NEWP

WP 42

NE-165 PSPPFS

PRIVATE STRATEGIES, PUBLIC POLICIES & FOOD SYSTEM PERFORMANCE

Estimating Brand Level Demand Elasticities and Measuring Market Power for Regular Carbonated Soft Drinks

by

Glenn E. Langan* and Ronald W. Cotterill*

WP - 42 August 1994

WORKING PAPER SERIES

A Joint USDA Land Grant University Research Project

Estimating Brand Level Demand Elasticities and Measuring Market Power for Regular Carbonated Soft Drinks

by

Glenn E. Langan* and Ronald W. Cotterill*

WP - 42 August 1994

* Graduate student and Professor and Director, Food Marketing Policy Center, Department of Agricultural and Resource Economics, University of Connecticut, Storrs, CT 06269-4021.

Estimating Brand Level Demand Elasticities and Measuring Market Power for Regular Carbonated Soft Drinks

Glenn E. Langan and Ronald W. Cotterill*

* Glenn E. Langan is a graduate assistant and Ronald W. Cotterill is the Director of the Food Marketing Policy Center; both are in the Department of Agricultural and Resource Economics, University of Connecticut, Storrs. This research was supported by USDA Grant No. 91-34178-6330.

Abstract

This paper reports econometric estimation of brand level demand (AIDS) elasticities for regular carbonated soft drinks using Information Resources, Inc. panel data. Own and cross price elasticities are used to measure actual and hypothetical market power that would arise from potential mergers or collusive pricing arrangements.

Introduction

Industrial organization economists have long appreciated the fact that brand level elasticities of demand have something to say about market power in differentiated product industries. The first major empirical effort in this area were the papers by Baker and Bresnahan during the 1980s (Baker and Bresnahan 1985, 1987). Baker and Bresnahan proposed a residual demand analysis framework. Within that framework they estimated residual demand elasticities for particular products in a differentiated product industry (beer). They were thus able to analyze own and cross price elasticities between two or three key products of interest, in this case Anheuser-Busch, Coors and Pabst beer, to determine the impact of a hypothetical merger upon prices and profits.

In this paper we propose to go beyond the residual demand framework to estimate the complete set of brand level demand own and cross price elasticities. Using Information Resources, Inc. (IRI) data for regular carbonated soft drinks for the period 1988 through 1990 we are able to construct a balanced panel data set that allows us to estimate own and cross price elasticities for eight carbonated soft drink brands and private label soft drinks. The demand framework that we will use is the Almost Ideal Demand System (AIDS). This framework is particularly useful for researchers with an industrial organization perspective because it uses as a dependent variable market share. The hypothesis within the demand framework is that there is a negative relationship between market share and price and this, in fact, measures a demand relationship[1].

---

[1]Considerable prior research on the relationship between market share and price has reported that a positive share price relationship exists and that it is evidence of the existence of market power. For manufactured food products see Wills (1985). Recent work by Cotterill and Haller (1994) resolves the apparent contradiction between these approaches explaining that the positive share price relationship is primarily an interfirm effect and that across local market and time for a particular brand the share price relationship is negative reflecting demand factors. Also see Haller (1994) for supporting evidence from the catsup industry.

The next section of this paper briefly presents the AIDS model that is used in the analysis. The third section discusses the variables used, relevant econometric issues, and empirical results. The fourth section, a discussion of related market power issues, is followed by conclusions.

The AIDS Model and Description of Data

The AIDS was developed by Deaton and Muellbauer out of a desire to increase the quality and ease of modeling consumer demand. The AIDS uses the following expenditure function:

$$\log c(u,p) = (1-u)\log a(p) + u \log b(p), \tag{1}$$

where u and **p** represent utility and prices, respectively. This expenditure function indirectly (via duality) represents a class of price-independent, generalized linear preferences (PIGLOG) which allow for exact aggregation over consumers. Flexible functional forms are chosen for log *a(p)* and log *b(p)* such that the expenditure function can be written as

$$\log c(u,p) = \alpha_0 + \sum_k \alpha_k \log p_k + \frac{1}{2}\sum_k \sum_j \gamma^*_{kj} \log p_k \log p_j + u\beta_0 \prod_k p_k^{\beta_k}. \tag{2}$$

Equation (2) is homogeneous of degree 1 in **p**, as theory requires, as long as

$$\sum_i \alpha_i = 1, \quad \sum_j \gamma^*_{kj} = \sum_k \gamma^*_{kj} = \sum_j \beta_j = 0.$$

Taking the logarithmic differentiation of (2), applying Shepherd's lemma, and substituting for u in terms of **p** and expenditures (x) results in the following AIDS demand functions:

$$w_i = \alpha_i + \sum_j \gamma_{ij} \log p_j + \beta_i \log(x/P), \tag{3}$$

where w_i represents budget shares and log P equals

$$\log P = \alpha_0 + \sum_k \alpha_k \log p_k + \frac{1}{2}\sum_j \sum_k \gamma_{kj} \log p_k \log p_j \ . \tag{4}$$

In most applications linearly approximated AIDS models (LA/AIDS) are used (e.g., Wessels and Wilen, 1992) in which the log of the price index is approximated by summing the products of budget shares and respective logged prices as represented by

$$\log P = \sum_i w_i \log p_i . \tag{5}$$

The AIDS model conveniently allows for imposition of restrictions; namely, adding-up,

$$\sum_i \alpha_i = 1, \quad \sum_i \gamma_{ij} = 0, \quad \sum_i \beta_i = 0 ,$$

homogeneity,

$$\sum_j \gamma_{ij} = 0 ,$$

and symmetry,

$$\gamma_{ij} = \gamma_{ji} .$$

The adding-up restriction is guaranteed by construction of the data, i.e. the sum of the budget shares of all the goods must equal one. Homogeneity and symmetry can both be tested by comparing the results of the restricted model with that of the unrestricted model. Restrictions cannot be imposed to guarantee the remaining general restriction of demand equations, i.e. nonpositivity of the substitution effect, but this can be checked by examining the eigenvalues of the Slutsky matrix (Deaton and Muellbauer).

The estimated coefficients on the price variables indicate the effect on budget shares (multiplied by 100) of a one percent change in the price of a given good, assuming (x/P) is held constant. The effect of changes in real expenditures on budget shares is indicated by the coefficient on (x/P). A coefficient greater than zero implies a luxury good, whereas necessities are associated with a negative coefficient.

Econometric Estimation and Empirical Results

The demand for nine regular carbonated soft drink groups, namely Coca Cola, Pepsi, RC, Sprite, 7 Up, Dr. Pepper, and Mountain Dew, a combined "All Other" brand, and a combined private label brand is analyzed using the LA/AIDS. Data on prices, quantities sold, and some promotional activities were obtained through IRI. IRI collects data by electronically recording the food purchases of customers at several thousand supermarket stores across the nation over time. The data is then averaged for a given geographic market. Data used in this paper is on a quarterly basis for the years 1988 through 1990 for 45 metropolitan areas. IRI data is supplemented with relevant data (e.g. population, temperature) for these same marketing areas from other sources.

In order to account for the panel structure of our data an error components or random effects model was used for econometric estimation (Judge, *et al.* p. 475; SHAZAM). The error components approach used for the study allows the disturbance term to consist of random and cross sectional components. A plot of residuals over time suggested no clear pattern. Hence, time binaries were not factored into the error components computations. The error components approach incorporates information from cross section binaries into the final parameter estimates but are not reported in the final regressions, thus economizing on variables and making the interpretation of regression results more manageable.

Brand prices are endogenous variables in a differentiated product industry. Therefore, a three-stage least squares estimation technique was used to reflect this endogeneity and to take advantage of information in the error variance-covariance matrix of the system of equations.

A system of 17 equations are estimated in which the first eight equations are the AIDS share equations and the remaining nine equations regress brand prices on a host of variables, including other brand prices. An illustration of the system of equations is provided in figure 1. Tables 1 and 2 provide a list of variables and descriptive statistics for variables used in the study.

Coke, Pepsi and All Other brands dominate the budget shares with each having approximately a quarter of total share. Dr. Pepper and Mountain Dew are at the high end of the price range, whereas Private Label, as expected, and RC are at the low end. The larger share soft drinks are associated with moderate prices. Private label brands have noticeably higher units per volume than other brands, suggesting that they market primarily small containers (probably 12 ounce cans).

The percent of volume sold associated with Sunday newspaper feature ads ranges from 6.44 percent (RC) to 13.95 percent (Mountain Dew). A much greater percent of volume sold is associated with supermarket aisle displays with a range between 29.6 percent (All Other) to 68.56 percent (Coke). Coke and Pepsi apparently flex their marketing muscles in this form of promotional activity. These two brands also dominate in terms of national advertising. The leading nationally advertised brand was either Coke or Pepsi in each time period of the study.

Temperature, Supermarket to Grocery Sales ratio, Market CR4, Sweetner, and Population are all variables that do not vary by brand but generally vary by cross section and over time. The captivity variables reflect whether the Coca Cola or Pepsi companies own the bottling company for their brands in a given market. Other than the Coca Cola and Pepsi brands this variable is only relevant for Sprite (Coca Cola Co.) and Mountain Dew (Pepsi Co.).

The All Other brand was not included in the initial estimation in order to avoid a singular matrix problem. This problem occurs because of the relationship between the adding-up feature of budget shares and the constant term. The coefficients for "All Other" are obtained after estimation by using the adding-up conditions.

Regression results are presented in table 3. Own price coefficients are significantly negative for most brands. Cross price coefficients are symmetric due to the imposition of symmetry restrictions. In the Coke equation we observe a positive cross price effect with Sprite. The result for the Sprite brand, owned by the Coca Cola company, may be due to complementary positioning of this brand *vis a vis* the Coke brand. This complementary positioning does not occur in the case of Pepsi and Mountain Dew (both owned by PepsiCo, Inc.). Positive cross price effects on Pepsi shares are found for all brands.

Own and cross price elasticities are presented in table 4. For each brand the own price elasticities are negative and significant. Cross price elasticities suggest the presence of both substitution and complementarity among soft drinks.

Measuring Market Power

The data found in table 4 is a rich source of information for economic analysis. For example, one can estimate the impact of market power and collusive pricing among firms by examining own and cross price elasticities. Let us use 1988 data (IRI) for Coke as an example. At an average price of $3.73 Coca Cola sold 338.7 million 192-ounce units of Coke nationwide. The Coca Cola company profit margin was 12.4 percent in 1988 (Tollison *et al.* p. 34). Assuming that rate holds for the Coke brand profits in 1988 are $155.8 million. This is shown as areas A and B in figure 2a. If Coke raises its price by ten percent to $4.10 the quantity demanded decreases, *ceteris paribus*, by 14.96 percent (50.7 million units) as suggested by Coke's own price elasticity figure of -1.496. Coke's profit is now $239.0 million and appears as areas A and C. In this case Coke exhibits power underneath its demand curve because higher prices lead to higher profits.

If we consider a hypothesized fully collusive pricing arrangement between Coke and Pepsi (each raise price 10 percent) we must now factor in the cross price elasticity between Coke and Pepsi which is 0.355. The impact of the joint pricing arrangement will decrease Coke's elasticity measure by the amount of the positive cross price elasticity, from -1.496 to -1.141. A ten percent price increase will result in a quantity demanded of 300.1 million units as compared to 288.0 million. Coca Cola's demand curve becomes steeper and its profitability (area D in figure 2b) increases to $249.1 million as a result of the collusive arrangement.

The Coke demand curve becomes steeper as more Coke substitutes are included in the collusive pricing arrangement. If Coke colludes on price with all non-Coca Cola brands the net elasticity for Coke is -1.073. A ten percent price increase results in 302.4 million units demanded and profitability of $251.0 million (area E in figure 2c).

The change in profitability between collusive and noncollusive pricing arrangements is not as large as one might expect. It suggests that nearly all of Coke's market power is unilateral and not coordinated market power. We should also note that the calculated profitability change is only with respect to Coke's profits and does not include the changes in the other brands' profits. Tacit collusion may benefit less dominant brands more than Coke. Finally, we continue to explore the sensitivity of our results to model specification.

Table 5 indicates that many soft drink prices, especially Coke and Pepsi prices, are highly correlated. These high correlations do not confirm the existence of collusive pricing but do suggest that the possibility exists and points to a need for further investigation.

Conclusions

IRI data and demand theory provide powerful insights into the marketing strategies of individual branded products. One can estimate demand elasticities and use these to measure actual market power and hypothetical market power that would arise from particular mergers, collusive pricing or other marketing strategies.

As research limitations, such as availability of brand level data and theoretical shortcomings, are reduced greater insights will be achieved. Equipped with better tools industrial organization economists will better understand how markets work.

Figure 1. System of Demand and Price Equations, Regular Carbonated Soft Drinks

$$Shr_{Coke} = \alpha_0 + \alpha_1 P_{Coke} + \alpha_2 P_{Pepsi} + \alpha_3 P_{RC} + \alpha_4 P_{Sprite} + \alpha_5 P_{7Up} + \alpha_6 P_{DrPep} + \alpha_7 P_{MtDew} + \alpha_8 P_{PrivLab} + \alpha_9 P_{AllOther} + \alpha_{10} ExpenditureX + \alpha_{11} Feature_{Coke} + \alpha_{12} Display_{Coke} + \alpha_{13} RelTVAdv_{Coke} + \alpha_{14} Temperature$$

$$Shr_{Pepsi} = \beta_0 + \beta_1 P_{Coke} + \beta_2 P_{Pepsi} + \beta_3 P_{RC} + \beta_4 P_{Sprite} + \beta_5 P_{7Up} + \beta_6 P_{DrPep} + \beta_7 P_{MtDew} + \beta_8 P_{PrivLab} + \beta_9 P_{AllOther} + \beta_{10} ExpenditureX + \beta_{11} Feature_{Pepsi} + \beta_{12} Display_{Pepsi} + \beta_{13} RelTVAdv_{Pepsi} + \beta_{14} Temperature$$

$$Shr_{RC} = \gamma_0 + \gamma_1 P_{Coke} + \gamma_2 P_{Pepsi} + \gamma_3 P_{RC} + \gamma_4 P_{Sprite} + \gamma_5 P_{7Up} + \gamma_6 P_{DrPep} + \gamma_7 P_{MtDew} + \gamma_8 P_{PrivLab} + \gamma_9 P_{AllOther} + \gamma_{10} ExpenditureX + \gamma_{11} Feature_{RC} + \gamma_{12} Display_{RC} + \gamma_{13} RelTVAdv_{RC} + \gamma_{14} Temperature$$

.
.
.

$$[Shr_{AllOther} = \delta_0 + \delta_1 P_{Coke} + \delta_2 P_{Pepsi} + \delta_3 P_{RC} + \delta_4 P_{Sprite} + \delta_5 P_{7Up} + \delta_6 P_{DrPep} + \delta_7 P_{MtDew} + \delta_8 P_{PrivLab} + \delta_9 P_{AllOther} + \delta_{10} ExpenditureX + \delta_{11} Feature_{AllOther} + \delta_{12} Display_{AllOther} + \delta_{13} RelTVAdv_{AllOther} + \delta_{14} Temperature]$$

$$P_{Coke} = \kappa_0 + \kappa_1 Shr_{Coke} + \kappa_2 P_{Pepsi} + \kappa_3 P_{RC} + \kappa_4 P_{Sprite} + \kappa_5 P_{7Up} + \kappa_6 P_{DrPep} + \kappa_7 P_{MtDew} + \kappa_8 P_{PrivLab} + \kappa_9 P_{AllOther} + \kappa_{10} ExpenditureX + \kappa_{11} Temperature + \kappa_{12} Feature_{Coke} + \kappa_{13} Display_{Coke} + \kappa_{14} Unit/Vol_{Coke} + \kappa_{15} RelTVAdv_{Coke} + \kappa_{16} SupMkt/GrocSale + \kappa_{17} MktCR4 + \kappa_{18} Population + \kappa_{19} Sweetner + \kappa_{20} CokeCaptive$$

$$P_{Pepsi} = \lambda_0 + \lambda_1 Shr_{Pepsi} + \lambda_2 P_{Coke} + \lambda_3 P_{RC} + \lambda_4 P_{Sprite} + \lambda_5 P_{7Up} + \lambda_6 P_{DrPep} + \lambda_7 P_{MtDew} + \lambda_8 P_{PrivLab} + \lambda_9 P_{AllOther} + \lambda_{10} ExpenditureX + \lambda_{11} Temperature + \lambda_{12} Feature_{Pepsi} + \lambda_{13} Display_{Pepsi} + \lambda_{14} Unit/Vol_{Pepsi} + \lambda_{15} RelTVAdv_{Pepsi} + \lambda_{16} SupMkt/GrocSale + \lambda_{17} MktCR4 + \lambda_{18} Population + \lambda_{19} Sweetner + \lambda_{20} PepsiCaptive$$

$$P_{RC} = \psi_0 + \psi_1 Shr_{RC} + \psi_2 P_{Coke} + \psi_3 P_{Pepsi} + \psi_4 P_{Sprite} + \psi_5 P_{7Up} + \psi_6 P_{DrPep} + \psi_7 P_{MtDew} + \psi_8 P_{PrivLab} + \psi_9 P_{AllOther} + \psi_{10} ExpenditureX + \psi_{11} Temperature + \psi_{12} Feature_{RC} + \psi_{13} Display_{RC} + \psi_{14} Unit/Vol_{RC} + \psi_{15} RelTVAdv_{RC} + \psi_{16} SupMkt/GrocSale + \psi_{17} MktCR4 + \psi_{18} Population + \psi_{19} Sweetner$$

.
.
.

$$P_{AllOther} = \omega_0 + \omega_1 Shr_{AllOther} + \omega_2 P_{Coke} + \omega_3 P_{Pepsi} + \omega_4 P_{RC} + \omega_5 P_{Sprite} + \omega_6 P_{7Up} + \omega_7 P_{DrPep} + \omega_8 P_{MtDew} + \omega_9 P_{PrivLab} + \omega_{10} ExpenditureX + \omega_{11} Temperature + \omega_{12} Feature_{AllOther} + \omega_{13} Display_{AllOther} + \omega_{14} Unit/Vol_{AllOther} + \omega_{15} RelTVAdv_{AllOther} + \omega_{16} SupMkt/GrocSale + \omega_{17} MktCR4 + \omega_{18} Population + \omega_{19} Sweetner$$

Table 1. Description of Variables and Related Notes

Shr_{Coke}	the percent of regular carbonated soft drink expenditures spent on Coca Cola
Shr_{Pepsi}	" " " Pepsi
Shr_{RC}	" " " RC
Shr_{Sprite}	" " " Sprite
Shr_{7Up}	" " " 7Up
Shr_{Drpep}	" " " Dr Pepper
Shr_{MtDew}	" " " Mountain Dew
$Shr_{PrivLab}$	" " " Private Label
$Shr_{AllOther}$	" " " All Other Brands
*P*__	natural log of price of ___ brand
ExpenditureX	natural log of (regular carbonated soft drink expenditures divided by a price index*)
Feature__	percent of ___brand's volume sold with feature advertising
Display__	percent of ___brand's volume sold with displays and point of purchase promotions
Unit/Vol__	number of units of ___brand divided by the volume sold of ___brand
RelTVAd__	___brand's national TV advertising as a percent of the leader
Temperature	mean temperature in local market for a given quarter
SupMkt/GrocSale	the percentage of all grocery sales in local market made by supermarkets
MktCR4	percentage of all grocery sales in local market made by top 4 grocery chains
Sweetner	price of most frequently used sweetner during study period (high fructose corn syrup)
Population	population in local market
CokeCaptive	binary variable to indicate a Coca Cola Co.-owned bottler for the local market
PepsiCaptive	binary variable to indicate a Pepsi Co.-owned bottler for the local market

*The price index (P^*) used is Stone's linear approximate price index, $\ln P^* = \Sigma\, Shr_i \cdot \ln P_i$.

Table 2. Descriptive Statistics

Variable	Mean	St.Dev.	Variance	Min	Max
Share:					
Coke	0.249	0.0831	0.0069	0.104	0.496
Pepsi	0.244	0.0616	0.0038	0.089	0.386
RC	0.020	0.0148	0.0002	0.001	0.085
Sprite	0.040	0.0138	0.0002	0.015	0.095
7-Up	0.052	0.0248	0.0006	0.015	0.141
DrPep	0.038	0.0349	0.0012	0.003	0.217
MtDew	0.031	0.0233	0.0005	0.005	0.111
PrivLab	0.076	0.0464	0.0022	0.002	0.264
AllOthr	0.250	0.0702	0.0049	0.107	0.450
Price:					
Coke	3.72	0.3072	0.0943	2.80	4.93
Pepsi	3.66	0.3826	0.1464	2.67	5.46
RC	3.30	0.4187	0.1753	2.25	5.14
Sprite	3.63	0.3130	0.0980	2.79	4.92
7-Up	3.79	0.3593	0.1291	2.85	5.05
DrPep	3.99	0.4245	0.1802	2.85	5.36
MtDew	3.93	0.4210	0.1773	2.86	5.32
PrivLab	2.34	0.2516	0.0633	1.66	3.19
AllOthr	3.60	0.4019	0.1615	2.10	5.01
Feature Ads:					
Coke	6.99	4.999	24.987	0.26	31.84
Pepsi	7.30	5.278	27.862	0.34	40.47
RC	6.44	6.792	46.133	0.00	38.31
Sprite	12.08	7.253	52.606	0.61	44.23
7-Up	7.37	5.981	35.768	0.00	29.54
DrPep	8.48	7.476	55.897	0.00	41.98
MtDew	13.95	9.157	83.847	0.00	60.82
PrivLab	11.98	9.018	81.324	0.00	55.30
AllOthr	12.63	6.395	40.894	0.91	42.48
ExpenditureX	4.45	0.928	0.862	2.48	7.57
Temperature:	58.09	15.605	243.52	18.80	91.64
SpMkt/GrcSale:	77.17	5.977	35.72	64.50	95.30
Market CR4:	62.86	13.580	184.41	23.90	88.10

Variable	Mean	St.Dev.	Variance	Min	Max
Displays:					
Coke	68.56	10.725	115.03	33.70	92.29
Pepsi	68.43	10.238	104.81	32.27	91.95
RC	44.86	20.404	416.32	0.00	88.42
Sprite	54.61	14.141	199.97	12.64	89.75
7-Up	46.55	15.084	227.54	4.58	80.63
DrPep	37.64	20.429	417.36	0.00	85.23
MtDew	39.44	21.422	458.88	0.10	85.15
PrivLab	29.80	14.079	198.21	1.09	68.57
AllOthr	29.63	9.459	89.47	9.48	56.54
Relative National Advertising:					
Coke	0.897	0.1515	0.0229	0.557	1.000
Pepsi	0.843	0.1962	0.0385	0.486	1.000
RC	0.046	0.0426	0.0018	0.003	0.119
Sprite	0.314	0.1488	0.0221	0.028	0.505
7-Up	0.298	0.1644	0.0270	0.095	0.567
DrPep	0.252	0.1348	0.0182	0.013	0.481
MtDew	0.071	0.0536	0.0029	0.001	0.185
PrivLab	---	---	---	---	---
AllOthr	0.015	0.0075	0.0001	0.006	0.032
Units per Volume:					
Coke	2.26	0.330	0.1090	1.16	2.84
Pepsi	2.25	0.333	0.1107	1.10	2.87
RC	2.47	0.363	0.1321	1.29	3.78
Sprite	2.35	0.275	0.0756	1.43	3.35
7-Up	2.52	0.250	0.0627	1.49	3.28
DrPep	2.36	0.289	0.0838	1.27	2.82
MtDew	2.28	0.342	0.1171	1.09	2.85
PrivLab	5.70	2.142	4.5894	2.73	13.24
AllOthr	3.61	0.836	0.6995	2.17	7.10
Sweetner:	20.73	3.092	9.56	14.40	25.50
Population:	3.1E+6	2.9E+6	8.4E+12	6.8E+5	1.6E+7
CokeCaptive:	0.437	0.496	0.246	0.0	1.0
PepsiCaptive:	0.522	0.500	0.250	0.0	1.0

Table 3. Almost Ideal Demand System (AIDS) Estimation Results: Error Components Model (3SLS) with Homogeneity and Symmetry Restrictions.

RHS	Coke Share	Pepsi Share	RC Share	Sprite Share	7Up Share	DrPep Share	MtDew Share	PrivLab Share	AllOthr Share*
Coke Price	-0.1189 (-4.551)[a]	0.0928 (4.553)[a]	0.0161 (1.864)[c]	-0.0218 (-2.645)[a]	0.0203 (2.018)[b]	-0.0015 (-0.176)	-0.0048 (-0.587)	0.0092 (0.976)	0.0085
Pepsi Price	0.0928 (4.553)[a]	-0.2053 (-7.789)[a]	0.0028 (0.330)	0.0137 (1.826)[c]	0.0306 (3.111)[a]	0.0259 (2.978)[a]	0.0195 (1.859)[c]	0.0015 (0.170)	0.0186
RC Price	0.0161 (1.864)[c]	0.0028 (0.330)	-0.0308 (-4.924)[a]	0.0038 (0.949)	0.0089 (1.767)[c]	-0.0028 (-0.608)	0.0077 (1.846)[c]	-0.0161 (-4.579)[a]	0.0105
Sprite Price	-0.0218 (-2.645)[a]	0.0137 (1.826)[c]	0.0038 (0.949)	-0.0098 (-1.230)[c]	0.0021 (0.462)	-0.0005 (-0.127)	0.0019 (0.371)	0.0061 (2.311)[b]	0.0046
7Up Price	0.0203 (2.018)[b]	0.0306 (3.111)[a]	0.0089 (1.767)[c]	0.0021 (0.462)	-0.0465 (-4.282)[a]	-0.0012 (-0.245)	-0.0046 (-1.028)	-0.0107 (-2.578)[a]	0.0013
DrPep Price	-0.0015 (-0.176)	0.0259 (2.978)[a]	-0.0028 (-0.608)	-0.0005 (-0.127)	-0.0012 (-0.245)	-0.0173 (-2.030)[b]	-0.0119 (-2.370)[b]	0.0049 (1.611)	0.0045
MtDew Price	-0.0048 (-0.587)	0.0195 (1.859)[c]	0.0077 (1.846)[c]	0.0019 (0.371)	-0.0046 (-1.028)	-0.0119 (-2.370)[b]	-0.0093 (-0.773)	0.0060 (2.418)[b]	-0.0045
PrivLab Price	0.0092 (0.976)	0.0015 (0.170)	-0.0161 (-4.579)[a]	0.0061 (2.311)[b]	-0.0107 (-2.578)[a]	0.0049 (1.611)	0.0060 (2.418)[b]	0.0053 (0.525)	-0.0061
AllOthr Price	0.0085 (0.764)	0.0186 (1.813)[c]	0.0105 (2.884)[a]	0.0046 (1.594)	0.0013 (0.302)	0.0045 (1.479)	-0.0045 (-1.778)[c]	-0.0061 (-0.659)	-0.0375
Expend index	0.0181 (2.738)[a]	0.0266 (4.418)[a]	-0.0094 (-4.793)[a]	0.0011 (0.708)	-0.0108 (-4.460)[a]	-0.0010 (-0.558)	0.0043 (2.864)[a]	-0.0132 (-2.659)[a]	-0.0157
__Feature	0.0006 (1.846)[c]	0.0005 (1.912)[c]	0.0002 (3.717)[a]	0.3E-04 (0.810)	0.0002 (1.975)[b]	0.0001 (1.286)	0.7E-05 (0.160)	0.0002 (2.266)[b]	
__Display	0.0010 (5.880)[a]	0.0007 (4.472)[a]	0.0001 (6.442)[a]	0.0003 (9.854)[a]	0.0002 (3.296)[a]	0.0002 (7.187)[a]	0.0002 (5.836)[a]	0.0005 (6.658)[a]	
__RelTVAd	0.0223 (3.920)[a]	0.0020 (0.611)	-0.0110 (-1.646)[c]	0.0041 (3.318)[a]	-0.0062 (-3.898)[a]	0.0096 (6.186)[a]	-0.0108 (-3.256)[a]	--- ---	
MeanTemp	-0.0004 (-6.575)[a]	-0.0005 (-8.146)[a]	0.9E-05 (0.382)	0.6E-05 (0.394)	-0.0002 (-7.468)[a]	-0.5E-04 (-2.603)[a]	0.4E-04 (2.424)[b]	0.0002 (4.895)[a]	
Constant	0.1847 (11.33)[a]	0.2039 (12.88)[a]	0.0066 (2.263)[b]	0.0243 (8.052)[a]	0.0586 (13.46)[a]	0.0343 (7.124)[a]	0.0259 (6.752)[a]	0.0511 (6.687)[a]	

[a] = significant at the .01 level
[b] = significant at the .05 level
[c] = significant at the .10 level

*Coefficients for All Other category were obtained by using the adding-up condition of the AIDS model.

Table 4. Own and Cross Price Elasticities for Regular Carbonated Soft Drinks[1]

	Coke	Pepsi	RC	Sprite	7Up	DrPep	MtDew	PrivLab	AllOther
Coke	-1.496**	0.355**	0.063+	-0.090**	0.078+	-0.009	-0.021	0.031	0.016
Pepsi	0.353**	-1.868**	0.009	0.052+	0.120**	0.102**	0.076+	-0.002	0.049
RC	0.909*	0.251	-2.508**	0.205	0.457+	-0.121	0.394+	-0.758**	0.636**
Sprite	-0.555**	0.338+	0.095	-1.248**	0.051	-0.015	0.047	0.151*	0.108
7Up	0.440*	0.637**	0.172+	0.048	-1.881**	-0.015	-0.083	-0.190*	0.077
DrPep	-0.032	0.685**	-0.073	-0.013	-0.030	-1.453**	-0.313*	0.131	0.125
MtDew	-0.186	0.598+	0.247+	0.056	-0.158	-0.393*	-1.307**	0.183*	-0.179*
PrivLab	0.163	0.062	-0.207**	0.086*	-0.132*	0.071+	0.083**	-0.918**	-0.037
AllOther[2]	0.050	0.090*	0.044**	0.021+	0.009	0.020+	-0.016	-0.020	-1.134**

[1] Elasticities are read from left to right;
** = 1 % significance level
* = 5 % significance level
+ = 10 % significance level

[2] t statistics for "All Other" are approximated in that covariances between expenditure and price coefficients are not accounted for in calculating standard errors of the elasticities. These approximations are reasonable because the covariances between expenditure and price coefficients for the other brands are quite small (the significance levels in these other equations do not change if these covariances are excluded in the calculation of the standard errors of the elasticities).

Source: University of Connecticut, Food Marketing Policy Center; Computations from IRI Infoscan data base.

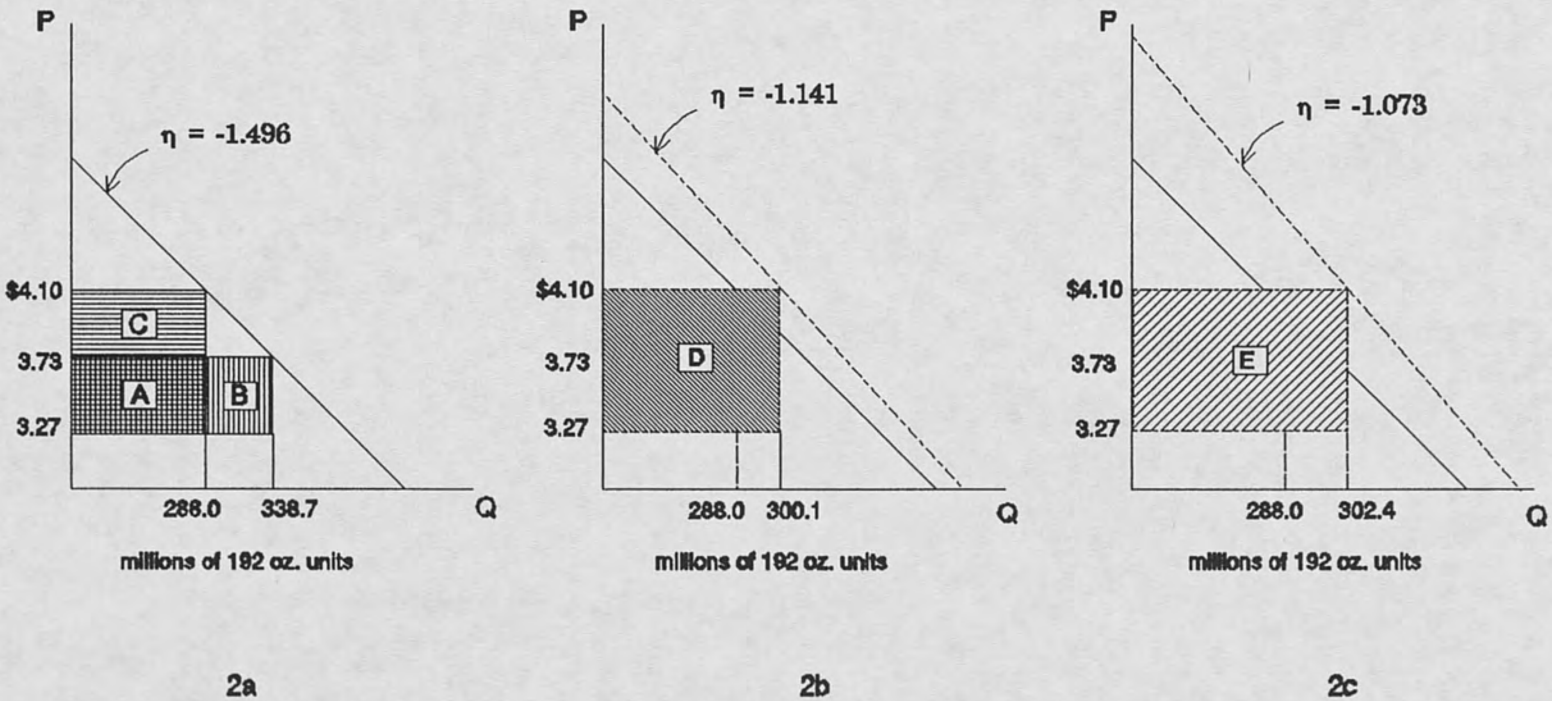

Figure 2. Coke profitability under different collusive arrangements

Table 5. Correlation Matrix of Regular Carbonated Soft Drink Prices, 1988 - 1990

	Coke	Pepsi	RC	Sprite	7-Up	DrPep	MtDew	PrivLab	AllOthr
Coke	1.000								
Pepsi	0.815	1.000							
RC	0.437	0.458	1.000						
Sprite	0.794	0.652	0.364	1.000					
7-Up	0.694	0.663	0.482	0.689	1.000				
DrPep	0.626	0.681	0.624	0.579	0.670	1.000			
MtDew	0.726	0.890	0.460	0.642	0.644	0.712	1.000		
PrivLab	0.047	0.124	0.288	0.058	0.052	0.088	0.126	1.000	
AllOthr	0.659	0.657	0.538	0.575	0.590	0.609	0.608	0.209	1.0000

References

Baker, J.B. and T.F. Bresnahan. "The Gains From Merger or Collusion in Product-Differentiated Industries." *Journal of Industrial Economics*. 33(4)(1985):427-443.

______. "Estimating the Residual Demand Curve Facing a Single Firm." *International Journal of Industrial Organization*. 6(1988):283-300.

Chalfant, J.A. "A Globally Flexible, Almost Ideal Demand System." *Journal of Business and Economic Statistics*. 5(1987):233-242.

Cotterill, R.W. and L.E. Haller. Marketing Strategies in Branded Dairy Product Markets. In *Competitive Strategy Analysis for Agricultural Marketing Cooperatives*, ed. R.W. Cotterill, 99-144. Boulder, Co.:Westview Press. forthcoming 1994.

Deaton A. and J. Muellbauer. "An Almost Ideal Demand System." *American Economic Review*. 70(1980):312-36.

Green, R. and J.M. Alston. "Elasticities in AIDS Models." *American Journal of Agricultural Economics*. 72(1990):442-445.

Haller, Lawrence E. *Branded Product Pricing Strategies in the Catsup and Cottage Cheese Industries: The Effects of Brand Share and Cooperative Presence*, unpublished Ph.D. dissertation, University of Connecticut, 1994.

Information Resources Incorporated. Infoscan data, 1988-90, Food Marketing Policy Center, University of Connecticut.

Judge, G.E., R.C. Hill, W.E. Griffiths, H. Lütkepohl and T.C. Lee. *Introduction to the Theory and Practice of Econometrics*. New York: John Wiley and Sons, 1988.

Leading National Advertisers. *Class/Brand Year-to-Date*. New York: 1988, 1989, 1990.

SHAZAM User's Reference Manual Version 7.0. New York: McGraw-Hill, 1993.

Tollison, R.D., D.P. Kaplan and R.S. Higgins. *Competition and Concentration: The Economics of the Carbonated Soft Drink Industry*. New York: Lexington Books, 1991.

Wessels, C.R. and J.E. Wilen. "Economic Analysis of Japanese Household Demand for Salmon," URI/OSU Research Paper Series. University of Rhode Island, Kingston, RI, 1992.

Wills, R. L. "Evaluating Price Enhancement by Processing Cooperatives," *American Journal of Agricultural Economics*, Vol. 67, No. 2 (May 1985), pp. 183 - 92.

Regional Research Project NE-165
Private Strategies, Public Policies & Food System Performance
Working Papers

1. Rogers, Richard T. and Julie Caswell. 1987."Strategic Management and Internal Organization of Food Marketing Firms." University of Massachusetts, Amherst, MA.

2. Roberts, Tanya. 1987. "Salmonellosis Control: Estimated Economic Benefits." ERS/USDA, Washington, D.C.

3. Lee, David R. 1987. "Labor Market Dynamics in the U.S. Food Sector." Cornell University, Ithaca, NY.

4. McLaughlin, Edward W. and Vithala R. Rao. 1987. "An Explanatory Modeling of the Decision Process of New Product Selection by Supermarket Buyers." Cornell University, Ithaca, NY.

5. Smith, Mark E., Eileen O. van Ravenswaay and Stanley R. Thompson. 1987. "Sales Loss Determination in Food Contamination Incidents: An Application to Milk Bans in Hawaii." Michigan State University, East Lansing, MI.

6. Zellner, James A. 1987. "Some Causes and Consequences of Food Industry Conduct: A Simultaneous Analysis." University of Florida, Gainesville, FL.

7. Caswell, Julie A. and Ronald Cotterill. 1988. "New Theoretical Approaches to Measuring Industry Performance." University of Massachusetts, Amherst, MA.

8. Lopez, Rigoberto A. 1988. "Political Economy of the United States Sugar Policies." Rutgers University, New Brunswick, NJ.

9. Azzam, Azzeddine, Emilio Pagoulatos and John Schroeter. 1988. "Agricultural Price Spreads and Market Performance." University of Connecticut, Storrs, CT.

10. Lopez, Rigoberto A., and Daniel Dorsainvil. 1988. "The Degree and Sources of Oligopsony Power: An Application to the Haitian Coffee Market." Rutgers University, New Brunswick, NJ.

11. Caswell, Julie A. 1988. "A Model of the Intra/Interstate Impacts of State Product Regulation." University of Massachusetts, Amherst, MA.

12. Cotterill, Ronald W. and Lawrence E. Haller. 1988. "Entry Barriers, the Queue of Potential Entrants, and Entry into Food Retailing Markets." University of Connecticut, Storrs, CT.

13. Caswell, Julie A. 1988. "An Alternative Measure of Aggregate Concentration with an Application to the Agribusiness Sector." University of Massachusetts, Amherst, MA.

14. McLaughlin, Edward W. and Vithala Rao. 1989. "The Strategic Role of Supermarket Buyer Intermediaries in New Product Selection: Implications for Systemwide Efficiency." Cornell University, Ithaca, NY.

15. Azzam, Azzeddine and Emilio Pagoulatos. 1989. "Testing for Oligopoly and Oligopsony Power." University of Nebraska-Lincoln.

16. Connor, John M. 1989. "Concentration Issues in the U.S. Beef Subsector." Purdue University, W. LaFayette, IN.

17. Manalo, Alberto B. 1989. "Benefits Sought by Apple Consumers." University of New Hampshire, Durham, NH.

18. Fletcher, Stanley, Kay H. McWatters and Anna V.A. Resurreccion. 1990. "Analysis of Consumer's Willingness to Pay for New Fried Food Prepared From Cowpea Flour." University of Georgia, Experiment, GA.

19. Padberg, Daniel I. and Julie A. Caswell. 1990. "Toward a More Comprehensive Theory of Food Labeling." University of Massachusetts, Amherst, MA.

20. Loehman, Edna. 1991. "Alternative Measures of Benefit for Nonmarket Goods which are Substitutes for Complements for Market Goods." Purdue University, W. LaFayette, IN.

21. Williams, Jr., Richard A. and Robert N. Brown. 1991. "Health and Safety Regulation of Small, High-Risk Subpopulations." FDA, Washington, DC.

22. McLaughlin, Edward W. 1991. "The Fresh Company." Cornell University, Ithaca, NY.

23. Connor, John M. and Everett B. Peterson. 1991. "Market-Structure Determinants of National Brand-Private Label Price Differences of Manufactured Food Products." Purdue University, W Lafayette, IN. & Virginia Polytechnic Institute & State University, Blacksburg, VA.

24. Steahr, Thomas E. and Pamela McMullin. 1991. "An Interdisciplinary Framework for the Analysis of Foodborne Disease." The University of Connecticut, Storrs, CT.

25. Ding, John Y. and Julie Caswell. 1991. "A Framework for Analysis of Alternative Restructuring Strategies Employed by Large Food Manufacturers in the 1980s." University of Massachusetts, Amherst, MA.

26. Coaldrake, Karen and Steve Sonka. 1992. "Leaner Pork: Can New Sector Linkages be Formed?" University of Illinois, Urbana, IL.

27. Coaldrake, Karen and Steve Sonka. 1992. "Canola as an Emerging Industry: A Processor and Producer Perspective." University of Illinois, Urbana, IL.

28. Hopkins, Yvette S. and John Connor. 1992. "Re-Examination of Event Studies Applied to Challenged Horizonal Mergers." U.S. Environmental Protection Agency and Purdue University, W. Lafayette, IN.

29. Peterson, Everett, Paul V. Preckel, Thomas W. Hertel and Anya M. McGuirk. 1992. "Impacts of Growth Stimulants in the Domestic Livestock Sector." Virginia Polytechnic Institute and State University, Blacksburg, VA and Purdue University, W. Lafayette, IN.

30. McLaughlin, Edward. 1992. "Strengthening the Competitive Position of Commodity Marketers." Cornell University, Ithaca, NY.

31. Cotterill, Ronald W. and Hachim M. Salih. 1992. "Testing for Risk Premiums in the Wheat-Flour Subsector." University of Connecticut, Storrs, CT.

32. Steahr. Thomas E. and Tanya Roberts. 1993. "Microbial Foodborne Disease: Hospitalizations, Medical Costs and Potential Demand for Safer Food." University of Connecticut, Storrs, CT and U.S.D.A., Economic Research Service.

33. Cotterill, Ronald W. and Don Pinkerton. 1993. "Motives for Mergers in Food Manufacturing." University of Connecticut, Storrs, CT and Chicago Board of Trade.

34. Rogers, Richard T. 1993. "Advertising Expenditures in U.S. Manufacturing Industries, 1967 and 1982" University of Massachusetts, Amherst, MA.

35. Eom, Young Sook. 1993. "Pesticide Residue Risks, Produce Choice, and Valuation of Food Safety: A Random Utility Approach" Clark University, Worcester, MA.

36. Caswell, Julie A. and Jaana K. Kleinschmit v.L. 1993. "Economic Criteria for Settling Federalism Disputes with an Application to Food Safety Regulation" University of Massachusetts, Amherst, MA.

37. Ding, John Y. and Julie A. Caswell. 1993. "Relatedness and Performance: A Reexamination of the Diversification-Performance Link" Ohio State University, Columbus, OH and University of Massachusetts, Amherst, MA.

38. Ding, John Y., Julie A. Caswell and Richard T. Rogers. 1994. "Restructuring's Effect on Related and Unrelated Diversification Among Top Food Manufacturing Firms in the 1980s" Ohio State University, Columbus, OH and University of Massachusetts, Amherst, MA.

39. Connor, John M. and Everett B. Peterson. 1994. "New Estimates of Welfare and Consumer Losses in U.S. Food Manufacturing." Purdue University, W. Lafayette, IN and Virginia Polytechnic Institute and State University, Blacksburg, VA.

40. Bhuyan, Sanjib and Ronald W. Cotterill. 1994. "Countervailing Power and Seller Performance in U.S. Food and Tobacco Manufacturing Industries." University of Connecticut, Storrs, CT.

41. Wen, Hong and Lawrence E. Haller. 1994. "Price Determination in the Bottled Water Industry: A Case Study of Poland Spring." University of Connecticut, Storrs, CT.

NE-165

PRIVATE STRATEGIES, PUBLIC POLICIES & FOOD SYSTEM PERFORMANCE

Working Paper Series

Purpose: The NE-165 Working Paper Series provides access to and facilitates research on food and agricultural marketing questions. It is intended to be a publication vehicle for interim and completed research efforts of high quality. A working paper can take many forms. It may be a paper that was delivered at a conference or symposium but not published. It may be a research report that ultimately appears in full or abbreviated form as a journal article or chapter in a book. Using the working paper series enables a researcher to distribute the report more quickly and in more extensive detail to key research users. A working paper may also be an end product in itself, for example, papers that collate data, report descriptive results, explore new research methodologies, or stimulate thought on research questions.

Procedures: Working papers may address any issues in the food and agricultural marketing area as described in the NE-165: Private Strategies, Public Policy and Food System Performance, project statement. This research agenda is available from Professor Ronald Cotterill, Executive Director of NE-165 at the address given below. A prospective working paper should be forwarded to the Executive Director who will coordinate a review of the paper by two research peers. Alternatively authors may submit two independent peer reviews with their paper. Based upon reviewer comments the Executive Director may accept, accept with revisions, or reject the submission. If accepted the Executive Director will issue working paper covers, and a mailing list to the author who shall have responsibility for preparing and distributing copies to all persons and organizations on the mailing list. Additional copies of working papers are available from the author or from the Food Marketing Policy Center at the University of Connecticut.

Professor Ronald W. Cotterill, Food Marketing Policy Center.
Department of Agricultural and Resource Economics
U-21, University of Connecticut
Storrs, Connecticut 06269-4021
Tel. No. (203) 486-2742
FAX (203) 486-2461