DAIRY PROMOTION RESEARCH AT CORNELL: WHAT HAVE WE LEARNED?

by

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September 1980 81-18

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INTRODUCTION

Since the passage of the Dairy Promotion Order in May of 1972, New York State dairy farmers have been contributing some 4 million dollars annually (about $267 per producer) for the purpose of promoting the consumption of dairy products. To monitor the effectiveness of this expenditure and to provide pertinent information to Advisory Board members responsible for managing these funds, the Department of Agricultural Economics at Cornell has conducted a number of studies since 1972. The purpose of this paper is to combine and classify the knowledge gained from these studies into a single unified resource. Hopefully, as a byproduct of this effort, gaps or weaknesses in our knowledge will become apparent and this, in turn, will provide direction for future research.

It should be noted at the outset that the research cited in this review does not represent the entire Order 2 funded research effort at Cornell, but only those studies conducted by the Agricultural Economics Department (hereafter referred to simply as "Department"). For instance, dairy supported research conducted by the Food Science Department is not included in this review. As such, this review represents only a partial cataloging of the knowledge gained at Cornell from research conducted under the auspices of New York State dairy farmers.

The paper discusses Department research from four main vantage points according to what we have learned about: (1) beverage consumption levels in New York State, (2) the factors affecting milk consumption, (3) the economic effectiveness of generic milk advertising, and (4) the relationship between nutrition education and milk consumption. For the sake of comparing present

and future findings, Departmental research results are supplemented by relevant information from other studies.

Beverage Consumption Levels

The popularity of milk as a beverage has been steadily decreasing in the United States. In 1954 average annual per capita sales of milk beverages[1/] was 285 pounds (USDA 1980). By 1978 this figure had declined to 250 pounds--representing a 12 percent drop in milk consumption nationally. The problem of decreasing consumer preferences for milk is particularly acute in New York State: annual per capita sales have declined 29 percent--from 328 pounds in 1950 to 233 pounds in 1978[2/]. In the 1972-78 period alone (a period representing intensified milk promotion efforts) per capita milk sales in New York State declined nine percent (USDA 1979).

These trends pose a serious threat to the viability of the Dairy Industry nationally and in particular to the economic survival of New York State dairy farmers. Therefore the need to monitor, explain and predict beverage consumption behavior is becoming more urgent.

Apparently, one reason why consumers are drinking less milk is that they are drinking more soft drinks: average daily per capita consumption of soft drinks by Americans in 1976 was 10.8 ounces--up 209 percent from the 1950 level (Table 1). In 1950 the average American consumed nearly three times

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[1] Milk beverages are defined to include: plain whole milk, lowfat milk, skim milk, flavored milks and drinks, and buttermilk.

[2] These figures were made available from correspondence with Lyle Newcomb, Milk Marketing Specialist with the NYS Department of Agriculture and Markets. The 1950 figure is computed on a milk-equivalent basis whereas the 1978 figure represents product pounds, hence the figures are not strictly comparable. However, the error should be small since whole milk sales in 1950 accounted for 92 percent of fluid sales in that year.

Table 1 Average Daily Per Capita Consumption of Major Beverages in the United States, 1950 and 1976.

Beverage	1950	1976	Percent Change
	(oz.)	(oz.)	
Coffee and Tea	15.0	13.8	-8.0
Soft Drinks	3.5	10.8	208.6
Beer and Wine	N.A.	10.6[1/]	N.A.
Milk	10.2	8.4	-17.6

N.A. - not available

[1/] A 1976 figure expressed in terms of the drinking population of 14-year olds and older

SOURCE: Brewster, Letitia and Michael F. Jacobson. The Changing American Diet. Washington, D.C.: Center for Science in the Public Interest, 1978.

as much milk as soft drinks. By 1976 soft drink consumption outpaced milk consumption by 29 percent.

Department surveys conducted in the spring and fall of 1973 (see Appendix Table A.2 for details regarding the data) revealed a pattern of beverage consumption in major New York State markets similar to the national pattern: coffee and tea is the most heavily consumed beverage (about 14 ounces daily) with soft drinks second at 10.1 ounces daily. Milk consumption, 7.8 ounces daily, accounted for less than 16 percent of total liquid intake and was 23 percent lower than soft drink consumption[3/].

The 1973 survey data also revealed that milk consumption in New York City (6.4 ounces daily) was 38 percent less than in the upstate markets of

[3] Note that these figures are not comparable to the national figures because they correspond to the 12-64 age group only.

Albany and Syracuse (Table 2). This finding confirmed information contained in market sales data for that year which indicated that per capita daily milk sales in New York City is some 33 percent lower than in the upstate markets.

Table 2 Per Capita Beverage Consumption in Three New York State Markets by Individuals, Age 12 to 64, 1973.

Beverage	Consumption	
	Ounces Per Day	Percent of Total
Coffee and Tea	14.1	28.2
Soft Drinks	10.1	20.2
Water	8.0	16.0
Milk	7.8	15.6
Beer and Wine	4.8	9.6
Fruit Drinks	4.1	8.2
Liquor	1.1	2.2
TOTAL	50.0	100.0

SOURCE: Forker, O. D., and D. A. Eiler. Testimony Presented at Public Hearing on New York State Dairy Promotion Order in Albany, New York on October 23, 1974. Department of Agricultural Economics, A.E. Staff Paper No. 75-8, Cornell University, May 1975. 19 pp.

Thus the data show an increasing preference for soft drinks, at the apparent expense of coffee, tea and milk consumption. Per capita milk sales in New York State have been declining at almost three times the national rate and this decline has continued despite intensified milk promotion efforts. Upstate consumers drink more milk than New York City residents. In 1973, 12 to 64-year olds in the Albany-Syracuse-New York City markets drank about as much milk as water.

While total per capita fluid milk sales have been declining, within the category of "fluid milk", frequently overlooked (or ignored) important

changes in the structure of the demand for milk have taken place. The per capita consumption of whole milk in the United States has declined 43 percent since 1954 while per capita consumption of lowfat and skim milk has increased by 1,062 percent during the period 1954-78 (USDA 1980). Whereas lowfat and skim milk accounted for just 2 percent of fluid milk sales in 1954, its share had increased to 31 percent by 1978. Data for New York State indicate a similar trend.[4/] These trends, if they continue, have important implications for the future pricing and promotional policies of milk.

Factors Affecting Milk Consumption

Since 1972 the Department has conducted six separate beverage consumption surveys in New York State (see Appendix Table A.2 for more information regarding these surveys). One survey, taken in November, 1972, provided information on adult attitudes towards selected beverages. Another, taken in September-October, 1974, focused on teenage beverage consumption habits and the influence of peers, parents and advertising awareness on these habits. Two surveys, conducted in the spring and fall of 1973, yielded base-line data on beverage consumption levels of individuals, age 12 to 64, living in the Albany, New York City, and Syracuse marketing areas.[5/]

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[4]See for instance milk consumption statistics published in various issues of New York Dairy Statistics (35).

[5]Unfortunately corresponding surveys taken in 1974 yielded unusable data.

This chapter discusses how these data have served to expand our knowledge regarding the following factors affecting milk consumption: age, sex, race, location, household size, income, prices, attitudes, social influences, and advertising awareness. Where Departmental survey information is weak, supplemental information from outside surveys will be used. This review should provide some hints regarding the relative importance of these factors in explaining the demand for milk. This, in turn, can be used to (1) help explain the observed per capita secular decline in milk consumption, (2) provide a basis for predicting future milk consumption trends, (3) suggest ways to enhance milk consumption by focusing attention on the key variables responsible for changes in milk consumption, and (4) provide direction for future research efforts.

Age. Since the average age of the American population is rising, the effect of growing older on milk consumption has important implications for the long-run demand prospects for milk.

An age breakdown of the 1973 Department Survey data reveals that milk consumption in New York drops sharply with age: from 17.2 ounces daily for adolescents to 7.8 ounces daily for young adults to 4.7 ounces daily for middle age and older individuals (Table 3).

Table 3 Per Capita Daily Beverage Consumption by Age. Groups, New York State, 1973.

Beverage	Age Group 12 to 17 Ounces Per Day	12 to 17 Percent	18 to 34 Ounces Per Day	18 to 34 Percent	35 to 64 Ounces Per Day	35 to 64 Percent
Coffee and Tea	2.8	5.5	13.3	24.8	18.6	39.7
Soft Drinks	15.4	30.4	12.5	23.2	6.3	13.5
Water	9.0	17.8	7.7	14.3	7.9	16.9
Milk	17.2	34.0	7.8	14.5	4.7	10.0
Beer and Wine	.5	1.0	7.0	13.0	4.4	9.4
Fruit Drinks	5.5	10.9	4.3	8.0	3.5	7.5
Liquor	.2	.4	1.2	2.2	1.4	3.0
TOTAL	50.6	100.0	53.8	100.0	46.8	100.0

SOURCE: Forker, O. D. Results from an Advertising Program in New York. Department of Agricultural Economics, AE-4406, University of Illinois. July 1976.

Beverages directly competitive with milk appear to change with age, also. Coffee and tea, which is only 5.5 percent of liquid intake for 12 to 17 year olds, accounts for nearly 40 percent of total beverage consumption by 35 to 64-year olds. On the other hand, soft drink consumption has nearly the reverse pattern: falling from 30.4 to 13.5 percent market share as age increases from the 12 to 17-year old group to the 35 to 64 age category.

The apparent inverse relationship between age and milk consumption suggested by the tabular analysis received statistical verification in the Thompson and Eiler study (1973). Compared with the effect of income, sex, race, consumption of alternative beverages and milk advertising awareness, they found the natural log of age to be the most statistically significant variable in estimating the probability of milk consumption in each of the three markets analyzed. Age was not found to be a statistically significant variable in explaining milk consumption among teenagers, however (Cook, Eiler, and Forker 1975).

Unfortunately, statistical analysis conducted by the Department yields no information on how the quantity of milk changes with age, holding other relevant factors constant. Quantifying this relationship is necessary to gain a clearer understanding of how an aging population is likely to affect milk demand.

Sex. The 1973 Department surveys show that males drink more milk than females. Looking at New York City white respondents only, males in the 18 to 34 age group consume 68 percent more milk than females (Table 4). This is so in spite of the fact that the Recommended Daily Dietary Allowances for Calcium is the same for both sexes in this age group (National Academy of Sciences 1968) and milk and cheese supplies about 66 percent of the calcium in American diets. Nationally, females in the 18 to 34-year old age group consumed only 72 percent of the RDA of calcium in 1965 (compared to 118 percent for males). This suggests that nutritional arguments could serve as a component of milk demand expansion programs.

Table 4 Per Capita Daily Milk Consumption by Whites in Three New York State Markets, by Age and Sex, 1973.

Age	New York City		Albany		Syracuse	
	Male	Female	Male	Female	Male	Female
	ounces per day					
12 - 17	16.8	11.7	23.6	16.3	25.6	19.7
18 - 34	7.9	4.7	12.2	8.3	12.0	8.4
35 - 64	4.3	3.4	7.2	4.7	7.8	4.8

SOURCE: Cook, C. B., D. A. Eiler and O. D. Forker. Beverage Consumption and Advertising Awareness in Selected New York State Markets 1973. Department of Agricultural Economics, A.E. Res. 74-10, Cornell University, September 1974.

Multivariate regression analysis found sex to be the most statistically significant variable in explaining teenage milk consumption (Cook, Eiler, Forker 1975). The analysis showed that sex difference in New York City is much greater than suggested by the data in Table 4; holding other factors such as age, family social position, soft drink and milk advertising awareness, race, day of week, location of residence, number of siblings, peer and parent influence constant, daily milk consumption by teenage males was 9.3 ounces higher than teenage females. The corresponding figure for Albany was 8.5 ounces--very close to the sex difference of 8.3 ounces given in Table 4--suggesting that in Albany factors other than sex difference either do not affect teenage milk consumption or are self-canceling.[6/]

Sex differences in milk consumption among teenagers is not justifiable on nutrition grounds; males in the 12-17 age category consumed about 90 percent of the RDA of calcium in 1965; females about 69 percent (National Academy of Sciences 1968). Here again the nutrition angle of dairy product promotion may need greater emphasis.

Race. The Health and Nutrition Examination Survey (HANES) revealed that some 73 percent of black females and 35 percent of black males between the ages of 18 and 44 in the United States received less than the RDA of calcium in 1971 (HEW 1974). Corresponding figures for the white population is 56 percent and 17 percent respectively. It is not surprising, therefore, that the 1973 Department surveys showed blacks in general consuming less milk than whites. The differences are particularly sharp among NYC black teenagers, where males consumed 21 percent less and females 26 percent less milk than their white counterparts (Table 5).

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[6]Regression results for the Syracuse market were not given.

Table 5 Mean Per Capita Milk Consumption by Race, Sex, and Age Group -- New York City, 1973.

Age	Males		Females	
	Black	White	Black	White
	- - - - - - -oz./day- - - - - - -			
12 - 17	13.2	16.8	8.6	11.7
18 - 34	6.9	7.9	4.5	4.7
35 - 65	5.3	4.3	2.7	3.4

SOURCE: Cook, C. B., D. A. Eiler and O. D. Forker. Beverage Consumption and Advertising Awareness in Selected New York State Markets 1973. Department of Agricultural Economics, A.E. Res. 74-10, Cornell University, September 1974.

That milk is a less popular drink among blacks than whites is illustrated by the fact that in general there are more milk drinkers among whites--the only exception is for blacks in the 35 to 65 age category where about 38 percent of blacks consume milk compared to 31 percent of whites (Table 6).

Table 6 Percent of Respondents Consuming Milk by Race, Sex, and Age -- New York City, 1973.

Age	Males		Females	
	Black	White	Black	White
	- - - - - - - Percent - - - - - - -			
12 - 17	67.6	83.6	66.6	72.2
18 - 34	42.5	47.7	30.7	37.2
35 - 65	37.9	30.7	25.3	30.2

SOURCE: Cook, C. B., D. A. Eiler and O. D. Forker. Beverage Consumption and Advertising Awareness in Selected New York State Markets 1973. Department of Agricultural Economics, A.E. Res. 74-10, Cornell University, September 1974.

More detailed analyses with this and other New York State data revealed that race differences were generally not statistically significant where other factors such as income were controlled (Cook, Eiler, Forker 1975). This finding

is at variance with other studies which show race exerting a strong influence on milk consumption. For instance, Boehm and Babb (1975), using national panel data, found black households consuming 23.5 gallons of fluid milk less than white households during May 1972-January 1974 even after controlling for factors such as income, occupation, family composition, region, education and city size. Furthermore, the race variable had a t-value of 9.75.

Thus there is evidence that significant race differences do exist in the consumption of milk. Coupling this fact with the race differences in calcium intake provides information that could be valuable to marketing agencies interested in the promotion of milk.

Location. As indicated earlier, one of the more interesting findings of the Department surveys is the low level of milk consumption in the New York City market relative to the upstate markets of Albany and Syracuse. The 1973 Surveys indicated that the average daily milk consumption by individuals age 12 to 64 in New York City was 6.4 ounces--40 percent less than the corresponding figure of 10.7 ounces in Syracuse and 35 percent less than the 9.8 ounces consumed daily in Albany (Forker 1976). Market sales data, which are somewhat higher than individual consumption figures, show that in the five-year period since the expanded milk promotion efforts began in 1972, per capita sales of milk have declined by 2.3 percent in New York City, despite the fact that some 5 million dollars in direct media advertising have been poured into this market (table 7).

Table 7 Adjusted Per Capita Daily Milk Sales: Selected New York State Markets, 1971-1977.

Year	Market		
	New York City	Albany	Syracuse
	- - - - - - - - ounces per day - - - - - - - -		
1971	8.54	11.12	13.66
1972	8.72	12.06	13.66
1973	8.80	12.46	13.84
1974[1/]	N.A.	N.A.	N.A.
1975	8.82	9.40	16.27
1976	8.52	9.24	15.92
1977[2/]	8.48	9.40	16.06

[1/] Milk strike year.

[2/] Based on first six months of the year only.

SOURCE: Thompson, S.R., D.A. Eiler and O.D. Forker. "An Econometric Analysis of Sales Response to Generic Fluid Milk Advertising in New York State," Search 6(3): (1976) 1-24., and

Thompson, S.R. An Analysis of the Effectiveness of Generic Fluid Milk Advertising Investment in New York State. Dept. Agr. Econ. A.E. Res. 78-17, Cornell University, September, 1978.

Of course it is possible that the decline would have been more rapid without the advertising effort, but the 16.5 percent increase in per capita milk consumption in Syracuse, where the advertising investment is considerably less, weakens the credibility of this argument. Whether actual consumption changes have occurred as suggested by the market data needs to be confirmed with independent survey data.

Income. Department research indicates that income and social position have little or no effect on milk consumption. Estimated income elasticities for the major milk markets in New York are quite small and in most cases not statistically significantly different from zero (Table 8).

Table 8 Income Elasticity Estimates for Milk in Selected New York State Markets Based in Time Series Market Data

	Market (SMSA)			
Data Period	New York City	Albany	Syracuse	Rochester
1/71 - 3/74[1/]	.15 (.44)	2.87 (7.87)	.13 (.74)	N.A.
1/75 - 6/77[2/]	.14 (.61)	.47 (.47)	.52 (.47)	N.A.
1/75 - 12/78[3/]	N.A.	N.A.	N.A.	.34 (1.98)

NOTE: Figure in parenthesis is the t-statistic.

N.A. - Not available.

1/ SOURCE: Thompson, S. R., D. A. Eiler and O. D. Forker. "An Econometric Analysis of Sales Response to Generic Fluid Milk Advertising in New York State". SEARCH, 6(3): (1976) 1-24.

2/ SOURCE: Thompson, S. R. An Analysis of the Effectiveness of Generic Fluid Milk Advertising Investment in New York State. Department of Agricultural Economics, A. E. Res. 78-17, Cornell University, September 1978.

3/ SOURCE: Thompson, S. R. The Response of Milk Sales to Generic Advertising and Producer Returns in the Rochester, New York Market. Department of Agricultural Economics, A. E. Staff Paper No. 79-26, June 1979.

However, these estimates may be misleading due to multicollinearity problems usually associated with using time series market data. Unfortunately, comparable estimates using survey data are not available.

Income elasticity estimates based on nationwide panel data yield some interesting results: whereas the demand for milk beverages as a group is highly unresponsive to income changes ($\eta_{c.y} = .05$), there is considerable variation in response for the different milk beverages (Table 9)[7/].

Table 9 Estimated Income Elasticities for Selected Milk Beverages, US.[1/]

Beverage	Income Elasticity
Total Fluid Milk	.0522*
Regular Whole Milk	-.0667*
2% Butterfat	.1594*
1% Butterfat	.0845
Skim Milk	.3176*
Buttermilk	-.1729*

1/ Estimates based on panel data: May 1972-January 1974.

* Estimated income elasticity statistically different from zero at the 10 percent probability level.

SOURCE: Boehm, William T. and Emerson M. Babb. Household Consumption of Beverage Milk Products. Exper. Stat. Bull No. 75, Purdue University, West Lafayette, Indiana, March 1975.

[7] Estimates presented in this table probably understate the magnitude of the actual income response because the entry/exit phenomenon is ignored in the analysis (see Thrasen, Hammond and Buxton 1977). Therefore the estimates may be viewed as setting a lower bound on the true values.

For instance, a 10 percent increase in income reduces whole milk consumption by .6 percent and increases skim milk consumption by 3.2 percent, ceteris paribus. The negative income elasticities for whole milk and buttermilk suggest that consumers view these beverages as "inferior" goods. Indeed, since 1954, per capita consumption of whole milk in the US has declined 41 percent and buttermilk 44 percent (USDA 1980). During this same period the consumption of lowfat and skim milk has increased 28,935 percent and 82 percent, respectively (USDA 1980). Note that 1% milk was the only milk beverage where income was not a statistically significant determinant of consumption.

An estimated income elasticity for total fluid milk of .05 means that secular per capita income increases cannot be expected to expand the demand for milk by very much.

Prices: Accurate knowledge of the sensitivity of consumer demand to milk price changes is extremely important to policy makers interested in achieving the twin goals of increased milk consumption and increased dairy farm income via price policy. If the demand for milk is known to be highly price inelastic, then producer revenues can be increased by increasing milk prices without worrying about a fall-off in consumer demand, other things being equal. During the 1972-1977 period nominal whole milk prices increased by nearly 36 percent in the New York metropolitan area and per capita sales of milk in the New York City market decreased 3.4 percent. This suggests that milk demand is relatively price inelastic. However, when the 1972 and 1977 milk prices are deflated by the Consumer Price Index, one observes that in real terms, milk prices actually decreased 3.1 percent during this period. What role then do prices play in the consumer demand for milk?

Department research conducted so far provides only a partial answer to this important question. Evidence from the time series data for selected

New York State markets reveals that the milk own-price response is generally not statistically significant except in the Rochester market where the estimated own-price elasticity is -.36. (Table 10).[9/]

Table 10 Direct and Cross-Price Elasticities of Fluid Milk in Selected New York State Markets Estimated from Time Series Data

Data Period	Market (SMSA)							
	New York City		Albany		Syracuse		Rochester	
	Own Price	Cross[4/] Price	Own Price	Cross[4/] Price	Own Price	Cross[4/] Price	Own Price	Cross[4/] Price
1/71-3/74[1/]	-.20 (7.45)	N.A.	-.002 (.02)	N.A.	.04 (.99)	N.A.	N.A.	N.A.
1/75-6/77[2/]	-.33 (1.13)	.27 3.87	-.07 (.36)	.09 (1.19)	-.02 (.09)	.10 (2.33)	N.A.	N.A.
1/75-12/78[3/]	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	-.36 (2.47)	.20[5/] (N.A.)

Figures in parenthesis are t-statistics.

[1/] SOURCE: Thompson, S. R., D. A. Eiler and O. D. Forker. "An Econometric Analysis of Sales Response to Generic Fluid Milk Advertising in New York State." SEARCH, 6(3): (1976) 1-24.

[2/] SOURCE: Thompson, S. R. An Analysis of the Effectiveness of Generic Fluid Milk Advertising Investment in New York State. Department of Agricultural Economics, A. E. Res. 78-17, Cornell University, September 1978.

[3/] SOURCE: Thompson, S. R. The Response of Milk Sales to Generic Advertising and Producer Returns in the Rochester, New York Market. Department of Agricultural Economics, A. E. Staff Paper No. 79-26, June 1979.

[4/] The cross-price elasticity estimate is for cola drinks.

[5/] In the analysis this value was imposed on the data rather than estimated to improve the precision of the own-price elasticity estimate.

[9] The estimated own-price elasticity is highly statistically significant in New York City market when the 1/71-3/74 data is used but this may be due to the omission of cola prices as a relevant explanatory variable. In addition, these estimates are not efficient since the data was not adjusted to remove the effects of serial correlation.

What little evidence there is on substitutes suggests that significant cross-price relationships may exist: for instance, a ten-percent increase in cola prices is estimated to increase daily per capita milk sales by 2.7 percent in the New York City market, ceteris paribus. This is a very significant finding and more effort needs to be directed toward discovering the effects that changes in the prices of other beverages will have on the demand for milk. During the June 1976 to June 1977 period, coffee prices doubled (from $2.07 per pound to $4.14) in the New York City area (BLS 1976-77). What impact did this phenomenon have on milk consumption? Furthur, Thompson and Eiler (1973) found that the consumption of fruit drinks or juices increased the probability of milk consumption. Are these beverages really complementary to milk?

On the national level, estimates based upon panel data reveal that consumers are quite sensitive to milk price changes in the "long run." Boehm and Babb put the long-run own-price elasticity of regular whole milk at -1.70 compared to their estimate of -.38 for the short-run response. (Table 11).[10/]

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[10]These estimates are probably downward biased in absolute value since prices of competing beverages were not included in the model.

Table 11 Short- and Long-Run Price Elasticities for Selected Beverage Milk Products Estimated from Panel Data, US, 1972-1974.

Beverage	Short-Run Elasticity	Long-Run Elasticity
Total Fluid Milk	-.14	-1.63*
Regular Whole Milk	-.38*	-1.70*
2% Butterfat	-.55*	-1.33*
1% Butterfat	-1.18*	-.83*
Skim Milk	-.12	-1.82*
Buttermilk	-1.78*	-1.52*

*statistically significant ($p \leq .10$)

SOURCE: Boehm, William T. and Emerson M. Babb. Household Consumption of Beverage Milk Products. Exper. Stat. Bull No. 75, Purdue University, West Lafayette, Indiana, March 1975.

In addition, they discovered elasticities varying according to type of milk. For instance, the demand for both 2% and 1% milk was less elastic than whole milk in the long run, whereas the opposite was true for the short run.

One implication of the widely differing magnitude between the short-run and long-run responses is that significant lags occur in consumer adjustment to changes in milk prices. This means that using a single milk price variable, either contemporaneous or lagged one period, may be an inadequate treatment of the milk price effect on milk sales. This possibility warrants further investigation.

A more serious implication of the highly elastic estimated long-run milk price response is that, over time, a ten-percent increase in milk prices will result in a greater than ten-percent decline in milk consumption, ceteris paribus. This places greater pressure to be effective on the ceteris paribus factors that positively influence the demand for milk, such as advertising.

Cross-price elasticities for products within the fluid beverage milk group provide some insight on how the composition of milk demand may change in response to changes on the relative prices of these products. For instance, Boehm and Babb estimate that a 10-percent increase in the price of whole milk leads to an immediate (short-run) 8.5 percent increase in the consumption of 2% milk, ceteris paribus (Table 12). It appears that consumers are more willing to switch from whole milk to 2% than vice-versa: A 10-percent increase in the price of 2% milk increases whole milk consumption by an estimated **two percent in the short run, ceteris paribus.**

Table 12 Cross-Price Elasticities of Selected Beverage Milk Products Estimated from Panel Data, US, 1972-1974.

	One Percent Change in Price of:			
Quantity Demanded of:	Regular Whole Milk	2% Milk	1% Milk	Skim Milk
Regular Whole Milk	-.38*	.20*	.29*	--
2% Milk	.85*	-.55*	.05*	--
1% Milk	-1.16*	3.06	-1.18*	--
Skim Milk	-.28	-.04	--	-.12

*statistically significantly different from zero ($p. \leq .10$)

SOURCE: Boehm, William T. and Emerson M. Babb. Household Consumption of Beverage Milk Products. Exper. Stat. Bull No. 75, Purdue University, West Lafayette, Indiana, March 1975.

The apparent ease with which consumers will switch from whole to 2% milk is good news for nutritionists who would like to see Americans reduce their saturated fat intake. Long-run cross-price effects as well as the cross-price effects for a greater range of beverages needs to be determined, however. In addition, the effects of milk price changes on the consumption of other beverages needs to be determined.

Attitudes. Knowledge of the existence of systematic differences in attitudes between milk consumers and nonconsumers would increase our understanding of current trends in milk consumption and point to sources of possible misinformation. A survey of adult consumers (over the age of 18) in seven New York State markets conducted by the Department in the fall of 1972 yielded information on 16 attitude variables pertaining to the nutritional, health, image and cost aspects of beverage consumption (see Appendix Table A.2 for more details regarding the data). Chi-square tests were performed with the data to see if statistically significant differences existed in the distribution of responses both across markets and among consumers and nonconsumers of milk (Eiler, Thompson 1974). The results are summarized by the investigators as follows (p. 19):

> "virtually no significant differences were observed between the nutritional attitudes of adult milk consumers and adult nonconsumers in any of the seven markets"

> ".... the lack of effective discrimination between consumers and nonconsumers based solely on their attitudes towards the cholesterol content of milk ... the same conclusion is apparent with respect to consumer-nonconsumer attitudes towards the appropriateness of milk in the diet of one who is concerned with heart disease."

and finally, as somewhat of an understatement:

> "Adult attitudes towards the nutritional composition of the various beverages are not always consistent with the actual nutritional content. This was revealed through the relative comparison of the nutritional attitude scales of the three alternative milks to their corresponding actual nutritional levels."

This last finding is perhaps the most interesting and is highlighted by a comparison of the data presented in Tables 13 and 14. These data show that adults are highly ignorant of the nutritional content of the various milk

beverages, in general believing that skim and lowfat milk is less nutritious than whole milk.[11]

Table 13 Percentage of Adults in New York State Markets Fully Agreeing[1] with Selected Statements Regarding the Nutritional Content of Certain Milk Beverages, 1972

Statement	Beverage		
	Whole Milk	Lowfat Milk	Skim Milk
	(%)		
Very high in protein	47.4	27.8	25.6
Very high in calcium	63.1	29.5	30.7
Very high in vitamins	43.1	20.2	21.3

[1]"Fully Agreeing" means that the respondent selected the leftmost circle for questions posed as follows: "whole milk is: very high in protein 0000000 very low in protein.

SOURCE: Eiler, D. A., and S.R. Thompson. "Adult Attitudes Toward Major Beverages in Seven New York Metropolitan Markets," SEARCH, 4(10) (April, 1974) 1-47.

Table 14 Nutritional Content of Selected Beverages (100 grams edible portion)

Nutritent	Beverages		
	Whole Milk	Lowfat Milk	Skim Milk
Protein (gm)	3.5	4.2	3.6
Calcium (mg)	118	143	121
Vitamin A (int'l units)	140	80	trace
Thiamin (mg)	.03	.04	.04
Riboflavin (mg)	.17	.21	.18
Niacin (mg)	.1	.1	.1
Absorbic Acid (mg)	1.0	1.0	1.0

SOURCE: Eiler, D. A., and S.R. Thompson. "Adult Attitudes Toward Major Beverages in Seven New York Metropolitan Markets," SEARCH, 4(10) (April, 1974) 1-47.

[11]The low nutritional scoring of lowfat and skim milk vis-a-vis whole milk by adult consumers may be due to the highly suggestive nature of the term "whole" in whole milk.

Note that while 63.1 percent of the white adults were sure that whole milk was high in calcium, only 29.5 percent thought this statement was true for lowfat milk. The fact is that lowfat milk is 21 percent higher in calcium than whole milk. Minorities, such as blacks and Hispanics, exhibited an even greater degree of ignorance concerning the nutritional qualities of the various beverages. For instance, 40 percent of blacks and Hispanics thought that orange juice was high in protein compared to 22 percent of whites who felt this way.

This general lack of nutritional knowledge on the part of adults leaves open the possibility that as consumers become better informed nutritionally milk will come to be viewed more favorably. Beer, coffee and soft drinks are almost devoid of nutrients.

While the analysis conducted with the 1972 Adult Attitude Survey revealed no systematic difference between consumers and nonconsumers with regard to nutritional beliefs, this does not warrant a closed book on the subject. Consumers are becoming increasingly nutrition conscious and today nutrition is likely to be a more important factor in food consumption decisions than it was in 1972. The relationship between nutritional attitudes (and knowledge) and milk consumption bears another look. One potentially fruitful line of research might be to compare beverage consumption levels of consumers who had received accurate nutrition information regarding these beverages with those who had not. Since milk is superior nutritionally to most substitute beverages, the hypothesis would be that those possessing the most accurate nutritional information, other things being equal, would have the highest levels of milk consumption.

Social Influences. Factors other than the demographic and economic characteristics of individuals affect behavior. Levy, Iverson, and Walberg (1979) point to the home environment, mass media and peer group influences as

agents of change in nutrition behavior. Department research yields some evidence with respect to the last of these factors. In particular, the relationship between parental and peer influence and teenage beverage consumption was investigated using data collected in the fall of 1974 (see Appendix Table A.2 for more details regarding the data).

Teenagers were asked (1) whether their parents were authoritarian, democratic, or permissive, (2) whether it was parents' or peers' opinions and ideas they respected most, and (3) whether they enjoyed their parents' or friends' company more. The marginal affect of these factors on the quantity of milk consumed by teenagers was, in general, not statistically significantly different from zero (Cook, Eiler, Forker 1975). There was some weak evidence that certain of these factors may effect teenage soft drink consumption, to wit; teenagers with democratic parents drank 3.2 ounces less soft drinks per day than teenagers with permissive parents in Albany and teenagers who respected parents' ideas and opinions consumed 2.9 ounces less soft drinks per day than teenagers who respected friends' ideas and opinions (Cook, Eiler, Forker 1975). These were the only statistically significant findings with respect to these variables. This data revealed that the sex of the respondent was much more important than social influences in explaining beverage consumption habits of teenagers.

Advertising awareness. The Department analyzed three separate data sets in an attempt to quantify the relationship between awareness to milk advertising and milk consumption. The first of these data sets, collected in the fall of 1973 (see Appendix Table A.2), was analyzed using a Probit Model which examined the effect of milk advertising awareness on the probability of milk consumption, holding constant other variables such as age, income, sex, ethnicity and consumption of other beverages (Thompson, Eiler 1973).

The estimated marginal advertising effect, along with the associated t-statistics are presented in Table 15.[12]

Table 15 The Estimated Marginal Effect of Advertising Awareness on the Probability of Milk Consumption in Selected New York State Markets by Consumers, Age 12-64, Spring 1973.

Market	Partial Regression Coefficient 1/	
	Aware	Aware · ln Age
Albany	.53 (.58)	-.10 (-.38)
New York City	1.04 (1.48)	-.24 (-1.24)
Syracuse	.52 (1.50)	-.36 (-1.25)

1/ Estimated from a Probit model, therefore not strictly interpretable as probability values. Numbers in parentheses are t-statistics.

SOURCE: Thompson, S. R., and D. A. Eiler. "A Multivariate Probit Analysis of Advertising Awareness on Milk Use." Canadian Journal of Agricultural Economics, 23(1) (February 1975) 65-73.

To test the (null) hypothesis that the effectiveness of advertising is independent of age, the interactive variable aware X ln age was included in the model. The estimated coefficients suggest that milk advertising awareness increases the probability of milk consumption and that this effect decreases with age. However, the estimated coefficients are not statistically significantly different from zero at the usual levels of statistical significance.

[12] These coefficients, since they are estimated using a Probit model, are not strictly interpretable as the change in the probability of milk consumption given a one unit change in the independent variable. However, they are indicative of the direction, magnitude, and statistical significance that the independent variable has on the probability of milk consumption.

A follow-up survey was conducted in the fall of 1973. A comparison of the milk consumption levels of consumers aware and not aware of milk advertising were made for both surveys and statistically significant differences were found in all markets (Table 16).

Table 16 Comparison of Per Capita Consumption of Milk by Respondents Aware and Unaware of Milk Ads1/ in New York City, Albany and Syracuse SMSA's, April and September, 1973.

Market 2/	April 1973		September 1973	
	Not aware	Aware	Not aware	Aware
	(ounces)		(ounces)	
New York City	4.5	8.6	4.3	8.9
Albany	7.4	13.5	7.3	14.6
Syracuse	7.4	15.4	7.7	14.6

1/ Aware means the respondent recalled hearing the ad and correctly identified the product as milk.

2/ Differences in all markets are statistically significant at the 5% level.

SOURCE: Cook, C. B., D. A. Eiler and O. D. Forker. Beverage Consumption and Advertising Awareness in Selected New York State Markets 1973. Department of Agricultural Economics, A. E. Res. 74-10, Cornell University, September 1974.

Unfortunately, the analyses did not go beyond comparison of simple means, therefore one does not know whether the higher average milk consumption levels for respondents aware of milk advertising is strictly attributable to advertising or to some other factor highly correlated with advertising awareness. The Probit analysis discussed earlier suggested that the probability of milk consumption was not significantly affected by advertising awareness when other factors were held constant. A simple comparison of sample means suggests that the quantity of milk consumed is significantly affected by advertising awareness. Whether the same result would occur when other factors such as age, sex and race are held constant needs to be examined.

A further comparison of the April and September surveys revealed an interesting finding; consumer awareness of advertising did not vary significantly between the two surveys. This occurred despite the fact that advertising levels for milk varied significantly during this period. In the Albany and Syracuse markets, per capita milk advertising expenditure was about .5 cents for the three months preceeding the April survey then dropped to near zero for the April to August period preceeding the September survey. The finding that the level of milk advertising awareness in September was no different than in April suggests that the retention rate for the message is at least five months in these markets. The time series estimates give a rate of decay for the Albany and Syracuse markets of one month (Thompson 1978). These conflicting results point to the need for further research regarding the rate at which milk advertising awareness decays following exposure.

Data collected in the Fall of 1974 on teenage beverage consumption was also analyzed in a limited way to ascertain how teenage milk consumption is influenced by the awareness to milk and soft drink ads (Cook, Eiler, Forker 1975). Regression results were reported for the New York City and Albany markets only and are presented in Table 17.

Table 17 The Estimated Marginal Effect of Milk and Soft Drink Advertising Awareness on the Quantity of Milk Consumed by Teenagers, Albany, New York City, Fall 1974

Market	Partial Regression Coefficient of: 1/ Aware of Milk Ad	Aware of Soft Drink Ad
Albany	-.11	-1.68
	(-.04)	(-1.11)
New York City	2.30	-1.80
	(1.65)	(-1.67)

1/ Variables held constant are: age, social position, sex, race, weekday, region of New York City, number of siblings, peer and parental influence. Numbers in parenthesis are t-statistics.

SOURCE: Cook, C. B., D. A. Eiler and O. D. Forker. A Study of Selected Family and Social Influences on Teenage Beverage Consumption in Three New York Markets Fall 1974. Department of Agricultural Economics, A. E. Res. 75-6, Cornell University, June 1975.

The results show that soft drink ads decrease the quantity of milk consumed by teenagers, but the effect is not highly statistically significant. Further, it appears that teenage awareness to milk ads has only a mildly stimulative effect on milk consumption in the New York City market and definitely no effect in the Albany market.

In summary, the evidence from these three independent data sets constitute weak support for the statement that milk advertising increases the per capita consumption of milk in certain markets. This reinforces findings from the time series data (to be discussed in detail later) which show milk advertising to be highly effective in the New York City market and somewhat less effective in the Rochester, Syracuse and Albany markets.

The Economic Effectiveness of Milk Advertising

Various aspects of the question "Is it profitable for dairy farmers to engage in generic advertising of milk?" was examined using monthly market data for four separate time intervals (see Appendix Table A.1). Some of the general findings were: (1) The existence of marked intermarket differences in the net producer returns from increased levels of advertising, (2) economic effectiveness of advertising is highly sensitive to the magnitude of the Class I - Class II price spread, (3) current levels of advertising were nearly one-half the level necessary to maximize profit, (4) carry-over effects lasting as long as five months, and (5) the existence of a highly inelastic long-run milk response to advertising. These findings are discussed in more detail in the following pages.

Intermarket differences in producer returns. Returns to the advertising effort were estimated by comparing the value of the increased sales of fluid milk due to advertising to the media cost of the advertising program. The estimated net return on a per capita basis for the New York City, Albany, Syracuse and Rochester markets are presented in Table 18 for the various data sets analyzed. The estimates indicate that advertising in New York City yields the greatest return. This is not surprising since per capita consumption of milk is lower in New York City than the Upstate markets and therefore has the greatest potential for being increased. Evidently the Syracuse and Rochester markets offer greater returns to advertising investment than the Albany market. It was estimated that annual per capita fluid milk sales were increased by 4.9 percent, 1.3 percent and 1.9 percent, respectively, in New York City, Albany and Syracuse due to the advertising effort.

Table 18 Estimated Producer's Per Capita Net Return from Generic Milk Advertising, Selected New York State Markets, Various Data Periods.

Data Period	Market (SMSA)			
	New York City	Albany	Syracuse	Rochester
	(cents)	(cents)	(cents)	(cents)
1/71 - 3/74 1/	10.7	2.8	-3.1	N.A.
1/75 - 6/77 2/	14.4	2.3	6.0	N.A.
1/75 - 12/78 3/	N.A.	N.A.	N.A.	6.3

1/ SOURCE: Thompson, S.R., and D.A. Eiler. "Producer Returns from Increased Milk Advertising." American Journal of Agricultural Economics, 57(3) (August 1975) 505-508.

2/ SOURCE: Thompson, S. R. An Analysis of the Effectiveness of Generic Fluid Milk Advertising Investment in New York State. Department of Agricultural Economics, A. E. Res. 78-17, Cornell University, September 1978.

3/ SOURCE: Thompson, S.R. The Response of Milk Sales to Generic Advertising and Producer Returns in the Rochester, New York Market. Department of Agricultural Economics, A. E. Staff Paper No. 79-26, June 1979.

Partly as a result of these intermarket differences, the following recommendation was made: "Regardless of the desired rate of return or budget size, decisions of optimal market allocation among the three markets would involve an approximate budget allocation of 96 percent to New York City, 1.5 percent to Albany, and 2.5 percent to Syracuse" (Thompson 1979).

Advertising effectiveness and the Class I - Class II price differential. Since advertising has the effect of shifting milk from Class II to Class I utilization, the greater the Class I - Class II price differential, the greater the economic effectiveness (as measured by the increase in the blend price) of the advertising program. One implication of this fact is that the level of advertising necessary to achieve a specified rate of marginal

return increases as the Class I - Class II price differential increases. This is illustrated in Table 19 for plausible ranges of the price differential, assuming a 40-percent Class I utilization rate. Note that for each 20 cent increment in the Class I - Class II price differential below the $2.40 level, the optimal level of advertising expenditures decreases by about eight percent. Thus if the calculated optimum is $4.25 million when the price differential is $2.40 (the recommended total advertising investment in the Federal Order No. 2 milk marketing area in 1976 based on the Thompson study (Thompson 1978). This amount would be reduced to 3.57 million if the price differential declined to $2.00.

The sensitivity of the optimum level of advertising expenditures to the magnitude of the Class I - Class II price differential has further implications for the timing of the advertising investment. If reliable predictions of the monthly magnitude of this price spread could be obtained, say for the next twelve months, then advertising expenditures could be planned so that their greatest impact would occur during the months with the greatest Class I - Class II price differential.[13/] Research designed to indicate the optimum temporal allocation of advertising expenditures needs to be done.

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[13]Intrayear variations in the Class I - Class II price differential can be substantial (see Appendix Table A-3).

Table 19 The Optimum Level of Milk Advertising Expenditures as a Function of the Class I - Class II Price Differential.

If the Class I - Class II Price Differential is:	Then the Optimum Level of Advertising Expenditure 1/ would be Changed by the following percentage
($/cwt)	(%)
3.20	30.6
2.80	15.4
2.40	0.0
2.00	-15.9
1.80	-23.8
1.60	-32.1
1.40	-40.1
1.20	-48.5

1/ The optimum would correspond to the level necessary to receive a 10% marginal return on the advertising investment when the Class I - Class II price differential is $2.40 per cwt and the Class I utilization rate is .40.

SOURCE: Thompson, S. R., D. A. Eiler and O. D. Forker. "An Econometric Analysis of Sales Response to Generic Fluid Milk Advertising in New York State." SEARCH, 6(3): (1976) 1-24.

Optimum level of advertising investment. Given an opportunity cost of 10 percent, Thompson (1978) estimated that the optimum level of advertising investment for 1976 in the Federal Order No. 2 milk marketing area to be about 4.25 million dollars. The actual investment in milk advertising during that year was $2.018 million--less than one-half the optimum level. Marginal rates of return from the suboptimal level of investment were estimated to be as high as 45 percent in New York City, 25 percent in Albany and 60 percent in Syracuse. From economic theory we know that profits are maximized when the marginal rates of return are equalized across markets and investment alternatives. Assuming that alternatives to advertising investment would yield dairy producers a ten-percent marginal rate of return means that the optimum advertising expenditures (in 1970 dollars) in 1976 should have been $2,036,932 in New York City, $26,829 in Albany and $52,851 in Syracuse (Thompson 1978).

The optimum level of advertising expenditures is highly sensitive not only to the magnitude of the Class I - Class II price differential, as previously noted, but also to the desired marginal rate of return on the investment. Thompson's estimates indicate that for each five percentage point increase in the desired marginal rate of return, optimum media advertising investment declines by 8.8 percent (Thompson 1976). Thus if alternative investments could yield dairy farmers a 15-percent (rather than a 10-percent) marginal rate of return, then the optimum level of advertising investment for 1976 would have been $3.9 million rather than the $4.25 million given.

Milk advertising carry over effects. The studies conducted by Thompson et al. indicate significant intermarket differences in the longevity of the advertising effect as well as time pattern of the effect. In the New York City market the most recent estimates suggest that milk advertising is effective for four months following the initial expenditure with the largest impact occurring two months after the expenditures (Table 20).

Table 20 Estimated Carry-Over Effects of Generic Milk Advertising Using a Linearly-Additive Sales Response Function for Different Data Periods, Markets, Estimating Procedures and Whether Cola Price is Included in the Model.

Data Period	Market	Estimating Procedure	Included Cola Price?	Estimated Coefficient and Corresponding t-statistic						
				a_t	a_{t-1}	a_{t-2}	a_{t-3}	a_{t-4}	a_{t-5}	$\sum_{i=0}^{n} a_{t-i}$
1/71-3/74[1/]	New York City	OLS	No	13.77 (1.80)*	16.91 (3.52)	17.88 (4.16)	16.68 (3.66)	13.29 (3.17)	7.73 (2.85)	86.27 (4.16)
1/75-3/77[2/]	"	"	Yes	15.43 (1.07)	22.17 (1.68)	24.00 (1.67)	20.91 (1.56)	12.91 (1.48)	0 0	95.42 (1.71
1/75-3/77[2/]	"	GLS	"	15.21 (1.35)	19.99 (2.18)	20.86 (2.14)	17.82 (1.95)	10.87 (1.80)	0 0	84.76 (2.23)
1/71-3/74[1/]	Albany	OLS	No	15.86 (.86)	11.59 (1.35)	7.87 (.92)	4.70 (.48)	2.07 (.29)	0 0	42.08 (1.34)
1/71-3/74[1/]	Syracuse	"	"	5.73 (.45)	3.59 (.67)	1.92 (.27)	.73 (.12)	0 0	0 0	11.96 (.67)

*Numbers in parentheses are t-values.

[1/] SOURCE: Thompson, S. R., and D. A. Eiler. "Producer Returns from Increased Milk Advertising." American Journal of Agricultural Economics, 57(3) (August 1975) 505-508.

[2/] SOURCE: Thompson, S. R. The Response of Milk Sales to Generic Advertising and Producer Returns in the New York City Market Revested. Dept. Agr. Econ., A. E. Staff Paper No. 78-8, Cornell University, January, 1978.

Furthermore, the analyses indicate that this effect "takes hold" in the New York City market as quickly as one month following the expenditure.

In the Rochester market advertising appears not to become effective until four months after the initial expenditure and then remains effective for only one more month (Table 21).

Table 21 Estimated Carry Over Effects Using a Double-Log Sales Response Function for Different Data Periods, Markets, Estimating Procedures and Whether Cola Price is Included in the Model.

Data Period	Market	Estimating Procedure	Included Cola Price?	Estimated Coefficient and Corresponding t-statistic						
				a_t	a_{t-1}	a_{t-2}	a_{t-3}	a_{t-4}	a_{t-5}	$\sum_{i=0}^{n_a} a_{t-i}$
1/71-3/74[1/]	New York City	OLS	No	.00402 (2.06)*	.00258 (2.70)	.00288 (3.00)	.00383 (5.04)	.00439 (5.20)	.00346 (3.99)	.02116 (4.84)
1/75-6/77[2/]	"	GLS	Yes	.00180 (.30)	.00622 (1.81)	.00825 (2.92)	.00784 (2.90)	.00514 (2.70)	0 0	.02931 (2.34)
1/71-3/74[1/]	Albany	OLS	No	.00018 (.07)	.00105 (.85)	.00147 (1.11)	.00143 (.95)	.00094 (.85)	0 0	.00506 (1.09)
1/75-6/77[2/]	"	GLS	Yes	.00443 (1.41)	0 0	0 0	0 0	0 0	0 0	.00443 (1.41)
1/71-3/74[1/]	Syracuse	OLS	No	.00051 (.28)	.00066 (.79)	.00062 (.57)	.00040 (.43)	0 0	0 0	.00219 (.79)
1/75-6/77[2/]	"	GLS	Yes	.0050 (1.79)	0 0	0 0	0 0	0 0	0 0	.0050 (1.79)
1/75-12/78[3/]	Rochester	OLS[4/]	Yes	.0007 (.28)	.0003 (.10)	.0016 (.67)	.0036 (.71)	.0047 (1.99)	.0040 (1.77)	.0149 (1.75)

*Numbers in parentheses are t-values.

[1/] SOURCE: Thompson, S. R., D. A. Eiler and O. D. Forker. "An Econometric Analysis of Sales Response to Generic Fluid Milk Advertising in New York State." SEARCH, 6(3): (1976) 1-24.

[2/] SOURCE: Thompson, S. R. An Analysis of the Effectiveness of Generic Fluid Milk Advertising Investment in New York State. Department of Agricultural Economics, A. E. Res. 78-17, Cornell University, September 1978.

[3/] SOURCE: Thompson, S. R. The Response of Milk Sales to Generic Advertising and Producer Returns in the Rochester, New York Market. Department of Agricultural Economics, A. E. Staff Paper No. 79-26, June 1979.

[4/] The data exhibited no serial correlation based on the Durban-Watson Statistic (D.W. = 2.00)

Carryover effects in the Albany and Syracuse markets are nil. In fact the statistical results indicate that milk advertising in general has had no statistically significant effect on milk sales in these markets. This is not surprising when two facts are considered: per capita milk consumption in the upstate markets is about 48-percent higher than in the New York City market, and advertising expenditures on a per capita basis were about double in New York City than in the upstate markets.

Comparison of the results in Tables 20 and 21 suggests that the estimated magnitude and pattern of milk advertising effects may be sensitive to the following factors: the time period the data corresponds to, whether or not the data is corrected for serial correlation, and whether or not cola price is included in the model. Definitive statements regarding the effect of these factors are generally not possible due to the simultaneous changing of more than one factor. However, estimates for the New York City market using the January 1975 - March 1977 data suggest that a GLS estimating procedure reduces the magnitude of the estimated advertising effect and increases its statistical significance, but does not effect the estimated pattern of the response.

However, the reader should be cautioned not to place too much faith in the estimated milk advertising carryover effects until further verification using alternative econometric procedures is done. The estimates presented in Tables 20 and 21 are derived by imposing the Almon polynomial lag function on the data. Maddala (1977) has warned that the Almon procedure can produce severely distorted estimates of the true lag distribution.

He recommends that those estimating an Almon type model should also use and report results from an unconstrained OLS method. In addition, where the length of the lag is unknown, Maddala suggests using the Hannan Inefficient estimating procedure and reporting these results along with the OLS and Almon model results.

Further evidence supporting Maddala's concern over the use of the Almon procedure is provided in a Monte Carlo study conducted by Cargill and Mayer (1974). There they investigated the relative performance of OLS, Hannan, and Almon estimating procedures in estimating distributed lags. The results of their extensive analyses are summarized by the authors as follows (p. 1,038):

> "By a wide margin OLS out-performs the other estimators tested, regardless of whether the criterion is efficiency, small sample bias , or robustness under departures from the assumptions of the classical linear model. Of particular importance is the robustness of OLS under misspecification.... when the independent series and residual process are highly autocorrelated, OLS continues to be a clear best choice. This is an important result since a major justification for using more sophisticated lag estimators is based on the problem of correlation between successively lagged x terms when OLS is used. These results certainly indicate that this problem may be overemphasized.

In addition, the results suggest that not only does the Almon procedure perform poorly in terms of tracking the true lag pattern, it also produces misleading information (in terms of statistical significance) of the length of the lag. In fact the pattern of the Almon estimates is very similar[14/] to that of advertising lag pattern estimated for the New York City market (Table 20); the initial period effect is fairly large, climbs substantially in the next period, then remains fairly constant for a number of periods before beginning

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[14]The actual estimates for the Monte Carlo study are presented in Appendix Table A.4.

its decline. This raises the question of whether the estimates presented in Tables 20 and 21 are more a feature of the estimating procedure than of the actual advertising response.

As a result of their study, Cargill and **Meyer** offer the following comment regarding the Almon method of estimating distributed lag functions (p. 1,043).

> "One case in which the Almon method might be desireable would be when there are insufficient observations to estimate a distributed lag by OLS and there is no a priori knowledge about the form of the lag. While this may be a plausible rationale for using Almon in small samples, it may be more advisable to simply abandon the attempt to extract detailed information from a limited sample."

Given the importance of knowing the precise timing of maximum impact of the advertising expenditure (e.g., to plan advertising expenditures so that the maximum impact would occur in the months with the largest Class I - Class II price differential) it is imperative to investigate to what extent the Almon procedure may be producing a misleading picture of the true structure of the milk advertising carryover effect in New York State.

Milk advertising elasticities. Milk advertising elasticities provide a clue as to the extent to which increased advertising levels can be expected to increase the consumption of milk, holding other factors constant. Estimates of the long-run milk advertising elasticity for New York State markets suggest that demand is highly unresponsive to increased levels of advertising expenditure. For instance, elasticity estimates indicate that if advertising expenditures were increased by one hundred percent in all markets, relative prices, income, and other factors unchanged, per capita milk consumption would increase by only 2.9 percent in New York City, .4 percent in Albany, .5 percent in Syracuse, and 1.5 percent in

Rochester (figures calculated on the basis of the elasticity estimates presented in Table 22 using the latest data period). Of course, with estimated milk long-run own-price elasticities **for milk as high as -1.70 (see Table 11), this means that relatively small milk price increases would be sufficient to negate increases in milk advertising investment.**

Table 22 Estimated Long-Run Milk Advertising Elasticites for Selected New York State Markets and Alternative Data Periods.

Market	Data Period	Long-Run Advertising Elasticity	T-Statistic
New York City	1/71 - 3/74	.021	4.84
	1/75 - 6/77	.029	2.34
Albany	1/71 - 3/74	.005	1.09
	1/75 - 6/77	.004	1.41
Syracuse	1/71 - 3/74	.002	.79
	1/75 - 6/77	.005	1.79
Rochester	1/75 - 12/78	.015	1.75

SOURCE: Table 21

Whether demand is as unresponsive to advertising as the estimates suggest needs further investigation. The estimates presented in Table 22 are produced by double-log sales response functions which implicitly assume that the advertising elasticity is constant with respect to the level of advertising expenditure. It seems more plausible that the advertising elasticity would increase with the level of the advertising effort: as consumers are exposed more frequently to the advertising message, they become more susceptible to change. Indeed, advertising elasticity estimates from the additive version of the sales response function (which implicitly assumes a more elastic advertising response to higher advertising expenditures) are

nearly twice those derived from the constant elasticity models (e.g., $\eta_{s \cdot a}$ = .047 for New York City using 1/75 - 3/77 data (Thompson 1978). Of course, this still indicates a disappointingly small response. It may be that the Almon procedure is producing downward biased estimates of the true long-run consumption response to milk advertising. This possibility warrants investigation.

Nutrition Education

About 20 percent of the funds that Order 2 dairy farmers contribute for milk promotion goes to the National Dairy Council which in turn uses the funds to conduct a nutrition education and research program. The implicit assumption is that a nutritionally enlightened public will consume more dairy products. The research conducted by the Department does not directly address the question of whether this assumption is valid but rather looks at the extent to which school children are being exposed to nutrition learning experiences in the classroom, the information sources teachers use, and the interest among teachers in attending nutrition workshops. Information on these questions was obtained from a survey of 2160 elementary school teachers taken in early 1976 (see Appendix Table A.2). The findings from this survey are discussed in this section.

Exposure of school children to nutrition education. The survey indicated that 75 percent of the teachers responding had taught nutrition or foods in their classrooms during the last school year . Nearly half of the teachers who did not teach nutrition said that their students were taught nutrition by the school nurse or some other teachers. This suggests

that some 87 percent of school children in grades K-6 living in New York City, upstate New York and northern New Jersey areas are being exposed to some form of nutrition education in the classroom.

Furthermore, the survey indicated that the average time teachers spent on nutrition or foods--9.7 hours during the 1974-75 school year--compares favorably with the time recommendations for certain nonintegrated nutrition education units. Thus it appears that in terms of coverage and intensity school children are receiving adequate exposure to nutrition education. The question of quality remains, however, as the specific content of the nutrition/foods classroom work was not examined.

Sources teachers use for nutrition education materials. The survey indicated that teachers most frequently consulted the following sources for nutrition information: school nurse, textbooks and magazines, and the Dairy Council. Approximately one-third of the teachers used Dairy Council materials.

Teacher interest in nutrition workshops. According to the survey, elementary teacher interest in nutrition workshops is low: only six percent of teachers said they wanted a nutrition/foods workshop. This compares to an expressed interest by nearly 20 percent of the teachers for workshops in such subject areas as language arts, math and science. These figures may reflect the increasing administrative pressure on teachers to place more emphasis on reading and math in the elementary school curriculum. The teachers indicated that if the subject "nutrition" was made into an easily accessible, sequentially graded curriculum which could be integrated into the basic curriculum of reading, math and social studies, it would help

alleviate some of the obstacles to incorporating nutrition in the grade school curriculum.

Does nutrition education lead to increased consumption of dairy products? This question is of paramount importance since dollars for nutrition education compete directly with dollars for media advertising, and studies clearly indicate that milk advertising (in New York City at least) is effective and should be increased.

Department studies provide no direct evidence on the hypothesized link between nutrition education, improved diets and increased milk consumption. However, evidence from outside studies can be brought to bear on this question. A review of a limited number of such studies by Eiler, Cook and Kaminaka (1976) lead them to conclude (p. 8.1), "while studies have demonstrated improvements in nutrition knowledge, they have shown no consistently demonstrable relationship between a child's exposure to nutrition education and his (sic) dietary behavior or milk consumption."

A review of the more recent literature by Levy, Iverson and Walberg (1979) lead them to conclude (p. 15), ".... education does have the potential to affect and change nutrition behavior." However, a look at the results of the quantitative studies Levy, Iverson and Walberg reviewed as well as the results of an earlier study by McKenzie, Mattinson and Yudkin (1967) and the most recent study by McDonald, Brun and Esserman (1980) all suggest that nutrition education has had no effect on enhancing consumer attitudes toward milk or increasing the consumption of milk (Table 23).

Table 23 The Effect of Nutrition Education on Knowledge, Attitudes, and Food Consumption Behavior: Evidence from Studies Designed to Yield Quantitative Results.

Investigator	Study Group	the Effect on: Knowledge	Attitudes	Behavior
McDonald, Brun, Esserman (1980)	917 children in grades K-6	+	?[1]	+[2]
Axelson and Delcampo (1978)	400 randomly selected high school students in Florida	+	*	*
Garet and Vaden (1978)	1010 6th graders from schools in a Midwestern city	*	0	0
Casper, Hayslip, and Force (1977)	45 fifth grade Mexican-American students	+	*	0
Boone and White (1976)	1368 8-12 year old students	+	*	?
Picardi and Porter (1976)	(?) high school students	+	?	?
Roth (1976)	1447 fifth-eighth graders in five Southwestern states	+	*	+
Head (1974)	4,700 students from North Carolina in grades 5, 7, and 10	+	*	?
Bell (1973)	1,500 fifth graders in Texas	+	*	+[3]
Baker (1972)	256 4th and 5th graders in Iowa	+	0	0
Boyson and Ahrens (1972)	59 Maryland second graders	+	0	0
McKenzie, Mattinson, and Yudkin (1967)	4,600 students aged 11-19	*	*	0[4]
Percentage of Test Results that showed a:[5]				
Postive effect		100%	0%	27%
No effect		0%	60%	45%
Inconclusive results		0%	40%	27%

Symbols have the following meaning:

* = no information was available on this question
\+ = statistically significant (P = .05) positive effect
0 = statistically insignificant (P .05) effect
? = results inconclusive or mixed

[1] Evidence was mixed: the test group showed a reduced preference for milk and increased avoidance of meat, poultry, fish and eggs, but a reduced avoidance of fruits and vegetables.

[2] The behavorial change was limited to an increased consumption of fruits and vegetables by the test group. Blacks in the test group had consumed more milk and dairy products than the control group.

[3] Increased vegetable consumption only.

[4] Nutrition information had no effect on milk consumption even though the milk was free to the students

[5] Studies with an asterisk are excluded from the calculation

Although 27 percent of the studies showed nutrition education has some positive effect on dietary behavior, this related almost entirely to enhanced consumption of fruits and vegetables. In fact, the McKenzie, Mattinson and Yudkin study found that school children failed to increase their consumption of milk despite an intensive campaign using posters, pamphlets, 30-minute lectures and films to persuade them to do so; and in spite of the fact that milk was free to the students.

Of course, the fact that studies to date have failed to show a convincing link between nutrition education and milk consumption should not lead to the hasty conclusion that nutrition education by the Dairy Council should be abandoned. As Eiler, Cook and Kaminaka (1976) have pointed out, the possibility of a long time lag between the initial exposure to nutrition information and subsequent behavioral response makes the response difficult to measure. In addition, while nutrition education alone may not affect milk consumption, it may positively predispose consumers toward milk and thus make milk advertising more effective. The possibility that nutrition education exposure interacts with media advertising to produce a larger sales response than would occur in the absence of nutrition education needs further investigation.

More evidence on the hypothesized link between nutrition education and dairy product consumption should appear as studies to monitor the increasing Federal involvement in nutrition education are completed. Since 1976 the funding levels of the major publicly supported nutrition education programs in New York State have increased nearly 90 percent to about $7 million in 1980 (Table 24).

Table 24 Funding Levels of the Major Publicly Supported and Dairy Supported Nutrition Education Programs in New York State, Fiscal Years 1/ 1976-81.

Year	Publicly Supported Programs					Dairy Supported Programs6/	Dairy Proportion of Total
	EFNEP2/	NET3/	WIC4/	Other5/	State Total		
	(Thousand Dollars)						(Percent)
1976	2,864	**	**	836	3,700	810	22.0
1977	2,864	**	**	784	3,648	907	24.9
1978	2,864	2,085	**	808	5,757	960	16.7
1979	2,864	2,012	1,100	873	6,849	1,004	14.7
1980	2,864*	1,512*	1,775*	875*	7,026*	1,004*	14.3*
1981	3,066	1,154*	1,775*	900*	6,895*	1,100*	16.0*

*Preliminary estimate.
**Program nonexistent in these years.

1/ Fiscal years run from October 1 - September 30; e.g., FY 76 = Oct. 1, 1975 - September 30, 1976.

2/ EFNEP is the Expanded Food and Nutrition Education Program. The Science and Education Administration (SEA) of the USDA administers EFNEP. State funding is through the Land Grant University System (Cornell in the case of New York). TARGET GROUPS are LOW-INCOME FAMILIES with children. SOURCE: correspondence with Chuck Graves of the budget office in SEA and with Ray Blanchard, fiscal officer of the Cooperative Extension Service at Cornell University.

3/ NET is the Nutrition Education and Training program. The Food and Nutrition Service (FNS) of the USDA administers NET. State funding is through the NYS Department of Education. The TARGET GROUP is SCHOOL CHILDREN. SOURCE: correspondence with Marge Reedy of the NYS Department of Education.

4/ WIC is the supplemental food program for Women, Infants and Children. FNS of the USDA administers WIC. State funding is through the NYS Department of Health. These figures represent the portion of WIC funds devoted to nutrition education. Before 1980 there was no requirement to spend WIC funds on nutrition education. As of FY 1980 State recipients of WIC funds must spend at least one-sixth of the administrative budget for nutrition education. SOURCE: correspondence with Virginia Sargent of the NYS Department of Health.

5/ This "other" category refers to nutrition education funds from the following sources: Smith-Lever funds, Urban Gardening funds, State Appropriations, and County Appropriations. The 1976-79 figures were provided by Ray Blanchard of the Cooperative Extension Service at Cornell. The 1980-81 figures are extrapolations based on data from the earlier years.

6/ The fiscal year for the expenditure of Dairy Council funds is May 1 - April 30; e.g., FY 1976 = May 1976 - April 1977. The figures were taken from tables provided by Lyle Newcomb at the August 21, 1980 meeting of the Dairy Promotion Order Advisory Board.

In fiscal year 1981, the USDA alone will spend some $150 million on nutrition education. This kind of effort will surely stimulate studies designed to determine the cost effectiveness of these programs and from these studies needed information on the relationships between nutrition knowledge and dietary behavior should be forthcoming.

Conclusions

Since 1972 some $32 million dollars have been invested in milk promotion in the Federal Order 2 marketing area. Between 1972 and 1977, the real price of milk in New York declined 3 percent while cola prices increased 21 percent and coffee prices increased 178 percent in real terms. Why, then, has per capita milk consumption decreased 14 percent in New York since 1972? Research conducted so far at Cornell provides some clues: milk consumption decreases steadily with age and the average age of the United States population is increasing; blacks and other minorities tend to drink less milk than white and their numbers are increasing relative to whites; milk advertising levels are low, both in absolute and relative terms. Other factors, such as attitudes and social influences were found to be not very relevant. Yet clearly more research needs to be done if a better understanding of why consumers are turning away from a highly nutritious, good tasting beverage is to be gained. To what extent is the relationship between age and milk consumption reversible? How would consumers respond to accurate information about the nutritional content of milk vis-a-vis the other beverages commonly consumed, such as soft drinks and coffee? Is the lower level of milk consumption by minorities due to misinformation about the product? Why are consumers increasingly turning to low fat milk and away from whole milk? How much can advertising be expected to increase the demand for milk? These are just a few of the questions that need to be investigated further.

APPENDIX

Table A.1 Time Series Data Used in Various Studies to Determine the Economic Effectiveness of Milk Advertising in New York State

Data Period	No. of Observations	Markets Studied	Publications[1/]
January, 1971 - March, 1974	39	Albany, New York City, Syracuse	13, 26, 15, 28, 31, 32
January, 1975 - March, 1977	27	New York City	24
January, 1975 - June, 1977	30	Albany, Binghamton, New York City, Syracuse	22, 23
January, 1975 - December, 1978	48	Rochester	25

[1/] Refer to the bibliography for the publication corresponding to each number.

Table A.2 Cross-Section Data Used in Various Studies Concerned with Evaluating the New York State Milk Promotion Efforts.

Date of Data Collection	Survey Objectives[1]	Survey Subjects	Survey Size	Survey Method	Publications[2]	Comments
November, 1972	Measure attitudes related to beverage consumption	Adults 18 years and older	1477	In-Home Interview	1 8 11	
April - May, 1973	Determine beverage consumption levels, socioeconomic characteristics and awareness to beverage advertising	12 to 65 year olds	3011	Telephone-Survey 24-hour recall	13 28 29	Blacks and Hispanics were underrepresented by almost 50%, this data was also combined with later data for further analysis. See comments in the next **data set description.**
September - October 1973[3]	Essentially the same as the Spring 1973 survey.	12 to 65 year olds	5481	Telephone-Survey 24 hour recall	5 6 13	The data was combined with the April - May 1973 data for purposes of analysis.
September - October, 1974	Measure teenage beverage consumption, parental and peer influences, and beverage advertising awareness	12 to 17 year olds	5481	Telephone-Survey 24 hour recall	6 10	
January - February, 1976	Measure time teachers spend on nutrition, use of nutrition sources, and workshop attendance	Elementary Public School teachers in New York and New Jersey	2160	Mailed Questionaire (Response rate = 47 percent)	9	

[1] Lists are meant to be suggestive of the main intent of collecting the data rather than exhaustive.

[2] Publication lists are not necessarily exhaustive.

[3] The Department conducted two other surveys in 1974 (similar to the 1973 surveys) but the data was not analyzed to the extent that publications were possible.

Table A.3 Monthly Class I - Class II Price Differentials in the New York - New Jersey Federal Milk Marketing Order, 1974 - 1979.

Month	Year 1974	1975	1976	1977	1978	1979
	($/cwt)					
January	3.09	2.33	2.31	2.41	2.10	2.10
February	3.37	2.33	3.21	2.47	2.10	2.04
March	3.13	2.44	2.75	2.33	2.12	2.26
April	2.90	2.20	2.30	2.05	2.10	2.23
May	3.74	2.36	2.82	2.21	2.21	2.29
June	3.93	2.34	2.63	2.51	2.34	2.23
July	3.01	2.03	1.96	2.34	2.14	2.02
August	2.22	1.71	1.63	2.26	1.73	1.82
September	1.94	1.42	2.59	2.25	1.62	1.74
October	1.91	1.94	3.07	2.24	1.69	2.03
November	2.27	1.77	2.54	2.14	1.65	2.24
December	2.75	1.96	2.35	2.06	1.77	2.10
Annual Average	2.86	2.07	2.51	2.28	1.96	2.11
Coefficient of Variability (%)	23.1	15.4	17.6	6.6	12.8	8.1
Range	1.91-3.93	1.42-2.44	1.63-3.21	2.06-2.51	1.62-2.34	1.74-2.29

SOURCE: Thompson, S. R. An Analysis of the Effectiveness of Generic Fluid Milk Advertising Investment in New York State. Department of Agricultural Economics, A. E. Res. 78-17, Cornell University, September 1978.

Table A.4 Simulation Results from a Monte Carlo Study Designed to Evaluate the OLS, Hannan, and Almon Lag Estimating Procedure.

Lag	True Value	Parameter Estimate (Mean Value)[1/]		
		OLS	Hannon	Almon
0	.5000	.4976	1.0674*	.9765
1	1.0000	.9840	1.4769*	2.1450
2	2.0000	2.0033	2.5909	3.2603
3	4.0000	3.9952	4.2311	4.1347
4	8.0000	7.9806	7.0903	4.6384
5	6.0000	6.0061	4.6618	4.6990
6	4.0000	4.0133	2.6558	4.3015
7	2.0000	2.0070	1.0110*	3.4888
8	1.0000	.9900	.3408*	2.3611
9	.5000	.5115*	.0905*	1.0764
10	0.0000	.0077*	-.0997*	-.1498*
11	0.0000	.0096*	-.0814*	-1.0445
12	0.0000	.0093*	-.0926*	-1.2764
13	0.0000	-.0144*	-.0349*	-.4589*
14	0.0000	-.0134*	.0021*	1.8553

* = less than 75% of the estimated parameters were statistically significantly different from zero.

[1/] Results are based on 100 replications with each relication containing 100 observations.

SOURCE: Tables I, II and IV in Cargill and Meyer (4).

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