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GENERIC ADVERTISING IMPACT ON DEMAND FOR GRAPEFRUIT JUICE

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Executive Summary

In 2000-01, TV advertising for grapefruit juice (GJ) by the Florida Department of Citrus (FDOC) occurred in 24 U.S. markets. Based on an analysis of ACNielsen sales in these 24 markets versus the remaining 27 ACNielsen markets in the U.S., TV advertising appears to be relatively effective in increasing GJ volume sales. GJ advertising was estimated to increase gallon sales by 4.5% to 5.1%. This estimated shift in GJ demand is similar to a recently estimated shift in OJ demand.

However, when the advertising impact on volume sales is translated into grower dollars, the benefits of advertising are much smaller than cost. In contrast, in a recent study the benefits of OJ advertising were estimated to be significantly greater than cost. Although GJ and OJ advertising may be having similar impacts in terms of percentage increases in volume sales, the volume sales level in the GJ market is less than a tenth of that in the OJ market. More potential first-time GJ buyers and more proven GJ consumers who might buy more are needed for GJ advertising to be as affective as in the case of OJ.

Introduction

The 2000-01 advertising campaign for GJ by the FDOC included TV advertisements in 24 markets, representing about 45% of the U.S. population. In 15 markets, the TV advertisements occurred during October and November in 2000, and January and February in 2001; in 9 markets, the TV advertisements occurred in February, March and the first week in April in 2001[1]. Coupons were also issued during October and November in the 15 markets, and January and February in all 24 markets. In past seasons, similar advertising campaigns occurred in about half of the 51 ACNielsen markets in the U.S. (50 cities and the remaining U.S.). Many of these markets in past campaigns are the same as in the 2000-01 campaign, although there are some differences.

This study examines the impact of FDOC advertising on GJ gallons sales in ACNielsen retail outlets. Market-by-market demand equations that relate retail GJ gallon sales to TV advertising by the FDOC, the prices of GJ, OJ and GJ cocktail and store promotions were estimated. A time trend variable is used to measure the impacts of changing consumer preferences, consumer income,

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[1] The 15 markets were Miami, Orlando, Jacksonville, Atlanta, Charlotte, Chicago, Cleveland, Detroit, New York, Tampa, Philadelphia, Boston, Pittsburgh, San Francisco and Seattle. The 9 markets were Birmingham, Denver, Nashville, Washington D.C., Houston, Buffalo, Memphis, Portland and Richmond.

inflation and population. The equations were estimated using ACNielsen data for grocery store chains doing at least $2 million annual business plus super centers. The ACNielsen data are on a weekly basis and include dollar and gallon sales for GJ, OJ and GJ cocktail; prices for these juices were derived by dividing dollar sales by gallon sales. ACNielsen also provided various data on store promotions. The period from week ending January 2, 1999 through April 14, 2001 was studied (120 weekly observations). Data for each of the 51 markets were used in the analysis (51 demand equations times 120 observations per equation).

In 2000-01, the 24 markets in which the FDOC advertised accounted for 53.5% of the total ACNielsen GJ gallon sales in the U.S. The ACNielsen data only cover about 35% of the total U.S. GJ market, so that the 24 markets in which advertising occurred account for an estimated 18.7% of the U.S. grapefruit market (53.5% times 35%). In this study, advertising in a market is assumed to affect sales in both ACNielsen and non-ACNielsen outlets in that market, and the impact of advertising in the 24 markets is applied to 53.5% of the GJ gallons sales in the U.S.

Model Specification

A double log demand equation was used in the analysis. Formally, the model can be written as

(1a) $$q_{iat} = c_{it} (p_{1iat})^{\beta 1} (p_{2iat})^{\beta 2} (p_{2iat})^{\beta 3} e^{\beta 4\, ad1iat + \beta 5\, ad2iat + \beta 6\, ad3iat + \beta 7\, tv1iat + \beta 8\, tv2iat + ri\ a}$$

or

(1b) $$\log (q_{iat}) = \beta_{it} + \beta_1 \log(p_{1iat}) + \beta_2 \log(p_{2iat}) + \beta_3 \log(p_{3iat}) + \beta_4\, ad1_{iat} + \beta_5\, ad2_{iat} + \beta_6\, ad3_{iat} + \beta_7\, tv1_{iat} + \beta_8\, tv2_{iat} + r_i\, a,$$

$i = 1, ..., 51,$
$a = 1$ for 1999, ..., $a = 3$ for 2001,
$t = 1, .., 52$,

where subscripts i, a and t stand for city, year, and week, respectively; q is GJ gallon sales; p_1 , p_2 and p3 are the prices of GJ, OJ and GJ cocktail, respectively; ad1, ad2 and ad3 are percentages (shares) of all commodity sales with store promotions involving newspaper ads, coupons with ads[2], and displays, respectively; tv1 is a dummy variable for TV advertising for the 2000-01 season and tv2 is a dummy variable for TV advertising in 1998-99 and 1999-2000; and the β's and r_i's are

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[2] In preliminary analysis, a dummy variable for coupons issued in 2000-01 was also included in equation (1). However, this variable was omitted from the model as its parameter estimate was not statistically different than zero. The coupon variable in equation (1), as well as the other store promotion variables, were provided by ACNielsen.

parameters. The parameter β_{it} is an intercept that varies by city and week — the i subscript allows different size cities to have different basic sales levels while the t subscript allows weekly variation in sales due to seasonality. The parameter r_i (times variable a) is a city-specific annual growth rate.

To remove the seasonality, model(1b) was 52 nd differenced for the 52 weeks in a year, i.e.,

$$(2) \quad \text{dlog}(q_{iat}) = \beta_1 \text{dlog}(p_{1iat}) + \beta_2 \text{dlog}(p_{2iat}) + \beta_3 \text{dlog}(p_{3iat}) + \beta_4 \text{dad1}_{iat} + \beta_5 \text{dad2}_{iat} + \beta_6 \text{dad3}_{iat} + \beta_7 \text{dtv1}_{iat} + \beta_8 \text{dtv2}_{iat} + r_i$$

where for general variable x, $dx_{iat} = x_{iat} - x_{ia-52,\,t}$. Note that the parameter β_{it} is eliminated by the differencing. Also, all parameters are the same across cities expect the growth rates — across city parameter restrictions were made given the relatively short time period studied; i.e., the data were not rich enough to estimate each city demand equation separately.

Also, note that $\text{dlog}(q_{iat}) = dq/q_{1iat}$ and $\text{dlog}(pj_{iat}) = dpj/pj_{iat}$ (j=1, 2, 3) or the percentage changes in gallon sales and prices, respectively. The price parameter β_j (j=1, 2, 3) is the elasticity of demand with respect to the price of juice j or the percentage change in gallon sales for a one percent change in the j^{th} price. Each store-promotion parameter β_j (j=4, 5, 6) indicates the percentage change in demand for a one percentage point change in the share of all commodity sales occurring during the corresponding promotion in question. The parameter (β_7 or β_8) for each TV dummy variable approximately indicates the percentage change in demand when the TV advertisement occurs — from equation (1a), the actual percentage changes are (100 times) $e^{\beta 78}$-1 and $e^{\beta 8}$-1. The growth parameter r_i indicates the percentage change in demand per year, all other factors constant.

Model Estimates

Equation (2) was estimated by the ordinary-least-squares (OLS) and seemingly-unrelated-regression (SUR) methods. Goodness of fit was measured by the square of the correlation coefficient between the actual and predicted values of the dependent variable ($\text{dlog}(q_{iat})$) which, in the case of the OLS estimates, is the R-square value. For both the OLS and SUR estimates, the square of this correlation coefficient was .56.

The parameter estimates that are common across cities (βs) are shown in Table 1 while the city growth rates (r_i) are shown in Table 2. The OLS and SUR estimates are generally about the same, although there are some differences. All of the SUR parameter estimates in Table 1 are statistically different than zero at the .10 level of significance; all the OLS parameter estimates except those for the GJ cocktail price and the coupon variable are significant. Most of the growth rate estimates in Table 2 are significant. The focus of attention will be on the FDOC advertising parameter estimates in Table 1, but before discussing these estimates, a few comments on the other parameter estimates are provided. The own-price elasticity estimate for GJ demand is -1.3 indicating GJ gallon sales are relatively sensitive to price. The cross price elasticity for the OJ price is positive, indicating a substitute relationship; however, the cross price elasticity for the GJ cocktail price is

negative (or not significantly different than zero in the OLS equation) indicating an unexpected complementary relationship. The parameters for the three store-promotion variables are all positive indicating these promotions are working as intended. Most of the growth rate parameters in Table 2 are negative indicating a declining sales trend in the GJ market in the past few years.

The FDOC advertising parameter estimates indicate that past TV advertising (1998-2000) was not effective in increasing demand. The OLS and SUR parameter estimates for past TV advertising were negative suggesting that the sales levels in these markets were below those in the non-advertised markets, all other factors constant. This result is consistent with last year's analysis on the effectiveness of GJ advertising. It is unlikely that FDOC advertising is actually negatively impacting demand. Perhaps the dummy variable for 1998-2000 advertising is picking up the impact of other factors underlying the negative trends in the GJ market.

In contrast to the above results, the FDOC advertising parameter estimates for TV advertising in 2000-01 were positive indicating this advertising was effective in increasing GJ demand. The OLS estimate of β_8 indicates TV advertising in 2000-01 increased demand by approximately 5.1% while the SUR estimate suggests that the increase was about 4.5%. In specification (1a), these estimates indicate the actual impacts were 5.3% and 4.6% — 100 ($e^{\beta 8}$-1) Both estimates are relatively large, being about the same size of the advertising impacts found in the OJ market in other studies (see Staff Report 2001-6, Economic and Market Research Department, FDOC).

Grapefruit juice cocktail gallon sales were also related to the same explanatory variables in Tables 1 and 2. Both TV advertising variables negatively impacted grapefruit juice cocktail gallon sales, suggesting the FDOC advertising is causing some grapefruit juice cocktail consumers to switch to 100% GJ.

Costs and Benefits

Average GJ sales are estimated at 140 million single strength equivalent (SSE) gallons per year over the last three seasons (1998-99 through 2000-01); the range in annual sales is estimated to be 120 to 154 million SSE gallons. The 24 markets where advertising occurred in 2000-01 account for an estimated 53.5% of average U.S. sales or about 75 million gallons. These 75 million SSE gallons are equivalent to about 73.6 million pounds solids (PS), assuming .981 PS per SSE gallons (a 40 degree Brix gallon of GJ which contains 3.924 PS is assumed to yield 4 SSE gallons).

In this study advertising was estimated to account for 4.6% to 5.3% of the GJ sales in these 24 markets or 3.4 to 3.9 million pound solids (.046 and .053 times 73.6 million PS), assuming the advertising impact carries over for an entire year. In model (2), the advertising impact only applies to the period from October 2000 through the first week in April 2001, depending on city. Given the data end in April 2001, the carry over impact of the 2000-01 advertising campaign could not be estimated. Past research suggests that the full advertising impact may not be carried over for a year. Over a week, about 5% of the advertising impact may be lost (Staff Report 2001-06). In this case,

the annual average advertising impacts would be about half the 4.6% to 5.3% impacts.

In the past five seasons, the delivered-in price received by growers has averaged about $.65/PS. Hence, on average, the value of the 3.4 and 3.9 million PS, induced by advertising under the assumption that the advertising impact is fully carried over, is equivalent to about $ 2.2 to $2.5 million (if the advertising impact depreciates at 5% per week, the dollar values would be about half these levels). In 2000-01, tag TV GJ advertising, including media-radio, is expected to total about $5.6 million. Hence, the $5.6 cost of advertising is more than twice the estimated benefits of $2.1 to$ 2.5 million.

A basic reason why the benefits of GJ advertising are less than costs is that the GJ market is relatively small. For example, the OJ gallon sales are over ten times the level of GJ gallons sales. Hence, if the GJ market were as large as the OJ market, the GJ advertising benefits might have been much greater, perhaps exceeding costs.

Concluding Comments

How might the GJ advertising situation be improved? In 2000-01, GJ advertising was about as effective as OJ advertising in terms of the estimated percentage increase in market sales due to advertising, but the costs of GJ advertising were greater than the benefits received by growers. The benefits of GJ advertising were relatively low in part because the market coverage of GJ advertising was limited to about half the U.S. This limitation suggests that the benefit-cost situation might be improved if the coverage of advertising could be extended in some way with little or no additional costs. For example, perhaps it is possible to tie GJ and OJ advertising together in a national program that covers all 51 U.S. markets for most of the weeks in a year. Such joint GJ-OJ advertising may also lessen the potential negative impact of OJ advertising on GJ sales (Staff Report 2001-6); this problem may be particularly important in markets where no GJ advertising occurs to counter the potential negative effect of OJ advertising. In considering a joint program, it should also be recognized that GJ advertising may negatively impact OJ sales.

Better targeting of GJ advertising among consumer groups may also be possible, although the data analyzed in this study do not provide a guide for this issue. For example, are there more potential GJ buyers among the young, health oriented consumer group or the older, health oriented but perhaps more drug-interaction conscious consumer group? Consumer attitudinal, buyer intention and demographic studies might help answer such questions.

Despite the unfavorable cost-benefit analysis, the results of this study are encouraging in that they suggest GJ advertising was effective in expanding the targeted market sales. To make GJ advertising cost effective, a means is needed to extend and stretch the impact of advertising, if possible.

Table 1. Grapefruit Juice Demand Parameter Estimates Common to All Cities.

	Method			
Variable	OLS		SUR	
FDOC TV Adv. (2000-01)	0.0513	*	0.0446	*
FDOC TV Adv. (1998-00)	-0.0254	*	-0.0199	*
GJ Price	-1.3528	*	-1.3418	*
OJ Price	0.1657	*	0.1667	*
GJ Cocktail Price	-0.0273		-0.0192	*
Newspaper Ad	0.0003	*	0.0003	*
Coupon	0.0004		0.0004	*
Dispaly	0.0027	*	0.0025	*

Note: Star (*) indicates parameter is statistically different than zero at the .10 level; based on ACNielsen Data from January 2, 1999 through April 14, 2001.

Table 2. Grapefruit Juice Demand Growth Rate Estimates By City.

Market	Method OLS		Method SUR		Market	Method OLS		Method SUR	
ALBANY	-0.1027	*	-0.1052	*	MILWAUKEE	-0.0302	*	-0.0309	*
ATLANTA	-0.1054	*	-0.1026	*	MINNEAPOLIS	-0.1514	*	-0.1505	*
BALTIMORE	-0.0880	*	-0.0886	*	NASHVILLE	-0.0695	*	-0.0696	*
BIRMINGHAM	-0.0763	*	-0.0767	*	NEW ORLEANS/MOBILE	-0.0287	*	-0.0301	*
BOSTON	-0.0872	*	-0.0862	*	NEW YORK	-0.0298	*	-0.0294	*
BUFFALO/ROCHESTER	-0.0880	*	-0.0891	*	OKLAHOMA CITY/TULSA	-0.0694	*	-0.0730	*
CHARLOTTE	-0.0477	*	-0.0467	*	OMAHA	-0.1560	*	-0.1576	*
CHICAGO	-0.0983	*	-0.0958	*	ORLANDO	0.0000		0.0003	
CINCINNATI	-0.1029	*	-0.1038	*	PHILADELPHIA	-0.0614	*	-0.0602	*
CLEVELAND	-0.1878	*	-0.1867	*	PHOENIX	-0.0251	*	-0.0256	*
COLUMBUS	-0.1474	*	-0.1475	*	PITTSBURGH	-0.2264	*	-0.2257	*
DALLAS	-0.0344	*	-0.0348	*	PORTLAND	-0.1233	*	-0.1212	*
DENVER	0.0101		0.0107		RALEIGH/DURHAM	-0.1000	*	-0.1008	*
DES MOINES	-0.0983	*	-0.0982	*	RICHMOND/NORFOLK	-0.0360	*	-0.0374	*
DETROIT	-0.1025	*	-0.1008	*	SACRAMENTO	0.0484	*	0.0484	*
GRAND RAPIDS	-0.1466	*	-0.1470	*	ST. LOUIS	-0.1730	*	-0.1736	*
HARTFORD/NEW HAVEN	-0.0835	*	-0.0853	*	SALT LAKE CITY/BOISE	0.0398	*	0.0391	*
HOUSTON	-0.0584	*	-0.0575	*	SAN ANTONIO	-0.0199		-0.0207	*
INDIANAPOLIS	-0.1336	*	-0.1346	*	SAN DIEGO	-0.0083		-0.0080	
JACKSONVILLE	-0.0435	*	-0.0427	*	SAN FRANCISCO	-0.0331	*	-0.0305	*
KANSAS CITY	-0.0511	*	-0.0532	*	SEATTLE	-0.0139		-0.0124	
LITTLE ROCK	-0.0492	*	-0.0520	*	SYRACUSE	-0.1198	*	-0.1212	*
LOS ANGELES	0.0156		0.0148		TAMPA	-0.0438	*	-0.0435	*
LOUISVILLE	-0.1433	*	-0.1449	*	WASHINGTON D.C.	-0.0256	*	-0.0242	
MEMPHIS	0.0405	*	0.0383	*	REMAINING U.S.	-0.0611	*	-0.0627	*
MIAMI	0.0032		0.0042						

Note: Star (*) indicates parameter is statistically different than zero at the .10 level; based on ACNielsen Data from January 2, 1999 through April 14, 2001.