File Copy

National Institute for Commodity Promotion Research & Evaluation

January 1996
NICPRE 96-01
R.B. 96-01

Generic Advertising Wearout: the Case of the New York City Fluid Milk Campaign

by

Carlos Reberte, Harry M. Kaiser, John E. Lenz, and Olan Forker

Department of Agricultural, Resource, and Managerial Economics
College of Agriculture and Life Sciences
Cornell University, Ithaca, New York 14853

Abstract

This paper examines two major generic fluid milk advertising campaigns in New York City during the 1986-92 period. Estimates from a time-varying parameter model show that the evolution of the impact of generic advertising on fluid milk sales over each campaign followed a bell-shaped pattern. Results also show that the first campaign was effective for twice as long as the second campaign and that it had a higher peak and average advertising elasticity. These findings may reflect long-term generic milk advertising wearout in the New York City market.

Key words: advertising wearout, generic milk advertising, time-varying parameters.

Preface

Carlos Reberte, Harry M. Kaiser, John E. Lenz, and Olan D. Forker are respectively, research associate, associate professor, research associate, and professor in the department of Agricultural, Resource, and Managerial Economics at Cornell University. Harry Kaiser and Olan Forker are co-directors of the National Institute for Commodity Promotion Research and Evaluation (NICPRE). The authors thank Jennifer Ferrero for her thorough editing and layout of this bulletin. This is the fourth research bulletin published by NICPRE.

Introduction

There has been a considerable amount of research on the economic impact of generic advertising over the past two decades (see Forker and Ward and the annotated bibliography by Hurst and Forker). With few exceptions, previous studies have assumed that advertising elasticities are constant over time. This assumption runs counter to the advertising wearout hypothesis, which states that the effectiveness of an advertising campaign will eventually decay. Dynamic advertising elasticities have important implications for both commodity promotion research and allocation of advertising expenditures. Econometric models that allow for time-varying market responses to generic promotion more accurately represent the sales/advertising relation (Kinnucan and Venkastewaran).

Despite its relevance for promotion program evaluation and resource allocation, only two studies have explored the question of generic advertising wearout. Kinnucan, Chang, and Venkastewaran (KCV, hereafter) studied the New York City (NYC) fluid milk campaign during the 1971-84 period. Although they did find evidence of campaign wearout,[1] they also discovered that successive campaigns displayed increasing effectiveness. Kinnucan and Venkastewaran examined the Ontario fluid milk campaign and found that advertising elasticities declined over the 1973-87 period.

The major objectives of this paper are to revisit the issue of milk advertising wearout in the NYC market[2] and to improve on the modeling and estimation procedures used in KCV. The commercials employed in generic fluid milk advertising in the NYC market over the 1986-92 period can be partitioned into two major campaigns. The first campaign focused on milk's nutritional benefits, while the second was aimed at increasing fluid milk consumption by adults. The present study estimates the rate of change of advertising elasticities over time and examines if these campaigns exhibited advertising wearout. Differences in effectiveness of the two campaigns are also examined.

Following KCV, a time-varying parameter model is used to model advertising wearout. However, the approach used in this study to model and estimate the time-varying advertising coefficients improves on KCV's approach in three major ways. First, the advertising goodwill variable[3] is specified to more appropriately account for the periods during which campaign effects overlap. Given carryover effects of advertising, at the start of a new campaign there is a period during which goodwill depends on both the new and old campaigns. KCV treated the contribution of the old campaign to the goodwill measure as if the new campaign had generated it. In this paper, the contribution of each campaign during the transition periods is properly identified. Second, the empirical model is estimated via Nonlinear Least Squares thus avoiding the *ad hoc* two-step linear estimation procedure used in KCV. Third, time-varying advertising goodwill coefficients are modeled using a flexible specification and a statistical test is applied to determine if these coefficients exhibit random variation.

---

[1]The last campaign in the period covered by the KCV study did not exhibit wearout.

[2]For this study, the NYC market includes northern New Jersey and several counties surrounding New York City.

[3]KCV treated the carryover effects of advertising on fluid milk demand as a stock (versus flow) concept and defined advertising goodwill as "an intangible demand-generating asset" (p. 405). This convention is adopted in the present study and the terms "goodwill", "advertising goodwill", and "stock of goodwill advertising" are used interchangeably.

The Conceptual Framework

Advertising wearout theory suggests that the effect of a particular campaign on sales varies over time-- at first increasing and then decreasing. A time-varying parameter model is used to test this hypothesis. Specifically, consider the following demand equation for fluid milk:

(1)
$$Y_t = \alpha + \sum_{k=1}^{K} \beta_k X_{tk} + \sum_{i=1}^{I} \gamma_{ti} G_{ti} + \mu_t \qquad t=1,\ldots,N \; ,$$

where Y_t denotes the quantity sold at period t (t=1,...,N), X_{tk} represents the t[th] observation on the [th]k (k=1,...,K) explanatory variable, G_{ti} is the stock of advertising goodwill (Nerlove and Waugh; Kinnucan and Forker; KCV) at period t generated by the i[th] (i=1,...,I) campaign, α, β_k and γ_{ti} are unknown parameters, and μ_t is a random error term with mean zero and variance σ^2_μ .

The parameter on G_{ti} , γ_{ti} , is subscripted by t to indicate that it can change over the sample observations. A difficulty with this model is that there are at least 1+K+N coefficients to be estimated with only N observations.[4] Thus, it is necessary to impose some structure on how γ_{ti} may vary over time. The goodwill parameter is specified as a function of calendar time and a random disturbance term (Singh et al.):

(2)
$$\gamma_{ti} = \exp(\Psi_{0i} + \Psi_{1i} T_{ti} + \Psi_{2i} T_{ti}^2) + \epsilon_{ti} \; ,$$

where exp(·) represents the exponential function, T_{ti} is a linear time trend, and Ψ_{0i} , Ψ_{1i} , and Ψ_{2i} are parameters common to all the observations corresponding to the i[th] campaign. The time trend variable, T_{ti} , measures the duration of the i[th] campaign from its inception until period t. This variable is assumed to capture time-related factors that have systematic effects on γ_{ti} and for which there are no observations available. The second order (quadratic) exponential function used to model the trajectory of γ_{ti} over time is quite flexible, allowing for a large family of unimodal response curves. Random factors affecting the goodwill parameter may include, for example, transitory changes in consumers' attitudes toward fluid milk caused by negative or positive health-related publicity. The following assumptions are made about the distribution of ϵ_{ti}:[5]

$$\epsilon_{ti} \sim (0,\sigma^2_{\epsilon i}); \quad E(\epsilon_{ti}\mu_t)=0 \;\; \forall t,i; \quad E(\epsilon_{ti}\epsilon_{\tau i}) = E(\epsilon_{ti}\epsilon_{th}) = 0 \;\; t\neq\tau,\; i\neq h.$$

The goodwill stock generated by the i[th] campaign at period t is expressed as:

(3)
$$G_{ti} = \sum_{j=0}^{J} \omega_{ji} A_{t-j} TH_{ji} \qquad i=1,\ldots,I.$$

The ω_{ji} are lag weights, A_{t-j} is per capita advertising expenditure in period t-j, J is the length of the weighting period, and TH_{ji} is a binary variable equal to one if A_{t-j} corresponds to the i[th] campaign theme and zero otherwise. Lagged advertising expenditures are included in the construction of G_{ti} to account for delays in the sales response to advertising (see Forker and Ward, p.169). Thus, the impact of a given campaign may extend beyond the end of the campaign and the stock of advertising goodwill at period t may consist of the sum of the goodwill stocks generated by the current and past campaigns. For this reason, TH_{ji}=1 for all periods t such that $t\in[\Upsilon_i, \Upsilon_{i+j}]$ where Υ_i and $\bar{\Upsilon}_i$ are the beginning and ending period, respectively, of the i[th] campaign. Also, the range of T_{ti} in (2) is $[1, \bar{\Upsilon}_i - \Upsilon_i + 1 + J]$, where $\bar{\Upsilon}_i - \Upsilon_i + 1$ is the length in months of the i[th] campaign.[6] That is, because of the lagged response of sales to advertising, the range of T_{ti} should not be truncated at the last period consumers were exposed to the i[th] campaign. The last two points were overlooked in KCV. Despite assuming a six month advertising carryover period, KCV modeled the impact of each campaign as lasting only from the first to the last period of the campaign. Moreover, for the overlapping period between two campaigns, they treated lagged advertising expenditures corresponding to the old campaign as pertaining to the new campaign.

The Empirical Model

Following Cox, a quadratic exponential function is used to model the lag weights:

(4)
$$\omega_{ji} = \exp(\phi_{0i} + \phi_{1i} j + \phi_{2i} j^2).$$

Previous studies (Thompson, Eiler, and Forker; Kinnucan; Kinnucan and Forker; KCV) have found that a lag length of six months is appropriate to model the carryover effect of generic milk advertising in the NYC market. A lag length of six is also consistent with Clarke's observation that "90 percent of the cumulative effect of advertising on sales of mature, frequently purchased, low-priced products occurs within 3 to 9 months of the advertisement" (p. 355). Based on the above considerations, the value of j in (4) is set to six.

---

[4]There are at least N goodwill coefficients, one for each time period. If two or more campaigns overlap there will be more than N goodwill coefficients.

[5] For simplicity, it is assumed that each campaign starts after the end of the previous campaign, i.e., there is no overlap of campaigns at period t.

[6]The first value of T_{t1} will not be one if the first campaign started before the sample period. Likewise, the sample may not include the last period of the last campaign.

To obtain a parsimonious lag structure, the weight on the six lag is restricted to zero and the weight on the current period advertising expenditures is restricted to one.[7] The latter restriction (e.g., $\omega_{6i}=\exp(\phi_{0i})=1$) requires $\phi_{0i}=0$, and the restriction on the sixth lag weight (e.g., $\omega_{6i}=\exp(\phi_{0i}+\phi_{1i}6+\phi_{2i}36)=0$) can be approximated by exp(-30). Using these restrictions

(5a) $$\phi_{0i}+\phi_{1i}6+\phi_{2i}36=\phi_{1i}6+\phi_{2i}36=-30.$$

Solving this expression for ϕ_{1i} yields

(5b) $$\phi_{1i}=-5-\phi_{2i}6.$$

After substituting ϕ_{1i} into φ the lag weights have the following form

(5c) $$\omega_{ji}=\exp[-5j+\phi_{2i}(j^2-6j)],\quad j=0,\ldots,5.$$

As Cox points out, this specification allows for both a geometric decay and a lagged peak of the lag coefficients, depending on the sign of ϕ_{2i}.

The empirical counterpart of the demand equation in (1) is specified as:

(6) $$lnQ_t=\alpha+\beta_1 lnPM_t+\beta_2 lnINC_t+\sum_{d=1}^{3}\pi_d QD_d+\sum_{i=1}^{I}\gamma_{ti}G_{ti}+\mu_t,$$

where ln denotes natural logarithm, Q_t is per capita consumption of fluid milk in gallons, PM_t is the retail price of milk deflated by a non-alcoholic beverages price index, INC_t is real per capita income, and the QD_d's are quarterly dummy variables included to account for seasonal shifts in milk consumption (d=1,2,3 for the winter, spring, and summer quarter, respectively).

Substituting (2) and (3) into (6) yields:

(7) $$lnQ_t=\alpha+\beta_1 lnPM_t+\beta_2 lnINC_t+\sum_{d=1}^{3}\pi_d QD_d+\sum_{i=1}^{I}[\exp(\Psi_{0i}+\Psi_{1i}T_{ti}+\Psi_{2i}T_{ti}^2)\sum_{j=0}^{5}\omega_{ji}A_{t-j}TH_{ji}]+\upsilon_t,$$

where:

(8) $$\upsilon_t=\mu_t+\sum_{i=1}^{I}\sum_{j=0}^{5}\epsilon_{ti}\omega_{ji}A_{t-j}TH_{ji},$$

is a heteroscedastic error term with variance

(9) $$\sigma^2_{\upsilon_t}=\sigma^2_\mu+\sum_{i=1}^{I}\sum_{j=0}^{5}\sigma^2_{\epsilon i}(\omega_{ji}A_{t-j}TH_{ji})^2.$$

The heteroscedasticity of υ_t is due to the presence of the stochastic term in (2). Testing for heteroscedasticity of the form represented by (9) is equivalent to testing for the adequacy of including an additive disturbance term in (2).

Note that although the logarithmic transformation is applied to milk sales, price, and income (following the extant literature in this area), the goodwill variable is not transformed because G_{ti} is zero when all the i^{th} campaign indicator variables (e.g., the TH_{ji}'s) are zero.

Data Issues and Estimation Procedures

Equation (7) was estimated using monthly data for the period January 1986 through December 1992.[8] The variable PM_t is the average price of a gallon of fluid milk for NYC deflated by a non-alcoholic beverages price index for the Northeast.[9] Per capita income was deflated by the CPI for all items for NYC. The advertising expenditure data were deflated by a media cost index specific to the NYC coverage area.[10]

The values of the T_{ti} and TH_{ji} variables are defined based on the primary message of each campaign.[11] Following this criterion, it is possible to identify two major campaigns for the sampling period. The first campaign covered the period January 1986-February 1989[12] and

---

[7]Note that the restriction $\omega_{0i}=1$ is merely a normalization with no effect on the advertising elasticities.

[8]Data on advertising expenditures are not available beyond December 1992.

[9]Note that no such index is available specifically for NYC.

[10]Data for fluid milk sales and price were obtained from the New York State Department of Agriculture and Markets and the New York/ New Jersey Federal Marketing Order. The advertising data were obtained from the advertising agency D'Arcy, Masius, Benton & Bowles. The non-alcoholic beverages price index was obtained from the CPI Detailed Report published by the Bureau of Labor Statistics. All the data used in the study are available from the authors upon request.

[11]This criterion is consistent with KCV's remark that "a campaign may be thought of as a single commercial in the sense that the basic message (e.g. drink more milk) is unchanged over time" (p.404).

[12]The beginning period of this campaign is September 1985.

emphasized the benefits of milk's nutrients. The second campaign ran from March 1989-December 1992 and its major theme was that adults should drink more milk.[13] Based on this, the values of the trend and campaign indicator variables are given by:

$$T_{t1} = 5,\ldots,47 \quad for\ t = 1,\ldots,43; \quad 0\ otherwise$$
$$T_{t2} = 1,\ldots,46 \quad for\ t = 39,\ldots,84; \quad 0\ otherwise$$
$$TH_{j1} = 1 \quad for\ t = 6,\ldots,38+j,\ j=0,\ldots,5; \quad 0\ otherwise$$
$$TH_{j2} = 1 \quad for\ t = 39,\ldots,84,\ j=0,\ldots,5; \quad 0\ otherwise.$$

The model was estimated by Nonlinear Least Squares (NLS) using the Davidson-Fletcher-Powell algorithm in Shazam version 7.0 with a convergence criterion of 0.000001.

Results and Testing Procedures

Following the suggestion of Bera and Jarque, the null hypotheses that the disturbances υ_t in (7) are homoscedastic and serially independent are tested simultaneously. Tests designed for diagnosing one misspecification at a time (one-directional tests) are not, in general, robust in the presence of other misspecifications. In particular, it is virtually impossible to determine the power and significance level of most one-directional tests in such cases. The test procedure proposed by Bera and Jarque, which is capable of testing a number of specifications simultaneously, is particularly appropriate for the current model since υ_t could potentially exhibit both heteroscedasticity and serial correlation.

The joint test is based on the Lagrange Multiplier (LM) principle and the test statistic is

$$(10) \qquad \Lambda = \lambda_H + \lambda_A,$$

where λ_H is the Breusch-Pagan test statistic for heteroscedasticity (Godfrey, p.128) and λ_A is the LM-based test statistic for first-order autocorrelation (Godfrey, p.117). For the model in (7)-(9), λ_H is one-half the explained sum of squares from the following regression:

$$(11) \qquad \frac{\hat{\upsilon}_t^2}{\hat{\sigma}_\upsilon^2} - 1 = a + \sum_{i=1}^{2}\sum_{j=0}^{5} b_{ji} Z_{t-ji} + r_{tH},$$

where $\hat{\upsilon}_t$ is the t[th] NLS residual from estimation of (7),

$$\hat{\sigma}_\upsilon^2 = (N-5)^{-1}\sum_{t=6}^{N}\hat{\upsilon}_t^2, \quad a = \sigma_\mu^2, \quad b_{ji} = \sigma_{\epsilon i}^2\omega_{ji}^2, \quad Z_{t-ji} = (A_{t-j}TH_{ji})^2,$$

and r_{tH} is an error term.[14]

The test statistic λ_A is N-5 times the uncentered R^2 for the regression

$$(12) \qquad \hat{\upsilon}_t = c\hat{\nabla}_t' + \rho\hat{\upsilon}_{t-1} + r_{tA},$$

where $\hat{\nabla}_t$ denotes the t[th] row of the matrix of derivatives of the regression equation in (7) evaluated at the least squares estimates, (c,ρ) is a vector of coefficients, and r_{tA} is an error term. The joint test statistic Λ has an asymptotic χ^2 distribution with degrees of freedom equal to the sum of the degrees of freedom of the two one-directional tests, (2×(5+1))+1=13 in this case. The calculated value of Λ is 8.853, with a P-value of 0.784. This result provides evidence that random elements do not impact the level of the goodwill parameter, γ_{ti}, (i.e., it is not necessary to add a random term ϵ_{ti} to the exponential quadratic function in (2)),[15] and that υ_t does not exhibit first-order autocorrelation.

The estimation results are reported in Table 1. The R^2 values indicate that the estimated model has relatively good explanatory power. The signs of the estimated coefficients are consistent with prior expectations based on economic theory and the wearout hypothesis.

Consistent with prior studies (Kinnucan; Kinnucan and Forker; Liu and Forker; KCV), the demand for milk in NYC is found to be price and income inelastic. The estimated seasonal coefficients indicate that the level of fluid milk consumption in this market raises in the winter and spring quarters and falls in the summer quarter.

The signs and magnitudes of the estimated coefficients associated with the linear and quadratic time trends ($\Psi_{\ell i}$, ℓ, i=1,2) imply that the advertising goodwill parameters, γ_{ti}(i=1,2), follow a bell-shaped pattern. For the demand equation in (7) the advertising goodwill elasticities are given by

$$(13) \qquad \zeta_{ti} = \frac{\partial Q_t}{\partial G_{ti}}\frac{G_{ti}}{Q_t} = \gamma_{ti}G_{ti} = \exp(\Psi_{0i} + \Psi_{1i}T_t + \Psi_{2i}T_t^2)\sum_{j=0}^{5}\omega_{ji}A_{t-j}TH_{ji}.$$

The value of ζ_{ti} depends not only on γ_{ti}, but on the level of the goodwill variable as well, which in turn depends on

[13]This campaign actually ended in February 1993.

[14]Note that the effective number of observations used to estimate (7) is N-5 because the goodwill variable includes lagged values of advertising expenditures.

[15]Kinnucan and Venkateswaran report similar results for the Ontario fluid milk campaign.

current and past advertising expenditures. Therefore, the evolution of ζ_{ti} over time will not correspond exactly to that of γ_{ti}.

The P-test (Davidson and MacKinnon, p.382) was used to test the model specification in (7) versus a nonnested model with no advertising goodwill term.[16] For each campaign, the alternative model was rejected while the model in (7) could not be rejected at the 5% significance level. These results imply that the estimated model is superior to a model that does not account for the impact of generic advertising on fluid milk demand. A Wald test of the joint null hypothesis that the goodwill coefficients are time-invariant and that the lag weights coefficient is the same for both campaigns (i.e., $\Psi_{01}=\Psi_{02}$, $\Psi_{\ell i} = 0$ for ℓ,i=1,2, and $\phi_{21}=\phi_{22}$) resulted in a test statistic of 42.04 with a P-value of 0. This result indicates that the goodwill coefficients vary over time and that the advertising elasticities differ between the two campaigns. Moreover, the latter cannot be attributed only to differences in the levels of advertising expenditures.

The values of the goodwill elasticities for the first campaign are plotted in Figure 1 for T_{t1}=10,...,42 (i.e., for the period June 1986-February 1989).[17] The elasticities for the second campaign for T_{t2} =6,...,46 (i.e., for the period August 1989-December 1992) are plotted in Figure 2. The highest values for ζ_{t1} and ζ_{t2} are 0.0902 and 0.0452. The lowest values for the first campaign is 0.002, while for the second campaign is close to zero. By way of comparison, KCV's elasticity estimates range from 0.0003 to 0.0720. Other fluid milk advertising elasticity values for the NYC market reported in the literature range from 0.00172 (Liu and Forker) to 0.054 (Kinnucan).

For the first campaign, the positive impact of advertising lasts until the end of the campaign or around 42 months from its inception. The advertising elasticity for this campaign has four major peaks. It achieves its two largest peaks in the fourteenth and sixteenth months. After an abrupt decline over the next three months, it starts rising again reaching its third and fourth peaks in the twenty-third through twenty-fourth and twenty-seventh months. It then declines for most of the remainder of the campaign.

The advertising elasticity for the second campaign has two major peaks: the first one, and highest, 11 months into the campaign, and the second one in the fourteenth month. By the twenty-first month the impact of this campaign on sales becomes negligible. The first campaign lasted twice as long before becoming ineffective. In addition, the average advertising elasticity for the second campaign is 0.00754, which is almost 80 percent lower than that for the first campaign. The first campaign clearly had a longer "shelf life" than the second campaign. The reason for this phenomenon, however, is uncertain. It is worth noting that the level of advertising expenditures is quite volatile for the last two-thirds of the second campaign (see Figure 3). Whether this is a factor affecting the performance of the second campaign remains to be explored.

In an earlier study of the NYC market, KCV found that the effectiveness of generic fluid milk advertising consistently increased over time and attributed this pattern to the dairy farm board and advertising agency becoming more adept as they gained experience in advertising milk. The highest elasticity value estimated in this study for the first campaign of the 1986-92 period is larger than the highest value estimated by KCV for the last campaign of the 1971-84 period--0.0902 versus 0.0720. This observation seems to be consistent with the pattern of increasing effectiveness over time found by KCV. However, the lower peak and average response along with the rapid decline of the advertising elasticities associated with the second campaign of the 1986-92 period indicate a decreasing effectiveness of generic milk advertising over this period. This finding may reflect a short-run deviation from KCV's pattern simply due to an ineffective second campaign. Alternatively, the decline in effectiveness over the 1986-92 period may reflect longer-term generic milk advertising wearout in the NYC market.[18] If the NYC market is indeed becoming less responsive to generic milk advertising, then advertising expenditures should be diverted to other markets in New York State with higher sales responsiveness. In any event, additional research on why the second campaign performed poorly relative to the first campaign is warranted.

---

[16]That is, each alternative model was obtained by dropping $\gamma_{ti}G_{ti}$ (i=1,2) from the demand equation in (7). Note that a nonnested hypothesis testing procedure is appropriate in this case because the alternative models cannot be obtained by imposing restrictions on the parameters of (7). Specifically, the advertising goodwill elasticities are always positive regardless of the values of $\Psi_{\ell i}$ and ϕ_{2i} (ℓ=0,1,2; i=1,2).

[17]Recall that the first sample period corresponds to the fifth period of the first campaign. Also, the elasticities for the first five sample periods cannot be computed due to the lag structure imposed on the goodwill variable.

[18]Kinnucan and Venkateswaran found a similar long-term decline in advertising effectiveness for the Ontario fluid milk campaign. These authors attributed the decrease in advertising elasticities over the 1973-87 period to "audience wearout."

Concluding Comments

The empirical results of this study show that the two major generic fluid milk advertising campaigns in NYC during the 1986-92 period exhibited wearout. These results provide further evidence of the dynamic behavior of sales responses to generic advertising (Ward and Myers; Kinnucan and Forker; KCV; Kinnucan and Venkateswaran). Policy recommendations based on econometric models that allow for time-varying advertising coefficients are likely to be more useful for promotion program managers. Taking into account the dynamic nature of advertising responses should improve strategic decisions regarding campaign duration, copy replacement and allocation of expenditures over time.

Another important finding of this study is that the two campaigns differed considerably in effectiveness. The peak and average advertising elasticity of the first campaign (January 1986 through February 1989) were much higher and its impact on sales lasted twice as long compared with the second campaign (March 1989 through December 1992). Program managers should carefully examine the message and spending strategies of each campaign to try to determine why the first campaign was so much more successful than the second campaign. In addition, long-term generic fluid milk advertising wearout in the NYC market should receive particular attention as a plausible cause for the overall decline in sales responsiveness over the 1986-92 period.

References

Bera, A. K., and C. M. Jarque. "Efficient Tests for Normality, Homoscedasticity and Serial Independence of Regression Residuals: Monte Carlo Evidence." *Economics Letters.* 7(1981):313-318.

Clarke, D.C. "Econometric Measurement of the Duration of Advertising Effect on Sales." *Journal of Marketing Research.* 13(1976):365-372.

Cox, T. L. "A Rotterdam Model Incorporating Advertising Effects: The Case of Canadian Fats and Oils", in *Commodity Advertising and Promotion,* eds. H. Kinnucan, S.R. Thompson and H.-S Chang, pp.139-164. Ames: Iowa State University Press, 1992.

Davidson, R., and J. G. MacKinnon. Estimation and Inference in Econometrics. New York: Oxford University Press, 1993.

Forker, O.D., and R.W. Ward. Commodity Advertising: The Economics and Measurement of Generic Programs. New York: Lexington Books, 1993.

Godfrey, L. G. Misspecification Tests in Econometrics: The Lagrange Multiplier Principle and Other Approaches. New York: Cambridge University Press, 1988.

Hurst, S. and O.D. Forker. *Annotated Bibliography of Generic Commodity Promotion Research (Revised).* Agricultural Economics Research 91-7. Cornell University, Ithaca, 1991.

Kinnucan, H. W. "Demographic Versus Media Advertising Effects on Milk Demand: The Case of the New York City Market." *Northeastern Journal of Agricultural and Resources Economics.* 15(1986):66-74.

Kinnucan, H. W., H.-S. Chang and M. Venkateswaran. "Generic Advertising Wearout." *Review of Marketing and Agricultural Economics.* 61(1993):401-415.

Kinnucan, H. W., and O. D. Forker. "Seasonality in the Consumer Response to Milk Advertising with Implications for Milk Promotion Policy." *American Journal of Agricultural Economics.* 68(1986):562-571.

Kinnucan, H. W., and M. Venkateswaran. "Generic Advertising and the Structural Heterogeneity Hypothesis." *Canadian Journal of Agricultural Economics.* 42(1994):381-396.

Liu, D. J., and Forker, O. D. "Generic Fluid Milk Advertising, Demand Expansion, and Supply Response: The Case Of New York City." *American Journal of Agricultural Economics.* 70(1988):229-236.

Nerlove, M., and F. Waugh. "Advertising Without Supply Control: Some Implications of a Study of the Advertising of Oranges." *Journal of Farm Economics.* 43(1961):813-837.

Singh, B.A. L., Nagar, N. K. Choudry and B. Raj. "On the Estimation of Structural Change: A Generalization of the Random Coefficient Model." *International Economic Review.* 17(1976):340-361.

Thompson, S. R., D. A. Eiler, and O. D. Forker. "An Econometric Analysis of Sales Response to Generic Milk Advertising in New York State." Cornell University Agr. Exp. Sta. No. 6, 1976.

Ward, R. W., and L. H. Myers. "Advertising Effectiveness and Coefficient Variation over Time." *Agricultural Economics Research.* 31(1979):1-11.

Table 1. Estimation Results

Parameter	**Variable**	**Estimated Value**	**T-Val**
α	Intercept	-3.3108	-5.3291
β_1	Price of Milk	-0.1208	-1.4991
β_2	Income	0.5683	6.5285
π_1	Winter Dummy Variable	0.0070	0.9452
π_2	Spring Dummy Variable	0.0115	1.3968
π_3	Summer Dummy Variable	-0.0568	-7.7039
Ψ_{01}	G_{t1} (First Campaign)	-27.4970	-4.3186
Ψ_{11}	$T_1 \times G_{t1}$ (First Campaign)	0.2115	2.1094
Ψ_{21}	$T_1^2 \times G_{t1}$ (First Campaign)	-0.0056	-2.3683
ϕ_{21}	Lag Weights (First Campaign)	-4.5779	-6.0257
Ψ_{02}	G_{t2} (Second Campaign)	-6.5742	-1.9486
Ψ_{12}	$T_2 \times G_{t2}$ (Second Campaign)	1.1114	1.8643
Ψ_{22}	$T_2^2 \times G_{t2}$ (Second Campaign)	-0.0518	-1.9218
ϕ_{22}	Lag Weights (Second Campaign)	-1.2450	-8.2867
SUM OF SQUARED RESIDUALS		0.039	
R^2		0.735	
$\overline{R}^2$		0.682	

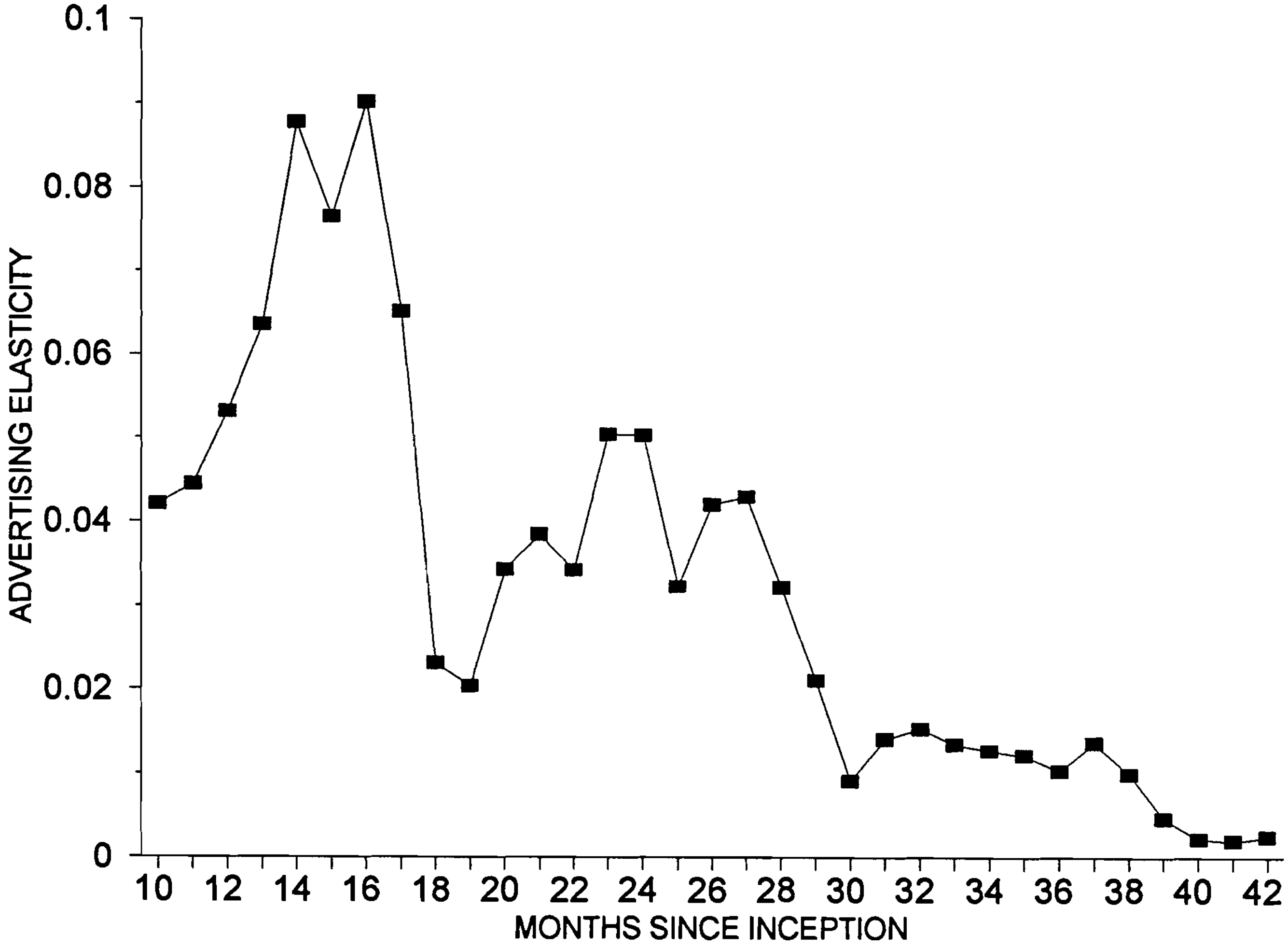

Figure 1. Advertising elasticity for the first campaign

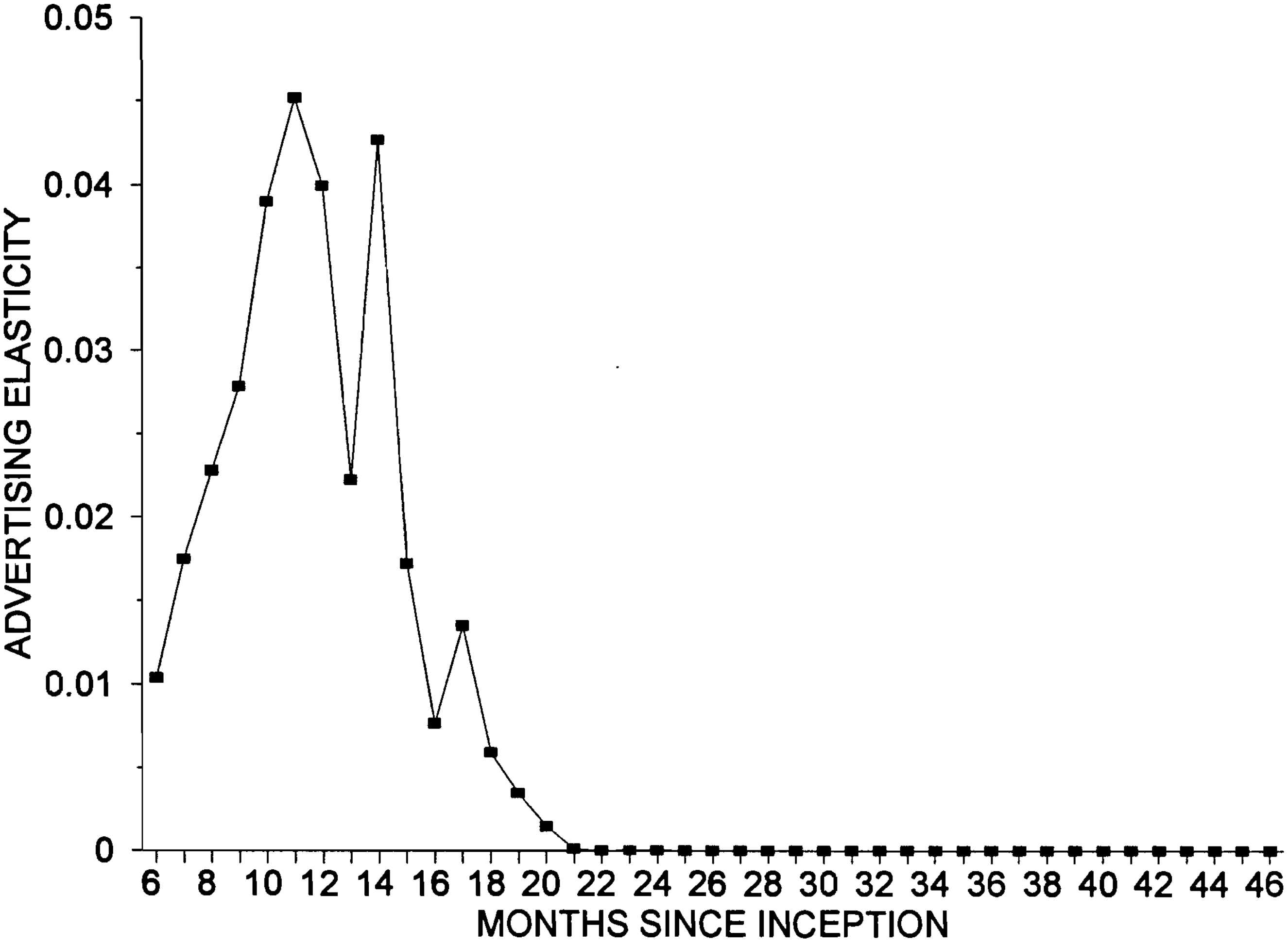

Figure 2. Advertising elasticity for the second campaign

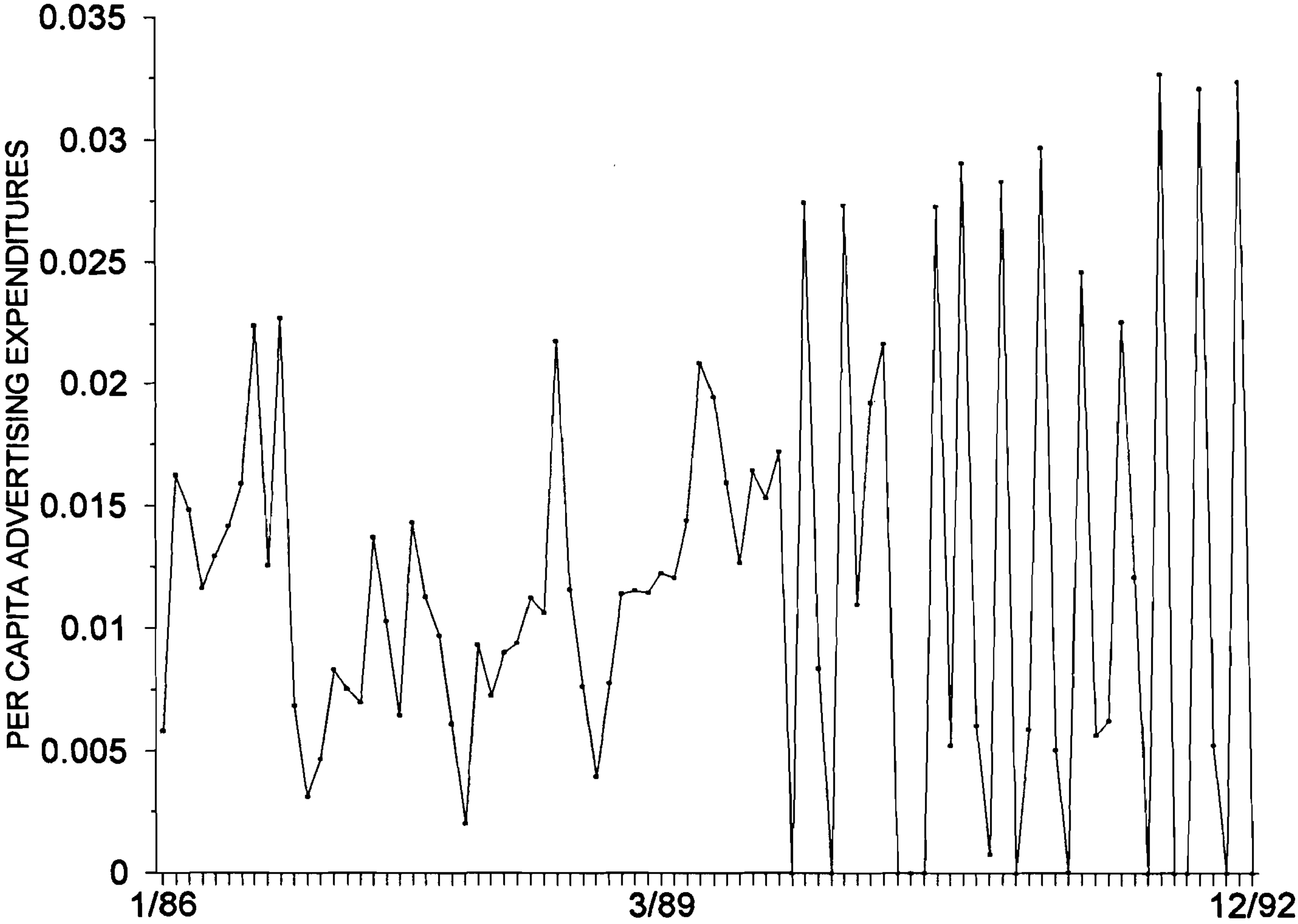

Figure 3. Real per capita advertising expenditures in cents January 1986 - December 1992

OTHER A.R.M.E. RESEARCH PUBLICATIONS

No. 94-06	Identifying a Reduced Set of Salient Attributes that Influence Consumers' Choice Among Whole, Low-Fat, and Skim Milk for Beverage Use	Heiko Miles Steven J. Schwager John E. Lenz
No. 94-07	Dairy Farm Management Business Summary New York State 1993	Stuart F. Smith Wayne A. Knoblauch Linda D. Putnam
No. 94-08	The Effects of Time-of-Use Electricity Rates on New York Dairy Farms	Mark Schenkel Richard N. Boisvert
No. 95-01	Supermarket Bakery Consumers Attitudes, Preferences, Behaviors	Edward W. McLaughlin Gerard Hawkes Kristen Park Debra Perosio
No. 95-02	The Economics of Converting Conventionally Managed Eastern Vineyards to Organic Management Practices	Gerald B. White
No. 95-03	Dairy Farm Management Business Summary New York State 1994	Stuart F. Smith Wayne A. Knoblauch Linda D. Putnam
No. 95-04	Impact of Generic Fluid Milk Advertising on Whole, Lowfat, and Skim Milk Demand	Harry M. Kaiser J. Carlos Roberte
No. 95-05	Mexico's Dairy Sector in the 1990s: A Descriptive Analysis	Charles F. Nicholson
No. 95-06	The Bioeconomics of Regulating Nitrates in Groundwater from Agricultural Production Through Taxes, Quantity Restrictions, and Pollution Permits	Arthur C. Thomas Richard N. Boisvert