Thompson, Stanley R.

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THE RESPONSE OF MILK SALES TO GENERIC ADVERTISING AND PRODUCER RETURNS IN THE ROCHESTER, NEW YORK MARKET*

By

Stanley R. Thompson**

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**Assistant Professor, Department of Agricultural Economics, Michigan State University, East Lansing, Michigan 48824.

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I. INTRODUCTION

For the period January 1975 to December 1978 generic fluid milk media advertising expenditures have averaged about 13.3¢ per capita per year in the Rochester, New York market.[1/] This expenditure figure can be compared to the average annual January 1975 to June 1977 expenditure levels of 9.1¢, 3.4¢, and 3.9¢ in the New York City, Albany, and Syracuse markets, respectively. The per capita advertising investment in the Rochester market is significantly greater than the New York City expenditure and substantially greater than the investment levels in either Albany and Syracuse.

In September 1978 an analysis was conducted of the economic effectiveness of fluid milk advertising in the New York City, Albany, and Syracuse markets.[2/] The results of the analysis indicated that the effect of advertising was to increase the Class I sales such that the farm value of the sales increase due to advertising exceeded the cost of the media expenditures in each of the three markets. To enable this assessment an economic relationship of the response of milk

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[1/] As defined in this study, the Rochester market includes the following counties: Livingston, Monroe, Ontario, and Wayne.

[2/] Thompson, Stanley R., "An Analysis of the Effectiveness of Generic Fluid Milk Advertising Investment in New York State," Agricultural Economics Research Report, A.E. Res. 78-17, Department of Agricultural Economics, Cornell University, Ithaca, New York, September 1978, 27 p.

sales to advertising expenditures was estimated for each market. These estimated relationships provided the basis for the analysis of the producer returns to advertising. The purpose of this report is to conduct an investigation into the economic effectiveness of fluid milk advertising in the Rochester, New York market. To facilitate market comparison the research methodology employed in the previous "three-market" study will be employed here.

II. ESTIMATED SALES RESPONSE MODEL

Methodology:

Data were obtained on fluid milk sales and retail prices, personal income, population, competitive beverage prices, generic milk advertising expenditures, and other data affecting the demand for Class I fluid milk. These data were available for the Rochester, New York market which is defined for the purposes of this study to include the following counties: Livingston, Monroe, Ontario, and Wayne. Monthly observations were available from January 1975 to December 1978. This time series included 48 months of the most recently available data. The monthly variation in actual fluid milk sales and generic advertising expenditures in the Rochester market is shown in Figure 1. The annual total media expenditure was: $132,107 in 1975; $118,159 in 1976; $110,934 in 1977; and $134,810 in 1978. The range in monthly expenditures was from a low of zero (occurring in five of the total 48-month analysis period) to a high of $22,983 in October 1978. The approximate per capita expenditures were: 14.1¢ in 1975; 12.6¢ in 1976; 11.9¢ in 1977; and 14.5¢ in 1978.

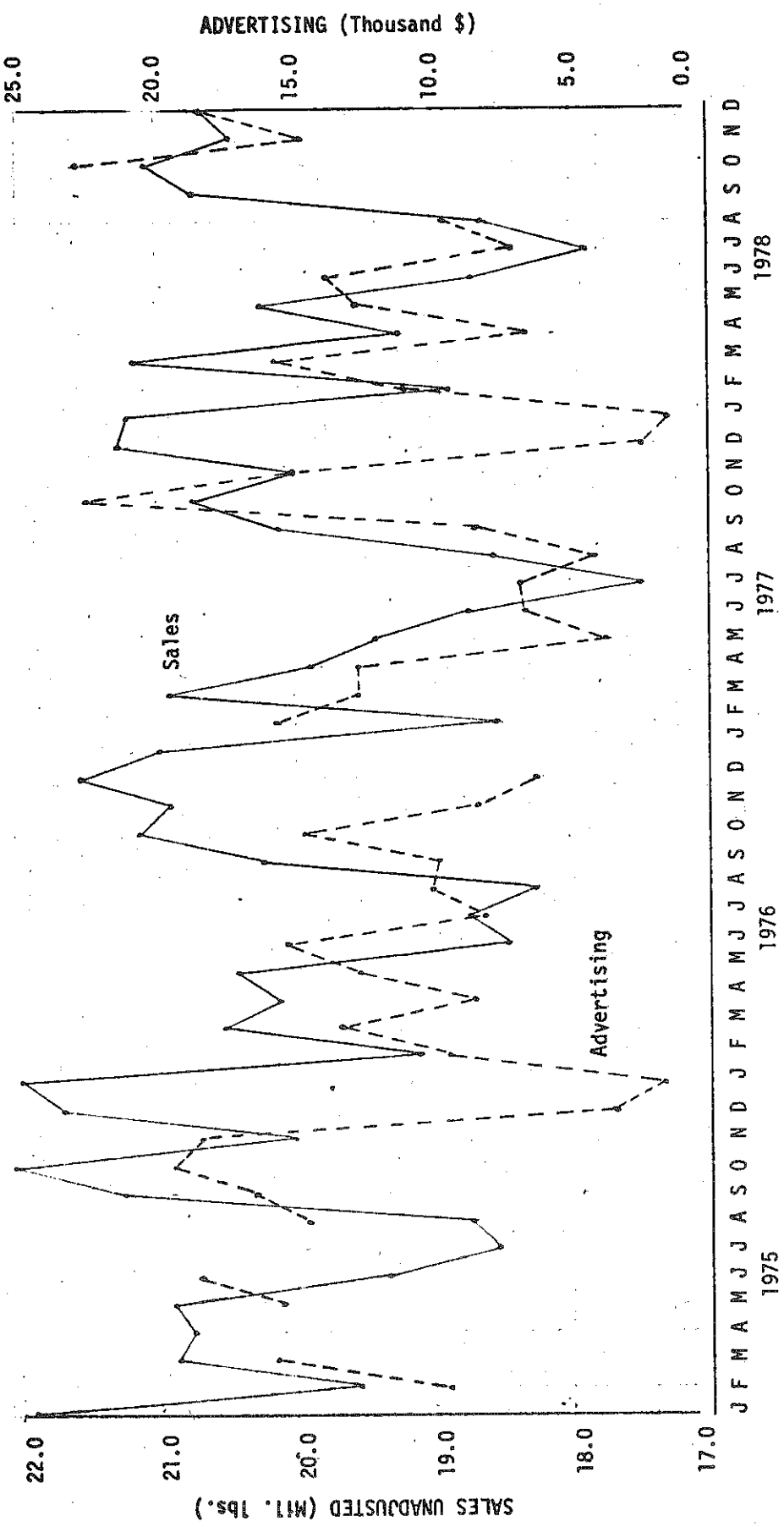

Figure 1. Actual Monthly Fluid Milk Sales and Generic Advertising Expenditures--Rochester, New York, January 1975 to December 1978.

The fluid Class I sales data are presented in Appendix Table 1. The sales data include regular whole milk, low-fat milk, and milk drinks. They were collected by the New York State Department of Agriculture and Markets--Division of Dairy Industry Services. The monthly sales data were placed on a daily basis and adjusted for the calendar composition of the month. The estimated average daily adjusted sales was: 10.73 oz. in 1975; 10.51 oz. in 1976; 10.36 oz. in 1977; and 10.42 oz. in 1978.

The generic fluid milk advertising data were actual (not budgeted) monthly expenditures. The monthly expenditure figures were placed on a per capita basis according to the population in the Rochester ADI (area of dominant influence) counties: Livingston, Monroe, Ontario, and Wayne. It should be noted that these are the identical counties that constitute the sales area. The expenditure data were deflated by an index of spot television advertising cost (see Appendix Table 1 for index definition and source).

Fluid milk price data were also obtained from the New York State Department of Agriculture and Markets--Division of Dairy Industry Services. The retail price of milk in one-half paper gallon containers was used and they were deflated by the Consumer Price Index (U.S. average for all items).

Competitive beverage price data were not available for the Rochester market. However, the retail price of cola drinks was available for the neighboring Buffalo, New York market, and hence, was used as a proxy for the cost of cola in the Rochester market.

Income data were obtained from the New York State Department of Commerce. Actual total personal income was used. The income data

were placed on a per capita basis and deflated by the Consumer Price Index.

The above data were used to estimate the following Class I sales response function:

$$
\begin{aligned}
(1)\quad \ln q_I = {} & -0.8692 \underset{(0.61)}{+0.0082}\ \text{DJAN} \underset{(2.28)}{-0.0363}\ \text{DFEB} \underset{(0.70)}{-0.0102}\ \text{DMAR} \\
& \underset{(2.78)}{-0.0323}\ \text{DAPR} \underset{(3.34)}{-0.0700}\ \text{DMAY} \underset{(9.79)}{-0.09952}\ \text{DJUN} \underset{(15.46)}{-0.1675}\ \text{DJLY} \\
& \underset{(11.98)}{-0.1316}\ \text{DAUG} \underset{(1.62)}{-0.0167}\ \text{DSEP} \underset{(0.37)}{+0.0042}\ \text{DOCT} \underset{(0.98)}{-0.0097}\ \text{DNOV} \\
& \underset{(1.98)}{+0.3427}\ \ln \text{INC} \underset{(2.47)}{-0.3607}\ \ln \text{PRC} \underset{(3/)}{+0.2000}\ \ln \text{SFTDK} \\
& \underset{(0.28)}{+0.0007}\ \ln A_t \underset{(0.10)}{+0.0003}\ \ln A_{t-1} \underset{(0.67)}{+0.0016}\ \ln A_{t-2} \\
& \underset{(0.71)}{+0.0036}\ \ln A_{t-3} \underset{(1.99)}{+0.0047}\ \ln A_{t-4} \underset{(1.77)}{+0.0040}\ \ln A_{t-5} \\
& \Sigma_{i=0}^{5} A_{t-i} = \underset{(1.75)}{0.0149};\ R^2 = 0.970;\ DW = 2.00.
\end{aligned}
$$

The above equation is a finite distributed lag model of lag length 5. Estimation was achieved by imposing the restriction that the lagged parameters must follow a third degree polynomial relationship over the finite 5 period length. The polynomial lag structure is defined in terms of a Lagrangian interpolation polynomial.[4/] Various lag lengths were fitted at alternative degree polynomials. In this process a 5 period-third degree polynomial (constrained to end at t-6 = 0) was selected as "best." The estimation of these lagged parameters for the advertising

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[3/] Equation 1 was estimated conditional on a cross-elasticity of soft drinks at 0.20. This procedure was necessitated because of a very high degree of intercorrelation between the soft drink and income variables.

[4/] Almon, S., "Distributed Lag Between Capital Appropriation and Expenditure," Econometrica, 33(1965):178-196.

variable enables an assessment of both the direct and carry-over effects of advertising on sales.

A double-log specification was selected to enable the estimation of a response function that would exhibit diminishing return to advertising. In addition, the selection was based on the superior statistical relationships generated by the double-log model over the non-log specification. Hence, based on the empirical examination of the economic relationship observed during the 48-month period in the Rochester market, the double-log specification seemed to best approximate the true functional form of the sales response function.[5/] The coefficients for price, income, and advertising can be directly interpreted as elasticities.

The use of the double-log specification, however, can pose a problem when some of the values of the regressors are zero. This problem was encountered with the advertising expenditure variable where zero expenditures occurred in five out of 48 observations. This "problem" was found to have a minor impact on the estimates and in this case was not deemed serious enough to warrant the selection of an alternative functional form.

Estimated Coefficients:

The estimated parameters of the Class I demand relation are presented in Equation 1, together with their corresponding t-ratios.

The estimated coefficients of the 11, zero-one dummy variables assess the seasonal variation in milk sales relative to December, the

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[5/] Although not estimated in this paper, a Box-Cox transformation procedure may have sprovided a closer approximation to the true functional form, see Box, G.E.P., and D.R. Cox (1964), "An Analysis of Transformations," J. Roy. Stat. Soc., B 26, 211-243.

base month. Interpretation of the price coefficient indicates that a 10 percent increase in retail price of milk will decrease per capita milk sales by 3.6 percent. The price elasticity of demand of -.36 is reasonable and similar to those reported in other studies.

The income elasticity of demand is estimated at 0.34. This implies that a 10 percent increase in real personal income can be expected to result in a corresponding fluid milk sales increase of 3.4 percent. Also, a 10 percent increase in the price of a 72 ounce carton of cola drinks can yield an expected increase in per capita fluid milk sales of 2.0 percent. These elasticity estimates are all reasonable and consistent with those obtained in other studies. Also, the t-ratios on all of these variables indicate that a high degree of confidence can be ascribed to the parameter estimates.

The estimated long-run advertising elasticity of demand is derived as the sum of the direct and carry-over effects of advertising on sales. In the Rochester market the long-run elasticity is estimated to be 0.0149. This elasticity estimate is approximately one-half of the estimate obtained in New York City and noticeably larger than those for the Albany and Syracuse markets.[6/] Despite some relatively low t-ratios associated with some of the lagged advertising parameters, the t-ratio of the total long-run effect is 1.75 which is indeed significant at the 95 percent level when performing a one-tail hypothesis test that the advertising effect is greater than zero.

[6/] Thompson, Stanley R., op. cit.

III. PRODUCER RETURNS

The returns to the advertising effort can be estimated by comparing the value of the estimated increase in milk sales due to advertising to the cost of the advertising effort. Since the data over which the sales response function was estimated contain a few observations when no advertising was made, an "arbitrarily small" media expenditure level of $1000 was used to replace the zero levels to enable the estimation of the double-log model.[7/] Accordingly, it is reasonable to compare milk sales at a given level of expenditure to those that could be expected if the smallest observed level obtained. In Figure 2 the actual per capita daily milk sales in 1978 are plotted against those sales estimated, assuming total monthly media expenditures of $1,000. In the latter case, all of the remaining regressors were held at their actual 1978 values.

For the calendar year 1978, the estimated fluid milk sales at the average 1978 level are compared to expected sales at the smallest observed level (see Table 1). The values of all of the other exogenous variables in the equation were those that actually occurred during January-December 1978. The difference between these two levels can be referred to as the sales gain attributable to advertising.

In the Rochester market the annual per capita sales gain attributed to advertising was 125 ounces, or a 3.4 percent increase over virtually not advertising. These figures compare to increases of 4.9, 1.3, and 1.9 percent in New York City, Albany, and Syracuse, respectively.

[7/] Total monthly media expenditures of $1,000 were included where zero expenditures were actually observed. This expenditure level was smaller than any of the actual non-zero expenditures during the period January 1975 to December 1978.

Figure 2. Actual and Estimated (Without Advertising) Per Capita Daily Fluid Milk Consumption NY-Metro SMSA, 1976

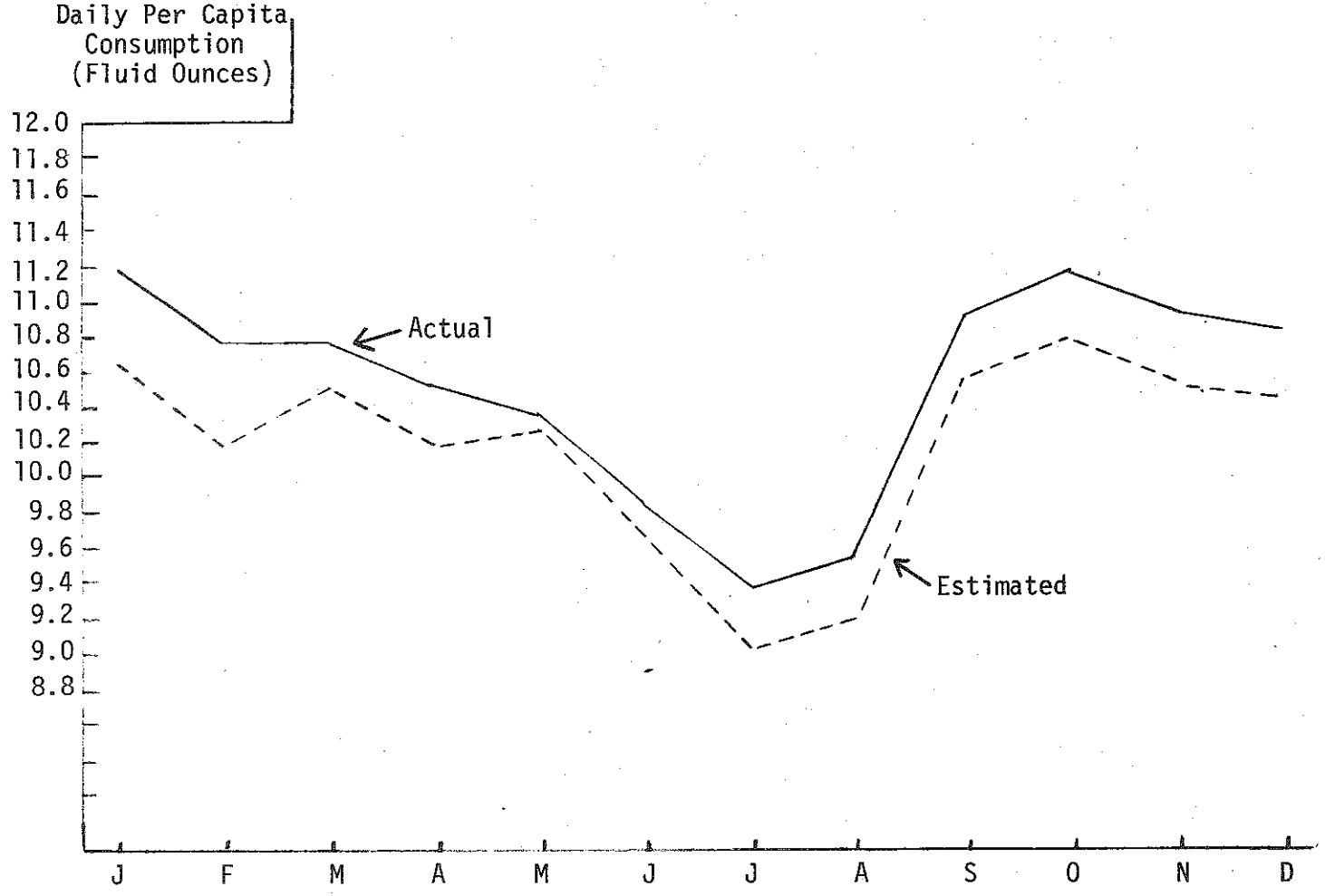

Table 1. Estimated 1978 Producer Returns to Fluid Milk Advertising, Rochester, New York*

Estimated per capita sales of fluid milk:[a/]	
- with advertising at 1/78 to 12/78 level	3835 oz.
- with advertising at the smallest observed 1978 level	3710 oz.
Per capita sales gain attributed to advertising	125 oz.
Farm value of per capita sales increase[b/]	20.8¢
Per capita expenditure calendar year 1978 (undeflated)	14.5
Producer's net return per capita from advertising	6.3¢

[a/] Sales were estimated using the actual January 1978 to December 1978: average monthly advertising expenditure, monthly milk price, monthly soft drink price, monthly income, and the estimate sales response coefficients as reported in the text.

[b/] Assuming no supply response and a Class I-Class I price differential of $2.47/cwt. (actual January-December 1978 average), each additional ounce of fluid milk has an estimated farm value of $.00166. Note: There are 14.88372 fluid ounces per pound of fluid milk.

*The market is defined to include the following New York State counties: Livingston, Monroe, Ontario, and Wayne.

The annual per capita consumption level at the average 1978 advertising level was 3835 ounces. This compares to consumption levels of 3072, 3401, and 3818 ounces in New York City, Albany, and Syracuse, respectively.[8/]

Assuming that the effect of the Rochester milk advertising program is to increase the utilization of total milk in the Class I market, the farm value of the per capita sales increase can be calculated. This farm value is quite sensitive to the magnitude of the Class I-Class II price differential, where the greater the differential, the greater the value of the increased sales. For calendar year 1978 the Class I-Class II price differential in the Rochester market averaged $2.47 per hundredweight.[9/] Employing the $2.47 per hundredweight differential, the farm value of the sales increase due to advertising is 20.8¢ per capita. After subtracting the actual 1978 per capita expenditure level of 14.8¢ per capita, the producer's average net return per capita from advertising is 6.3¢.

IV. SUMMARY AND CONCLUSIONS

The purpose of this report was to investigate the economic effectiveness of the fluid milk advertising program in the Rochester, New York market. In this quest, the response of fluid milk sales to generic advertising expenditures was estimated together with the corresponding returns to producers in the Rochester market.

[8/] The figures for New York City, Albany, and Syracuse were calculated for the July 1976 to June 1977 period, see Thompson, S.R., op. cit.

[9/] The Rochester Class I-Class II price differential was determined by adding $0.46 to the average 1978 Federal Order No. 2 Class I price (i.e., $11.54 + $0.46 = $12.00) and subtracting $0.05 from the Federal Order No. 2 Class II price (i.e., $9.58 - $0.05 = $9.53).

Monthly data from January 1975 to December 1978 were used to estimate the sales response model. All of the estimated parameters had the correct expected direction of influence and were of reasonable magnitude. The estimated effect of advertising on sales was estimated to carry-over five months which generated a long-run advertising elasticity estimate of 0.0149. This elasticity estimate is somewhat smaller than that previously estimated for New York City and larger than those estimated for the Albany and Syracuse markets.

When fluid milk sales at the average 1978 advertising level were compared to expected sales at the smallest observed advertising expenditure level in the 48-month period, the estimated average net producer's return per capita from advertising was 6.3¢. This net return figure is also somewhat smaller than that previously estimated for New York City and larger than the net return estimates in the Albany and Syracuse markets.

Although the findings reported in this study are only estimates of the true economic relationships in the Rochester fluid milk market, the results support the hypothesis that generic fluid milk advertising in Rochester is a profitable activity.

Appendix Table 1. Milk Sales, Generic Advertising Expenditures, and Other Data for Rochester, New York (January 1975 to December 1978)

		Adjusted Per Capita Sales[a] (Ounces)	Per Capita Monthly Advertising (Dollars)[b]	Per Capita Personal Income[c] (Dollars)	Retail Milk Price Quart[d] (Dollars)	Market Population (000)[e]	Consumer Price Index	Cost of Advertising Index[g]	Retail[h] Cola Price 72 oz. Carton (Dollars)
1975	Jan.	11.13	0	6474.4	.385	931,498	156.1	80	1.517
	Feb.	11.15	.01021	6515.5	.385	931,881	157.2	78	1.644
	Mar.	10.91	.01703	6556.6	.385	932,264	157.8	81	1.720
	Apr.	11.02	0	6597.8	.385	932,647	158.6	80	1.664
	May	10.52	.01652	6638.8	.385	933,030	159.3	81	1.588
	Jun.	10.55	.01984	6679.8	.385	933,413	160.6	76	1.578
	Jul.	9.47	0	6720.7	.385	933,800	162.3	73	1.577
	Aug.	9.75	.01569	6759.2	.385	933,933	162.8	72	1.584
	Sep.	11.19	.01753	6797.6	.385	934,066	163.6	76	1.586
	Oct.	11.19	.02102	6835.9	.395	934,199	164.6	82	1.530
	Nov.	10.86	.01979	6874.3	.415	934,332	165.6	84	1.647
	Dec.	11.07	.00395	6912.7	.415	934,465	166.3	86	1.586
1976	Jan.	11.05	.00201	6951.1	.425	934,598	166.7	84	1.552
	Feb.	10.47	.01002	6989.5	.425	934,731	167.1	84	1.527
	Mar.	10.98	.01410	7027.8	.425	934,864	167.5	92	1.483
	Apr.	10.52	.00914	7066.1	.425	934,997	168.2	99	1.456
	May	10.65	.01352	7104.5	.425	935,130	169.2	103	1.483
	Jun.	9.78	.01625	7142.8	.425	935,263	170.1	96	1.444
	Jul.	9.42	.00861	7181.1	.425	935,400	171.1	92	1.483
	Aug.	9.58	.01075	7233.4	.425	935,083	171.9	92	1.356
	Sep.	10.69	.01058	7285.6	.435	934,766	172.6	110	1.476
	Oct.	11.00	.01588	7337.9	.435	934,499	173.3	114	1.459
	Nov.	11.01	.00886	7390.3	.435	934,132	173.8	121	1.434
	Dec.	10.94	.00665	7442.7	.435	933,815	174.3	114	1.423
1977	Jan.	10.98	0	7495.1	.435	933,498	175.3	103	1.457
	Feb.	10.58	.01682	7547.6	.435	933,181	177.1	99	1.468
	Mar.	10.71	.01365	7600.1	.435	932,864	178.2	108	1.468
	Apr.	10.38	.01366	7652.7	.435	932,547	179.6	118	1.486
	May	10.22	.00415	7705.3	.445	932,230	180.6	113	1.465
	Jun.	9.95	.00729	7757.9	.445	931,913	181.8	111	1.486
	Jul.	9.13	.00741	7810.6	.455	931,600	182.0	98	1.447
	Aug.	9.51	.00445	7858.6	.455	931,467	183.3	94	1.419
	Sep.	10.55	.00898	7906.5	.455	931,334	184.0	100	1.468
	Oct.	10.88	.02397	7954.6	.455	931,201	184.5	109	1.486
	Nov.	10.64	.01613	8002.5	.455	931,068	185.4	115	1.470
	Dec.	10.74	.00252	8050.5	.455	930,935	186.1	119	1.467
1978	Jan.	10.19	.00178	8098.6	.455	930,802	187.2	111	1.460
	Feb.	10.78	.01183	8146.6	.455	930,669	188.4	99	1.463
	Mar.	10.78	.01701	8194.8	.455	930,536	189.8	113	1.489
	Apr.	10.50	.00736	8242.8	.465	930,403	191.5	110	1.489
	May	10.36	.01383	8290.8	.465	930,270	193.3	121	1.563
	Jun.	9.82	.01494	8338.9	.475	930,137	195.3	117	1.638
	Jul.	9.38	.00762	8387.1	.475	930,000	196.7	101	1.702
	Aug.	9.55	.01037	8435.2	.475	929,867	197.8	97	1.581
	Sep.	10.86	0	8483.4	.475	929,734	199.3	91	1.652
	Oct.	11.12	.02473	8531.5	.485	929,601	200.9	110	1.693
	Nov.	10.86	.01579	8579.8	.495	929,468	202.0	120	1.690
	Dec.	10.80	.01975	8627.9	.495	929,335	202.9	112	1.568

FOOTNOTES FOR APPENDIX TABLE 1

a/ The net sales within the Rochester market (Livingston, Monroe, Ontario, and Wayne Counties) were adjusted for the type of days in the month, i.e., number of Sundays, Mondays, etc. The sales were also placed on a per capita basis according to the population in the SMSA. Source for adjusting data for calendar composition: John P. Rourke, Adjusting In-Area Sales Data for Calendar Composition, USDA, Agr. Mktg. Ser. Fed. Milk Order Mktg. Stat., MOMS, No. 196, April 1976 and FMOMS No. 210, June 1977 and subsequent issues.

b/ Includes media advertising expenditures for television, radio, and newspaper. Advertising expenditures were placed on a per capita basis according to the population in the Rochester market. Source: Margaret R. Bailey, Asst. Sec.-Treas., Rochester Cooperative Milk Producers Bargaining Agency, Inc.

c/ Personal income within Rochester market before taxes. Personal income was placed on a per capita basis according to the market population. Source: New York State Department of Commerce, Personal Income, New York State By County, 1974 and 1975, July 11, 1977; and M. Bill Granger, New York State Department of Commerce, 1978.

d/ Source: "Survey of Prices" (price of one-half gal. paper containers), New York State Department of Agriculture and Markets--Division of Dairy Industry Services.

e/ Population source: U.S. Bureau of Census. The counties included in the Rochester market include: Livingston, Monroe, Ontario, and Wayne.

f/ Consumer Price Index (CPI), U.S. average--all items. Source: Survey of Current Business, U.S. Department of Commerce, Bureau of Economic Analysis (various issues).

g/ Index of spot television advertising cost (1967 = 100). Source: Media Decisions.

h/ Retail price of cola drink (throwaway, 72 oz. carton) in the Buffalo, New York area. Source: U.S. Department of Labor, Bureau of Labor Statistics, Estimated Retail Food Prices By City. Note: Since this document is no longer published, monthly estimates were made for the period July-December 1978.