National
Institute for
Commodity
Promotion
Research &
Evaluation

December 2004
NICPRE 04-04
R.B. 2004-11

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Impact of Generic Milk Advertising on New York State Markets, 1986-2003

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Under the Dairy and Tobacco Adjustment Act of 1983, farmers are assessed 15 cents per hundredweight (cwt) on all milk sold in the contiguous United States. In 2003, New York dairy farmers contributed approximately $17.93 million to federally-authorized dairy promotion and advertising funds. These contributions are allocated not only to the national program,[1] but also to the regional, state, and local programs operating in markets where milk is ultimately sold. The federal legislation specifies that at least 5 cents of the 15 cent per cwt checkoff must be allocated to the national program, and allows for credits of up to 10 cents per cwt for contributions to authorized regional, state, or local promotion programs. In 2003, of the $17.93 million paid by New York dairy farmers, approximately $11.95 million was allocated to regional, state, and local programs operating in the markets where New York milk is sold.

The largest regional program operating in New York state is the American Dairy Association and Dairy Council (ADADC). Other programs receiving financial support from New York dairy farmers include Milk for Health on the Niagara Frontier, which is located in the Buffalo area, and the Rochester Health Foundation. In addition, to the extent that New York state milk flows to New England, the New England Dairy Promotion Board receives New York dairy farmers' financial support. Finally, some New York state milk flows west into Ohio,

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[1] Operated by Dairy Management, Incorporated (DMI).

where ADADC Mideast receives financial support from New York state dairy promotion funds.

These advertising and promotion organizations are engaged in a wide range of promotional activities including nutrition education, various point-of-sale merchandising activities, and media advertising. The present study focuses solely on the media advertising activities in five New York markets--New York City, Albany, Syracuse, Rochester, and Buffalo. The majority of dairy checkoff funds in New York state have been invested in media advertising. Under contract with the New York Milk Promotion Advisory Board (NYMPAB), ADADC implements the advertising programs in the New York City, Albany, and Syracuse markets. Through a contractual relationship with the Rochester Health Foundation, ADADC places advertising in the Rochester market as well. Milk for Health on the Niagara Frontier operates an independent advertising program in the Buffalo market.

This economic report provides an updated analysis on the responsiveness of fluid milk sales to milk advertising in the New York City, Albany, Syracuse, Rochester, and Buffalo markets. A previous study by Cornell economists was conducted in 2002 (Kaiser and Chung). Given the length of time that has passed since this was last studied, it is important to reexamine the relative responsiveness and rates of return associated with advertising among these markets. The following sections describe the conceptual fluid milk demand model used to evaluate advertising in the markets being analyzed, document the data collected for this analysis, discuss some specific issues related to model estimation, and report and interpret the econometric results. Finally, the econometric results are used to simulate the impacts of the New York state advertising program on the farm milk price and producer rates of returns for these five markets.

The Model

In each market, per capita fluid milk sales are assumed to be affected not only by generic advertising expenditures, but also by the retail price of milk, prices of substitutes for milk, consumer income, competing advertising expenditures for milk substitutes, and race and age population demographic variables. In addition, the demand equation for each market incorporates a set of variables to account for seasonality in fluid milk consumption. The general form for the demand equation for each market can be expressed as:

Quantity = f(milk price, substitute price, income, age demographics, race demographics, competing beverage advertising expenditures, generic milk advertising expenditures, seasonality).

Regardless of the functional form chosen for estimation, economic theory provides a basis for expectations as to the signs of the price and income variables. With fluid milk quantity as the dependent variable, the estimated coefficient for fluid milk price should have a negative sign. In other words, the expected consumer response to an increase in the price of milk is lower consumption. When the price of a substitute for milk rises, making milk a relatively better buy, the effect should be to increase milk consumption. Thus, the estimated coefficient for any substitute price is expected to be positive. The estimated coefficient for income is expected to have a positive sign. When income rises, consumers can be expected to purchase more milk, as well as more of most goods.

One can also make reasonable hypotheses on the expected signs for the race and age demographics, competing advertising, and milk advertising variables. The proportion of the population less than 10 years old is an important milk consuming age cohort and therefore is expected to be positively correlated with milk consumption. However, once children reach the age of 10 and over, they start to abandon milk and switch to competing beverages such as soda. Accordingly, we expect the percent of population between 10-14 years old to be negatively correlated with milk consumption. In terms of racial demographics, Hispanics tend to consume more milk than Caucasians, while African Americans typically consume less milk than Caucasians. Some studies have also shown Asians consume more milk than Caucasians (Schmit and Kaiser). Accordingly, we expected the percent of the population that is Hispanic and that is Asian to have a positive correlation with milk consumption, and the percent of the population that is African American to have a negative correlation. Advertising of milk substitutes should also decrease milk consumption. Therefore, there should be an inverse relationship between competing advertising expenditures and milk consumption. If milk advertising is effective, an increase in milk advertising should be associated with greater milk consumption; thus estimated generic milk advertising coefficients should have positive signs when this advertising is working as intended.

Data

For each of the five markets being analyzed, the relevant market area is assumed to be the dominant market area (DMA) for the television stations broadcasting from the major city in the market. In each market, this definition leads to a multi-county designation. Of the five markets included in this study, the New York City market is the only one in which a significant portion of the DMA lies outside the boundaries of New York state. The New York City DMA includes roughly the northern half of New Jersey. In the past, we have obtained fluid milk sales data for the New Jersey portion of the New York City DMA from the New Jersey Department of Agriculture, and more recently from the Market Administrator's Office for Order #2. Unfortunately, data are no longer available from either of these sources. Therefore, in the present analysis of the New York City DMA, only the New York State portion is considered, and it is assumed that per capita milk sales in northern New Jersey are the same as per capita sales in New York City. All data used in the model were collected on a monthly basis over the period 1986-2003.

Fluid milk sales for each of the five markets are estimates based on data collected by the Division of Dairy Industry Services and Producer Security (DIS), New York State Department of Agriculture and Markets. Each year, in May and October, every plant and milk dealer with route sales in New York state must file a report showing the amounts of milk sold in each county in which they do business. In addition, all plants from which processed fluid milk is delivered to New York state dealers, or sold on routes in New York state, must file monthly plant reports. Based on these reports, it is possible to trace all milk sold into any designated market area back to the plants in which it was processed. Based on the May report, and the monthly plant reports for May, plant-specific allocation factors can be developed and applied to the monthly plant reports to estimate monthly in-market sales for January through June. Likewise, the October report provides the basis for estimating monthly in-market sales for July through December.

Fluid milk prices for each market comes from the DIS publication titled *Survey of Retail Milk Prices for Selected Markets in NYS*. This report contains retail prices for each type of milk (whole, 2%, 1%, and skim) in various container sizes for several cities in New York. The price series used in this analysis are for whole milk in half-gallon containers.

The Consumer Price Index (CPI) for nonalcoholic beverages in the Northeast is used as a proxy for the substitute price in each equation. This series is available in the *CPI Detail Report* published by the Federal Bureau of Labor Statistics. This same report is also the source for the CPI for all items which is used as a deflator for income.

Two different income measures were used in this study. The first is from the New York State Department of Labor's *Employment Review*. For each of the five markets being studied, this periodical contains timely reports of average weekly earnings of production workers in the manufacturing sector. Liu and Forker also used this variable as a proxy for consumer income. The second was per capita income for each region collected from the U.S. Census Bureau. Since this figure was only available on an annual basis, it was extrapolated to a quarterly basis using state-wide seasonal trends in income. Based on the best statistical results, we used the average weekly earning measure in the demand functions for New York City and Rochester, and the regional income measure for Buffalo and Syracuse. Neither measure was used in Albany because of statistical problems.

Nominal advertising expenditures for competing beverages were based on monthly *AD*VIEWS* data (Copyright 2004, Nielsen Media Research) and provided by Lowe World Wide, Inc., the marketing agency contracted for the national milk advertising campaign with Dairy Management, Inc. The products included coffee and tea, bottled water, fruit and vegetable juices, carbonated beverages, and other nonalcoholic, non-dairy beverages. To adjust for inflation and seasonal change in media costs, these expenditures were deflated by Media Cost Indices provided by Lowe World Wide, Inc. The resulting advertising expenditures, which are on a national basis, were then prorated on a population basis to obtain an estimate of the portion of the national advertising effort affecting each of the New York state markets. For the Albany and New York City demand models, bottled water advertising was used to represent competing advertising, and for Rochester juice advertising was used. None of the competing advertising products gave the correct signs in the Buffalo and Syracuse models and were subsequently excluded.

Monthly nominal generic advertising expenditures on radio and television in New York City, Albany, Syracuse, and Rochester markets were provided by ADADC from their contracted advertising agency handling the fluid milk account. Nominal radio and television expenditures in the Buffalo market are provided by DIS from audits of Milk for Health on the Niagara Frontier. For all five markets, adjustments are made to advertising expenditures to transform them into a measure of advertising effort. These adjustments account for not only year-to-year inflation in media costs, but also quarter-to-quarter variations in media costs within any year. Monthly national fluid milk advertising expenditures were supplied by Lowe World Wide, Inc. and Dairy Management, Inc. These expenditures are deflated and prorated on a population basis to obtain an estimate of the portion of the national fluid milk advertising effort affecting each of the markets under study here.

Estimation

A double-log equation of the following form was specified for each market:

$$(1) \quad \ln SALES_t = \alpha_0 + \alpha_1 \ln (PRICE_t/SUB_t) + \alpha_2 \ln INCOME_t + \alpha_3 \ln DEMOGR_t$$

$$+ \sum_{i=0}^{m} \beta_i \ln BEVAD_{t-i} + \sum_{j=0}^{n} \omega_j \ln MILKAD_{t-j} + \sum_{k=1}^{3} \delta_k \, DUMQ_{k,t} \,,$$

where $SALES_t$ is quarterly per capita fluid milk sales, $PRICE_t$ is the average quarterly retail fluid milk price, SUB_t is the quarterly nonalcoholic beverage price index, $INCOME_t$ is the quarterly income measure deflated by the CPI for all items, $DEMOGR_t$ are quarterly age and/or race demographic variables, $BEVAD_t$ is a vector of deflated advertising expenditures for competing milk products in the current and previous quarters, $MILKAD_t$ is a vector of deflated generic milk advertising expenditures in the current and previous quarters, and $DUMQ_{k,t}$ is a vector of quarterly dummy variables for the first, second, and third quarter of the year. Because there is a high correlation between the retail fluid milk price and the nonalcoholic beverage price index, inclusion of these two variables separately in the model causes multicollinearity problems. To deal with this problem, a ratio of the retail milk price to the nonalcoholic beverage price index is used. Quarterly data from 1986 through 2003 are used to estimate the coefficients in equation (1). The model was estimated using two-stage least squares by estimating a price instrument for the endogenous retail milk price as a function of exogenous variables in the model.

The coefficients on all advertising variables are estimated with a second order polynomial distributed lag function with endpoint restrictions imposed. This approach is used to estimate the effect on current quarterly sales of not only current quarterly advertising, but also advertising in past quarters. This assumes that the impact of advertising is distributed over time rather than being limited to only the quarter that the advertising is implemented, which is a common assumption (Liu and Forker, Kaiser and Reberte). The length of the lag for each market was set at four quarters.

One advantage of the double-log form is that it provides coefficient estimates that are direct estimates of elasticities. An estimated elasticity is a measure of the percentage change in the dependent variable, sales in this case, resulting from a one percent change in an independent variable, all else held constant. In the equation specified above, α_1 is the own price elasticity (the elasticity of milk sales with respect to the milk price), α_2 is the income elasticity (the elasticity of milk sales with respect to income), α_3 is a vector of racial and age elasticities (the elasticity of milk sales with respect to racial and age demographics), and β_i and ω_j are the competing and own advertising elasticities (the elasticity of milk sales with respect to competing beverage and milk advertising expenditures in the current and previous months).

Results

The estimation results are presented for each market in the Appendix of this report. In this section, the focus is on the estimated generic milk advertising elasticities for each of the five markets.

Generic milk advertising had a positive impact on milk sales in all markets, and was statistically significant in four out of the five markets. Syracuse had the highest average long-run generic milk advertising elasticity of 0.090, i.e., a ten percent increase in generic milk advertising expenditure resulted in an average increase in per capita milk sales of 0.9 percent.[2] Buffalo and Rochester were close behind with average long-run advertising elasticities of 0.079 and 0.077, respectively. New York City had an advertising elasticity of 0.048, which was also statistically significant. Albany had the lowest advertising elasticity of 0.038, which was the only statistically insignificant elasticity. Interestingly, all of the advertising elasticities were higher than the ones estimated two years ago by Kaiser and Chung. These results indicated that generic fluid milk advertising in New York state have had a positive impact on milk sales.

The estimated model was used to simulate the impact of New York state generic milk advertising on producer returns. The model was simulated under two advertising scenarios over the 1986-2003 period: (1) with combined national and New York state milk advertising expenditures equal to historic monthly levels, and (2) with national milk advertising expenditures equal to historic levels, but no New York state generic milk advertising. This implicitly assumes that dollars spent on the New York program have the same impact as dollars spent on the national program. A comparison of the results of the two scenarios provides a measure of the state program's impact on New York markets. The bottom-line measure that

New York dairy farmers are interested in is whether the benefits of state-level advertising are greater than the costs in each of the five markets.

The benefits of fluid milk advertising are the additional Class I revenues created by increasing fluid milk sales since milk going into fluid use receives a premium (Class I differential) compared to milk going into manufactured dairy products. Accordingly, the benefits in each market due to state milk advertising are equal to:

$$BENEFIT = DF * \Delta SALES * POP,$$

where: BENEFIT is the monetary value of benefits in the market due to state-level advertising, ΔSALES is the change in per capita sales in the market due to state-level milk advertising, and POP is the market population. The benefits associated with New York state generic milk advertising were computed quarterly from 1986 to 2003 by simulating the above two scenarios and taking the difference in per capita sales to obtain ΔSALES. To account for inflation, the Class I differential in each market was deflated by the CPI (in 2003 dollars). The cost in each market due to state milk advertising is the advertising cost. As was the case before, to account for inflation, advertising cost (COST) was deflated by the Media Cost Index (in 2003 dollars). A benefit-cost ratio for state-level advertising in each market can then be calculated as:

$$BCR = BENEFIT/COST.$$

Table 1 displays the estimated average BCRs to New York state generic milk advertising from 1986 to 2003 for the five markets and a weighted average for all five markets. It is clear from these findings that state spending on generic milk advertising over the period 1986-2003 has been profitable for dairy farmers. The weighted average BCR for the five markets was 2.81,

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[2] The estimated advertising elasticity for Buffalo may be biased upward for two reasons. First, there are some milk sales in this market from Canadians living over the border which are attributed to the Buffalo population. Second, there is some milk advertising from Ontario in this market which is not included in the demand equation.

i.e., an additional dollar spent on state generic milk advertising resulted in an average increase of $2.81 in Class I revenue. This figure is higher than our previous study using similar data over the period 1986-1999, which estimated an average BCR for New York state of 2.12.

In terms of individual New York state markets, Rochester had the highest BCR (4.18), which is followed by Syracuse (3.29) and Buffalo (3.17). All markets had benefit-cost ratios above one indicating that the New York state contribution to the overall advertising program had benefits that exceeded costs, on average, over this period of time.

Conclusion

The purpose of this study was to examine the responsiveness of fluid milk sales to milk advertising in the New York City, Albany, Syracuse, Rochester, and Buffalo markets. Fluid milk demand equations for New York City, Albany, Syracuse, Rochester, and Buffalo were estimated with quarterly data from 1986-2003. The demand equations included the following explanatory variables: retail milk price, nonalcoholic beverage price index, per capita earnings (or income) in the manufacturing sector, population percentages by age and race, competing beverage advertising expenditures, generic milk advertising expenditures, and seasonality variables.

The results indicated that generic milk advertising was positive and statistically significant in all but one market. The highest advertising elasticity was in the Rochester market, followed by Syracuse and Buffalo. The model was simulated to determine the impact of the New York state portion of advertising expenditures on producer milk returns. Benefit-cost ratios were also estimated for each of the five markets. The weighted average BCR for the five markets was 2.81. In terms of individual New York state markets, Rochester had the highest

BCR, which was followed by Syracuse and Buffalo. All of the market BCRs were above 1.00, indicating that New York state's contribution to the overall advertising program had benefits that exceeded costs, on average, over this period of time.

Table 1. Benefit-cost ratios to New York state generic milk advertising, evaluated at sample means, for the five New York markets.

	Albany	Buffalo	NYC	Rochester	Syracuse	Market average
Benefit-cost ratio	1.87	3.17	2.69	4.08	3.29	2.81

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Appendix Table 1. Estimated Per Capita Demand Equations for Albany.

LS // Dependent Variable is LOG(PSALES)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.483423	1.409869	-0.342885	0.7330
LOG(PRICEF/NYALL)	0.090188	0.161319	0.559066	0.5784
LOG(NEBEV/NYALL)	0.256663	0.205484	1.249064	0.2169
DUM1	-0.049640	0.015755	-3.150701	0.0026
DUM2	-0.069627	0.015334	-4.540741	0.0000
DUM3	-0.047706	0.015301	-3.117930	0.0029
LOG(HISP)	0.255757	0.159648	1.602002	0.1149
LOG(RAGE1014)	-1.567276	0.698764	-2.242925	0.0290
LOG(PSALES(-1))	0.316506	0.128852	2.456359	0.0172
PDL01	0.006558	0.007873	0.832887	0.4085
PDL02	-0.002117	0.002853	-0.742094	0.4612

R-squared	0.739197	Mean dependent var	4.118083
Adjusted R-squared	0.691778	S.D. dependent var	0.072162
S.E. of regression	0.040063	Akaike info criterion	-6.283599
Sum squared resid	0.088277	Schwarz criterion	-5.918657
Log likelihood	124.7088	F-statistic	15.58868
Durbin-Watson stat	1.975298	Prob(F-statistic)	0.000000

Lag Distribution of LOG(PADV)i	i	Coefficient	Std. Error	T-Statistic
. * |	0	0.00525	0.00630	0.83289
. *|	1	0.00787	0.00945	0.83289
. *|	2	0.00787	0.00945	0.83289
. * |	3	0.00525	0.00630	0.83289
Sum of Lags		0.02623	0.03149	0.83289

Lag Distribution of LOG(PBOTWATER)i	i	Coefficient	Std. Error	T-Statistic
* .|	0	-0.00176	0.00238	-0.74209
* .|	1	-0.00282	0.00380	-0.74209
* .|	2	-0.00318	0.00428	-0.74209
* .|	3	-0.00282	0.00380	-0.74209
* .|	4	-0.00176	0.00238	-0.74209
Sum of Lags		-0.01235	0.01664	-0.74209

Appendix Table 2. Estimated Per Capita Demand Equations for Buffalo.

LS // Dependent Variable is LOG(PSALES)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.725303	2.468700	-1.509014	0.1375
LOG(PRICEF/NEBEV)	-0.036687	0.180365	-0.203404	0.8396
LOG(PCINCOME/NYALL)	0.354592	0.246395	1.439122	0.1562
LOG(BLACK)	-0.959324	0.379005	-2.531166	0.0145
LOG(HISP)	0.334594	0.140654	2.378846	0.0211
LOG(RAGE1014)	-0.582946	0.451819	-1.290221	0.2028
LOG(PSALES(-1))	0.452749	0.123734	3.659059	0.0006
DUM1	-0.076563	0.017025	-4.497242	0.0000
DUM2	-0.094185	0.015360	-6.131700	0.0000
DUM3	-0.079705	0.013916	-5.727453	0.0000
PDL01	0.007435	0.003630	2.048231	0.0457

R-squared	0.829095	Mean dependent var	4.092357
Adjusted R-squared	0.795584	S.D. dependent var	0.076137
S.E. of regression	0.034423	Akaike info criterion	-6.578504
Sum squared resid	0.060434	Schwarz criterion	-6.201109
Log likelihood	126.9594	F-statistic	24.74115
Durbin-Watson stat	1.820740	Prob(F-statistic)	0.000000

Lag Distribution of LOG(PADV)i		Coefficient	Std. Error	T-Statistic
. * |	0	0.00620	0.00302	2.04823
. * |	1	0.00991	0.00484	2.04823
. *|	2	0.01115	0.00544	2.04823
. * |	3	0.00991	0.00484	2.04823
. * |	4	0.00620	0.00302	2.04823
Sum of Lags		0.04337	0.02117	2.04823

Appendix Table 3. Estimated Per Capita Demand Equations for New York City.

LS // Dependent Variable is LOG(PSALES)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.843240	0.626923	-2.940138	0.0048
LOG(PRICEF/NEBEV)	-0.019110	0.092254	-0.207152	0.8366
LOG(PCEARNINGS/NYALL)	0.131553	0.086328	1.523869	0.1332
LOG(RAGE1014)	-1.466993	0.278487	-5.267731	0.0000
LOG(PSALES(-1))	0.182425	0.134686	1.354447	0.1810
DUM1	-0.038284	0.012669	-3.021883	0.0038
DUM2	-0.040277	0.011129	-3.619030	0.0006
DUM3	-0.052209	0.010956	-4.765264	0.0000
PDL01	0.006746	0.004477	1.506739	0.1375
PDL02	-0.004907	0.001881	-2.608764	0.0116

R-squared	0.920409	Mean dependent var	3.887124
Adjusted R-squared	0.907618	S.D. dependent var	0.093796
S.E. of regression	0.028509	Akaike info criterion	-6.976357
Sum squared resid	0.045514	Schwarz criterion	-6.644592
Log likelihood	146.5699	F-statistic	71.95541
Durbin-Watson stat	1.701424	Prob(F-statistic)	0.000000

Lag Distribution of LOG(PADV)i	i	Coefficient	Std. Error	T-Statistic
. * |	0	0.00562	0.00373	1.50674
. * |	1	0.00899	0.00597	1.50674
. *|	2	0.01012	0.00672	1.50674
. * |	3	0.00899	0.00597	1.50674
. * |	4	0.00562	0.00373	1.50674
Sum of Lags		0.03935	0.02612	1.50674

Lag Distribution of LOG(RBOTWATER/USPOP)i	i	Coefficient	Std. Error	T-Statistic
* .|	0	-0.00409	0.00157	-2.60876
* .|	1	-0.00654	0.00251	-2.60876
* .|	2	-0.00736	0.00282	-2.60876
* .|	3	-0.00654	0.00251	-2.60876
* .|	4	-0.00409	0.00157	-2.60876
Sum of Lags		-0.02863	0.01097	-2.60876

Appendix Table 4. Estimated Per Capita Demand Equations for Rochester.

LS // Dependent Variable is LOG(PSALES)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.189225	3.097366	-1.029657	0.3076
LOG(PRICEF/NEBEV)	-0.561764	0.225400	-2.492297	0.0157
LOG(PCEARNINGS/NYALL)	0.231577	0.388451	0.596155	0.5535
LOG(BLACK)	-5.782562	1.387113	-4.168774	0.0001
LOG(ASIAN)	1.837481	0.625678	2.936784	0.0048
DUM1	-0.029294	0.021264	-1.377644	0.1738
DUM2	-0.079740	0.020898	-3.815707	0.0003
DUM3	-0.085626	0.021268	-4.026070	0.0002
PDL01	0.013197	0.009759	1.352350	0.1817
PDL02	-0.040337	0.019737	-2.043731	0.0457

R-squared	0.817613	Mean dependent var	3.995621
Adjusted R-squared	0.788300	S.D. dependent var	0.120954
S.E. of regression	0.055652	Akaike info criterion	-5.638542
Sum squared resid	0.173441	Schwarz criterion	-5.306776
Log likelihood	102.4219	F-statistic	27.89320
Durbin-Watson stat	0.872560	Prob(F-statistic)	0.000000

Lag Distribution of LOG(PADV)i		Coefficient	Std. Error	T-Statistic
. * |	0	0.01100	0.00813	1.35235
. * |	1	0.01760	0.01301	1.35235
. *|	2	0.01980	0.01464	1.35235
. * |	3	0.01760	0.01301	1.35235
. * |	4	0.01100	0.00813	1.35235
Sum of Lags		0.07699	0.05693	1.35235

Lag Distribution of LOG(PJUICES)i		Coefficient	Std. Error	T-Statistic
* .|	0	-0.03361	0.01645	-2.04373
* .|	1	-0.05378	0.02632	-2.04373
* .|	2	-0.06051	0.02961	-2.04373
* .|	3	-0.05378	0.02632	-2.04373
* .|	4	-0.03361	0.01645	-2.04373
Sum of Lags		-0.23530	0.11513	-2.04373

Appendix Table 5. Estimated Per Capita Demand Equations for Syracuse.

LS // Dependent Variable is LOG(PSALES)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.992284	3.354636	-0.593890	0.5550
LOG(PRICEF/NEBEV)	-0.031915	0.163566	-0.195122	0.8460
LOG(PCINCOME/NYALL)	0.253806	0.333535	0.760957	0.4499
LOG(BLACK)	-0.966361	0.384243	-2.514977	0.0148
LOG(HISP)	0.245834	0.124684	1.971649	0.0536
LOG(PSALES(-1))	0.534331	0.108980	4.903041	0.0000
DUM1	-0.086861	0.015167	-5.727177	0.0000
DUM2	-0.099273	0.013005	-7.633240	0.0000
DUM3	-0.078895	0.012450	-6.337069	0.0000
PDL01	0.007195	0.003620	1.987791	0.0517

R-squared	0.830612	Mean dependent var	4.087621
Adjusted R-squared	0.803389	S.D. dependent var	0.076750
S.E. of regression	0.034031	Akaike info criterion	-6.622216
Sum squared resid	0.064856	Schwarz criterion	-6.290450
Log likelihood	134.8832	F-statistic	30.51139
Durbin-Watson stat	1.846255	Prob(F-statistic)	0.000000

Lag Distribution of LOG(PADV)	i	Coefficient	Std. Error	T-Statistic
. * |	0	0.00600	0.00302	1.98779
. * |	1	0.00959	0.00483	1.98779
. *|	2	0.01079	0.00543	1.98779
. * |	3	0.00959	0.00483	1.98779
. * |	4	0.00600	0.00302	1.98779
Sum of Lags		0.04197	0.02112	1.98779

Appendix Table 6. Definition of Variables in Demand Models.

LOG(PSALES) = natural logarithm of per capita fluid milk sales;

C = regression intercept;

LOG(PRICEF/NYALL) = natural logarithm of retail fluid milk price instrumental variable divided by Consumer Price Index for all items in New York state;

LOG(NEBEV/NYALL) = natural logarithm Consumer Price Index for non-alcoholic beverages in Northeast divided by Consumer Price Index for all items in New York state;

DUM1 = indicator variable for quarter 1, equals 1 for quarter 1, 0 elsewise;

DUM2 = indicator variable for quarter 2, equals 1 for quarter 2, 0 elsewise;

DUM3 = indicator variable for quarter 3, equals 1 for quarter 3, 0 elsewise;

LOG(HISP) = natural logarithm of percent of region's Hispanic population;

LOG(RAGE1014) = natural logarithm of percent of regions population between 10-14 years of age ;

LOG(PSALES(-1)) = = natural logarithm of per capita fluid milk sales lagged one quarter;

LOG(PADV)i = natural logarithm of per capita generic milk advertising;

LOG(PBOTWATER)i = natural logarithm of per capita bottle water advertising;

LOG(PCINCOME/NYALL) = natural logarithm of per capita income divided by Consumer Price Index for all items in New York state;

LOG(BLACK) = natural logarithm of percent of region's African American population;

LOG(PCEARNINGS/NYALL) = natural logarithm of per capita earnings divided by Consumer Price Index for all items in New York state;

LOG(ASIAN) = natural logarithm of percent of region's Asian American population;

LOG(PJUICES)i = natural logarithm of per capita fruit juice advertising.

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