Generic Advertising and Retail Sales of Grapefruit Juice

The purpose of this paper is to report the result of a study of the impact of Florida Department of Citrus (FDOC) processed grapefruit consumer advertising on retail demand for grapefruit juice. In this study, it is assumed that retail per capita demand for grapefruit juice (q_t) is a function of grapefruit juice price (p_{2t}), its substitute prices (orange juice (p_{1t}), grapefruit-juice cocktail (p_{4t}), and other 100-percent fruit juices (p_{3t})), real per capita income (inc_t), a time trend (log(t)), seasonality (s_1 and s_2), and current and lagged grapefruit juice advertising effort (adv_{t-j}, j=0,1,2,...). The measure for advertising effort is household gross rating points (GRPs) per week. Formally, the demand model can be expressed as

$$(1) \quad q_t = \alpha + \Sigma\beta_i p_{it} + \gamma_1 inc_t + \gamma_2 \log t + \gamma_3 s_1 + \gamma_4 s_2 + \Sigma\lambda adv_{t-j} + \epsilon_t,$$

where subscript t is time measured on a weekly basis; q is per capita single-strength-equivalent (SSE) grapefruit juice gallon sales; all prices and per capita income are deflated by the consumer price index (CPI); ϵ is the disturbance term; and α, β, γ, and λs are parameters to be estimated.

Scanner data for retail grocery stores with annual sales for all products of $4 million or greater, provided by Nielsen Marketing Research, were used to estimate the assumed demand relationship. The period studied was from week ending September 17, 1988 through the week ending July 14, 1990 (86 weekly observations). Ordinary least squares method with selected polynomial distributed lag structures for current and lagged advertising effort was used to estimate the demand parameters. Results are presented in Table 1.

In Table 1, PDL(n,m,[far|both]) represents the n^{th} order polynomial distributed lag structure with a lag length of m and a zero restriction (i.e., "far" if the impact of the m^{th} lagged advertising equals zero, or "both" if both the impact of the $t+1^{th}$ and the m^{th} lagged

advertising are zero). For example, PDL(3,11,far) represents a third-order polynomial distributed lag structure with eleven lagged advertising variables, and the impact of advertising effort eleventh weeks ago is restricted to zero. Results shown in Table 1 indicate that (1) both PDL(3,11,far) and PDL(4,11,far) indicate the advertising effort which was more than six weeks ago had no impact on grapefruit juice sales; and (2) based on adjusted R^2 and t-ratios of parameter estimates for current and lagged advertising variables a demand structure with PDL(3,7,both) was chosen for analysis.

In order to analyze the impact of advertising on the demand for grapefruit juice the following formula was used

(2) change in revenue = $(\Sigma\lambda_j^* adv_{t-j})^*$population*CPI $\quad j=0,1,2,...,6;$

where λ_j^* is the estimate for λ_j (see equation (1)). Results are presented in Table 2.

During the 1988-89 and 1989-90 seasons, the FDOC spent $7.93 million (media and production costs) to advertise grapefruit juice in the U.S. Three advertising impact estimates are shown in Table 2. They are the low estimates (average impact estimate minus two standard deviations), average estimate, and high estimates (average impact estimate plus two standard deviations). The estimated returns from advertising at the retail level is $9.09 million for the study period (i.e. from September 17, 1988 through July 14, 1990). Note that it is believed that gallon sales of grapefruit juice in $4-million-and-greater grocery stores represent about 74 percent of total grapefruit juice gallon sales in all retail outlets. Therefore, the estimated returns represent only 74 percent of the total return. The total return estimates from advertising are presented in the bottom line in Table 2. The estimates ranged from $6.88 million to $17.70 million with an average estimate of $12.29 million.

Table 1. Advertising lag structure estimates for grapefruit juice -- September 17, 1989 through July 14, 1990

LAG	PDL(3,11,far)	PDL(4,11,far)	PDL(3,7,both)
0	0.6127 (0.1642)[a]	0.2436 (0.2217)	0.2209 (0.0486)
1	0.5271 (0.1361)	0.4073 (0.1412)	0.3787 (0.0834)
2	0.4475 (0.1206)	0.4697 (0.1173)	0.4734 (0.1042)
3	0.3739 (0.1148)	0.4521 (0.1160)	0.5049 (0.1112)
4	0.3062 (0.1138)	0.3760 (0.1141)	0.4734 (0.1042)
5	0.2445 (0.1130)	0.2627 (0.1098)	0.3787 (0.0834)
6	0.1888 (0.1092)	0.1336 (0.1084)	0.2209 (0.0486)
7	0.1391 (0.1005)	0.0102 (0.1113)	
8	0.0953 (0.0858)	-0.0863 (0.1126)	
9	0.0576 (0.0644)	-0.1344 (0.1016)	
10	0.0258 (0.0359)	-0.1128 (0.0675)	
Mean Lag	2.8611 (1.1994)	1.6645 (2.0113)	3.0000 (0.4113)
Sum of Lags	3.0185 (0.9829)	2.0216 (1.0402)	2.6509 (0.5836)
R-square(adj.)	0.8254	0.8358	0.8374

[a]Numbers in parentheses are standard errors for parameter estimates.

Table 2. Estimated returns from advertising -- September 17, 1988 through July 14, 1990

year	GRPs	Low Estimate	Average Estimate	High Estimate	Number of Weeks
			--- Thousand Dollars ---		
1988[a]	804	555	992	1,429	16
1989	2,525	3,449	6,162	8,876	52
1990[b]	570	1,085	1,939	2,792	28
Sum	3,899	5,089	9,093	13,097	96
Total Return[c]		6,877	12,288	17,698	

[a]From September 17, 1988 through December 31, 1988.

[b]From December 31, 1989 through July 14, 1990.

[c]Equals the sum of estimated returns divided by 0.74.