated to be 2.86% higher, on a fat basis as a result of the Dairy Program.

The results show that the average BCR for the Dairy Program was 6.20 (non-fat solids basis) and 9.85 (milk-fat basis) from 1999 through 2009. This means that each dollar invested in generic dairy marketing by dairy farmers during the period would return between $6.20 and $9.85, on average, in net revenue to farmers. The level of the BCR suggests that dairy farmer expenditures on advertising and non-advertising promotions have been a successful investment.

In another interpretation of the BCR, the increase in real (2009 dollars) generic dairy marketing expenditures resulting from the Dairy Program costs dairy producers an additional $151.7 million per year on average from 1999 through 2009. The additional generic dairy marketing resulted in higher demand, prices, and net revenue for dairy producers nationwide. Based on the simulations conducted, we estimate that the average annual increase in producer surplus (reflecting changes in both revenues and costs) due to the additional generic marketing under the Dairy Program was $940 million on a non-fat basis and $1.494 billion on a fat basis. Dividing $840 (or $1,494) million by the additional Dairy Program cost of $151.7 million results in the estimated benefit-cost ratios of 6.20 (non-fat basis) and 9.85 (fat basis).

Table 4. Average Market Impacts of Dairy Farmer Generic Marketing Program, 1999-2009.

Item	**Non-fat basis**	**Fat basis**
Change in all milk price (percent)	1.86%	2.81%
Change in total milk marketings	2.05%	2.86%
Change in producer surplus ($ million per year)	940	1,494
Change in marketing costs ($ million per year)	151.7	151.7
Benefit-cost ratio	6.20	9.85
Lower bound of 90% confidence interval for BCR	3.84	1.18

To make allowance for the error inherent in any statistical estimation, a 90% confidence interval was calculated for the average BCR, providing a lower for the average BCR. One can be 90% “confident” that the true average BCR lies within those bounds. The estimated lower bound for the average BCR in the non-fat and fat model is 3.84 and 1.18, respectively. Since both lower bounds are above 1.0, it is reasonable to conclude that these confidence intervals give credence to the finding that the benefits of the Dairy Program’s marketing activities have been greater than the cost of the programs.

The change in generic dairy marketing expenditures noted previously is a mere 0.60% of the recent average annual value of farm milk marketings from 1999 through 2009 ($24.46 billion).

The marketing activities resulted in modest gains in the quantity of dairy products and a positive effect on milk prices, resulting in large positive net revenue from the marketing investment.

In addition to computing a BCR for the overall marketing efforts of dairy farmers, an average BCR was also calculated for generic advertising and non-advertising activities by dairy farmers. Similar to the elasticity results, the average BCR for advertising was significantly higher than for non-advertising. The average BCR for generic advertising in the non-fat model was 8.56 compared with 6.60 for non-advertising marketing activities, and this difference was statistically significant at the 1% level. The average BCR for generic advertising in the fat model was 15.06 compared with 8.41 for non-advertising marketing activities, and this difference was statistically significant at the 1% level. Hence, dairy farmers are receiving a higher return from their generic advertising activities than the non-advertising marketing activities.

APPENDIX TABLES

Table A1. Description of Variables Used in Econometric Models.[a]

Variable	Description	Units	Mean[b]
	Consumption/Production Variables		
RFDPC	Annual retail fluid demand per capita	lbs	192.1 (9.89)
RDDPCNF	Annual retail all-dairy product demand per capita on a non-fat basis	lbs	554.6 (11.83)
RDDPCF	Annual retail all-dairy product demand per capita on a fat basis	lbs	589.3 (26.44)
MILK	Milk marketings	bil lbs	169.0 (12.4)
	Prices and Price Indices		
RFPCPI	Consumer retail price index for fresh milk and cream deflated by consumer price index for nonalcoholic beverages (1982–84=1)	#	1.18 (0.11)
RFP	Consumer retail price index for fresh milk and cream (1982-84=1)	#	1.68 (0.24)
RDPCPI	Consumer retail price index for all-dairy products deflated by consumer retail price index for all items (1982–84=1)	#	0.93 (0.03)
RBEVCPI	Consumer retail price index for non-alcoholic beverages (1982–84=1)	#	1.42 (0.10)
CPIALL	Consumer retail price index for all items (2009=1)	#	0.84 (0.09)
WFP	Wholesale fluid milk price index (1982-84=1)	#	1.58 (0.18)
P1	Class I milk price	$/cwt	16.10 (2.30)
AMP	All milk price	$/cwt	14.47 (2.14)
PRATION	Price of dairy ration	$/cwt	5.54 (1.45)
	Demographic and Income Variables		
INCPC	Annual per capita disposable income, deflated by the consumer retail price index for all items (2007=1)	$	32,410 (2,410)
AGE5	Percent of the population under age six	%	6.94 (0.18)
FAFH%	Food away from home expenditures as percent of total food expenditures	%	50.8 (2.16)
POP	Civilian U.S. population	mil	287.7 (13.0)
	Marketing Expenditures		
GFMA	Annual generic fluid milk advertising expenditures	$mil	58.9

	by dairy farmers deflated by media cost index (2009 $)		(50.7)
GFMN	Annual generic fluid milk non-advertising marketing expenditures by dairy farmers deflated by consumer price index (2009 $)	$mil	48.3 (29.0)
GFDA	Annual generic milk and dairy advertising expenditures by dairy farmers, deflated by media cost index (2009 $)	$mil	147.1 (75.3)
GFDN	Annual generic milk and dairy non-advertising marketing expenditures by dairy farmers, deflated by media cost index (2009 $)	$mil	113.4 (58.8)
GPMA	Annual generic fluid milk advertising expenditures by fluid milk processors, deflated by media cost index (2009 $)	$mil	63.7 (29.7)
GPMN	Annual generic fluid milk non-advertising marketing expenditures by fluid milk processors, deflated by consumer price index (2009 $)	$mil	21.7 (12.9)
CBA	Annual soy milk + bottled-water advertising expenditures deflated by media cost index (2009 $)	$mil	217.4 (142.1)

[a] Quarterly dummy variables are also included in the model to account for seasonality in demand.
[b] Computed over the period 1995–2009. Standard deviation in parentheses.

Note that in the tables that follow, all variables are defined as in Table A1. In addition, the following variables are used:

DUMQ1 = indicator variable for first quarter equaling 1 for first quarter and 0 otherwise,

DUMQ2 = indicator variable for second quarter equaling 1 for second quarter and 0 otherwise,

DUMQ3 = indicator variable for third quarter equaling 1 for third quarter and 0 otherwise,

DUM2009 = indicator variable for 2009 equaling 1 for 2009 (all quarters) and 0 otherwise,

PDL = polynomial distributed lag specification,

T = time trend equaling 1 for 1995.1, 2 for 1995.2, and so on,

LOG = natural logarithm operator,

D = difference operator, e.g,, D X = $X_t - X_{t-1}$.

Table A2. Econometric estimation of fluid milk demand equation.

Dependent Variable: LOG(RFDPC)
Method: Least Squares
Sample (adjusted): 1997Q4 2009Q4
Included observations: 49 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.387267	0.958930	-1.446682	0.1564
LOG(RFPCPI /RBEVCPI)	-0.126104	0.025123	-5.019502	0.0000
DUMQ1	-0.014864	0.002760	-5.386161	0.0000
DUMQ2	-0.054940	0.002754	-19.95033	0.0000
DUMQ3	-0.044623	0.002790	-15.99366	0.0000
DUM2009	-0.051011	0.007757	-6.576344	0.0000
LOG(INCPC)	0.129586	0.087274	1.484814	0.1461
LOG(AGE5)	0.560599	0.244083	2.296755	0.0274
LOG(FAFH%)	-0.684971	0.173256	-3.953521	0.0003
PDL01	0.001319	0.000667	1.977004	0.0555
PDL02	0.002675	0.001809	1.478297	0.1478
PDL03	-0.000781	0.000556	-1.404114	0.1686

R-squared	0.982828	Mean dependent var	-3.052287
Adjusted R-squared	0.977723	S.D. dependent var	0.043739
S.E. of regression	0.006528	Akaike info criterion	-7.016443
Sum squared resid	0.001577	Schwarz criterion	-6.553140
Log likelihood	183.9029	Hannan-Quinn criter.	-6.840667
F-statistic	192.5173	Durbin-Watson stat	1.991413
Prob(F-statistic)	0.000000		

<table>
<tr><th>Lag Distribution of
LOG(((GFMA+GPMA))/POP)</th><th>i</th><th>Coefficient</th><th>Std. Error</th><th>t-Statistic</th></tr>
<tr><td>. * |</td><td>0</td><td>0.00122</td><td>0.00062</td><td>1.97700</td></tr>
<tr><td>.   * |</td><td>1</td><td>0.00223</td><td>0.00113</td><td>1.97700</td></tr>
<tr><td>.   * |</td><td>2</td><td>0.00304</td><td>0.00154</td><td>1.97700</td></tr>
<tr><td>.   * |</td><td>3</td><td>0.00365</td><td>0.00185</td><td>1.97700</td></tr>
<tr><td>.   * |</td><td>4</td><td>0.00406</td><td>0.00205</td><td>1.97700</td></tr>
<tr><td>.   *|</td><td>5</td><td>0.00426</td><td>0.00215</td><td>1.97700</td></tr>
<tr><td>.   *|</td><td>6</td><td>0.00426</td><td>0.00215</td><td>1.97700</td></tr>
<tr><td>.   * |</td><td>7</td><td>0.00406</td><td>0.00205</td><td>1.97700</td></tr>
<tr><td>.   * |</td><td>8</td><td>0.00365</td><td>0.00185</td><td>1.97700</td></tr>
<tr><td>.   * |</td><td>9</td><td>0.00304</td><td>0.00154</td><td>1.97700</td></tr>
<tr><td>.   * |</td><td>10</td><td>0.00223</td><td>0.00113</td><td>1.97700</td></tr>
<tr><td>. * |</td><td>11</td><td>0.00122</td><td>0.00062</td><td>1.97700</td></tr>
<tr><td></td><td>Sum of Lags</td><td>0.03692</td><td>0.01867</td><td>1.97700</td></tr>
</table>

Lag Distribution of LOG((GFMN+GPMN)/POP)	i	Coefficient	Std. Error	t-Statistic
. * |	0	0.00234	0.00158	1.47830
. * |	1	0.00401	0.00271	1.47830
. * |	2	0.00501	0.00339	1.47830
. *|	3	0.00535	0.00362	1.47830
. * |	4	0.00501	0.00339	1.47830
. * |	5	0.00401	0.00271	1.47830
. * |	6	0.00234	0.00158	1.47830
	Sum of Lags	0.02808	0.01900	1.47830

Lag Distribution of LOG((CBA)/POP)	i	Coefficient	Std. Error	t-Statistic
* .|	0	-0.00070	0.00050	-1.40411
* .|	1	-0.00125	0.00089	-1.40411
* .|	2	-0.00164	0.00117	-1.40411
* .|	3	-0.00187	0.00133	-1.40411
* .|	4	-0.00195	0.00139	-1.40411
* .|	5	-0.00187	0.00133	-1.40411
* .|	6	-0.00164	0.00117	-1.40411
* .|	7	-0.00125	0.00089	-1.40411
* .|	8	-0.00070	0.00050	-1.40411
	Sum of Lags	-0.01288	0.00918	-1.40411

Table A3. Econometric estimation of fluid milk supply equation.

Dependent Variable: LOG(RFDPC *POP)
Method: Least Squares
Sample (adjusted): 1995Q2 2009Q4
Included observations: 59 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.423536	0.476874	5.082133	0.0000
LOG(RFDPC (-1)*POP(-1))	0.215500	0.141258	1.525581	0.1333
LOG(WFP/CPIALL)	0.093388	0.061675	1.514198	0.1361
LOG(P1/CPIALL)	-0.056875	0.027128	-2.096530	0.0410
DUMQ1	-0.025357	0.006986	-3.629573	0.0007
DUMQ2	-0.062724	0.005088	-12.32668	0.0000
DUMQ3	-0.043516	0.003377	-12.88600	0.0000
LOG(T)	-0.006565	0.003097	-2.119934	0.0389

R-squared	0.900507	Mean dependent var	2.622330
Adjusted R-squared	0.886852	S.D. dependent var	0.024037
S.E. of regression	0.008085	Akaike info criterion	-6.672050
Sum squared resid	0.003334	Schwarz criterion	-6.390350
Log likelihood	204.8255	Hannan-Quinn criter.	-6.562086
F-statistic	65.94305	Durbin-Watson stat	1.947071
Prob(F-statistic)	0.000000		

Table A4. Econometric estimation of retail-processor price margin equation.

Dependent Variable: RBEV
Method: Least Squares
Sample (adjusted): 1995Q2 2008Q4
Included observations: 55 after adjustments
Convergence achieved after 26 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	40.29635	5.825924	6.916731	0.0000
WFP	617.9122	40.43566	15.28137	0.0000
T	0.584672	0.069795	8.377022	0.0000
AR(1)	0.475251	0.128782	3.690348	0.0005

R-squared	0.989075	Mean dependent var	167.7329
Adjusted R-squared	0.988432	S.D. dependent var	24.48365
S.E. of regression	2.633279	Akaike info criterion	4.844284
Sum squared resid	353.6420	Schwarz criterion	4.990271
Log likelihood	-129.2178	Hannan-Quinn criter.	4.900738
F-statistic	1539.077	Durbin-Watson stat	1.823077
Prob(F-statistic)	0.000000		

Inverted AR Roots	.48

Table 5. Econometric estimation of all-dairy demand equation on a milk-fat equivalent basis.

Dependent Variable: D(LOG(RDDPCF))
Method: Least Squares
Sample (adjusted): 1996Q4 2009Q4
Included observations: 53 after adjustments
Convergence achieved after 10 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOG(RDPCPI))	-0.218245	0.156696	-1.392792	0.1705
D(LOG(RPCINC))	0.951626	0.217674	4.371793	0.0001
D(LOG((GFDA + GFDA(-1)+ GPMA + GPMA(-1))/POP))	0.055487	0.037385	1.484221	0.1447
D(LOG((GFDN(-4)+ GPMN(-4))/POP(-4)))	0.016521	0.005984	2.760990	0.0083
DUMQ1	-0.048377	0.010547	-4.586657	0.0000
DUMQ3	0.019948	0.009791	2.037501	0.0475
DUM2009	-0.011214	0.011586	-0.967858	0.3383
AR(2)	-0.423864	0.134910	-3.141831	0.0030

R-squared	0.717543	Mean dependent var	0.001800
Adjusted R-squared	0.673606	S.D. dependent var	0.044409
S.E. of regression	0.025371	Akaike info criterion	-4.372149
Sum squared resid	0.028966	Schwarz criterion	-4.074746
Log likelihood	123.8619	Hannan-Quinn criter.	-4.257782
Durbin-Watson stat	2.349558		

Table 6. Econometric estimation of all-dairy demand equation on a solids-not-fat equivalent basis.

Dependent Variable: D(LOG(RDDPCNF))
Method: Least Squares
Sample (adjusted): 1996Q1 2009Q4
Included observations: 56 after adjustments
Convergence achieved after 9 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOG(RDPCPI))	-0.287993	0.084985	-3.388744	0.0014
D(LOG(RPCINC))	0.170345	0.115952	1.469103	0.1479
D(LOG((GFDA(-1)+ GPMA (-1))/POP(-1)))	0.036341	0.009537	3.810414	0.0004
D(LOG((GFDN + GPMN)/POP))	0.015473	0.003029	5.108255	0.0000
AR(2)	-0.541244	0.121096	-4.469558	0.0000

R-squared	0.573636	Mean dependent var	-0.000270
Adjusted R-squared	0.540196	S.D. dependent var	0.022973
S.E. of regression	0.015578	Akaike info criterion	-5.400926
Sum squared resid	0.012376	Schwarz criterion	-5.220091
Log likelihood	156.2259	Hannan-Quinn criter.	-5.330817
Durbin-Watson stat	2.531316		

Table A7. Econometric estimation of farm milk supply equation.

Dependent Variable: LOG(MILK)
Method: Least Squares
Sample (adjusted): 1995Q2 2009Q4
Included observations: 59 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.089464	0.134895	0.663211	0.5101
LOG(MILK(-1))	0.981624	0.040354	24.32517	0.0000
LOG(AMP(-1)/PRATION(-1))	0.018594	0.008245	2.255263	0.0284
LOG(T)	0.003652	0.003290	1.109814	0.2722
DUMQ1	0.034076	0.003581	9.515960	0.0000
DUMQ2	0.035339	0.003635	9.722097	0.0000
DUMQ3	-0.042460	0.003975	-10.68112	0.0000

R-squared	0.985154	Mean dependent var	3.742294
Adjusted R-squared	0.983441	S.D. dependent var	0.074163
S.E. of regression	0.009543	Akaike info criterion	-6.354948
Sum squared resid	0.004736	Schwarz criterion	-6.108461
Log likelihood	194.4710	Hannan-Quinn criter.	-6.258730
F-statistic	575.1177	Durbin-Watson stat	2.220870
Prob(F-statistic)	0.000000		

OTHER A.E.M. RESEARCH BULLETINS

RB No	Title	Fee (if applicable)	Author(s)
2009-01	Dairy Farm Management Business Summary, New York State, 2008	($20.00)	Knoblauch, W., Putnam, L., Karszes, J. and J. Anderson
2008-03	Dairy Farm Management Business Summary, New York State, 2007	($20.00)	Knoblauch, W., Putnam, L., Karszes, J., Murray D. and R. Moag
2008-02	100 Years of Dairy Farming: Town of Dryden, Tompkins County		Stanton, B., Conneman, G., Crispell, C. and S. Smith
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