EFFECT OF GENERIC ADVERTISING ON THE DEMAND FOR FLUID MILK: THE CASE OF THE TEXAS MARKET ORDER

Oral Capps, Jr. and John D. Schmitz

Abstract

This analysis indicates that generic advertising expenditures, *ceteris paribus*, generated rightward shifts in demand for fluid milk in the Texas Market Order over the period January 1980 to September 1988. Generally, the results from this study are in agreement with previous research efforts which suggest that generic advertising can increase the demand for fluid milk. Importantly, in this analysis, the impacts of television and radio advertising have been effectively disentangled. Television advertising generates a response that wears off more quickly than radio advertising. Also, the long-run effect of radio advertising is about 1.75 times greater than the long-run effect of television advertising.

Key words: generic advertising, fluid milk, distributed lag models

Recent efforts in promoting and advertising farm commodities to expand the demand for farm products have increased in both domestic and international markets. While brand advertising is usually associated with promotional efforts of major agribusiness firms or food manufacturers, generic advertising is more linked with the efforts of producer organizations to increase demand for farm products. In 1988, over $500 million was collected from producers to promote agricultural commodities, with dairy producers alone contributing roughly $150 million (Liu and Forker).

Fresh fluid milk products are of vital importance to the dairy industry. On the basis of expenditure patterns in the 1980s, fresh whole milk constitutes approximately 30 percent of the total dairy budget, while other fresh milk products (lowfat, skim, buttermilk, chocolate milk, and yogurt) constitute another 20 percent, approximately, of this budget (Haidacher, Blaylock, and Myers). Whole milk and lowfat milk make up the bulk of fluid components.

Given the importance of fluid milk products to the dairy industry, it is important to conduct regional analyses to determine whether advertising efforts can stimulate rightward shifts in demand. In this light, the research reported in this paper attempted to identify and assess the effect of generic advertising on the demand for fluid milk in the Texas Market Order over the period of January 1980 to September 1988. In this study, fluid milk refers to the aggregate of whole milk, 1 percent lowfat milk, 2 percent lowfat milk, and skim milk. Promotion efforts during this period were conducted primarily by way of television and radio. Attempts were made to separate advertising expenditures by media type and measure the corresponding change in demand.

Four federal marketing orders currently operate in Texas (Texas, Texas Panhandle, Lubbock-Plainview, and Rio Grande Valley). Formerly there were five orders, but the Red River Valley Order became part of the Texas Order as of the last quarter of 1982 (Schwart). The Texas Order, however, encompasses more producers, handlers, and consumers than the other three Texas orders combined (Knutson, Hunter, and Schwart). The Texas Order incorporates six of the largest Standard Metropolitan Statistical Areas (SMSAs) in the state (Figure 1). Approximately 80 to 85 percent of the people living in Texas live within the bounds of the Texas Order (Seton; Knutson, Schwart, and Smith).

MODEL DEVELOPMENT

Advertising and promotion expenditures are financed through a 15 cent per hundred weight assessment authorized under the 1983 Dairy and Tobacco Adjustment Act. This assessment on all milk marketed generates about $200 million annually. Ge-

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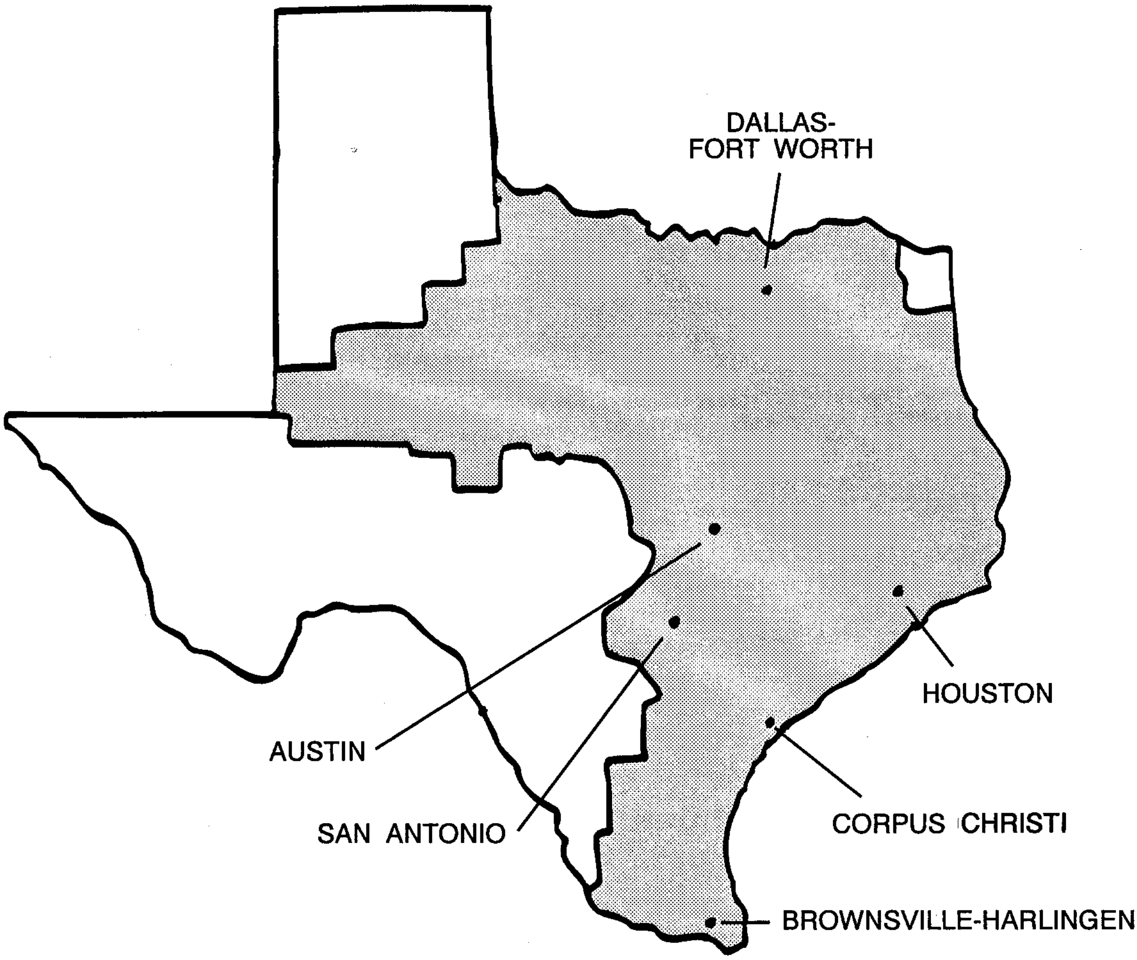

Figure 1. The Texas Milk Order and Major Metropolitan Markets Served (The geograhical area of the Texas Milk Marketing Order is the shaded portion of the map.)

neric advertising expenditure budgets for fluid milk promotion in Texas are available for television and radio. Evidence exists to indicate that generic advertising, with appropriate lags, affects consumption of dairy products, particularly milk products (Kinnucan and Forker; Kinnucan 1986, 1987; Thompson and Eiler 1977; Liu and Forker; Ward and McDonald; Ward and Dixon 1989). Except for the Ward and McDonald study and the Ward and Dixon study, the markets typically studied have been either New York City or Buffalo. Ward and McDonald, however, considered ten milk market order regions (Eastern Colorado, Southeastern Florida, Georgia, Great Basin, Greater Kansas City, Southern Michigan, New England, Middle Atlantic, Upper Midwest, and Virginia). Ward and Dixon considered twelve milk market regions, the ten previously mentioned plus California and Texas. In the respective studies, advertising expenditures were not disaggregated by medium (i.e. television and radio).

The seminal work of Basmann provides the theoretical framework for the introduction of advertisement variables in demand functions. Empirical analyses of various dairy product promotional programs based on monthly data support the notion of a hump-shaped lag pattern (Kinnucan 1986, 1987; Thompson and Eiler 1977; Ward and McDonald). The estimated lag structures from these studies yield small initial period responses in relation to the total response. The peak effect usually occurs two to four months beyond the initial expenditure. The availability of time-series data permits the application of distributed lag models to obtain estimates of both the short- and long-run effects of advertising on sales. In fact, econometric studies of advertising typically use a distributed lag specification with variables expressed in logarithms (e.g. Thompson and Eiler 1975, second degree polynomial with lag length of six; Kinnucan 1986, 1987, second degree polynomial with lag length of six; Ward and Dixon 1989, second degree polynomial with a lag length of twelve).

An alternative approach, suggested by Nerlove and Arrow, is to specify in the demand equation a single variable, "goodwill." In this approach, the goodwill variable is a weighted average of current and past advertising expenditures. The weights follow a Pascal distribution and sum to unity (Kinnucan and Forker).

What the length of the lag structure for advertising expenditures should be is an empirical question (Myers). For dairy products, according to Liu and Forker, the full effect of fluid milk advertising is not apparent until two months after the initial exposure. The carryover effect for fluid milk products, where advertising continues to affect consumption beyond the initial impact, lasts for roughly six months. Studies of generic advertising of fluid milk conducted by Kinnucan (1986, 1987) in two different cities, Buffalo and New York, indicate lag lengths of six months. Clarke concluded that 90 percent of the cumulative effects of advertising for frequently purchased products, such as fluid milk, are captured within 3 to 9 months.

Much of the literature on commodity promotion suggests the existence of diminishing marginal returns to advertising (Simon and Arndt). Commonly used functions that permit marginal returns to advertising to diminish with increases in expenditure are the double-logarithmic, semilogarithmic, and logarithmic-inverse forms. However, it is not uncommon for zero levels of advertising expenditures to exist for some observation periods. With the use of logarithmic transformations, however, problems arise when zero levels of advertising occur. To circumvent this problem, a semi-logarithmic functional form is used in this study. That is, the dependent variable, fluid milk consumption in the Texas Market Order, is expressed in terms of logarithmic variables, while the advertising variables are expressed in terms of actual variables.

Over the period of January 1980 to September 1988, the level of generic advertising in the Texas Order ranged from $0 to almost $254,000/month for television and $0 to nearly $200,000/month for radio. Strikingly, as exhibited in Table 1, the number of zero observations for television advertising is 79 (75 percent of the sample observations), and the number of zero observations for radio advertising is 40 (38 percent of the sample observations). No information exists on brand advertising in the Texas Order. This analysis excludes national advertising that appears in various Texas television markets. The markets make up about 5.5 percent of the television households in the United States (personal correspondence with Judy Hage, AMPI).

Deflating advertising expenditures is a data issue that should not be treated lightly (Ward, Chang, and Thompson). Because appropriate media cost indices to deflate advertising expenditures were difficult to construct because of the lack of pertinent information, the Consumer Price Index (1982-1984=100) was used.

In addition to advertising, other variables may influence the demand for fluid milk. These variables include the price of fluid milk, the prices of other beverages, income, and seasonality. Haidacher, Blaylock, and Myers concluded that although the demand for dairy products was sensitive to a number of factors, sensitivity to changes in relative prices and income was the most pronounced. Prior milk demand studies have utilized an index of coffee, tea, and cola prices as well as an index of beverage prices to determine cross-price effects of competing products (Wilson and Thompson; Prato). A major problem in demand analyses is in defining plausible substitutes for milk. In this study, to circumvent this problem as well as potential collinearity problems, the index of non-alcoholic beverages was used. To capture seasonal patterns in fluid milk consumption (Kinnucan 1986; Ward and Dixon 1989), monthly dummy variables were used.

EMPIRICAL MODEL

Monthly time-series observations from January 1980 to September 1988 (105 observations) were used in this study. The data are available from the authors upon request. To avoid "data interval bias" in the estimation of advertising effects, Clarke recommends the use of monthly data in most situations.

Alternative specifications of the demand model for fluid milk are as follows:

(1) $\ln QFM_t = f(\ln PFM_t, \ln PNA_t, \ln INC_t, \text{SEASONALITY}, \text{TREND}, ADV_t, \ldots, ADV_{t-j})$,

and

(2) $\ln QFM_t = f(\ln PFM_t, \ln PNA_t, \ln INC_t, \text{SEASONALITY}, \text{TREND}, TV_t, \ldots, TV_{t-k}, RAD_t, \ldots, RAD_{t-l})$.

The variables are defined as follows:

Table 1. Nominal Monthly Generic Advertising Expenditures in the Texas Order for Fluid Milk by Medium, January 1979 to September 1988

Month	Year	Television	Radio	Total	Month	Year	Television	Radio	Total
January	1979	0	9,810	9,810	January	1984	253,097	36,914	290,711
February	1979	0	34,756	34,756	February	1984	0	51,287	51,287
March	1979	0	25,424	25,424	March	1984	0	81,765	81,765
April	1979	0	46,068	46,068	April	1984	203,277	0	203,277
May	1979	0	24,387	24,387	May	1984	78,981	0	78,981
June	1979	0	10,624	10,624	June	1984	203,598	0	203,598
July	1979	0	11,613	11,613	July	1984	0	0	0
August	1979	0	12,766	12,766	August	1984	0	0	0
September	1979	97,938	3,856	101,794	September	1984	115,965	109,726	225,691
October	1979	55,956	2,040	57,996	October	1984	90,875	198,302	289,177
November	1979	0	2,040	2,040	November	1984	59,925	102,224	162,149
December	1979	15	9,392	9,407	December	1984	130,531	133,806	264,337
January	1980	0	0	0	January	1985	0	0	0
February	1980	0	0	0	February	1985	0	66,911	66,911
March	1980	0	0	0	March	1985	0	89,361	89,361
April	1980	0	0	0	April	1985	0	72,234	72,234
May	1980	0	0	0	May	1985	0	50,600	50,600
June	1980	0	0	0	June	1985	0	94,415	94,415
July	1980	0	0	0	July	1985	0	0	0
August	1980	0	0	0	August	1985	104,191	0	104,191
September	1980	0	0	0	September	1985	203,668	14,224	217,892
October	1980	0	0	0	October	1985	4,250	5,525	9,775
November	1980	0	0	0	November	1985	37,033	81,803	118,836
December	1980	0	0	0	December	1985	0	0	0
January	1981	0	0	0	January	1986	0	18,280	18,280
February	1981	0	0	0	February	1986	0	73,309	73,309
March	1981	0	0	0	March	1986	0	0	0
April	1981	0	0	0	April	1986	0	57,387	57,378
May	1981	0	0	0	May	1986	0	38,316	38,316
June	1981	105,723	38,094	143,817	June	1986	0	0	0
July	1981	109,146	30,360	139,506	July	1986	0	0	0
August	1981	0	48,697	48,697	August	1986	0	0	0
September	1981	0	0	0	September	1986	0	54,938	54,938
October	1981	0	83,754	83,754	October	1986	0	0	0
November	1981	0	139,563	139,563	November	1986	0	0	0
December	1981	52,594	0	52,594	December	1986	0	0	0
January	1982	39,380	0	39,380	January	1987	0	81,638	81,638
February	1982	49,319	0	49,319	February	1987	0	80,802	80,802
March	1982	187,227	0	187,227	March	1987	0	116,511	116,511
April	1982	153,826	00	153,826	April	1987	0	68,040	68,040
May	1982	153,956	57,679	211,635	May	1987	0	84,455	84,455
June	1982	0	18,987	18,987	June	1987	0	46,308	46,308
July	1982	0	0	0	July	1987	0	75,009	75,009
August	1982	0	84,233	84,233	August	1987	0	74,546	74,546
September	1982	0	70,549	70,549	September	1987	0	67,623	67,623
October	1982	0	149,362	149,362	October	1987	0	59,179	59,179
November	1982	0	131,338	131,338	November	1987	0	59,315	59,315
December	1982	0	59,938	59,938	December	1987	0	9,891	9,891
January	1983	0	43,032	43,032	January	1988	0	55,962	55,962
February	1983	0	185,211	185,211	February	1988	0	55,962	55,962
March	1983	0	91,694	91,694	March	1988	0	55,962	55,962
April	1983	0	59,130	59,130	April	1988	11,881	62,772	62,772
May	1983	0	82,131	82,131	May	1988	35,554	62,882	98,436
June	1983	0	69,323	69,323	June	1988	35,599	63,188	98,787
July	1983	0	106,979	106,979	July	1988	22,250	98,145	120,395
August	1983	0	32,102	32,102	August	1988	32,344	66,105	98,449
September	1983	0	74,225	74,225	September	1988	28,166	66,177	94,343
October	1983	0	112,782	112,782					
November	1983	0	128,300	128,300					
December	1983	0	83,371	83,371					

Data obtained from R.W. Ward, University of Florida.

Table 2. Descriptive Statistics of the Variables in the Models

Variable	N	MEAN	STD. DEV.	MIN	MAX
QFM	(millions of pounds)	213.76	12.89	178.92	238.73
PFM	($ / gallon)	2.42	0.28	1.78	2.87
PNA	(index, 1982-84 = 100)	100.33	5.62	89.65	112.69
INC	(billions of $)	192.19	14.81	161.04	210.75
ADV	(1982-84 $)	67,363	68,013	0	285,770
TV	(1982-84 $)	23,515	53,949	0	249,480
RAD	(1982-84 $)	43,848	45,447	0	189,510

$\ln QFM_t$=natural logarithm of consumption of fluid milk (whole milk, 1 percent lowfat milk, 2 percent lowfat milk, and skim milk) in the Texas Milk Marketing Order in time period t (millions of pounds);

$\ln PFM_t$=natural logarithm of the real price of fluid milk in Dallas ($/gallon, 1982-84=100);

$\ln PNA_t$=natural logarithm of the real price index of non-alcoholic beverages in time period t (1982-84=100);

$\ln INC_t$=natural logarithm of real income in Texas in time period t measured in 1982-84 dollars;

SEASONALITY = a 0-1 dummy variable for each month except for the base month December to avoid the dummy variable trap;

TREND = the first observation is 1, the last observation is 105, with intermediate observations running chronologically;

ADV_{t-j}=real combined television and radio advertising expenditure in 1982-84 dollars with lag j;

TV_{t-k}=real television advertising expenditure in 1982-84 dollars with lag k; and

RAD_{t-l} =real radio advertising expenditure in 1982-84 dollars with lag $_l$.

Importantly, lags j, k, and l need not be equal.

The variable PFM_t is a weighted average price of whole milk, lowfat milk, and skim milk in Dallas and is to be considered as a representative price level for the Texas Market Order. The coefficient associated with this variable was hypothesized to be negative. The variable PNA represents the cross-price effect of substitute goods, such as soft drinks and juices and, consequently, the coefficient associated with this variable was hypothesized to be positive. Following Kinnucan (1986), Liu and Forker, and Ward and McDonald, income effects are hypothesized to be positive for fluid milk. Similar to Liu and Forker and Ward and McDonald, a trend variable was used to capture consumer perceptions toward dairy products. The trend variable encompasses concerns over nutrition and health, population growth, and changes in demographic variables, particularly age and ethnicity.[1] Based on the Liu and Forker and the Ward and McDonald studies, the coefficient associated with the trend variable was hypothesized to be negative. The variable ADV combines the effect of television and radio into a single measure, while the variables TV and RAD measure the level of advertising expenditures by medium. All coefficients associated with the set of advertisement variables were hypothesized to be positive.

DESCRIPTIVE STATISTICS

Descriptive statistics of the continuous variables in the models are exhibited in Table 2. Average fluid milk consumption was nearly 215 million pounds over the sample period. The average real price of fluid milk in Dallas was about $2.42 per gallon. Real income in Texas on average was about $192 billion (1982-1984 $). Real television advertising expenditures for fluid milk averaged $23,515 per month, while real radio advertising expenditures averaged close to $43,848 per month.

EMPIRICAL RESULTS

The estimated coefficients and associated t-statistics respective of the demand models are exhibited in Tables 3 and 4. Because serial correlation problems were evident with OLS estimation, the estimated coefficients in the respective tables correspond to GLS parameter estimates. A second-order serial correlation correction was employed in lieu of the traditional first-order correction due to the use of monthly time-series data. All tests of significance were conducted at the 0.05 level.

The model which combines television and radio advertising was estimated using a polynomial distributed lag specification of degree three and length

[1] Monthly data pertaining to population, age, and race were not available for the Texas Order. These factors, along with health and nutrition, are considered as the primary components of the trend variable.

of lag of twelve months, imposing both head and tail restrictions. The model which delineates both television and radio advertising was also estimated using a polynomial distributed lag specification of degree three, with length of lag of 12 months for television advertising and length of lag of 12 months for radio advertising.[2]

Table 3. Estimated Coefficients for the Fluid Milk Demand Model with Combined Advertising Effects and Second-Order Autocorrelation Correction

Variable Name	Estimated Coefficient	t-Statistic
RHO1	-.5442	-6.21*
RHO2	-.4410	-5.03*
lnPFM	.0246	2.02*
lnPNA	.1172	2.01*
INC	.3794	8.68*
M1	.0344	2.89*
M2	-.0631	-5.58*
M3	.0065	0.76
M4	-.0211	-1.98*
M5	-.0132	-1.23
M6	-.0641	-6.83*
M7	-.0144	-1.35
M8	.0098	0.93
M9	.0081	0.95
M10	.0398	3.50*
M11	-.0153	-1.25
T	.8531E-03	5.85*
AD0	0.339E-08	0.77
AD1	0.621E-08	0.90
AD2	0.845E-08	1.06
AD3	0.101E-07	1.30
AD4	0.112E-07	1.65*
AD5	0.119E-07	2.19*
AD6	0.120E-07	2.83*
AD7	0.116E-07	2.87*
AD8	0.108E-07	2.22*
AD9	0.949E-08	1.63*
AD10	0.774E-08	1.25
AD11	0.556E-08	0.99
AD12	0.298E-08	0.81
CONSTANT	-2.4791	-3.01*

$\bar{R}^2$ = .9182
DW = 1.92
F_{SEAS} = 36.55 (Joint test of the significance of the monthly dummy variables)
F_{ADV} = 4.45 (Joint test of the significance of the advertisement variables)
ADi = Lag of advertising i periods
* Statistically significant at the .05 level.

Model With Combined Advertising Effects

The goodness-of-fit, adjusting for degrees of freedom, for the model with combined advertising effects was 0.9182. Contrary to prior expectations, the own-price coefficient was positive and statistically different from zero. The own-price elasticity of demand for fluid milk was, however, close to zero at 0.02.

The coefficient associated with the index of nonalcoholic beverages was positive in accord with *a priori* expectations and significantly different from zero. The cross-price elasticity between nonalcoholic beverages and fluid milk was 0.11, in line with the cross-price elasticity estimates obtained by Kinnucan (1986) and by Liu and Forker. In the Kinnucan study, the cross-price elasticity of fluid milk with respect to cola was 0.15, while the cross-price elasticities of fluid milk with respect to coffee was 0.02. In the Liu and Forker study, the cross-price elasticity of fluid milk with respect to cola was 0.08. Thus, in the Texas Market Order, non-alcoholic beverages are substitutes for fluid milk.

Also, the income coefficient was positive and significantly different from zero. The income elasticity for fluid milk in the Texas Order was estimated to be 0.38; this estimate is notably smaller than the income elasticity obtained by Kinnucan (1986) in the New York City Metropolitan Area (1.12) and notably higher than that obtained by Ward and McDonald for ten milk market order regions (0.10). But it is in line with the income elasticity obtained by Liu and Forker for New York City (0.48) and that obtained by Kinnucan (1987) for Buffalo (0.35).

As expected, on the basis of the joint test of the significance of the monthly dummy variables, seasonality was a key factor in the demand for whole milk. Seasonal dummy variables were not significantly different from the base month (December), except for January, February, April, June, and October. Over the sample period, holding all other factors invariant, fluid milk consumption levels were significantly higher in the months of January and October relative to December and were significantly lower in the months of February, April, and June relative to December.

[2] Alternative lengths of lags and degrees of polynomials were considered. However, the data best supported a length of lag of 12 and a polynomial degree of 3 for all the advertising variables.

Table 4. Estimated Coefficients for the Whole Milk Demand Model with Television and Radio Advertising and Second-Order Autocorrelation Correction

Variable Name	Estimated Coefficient	t-Statistic	Variable Name	Estimated Coefficient	t-Statistic
RHO1	-.5550	-6.37*	TV5	0.111E-07	1.92*
RHO2	-.4518	-5.19*	TV6	0.998E-08	2.06*
ln PFM	.0321	2.33*	TV7	0.843E-08	1.73*
ln PNA	.1328	2.24*	TV8	-0.664E-08	1.15
ln INC	.3684	8.40*	TV9	-0.479E-08	0.71
M1	.0338	2.81*	TV10	0.302E-08	0.43
M2	.0638	-5.59*	TV11	0.153E-08	0.24
M3	.0059	0.69	TV12	0.466E-09	0.11
M4	-.0218	-2.02*	RAD0	0.322E-08	0.62
M5	-.0139	-1.29	RAD1	0.639E-08	0.77
M6	-.0649	-6.90*	RAD2	0.940E-08	0.97
M7	-.0150	-1.40*	RAD3	0.121E-07	1.24
M8	.0090	0.84	RAD4	0.144E-07	1.63*
M9	.0074	0.87	RAD5	0.163E-07	2.15*
M10	.0388	3.37*	RAD6	0.175E-07	2.69*
M11	-.0156	-1.27*	RAD7	0.180E-07	2.88*
T	0.904E-03	6.05*	RAD8	0.177E-07	2.60*
TV0	0.428E-08	1.07	RAD9	0.165E-07	2.19*
TV1	0.824E-08	1.15	RAD10	0.142E-07	1.84*
TV2	0.104E-07	1.27	RAD11	0.108E-07	1.58*
TV3	0.115E-07	1.43	RAD12	0.609E-08	1.39
TV4	0.116E-07	1.65*	CONSTANT	2.3524	-2.86*

$\bar{R}^2$ = .9183 DW = 1.94
F_{SEAS} = 36.95 (joint test of the significance of the monthly dummy variables)
F_{RADADV}= 4.18 (joint test of the significance of the radio advertising variables)
F_{TVADV} = 2.14 (joint test of the significance of the television advertising variables)
F_{ADV} = 2.80 (joint test of the significance of both radio and television advertising variables)
TV_i=lag of television advertising i periods
RAD = lag of radio advertising i periods
*Stastically significant at the 0.05 level.

The coefficient associated with the trend variable was positive and significantly different from zero.[3] This result is in contrast to the negative and significant coefficient associated with trend obtained by Liu and Forker for New York City and obtained by Ward and McDonald for ten milk market order regions.

The polynomial distributed lag model provides useful information about the impact of advertising on the demand for fluid milk. In conjunction with prior expectations, all advertising coefficients were not only positive but also took on a hump-shaped pattern (Figure 2). Peak advertising effects occurred four to eight months after initial levels of expenditure. Defining w_s as the weight associated with lag period s, the long-run response in the consumption of fluid milk due to a unit change in advertising is measured by the product of Σ w_s and QFM_t. For this model, at the sample means, the sum of the respective weights was 0.0239E-03. If real advertising expenditures increase by $1, then fluid milk consumption, in the long run, increases by almost 24 pounds in the Texas Market Order, *ceteris paribus*. The long-run advertising elasticity, at the sample means, was 0.0075. The long-run response and the long-run elasticity parallel those obtained by other

[3] Analyses were conducted with both time trend and population as separate exogenous factors. However, these variables were highly correlated, and it was not possible to disentangle their separate effects. Because the trend variable subsumes population growth, health and nutrition concerns, and age and race effects, it was decided to use this factor in they analysis.

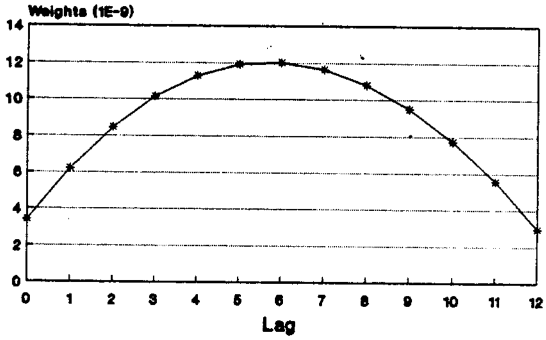

Figure 2. Estimating Weights of the Milk Distruted Lag Model for Fluid Milk Consumption: Aggregate Expenditures

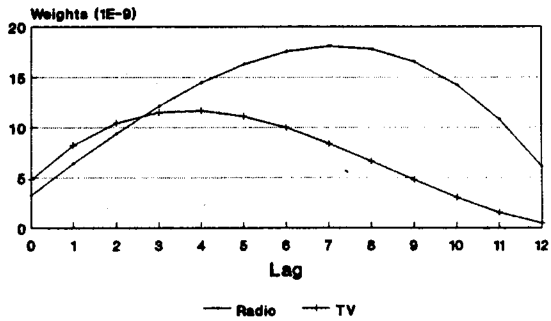

Figure 3. Estimated Weights of the Distributed Lag Model for Fluid Milk Consumption: Television and Radio

researchers for different regions. The mean lag, defined as $\Sigma sw_s / \Sigma w_s$, may be interpreted as the average length of time for unit changes in advertising expenditure to be transferred to changes in fluid milk consumption. For this model specification, the mean lag was 5.8951 months or nearly 6 months.

Model With Separate Advertising Effects

The $\bar{R}^2$ statistic for the model with separate advertising effects was 0.9183. Similar to the model with combined advertising effects, the own-price coefficient was positive, and significantly different from zero. The own-price elasticity in the model with separate advertising effects was 0.03, again very close to zero. The coefficient associated with the index of non-alcoholic beverages was positive, in accord with expectations, and significantly different from zero. Also, the income coefficient was positive and statistically different from zero. The cross-price and income elasticities are comparable to those obtained from the model with combined advertising effects. As with the model with combined advertising effects, seasonality was a key factor in the demand for whole milk. In fact, the seasonal pattern evident for the model with combined advertising effects is consistent with the model for separate advertising effects. Again, the coefficient associated with the trend variables was positive and significantly different from zero.

All coefficients associated with television advertising and with radio advertising were positive. For both types of advertising, inverted v-lag patterns were evident (Figure 3). Significant television advertising effects occurred in the fourth, fifth, sixth, and seventh months after initial levels of expenditure. Significant radio advertising effects occurred from the fourth month to the eleventh month after initial levels of expenditure. The long-run response of fluid milk consumption due to a unit change in television (radio) advertising at the sample means was 0.0198E-03 (0.0348E-03). If real television (radio) advertising expenditures increase by $1, then fluid milk consumption, in the long run, increases by almost 20 (35) pounds, *ceteris paribus*. The long-run elasticity, at the sample means, for television (radio) advertising was 0.0021 (0.0071). The elasticities of advertising from this analysis are, to a degree, similar to those reported by Liu and Forker (short-run elasticity of 0.0017; long-run elasticity of 0.0028) and by Ward and McDonald (short-run elasticity of 0.0039; long-run elasticity of 0.0085).

The mean lag for television advertising was 4.6818 months, while the mean lag for radio advertising was 6.4923 months. The average length of time for a unit change in television advertising expenditure to be transferred to a change in fluid milk consumption is consequently about three-fourths that for a unit change in radio advertising expenditure. However, the long-run effect of radio advertising is about 1.75 times greater than the long-run effect of television advertising. Consequently, television may be the appropriate medium to bring about changes in fluid milk consumption more quickly, but radio may be the appropriate medium to bring about changes in fluid milk consumption over the long run.

CONCLUDING COMMENTS

This analysis indicates that generic advertising expenditures over the period of January 1980 to September 1988, *ceteris paribus*, can generate rightward shifts in demand for fluid milk consumption in the Texas Market Order. Generally, the results from this study are in agreement with previous research efforts which suggest that generic advertising can increase the demand for fluid milk. Importantly, in this analysis, the impacts of television and radio advertising have been effectively disentangled. Television advertising generates a response that wears off more quickly than does radio advertising. Radio appears to be the more appropriate medium to bring about changes in fluid milk consumption over the long run. This information could be used by the dairy industry to allocate advertising budgets more effectively.

Seasonality is also a key factor in demand for fluid milk. Income and non-alcoholic beverages are also key determinants of demand for fluid milk in the Texas Market Order. Consumers are, in addition, not very sensitive to changes in own-price. Finally, the trend variable, a proxy for health and nutrition, population growth, and age and race effects, is positively associated with fluid milk consumption in the Texas Market Order.

Several factors limit the conclusions that can be drawn from this study. First, although this study established a link between advertising and fluid milk sales, this study failed to: (1) ascertain whether the benefits of advertising exceed the cost of the program, and (2) determine whether the allocation of funds for advertising is economically efficient. Additional work to address these issues is certainly worthwhile. Second, because of the reliance on time-series observations, demographic factors such as household size, age/sex distribution, and ethnicity were not explicitly considered, principally due to the unavailability of monthly data. In this regard, a follow-up study with emphasis on household consumption patterns may be worthwhile. Finally, a definitive assessment of how nutrition and health concerns affect the demand for fluid milk products is unequivocally worthy of investigation. Although there has been considerable discussion of how concerns over nutrition and health affect the demand for dairy products, few empirical studies, except for the recent work by Jensen, Kesaven, and Johnson quantitatively link them. The dairy industry has spent millions of dollars in nutrition-related research as well as promoting health-related aspects of dairy products. Concern for reducing fat intake has been cited as a major factor influencing the trend away from whole milk to lowfat and skim milk (Jones and Weimer).

The analysis in this paper constitutes a first step in assessing the demand for fluid milk in the Texas Order, with emphasis on the effects of generic advertising. Given that consumption patterns generally differ among regions in the United States, further efforts in this regard should pay dividends to the dairy industry.

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