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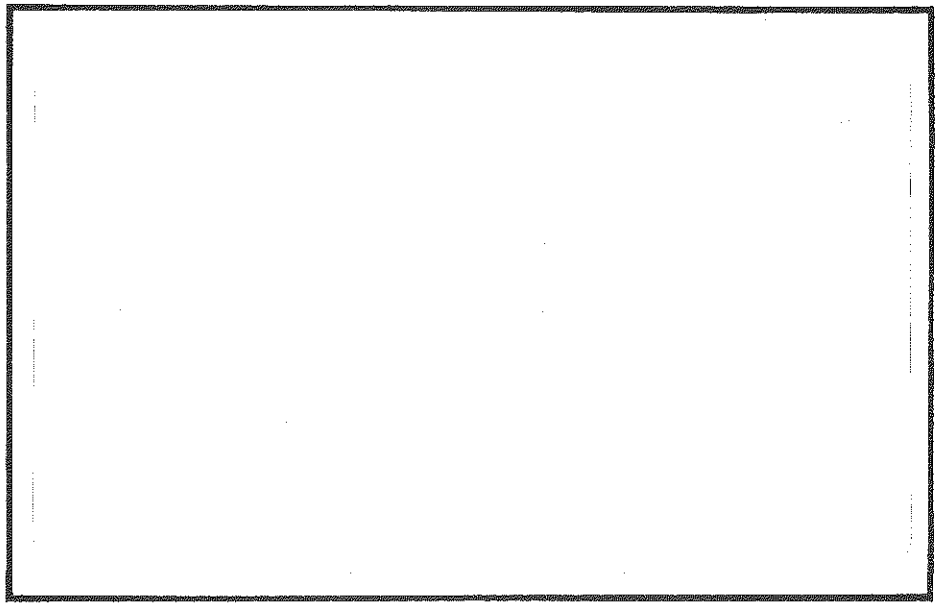

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DEMOGRAPHIC VERSUS MEDIA ADVERTISING EFFECTS ON MILK DEMAND: THE CASE OF THE NEW YORK CITY MARKET

by

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DEMOGRAPHIC VERSUS MEDIA ADVERTISING EFFECTS ON MILK DEMAND: THE CASE OF THE NEW YORK CITY MARKET

The declining trend in per capita milk consumption in the United States over the past two decades has implications that go beyond the economic concerns of the dairy industry. Calcium intake for one-third of the population is below the 1980 Recommended Dietary Allowances (USDA SEA 1981) and Americans depend on milk products for some 75 percent of their calcium intake (Brewster and Jacobson 1978). Dairy surpluses in the 1979-80 fiscal year cost taxpayers a record $1.3 billion under the then current price support program and will approach $2.0 billion in the 1980-81 fiscal year (USDA ERS 1981).

To more adequately address the varying concerns of dairy farmers, nutritionists and taxpayers, the underlying forces responsible for the declining trend in milk consumption need to be identified and quantified. This information could then be used to gauge the extent to which public measures, e.g., price or income policies, and private measures, e.g., promotional efforts, might be effective in expanding overall demand for milk.

Numerous studies have documented the importance of age, race and sex as determinants of milk demand (recent examples are Boehm and Babb 1975 and Salathe 1979). Both the average age of the US population and the proportion of nonwhites are increasing steadily. The adverse effects of these trends on milk consumption are the central focus of this paper. The New York City metropolitan area serves as the basis for the analysis because data readily exist and the demographic trends of interest are even more marked than those occurring nationally. Moreover, because milk has been heavily promoted in the New York City area since 1972, the opportunity is available to measure the extent to which nonbrand advertising of milk might be expected to offset the effects of demographic trends. As a byproduct of the analysis, additional information regarding the effects of milk prices, substitute beverage prices and incomes on milk demand is generated.

In this paper, the model is presented and the data are discussed. Estimates of milk sales in the absence of demographic changes are compared with actual milk sales, and the farm value of the milk sales gain attributable to advertising is measured. Finally, implications of the study are discussed.

The Model

In addition to advertising and demographic factors, other variables influence the demand for milk. These variables include seasonality in consumer preferences for milk, consumer income, the price of milk and the prices of other beverages. Further, the total effect of a given advertising expenditure may not be realized immediately but instead may be distributed over time. To take into account these factors a sales response function of the form

$$\ln q_{It} = \alpha + \sum_{j=1} \phi_j Z_{jt} + \theta \ln I_t + \lambda \ln PM_t + \gamma \ln PC_t + \delta \ln PCF_t$$

$$+ \sum_{i=0}^{N} \beta_i \ln A_{t-i} + \zeta \ln AGE_t + \pi \ln Race_t + \tau T_t + \varepsilon_t \quad (1)$$

is specified where:

q_I = per capita daily Class I milk sales,

Z = eleven zero-one dummy seasonality variables with December as the base class,

I = per capita before tax personal income in 1967 dollars,

PC = cola price index deflated by the CPI (1967=100) for all items,

PCF = coffee price index deflated by the CPI for all items,

A = per capita monthly media milk advertising expenditures in 1975 dollars,

AGE = percentage of the population under age 20,

RACE = percentage of the population which is nonwhite, and

T = trend variable, incremented by one for each successive month in the data series.[1/]

Equation (1) is similar to one used by Thompson, Eiler and Forker (1976) and is specified in double-log form to allow advertising to have a diminishing marginal effect on sales. A trend variable is included in the model to account for the potential combined influences of the following omitted factors: (1) nonmedia promotional activities conducted by the American Dairy Association, (2) nutrition education and research efforts by the Dairy Council of New York and (3) possible secular improvements in milk quality.[2/] Specifying the trend variable in

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[1/] The actual data along with a more complete description of the variables are provided in the appendix.

[2/] Professor Bandler of the Food Science Department, Cornell University, asserts that the quality of milk available to New York City consumers has improved noticeably since 1975.

linear form allows the coefficient of T to be interpreted as the instantaneous rate of change in milk sales due to the passage of time.[3]

The length of the lag distribution, N, is unknown a priori. While theoretically the lag length could be infinite, as a practical matter the major effect of the advertising expenditure can be expected to occur within some finite period. The procedure here for choosing the lag length is to let the data decide by terminating the lag at the point where an additional lagged term in A is statistically not significantly different from zero.

Generally lagged regressors of economic time series are highly collinear because of serial correlation in the series or a secular decreasing or increasing trend in the data. Under these circumstances the ordinary least squares (OLS) regression estimates of the individual lag parameters can be very imprecise. To reduce this problem researchers have used procedures which restrict the shape of the lag distribution in various ways. One such procedure, the Almon method (1965), restricts the lag distribution to lie on low order polynomial. This method was applied to earlier analyses of parts of the data used in this study (see, e.g., Thompson, Eiler and Forker 1976). Later analysis of this procedure, as well as a more general procedure, the Shiller method (1973), showed the Almon method to be inappropriate for this data (Kinnucan 1981).[4] On the basis of this finding no restrictions other than lag length are imposed on the β_i parameters in equation (1).

The Data

Monthly data for the period January 1971 through June 1980 pertaining to the New York City metropolitan area were gathered to estimate equation (1).[5] Annual averages of these data for the

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[3] When a variable y is a function of time, $y=f(t)$, its instantaneous rate of growth is defined as $\frac{d \ln y}{d_t}$. In equation (1) $\partial \ln q_I / \partial T = \tau$.

[4] Statistical tests revealed that the Almon estimates had a significantly larger mean squared error than the corresponding OLS estimates. This result was not surprising because of the nature of the advertising data: month-to-month variation in milk advertising is typically erratic, reducing the possibility of serial correlation or a significant trend in the series. In fact, simple correlations between the lagged values never exceeds 0.4.

[5] The New York City metropolitan area is defined to include the following counties: Bronx, Kings, Nassau, Queens, New York, Richmond, Rockland, Suffolk and Westchester. The efforts of Lyle Newcomb and Ed Johnston of the New York State Department of Agriculture and Markets in obtaining the milk sales data is greatly appreciated.

1971-1979 period are presented in table 1. Interyear variation in the data is irregular except for the demographic variables, where a steadily increasing trend in the nonwhite proportion of the population and a decreasing trend in the under 20 population proportion is observed. The relative stability of real milk prices combined with rapidly increasing real cola and even more rapidly increasing coffee prices (76 percent between 1976 and 1977 alone) are factors favoring enhanced milk demand as are the overall rises in real incomes and advertising efforts. Yet the figures pertaining to per capita milk sales indicate a relatively flat trend over the period. This suggests that the favorable effects of the sympathetic trends in the economic factors and advertising have been negated by the trends in demographic factors. This theme is explored further in the following sections.

Regression Results

The OLS estimates of equation (1) along with regression results pertaining to alternative specifications of equation (1) are presented in table 2. All regressions are based on 108 observations (July 1971-June 1980 data) and are computed using the econometric software package, TROLL. The following discussion relates to regression no. 1 unless otherwise indicated.

The regression results indicate that equation (1) "explains" 87 percent of the variation in milk sales. The dummy variables, which account for the major portion of the explanatory power of the model, suggest a distinct seasonal pattern in milk demand, i.e., a general tapering-off of consumption during the summer months.

The estimated effects of the economic variables agree with a priori expectations. A one sided t-test indicates that the estimated income elasticity, at 0.416, is significantly greater than zero at the 5 percent probability level. The own-price elasticity is estimated to be -0.095 but is not statistically significantly less than zero at the usual probability levels. This should not be interpreted to mean that milk price has no significant effect on milk demand. Rather, insufficient variation in the real price of milk over the sample period precludes a precise determination of the effect of this variable.

The cross-price elasticities pertaining to cola and coffee are positive and statistically significant at the 1 percent level, suggesting that rises in the prices of these beverages induce consumers to purchase more milk. Note that these variables can have a greater impact on milk consumption than would be inferred on the basis of their relatively small elasticities, because of the large increases in cola and coffee prices that can occur over relatively short time periods, e.g., between Jan. 1976 and July 1977 the real price of coffee increased 138 percent and between Jan. 1974 and May 1975 the real price of cola increased 38 percent.

According to the regression results, generic media advertising of milk has a positive, statistically significant effect on milk sales in the New York City metropolitan area. Carryover effects are estimated to

Table 1. MILK SALES, ADVERTISING EXPENDITURES, PRICES, INCOME AND DEMOGRAPHIC DATA
New York City Metropolitan Area,[a/] 1971-1979

Year	Annual Per Capita Milk Sales	Per Capita Advertising Expenditures 1975 Dollars[b/]	Per Capita Personal Income 1967 Dollars[c/]	Retail Milk Price 1967 Dollars[d/]	Cola Price Index 1967=100[d/]	Coffee Price Index 1967=100[d/]	Percent Population Nonwhite[e/]	Percent Population Less Than Age 20
	(gallons)	(cents)	(dollars)	(cents/qt.)	----------percent----------			
1971	24.5	3.3	4191	24.8	100	97	17.9	33.4
1972	25.1	5.7	4290	24.5	98	91	18.4	32.7
1973	25.8	8.9	4250	25.1	94	97	19.0	32.4
1974	25.6	9.0	4206	27.3	105	104	19.4	32.0
1975	25.8	9.5	4176	25.6	121	104	19.9	31.4
1976	25.1	8.2	4185	25.4	110	138	20.5	30.9
1977	25.5	5.8	4303	24.8	110	243	20.7	30.2
1978	26.6	5.0	4460	24.1	112	210	21.1	29.6
1979	26.0	4.7	4463	25.0	112	181	21.5	29.1
Percent change 1971-1979	6.1	42.4	6.5	0.8	12.0	86.6	20.1	-12.9

[a/] The New York City metropolitan area includes the five boroughs plus Nassau, Rockland, Suffolk and Westchester counties. All per capita figures are computed using a population series based on the 1970 and 1980 census counts and on Federal-State cooperative population estimates for the intervening years.

[b/] Based on the Media Coverage Area population. The counties included in the MCA are those used by the Broadcasting Yearbook of the Storer Publishing Co. A media cost index supplied by D'Arcy, MacManus and Maslus, Inc. was used to deflate the series.

[c/] Before tax income. Deflated by the Consumer Price Index for all items in the New York, Northeastern New Jersey area.

[d/] Deflated by the CPI for all items in the New York, Northeastern New Jersey area.

[e/] It is uncertain to what extent the nonwhite category includes persons of Spanish/Hispanic origin. In the 1970 census, 93 percent of Spanish-origin persons classified themselves as "white." By 1980 only 56 percent reported "white," while another 40 percent reported in the "Other" category (U.S. Dept. of Commerce, April 1981). This suggests that the "nonwhite" series used in this study contains an increasing number of Hispanics as the series progresses through time.

Table 2. REGRESSION RESULTS FOR VARIOUS DOUBLE-LOG SPECIFICATIONS OF THE MILK DEMAND EQUATION
New York City Metropolitan Area, July 1971-June 1980 Data

Independent Variable	Regression No. 1		Regression No. 2		Regression No. 3		Regression No. 4[a]	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
Intercept	1.781	0.32	-4.26	-4.31	-10.06	-5.01	-1.866	-2.35
January	0.001	0.10	-0.002	-0.17	0.003	-0.29	-0.003	-0.28
February	0.001	0.06	-0.001	-0.07	0.002	-0.15	0.000	0.000
March	0.019	1.61	0.018	1.50	0.017	1.41	0.015	1.31
April	-0.004	-0.36	-0.007	-0.58	0.008	-0.68	-0.008	-0.67
May	-0.012	-1.07	-0.015	-1.33	0.018	-1.50	-0.020	-1.61
June	-0.018	-1.52	-0.021	-1.89	0.024	-2.08	-0.024	-1.96
July	-0.105	-9.49	-0.104	-9.39	-0.101	-9.19	-0.107	-9.13
August	-0.103	-9.89	-0.101	-9.53	-0.106	-9.25	-0.100	-8.58
September	-0.026	-2.47	-0.023	-2.18	-0.023	-2.06	-0.021	-1.75
October	-0.011	-1.03	-0.009	-0.83	-0.009	-0.80	-0.005	-0.44
November	-0.023	-2.20	-0.022	-2.06	-0.022	-1.97	-0.018	-1.50
Income	0.416	1.71	0.858	6.60	1.047	6.20	0.454	4.57
Milk Price	-0.095	-1.30	-0.072	-1.17	-0.106	-1.68	-0.126	-1.81
Cola Price	0.149	2.99	0.214	5.24	0.202	4.69	0.061	2.08
Coffee Price	0.044	2.93	0.048	3.72	0.035	2.88	---	---
Race	-2.738	-2.97	-0.593	-5.24	---	---	---	---
Age	1.177	0.80	---	---	0.722	4.49	---	---
Trend	0.006	1.70	---	---	---	---	---	---
A_t	0.00811	3.43	0.00730	3.06	0.00666	2.72	0.00342	1.93
A_{t-1}	0.00487	2.04	0.00384	1.61	0.00300	1.23	0.00473	4.76
A_{t-2}	0.01008	4.32	0.00929	3.95	0.00859	3.55	0.00545	7.44
A_{t-3}	0.00532	2.26	0.00432	1.84	0.00343	1.42	0.00556	6.49
A_{t-4}	0.01179	4.93	0.01078	4.60	0.00978	4.06	0.00507	5.33
A_{t-5}	0.00295	1.22	0.00191	0.81	0.00087	0.36	0.00398	4.62
A_{t-6}	0.00784	3.33	0.00735	3.30	0.00613	2.69	0.00229	4.17
Sum	0.05096	---	0.04479	---	0.03846	---	0.03050	---
R^2	0.866		0.855		0.845		0.792	
$\bar{R}^2$	0.825		0.816		0.803		0.755	
DW	1.53		1.41		1.33		1.31	
COND(X)[b]	149.5		6.97		7.57		6.28	
RSS	.03423		.03700		.03960		.05332	

[a] A second degree polynomial (Almon) restriction with a tail point constraint is imposed on the lag structure of this equation.

[b] The COND(X) statistic indicates the degree of multicollinearity in the raw data matrix. Multicollinearity is considered severe when this statistic exceeds 100. COND(X) statistic values less than 30 indicate multicollinearity is not adversely affecting the precision of the individual regression coefficients. The raw data used in the regressions are expressed as deviations from their respective means. This reduces the magnitude of the computed COND(X) statistic considerably.

last six months with the maximum impact occurring four months after the initial expenditure. The estimated long-run advertising elasticity (the sum of the initial and carryover effects) is 0.051. The irregular pattern of the estimated lag distribution is surprising in light of the low collinearity among the lagged regressors.[6/] One plausible explanation is that the advertising expenditure series does not adequately reflect monthly variations in the effectiveness of the advertising message. This may occur as the result of (a) constantly changing commercials (e.g., during the period February 1975 through June 1980 61 different milk commercials were televised) and (b) monthly variations in the media mix among television, radio and newspapers. If monthly variations in the quality of the advertising signal is not well correlated with the actual level of expenditures then a perturbed pattern in the estimated response may occur. An additional explanation for the peculiar pattern in the estimated lag response is the possibility of a seasonal response to the advertising message (see Kinnucan 1981). In any case, for the purposes of this paper, it is the sum of the lag coefficients, not the individual lag coefficients themselves, that is of key importance.[7/]

These estimated elasticities suggest that milk sales in the New York City metropolitan area are relatively unresponsive to changes in economic factors. The own-price, cross-price and income elasticities are all closer to zero than to one. Even the long-run advertising elasticity at $\eta_{s \cdot a}=0.051$ represents a highly inelastic response.[8/]

By contrast, the elasticities for the demographic factors are quite large. According to the estimates in regression no. 1, for each percentage point increase in the proportion of the population under 20, milk sales increase by 1.3 percent, ceteris paribus; and for each percentage

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6/ Imposing an Almon polynomial restriction on the shape of the lag distribution produces a nice-looking lag pattern (see, e.g., regression no. 4 in table 2) but this procedure results in an eight percent downward bias in the estimated long-run advertising elasticity and is inappropriate when data are not highly collinear.

7/ As long as the "measurement error" in the advertising expenditure series does not bias this sum, its influence in terms of measuring advertising effectiveness is inconsequential. More important sources of bias in the estimated advertising elasticity are discussed later in the paper.

8/ Given the relatively small amounts that are spent on media advertising in any given month (about $125,000 per month over the last three years) a 100 percent increase in advertising does not represent a very large increase in absolute terms. An increase of this magnitude would have represented a total additional investment (in 1979) of about $91 per producer.

point increase in the nonwhite portion of the population, milk sales decrease 2.7 percent, ceteris paribus. Given the relatively large changes in these factors over the sample period (the nonwhite proportion of the population increased 20 percent; the under-age-20 population proportion decreased 13 percent) the magnitudes of these elasticities imply implausibly large reductions in per capita milk consumption.

Further analysis reveals that the age, race and trend variables are highly collinear (simple correlations between the variables is in excess of 0.98 in absolute value). To increase the precision with which these elasticities could be estimated it became necessary to re-estimate equation (1) dropping the trend term and, alternately, the age and race variables (the results are represented by regression nos. 2 and 3 of table 2). This approach, while introducing bias into the estimated age and race elasticities, produces elasticities of a more reasonable magnitude, i.e., a race elasticity of -0.593 and an age elasticity of 0.722. Moreover, the very large t-ratios corresponding to these estimates (in excess of 4.5 in absolute value) suggest that the biased estimates probably have a lower mean squared error[9/] than the unbiased estimates obtained from the more completely specified model represented by equation (1). Therefore, these elasticities will form the bases for further analysis with respect to the effects of changes in demographic characteristics on milk demand in the New York City market.

The positive coefficient of the trend term, while not precisely measured because of its high intercorrelation with the age and race variables, suggests that the combined influence of potentially relevant omitted variables (discussed earlier) had a positive influence on milk sales.

A Digression on Sources of Bias in the Estimated Advertising Elasticity

The long-run advertising elasticity estimated from equation (1) is large compared to previous estimates obtained from a double-log specification of the sales response function. Thompson, Eiler and Forker (1976), using data for the period January 1971 to March 1974, put the elasticity at 0.021. In a later study Thompson (1978), employing data for the January 1975 to June 1977 period, estimated the elasticity at 0.029. The difference in the estimates may be ascribed to three factors: (1) differences in data periods, (2) differences in model specification, and (3) differences in techniques used to estimate the distributed lag

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9/ The mean squared error of an estimator is its variance plus bias squared. Note further that the TROLL-produced diagnostic statistic for multicollinearity is significantly reduced by the elimination of the trend and age or race variables (compare COND(X) numbers in table 2 and see footnote b).

relationship between milk sales and advertising expenditures. The likely effect of these differences is examined below.

The Kinnucan estimate is based on data covering the period January 1971 through June 1980 and hence the Thompson, Eiler and Forker, and Thompson estimates may be regarded as results based on subperiods of the Kinnucan study. The subperiod estimates (0.021 and 0.029) are in close enough agreement to suggest no significant changes in the advertising elasticity over time.[10/] Hence the estimated elasticity based on the longer time period should be superior on this score because larger samples generally yield statistically superior results.

Relative to equation (1), the subperiod elasticity estimates flow from models which exclude all or most of the following relevant explanatory variables: cola price, coffee price, age, race and trend. If a statistical correlation between these excluded variables and advertising expenditures exists, the omission of these variables will bias the estimated advertising effect. Comparing the 1971-1980 estimate ($\eta_{s \cdot a}$=0.051) with the subperiod estimates ($\eta_{s \cdot a}$=0.021 and $\eta_{s \cdot a}$=0.029) one would expect the direction of the bias to be downward. To check this, equation (1) was re-estimated omitting the age, race, coffee price and trend variables.[11/] The resulting long-run advertising elasticity estimate is 0.032, suggesting that excluding these variables from the milk sales response function leads to a 33 percent downward bias in the estimated long-run advertising elasticity (excluding the demographic variables alone results in a 30 percent downward bias in the elasticity). Apparently then, 86 percent ((0.032-0.051)/(0.029-0.051) X 100) of the discrepancy between the overall and the subperiod estimates can be attributed to the omission of relevant explanatory variables.

In addition to time period and model specification differences, the estimates based on the subperiod samples use a procedure which restricts the distributed-lag advertising response to follow a low-order polynomial which terminates with a zero response. In contrast the 1971-1980 estimates impose no restrictions on the form of lag. A study employing the same model and data used by Thompson shows that the imposition of polynomial and end-point restrictions results in a downward bias of six percent in the estimated long-run advertising elasticity (Kinnucan 1981). Applying this result to the specification error result discussed above we would expect an estimated long-run advertising elasticity of 0.030 when the January 1971 through June 1980 data are used. Indeed, as indicated by regression no. 4, table 2, when a second degree polynomial restriction with an end-point constraint is imposed on the misspecified milk demand equation, the resulting estimated long-run advertising elasticity is 0.031. This estimate is close enough to the later subperiod estimate

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[10/] In fact, the difference between the two subperiod estimates may be ascribed to the omission of cola prices in the earlier study.

[11/] Cola price is retained since the later subperiod study does include this variable.

(0.029) to argue that earlier estimates of the long-run milk advertising elasticity for the New York City market had downward biases as large as 59 percent (0.021 compared with 0.051), due to the omission of relevant explanatory variables and the use of inappropriate procedures for estimating the distributed lag.

Estimated Effects of Demographic Changes on Milk Sales

One way to gain some additional insight regarding the magnitude of age and race effects on milk consumption is to compare milk sales in the absence of changes in these factors with actual sales. Looking at the age effect first, the model (regression no. 3) predicts that if the age structure in 1979 had remained unchanged from 1972 (i.e., with 32.6 percent of the population under 20), then milk sales would be 28.5 gallons or 9.6 percent higher than actual sales (table 3). If the racial composition had remained unchanged since 1972 (at 18.4 percent nonwhite) the model (regression no. 2) predicts milk sales in 1979 of 28.8 gallons - a 10.8 percent rise over the actual sales.

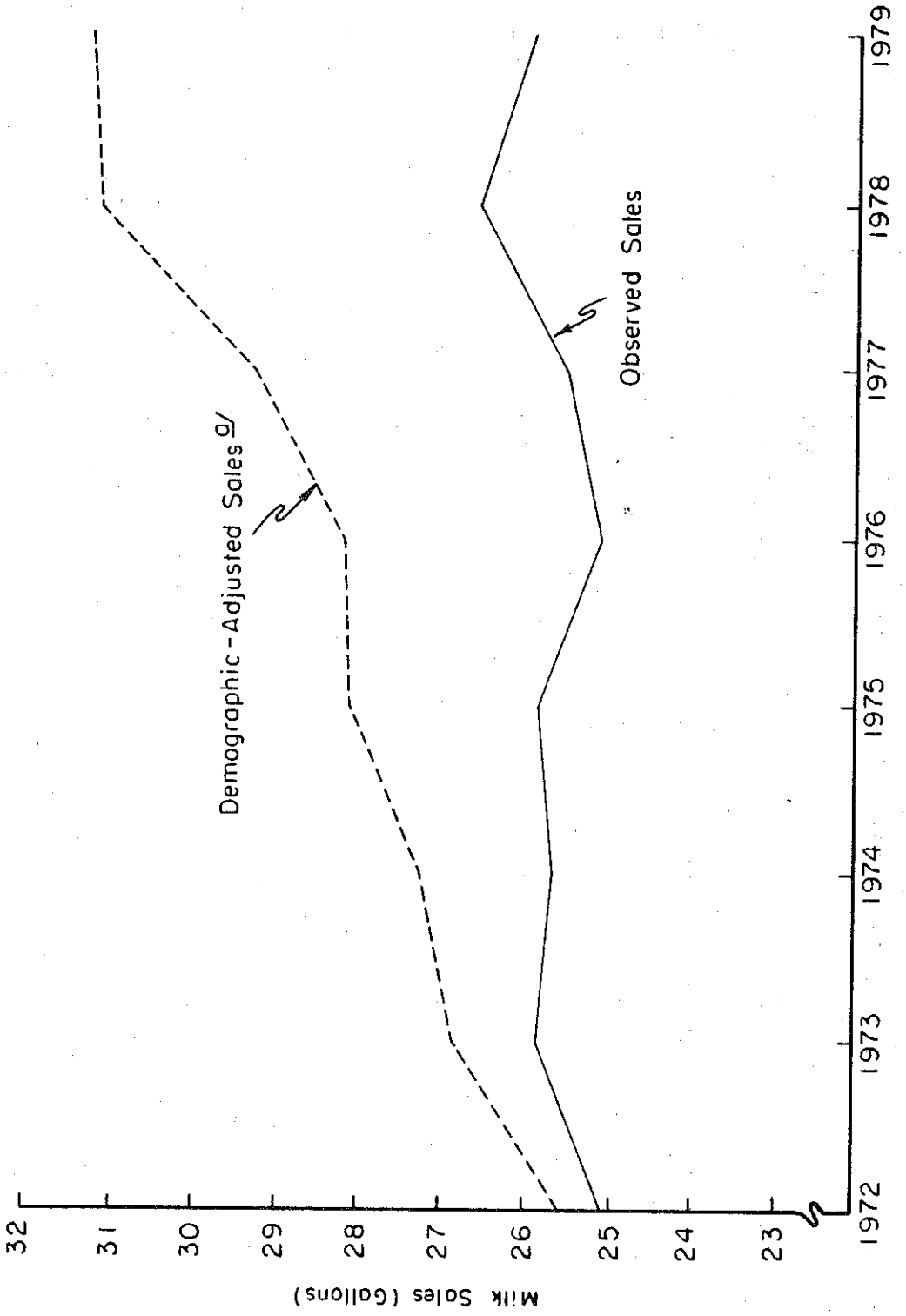
Table 3. ESTIMATED PER CAPITA MILK SALES IN 1979 WHEN AGE AND RACE FACTORS ARE HELD AT 1972 LEVELS, New York City Metropolitan Area

Population Nonwhite	Population Under 20	Estimated Milk Sales in 1979[a/]
percent	percent	gallons
21.5 (1979 level)	29.0 (1979 level)	26.0
21.5 (1979 level)	32.6 (1972 level)	28.5
18.4 (1972 level)	29.0 (1979 level)	28.8
18.4 (1972 level)	32.6 (1972 level)	31.3

a/ Actual milk sales in 1979 were 26 gallons per person. Estimates are OLS projections based on regression nos. 2 and 3 of table 2.

Combining the two effects, these estimates suggest that milk sales in the absence of age structure and racial composition changes would have been 31.3 gallons per person by 1979 - or 20.2 percent higher than the observed level. A graph showing the combined effect of changes in these two factors on milk sales in the New York City metropolitan area over the period 1972-1979 is presented in figure 1. This graph illustrates dramatically that per capita milk sales would have increased over the period had it not been for changes in the demographic composition of the population. While these estimates should not be regarded as precise due to the above described difficulties in measuring the independent effects of the age and race factors, they do provide some idea of the importance of these demographic changes in understanding the observed trend in milk consumption.

FIGURE 1. DEMOGRAPHIC-ADJUSTED TREND IN PER CAPITA MILK SALES VERSUS THE OBSERVED TREND, New York City Metropolitan Area, 1972-1979



a/ Based on holding age and race factors constant at their January, 1972 levels

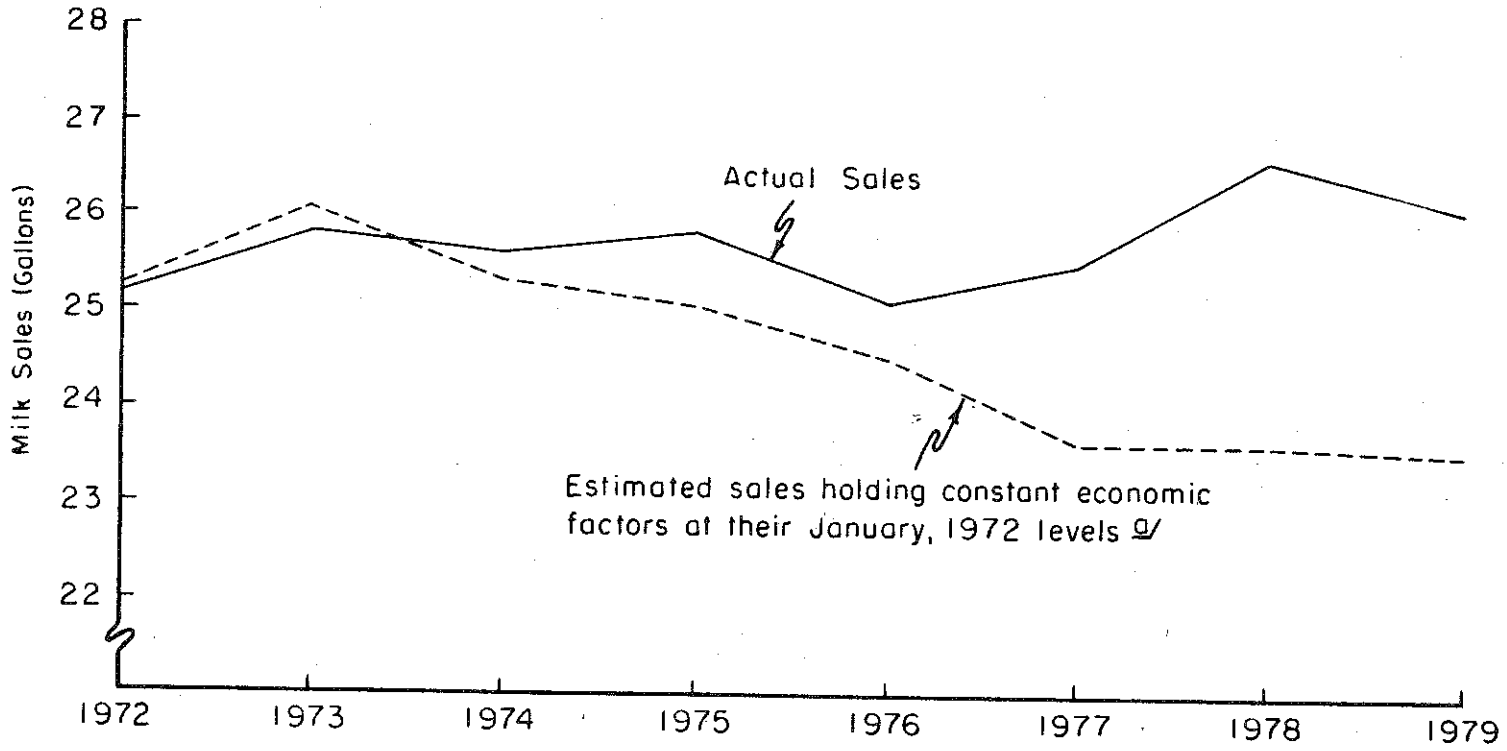
The Estimated Trend in Per Capita Milk Sales Attributable to Milk Promotion

The estimates presented in the last section suggest that per capita milk sales in the New York City metropolitan area would have increased 22.6 percent between 1972 and 1979 had the age structure and racial composition of the market population remained unchanged. The principal forces responsible for this (demographic-adjusted) sales increase appear to be (1) the generally favorable trends on the economic factors affecting milk consumption, i.e., rising real personal incomes, the nearly constant level of real milk prices, large increases in real cola prices and even larger increases in real coffee prices, and (2) dairy sponsored promotional efforts, principally in the form of a $12.2 million media campaign since 1971. The purpose of this section is to isolate that portion of the estimated sales increase attributable to the promotional effort.

The approach is to remove from the sales trend estimated in figure 1 that portion associated with economic factors. That portion is estimated by using regression equation (1) to estimate annual milk sales when the income and price variables are held constant at their January 1972 levels. The same equation is then used to estimate actual sales. The difference between these two estimates, illustrated in figure 2, is taken to be the sales change attributable to the economic factors. Note that beginning in 1973, actual sales are larger than sales estimated on the basis of constant trends in the economic variables. This suggests that the observed trends in the economic variables did, indeed, have a favorable influence on milk sales over this period.

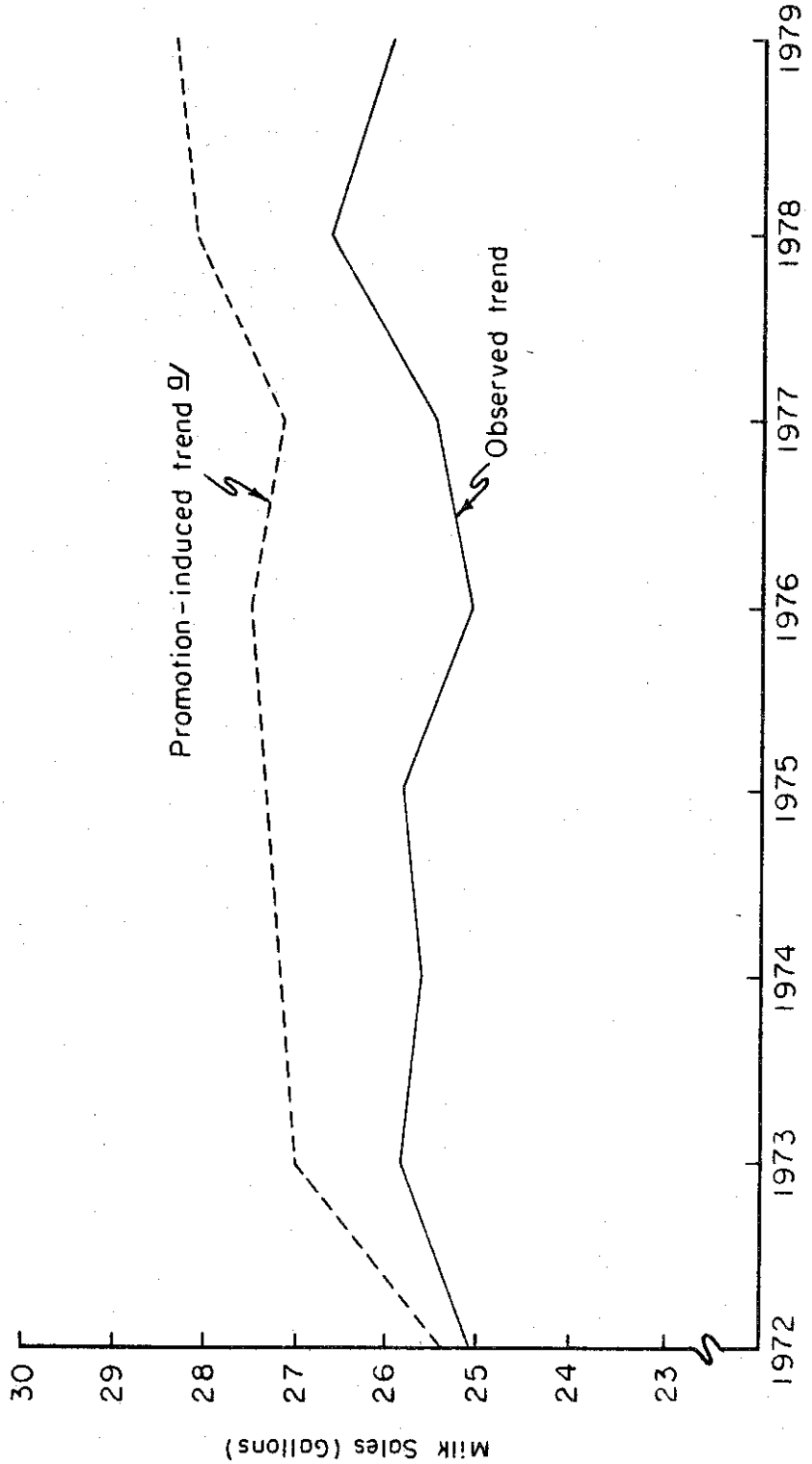
To arrive at the trend in milk sales attributable to the promotional effort, the sales change attributable to the economic factors is subtracted from total demographic-adjusted sales (the numbers represented by the dashed line of figure 1). The resulting trend, compared with the actual trend, is presented in figure 3. The estimated trend suggests that the promotional efforts contributed about one-half to the overall (demographic-adjusted) rise in per capita milk sales observed over the period. Alternatively, the promotional efforts appeared to have been successful in neutralizing the adverse effects of racial composition changes but not the adverse effects of the age structure changes. Its year-to-year effect, however, is uneven; relatively large promotion-induced sales changes appeared to have occurred between 1972-1973 and 1977-1978; modest promotion-induced changes occurred between 1973-1976 and 1978-1979; and an actual promotion-induced decline appeared to have occurred between 1976-1977. This uneven pattern is to some extent explicable in terms of the pattern of the advertising expenditures. For example, real per capita advertising expenditure increased 56 percent between 1972-1973, remained fairly constant between 1973-1976, and declined 29 percent in 1977 to remain fairly constant at this lower level for the remaining years (see table 4). The accelerated promotion-induced trend between 1977-1979, despite the sharp 1977 cutback in real advertising, is somewhat puzzling but may be due to improvements in milk quality presumed to have occurred over this period.

FIGURE 2. ESTIMATED TREND IN PER CAPITA MILK SALES HOLDING ECONOMIC FACTORS CONSTANT AT 1972 LEVELS COMPARED TO THE ACTUAL TREND, New York City Metropolitan Area, 1972-1979



a/ Economic factors held constant are personal income, and milk, cola and coffee prices

FIGURE 3. PROMOTION-INDUCED TREND IN PER CAPITA MILK SALES VERSUS THE OBSERVED TREND, New York City Metropolitan Area, 1972-1979



9/ This line represents the estimated trend in milk sales - net of the influences of income, and milk, cola and coffee prices and assuming no change in the age structure and racial composition of the market population since 1972. The dominant force explaining the generally upward trend is presumably media advertising.

The Economic Effectiveness of Generic Advertising of Milk

The statistical results presented earlier suggest that a clear, positive relationship between milk sales and generic advertising exists. Yet, as Hadar (1971, p. 128) points out, for advertising to be profitable it must bring about a sufficiently large shift in demand to compensate for costs. One way to determine if generic advertising in the New York City metropolitan area has been profitable for dairy producers is to compute the farm value of the sales increase attributable to advertising and compare this figure with the cost of advertising.[12/] This is done for 1972-1979 (table 4).

Estimated milk sales with "no" advertising is computed via equation (1) by setting the advertising variables at their lowest observed levels (approximately $9,000 per month in real terms) and letting the model predict milk sales, given the actual changes occurring in the other variables.[13/] The increase in milk sales attributable to advertising is computed as the difference between estimated actual milk sales and estimated milk sales with no advertising. The farm value (fv) of this sales gain is then computed on a month-by-month basis using the formula $fv = g \cdot pd \cdot N \cdot C$, where g=sales gain in gallons attributable to advertising, pd=Class I-Class II milk price differential, N=population of the Standard Metropolitan Statistical Area (SMSA), and C=1.28/14.88372 = a unit conversion factor (pounds to gallons).[14/] The advertising cost is the portion of the media expenditure in the market that pertains to SMSA population (generally this represents 60 percent of the total expenditure in the New York City market). For the dairy producer, the profitability of the advertising expenditures is the difference between the farm value of the sales increase and the cost of advertising.

The estimated annual increase in per capita milk sales attributable to advertising ranges from 1.6-3.1 gallons for an annual average increase

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[12/] An alternative procedure suggested by Hadar is to measure the price reduction required to offset the loss in sales when advertising is reduced to zero. Under this criterion, for advertising to be profitable "one dollar's worth of advertising per unit of output must in some sense be more effective than a discount of one dollar" (p. 128).

[13/] Setting advertising at the lowest observed level rather than at zero reduces the prediction error because the predicted value is based on observations which lie within the range of the original data.

[14/] In addition to the magnitude of the monthly sales gain (g), the size of the Class I-Class II price differential (pd) in any given month has a major influence on the profitability of the advertising investment (see, e.g., Thompson and Eiler 1977).

Table 4. ESTIMATED COSTS AND RETURNS TO GENERIC MILK ADVERTISING
New York City Metropolitan Area,[a/] 1972-1979

Year	Estimated Annual Milk Sales	Estimated Annual Milk Sales with Advertising at its Lowest Observed Level[b/]	Sales Gain Attributable to Advertising	Farm Value of the Sales Increase[c/]	Advertising Cost[d/]	Producers' Net Return from Advertising	Average Return per Media Dollar Invested	Average Annual Class I-Class II Milk Price Differential[e/]	Per Capita Advertising Expenditures 1975 Dollars
	gallons per person			current dollars				($/cwt)	(cents)
1972	25.1	23.5	1.6	$ 3,631,353	$ 510,479	$ 3,120,874	$7.11	$2.35	5.7¢
1973	25.8	22.7	3.1	6,681,778	814,357	5,867,422	8.21	2.23	8.9
1974	25.6	22.7	2.9	8,290,977	891,476	7,399,501	9.30	2.86	9.0
1975	25.8	23.0	2.8	5,525,433	1,066,910	4,458,523	5.18	2.07	9.5
1976	25.1	22.5	2.6	6,280,930	1,160,988	5,119,942	5.41	2.51	8.2
1977	25.5	23.6	1.9	4,080,726	965,281	3,115,445	4.23	2.27	5.8
1978	26.6	24.0	2.6	4,793,009	870,600	3,922,409	5.51	1.96	5.0
1979	26.0	23.7	2.3	4,540,687	936,976	3,603,711	4.85	2.09	4.7
Totals:									
1972-1979	205.5	185.7	19.8	$43,824,893	$7,217,067	$36,607,827	$6.07	----	56.8¢

a/ The New York City Metropolitan Area includes the five boroughs plus Nassau, Rockland, Suffolk and Westchester counties. Per capita figures are computed using a population series based on the 1970 and 1980 census counts and Federal-State Cooperative population estimates for the intervening years.

b/ The smallest observed advertising expenditure over the sample period is .06¢ per capita which represents a monthly investment of approximately $9,000 in real terms. Sales estimates are OLS projections from a model which includes the following variables: seasonality in milk sales, consumer income, age and racial composition of the market population, milk price, cola price and coffee price.

c/ Computed using the following formula: $v_j = g_j \cdot pd_j \cdot SMSApop_j \cdot C$ where v=farm value of the sales increase in month j, g=per capita milk sales gain in gallons in the jth month, pd=Class I-Class II milk price differential in dollars per hundredweight in the jth month, SMSApop=New York metro area population in the jth month, and C=1.28/14.88372 = a conversion factor to change pounds to gallons. The annual farm value is then the sum of the corresponding monthly values of v.

d/ The advertising cost is computed on the basis of the Standard Metropolitan Statistical Area population, not the Media Coverage Area population. This is done because the milk sales data pertain to the SMSA rather than the MCA. In 1980, the MCA contained abaout 1.6 times the population of the SMSA in New York City (MCA population was 17,854,116 compared with 10,802,972 for the SMSA population.

e/ The profitability of milk advertising is very sensitive to the magnitude of this price differential. For example, when the price differential is $2.00, each additional gallon of fluid milk sold has a farm value of 17.2¢ ($\frac{200¢}{100 \text{ lbs.}} \times \frac{100 \text{ lbs.}}{1488.372 \text{ oz.}} \times \frac{128 \text{ oz.}}{\text{gallon}} = 17.2¢$). A price differential of $3.00 yields a farm value of 25.8¢ for each additional gallon sold.

of 2.5 gallons per person over the 1972-1979 period.[15] On average, this represents a 10 percent increase in milk sales. The farm value of this sales increase over the eight-year period is approximately $44 million. When compared with the cost of achieving this sales increase ($7.2 million),[16] dairy producers realized a net return of $37 million from advertising a $6.07 average return on investment. Thus it appears that the investment in the New York City metropolitan area has stimulated demand sufficiently to make advertising highly profitable to affected dairy producers.

Limitations

A number of limitations regarding this study must be made clear if the conclusions and implications are to be regarded in appropriate perspective. First, the procedure used to estimate the age and race elasticities are biased, therefore any conclusions based on the estimated effects of these factors must be treated with caution. The nature of the bias, however, appears to be in the direction of providing more conservative estimates of the effect of each factor, so that resulting inferences are likely to understate the true effect of changes in these variables. The problem which forced a biased approach - multicollinearity - could possibly be overcome by ex ante adjustment of the data using an adult-equivalent scale deflator (see, e.g., Price). Yet, this approach is not without difficulties and, given the precision and reasonable size of the biased estimates, may be unnecessary.

Another limitation of the study has to do with the way in which the advertising variable is measured. Ideally such a measure would reflect actual changes in the quality and quantity of advertisements as perceived by consumers. The dollar expenditure measure used in this study probably falls short of the ideal measure, particularly since it represents expenditures on advertisements in different media as well as advertisements of varying effectiveness (e.g., the 61 different milk commercials that appeared on television in New York City since 1975 were probably not all equally effective). The resulting measurement error may account for the irregular pattern in the estimated lagged response and would downward bias the estimated long-run advertising elasticity.[17] These

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[15] Thompson's estimates of the sales gain are much smaller (in the neighborhood of one gallon per year) due to the severe downward bias in his estimates of the long-run advertising elasticity. The nature of this bias was discussed in detail earlier in the text.

[16] This $7.2 million is the portion of the total advertising expenditure ($12.2 million) that relates to the portion of the Media Coverage Area population for which milk sales figures are available (see footnote d table 4).

[17] When a variable is measured with error the corresponding regression coefficient has a downward bias in absolute value (see, e.g., Rao and Miller, pp. 179-182).

potential problems might be avoided by devising a quantity measure for advertising, based perhaps on demographic rating points, a measure used by the advertising industry to indicate actual impact.

A final, perhaps more important limitation of the study, is the inadequate treatment of the potential effects of the other components of the New York milk promotion program. Media advertising in New York City represents only about 50 percent of the total dairy funds collected for milk promotion in New York State. An additional 20 percent of the funds are spent on nutrition education and research - one half of which is targeted for the New York City area. Further, milk quality research at Cornell, funded primarily by dairy promotion dollars, may have resulted in significant improvements in the quality of milk available to New York City consumers since 1975. A trend variable probably represents an inadequate treatment of these and other nonmedia promotional influences. To the extent that this is true, the estimated effectiveness of the media advertising component of the promotional program would be overstated.

Conclusions and Implications

With the above caveats in mind, some conclusions can be drawn. First, the results presented in this study indicate that trends in the demographic factors of age and race have strong negative consequences for fluid milk demand in the New York City metropolitan area. During the 1971-1979 period the nonwhite proportion of the population grew by 20 percent and the under 20 population proportion decreased by 13 percent. According to the estimated age elasticity (0.72) the change in the age structure over this period, considered alone and assuming no changes in beverage prices and income, would have resulted in a 9.4 percent decrease in per capita milk sales. Similarly, the estimated race elasticity (-0.60) leads to an expected 12-percent decrease in milk sales, ceteris paribus.

The fact that per capita milk sales in this market remained relatively constant over this period suggests that the favorable trends in economic factors affecting milk consumption (nearly constant real milk prices, large increases in real cola and even larger increases in coffee prices, and increasing real per capita incomes) as well as the $12.2 million investment in media advertising have worked to offset the adverse effects of the demographic trends. The statistical results verify this contention.

Second, the study suggests that generic media advertisement of milk in the New York City metropolitan area is a profitable activity for dairy producers. The model estimates a ten-percent average annual increase in per capita milk sales as a result of the promotion effort. This sales increase translates into an average $6.07 return on investment to dairy farmers.

The positive experience of the advertising effort in the New York City metropolitan area suggests that promotional policy may be a valuable

tool in reducing the current excess supply problem. Dairy farmers may want to consider expanding their promotional efforts into other markets to further enhance milk demand. In a time of budget austerity, costly dairy surpluses create especially adverse publicity. Moreover, in addition to the positive economic advantages, any producer-funded effort to reduce surpluses is likely to have politically favorable effects.

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APPENDIX

Appendix Table 1a. MILK SALES, POPULATION, GENERIC MILK ADVERTISING EXPENDITURES AND RELATED DATA, New York City Metropolitan Area, January 1971-June 1980.

	TOTAL FLUID MILK SALES (POUNDS) 1/	CALENDER COMPOSITION ADJUSTMENT FACTOR 2/	SMSA POPULATION 3/	MEDIA COVERAGE (MCA) POPULATION 4/	GENERIC MILK ADVERTISING EXPENDITURES 5/	MEDIA COST INDEX (1975=100) 6/
1971 JAN	2.129990E+08	0.9894	1.159144E+07	1.857286E+07	38933.	68.
---- FEB	1.951380E+08	1.	1.159318E+07	1.858104E+07	37114.	68.
---- MAR	2.206017E+08	1.0085	1.159492E+07	1.858922E+07	68691.	68.
---- APR	2.061490E+08	1.0107	1.159667E+07	1.859739E+07	42718.	73.
---- MAY	2.053120E+08	0.9589	1.159841E+07	1.860558E+07	18531.	73.
---- JUNE	2.056250E+08	1.0007	1.160016E+07	1.861378E+07	0.	73.
---- JULY	1.945165E+08	1.0214	1.160190E+07	1.862221E+07	0.	68.
---- AUG	1.875648E+08	0.9787	1.159882E+07	1.862302E+07	9302.	68.
---- SEPT	1.992958E+08	1.0021	1.159575E+07	1.862384E+07	52114.	68.
---- OCT	2.070302E+08	0.9894	1.159267E+07	1.862466E+07	54982.	80.
---- NOV	1.997042E+08	1.0009	1.158960E+07	1.862547E+07	68934.	80.
---- DEC	2.141564E+08	1.0103	1.158652E+07	1.862629E+07	16772.	80.
1972 JAN	2.084602E+08	0.9887	1.158345E+07	1.862710E+07	0.	72.
---- FEB	1.978044E+08	1.0008	1.158037E+07	1.862792E+07	0.	72.
---- MAR	2.179405E+08	1.0103	1.157730E+07	1.862874E+07	41052.	72.
---- APR	2.017219E+08	0.9805	1.157422E+07	1.862955E+07	46678.	74.
---- MAY	2.099809E+08	1.0085	1.157115E+07	1.863037E+07	18676.	74.
---- JUNE	2.051234E+08	1.0107	1.156807E+07	1.863118E+07	52315.	74.
---- JULY	1.913041E+08	0.9889	1.156500E+07	1.863210E+07	1.607430E+05	73.
---- AUG	1.996902E+08	1.0028	1.155284E+07	1.861670E+07	1.140460E+05	73.
---- SEPT	2.113005E+08	1.02	1.154068E+07	1.860133E+07	63583.	73.
---- OCT	2.167437E+08	0.9787	1.152852E+07	1.858597E+07	1.384240E+05	84.
---- NOV	2.143828E+08	1.0021	1.151636E+07	1.857062E+07	1.010390E+05	84.
---- DEC	2.183298E+08	0.9894	1.150420E+07	1.855530E+07	86094.	84.
1973 JAN	2.248715E+08	1.0083	1.149205E+07	1.853997E+07	74884.	76.
---- FEB	2.032234E+08	1.	1.147989E+07	1.852466E+07	1.142290E+05	76.
---- MAR	2.296432E+08	1.0216	1.146773E+07	1.850936E+07	1.498480E+05	76.
---- APR	2.104055E+08	0.9759	1.145557E+07	1.849408E+07	1.461410E+05	83.
---- MAY	2.217299E+08	1.0062	1.144341E+07	1.847880E+07	1.330610E+05	83.
---- JUNE	2.099095E+08	1.0177	1.143125E+07	1.846354E+07	73109.	83.
---- JULY	1.962167E+08	0.9794	1.141910E+07	1.844840E+07	1.237570E+05	73.
---- AUG	2.009842E+08	1.0107	1.141092E+07	1.843994E+07	1.106190E+05	73.
---- SEPT	2.018928E+08	0.9794	1.140273E+07	1.843147E+07	97479.	73.
---- OCT	2.201039E+08	1.0093	1.139455E+07	1.842302E+07	88092.	93.
---- NOV	2.088210E+08	1.0121	1.138636E+07	1.841458E+07	1.012010E+05	93.
---- DEC	2.090945E+08	0.9866	1.137818E+07	1.840613E+07	1.030890E+05	93.
1974 JAN	2.133700E+08	1.0066	1.137000E+07	1.839768E+07	54334.	82.
---- FEB	1.947180E+08	1.	1.136181E+07	1.838925E+07	80552.	82.
---- MAR	2.141548E+08	0.9876	1.135363E+07	1.838082E+07	2.172680E+05	82.
---- APR	2.067503E+08	1.0091	1.134544E+07	1.837238E+07	1.330810E+05	88.
---- MAY	2.159808E+08	1.012	1.133726E+07	1.836395E+07	51200.	88.
---- JUNE	2.100936E+08	0.9785	1.132908E+07	1.835552E+07	1.451390E+05	88.
---- JULY	1.936251E+08	1.0085	1.132090E+07	1.834720E+07	85100.	81.
---- AUG	1.987093E+08	1.0209	1.131585E+07	1.834315E+07	95280.	81.
---- SEPT	2.063164E+08	0.9755	1.131080E+07	1.833910E+07	1.060100E+05	81.
---- OCT	2.184835E+08	1.0066	1.130575E+07	1.833506E+07	1.600680E+05	98.
---- NOV	2.085280E+08	1.0176	1.130070E+07	1.833101E+07	1.666440E+05	98.
---- DEC	2.151890E+08	0.9793	1.129565E+07	1.832696E+07	1.500000E+05	98.

Appendix Table 1a (Continued)

		TOTAL FLUID MILK SALES (POUNDS)	CALENDER COMPOSITION ADJUSTMENT FACTOR	SNSA POPULATION	MEDIA COVERAGE (MCA POPULATION	GENERIC MILK ADVERTISING EXPENDITURES	MEDIA COST INDEX (1975=100)
1975	JAN	2.164595E+08	1.0133	1.129060E+07	1.832291E+07	0.	95.
----	FEB	1.972545E+08	1.	1.128555E+07	1.831980E+07	3.235730E+05	95.
----	MAR	2.132760E+08	0.9632	1.128050E+07	1.831482E+07	79783.	95.
----	APR	2.081234E+08	1.0012	1.127545E+07	1.831077E+07	74675.	104.
----	MAY	2.162316E+08	1.0212	1.127040E+07	1.830672E+07	1.129270E+05	104.
----	JUNE	2.152479E+08	0.9747	1.126535E+07	1.830267E+07	3.117750E+05	104.
----	JULY	1.933548E+08	1.007	1.126030E+07	1.829870E+07	1.658720E+05	94.
----	AUG	1.954534E+08	0.988	1.125526E+07	1.829722E+07	78875.	94.
----	SEPT	2.057558E+08	1.0082	1.125502E+07	1.829573E+07	1.708720E+05	94.
----	OCT	2.186031E+08	1.0133	1.125227E+07	1.829424E+07	1.769750E+05	107.
----	NOV	2.023802E+08	0.9781	1.124973E+07	1.829275E+07	2.379480E+05	107.
----	DEC	2.181427E+08	1.0077	1.124709E+07	1.829126E+07	0.	107.
1976	JAN	2.178728E+08	1.0224	1.124445E+07	1.828978E+07	25617.	110.
----	FEB	1.915877E+08	1.0010	1.124181E+07	1.828629E+07	1.293330E+05	110.
----	MAR	2.178139E+08	1.0082	1.123916E+07	1.828680E+07	1.297050E+05	110.
----	APR	2.024814E+08	1.015	1.123652E+07	1.828531E+07	2.084270E+05	127.
----	MAY	2.037437E+08	0.9837	1.123388E+07	1.828382E+07	2.570880E+05	129.
----	JUNE	1.947389E+08	1.0019	1.123124E+07	1.828234E+07	1.756750E+05	129.
----	JULY	1.964523E+08	1.0214	1.122860E+07	1.828101E+07	1.069970E+05	118.
----	AUG	1.870216E+08	0.9782	1.122613E+07	1.827268E+07	2.676530E+05	116.
----	SEPT	1.976154E+08	1.0036	1.121167E+07	1.826315E+07	67480.	116.
----	OCT	2.066132E+08	0.9876	1.120320E+07	1.825422E+07	2.926960E+05	130.
----	NOV	2.028623E+08	1.0092	1.119474E+07	1.824531E+07	1.910650E+05	130.
----	DEC	2.141742E+08	1.0139	1.118627E+07	1.823640E+07	0.	130.
1977	JAN	2.049387E+08	0.9837	1.117781E+07	1.822749E+07	0.	130.
----	FEB	1.861848E+08	1.	1.116934E+07	1.821858E+07	71895.	132.
----	MAR	2.073312E+08	1.0077	1.116088E+07	1.820968E+07	1.531180E+05	130.
----	APR	1.877605E+08	1.0162	1.115241E+07	1.820078E+07	15467.	148.
----	MAY	1.936568E+08	0.979	1.114395E+07	1.819189E+07	1.415050E+05	148.
----	JUNE	1.894989E+08	1.0055	1.113548E+07	1.818301E+07	2.312080E+05	148.
----	JULY	1.960985E+08	0.9844	1.112703E+07	1.817422E+07	2.458180E+05	140.
----	AUG	1.992214E+08	1.009	1.111746E+07	1.816539E+07	90369.	140.
----	SEPT	2.136743E+08	1.0157	1.110788E+07	1.815656E+07	67261.	140.
----	OCT	2.203772E+08	0.9837	1.109831E+07	1.814774E+07	2.718220E+05	165.
----	NOV	2.171241E+08	1.0011	1.108874E+07	1.813893E+07	2.059020E+05	165.
----	DEC	2.278155E+08	1.0223	1.107916E+07	1.813011E+07	83206.	165.
1978	JAN	2.168922E+08	0.9823	1.106959E+07	1.812130E+07	25237.	148.
----	FEB	2.009416E+08	1.	1.106002E+07	1.811250E+07	1.035820E+05	148.
----	MAR	2.244872E+08	1.0129	1.105044E+07	1.810370E+07	1.419100E+05	148.
----	APR	2.123051E+08	0.9751	1.104087E+07	1.809490E+07	1.495350E+05	160.
----	MAY	2.170031E+08	1.0099	1.103130E+07	1.808611E+07	1.125290E+05	160.
----	JUNE	2.033726E+08	1.0147	1.102173E+07	1.807733E+07	1.454520E+05	160.
----	JULY	1.935987E+08	0.9832	1.101216E+07	1.806854E+07	1.356510E+05	147.
----	AUG	1.976108E+08	1.0094	1.100177E+07	1.805966E+07	1.072300E+05	147.
----	SEPT	2.122756E+08	1.0126	1.099138E+07	1.805070E+07	58780.	147.
----	OCT	2.113590E+08	0.9823	1.098099E+07	1.804174E+07	2.013100E+05	175.
----	NOV	2.118682E+08	1.0057	1.097061E+07	1.803278E+07	1.104850E+05	175.
----	DEC	2.164332E+08	0.9833	1.096022E+07	1.802382E+07	1.386700E+05	175.

Appendix Table 1a (Continued)

	TOTAL FLUID MILK SALES (POUNDS)	CALENDER COMPOSITION ADJUSTMENT FACTOR	SMSA POPULATION	MEDIA COVERAGE (MCA) POPULATION	GENERIC MILK ADVERTISING EXPENDITURES	MEDIA COST INDEX (1975=100)
1979 JAN	2.192478E+08	1.0067	1.094983E+07	1.801488E+07	32110.	174.
---- FEB	1.887701E+08	1.	1.093944E+07	1.800594E+07	1.109400E+05	174.
---- MAR	2.142929E+08	1.0201	1.092905E+07	1.799699E+07	1.153500E+05	174.
---- APR	1.995227E+08	0.9771	1.091867E+07	1.798805E+07	2.444950E+05	167.
---- MAY	2.054399E+08	1.0099	1.090828E+07	1.797912E+07	1.581500E+05	167.
---- JUNE	2.002420E+08	1.0139	1.089789E+07	1.797019E+07	1.197250E+05	167.
---- JULY	1.841299E+08	0.9839	1.088751E+07	1.796130E+07	1.410700E+05	173.
---- AUG	1.993745E+08	1.0122	1.087811E+07	1.794943E+07	1.329550E+05	171.
---- SEPT	1.989000E+08	0.9743	1.086872E+07	1.793747E+07	1.757500E+05	173.
---- OCT	2.144079E+08	1.0087	1.085933E+07	1.792554E+07	1.975200E+05	205.
---- NOV	2.050686E+08	1.0167	1.084994E+07	1.791360E+07	1.529150E+05	205.
---- DEC	2.075432E+08	0.9817	1.084054E+07	1.790168E+07	49095.	205.
1980 JAN	2.091782E+08	1.0098	1.083115E+07	1.788976E+07	47010.	212.
---- FEB	1.956675E+08	1.0431	1.082176E+07	1.787786E+07	1.269150E+05	212.
---- MAR	2.110604E+08	0.9817	1.081236E+07	1.786595E+07	2.003100E+05	212.
---- APR	1.985024E+08	1.0022	1.080297E+07	1.785411E+07	1.259310E+05	212.
---- MAY	2.057622E+08	1.0201	1.079358E+07	1.784227E+07	1.310760E+05	212.
---- JUNE	1.984929E+08	0.9771	1.078419E+07	1.783043E+07	1.238440E+05	212.

1/ The January 1971-March 1974 figures were derived from the data appendix table (p.21) in Thompson, S. R., D. A. Eiler, and O. D. Forker. "An Econometric Analysis of Sales Response to Generic Milk Advertising in New York State," Search 6 (1976). To convert the published per capita sales figures to total sales the following formula was used: TMS = PCS(TEF) x POP(TEF) x CALADJ x DAYS x 1 LB./14.88372 OZ. where TMS = total milk sales in pounds, PCS = adjusted per capita daily milk sales in ounces, POP(TEF) = SMSA population as published in Thompson, Eiler, Forker, CALADJ = the calendar composition adjustment factor (see footnote 2), DAYS = the number of days in the respective months, 1 LB./14.88372 OZ. = an ounces to pound conversion factor. The 1973-March 1974 total sales figures were computed to reflect the updated CALADJ factors. Since data are not available for the April-December 1974 period these were estimated as the simple average of total milk sales in 1972, 1973, and 1975 for the corresponding months e.g., April 1974 sales = April 1972 sales + April 1973 sales + April 1975 sales/3. The January 1975-June 1977 figures were derived from data in appendix table 1 of Thompson, S. R. "An Analysis of the Effectiveness of Generic Fluid Milk Advertising in New York State," A.E. Res. 78-17, Department of Agricultural Economics, Cornell University, (September 1978), p.22. In addition to the SMSA counties (see footnote 3), Bergen County, New Jersey is included in these per capita sales figures. To obtain total sales figures exclusive of Bergen County procedure is used: step 1.: RPCS = PCS(T) x POPB(T)/POPB(K) where RPCS = revised per capita milk sales, POP(T) = SMSA population figures as published by Thompson, and POP(K) = SMSA and Bergen County population based on sources and procedures described in footnote 3. Step 2.: (impute TMS = RPCS x POP(K) x CALADJ x DAYS x 1 LB./14.88372 OZ. where the as yet undefined variable POP(K) = New York City SMSA population (exclusive of Bergen County) as described in footnote 3. The July 1977-June 1980 figures were made available by Lyle Newcomb, Milk Marketing Specialist with the NYS Department of Agriculture and Markets. A milk strike in February through April of 1979 adversely affected milk sales figures for these months. Therefore milk sales in these months were taken to be the simple average of sales in the corresponding months of 1977, 1978, and 1980.

2/ Milk sales vary according to the day of the week e.g., milk sales are typically much larger on Saturday than on Sunday. The number of times a particular day occurs in any given month can vary from year-to-year. For example, in 1973 January had five Mondays but only four Mondays in 1974. If consumers buy more milk on Mondays than other days of the week then we would expect the January 1973 sales to be higher than the January 1974 sales, citeris paribus. Dividing monthly in-area milk sales by the calendar composition adjustment factor removes the effect of monthly milk sales variation attributable to year-to-year differences in the monthly occurance of Mondays, Tuesdays, Wednesdays, etc. The adjusted figure reflects what the sales in the month would have been if all days were average sales days. The basic source for these adjustment factors is: U.S.D.A., A.M.S. Federal Order Market Statistics (FMOS). Adjustment factors for specific years were taken from the following issues: 1971-72-FMOS #158, 1973-FMOS #171, 1974-FMOS # 184, 1975-FMOS #196, 1976-FMOS #210, 1977-FMOS #221, 1978-FMOS #233, 1979-80-FMOS #243.

3/ The Standard Metropolitan Statistical Area is defined to include the following counties: Bronx, Kings, New York, Queens, Nassau, Richmond, Rockland, Suffolk, and Westchester. The July figure in each of the years 1971-1979 are derived from county estimates published in: U.S. Dept. of Commerce, Bureau of Census, Federal-State Cooperative Program for Population Estimates, Series P-26, annual issues. The monthly estimates are based on linear interpolation of these annual estimates using the 1970 and 1980 census counts as endpoints.

4/ The Media Coverage Area is comprised of the following counties: Fairfield, CT; New Jersey-Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, Sussex, Union; Pike, PA; New York-Dutchess, Orange, Putnam, Sullivan, Ulster plus the nine SMSA counties listed in footnote 3. Procedures and sources used to obtain monthly estimates of the MCA population are identical to those described in footnote 3. The MCA counties were obtained from the Broadcasting Yearbook, Storer Broadcasting Co., Washington, D.C. and is defined as the estimated population viewing television stations of a given market.

5/ Includes media advertising expenditures for television, radio, and newspaper. In general about 85 percent of the expenditures represent television advertising. Expenditures for network television advertising are included in a pro rata basis (MCA population divided by U.S. population). The July 1977-June 1980 figures were made available by Lyle Newcomb, Milk Marketing Specialist, NYS Department of Agriculture and Markets. The January 1971-March 1974 and January 1975-June 1977 figures were obtained from the Search and A.E. Research publications listed in footnote 1. The April-December 1974 expenditures were obtained from advertising invoices of the American Dairy Association and Dairy Council of Syracuse, New York.

6/ The January 1971-March 1974 and January 1975-June 1977 figures were obtained by multiplying the Cost of Advertising Index figures published in the Search and A.E. Research publications (see footnote 1) by .68 (a conversion factor to change the base from 1971 = 100 to 1975 = 100). The July 1977-June 1980 index numbers are a weighted average of the Television and Radio Cost Indices computed by the D'Arcy, MacManus, and Masuis Advertising Agency. These latter figures are designed to reflect actual average costs incurred by the advertising agency for spot TV and radio time. The annual value of the index was multiplied by .940, 1.014, .936, and 1.108 to obtain first, second, third, and fourth quarter index values respectively. These weighting factors reflect the historical average quarterly variation in media costs. A constant index number of 212 is used in 1980 since media time was purchased on contract for the entire year. The April-December 1974 numbers are extrapolated values.

Appendix Table 1b. PERSONAL INCOME, PRICES, AND DEMOGRAPHIC DATA, New York City Metropolitan Area, January 1971-June 1980.

	TOTAL BEFORE TAX PERSONAL INCOME 1/ (DOLLARS)	RETAIL FLUID MILK PRICE 2/ ($/QRT)	COLA PRICE INDEX 3/ (1967=100)	COFFEE PRICE INDEX 3/ (1967=100)	CONSUMER PRICE INDEX 4/ (1967=100)	PERCENT NONWHITE POPULATION 5/	PERCENT POPULATION LESS THAN AGE 20 6/
1971 JAN	59833.4	0.31	122.6	125.2	122.5	17.7624	33.5332
---- FEB	60225.7	0.31	123.7	125.	123.5	17.787	33.5173
---- MAR	60620.6	0.31	124.9	123.8	124.3	17.8116	33.4965
---- APR	61018.	0.3	125.2	123.1	124.6	17.8362	33.4816
---- MAY	61418.2	0.314	125.7	122.6	125.2	17.8608	33.4657
---- JUNE	61396.1	0.314	126.3	122.4	126.1	17.8854	33.4456
---- JULY	61374.1	0.314	126.4	121.6	126.8	17.91	33.426
---- AUG	61352.	0.314	126.7	121.8	126.9	17.9489	33.3569
---- SEPT	61417.9	0.314	127.	119.1	127.5	17.9878	33.2858
---- OCT	61483.9	0.314	127.3	119.3	127.5	18.0267	33.2147
---- NOV	61550.1	0.313	127.1	119.	127.6	18.0656	33.1436
---- DEC	62341.2	0.314	127.1	118.5	128.	18.1046	33.0725
1972 JAN	63142.4	0.321	127.7	118.2	128.4	18.1435	33.0014
---- FEB	63954.	0.321	127.8	118.3	129.5	18.1824	32.9304
---- MAR	64209.5	0.321	128.1	118.3	130.	18.2213	32.8593
---- APR	64626.8	0.321	128.2	118.2	130.3	18.2602	32.7882
---- MAY	64965.9	0.324	128.2	118.1	130.5	18.2991	32.7171
---- JUNE	65010.8	0.323	127.8	117.2	130.9	18.338	32.646
---- JULY	65055.8	0.321	128.2	117.2	131.4	18.377	32.575
---- AUG	65100.8	0.319	128.	116.4	131.7	18.4312	32.5609
---- SEPT	65658.2	0.323	128.	120.6	132.9	18.4853	32.5468
---- OCT	66220.3	0.319	128.7	122.4	133.2	18.5395	32.5327
---- NOV	66787.3	0.319	129.3	122.9	133.3	18.5936	32.5187
---- DEC	66304.7	0.329	129.1	123.1	133.7	18.6478	32.5046
1973 JAN	65825.6	0.33	129.6	124.3	133.7	18.7019	32.4905
---- FEB	65350.	0.335	129.5	127.3	134.9	18.7561	32.4764
---- MAR	65873.1	0.338	130.2	128.4	136.5	18.8102	32.4623
---- APR	66400.4	0.336	130.5	129.7	137.4	18.8644	32.4482
---- MAY	66931.9	0.339	131.4	133.4	138.1	18.9185	32.4342
---- JUNE	67467.7	0.344	132.	137.3	139.1	18.9727	32.4201
---- JULY	68007.7	0.346	131.7	138.2	139.2	19.027	32.406
---- AUG	68552.2	0.344	131.3	138.6	141.7	19.0641	32.3698
---- SEPT	69113.9	0.345	131.2	139.	142.3	19.1013	32.3335
---- OCT	69680.2	0.364	133.2	140.4	143.1	19.1385	32.2972
---- NOV	70251.3	0.384	134.4	141.2	144.4	19.1756	32.261
---- DEC	70808.6	0.411	135.6	142.1	145.9	19.2128	32.2247
1974 JAN	71370.4	0.415	136.4	145.3	146.8	19.2499	32.1885
---- FEB	71936.8	0.423	138.6	148.3	149.	19.2871	32.1522
---- MAR	72393.2	0.426	141.4	150.1	150.8	19.3242	32.116
---- APR	72852.6	0.434	146.5	153.8	150.9	19.3614	32.0797
---- MAY	73315.1	0.438	152.5	156.6	152.5	19.3985	32.0435
---- JUNE	73598.4	0.431	158.6	160.4	153.8	19.4357	32.0072
---- JULY	73882.7	0.42	165.8	163.4	154.6	19.473	31.971
---- AUG	74168.4	0.414	174.8	168.5	156.9	19.5052	31.9208
---- SEPT	74581.7	0.409	178.2	170.8	158.7	19.5375	31.8707
---- OCT	74997.3	0.408	182.7	171.8	160.	19.5697	31.8205
---- NOV	75415.5	0.411	191.5	169.1	160.9	19.602	31.7703
---- DEC	75829.9	0.426	193.1	168.6	161.7	19.6342	31.7201

Appendix Table 1b (Continued)

	TOTAL BEFORE TAX PERSONAL INCOME (DOLLARS)	RETAIL FLUID MILK PRICE ($/QRT)	COLA PRICE INDEX (1967=100)	COFFEE PRICE INDEX (1967=100)	CONSUMER PRICE INDEX (1967=100)	PERCENT NONWHITE POPULATION	PERCENT POPULATION LESS THAN AGE 20
1975 JAN	76246.6	0.433	203.1	167.7	161.7	19.6665	31.67
---- FEB	76665.7	0.43	207.4	167.2	163.2	19.6987	31.6198
---- MAR	77013.2	0.431	209.5	167.1	163.4	19.7309	31.5696
---- APR	77362.4	0.423	210.1	166.9	163.7	19.7632	31.5195
---- MAY	77713.2	0.436	202.6	164.6	164.3	19.7954	31.4693
---- JUNE	78063.9	0.423	200.4	164.5	165.2	19.8277	31.4191
---- JULY	78713.7	0.415	198.	164.5	166.6	19.86	31.369
---- AUG	79019.	0.424	197.	166.1	167.5	19.9167	31.3238
---- SEPT	79436.6	0.421	195.5	172.2	169.3	19.9735	31.2885
---- OCT	79654.7	0.415	194.1	184.8	170.	20.0302	31.2482
---- NOV	79873.7	0.43	194.5	192.9	171.4	20.087	31.208
---- DEC	80213.	0.436	194.2	196.1	172.4	20.1437	31.1677
1976 JAN	80553.7	0.445	193.2	198.	172.7	20.2005	31.1275
---- FEB	80896.2	0.443	194.	199.1	173.5	20.2572	31.0872
---- MAR	81153.1	0.45	192.8	202.1	173.9	20.314	31.047
---- APR	81410.9	0.449	192.4	212.	174.3	20.3707	31.0067
---- MAY	81669.7	0.446	193.5	222.2	174.9	20.4275	30.9665
---- JUNE	82330.4	0.448	193.9	233.1	176.	20.4842	30.9262
---- JULY	82996.4	0.446	194.	249.1	176.7	20.541	30.886
---- AUG	83667.9	0.444	193.9	262.4	177.6	20.5554	30.831
---- SEPT	84095.4	0.45	195.2	270.	178.6	20.5698	30.776
---- OCT	84525.1	0.459	196.	275.2	179.	20.5842	30.721
---- NOV	84957.1	0.45	195.5	289.9	179.	20.5986	30.666
---- DEC	85638.4	0.449	195.7	309.6	179.7	20.613	30.611
1977 JAN	86325.1	0.453	198.5	331.4	180.5	20.6274	30.556
---- FEB	87017.6	0.455	199.1	364.1	182.1	20.6418	30.5009
---- MAR	87429.6	0.455	199.9	389.7	182.9	20.6562	30.4459
---- APR	87843.6	0.454	201.3	440.8	183.7	20.6706	30.3909
---- MAY	88259.7	0.456	201.6	486.2	184.6	20.685	30.3359
---- JUNE	88585.3	0.469	204.5	511.4	186.2	20.6994	30.2809
---- JULY	88912.1	0.461	202.7	505.8	186.4	20.714	30.226
---- AUG	89240.4	0.459	204.	496.1	187.2	20.7441	30.1762
---- SEPT	89760.3	0.455	207.1	487.5	187.3	20.7742	30.1265
---- OCT	90283.3	0.45	207.4	479.5	187.6	20.8042	30.0767
---- NOV	90809.5	0.465	208.2	464.4	188.5	20.8343	30.027
---- DEC	91512.2	0.478	206.	457.5	188.8	20.8644	29.9772
1978 JAN	92220.4	0.463	209.1	453.1	189.3	20.8945	29.9274
---- FEB	92934.4	0.474	210.5	450.2	190.7	20.9245	29.8777
---- MAR	93629.2	0.473	213.6	446.5	191.9	20.9546	29.8279
---- APR	94329.2	0.47	216.8	433.2	192.9	20.9847	29.7782
---- MAY	95034.6	0.466	216.8	424.6	194.1	21.0148	29.7284
---- JUNE	95599.9	0.471	218.6	415.6	196.1	21.0448	29.6786
---- AUG	96168.6	0.468	219.4	408.5	196.7	21.075	29.629
---- SEPT	96741.	0.475	220.4	388.8	196.7	21.1122	29.5793
---- OCT	97737.	0.47	221.4	377.7	197.7	21.1494	29.5297
---- NOV	98743.2	0.469	223.4	371.8	199.2	21.1866	29.48
---- DEC	99760.1	0.469	224.	370.6	199.8	21.2237	29.4304
---- DEC	99765.9	0.476	225.4	368.6	200.9	21.2609	29.3807

Appendix Table 1b (Continued)

	TOTAL BEFORE TAX PERSONAL INCOME (DOLLARS)	RETAIL FLUID MILK PRICE ($/QRT)	COLA PRICE INDEX (1967=100)	COFFEE PRICE INDEX (1967=100)	CONSUMER PRICE INDEX (1967=100)	PERCENT NONWHITE POPULATION	PERCENT POPULATION LESS THAN AGE 20
1979 JAN	99771.6	0.488	230.1	363.	202.3	21.2981	29.3311
---- FEB	99777.7	0.502	233.6	357.5	204.7	21.3353	29.2814
---- MAR	1.003957E+05	0.535	233.8	342.3	206.3	21.3725	29.2318
---- APR	1.010175E+05	0.556	234.8	343.6	208.1	21.4097	29.1821
---- MAY	1.016433E+05	0.526	237.4	341.2	210.3	21.4469	29.1325
---- JUNE	1.027254E+05	0.528	237.9	347.3	212.2	21.484	29.0828
---- JULY	1.038189E+05	0.529	238.3	376.8	214.1	21.5212	29.0332
---- AUG	1.049242E+05	0.529	239.2	411.7	215.3	21.5584	28.9835
---- SEPT	1.056693E+05	0.531	242.7	425.9	217.8	21.5956	28.9339
---- OCT	1.064197E+05	0.546	246.4	432.4	219.3	21.6328	28.8842
---- NOV	1.071758E+05	0.551	247.5	438.1	220.7	21.67	28.8346
---- DEC	1.081532E+05	0.551	247.2	440.7	222.4	21.7072	28.7849
1980 JAN	1.091396E+05	0.557	246.5	442.1	225.5	21.7443	28.7353
---- FEB	1.101350E+05	0.561	253.6	436.8	227.7	21.7815	28.6856
---- MAR	1.111394E+05	0.561	255.4	432.3	229.8	21.8187	28.636
---- APR	1.121529E+05	0.56	260.1	430.4	232.4	21.856	28.5863
---- MAY	1.131757E+05	0.568	263.2	430.	234.1	21.8933	28.5367
---- JUNE	1.142079E+05	0.574	267.1	429.2	236.7	21.9306	28.487

1/ The income figures were computed using a three step procedure. First annual county total income figures taken from the NYS Bureau of Business. Personal Income in Areas and Counties, Research Bulletin # 47 (August 1979) were summed to obtain an SMSA total income figure. This value was assigned to the month of August in each of the respective years (Bob Scardamalio of the NYS Department of Commerce provided the 1977 and 1978 income figures. The 1979 and 1980 figures are extrapolated from these past values.) Second total seasonally adjusted total personal income figures for the State of New York (source: NYS Bureau of Business Research. Quarterly Summary of Business Statistics, various issues 1971-1980) were used to distribute the annual New York City incomes estimates throughout the year on a quarterly basis using the following formula: New York City income in quarter t = New York State income in quarter t x $\frac{\text{New York City annual income estimate}}{\text{New York State income estimate for August}}$.

Third, the monthly income figures were then obtained by linear interpolation between the quarterly figures using the econometric software program TROLL.

2/ Sources: NYS Department of Agriculture and Markets, Dairy Industry Services. "Prevailing Price of Homogenized Vitamin D Milk in Chain or Supermarket Stores, New York City, 1970-1979," table 24. And "Prevailing Prices of Milk to Consumers in New York State 1979-1980."

3/ The indices pertain to U.S. city average prices for the respective beverages. Unfortunately, a price level series for cola and coffee specific to the New York-Northeastern New Jersey area was discontinued by the U.S. Department of Labor in June 1978, the source of these data is U.S. Department of Labor: The Consumer Price Index - U.S. City Average and Selected Areas and CPI Detailed Report.

4/ Consumer price index for all items in the New York-N.E. New Jersey Area. Source: NYS Bureau of Business Research. Quarterly Summary of Business Statistics, various issues.

5/ The nonwhite category presumably includes Hispanics. However, the 1970 census classified 93 percent of Spanish-origin persons as "white" (U.S. Department of Commerce. Bureau of Census. Data User News, Vol. 16, No. 4, (April 1981). Further, despite a revised questioning format designed to identify Hispanics in the 1980 census, 56 percent still reported their race as "white." Thus in practice the nonwhite category probably largely excludes the Hispanic population (although perhaps a lesser extent in the more recent years of the series). Gretchen Anderson computed annual figures for this series from unpublished data provided by Rogert A. Herriot Population Division, U.S. Bureau of Census. Monthly figures for 1971-1978 are on linear interpolations of these annual estimates. The 1979-1980 figures are linear extrapolations based on the historic trend.

6/ Sources and procedures used to construct this series is identical to those described in footnote 5.