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Measuring the Impacts of Generic Fluid Milk and Dairy Marketing

by:

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Abstract

While per capita fluid milk consumption has been declining for decades in the United States, generic fluid milk marketing activities sponsored by fluid milk processors and dairy farmers have helped mitigate 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 11-year period 1995 through 2005, we estimate that a one-percent increase in generic fluid milk marketing expenditures resulted in a 0.051 percent increase in per capita fluid milk consumption when holding all other demand factors constant.

What about the impact on total consumption of fluid milk? From 2001 through 2005, generic fluid milk marketing activities increased fluid milk commercial disappearance by 22.5 billion pounds in total or 4.5 billion pounds per year. Put differently, had there not been generic fluid milk marketing conducted by the two national programs, fluid milk consumption would have been 8.2 percent less than it actually was over this time period. Hence, the bottom line is that the combined efforts of dairy farmers and fluid milk processors to market fluid milk have had a positive and statistically significant impact by partially mitigating declines in fluid milk consumption.

In terms of the total dairy demand analysis, the average generic dairy marketing elasticity for the period 1990 through 2005 was 0.074; i.e., a one-percent increase in expenditures for these marketing activities would increase per capita dairy demand by 0.074 percent. Thus, the total

marketing effort by dairy farmers and 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 2000 through 2005. The benefits of the Dairy Program were calculated as the change in dairy farmers' net revenue due to demand enhancement from all marketing activities under the Dairy Program. The costs of the Dairy Program were calculated as the difference in total assessment revenues before and after the national program was enacted. The results show that the average BCR for the Dairy Program was 4.33. This means that each dollar invested in generic dairy marketing by dairy farmers would return \$4.33, on average, in net revenue to farmers.

To make allowances for the error inherent in any statistical estimation, a 95-percent confidence interval was calculated for the average BCR. The confidence interval provides a lower and an upper bound for the average BCR. One can be "confident" that the true average BCR lies within these bounds 95 percent of the time. The estimated lower and upper bounds for the average BCR were 3.70 and 4.95, respectively. This confidence interval demonstrates that one could be 95 percent confident that the true average BCR lies between 3.70 and 4.95. This confidence interval give credence to our finding that the benefits of the Dairy Program's marketing activities have been considerably greater than the cost of the program.

Measuring the Impacts of Generic Fluid Milk and Dairy Marketing

Evaluation of generic commodity promotion programs is a necessary component of managing producer checkoff dollars to determine net benefits to producers. One component of such an evaluation requires the estimation of demand effects of the generic marketing programs. This paper addresses this component by estimating national retail demand relationships for fluid milk and dairy products, incorporating generic marketing expenditures. The demand relationships are then combined with market-level supply relationships to simulate returns to producers of the generic marketing programs.

Unlike all previous evaluations of the dairy and fluid milk processor checkoff programs, this analysis does not include an economic evaluation of solely generic advertising of fluid milk and cheese. We chose to no longer evaluate advertising by itself because such advertising, and particularly advertising sponsored by dairy farmers, has been declining in importance in recent years. Instead, the economic evaluation focuses on the combined 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.

The first model 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, including public relations, sales promotions, nutrition education, and sponsorships conducted by fluid milk processors and dairy farmers. 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 total dairy demand model for all fluid milk and dairy products used to evaluate the economic impacts of all generic marketing activities for those products. The total dairy demand model is included because the dairy farmer programs now emphasize an “all dairy” promotion strategy (e.g., 3-A-Day) over product-specific campaigns. As in the first model, marketing activities in the second include generic advertising, sales promotions, public relations, nutrition education, and sponsorships. 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.

Trends in Fluid Milk Consumption

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, and aggressive advertising and marketing by producers of beverages that compete with fluid milk. As the model described in this report uses quarterly data covering the period 1995 through 2005, the following is a brief graphical overview of changes in per capita fluid milk consumption and factors hypothesized to affect milk consumption over this time period. 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 steady decline in per capita fluid milk commercial disappearance since 1995 (along with seasonal/quarterly changes). From 1995 through 2005, annual commercial disappearance declined by 11.3 percent. This translates into an average annual rate of decline of a little more than one-percent per year.

One potential cause of declining per capita fluid milk consumption may be the positive 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 milk product, which causes some people who would normally drink milk to consume a different beverage if the preferred 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 2005, the annual average percentage of expenditures on food consumed away from home increased by 11.4 percent. 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 2005. It is evident from Figures 1 and 2 that per capita fluid milk consumption and eating away from home are negatively related. Thus the increase in food consumed away from home appears to be responsible for some of the decrease in per capita fluid milk consumption.

Another potential reason why per capita fluid milk consumption has declined may be changes in U.S. demographics. One important change is the declining proportion of young children in the population since 1995 (the decline has leveled out since 2003). Since young children are one of the largest milk-consuming cohorts, any decline in that cohort negatively

Figure 1. Per Capita Fluid Milk Commercial Disappearance.

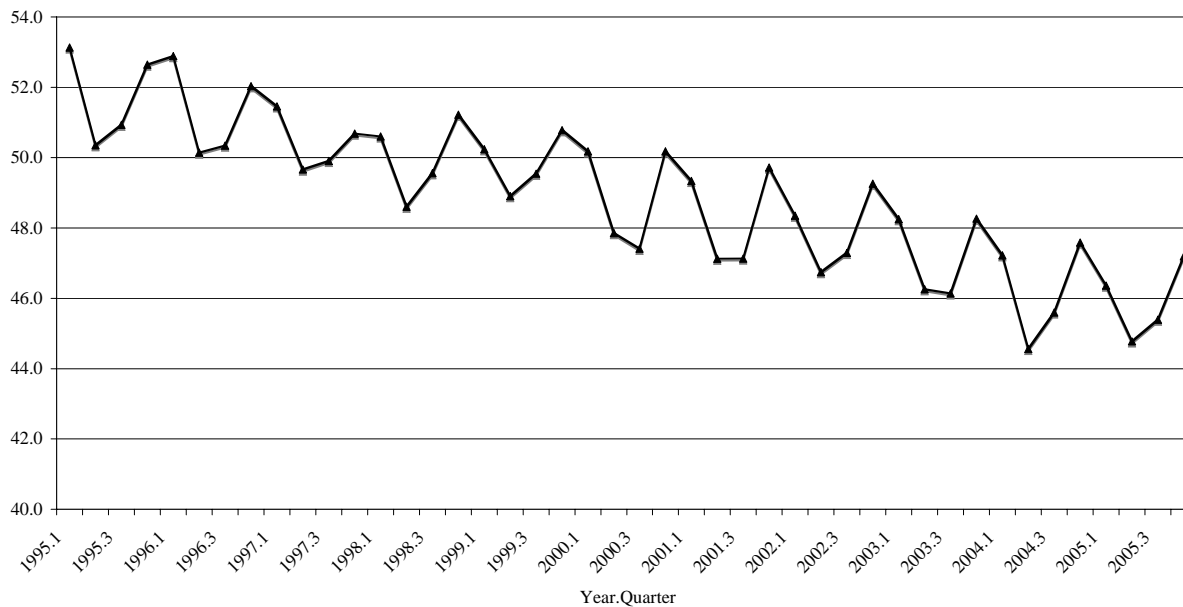
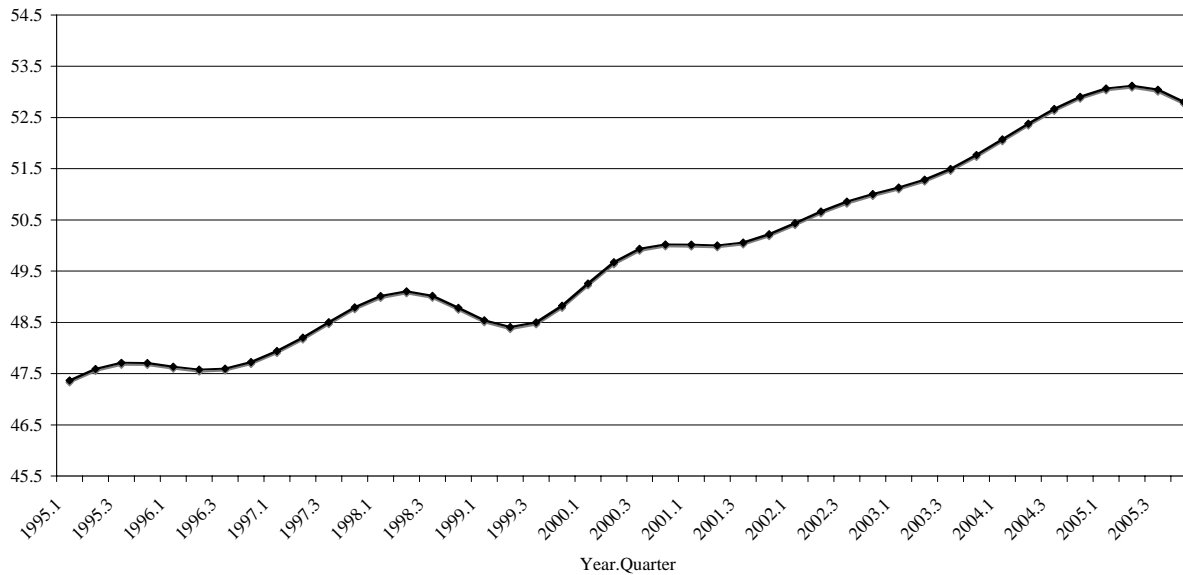


Figure 2. Expenditures on Food Consumed Away From Home as a Percentage of Total Food Expenditures.



impacts per capita fluid milk consumption. Figure 3 shows the percentage of the population that was less than six years old from 1995 through 2005, a segment of the population that has decreased by almost 8 percent since 1995. Therefore, there is a positive correlation between per capita milk consumption and this age cohort—both are declining.¹

Since 1995, the retail price of fluid milk products has generally been rising relative to other non-alcoholic beverages. This pattern is displayed in Figure 4 (note that any value above 1.0 means the consumer price index for fluid milk is higher than the consumer price index for non-alcoholic beverages). Since 1995, retail prices for fluid milk have consistently risen relative to the retail prices for non-alcoholic beverages. From 1995 through 2005, annual average fluid milk prices rose 28.5 percent 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. Since 1995, two beverages that have grown the most in per capita consumption are bottled water and soy milk, due in part to increased advertising and promotion by these beverages. Figure 5 displays real (inflation-adjusted) advertising expenditures for bottled water and soy milk. Combined advertising for bottled water and soy milk (in 2005 dollars) increased from about \$98 million in 1995 to \$224 million in 2005, a 129 percent increase. Both of these products have had huge increases in per capita consumption over this time period, undoubtedly taking away some market share from fluid milk.

¹ Since 2000, the positive relationship between per capita fluid milk consumption and the percent of the population under six years old has weakened considerably with the flattening out of the age demographic variable. However, this positive relationship nevertheless holds for the period 1995 through 2005.

Figure 3. Percentage of Population Under Six Years of Age.

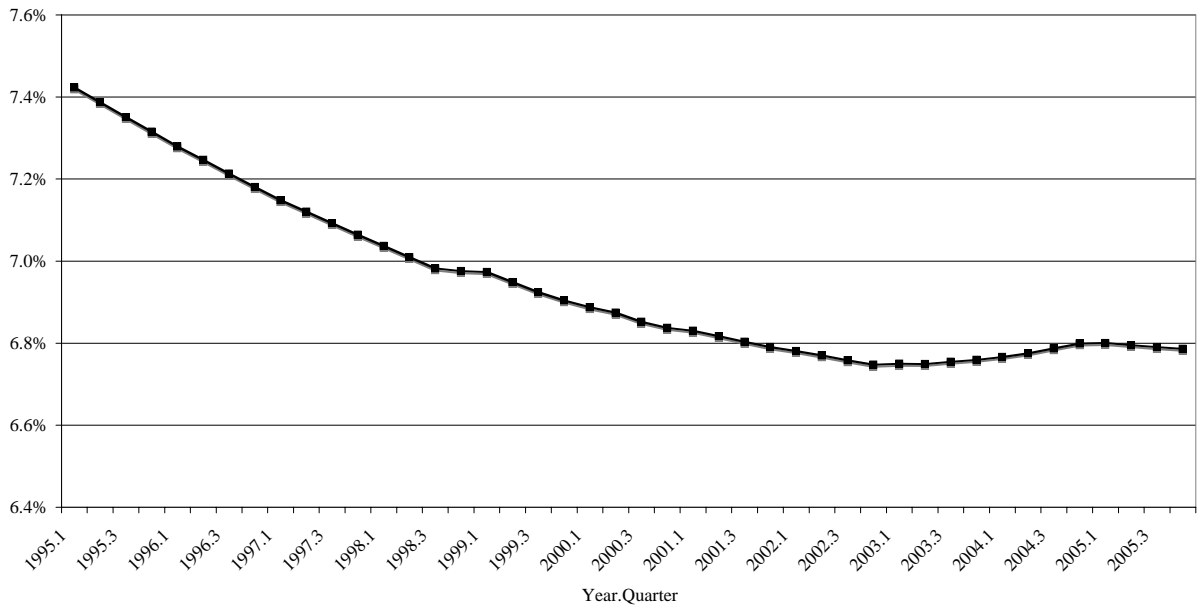


Figure 4. Retail Price of Fluid Milk Relative to Other Beverage Prices.

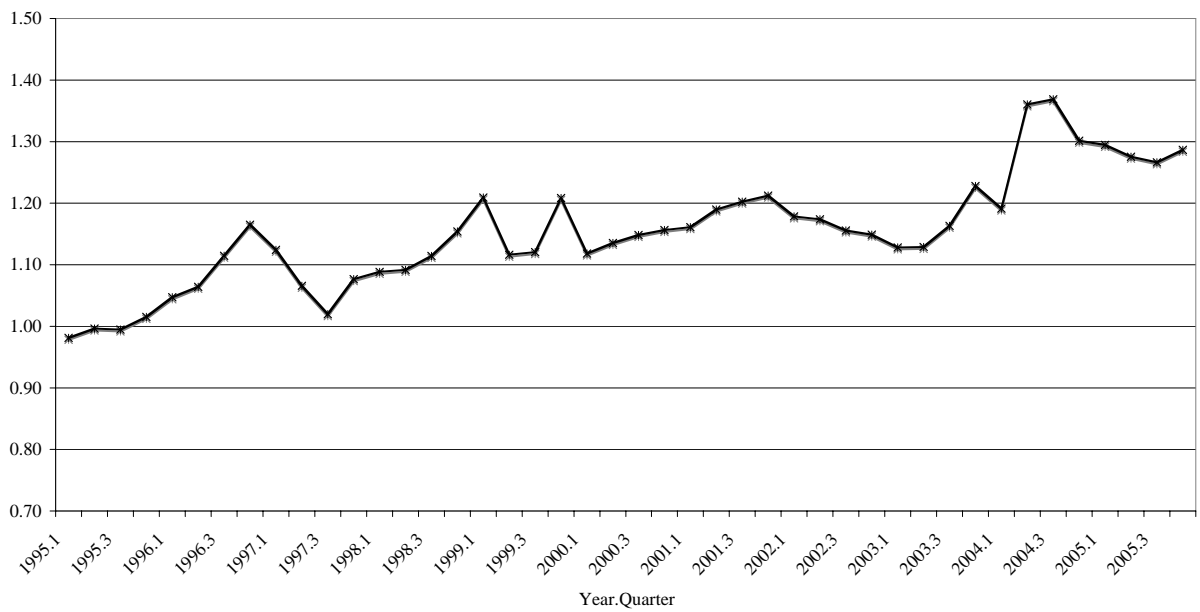
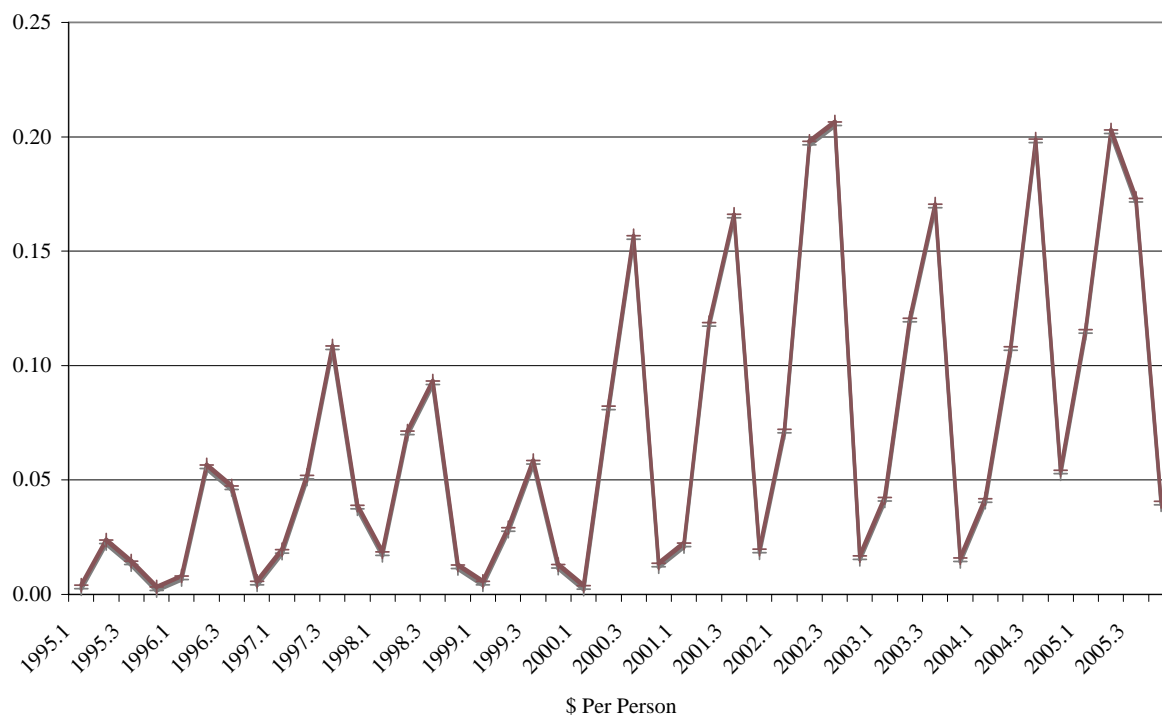


Figure 5. Real Per Capita Bottled Water Advertising.



One factor that may have diminished some of the decline in per capita fluid milk consumption is the growth in real 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 2005 dollars) from 1995 through 2005. Since 1995, real per capita income has increased by 30.3 percent.

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 the combined real expenditures (in 2005 dollars) on generic fluid milk

Figure 6. Real Per Capita Personal Disposable Income.

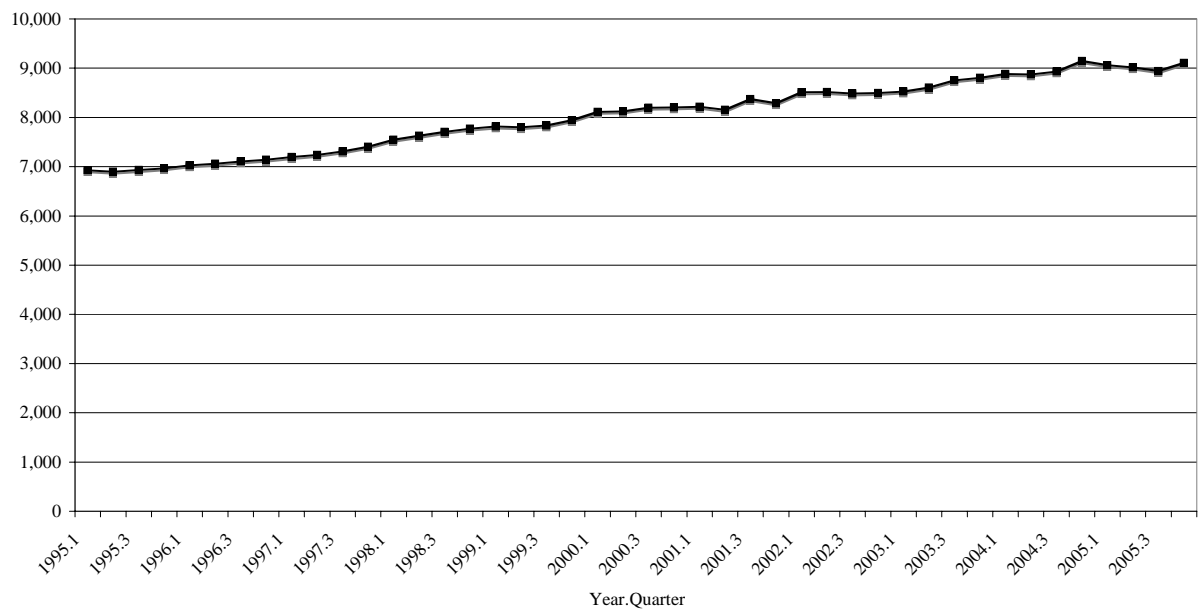
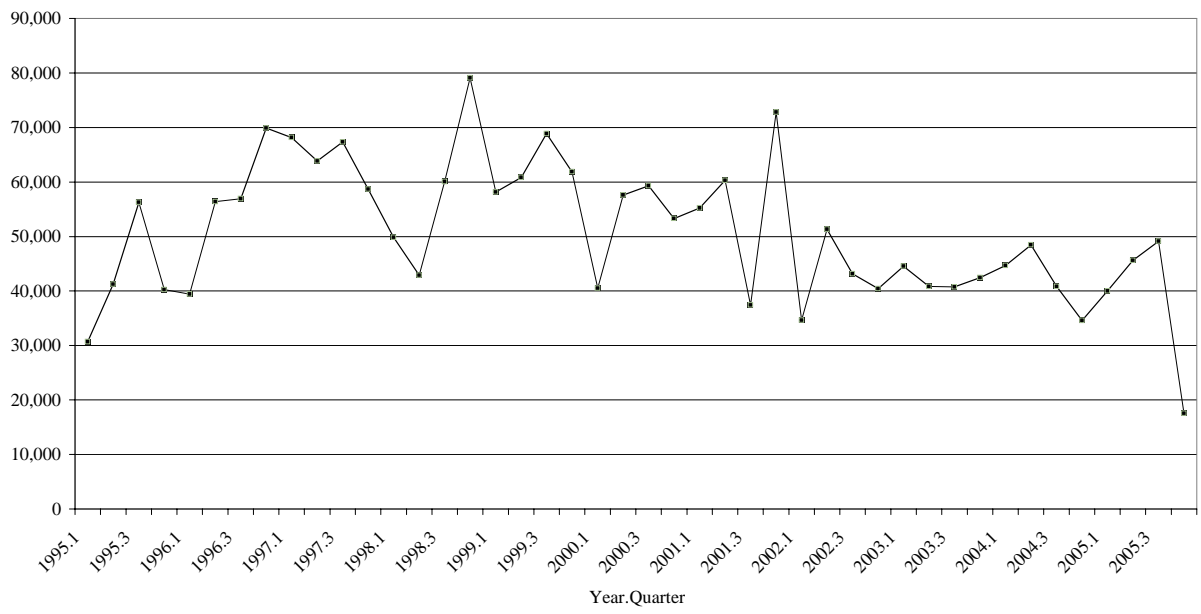


Figure 7. Real Total Fluid Milk Marketing.



marketing efforts by these two programs. From 1995 to 1998, there was steady growth in real expenditures for generic fluid milk marketing, from about \$168 million in 1995 to \$232 million in 1998. Since 1998, however, such expenditures have been declining. Between 1995 and 2005, combined annual average real expenditures declined by almost 10 percent reaching a low of \$152 million in 2005. This decline may have had an impact on declining per capita fluid milk consumption over this period.

Econometric Fluid Milk Demand Model

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 advertising 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 bottled-water and soy milk advertising (combined), and expenditures on generic fluid milk marketing. As mentioned in the introduction, the marketing expenditures included funds spent on fluid milk advertising, public relations, sales promotions, nutrition education, and sponsorships by dairy farmers and milk processors. Since the goals of the farmer and processor marketing programs are the same with regards to fluid

milk, all generic fluid milk marketing activities by both programs were aggregated into a single marketing variable. Mathematically, the model is expressed as follows:

$$(1) \quad \ln(\text{FLUID}/\text{POP}) = \alpha_0 + \alpha_1 \ln(\text{RFPCPI}/\text{RBEVCPI}) + \alpha_2 \ln(\text{INCPC}/\text{RBEVCPI}) \\ + \alpha_3 \ln(\text{FAFH}\%) + \alpha_4 \ln(\text{AGE5}) + \alpha_5 \text{DUMQ1} + \alpha_6 \text{DUMQ2} + \alpha_7 \text{DUMQ3} \\ + \alpha_8 \ln(\text{GOODWILLMILK}) + \alpha_9 \ln(\text{GOODWILLCOMP}),$$

where, FLUID is fluid milk sales in billion pounds, POP is civilian population in the United States in millions, RFPCPI is the retail consumer price index for fluid milk beverages, RBEVCPI is the retail nonalcoholic beverage consumer price index, INCPC is per capita disposable income, FAFH% is expenditures on food consumed away from home as a percentage of total food expenditures, AGE5 is the percentage of the population that is 5 years old and under, DUMQ1, DUMQ2, and DUMQ3 are binary indicator variables to capture quarterly seasonality in milk consumption, GOODWILLMILK is a goodwill variable to capture the impact of real, inflation adjusted milk marketing expenditures by dairy farmers and fluid milk processors on milk demand, and GOODWILLCOMP is a goodwill variable to measure the combined impact of real soy milk and bottled water advertising expenditures on milk demand.

The model was estimated using Ordinary Least Squares with national quarterly data from 1995 through 2005. To account for the effects of inflation, all prices and income were deflated by the consumer price index for nonalcoholic beverages. Generic fluid milk marketing and bottled-water and soy milk advertising expenditures were deflated by a media cost index computed from annual changes in promotion and advertising costs by media type supplied by Dairy Management, Inc. Because marketing has a carry-over effect on demand, past fluid milk marketing expenditures also were included in the model as explanatory variables using a distributed-lag structure. Specifically, a second-order polynomial lag structure with both end

point restrictions was imposed. The demand model included current expenditures and eight quarters of lagged real generic milk marketing expenditures to capture the carry-over effect of the marketing activities. The length of lag used here indicates that such demand enhancing activities as the *Got Milk?* and milk mustache campaigns have long-lasting effects on consumers. Identical procedures were used to capture this carry-over effect for bottled-water and soy milk advertising.

The complete estimation results are reported in Appendix Table 1. The model appears to fit the data well. The adjusted coefficient of determination is over 0.97, i.e., the explanatory variables explain over 97% of the variation in per capita fluid milk consumption over the sample period. Various statistical diagnostics were performed and no statistical problems were found except for auto-correlation, which was corrected for using an auto-regressive error correction procedure. Finally, all variables have coefficients that are statistically significant at the 10% level or better, and have expected signs.²

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 one-percent change in one of the identified demand factors while holding all other factors constant. Table 1 provides average elasticities for the period 1995 through 2005 for variables found to have a statistically significant effect on consumption.³ For example, a price elasticity of demand for fluid milk equal to -0.114 means that a one-percent increase in the real (inflation-adjusted) retail fluid milk price decreases per capita fluid milk quantity demanded by 0.114 percent.

² Income was not statistically significant based on a two-sided t-test, however, it was significant at the 8% level based on a one-sided t-test.

³ The estimated model fit the data extremely well. All variables were statistically significant at the one-percent significance level. The adjusted goodness-of-fit measure indicated that the explanatory variables explained over 97 percent of the variation in per capita fluid milk consumption. Various statistical diagnostics were performed and no statistical problems were found except for auto-correlation, which was corrected for using an auto-regressive error correction procedure.

Table 1. Average Elasticity Values (1995-2005) for Factors Affecting the Retail Demand for Fluid Milk.¹

Demand Factor	Elasticity
Retail price	-0.114*
Per capita income	0.108**
Percent of food-away-from-home expenditures	-0.709*
Percent of population younger than six years of age	0.366*
Bottled-water + soy milk advertising	-0.008**
Generic milk marketing	0.056*

¹ Example: A one-percent increase in the retail price of fluid milk is estimated to reduce per capita sales of fluid milk by 0.114 percent.

* = Statistically significant at the 5 percent significance level or better.
** = Statistically significant at the 10 percent significance level or better.

The most important factors influencing per capita fluid milk demand are the proportion of food expenditures on food eaten away from home and the percentage of the population under six years of age. While not as large in magnitude, retail fluid milk prices, income, expenditures on generic milk marketing efforts, and bottled-water plus soy milk advertising expenditures also impacted per capita fluid milk demand. Each factor is further discussed in detail.

The amount of food that is consumed away from home, which was measured in this model as real per capita expenditures on food eaten away from home as a percentage of total expenditures on food, was the most important factor affecting milk consumption. The estimated elasticity for this factor was -0.709. This means that a one-percent increase in the food consumed away from home would measure result in a 0.709 percent 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 milk beverages. One can hypothesize that because of these limited choices, some people who would ordinarily choose 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 milk consumption. Efforts to increase the variety of fluid milk beverages offered to customers may increase the competitiveness of fluid milk.

Another important milk demand factor continues to be demographic changes. Specifically, the percentage of the population under six years of age had an estimated elasticity of 0.366. This means that a one-percent increase in this age cohort measure would result in a 0.366 percent increase in per capita fluid milk demand when holding all other demand factors constant. This result is consistent with previous studies (including last year's analysis), which show that one of the largest milk-consuming segments of the population is young children.

Not surprisingly, the retail price of fluid milk has a negative and statistically significant impact on per capita demand. The results indicate that a one-percent increase in the real retail price of fluid milk would result in a 0.114 percent decrease in per capita fluid milk quantity demanded. The magnitude of this elasticity is relatively small, which indicates that U.S. consumers' milk purchasing behavior is relatively insensitive to changes in the retail price. This result, which is consistent with the other studies, is likely due to the fact that fluid milk is generally regarded as a staple commodity in the United States. However, as described in the previous section, the retail price of milk has increased substantially since 1995 (28.5 percent) relative to the price of other beverages. Consequently, the increase in fluid milk prices has contributed to the decline in per capita consumption.

Per capita disposable income had a positive and statistically significant (based on a one-sided t-test) impact on per capita fluid milk consumption. A one-percent increase in real per capita income would result in a 0.108 percent 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 milk products as a staple commodity in the United States. With income up by over 30 percent since 1995, this has lessened the decline in per capita fluid milk consumption,

Combined soy milk and bottled-water advertising also has had a negative impact on fluid milk demand during the study period. The estimated fluid milk demand elasticity with respect to combined soy milk and bottled-water advertising was -0.008 , and statistically significant. While relatively small in magnitude, the huge percentage increase in competing advertising likely had a non-trivial negative impact on fluid milk consumption over this time period.

Finally, the generic fluid milk marketing activities conducted by fluid milk processors and dairy farmers have had a positive and statistically significant impact on per capita fluid milk demand. The average marketing elasticity was computed to be 0.056 and was statistically significantly different from zero at the one-percent significance level. Thus, a one-percent increase in generic fluid milk marketing would increase per capita fluid milk consumption by 0.056 percent holding all other demand factors constant. This generic marketing elasticity is virtually identical to the one estimated last year, which was 0.054.

To examine the impact of dairy farmer and milk processor marketing on total consumption of fluid milk, the estimated demand equation was simulated for two scenarios for the period from 2001 through 2005: (1) a baseline scenario in which the combined fluid milk marketing 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 percent 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 8 displays the simulation results for quarterly fluid milk commercial disappearance for the two scenarios. It clearly shows the positive impact on total fluid milk consumption due to the milk-processor and dairy-farmer marketing programs. From 2001 through 2005, these marketing activities were responsible for creating 22.5 billion pounds of fluid milk commercial disappearance, which averages to 4.5 billion pounds per year. Put differently, had there not been generic fluid milk marketing conducted by the two national programs, fluid milk consumption would have been 8.2 percent 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 fluid milk consumption.

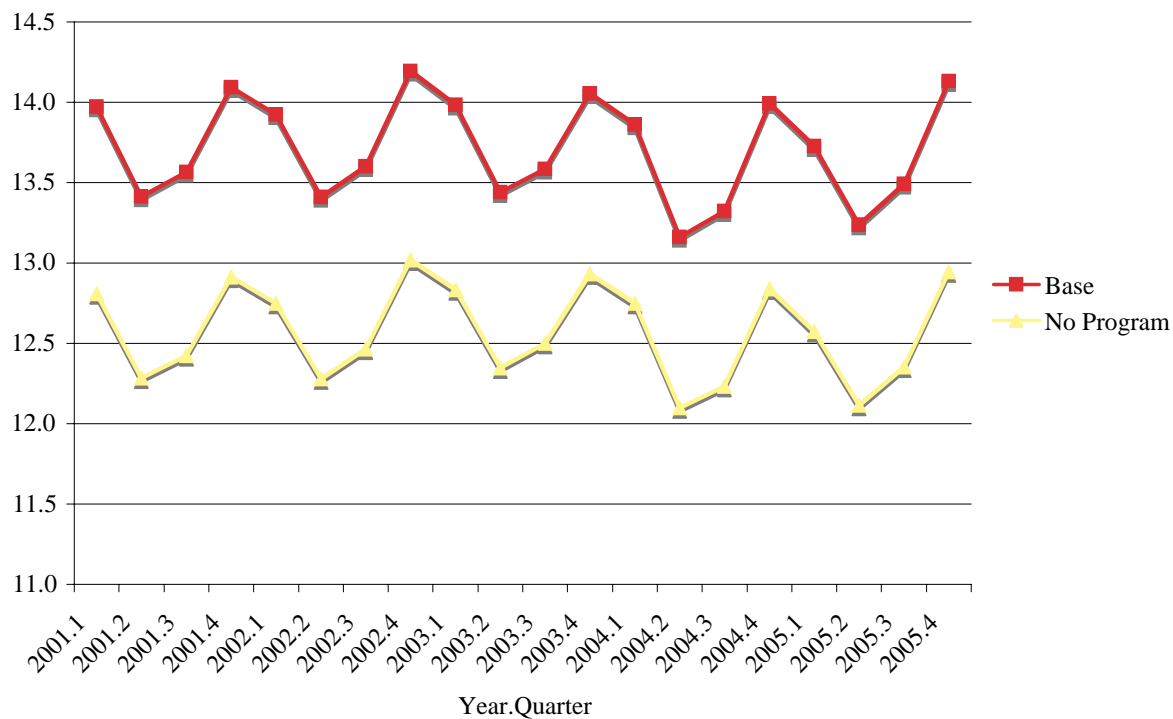
Econometric Overall Dairy Demand Model

To examine the overall impact of the fluid-processor and dairy-farmer programs on overall dairy demand, a farm milk supply, retail milk demand, and retail supply model was estimated. The model begins in the farm market, where raw milk is produced and sold by farmers. Farm milk supply was modeled by the following milk supply function:

$$(2) \quad MILKS = F(AMP / PR, X^f),$$

where *MILKS* is national commercial milk marketings, *AMP* is the expected all-milk price deflated by the feed ration price *PR*, and X^f is a vector of milk supply shifters, which include

Figure 8. Simulated Base and No-National Fluid Milk and Dairy Programs.



seasonality via quarterly dummy variables and lagged farm production to account for production capacities.

The demand and supply structure at the retail level is specified as below:

$$(3) \quad Q^d / POP = D(RDPCPI / CPIALL, X^d)$$

$$(4) \quad Q^s = S(P / AMP, X^s)$$

$$(5) \quad Q^d = Q^s,$$

where Q^d is the retail demand for dairy products, which include fluid milk, cheese, frozen products, and butter⁴, POP is the civilian population, Q^s is the retail supply for dairy products.

⁴ Since all products were expressed on a milk-fat equivalent basis, non-fat dry milk is not included. The summation of fluid milk, cheese, butter, and frozen dairy products, on a milk fat equivalent basis, is used as a measure of total dairy demand.

At equilibrium, the retail demand and supply are cleared by equation (5). *RDPCPI* is the retail consumer price index for all dairy products, and *CPIALL* is the retail consumer price index for all items. In the demand equation (3) the retail dairy price index is deflated by the price index for all items, while in the supply equation (4) the dairy price is deflated by the farm all-milk price. X^d is a vector of retail demand shifters, which include seasonality via quarterly dummy variables, real per capita income, real per capita expenditures on food away from home, and the total real dairy marketing expenditures at the per capita level. Expenditures for the following marketing activities were aggregated into one variable assumed to impact the total dairy demand model: total dairy-farmer expenditures for generic milk and cheese advertising, public relations, sponsorships, retail promotions, and nutrition education and total milk-processor expenditures for generic milk advertising, public relations, and promotions.⁵ X^s is a vector of retail supply shifters, which include seasonality via quarterly dummy variables and a time trend as a proxy for technological change.

The linkage between farm supply and retail supply is simplified in this study as below:

$$(6) \quad MILKS = Q^s + diff,$$

where *diff* is the residuals between farm production and retail supply. Since *diff* is relatively small, it is treated as exogenous.

All equations were estimated in double-logarithmic form. Since prices are endogenous, auxiliary regressions of both retail and farm prices on all the variables in X^d , X^s , and X^f were performed, and the predicted prices were used in all the equations. The estimated model results

⁵ Considerably more than 90 percent of the combined marketing budgets of dairy farmers and fluid milk processors is spent on fluid milk and cheese marketing activities. Hence, expenditures on fluid milk and cheese marketing are used as a measure of the overall dairy marketing efforts of the two programs.

using the data over the time period from 1990 through 2004 are provided in Appendix Tables 2 and 3.

Here we will focus on the retail demand elasticities, which are presented in Table 2. The supply elasticities can be found in Appendix Table 3. All demand elasticities were statistically significantly different from zero at the 1-percent significance level, except for income, which was significant at the 10-percent level. The most important factor in the model impacting per capita disappearance of all dairy products was per capita expenditures on food consumed away from home. The results indicate that a 1-percent increase in per capita food-away-from-home expenditures would result in a 0.77 percent increase in combined per capita total dairy demand, which is likely due to the large amount of cheese consumed away from home. The average price elasticity for 1990 through 2004 was -0.671 ; in other words, a one-percent increase in the retail price of dairy products would result in a 0.671 percent decrease in per capita quantity demanded for all dairy products. Income was also an important factor in the total demand model. The estimated income elasticity was 0.175, indicating that these dairy products are normal goods; that is, consumption rises with increases in income.

Table 2. Average Elasticity Values (1990–2004) for Factors Affecting Total Dairy Retail Demand.

Demand Factor	Elasticity
Retail price	-0.671^*
Per capita income	0.175^{**}
Per capita food-away-from-home expenditures	0.770^*
Generic dairy marketing	0.074^*
* = Statistically significant at the one-percent level or better. **=Statistically significant at the 10 percent better.	

The major interest here is the combined advertising and promotion (or “marketing”) elasticity. The average marketing elasticity for this period was 0.074; a one-percent increase in expenditures for these combined marketing activities would increase per capita total dairy demand by 0.074 percent. Thus, the total marketing effort by dairy farmers and milk processors has had a positive and statistically significant impact on dairy consumption.

Benefit-Cost Analysis for the Dairy Program

One way to measure whether the benefits of a program outweigh the cost is to compute a benefit-cost ratio (BCR). A BCR can be computed as the change in net revenue⁶ due to generic dairy marketing divided by the cost of the checkoff program. While we were able to estimate a BCR for producers for the Dairy Program, we could not compute one at this time for milk processors under the Fluid Milk Program because data on packaged fluid milk wholesale prices, which are necessary in calculating processor net revenue, are proprietary and therefore not available.

We calculated BCRs by simulating two scenarios: (1) a baseline scenario in which combined 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 percent 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 net revenue (what

⁶ “Net revenue” is defined as the aggregate gain in total revenue from price and product disappearance enhancements due to generic dairy marketing less the increase in supply costs for the additional milk marketed by dairy farmers.

economists call “producer surplus”) due to demand enhancement from all marketing activities under the Dairy Program (i.e., the difference in net revenue between scenarios 1 and 2). The demand enhancement reflects increases in quantity and price as a result of the 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.

The average all milk price over this period in the base line scenario was \$14.61 per hundredweight. In the counter-factual no-national-Dairy-Program scenario, the average all milk price was \$14.23 per hundredweight, which is 38 cents lower. Thus, had there been no national program over this period, the price farmers receive for their milk would have been 2.6 percent lower than it actually was.

The results show that the average BCR for the Dairy Program was 4.33 from 2000 through 2005. This means that each dollar invested in generic dairy marketing by dairy farmers during the period would return \$4.33, on average, in net revenue to farmers. The level of the marketing BCR suggests that the combined marketing programs supported by dairy farmers have been a successful investment.

In another interpretation of the BCR, the increase in nominal generic dairy marketing expenditures resulting from the Dairy Program costs dairy producers an additional \$130 million per year on average (i.e., the difference between \$304 million annually under the baseline scenario and \$174 million under the no-Dairy-Program scenario). 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 \$562.9 million. Dividing \$562.9 million by the additional Dairy Program cost of \$130 million results in the estimated benefit-cost ratio of 4.33.

To make allowance for the error inherent in any statistical estimation, a 95 percent confidence interval was calculated for the average BCR, providing a lower and upper bound for the average BCR. One can be 95 percent “confident” that the true average BCR lies within those bounds. The estimated lower and upper bounds for the average BCR were 3.70 and 4.95, 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.

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, the change in generic dairy marketing expenditures noted previously is a mere 0.55 percent of the average annual value of farm milk marketings from 2000 through 2005 (\$23.58 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.

Appendix Table 1. Econometric Results for the Retail Fluid Milk Demand Equation.*

Variable	Coefficient
CONSTANT	-2.837 (-7.03)
RFPCPI/RBEVCPI	-0.114 (-3.53)
INCPC/RBEVCPI	0.108 (1.41)
FAFH%	-0.709 (-4.83)
AGE5	0.366 (1.98)
GOODWILLCOMP	-0.008 (-1.59)
GOODWILLMILK	0.056 (2.00)
DUMQ1	-0.020 (-4.40)
DUMQ2	-0.053 (-17.59)
DUMQ3	-0.037 (-7.82)
AR(1)	-0.227 (-1.14)
Adjusted R ²	0.974
Durbin-Watson	2.28

* t-values are given in parentheses in all the appendix tables.

Appendix Table 2. Econometric Results for the Retail Total Dairy Demand Equation.

Variable	Coefficient
CONSTANT	0.299 (0.24)
RDPCPI/CPIALL	-0.642 (-2.14)
INCPC/CPIALL	0.163 (1.20)
FAFH%	0.742 (2.50)
GOODWILLDAIRY	0.074 (4.72)
DUMQ2	-0.029 (-3.82)
Adjusted R ²	0.588
Durbin-Watson	1.896

Appendix Table 3. Econometric Results for the Retail and Farm Supply Equations.

Variable	Coefficient
Retail Supply	
CONSTANT	2.0536 (38.44)
DUMQ1	-0.0582 (-8.49)
DUMQ2	-0.0493 (-7.18)
DUMQ3	-0.0334 (-4.92)
T	0.3553 (22.53)
PD/AMP	0.0241 (1.04)
Adjusted R ²	0.950
Durbin-Watson	1.81
Farm Supply	
CONSTANT	0.1934 (2.22)
DUMQ1	0.0396 (11.40)
DUMQ2	0.0452 (12.54)
DUMQ3	-0.0410 (-10.97)
AMP/PR	0.0547 (4.01)
MILKS(-1)	0.9372 (37.80)
Adjusted R ²	0.977
Durbin-Watson	1.95

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