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**Assessing the Impact of Carbonated Soft-Drink Marketing Practices on U.S. Consumers**

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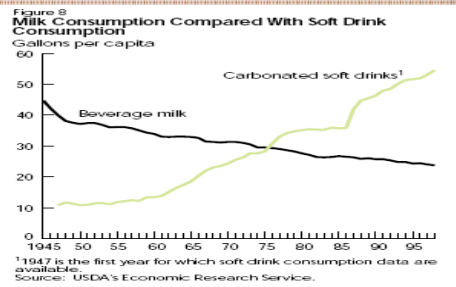
# Assessing the Impact of Carbonated Soft-Drink Marketing Practices on U.S. Consumers



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## Rise in Soft Drink Consumption Over Decades



## Descriptive Statistics All Obs. = 2,291,540

Variable	Mean	Std. Dev.	Min	Max
<i>dependent</i>				
HH TotOz Purchased for Week	105.058	282.601	0	12235.6
<i>marketing mix</i>				
AvgBrandP/wk (wtd, USmktshare)	1.026	0.276	0.086	1.832
DiscSale (sale only)	0.092	0.289	0	1
DiscCoupn (coupon or w/other)	0.017	0.128	0	1
HH GRP / Wk (advertisg exposure)	173.162	126.578	2.752	748.196
<i>demographic</i>				
HH Income <sup>a</sup>	20.994	5.864	3	27
HH size (actual # residents)	2.412	1.339	1	9
Female HH head, Edu <sup>b</sup>	3.768	1.678	0	6
Male HH head, Edu <sup>b</sup>	3.158	2.120	0	6
FemUndrEmp (un-, or <35hrs/wk)	0.497	0.500	0	1
Man <Full Emp (<35hrs/wk)	0.061	0.239	0	1
Man No Emp	0.199	0.400	0	1
African American <sup>c</sup>	0.141	0.348	0	1
Asian	0.045	0.208	0	1
Other Race	0.058	0.234	0	1
Hispanic <sup>d</sup>	0.076	0.265	0	1
Male HH head, Age <sup>e</sup>	5.126	3.415	0	9
Female HH head, Age <sup>e</sup>	6.095	2.764	0	9

<sup>a</sup> HHinc = in the data set, HH income is divided at 1/2 the poverty level for a family of 4, at 1x, 2x, 3x, 4x with above 4x (>US\$100k) used as the control (3 - 27 is the A.C. Nielsen category assignment)  
<sup>b</sup> xxxEdu = measured for head of HH, by highest level completed: 1-grade school, 2-some high school, 3-high school, 4-some college, 5-college, 6-some graduate school or more  
<sup>c</sup> "White" is used as control for race variables  
<sup>d</sup> Hispanic = a yes/no category external to the White/Afr.Amer./Asian/Other race categories in A.C. Nielsen data  
<sup>e</sup> xxxAge = one of nine categories, youngest 1 to oldest 9

## Research Objective: Discover which demographic characteristics are associated with largest purchase responses to the marketing mix for sweetened CSDs.

### Motivation

- 1) Meta-Analysis of studies on effects of soft-drink consumption find "clear association" with increased body weight, lower nutrient intake, and increased risk of severe medical problems (Vartanian, et al., 2006).
- 2) Consumers vary in tastes and responses to marketing. Can these differences be identified by demographic characteristics using nationwide purchase patterns?

### The Model

> Rejecting assumptions of strict preference ordering and informed utility maximization for CSD consumption, a reduced form model derives answers straight from data, without filter of economic theory.

$$Q_{ict} = \beta_0 + \beta_1 P_{ct} + \beta_2 Sale_{ict} + \beta_3 Coupn_{ict} + \beta_4 Adv_{ct} + \sum_{k=5}^{21} \beta_k X_{ki} + \sum_{m=2}^4 Ssn_m + \epsilon_{ict}$$

>  $Q_{ict}$  = CSD volume in oz purchased by HH in week (1 wk.=t)  
 >  $\beta_0$  = model intercept  
 >  $P_{ct}$  = cross-brand price index for all sweetened CSDs in DMA, weighted by U.S. market share over data set, at week t  
 >  $Sale_{ct}$  = HomeScan entry indicates sale (only discount) item at time of purchase  
 >  $Coupn_{ct}$  = HomeScan entry indicates coupon (only, or other deal) at time of purchase  
 >  $Adv_{ct}$  = Gross Rating Point (GRP) advertising exposure to representative HH in DMA at week t, composite across all sweetened CSD manufacturer/advertisers  
 >  $X_{ki}$  = time-invariant demographic characteristics, including:  
 HH size; education-level, employment (35+hrs/wk=control), and age for head of HH by sex; 5 x Inc (\$100k+=control); 3 x Race (Wh=control); Hispanic (Y/N)  
 >  $Ssn_m$  = seasonal dummy (spring=Ssn1=control)  
 >  $\epsilon_{ict}$  = an idiosyncratic i.i.d. error component.

### Data and Estimation

(13,379 Households over 16 Designated Marketing Areas [DMA] in U.S.) \* (152 weeks) + (fill-in non-purchase observations to avoid biasing of results) = 2,291,540 household-level observations, 2006-2008

**Household (HH) characteristics:** Income; Age, Education, and Hours of Employment of HH head; Race; HH size  
**Marketing mix:** Brand-level prices (DMA cross-brand-avg./wk); Sales and Couponing on Actual Purchases; Advertising Exposure at HH-level  
**Source:** A.C. Nielsen HomeScan Data & Advertising Data.

> Dependent variable: HH quantity (in ounces=oz) purchased in a week  
 > Model selection: linear tobit  
 > Estimator used: tobit ML

Designated Marketing Areas (DMAs) in data set: Atlanta, Baltimore, Boston, Chicago, Detroit, Hartford & New Haven, Houston, Kansas City, Los Angeles, Miami - Ft. Lauderdale, New York, Philadelphia, San Francisco - Oakland - San Jose, Seattle - Tacoma, Springfield - Holyoke (MA), Washington D.C.

## Linear Tobit - Selected Results

Variables	Coefficients	Std. Errors	t-ratios
Avg Brand P /wk	-9.627	1.934	-4.98
DiscSale	939.294	1.553	604.8
DiscCoupn	988.236	3.159	312.83
HH GRP /wk	0.129	0.005	27.64
0 to Half Pov4* Inc	224.293	3.279	68.41
Half to x1 Pov4 Inc	207.694	2.495	83.25
1 to x2 Pov4 Inc	149.914	1.925	77.9
2 to x3 Pov4 Inc	116.071	1.730	67.11
3 to x4 Pov4 Inc	69.612	1.695	41.07
Household size	95.755	0.424	225.62
Fem head, Edu Level	-17.705	0.470	-37.65
Male head, Edu Level	-5.621	0.514	-10.93
Fem head, 0,<Full Emp	-29.527	1.226	-24.08
Male head, <Full Emp	-26.841	2.289	-11.73
Hispanic	-69.011	1.673	-41.25
Male head, 0 Emp	-69.011	1.673	-41.25
African American	44.430	1.521	29.21
Asian	-111.518	2.789	-39.99
Other Race	22.199	2.543	8.73
Hispanic (y/n)	3.670	2.252	1.63
Male head, Age	11.440	0.326	35.14
Female head, Age	-8.900	0.302	-29.48
Summer	27.539	1.527	18.04
Fall	17.333	1.557	11.13
Winter	15.792	1.640	9.63
Constant	-793.849	3.825	-207.54

\*All coeffs signif. to 1%, except Hispanic  
 \*Log likelihood = -5416141.5  
 \*Number of obs = 2,291,540  
 \*uncensored obs = 621,763  
 \* U.S. poverty level for family of four

### Conclusions

- > All explanatory variables show expected signs and are correlated to increased soft drink purchase (versus control: White, >\$100k/yr, 35+hrs/wk, spring) to 1% statistical significance level; Hispanic, 10%.
- > As this is not a structural model, causality cannot be inferred, and robustness checks must be done separately.
- > For the un- and underemployed, purchase quantity is less than the control, perhaps suggesting that people do not view sweetened CSDs as cheap calorie vectors in practice.

### Future Research

- > Model with state dependence lags for cyclical "stocking" purchases.
- > Check Public records of junk-food taxes at state and city level to discover natural experiments of policy-induced price shocks; examine variation in demand responses by demographic characteristics.

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