RESEARCH PAPER: 2003-1

ADVERTISING IMPACTS ON DEMAND FOR ORANGE JUICE – MAY 2003

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May 2003

Executive Summary

This study examines the impact of FDOC TV advertising on the demand for orange juice (OJ) over the five-year period from 1997-98 through 2001-02. In a regression analysis, per capita retail OJ gallon sales were related to TV advertising by the FDOC, advertising by major bands, in-store OJ displays with newspaper ads, inflation-adjusted prices of OJ and grapefruit juice (GJ), a dummy variable for September 11, and time. This relationship was simulated with advertising and without advertising over the 1997-98 through 2001-02 period. The results indicate FDOC advertising increased OJ demand by about 5%. The 95% confidence interval for the impact of advertising is roughly 2.5% to 7.5%. These impacts are similar to past FDOC estimates.

The amount of Florida OJ movement generated by FDOC advertising is estimated at 325.7 million SSE gallons over the five years studied, or 65.1 million SSE gallons per year on average. Associated short-run grower returns to FDOC advertising were estimated under two assumptions: constant prices versus increased prices in response to advertising. Over the 1997-98 through 2001-02 period, the FDOC spent $90.8 million on TV advertising or $18.2 million per year on average. Based on an average delivered-in price over the study period of $.86 per SSE gallon, the value of the 325.7 million SSE gallons was $280 million. Comparing this to the cost of $90.8 million, the benefit-cost ratio is estimated at 3.09 ($3.09 return for each dollar spent on advertising). The 95% confidence interval for the benefit-cost ratio is estimated at 1.54 to 4.63.

Prices are not likely to remain constant, however, in absence of FDOC advertising. Hypothetically, if prices were constant and FDOC advertising had not occurred, Florida OJ movement would have been expected to decline by 65.1 million SSE gallons per season. If this decline in movement had occurred, inventories in terms of weeks of supply would have increased by an estimated 74% by the end of the 2001-02 season. With such increases in inventories, prices would not be expected to remain constant. Based on a world OJ model that takes imports into account, the OJ delivered-in price without advertising is estimated at $.10 to $.06 per SSE gallon below the actual, with-advertising price, depending on the elasticity of demand. This result is for situations when the U.S. is a net importer. With increases in U.S. OJ production, however, the U.S. may become self sufficient (except for imports for blending), in which case the without-advertising price decline could be much steeper.

Applying the above price declines to average Florida production over the period studied, benefit-cost ratios of 7.7 and 4.3 are estimated, depending on the price elasticity assumption. If the U.S. becomes self sufficient in OJ, the benefit-cost ratio could be several times larger.

Presently, grower prices are relatively low due to growth in supply over the 1990s. Grower prices over the last several seasons have barely covered costs on average, and some growers likely experienced

lower prices and/or higher costs, and losses. But if advertising had not occurred, the results of this study suggest that prices may have been well below costs. Such a situation would be expected to result in some growers going out of business, perhaps somewhat like as has been occurring in the grapefruit industry. Without FDOC advertising, the Florida OJ industry may become significantly smaller and perhaps more prone to domination by larger producers in the world such as Brazil. Such possible domination could have important implications for the prices received by surviving Florida growers. For a world OJ industry dominated by a few, the likelihood of uncompetitive low grower prices increases.

Finally, it should be noted that in some upcoming seasons large orange crops in Florida and Brazil may result in grower prices that are below some growers' costs. These growers may be able to survive at such prices for a while depending on the magnitude of the losses (perhaps a year or several if prices nearly cover costs). But these growers may not be able to survive at significantly lower prices that may occur with large crops but without advertising. That is, for some market situations advertising may not make growers a profit, but minimize their losses and perhaps keep them in business until demand is increased sufficiently to provide profitability.

Introduction

This study examines the impact of FDOC advertising on the demand for OJ over the 1997-98 through 2001-02 seasons. First, the impact of advertising is estimated by regression using data on sales in ACNielsen retail outlets doing $2 million business annually. These outlets cover roughly half the OJ consumed in the U.S. and the regression results were adjusted to reflect U.S. demand. Over the period studied, Florida's share of the U.S. OJ market was an estimated 89%, and the impact of advertising on Florida OJ gallon sales was determined as this share times the U.S. impact. The impact on gallon sales was then translated into dollars and compared to the costs of advertising. Benefit-cost ratios are considered for two assumptions: prices are constant versus prices increase in response to advertising.

In the regression analysis, per capita retail OJ gallon sales were related to FDOC advertising, brand OJ advertising, in-store OJ displays with newspaper ads, inflation-adjusted prices of OJ and GJ, a dummy variable for September 11, and time (consumer income was initially considered but was highly correlated with time and statistically insignificant). The OJ brand advertising in this model is the aggregate advertising by the three major OJ brands—Tropicana, Minute Maid and Florida's Natural.

The ACNielsen data are on a weekly basis and include dollar and gallon sales for OJ and GJ, as well as in-store promotion measures (prices were derived by dividing dollar sales by gallon sales). U.S. Department of Commerce data on the U.S. population and the consumer price index (CPI) were used to transform gallon sales to per capita levels and deflate prices, respectively. Advertising was measured by TV gross rating points (GRPs). The GRP data were provided by the Richards Group. The GRP data are quarterly and were combined with the weekly ACNielsen data by repeating the quarterly GRP levels for each week in a given quarter. The period from week ending 10/11/97 through 12/28/02 was studied (273 weekly observations).

Model Specification

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

$$(1)\qquad q_t = \alpha_0 + \alpha_1 * p_{1t} + \alpha_2 * p_{2t} + \alpha_3 * t + \alpha_4 * s_{1t} + \alpha_5 * s_{2t} + \alpha_6 * dis_t + \alpha_7 * d911_t, \qquad t=1, ..., 273,$$

where subscript t stands for time (week); q_t is per capita OJ gallon sales; p_{1t} and p_{2t} are CPI deflated prices for OJ and GJ respectively; s_{1t} and s_{2t} are OJ advertising stock variables for FDOC advertising and brand advertising, respectively; dis_t is the percentage of all commodity sales with in-store OJ displays accompanied by newspaper ads; $d911_t$ is a dummy variable equal to one (zero) after (before) 9-11-01; and the α's are parameters to be estimated.

The advertising variables can be thought of as psychological stocks of past and present advertising. Over time advertising messages wear off and are assumed to be subject to a decay factor (λ) which indicates how much advertising is remembered and remains effective. Formally, the advertising stock variables are defined by

$$(2)\qquad s_{i\,t} = ad_{i\,t} + \lambda\, s_{i\,t-1}$$

or, by recursively substituting for $s_{i\,t-1}$,

$$(3)\qquad s_{i\,t} = \lambda^{m+t}\, s0_i + s1_{it}, \qquad i=1, 2, \qquad m= 40 \text{ (weeks before start of the sample)}$$

where ad_{it} is advertising in week t of type i — i=1 for FDOC, i=2 for brand; the decay factor $\lambda = .95$ based on previous studies; $s0_i$ is the stock of advertising existing in the week before the first observation on advertising (40 weeks before the first week of the sample used to estimate the model); and $s1_{it} = \sum_{j=0 \text{ to } m+t-1} \lambda^j ad_{i\,t-j}$ (M. Brown and J. Lee, 1999). Note that the stock of advertising is composed of (1) the surviving pre-sample stock, $\lambda^{t+m} s0_i$, and (2) the surviving advertising created during the sample period and prior 40 weeks, $s1_i$.

Substituting expression (3) into equation (1) results in

$$(4)\qquad q_t = \alpha_0 + \alpha_1 * p_{1t} + \alpha_2 * p_{2t} + \alpha_3 * t + \alpha_4 * s1_{1t} + \alpha_5 * s1_{2t} + \alpha_6 * dis_t + \alpha_7 * d911_t + \alpha_8\, \lambda^{t+m},$$

where $\alpha_8 = \alpha_4 * s0_1 + \alpha_5 * s0_2$.

OJ gallon sales are also expected to be dependent on the season of the year, and the intercept α_0 was allowed to vary by week by adding 51 weekly dummy variables to equation (4).

Model Estimates

Initially, equation (4) was estimated by ordinary least squares, but the errors followed a first-order autocorrelation pattern and the equation was re-estimated correcting for this problem. Also, in preliminary analysis, the coefficient estimate for the pre-sample stock (α_8) was not statistically different from zero at the $\alpha = 95\%$ level; and real per capita income was included in the model and its coefficient was likewise statistically insignificant. Based on the F test, both these variables were dropped from the model. It should be noted that the time variable in the model is highly correlated with real per capita income (.96 correlation coefficient) and the coefficient estimate for time likely reflects both trend and income effects.

The estimates of equation (4), excluding those for the intercept and 51 dummy variables for brevity, are shown in Table 1. All the coefficient estimates in the table are statistically significant, except that for brand advertising (the coefficients for the dummy variables indicated a significant seasonal pattern). As expected, the prices of OJ and GJ impact OJ demand negatively and positively, respectively; FDOC and brand adverting have positive effects, displays with newspaper ads have a positive impact and the 9-11 dummy has a negative impact. The primary interest is in the FDOC advertising impact but several comments on the other estimates are noteworthy. First, brand advertising was closer to being significant than in past studies. Brand advertising decreased in 2002 with a decline in Minute Maid's advertising as it changed its focus from RECON to NFC; at the same time OJ sales were slumping; hence, the regression results suggest a possible brand impact although not different from zero at most levels of statistical significance normally used in such analyses. Second, the 9-11 dummy may be capturing a number of possible effects including reduced asset holdings; growing competition from other beverages; the reduction in the FDOC field staff; and the steep reduction of FDOC advertising in the last half of 2001. When this dummy is deleted from the model, the FDOC advertising impact is in fact notably larger than shown in Table 1. Third, the OJ price elasticity estimate is -.28 (percentage change in quantity for a one percent change in price). That is, OJ is relatively inelastic which in context of the advertising results suggest that the OJ price may be very sensitive to changes in advertising as well as other factors. Lastly, a double log model was also estimated indicating the impact of advertising may be larger than that for our linear model (4). This result, however, was discounted as it is related to strong advertising impacts at low unobserved advertising levels (in the estimated double log model, the advertising impact increases as the level of advertising decreases). Despite FDOC advertising being at or near zero in the last two quarters in 2001, the stock of past and present advertising was still substantially greater than zero and there were no observations in the sample that might imply what the impact of a stock near zero might be. The linear results are used to be conservative.

Equation (4) was simulated with advertising (GRPs set at observed values) and without advertising (GRPs set to zero) over the 1997-98 through 2001-02 seasons (October through September). The results indicate advertising increased OJ demand by about 5% (Table 1). The 95% confidence interval for the impact of advertising is roughly 2.5% to 7.5%, based on two standard deviations above and below the advertising coefficient estimate. These advertising impacts are similar to past FDOC estimates (Figure 1).

Grower Returns

Based on the simulation of equation (4), FDOC advertising generated 190.6 million SSE gallons over the five-year period from 1997-98 through 2001-02 in ACNielsen outlets doing $2 million business annually (Table 2). Over this period, OJ sales in these stores accounted for an estimated 52.1% of total OJ consumption in the U.S. (Table 3). Hence, assuming the impact of advertising in the ACNielsen market segment is representative of the impact in the remaining U.S. market, FDOC advertising is estimated to have increased U.S. OJ sales by 365.9 million SSE gallons over the five-year period or 73.1 million SSE gallons per year. Florida OJ production averaged about 89% of U.S. OJ consumption over this period (Table 4), and we estimate the amount of Florida OJ movement generated by FDOC advertising at 325.7 million SSE gallons (.89* 365.9) or 65.1 million SSE gallons per year on average. This impact is used to estimate grower returns to FDOC advertising. The returns are measured by two benefit-cost measures as described below.

Advertising Benefit-Cost Ratios

In this section, we examine short-run benefits and costs. During the five-year period from 1997-98 through 2001-02, grower prices were relatively low (Table 5) and the Florida orange tree population was relatively stable (Table 6). Price levels appear to have been too low to result in more than a relatively small expansion in the number of trees planted and the total tree population. Orange acreage actually declined. In a long-run analysis, Forecasting and Business Analytics, LLC (FABA) found advertising supported prices in previous years had large impacts on tree planting levels and eventually orange production. Given the more recent stable production base, a short-run analysis is considered in the present study.

First, we assume prices are fixed and the benefits of advertising arise from increased OJ sales. Alternatively, we examine the situation where the quantity of OJ sold by growers is fixed, and the benefits from advertising arise from an increase in price.

Constant Prices

Consider grower returns or profits with advertising versus without. Let these profits be

(5) $\Pi_1 = TR_1 - TVC_1 - TFC_1$

(6) $\Pi_0 = TR_0 - TVC_0 - TFC_0$

where subscripts $_1$ and $_0$ indicate with and without advertising, respectively; Π is grower returns, TR is total revenue, TVC is total variable cost, and TFC is total sunk or fixed cost.

Let the total revenues be

(7) $TR_1 = P_d*(Q_0 + Q_A)$
(8) $TR_0 = P_d*Q_0$

where P_d is the delivered-in price (net of the FDOC tax); Q_0 is the quantity of processed oranges sold without advertising; and Q_A is the additional quantity sold with advertising, that is, $Q_0 + Q_A$ is the total quantity with advertising.

In defining benefit-cost ratios an important issue is what are fixed and variable costs. In the short run, some costs can not be varied. For example, over a year, or perhaps several years, cultural and grower costs may be fixed. In addition, for both with and without advertising market conditions, the entire crop may be harvested so that pick and haul costs can also be treated as if fixed. In this case, the main variable cost is the cost of FDOC advertising which we denote by C_A. Also, for the without-advertising situation, Q_A is not sold and assumed to be kept in inventory at a cost of C_I. Comparing the with-advertising variable costs to those for the without-advertising situation, advertising increases costs by C_A dollars while storage savings decreases it by C_I dollars. That is, $TVC_1 = TVC_0 + C_A - C_I$. The fixed costs are assumed to be the same for both situations, i.e, $TFC_1 = TFC_0$. Hence, for this case, profits can be written as

(9) $\Pi_1 = P_d*(Q_0 + Q_A) - TVC_0 - C_A + C_I - TFC_0$
(10) $\Pi_0 = P_d* Q_0 - TVC_0 - TFC_0$

and the gain from advertising is

(11) $\Pi_1 - \Pi_0 = P_d*Q_A - C_A + C_I$.

In the present analysis, the inventory related gain C_I is not considered. Letting, $B= P_d*Q_A$ be the benefits of advertising, the benefit-cost ratio, in this case, is

(12) $B/C = P_d*Q_A /C_A$.

Note that the benefits are the additional volume sales generated by advertising times the delivered-in price.[1]

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[1] Valuing the benefits as additional sales Q_A times the on-tree price would understate grower returns. The on-tree price is the delivered-in price minus pick and haul costs. As long as the delivered-in price exceeds average pick and haul costs or the on-tree price is positive, the entire crop would be expected to be harvested as revenues

Fixed OJ Volume, Price Increases

In the short-run, growers may harvest and sell all that is produced (Q) regardless the price. Both fixed and variable costs are assumed to be the same for the with- versus the without-advertising situations. In this case, total revenues are

(13) $TR_1 = P_{d,1} * Q$
(14) $TR_0 = P_{d,0} * Q$

where $P_{d,1}$ and $P_{d,0}$ are the delivered-in prices for the with- versus without-advertising situations.

Now, the gain from advertising is

(15) $\Pi_1 - \Pi_0 = (P_{d,1} - P_{d,0}) * Q - C_A,$

and, the benefit-cost ratio is

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will cover all pick and haul costs and some portion of total fixed costs. Hence, given positive, with-versus-without-advertising on-tree prices, pick and haul costs would not be expected to change and factor in the calculation of benefits. Formally, let the total variable costs be

(a) $TVC_1 = P_{ph} * (Q_0 + Q_A) + C_A - C_I$
(b) $TVC_0 = P_{ph} * (Q_0 + Q_A)$

where P_{ph} is the pick and haul cost per unit.

Now grower returns can be written as

(c) $\Pi_1 = P_d * (Q_0 + Q_A) - P_{ph} * (Q_0 + Q_A) - C_A + C_I - TFC_0$
(d) $\Pi_0 = P_d * Q_0 - P_{ph} * (Q_0 + Q_A) - TFC_0$

or

(e) $\Pi_1 = (P_d - P_{ph}) * (Q_0 + Q_A) - C_A + C_I - TFC_0$
(f) $\Pi_0 = (P_d - P_{ph}) * Q_0 - P_{ph} * Q_A - TFC_0$

where the term $(P_d - P_{ph})$ is the on-tree price.

The gain from advertising can then be written as

(g) $\Pi_1 - \Pi_0 = (P_d - P_{ph}) * Q_A - C_A + C_I + P_{ph} * Q_A$

Hence, letting $B = (P_d - P_{ph}) * Q_A$ and the benefit-cost ratio be $B/C = (P_d - P_{ph}) * Q_A / C_A$ ignores not only C_I but also the term $P_{ph} * Q_A$. This measure thus understates the benefit-cost ratio by the amount $(C_I + P_{ph} * Q_A)/C_A$.

$B/C = (P_{d,1} - P_{d,0}) * Q / C_A$.

Application

To apply the above benefit-cost ratios, we first estimate the cost of FDOC advertising. Table 7 shows the TV GRPs purchased by the FDOC to advertise OJ over the five-year period studied; Table 8 shows the corresponding dollar amounts based on the FDOC Annual Financial Reports. Over the 1997-98 through 2001-02 period, the FDOC spent $90.8 million on TV advertising or $18.2 million per year on average.

Estimated benefits of advertising are shown in Table 9, assuming constant prices. Three scenarios are shown. The first scenario is based on the 325.7 million advertising-generated SSE gallons previously estimated based on the regression model; the second scenario is based on an advertising impact that is 50% less (roughly two standard deviations) than that in the first scenario; and the third scenario is based on an advertising impact that is 50% more than that in the first scenario. The last two scenarios roughly define a 95% confidence interval for this analysis.

Based on an average delivered-in price over this period of $.86 per SSE gallon (Table 5), the value of the 325.7 million SSE gallons was $280 million. Comparing this to the cost of $90.8 million, the benefit-cost ratio is estimated at 3.09 ($3.09 return for each dollar spent on advertising). Based on the other two scenarios, the 95% confidence interval for the benefit-cost ratio is estimated at 1.54 to 4.63.

Prices are not likely to remain constant, however, in absence of FDOC advertising. Table 10 shows the Florida OJ supply, demand and inventory situation over the five-years studied. Hypothetically, if prices were constant and FDOC advertising had not occurred, Florida OJ movement would have been expected to decline by 65.1 million SSE gallons per season as mentioned above. If this decline in movement had occurred, inventories in terms of weeks of supply would have increased by 74% by the end of the 2001-02 season—with (without) advertising ending inventories are estimated at 21.2 (36.9)weeks supply. With such increases in inventories as shown in the table, prices would not be expected to remain constant. A regression of the Florida processed orange delivered-in price on Florida's beginning inventory expressed in weeks supply using data for the period from 1994-95 through 2001-02 indicates that for each week increase the price decreases by $.026 per pound solid (PS) (aggregate Florida and Brazil OJ production was also included as an explanatory variable but was not significant). This result is supported by the experience of the Florida grapefruit industry where high inventories and low prices have occurred. Hence, we expect prices would decrease as inventories increase without advertising, but the above simple regression results do not reveal an important interrelationship between the U.S. and other world markets that bears on price. A price decline will likely result in less imports, reducing the overall U.S. OJ supply and moderating the price decline to some degree. Following the approach taken by Brown, Lee and Spreen, we develop a simple model of world OJ supply and demand that addresses the import situation straightforwardly.

Consider the supply and demand for OJ in the U.S. and rest of the world (RW). Assume the supply of OJ in the U.S. and RW is fixed at Q1 and Q2, respectively. (Supply is assumed to be fixed only in a given season; season-to-season changes in supply can occur and exert significant impacts on price; the following analysis, however, does not focus on such impacts at no loss to the main objective of determining the impact of advertising on price.) Let the U.S. demand be described by $q_1 = q_1(p+t, a)$ where p is the Brazil FOB price, t is the tariff plus transportation cost to the U.S., and a is FDOC advertising. Let RW demand be described by $q_2 = q_2(p)$.

Given these definitions, the price p is now determined by equating excess demand in the U.S. to excess supply in the RW, that is,

(16) $q_1(p + t, a) - Q_1 = Q_2 - q_2(p)$.

Note that excess supply $Q_2 - q_2(p)$ describes the U.S. import supply curve.

Differentiating this equality, holding constant the tariff and supplies Q_1 and Q_2, find

(17) $(\partial q_1/\partial p)dp + (\partial q_1/\partial a)\, da = -(\partial q_2/\partial p)dp$

or solving for the change in price find

(18) $dp = -(\partial q_1/\partial a)da / ((\partial q_1/\partial p) + (\partial q_2/\partial p))$.

This result allows estimation of the change in price (dp) due to a change in advertising (da), taking into account the elasticity of U.S. demand and the elasticity of import supply or the negative of the elasticity of demand in the RW.

Assuming that the Florida grower price is correlated with the Brazil FOB price p, estimates of the price declines without advertising are shown in Table 11, based on the short-run model described above and in the footnote of the table. To apply this model, estimates of the U.S. and RW demand slopes are required. Table 12 shows, the slope estimates used in this study. We consider two sets of slopes. The first is based on the relatively inelastic U.S. OJ demand slope estimated in this study (Table 1); the second is based on a more elastic U.S. OJ demand found in previous studies. Two RW demand slopes were assumed based on previous studies. The term $(\partial q_1/\partial a)da$ was set equal to the advertising impact for the U.S. shown in Table 2 (365.9 million SSE gallons over five years or 73.1 million SSE gallons per year). Based on these estimates, the delivered-in price of OJ is estimated to decline by \$.10 per SSE gallon to

\$.06 per SSE gallon.[2] The decline in price is greater the more inelastic demand is. This describes the situation when the U.S. is a net importer.

With increases in U.S. OJ production, however, the U.S., may become self sufficient (except for imports for blending) or possibly become a net exporter which almost happened in 2001-02. If the U.S. were to become self sufficient, the without-advertising price decline could be much steeper than described by equation (18). The self-sufficiently impact can be estimated by $dp = -(\partial q_1/\partial a)da / (\partial q_1/\partial p)$ or like that which would occur if the U.S. market were in isolation (Brown, Lee and Spreen, 1996). An estimate of the without-advertising price decline under self sufficiency is \$.29 per SSE gallon. This result, although relatively large, is consistent with the previous regression result that indicated price could decrease by \$.026 per PS or \$.027 per SSE gallon for each week increase in inventory. Recall that without advertising and constant prices inventories were estimated to increase from 21.2 to 36.9 weeks supply, an increase of 15.7 weeks; hence, the predicted price change is \$.027*15.7 = \$.42 per SSE gallon. The reason why the advertising impact on price under self sufficiency is so much larger than when imports occur is that, under self sufficiency, the U.S. price is being determined in context of a quite inelastic U.S. demand only; while when imports occur, price is determined by a less inelastic weighted sum of U.S. and RW demand elasticities. Lost sales without advertising must be sold by reducing price and the more inelastic demand is, the more price must be decreased to stimulate consumers to buy.

Applying the price declines under the assumption of imports, to average Florida production over the period studied, benefit-cost ratios of 7.7 and 4.3 are estimated, depending on the price elasticity assumption. For the self-sufficiency assumption, the benefit-cost ratio is estimated at 21.8. These results suggest the benefits of advertising are likely much greater than estimated assuming constant prices.

Presently, grower prices are too low (largely due to growth in supply over the 1990s) for present advertising supported prices to stimulate tree plantings. Table 5 shows that grower prices over the last several seasons have barely covered costs on average, and some growers likely experienced lower prices and/or higher costs, and losses. But if advertising had not occurred, the results of this study suggest that prices could have been well below costs. Such a situation would be expected to result in some growers going out of business, perhaps somewhat like as has been occurring in the grapefruit industry. Although not analyzed in this study, another factor bearing on this issue is other competitive beverage advertising. As found by FABA, this advertising has had a significant negative impact on OJ demand. Hence, without-FDOC advertising and continued and perhaps growing competitive advertising, the Florida OJ industry may become significantly smaller and perhaps more prone to being dominated by larger producers in the world

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[2] In comparison, FABA estimated that FDOC advertising increased the (all sales) on-tree price for oranges by 20%. Over the five-year period studied, the actual (with-advertising) processed orange on-tree price averaged \$.559 per SSE gallon (Table 5). Hence, based on FABA's finding, a rough estimate of the without-advertising price would be \$.466 per SSE gallon (\$.559 divided by 1.20) or \$.093 per SSE gallon less than the with-advertising price. It should be noted that this estimate is based on simulation of a long-run model where price increases are dampened by supply increases as opposed to the short-run estimates in the present study. That is, in the short-run the FABA model would be expected to predict a larger price increase due to advertising.

such as Brazil. Such possible domination could have important implications for the prices received by surviving Florida growers. For a world OJ industry dominated by a few, the likelihood of uncompetitive low grower prices increases.

Finally, it should be noted that in some upcoming seasons large orange crops in Florida and Brazil may result in grower prices that are below some growers' costs. These growers may be able to survive at such prices for a while depending on the magnitude of the losses (perhaps a year or several if prices nearly cover costs). But these growers may not be able to survive at significantly lower prices that may occur with large crops but without advertising. That is, advertising may not make growers a profit, but minimize their losses and perhaps keep them in business until demand is increased sufficiently to provide profitability.

Table 1. Estimated linear per capita retail demand equation for OJ, based on ACNielsen weekly data for week ending 10/11/97 through 12/28/02, for stores doing at least $2 million business annually.[a]

Variable[b]	Coefficient Estimate	Standard Error	t Value	Pr > |t|	Elasticity
OJ Price	-6.27E-03	1.67E-03	-3.75	0.0002	-0.28
GJ Price	3.14E-03	1.63E-03	1.93	0.0555	0.16
Time[c]	-2.40E-05	4.63E-06	-5.28	<.0001	
FDOC Advertising	1.58E-07	3.70E-08	4.26	<.0001	0.05
Brand Advertising	3.58E-08	2.59E-08	1.38	0.1686	0.03
Newspaper Ads	1.05E-04	2.96E-05	3.54	0.0005	0.16
9-11-01 Dummy	-1.40E-03	6.20E-04	-2.26	0.0246	

R-Square	0.89
DW	2.03

Predicted Gallons With Versus Without FDOC Advertising Over 5-Year Period from 10/11/97 thru 10/05/02	Actual	Predicted		
		Without Advertising	With Advertising	Increase
	- - - - - - - - - million SSE gallons - - - - - - - - -			- - % - -
	3,971.8	3,781.3	3,971.8	5.0%

[a]Model estimates are corrected for first-order auto-correlation.

[b]Additionally, coefficients for 51 seasonality dummy variables and an intercept were estimated.

[c]Per capita real income and a declining trend variable for the stock of unmeasured pre-sample advertising were initially included in the equation but were statistically insignificant based on the F test and omitted; the correlation between the income variable and time was .96 so that the time variable likely captures much of the income effect in addition to trend effects.

Table 2. Estimated gallon sales generated by advertising, 1997-98 through 2001-02.

Row	Item	ACNielsen >$2M	ACNielsen Share of Total U.S. Presumed Consumption	Total U.S. Presumed Consumption
		- mil. gal. -	- - % - -	- mil. gal. -
A	With Advertising Gallon Sales	3,971.8	52.1	7,627.3
B	Without Advertising Gallon Sales	3,781.3	52.1	7,261.4
C=A-B	U.S. Gallon Sales Due to Advertising	190.6	52.1	365.9
D=.89*C	Florida Gallon Sales Due to Advertising	169.6	52.1	325.7

Table 3. ACNielsen share of U.S. orange-juice consumption.

October-September Season	Total U.S. Presumed Consumption	ACNielsen >$2M	
	----------- mil. SSE gal. -----------		-- % --
1997-98	1,596.4	818.9	51.3
1998-99	1,546.9	794.4	51.4
1999-00	1,598.6	808.5	50.6
2000-01	1,481.5	806.4	54.4
2001-02	1,468.2	777.1	52.9
TOTAL	7,691.6	4,005.3	52.1
Average	1,538.3	801.1	52.1

Table 4. U.S. orange-juice supply and consumption.

Season	Florida Begin. Inventory	Florida Production	Other U.S. Production	U.S. Imports	U.S. Exports	Florida Ending Inventory	Pres. Consumption	Inventory	Del-In Price
	------------------ million SSE gallons ------------------							weeks	$/PS
1980-81	413.5	857.4	117.6	193.6	91.4	413.6	1,077.0	20.0	1.06
1981-82	413.6	643.5	51.1	328.2	79.1	336.0	1,021.3	17.1	1.10
1982-83	336.0	801.5	145.3	391.0	81.7	308.7	1,283.4	12.5	1.10
1983-84[a]	308.7	593.3	48.4	501.5	77.0	269.0	1,105.9	12.6	1.38
1984-85[a]	242.6	569.3	48.6	634.4	57.9	291.2	1,145.8	13.2	1.52
1985-86[a]	291.2	638.0	40.5	504.4	44.4	238.6	1,191.1	10.4	1.02
1986-87[a]	238.6	706.6	65.4	553.6	59.3	243.5	1,261.4	10.0	1.14
1987-88[a]	243.5	830.8	70.9	447.8	65.3	258.8	1,268.9	10.6	1.44
1988-89[a]	258.8	886.1	73.9	379.5	71.4	258.8	1,268.1	10.6	1.45
1989-90[a]	258.8	541.7	97.8	527.6	87.9	234.9	1,103.1	11.1	1.54
1990-91[a]	234.9	841.2	36.5	319.8	93.9	238.9	1,099.6	11.3	1.25
1991-92[a]	238.9	811.3	103.3	285.4	107.2	205.7	1,126.0	9.5	1.18
1992-93[a]	205.7	1,130.8	68.5	298.3	116.8	300.1	1,286.4	12.1	.82
1993-94	378.5	1,058.2	69.1	424.9	110.3	439.5	1,380.9	16.5	.92
1994-95	439.5	1,206.5	46.7	240.4	141.5	409.8	1,381.8	15.4	.89
1995-96	409.8	1,213.3	53.1	221.0	128.1	394.8	1,374.4	14.9	1.02
1996-97	394.8	1,388.3	51.1	294.9	149.0	545.9	1,434.1	19.8	.83
1997-98	545.9	1,486.8	59.0	280.8	146.3	629.8	1,596.3	20.5	.84
1998-99[b]	628.8	1,154.6	71.4	350.2	146.6	511.6	1,546.9	17.2	.95
1999-00[b]	511.6	1,422.4	88.8	339.4	145.2	618.4	1,598.6	20.1	.86
2000-01[b]	618.4	1,357.1	41.6	257.7	122.9	670.4	1,481.5	23.5	.78
2001-02[b]	670.4	1,415.2	36.7	188.8	181.2	661.7	1,468.2	23.4	.78
2002-03e[b]	661.7	1,195.2	53.7	275.0	140.0	594.1	1,451.5	21.3	.89
Average 97-98 thru 01-02		1,367.2					1,538.3		
% of Presumed Consumption		88.9%					100.0%		

SOURCE: Florida Department of Citrus.
[a]COJ inventory not reported.
[b]CSSOJ inventory not reported.

Table 5. Florida processed orange grower prices and costs.

Row	Item	Season					
		1997-98	1998-99	1999-00	2000-01	2001-02	1997-98 thru 2001-02
		$ per box					
A	Delivered-In Price[a]	5.48	6.48	5.52	5.13	5.15	5.51
B	On-Tree Price[a]	3.68	4.59	3.60	3.16	3.08	3.59
C	Grower Cost[b,c]	2.97	2.88	2.91	3.00	2.95	2.95
		million boxes					
D	Processed[a]	232.990	175.140	223.607	213.598	220.476	1,065.811
		$ million					
E=A*D	Delivered-In Revenue[a]	1,276.785	1,134.907	1,234.311	1,095.758	1,135.451	5,877.212
F=B*D	On-Tree Revenue[a]	858.390	804.741	805.653	674.465	678.563	3,821.812
G=C*D	Grower Cost[b,c]	692.446	505.104	651.591	639.726	650.845	3,139.712
		PS/box					
H	FCOJ Juice Yields[d]	6.555	6.790	6.432	6.567	6.573	6.600
		SSE gallons per box					
I=H/1.029		6.371	6.599	6.251	6.382	6.388	6.414
		million SSE gallons[e]					
J		1,486.8	1,154.6	1,422.4	1,357.1	1,415.2	6,836.100
		$ per SSE gallon					
K=E/J	Delivered-In Price[a]	.86	.98	.87	.81	.80	.86
L=F/J	On-Tree Price[a]	.58	.70	.57	.50	.48	.56
M=G/J	Grower Cost[b,c]	.47	.44	.46	.47	.46	.46
N=L-M	Grower Return	.11	.26	.11	.03	.02	.10

[a]FASS, "Citrus Summary 2001-02."

[b]Ron Muraro, "Budgeting Costs and Returns for Central Florida Citrus Production, 2001-02, 2000-01, 1999-00, 1998-99, and 1997-98."

[c]Cultural, management and interest costs.

[d]FCPA.

[e]Includes production from FCOJ and NFC; hence, juice production does not exactly equal processed boxes times FCOJ SSE gallons per box since NFC yields are slightly different than FCOJ yields.

Table 6. Florida round-orange acreage and tree numbers by commercial inventory.

Year of Inventory	Number of Acres	% Change from Previous Acre Inventory	Number of Trees	% Change from Previous Tree Inventory
	- thousand -	- - % - -	- million -	- - % - -
1966	695.8	–	53.8	–
1968	713.4	2.5	56.6	5.2
1970	715.8	.3	57.8	2.1
1972	659.4	-7.9	53.7	-7.0
1974	642.4	-2.6	52.5	-2.3
1976	628.6	-2.1	51.6	-1.8
1978	616.0	-2.0	50.8	-1.5
1980	627.2	1.8	52.0	2.2
1982	636.9	1.5	53.5	2.9
1984	574.0	-9.9	49.9	-6.8
1986	466.3	-18.8	43.5	-12.9
1988	536.7	15.1	54.5	25.5
1990	564.8	5.2	62.6	14.9
1992	608.6	7.8	72.8	16.3
1994	653.4	7.4	81.6	12.1
1996	656.6	.5	84.2	3.1
1998	658.4	.3	85.4	1.5
2000	665.5	1.1	87.2	2.1
2002	648.8	-2.5	85.8	-1.7

SOURCE: Florida Agricultural Statistics Service, *Commercial Citrus Inventory*, various issues.

Table 7. FDOC orange juice household GRPs (TV).

Year	Q1 (JFM)	Q2 (AMJ)	Q3 (JAS)	Q4 (OND)	TOTAL	% Change from Previous Year	July-June Fiscal Year	GRPs
1996	NA	NA	528	1,727	2,255	NA	NA	NA
1997	792	846	418	1,466	3,522	56.2	1996-97	3,893
1998	1,140	892	675	996	3,703	5.1	1997-98	3,916
1999	1,102	460	705	1,090	3,357	-9.3	1998-99	3,233
2000	1,646	225	1,071	1,227	4,169	24.2	1999-00	3,666
2001	1,456	360	66	0	1,882	-54.9	2000-01	4,114
2002	1,648	1,258	681	882	4,469	137.5	2001-02	2,972

Table 8. FDOC processed orange media expenditures and GRPs.

Item	Fiscal Year					TOTAL
	1997-98	1998-99	1999-00	2000-01	2001-02	
	million $					
Media Production	1.720	1.396	1.164	1.125	2.049	7.454
Music Copyright	0.000	0.000	0.000	0.000	0.385	0.385
Media/National	13.461	11.818	13.933	15.491	18.614	73.317
Agency	2.000	1.900	1.900	1.900	1.900	9.600
TOTAL	17.181	15.114	16.997	18.516	22.948	90.756
	GRPs					
FDOC OJ GRPs[a]	3,916	3,233	3,666	4,114	2,972	17,901
	$ per GRP					
Cost Per GRP	4,387	4,675	4,636	4,501	7,721	5,070

[a]TV.

Table 9. Estimated benefit-cost ratios for FDOC advertising, 1997-98 through 2001-02, assuming constant prices.

Row	Item	Scenario		
		Low[a]	Middle[b]	High[c]
		------------ $ per SSE gallon -----------		
A	Average Delivered-In Priced	0.860	0.860	0.860
		------------- million gallons ------------		
B	Gallons Generated by Advertising	162.8	325.7	488.5
		--------------- million $ --------------		
C=A*B	$ Generated by Advertising	140.0	280.0	420.0
D	FDOC Cost	90.8	90.8	90.8
		---------------- B/C[d] ----------------		
E=C/D	Benefit-Cost Ratio	1.54	3.09	4.63

[a]50% below middle scenario (roughly 2 standard deviations).
[b]Based on regression model.
[c]50% above middle scenario (roughly 2 standard deviations).
[d]Dollar benefits per one dollar of advertising.

Table 10. Florida OJ production, imports, movement and inventories, With versus Without FDOC advertising.

Item	Season					
	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03
ACTUAL: With Advertising						
	million SSE gallons					
Beginning Inventory	545.9	629.8	511.6	618.4	670.4	661.7
Production	1,486.8	1,154.6	1,422.4	1,357.1	1,415.2	1,194.0
Imports & Misc. Supplies	165.3	192.7	167.3	184.5	129.5	188.9
Availability	2,198.0	1,977.1	2,101.3	2,160.0	2,215.0	2,044.6
Movement	1,568.2	1,465.5	1,482.9	1,489.6	1,553.3	1,451.8
Ending Inventory	629.8	511.6	618.4	670.4	661.7	592.8
	weeks supply					
Carryover	20.9	18.2	21.7	23.4	22.2	21.2
ESTIMATED: Without Advertising, Constant Prices						
	million SSE gallons					
Beginning Inventory	545.9	694.9	641.9	813.8	930.9	987.5
Production	1,486.8	1,154.6	1,422.4	1,357.1	1,415.2	1,194.0
Imports & Misc. Supplies	165.3	192.7	167.3	184.5	129.5	188.9
Availability	2,198.0	2,042.2	2,231.6	2,355.4	2,475.6	2,370.4
Movement With Advertising	1,568.2	1,465.5	1,482.9	1,489.6	1,553.3	1,451.8
Loss Without Advertising	-65.1	-65.1	-65.1	-65.1	-65.1	-65.1
Movement Without Advertising	1,503.1	1,400.4	1,417.8	1,424.5	1,488.2	1,386.7
Ending Inventory	694.9	641.9	813.8	930.9	987.5	983.7
	weeks supply					
Carryover	24.0	23.8	29.8	34.0	34.5	36.9
Increase in Weeks Supply	%					
Without Advertising	15.0	31.0	37.6	45.2	55.4	74.0

Table 11. Potential price decline without FDOC advertising and benefit-cost ratios.[a]

Row	Item	U.S. Net Importer Elasticity Assumption		U.S. Self Sufficient
		Present Study	FABA/Past Studies	
		-------- $ per SSE gallon --------		
A	Average Delivered-In Price With Advertising	0.86	0.86	0.86
B	Potential Price Decrease[b]	-0.10	-0.06	-0.29
C=A+B	Grower Return Without Advertising	0.76	0.80	0.57
		----- million SSE gallons per year ----		
D	5-Year Average Florida OJ Production	1,367.0	1,367.0	1,367.0
		-------- million $ per year -------		
E=A*D	Grower Return With Advertising	1,175.3	1,175.3	1,175.3
F=C*D	Grower Return Without Advertising	1,035.0	1,096.7	780.3
G=E-F	Advertising Benefit Per Year	140.3	78.6	394.9
H	Cost of Advertising Per Year	18.2	18.2	18.2
		----------- B/C[c] -----------		
I=G/H	Benefit-Cost Ratio	7.7	4.3	21.8

[a]Short-run impacts: assumes inventories in balance; excludes long-run-supply adjustments due to planting responses to price changes, growers exiting/entering the industry, weather-related supply shifts, and fresh-processed utilization changes.
In the long-run, price declines resulting from lack of advertising may result in reduced plantings, perhaps some growers going out of business and reduced OJ production, relieving the downward pressure on prices estimated.

[b]Based on following world excess demand-excess supply model:

U.S. Excess Demand = q1-Q1;
RW Excess Supply = Q2-q2;
Equilibrium: Excess Demand = Excess Supply or q1-Q1 = Q2-q2;

Q1 = U.S. OJ Production
Q2 = Rest of World (RW) OJ Production;
q1(p+t,a) = U.S. OJ Demand as a function of p and a;
p = FOB Santos price;
t = tariff plus transportation cost;
p+t = U.S. FOB price;
a = U.S. advertising;
q2(p) = RW OJ Demand as a function of p;

Differentiating the equilibrium condition, assuming Q1 and Q2 fixed, yields:

$(\partial p1/\partial p)dp+(\partial q1/\partial a)da = -(\partial q2/\partial p)dp$, or, solving for dp,
$dp = -(\partial q1/\partial a)da / (\partial q1/\partial p + \partial q2/\partial p)$;
$(\partial q1/\partial a)da = -73$ million gallons per year;
$\partial q1/\partial p = 101$ or 253 million gallons decrease per dollar price increase per year (and vice versa);
$\partial q2/\partial p = 612$ or 1,020 million gallons decrease per dollar price increase per year (and vice versa);
(In general for variables x and y, $\partial y/\partial x$ is the change in y for one unit change in x; dx is the change in x).

[c]Dollar benefits per one dollar of advertising.

Table 12. Estimates of quantity/price OJ demand slopes in U.S. and Rest-of-World markets.

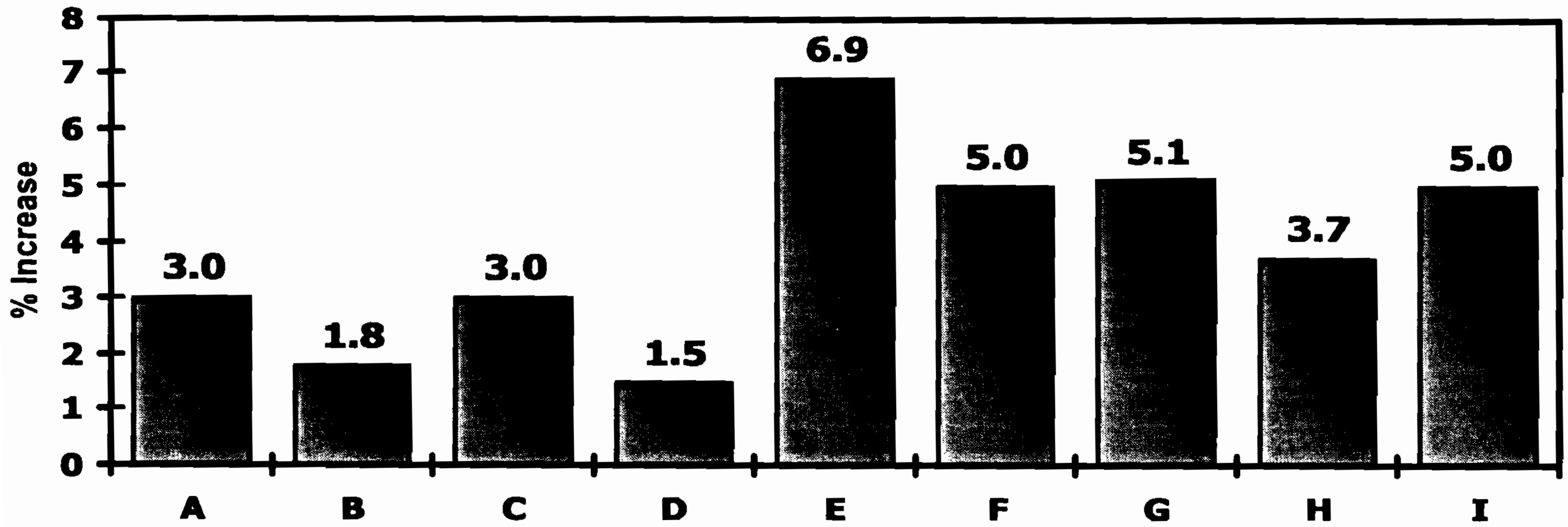
Market	q Quantity	p Price[a]	Price Elasticity[b]		Price Slope[c]	
			Present Study	FABA/Past FDOC Studies	Present Study	FABA/Past FDOC Studies
	mil. SSE gal.	$/SSE gal.	---- $(\partial q/\partial p)(p/q)$ ----		--- mil. SSE gal./ $ ---	
U.S.	1,538	4.25	-0.28	-0.70	-101	-253
RW[d]	1,835	0.90	-0.30	-0.50	-612	-1,020
TOTAL[d]	3,373	NA	NA	NA	-713	-1,273

[a]Retail price for U.S.; Rotterdam bulk FCOJ price for RW.
[b]At retail level for U.S.; at Rotterdam FOB level for RW.
[c] $\partial q/\partial p$.
[d]USDA(FAS), "World Horticultural Trade and U.S. Export Opportunities," August 2002:

World OJ Supply, Movement & Inventory

Item	1999-00	2000-01	2001-02	Average
	------------ 65° Brix MT ------------			
Beginning Inventory	770,904	771,224	592,142	711,423
Production	2,489,336	2,134,067	2,472,554	2,365,319
Availability	3,260,240	2,905,291	3,064,696	3,076,742
Movement	2,489,016	2,313,149	2,464,887	2,422,351
Ending Inventory	771,224	592,142	599,809	654,392
	---------- million SSE gallons ----------			
Movement	3,466	3,221	3,433	3,373

Figure 1. Percent Increase in OJ Demand Due to FDOC Advertising



Time Period		STUDY
1987-92	A	Lee, J.L, "The Impacts of Generic Advertising on the Demand for Orange Juice and Grapefruit Juice," FDOC-EMRD Staff Report 93-5, 05/20/93.
1992-96	B	Brown, M.G., "Advertising Impacts Under Constant-Price Vs. Constant-Quantity Assumptions: A Case Study of the Impact of Generic OJ Advertising," FDOC-EMRD Staff Report 96-12, 12/04/96.
1992-96	C	Brown, M.G., and J.Y. Lee, "Incorporating Generic and Brand Advertising Effects in the Rotterdam Demand System," *Int'l. J. of Adv.*, Vol. 16, No. 3, pp. 211-220, 1997.
1993-94	D	Brown, M.G., J.Y. Lee, and T.H. Spreen, "The Impact of Generic Advertising and the Free Rider Problem: A Look at the U.S. OJ Market and Imports," *Agribusiness*, Vol. 12, No. 4, pp. 309-316, July/Aug. 1996.
1996-97	E	Brown, M.G., and J.Y. Lee, "Health and Nutrition Impacts on the Demand for OJ in 50 Metropolitan Regions," *J. of Food Products Marketing*, Vol. 5, No. 3, pp. 31-47, 1999.
1997-00	F	Brown, M.G., "Generic Advertising Impact on Demand for OJ," FDOC-EMRD Staff Report 2001-6, 04/30/01.
1997-01	G	Brown, M.G., "Advertising Impacts on Demand for OJ, January 2002," FDOC-EMRD Staff Report 2002-2, 03/05/02.
1997-01	H	Brown, M.G., "Advertising Impacts on Demand for OJ, January 2002," FDOC-EMRD Staff Report 2002-2, 03/05/02.
1998-02	I	Brown, M.G., PRESENT STUDY.

References

ACNielsen. Data provided to the Florida Department of Citrus. Atlanta, Georgia.

Brown, M., J. Lee. and T. Spreen (1996). "The Impact of Generic Advertising and the Free Rider Problem: A look at the U.S. Orange Juice Market and Imports." *Agribusiness, An International Journal* 12(4) July/August:309-316.

Brown, M., and J. Lee (1997). "Incorporating Generic and Brand Advertising Effects in the Rotterdam Demand System." *International Journal of Advertising* 16:211-220.

Brown, M., and J. Lee (1999). "Health and Nutrition Advertising Impacts on the Demand for OJ in Fifty Metropolitan Regions."*Journal of Food Products Marketing,* vol. 5: 31-47.

Florida Agricultural Statistics Service (2003). *Citrus Summary 2001-02*. Orlando, Florida.

Florida Agricultural Statistics Service (2002). *Commercial Citrus Inventory 2002*, and previous reports. Orlando, Florida.

Florida Citrus Processors Association. Various reports. Winter Haven, Florida.

Florida Department of Citrus. *Annual Financial Report*, various years. Lakeland, Florida.

Florida Department of Citrus, Economic and Market Research Department (2002). *Citrus Reference Book*. Lakeland, Florida.

Florida Department of Citrus, Economic and Market Research Department. Various Staff Reports. University of Florida, Food and Resource Economics Department, Gainesville Florida.

Forecasting and Business Analytics, LLC (2003a). Report to the Florida Department of Citrus: *Evaluating the Economic Impacts Associated with Advertising Efforts of the Florida Department of Citrus (FDOC) on the Retail Demand for Orange Juice*. March. College Station, Texas.

Forecasting and Business Analytics, LLC (2003b). Report to the Florida Department of Citrus: *Returns to Florida Orange Growers from Orange Juice Advertising by the Florida Department of Citrus (Objective 2 & 3)*. April. College Station, Texas.

Muraro, R (2002). *Budgeting Costs and Returns for Central Florida Citrus Production, 2001-2*, and various previous report. University of Florida, Food and Resource Economics Department, Gainesville, Florida.

The Richards Group (2002). Data provided to the Florida Department of Citrus, Houston, Texas.

United States Department of Agriculture, Foreign Agricultural Service (2002). *Horticultural Trade and U.S. Export Opportunities*. August.