Market Competitiveness, Demographic Profiling of Demand and Tax Policies Associated with Sparkling and Non-Sparkling Bottled Water in the United States

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ABSTRACT

Bottled water has become the second largest in the nonalcoholic beverage market just behind the market for soft drinks. Knowledge of price sensitivity, substitutes or complements, and demographic profiling and tax issues with respect to consumption of sparkling and non-sparkling bottled water is important for manufacturers, retailers, advertisers, and other stakeholders from a competitive intelligence and strategic decision-making perspective. Using nationally representative household level data from 62,092 households (Nielsen Homescan), and tobit econometric procedure, factors affecting the demand for sparkling and non-sparkling bottled water will be determined. Moreover, own-price, cross-price, and income elasticities for sparkling and non-sparkling bottled water will be estimated. Finally, we evaluate the effect of a 10% tax on bottled water as they affect for non-sparkling bottled water and sparkling bottled water consumption.

JEL classification: D11; D12; H25

KEY WORDS: Sparkling bottled water; Non-sparkling bottled water, Tax policy; Nielsen Homescan Panel; Tobit model

I. INTRODUCTION

There have been major changes in nonalcoholic beverage consumption in the United States during the past decades. Carbonated soft drinks, even though by far remains the biggest liquid refreshment beverage category, their market share continued shrunk. Over the past decades, American consumers have increasingly looked to bottled water as a substitute for carbonated soft drinks. According to Beverage Marketing Corporation (2014), bottled water's performance in 2013 was considerably more vibrant than most major liquid refreshment beverage segment. Growing by 4.7%, in 2013 the volume of bottled water consumed in the United States was more than 10 billion gallons. Per capita consumption also reached a new peak of 32. Bottled water has become the second largest commercial beverage category by volume in United States beverage market, just behind carbonated soft drinks. Growing concerns about healthiness, convenience and increasing income are some of the major factors driving the bottled water market growth.

One major criticism on bottled water says that bottled water creates garbage and has negative environmental effects. On these ground, there are economic arguments supporting tax on bottled water to limit their production and therefore reduce their disposal. In fact, as of January 2014, 17 states and the District of Columbia (D.C.) applied sales taxes to bottled water sold through food stores and 34 states and D.C. applied sales taxes to bottled water sold through vending machines (Bridging the Gap Program, 2014). For a tax program, the own price elasticity is the key that determines the effect of the tax. Low price elasticity makes programs either environmentally ineffective or expensive (Peter Berck et al., 2013). Therefore, it is necessary to examine the own-

price elasticity as well as the cross-price elasticities of bottled water to know how well a bottled water tax will reduce bottle water consumption and bottle garbage.

We could find only six prior studies pertaining to bottled water in the extant literature. Uri (1986) estimated demand relationships for seven beverage categories, including bottled water, in the United States using cross-sectional data for 1982. Consumer's income, age, and presence of liver associated diseases were considered as socio-demographic variables in this study. Their estimated own-price elasticity of bottled water is -0.79. Pittman (2004) analyzed the demand for sixteen nonalcoholic beverages including bottled water using the 1999 ACNielsen Homescan Panel data and their research indicated that no group of demographics was significant in affecting the level of consumption of bottled water. Zheng and Kaiser (2008) focused on five nonalcoholic beverages including bottled water using annual time-series data for the United States from 1974 through 2005 in estimating impacts of advertising. Their result reveals that bottled water is the most price-elastic category within the market for U.S. nonalcoholic beverages, which are all price-inelastic to varying degrees. The elasticity of bottled water is about -0.498. Even though Pittman (2004) considered socio-economic-demographic characteristics in determining the demand for bottled water, this analysis was restricted to data from calendar year 1999. Zheng and Kaiser (2008) did not incorporate socio-demographic characteristics into their demand model. In our analysis, we develop and use a richer data set based on Nielsen Homescan panels for household purchases of bottled water and socio-demographic characteristics in the year 2011. Smith (2010) estimated how beverage-purchasing decisions would change as a result of a hypothetical tax on caloric sweetened sodas, fruit drinks, sports and energy drink, and powdered mixes. Their

study found that consumers facing a higher price induced by a tax would react by adjusting their choices among alternative beverages, such as bottled water. Zhen et al. (2011) estimated demand for nine nonalcoholic beverages under habit formation. By using dynamic AIDS model, they found that the own-price elasticity of bottled water is about -1.1 in low income households and -1.25 in high income households. Their research revealed that demand for bottled water by low-income households is less elastic to own-price changes compared with high-income households, and there is evidence that high-income households consider beverages to be more substitutable than low-income households do. Dharmasena and Capps, JR (2012) used QUAIDS model to estimate the expenditure, for the 10 non-alcoholic beverage categories over the period from 1998 to 2003. Their estimated own-price elasticity of bottled water is -0.754 and their research further reveals that the consumption of bottled water is negatively impacted by a proposed tax.

Given this background, the specific objectives of this article are: (1) to determine the factors affecting the demand of bottled water;(2 to estimate the own-price elasticity, cross-price elasticities and income elasticity of sparkling and non-sparkling bottled water; (3) once the decision to purchase bottled water is made, to determine the drivers of purchase volume and (4) How would a proposed 10% tax on bottled water affect the purchase volume.

This article use monthly data derived from the Nielsen Homescan panels for the calendar year 2011. We use Tobit model to generate own-price and cross-price elasticities of sparkling and non-sparkling bottled water, which in turn will be used to estimate the result of a proposed tax on bottled water. The remainder of the paper is set

out as follows. Tobit model is outlined in Section II. Section II is data description and analysis. Section IV investigates the relevant data and provides empirical estimation, including the estimation of own-price, cross-price and income elasticities. Section V presents the effects of the proposed tax on bottled water and implications. A final section concludes.

II. The Tobit model

In the data set, we observed that there is a large concentration of households who spend zero dollars on bottled water. When testing hypotheses about the relationship between the consumption of bottled water and the explanatory variables, we needed to take account of the concentration of observation at zero because the explanatory variables might have been expected to both influence the probability of whether a household spent zero dollars on bottled water and how much they spent, given that they spent something. In this case, this article used Tobit Model. The stochastic model underlying the Tobit Model generally represented in the way as follows:

The latent Model:

(1) $$y_i^* = \mathbf{X}_i'\beta + \mu_i^*$$

We censored at $\mathrm{C} = 0$:

(2) $$y_i = y_i^* \; if \; y_i^* > 0;$$

$$y_i = 0 \; if \; y_i^* \leq 0$$

So, the observed model:

(3) $$y_i = \mathbf{X}_i'\beta + \mu_i \; if \; y_i > 0$$

$$y_i = 0 \; otherwise.$$

Where i $= 1,2,3$ ...N is the number of observations. The latent model has a dependent variabley_i^*, and the vector of explanatory variables ($\mathbf{X}_i'$) and the vector of coefficients β and a disturbance term μ_i^* that is normally distrusted with a mean of zero. Since we censored at point 0, the observed model, has a dependent variable y_i , with independent variables and coefficients and an error ter. Because of the censoring, the lower tail of the distribution of y_i and of μ_i, is cut off and the probabilities are piled up at the cut-off point.

The unconditional expected value for y_i^* is expressed in equation 4 and the corresponding conditional expected value for y_i is shown in equation 5. The normalized index value, z , equals $\mathbf{X}_i'\beta/\sigma$. Also, F(z) is the cumulative distribution function (CDF) associated with z and f(z) is the corresponding probability density function. The ratio $F^{-1}f$ (a PDF divided by a CDF) is called Inverse Mill's ratio.

(4) $$\mathrm{E}(y^*) = \mathbf{X}_i'\beta F(z) + \sigma f(z)$$

(5) $$\mathrm{E(y)} = \mathbf{X}_i'\beta + \sigma[f(z)/F(z)]$$

The unconditional marginal effect measures the overall effect for an x_k change on y^*:

(6) $$\frac{\partial \mathrm{E}(y^*)}{\partial x_k} = \beta F(z).$$

The conditional marginal effect measures the effect on an x_k change on y for y > 0:

(7) $$\frac{\partial \mathrm{E(y)}}{\partial x_k} = \beta\left[1 - \frac{zf(z)}{F(z)} - \frac{f(z)^2}{F(z)^2}\right]$$

As $\mathrm{E}(y^*) = \mathrm{E(y)F(Z)}$, we could obtain:

(8) $$\frac{\partial \mathrm{E}(y^*)}{\partial x_k} = \mathrm{F(z)}\left(\frac{\partial \mathrm{E(y)}}{\partial x_k}\right) + E(y)(\frac{\partial F(z)}{\partial x_k})$$

Therefore, the total change in y^* can be disaggregated into two parts: (1) the change in y^* of those above zero, weighted by the probability of being above zero; and (2) the

change in the probability of being above zero, weighted by the expected value of y^* if above (McDonald and Moffitt's 1980).

Based on model fit, significance of the variables, Akaike and Schwarz information criteria, the semi-log model suit the model most. Therefore, we used logged price variable in our Tobit model. The model for estimating unconditional elasticities is represented as follows:

(9) Own-Price $$\varepsilon_{ii}^{U} = \frac{\beta}{P_i^U} F(z) \frac{P_i^U}{Q_i^U}$$

(10)Cross- Price Own-Price $$\varepsilon_{ij}^{U} = \frac{\beta}{P_j^U} F(z) \frac{P_j^U}{Q_j^U}$$

(11)Income: Own-Price $$\varepsilon_{I}^{U} = \frac{\beta}{I_i^U} F(z) \frac{I_i^U}{Q_i^U}$$

The model for estimating conditional elasticities is represented as follows:

(12) Own-Price $$\varepsilon_{ii}^{C} = \frac{\beta}{P_i^C} (1 - z \frac{f(z)}{F(z)} - \frac{f(z)^2}{F(z)^2} \frac{P_i^C}{Q_i^C}$$

(13)Cross- Price Own-Price $$\varepsilon_{ij}^{C} = \frac{\beta}{P_{ij}^C} (1 - z \frac{f(z)}{F(z)} - \frac{f(z)^2}{F(z)^2} \frac{P_j^C}{Q_i^C}$$

(14)Income: Own-Price $$\varepsilon_{I}^{C} = \frac{\beta}{I_i^C} (1 - z \frac{f(z)}{F(z)} - \frac{f(z)^2}{F(z)^2} \frac{I_i^C}{Q_i^C}$$

Equation 8 could be manipulated to obtain the changes in the probability of being above the limit (for the conditional sample) for consumption of each beverage category in response to a change an explanatory; in other words,

(15) $$\frac{\partial \mathrm{F(z)}}{\partial \mathrm{X}} = \frac{1}{E(y)}\left[\frac{\partial E(y^*)}{\partial X} - F(z)\left(\frac{\partial Ey}{\partial X}\right)\right]$$

III. Data

Our research relied on the use of Nielsen Homescan data from 2011, with coverage of 62,092 households. The Nielsen Homescan data are a national panel of households who scan their food purchases for home use from all retail outlets (Alviola 2010). The Nielsen Homescan data therefore provides the detailed purchase of each beverage, including price and quantity, as well as the demographic characteristics of each household. Table 1 represents the summary statistics of all variables included in the model.

The beverage included in this study are sparkling bottled water, non-sparkling bottled water, carbonated soft drinks, fruit drink, coffee, tea, whole milk, 1% milk, 2% milk, and isotonic. The majority of the sample of households purchased fruit drink during the calendar year 2011 (95%), followed by carbonated soft drinks (94%), whole milk (90%), tea (78%), non-sparkling water (74%), coffee (72%), 2% milk (57%), 1% milk (40%), isotonic (15%) and sparkling bottled water (1%).

Quantity data are standardized as liquid gallons, and the expenditures are expressed in dollars. Price is in dollars per gallon for each beverage category and is generated as the ratio of expenditure to volume. Sparkling bottled water has the highest average paid price (10.5 $/gallon), followed by isotonic (8.2 $/gallon), fruit drink (7.4 $/gallon), carbonated soft drink (6.5 $/gallon). Whole milk (4.2 $/gallon), 1% milk (4.2 $/gallon), 2% milk (4.1 $/gallon), coffee (4.1 $/gallon), tea (3.2 $/gallon), and non-sparkling bottled water (3.7 $/gallon) have similar average paid price.

The income variable is expressed in thousand dollars, ranging from 5 to 112.5. The average household income level of the sample is around $60,000. Household size measures the number of family members, ranging from 1 to 9. Additionally, most of the households have no children (78%), followed by households only have children between 13 – 17 years old (6%).

Besides, a number of other demographic variables are included in the demand equations. Household head is defined as the female head. If a household does not have a female head, then the household head is the male head. Age represents the age of household head, which has seven categories of age levels to be chosen form, ranging from "less than 25" to "greater than 64". Majority of the sample of households are older than 45. Employment are indicator variable representing whether the household head is fulltime employed, part-time employed or employed neither fulltime or part-time. Roughly 57% of household heads are employed either part-time or fulltime. Education variable indicates the education level of household head, which has four categories ranging from "less than high school" to "post college". More than 80% of households had at least completed university or college.

Race and ethnicity variables are also under consideration. Race is grouped as White, Black, Aian and Other. Roughly 84% of the sample is classified as White. Household ethnicity is represented as Hispanic origin or not Hispanic origin. Over 90% of the sample is non-Hispanic origin. Regions provided in the data are labeled as (i) New England, (ii) Middle Atlantic, (iii) East North Central, (iv) West North Central, (v) South Atlantic, (vi) East South Central, (vii) West South Central, (viii) Mountain, and (ix) Pacific. Over 70% of the households are located in South Atlantic, East South Central,

Middle Atlantic, West South Central and Pacific. Detailed classification information is shown in table 2. Chart 1-7 graphically illustrate the distribution of each demographical variable.

Table 1. Summary Statistics of the Variables in the Model

Variable	Mean	Standard Deviation
Price of non-sparkling bottled water	3.681	4.583
Price of sparkling bottled water	10.544	9.126
Price of carbonated soft drink	6.471	9.910
Price of fruit drink	7.405	4.577
Price of coffee	4.103	3.252
Price of tea	3.190	13.873
Price of whole milk	4.157	1.318
Price of 1% milk	4.176	1.380
Price of 2% milk	4.107	1.361
Price of isotonic	8.193	7.523
Household Income	58.315	31.928
Household Size	2.356	1.287
Age of household head 25-29	0.018	0.132
Age of household head 30-34	0.038	0.191
Age of household head 35-44	0.147	0.355
Age of household head 45-54	0.276	0.447
Age of household head 55-64	0.298	0.457
Age of household head 65 or older	0.222	0.415
Employment status part-time	0.178	0.383
Employment status full-time	0.390	0.488
Education high school	0.237	0.426
Education undergraduate	0.618	0.486
Education post-college	0.120	0.325
Black	0.094	0.292
Asian	0.029	0.167
Other	0.040	0.196
Hispanic	0.051	0.220
Children less than 6 years	0.028	0.164
Children 6-12 years	0.052	0.223
Children 13-17 years	0.067	0.250
Children under 6 and 6-12 years	0.024	0.154
Children under 6 and 13-17 years	0.004	0.064
Children 6-12 and 13-17 years	0.033	0.179
Children under 6, 6-12,and 13-17	0.005	0.070
Female head only	0.250	0.433
Male head only	0.096	0.295
New England	0.045	0.208
Middle Atlantic	0.131	0.337
East North Central	0.181	0.385

West North Central	0.086	0.281
South Atlantic	0.198	0.399
East South Central	0.060	0.238
West South Central	0.102	0.303
Mountain	0.073	0.260

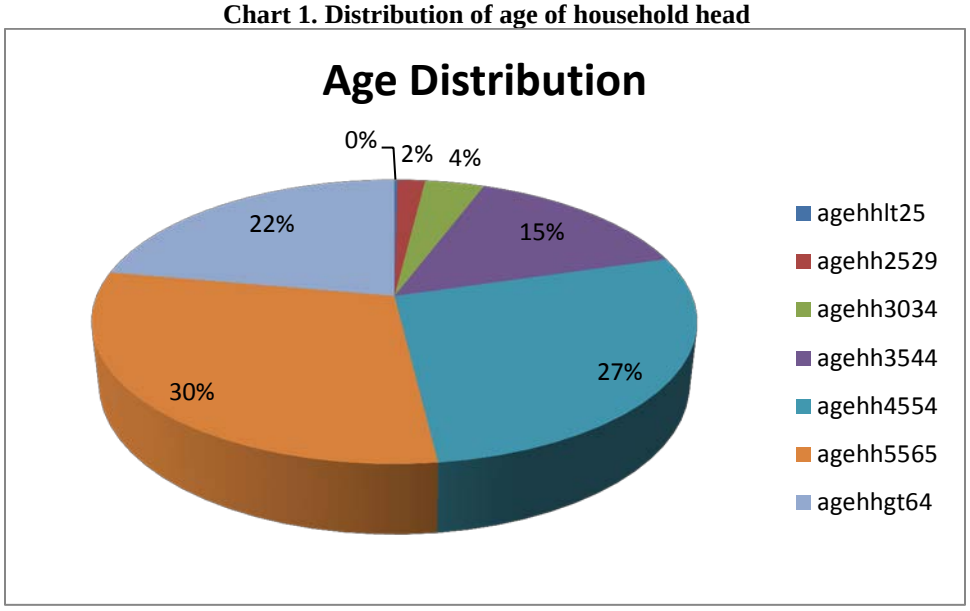
Source: Nielsen Homescan Panel for Calendar Year 2011

Table 2 Census Bureau Regions and States

New England	**Middle Atlantic**	**East North Central**
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	New Jersey, New York, Pennsylvania	I Indiana, Illinois, Michigan, Ohio, Wisconsin
West North Central	**South Atlantic**	**East South Central**
Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota	Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia	Alabama, Kentucky, Mississippi, Tennessee
West South Central	**Mountain**	**Pacific**
Arkansas, Louisiana, Oklahoma, Texas	Arizona, Colorado, Idaho, New Mexico, Montana, Utah, Nevada, Wyoming	Alaska, California, Hawaii, Oregon, Washington

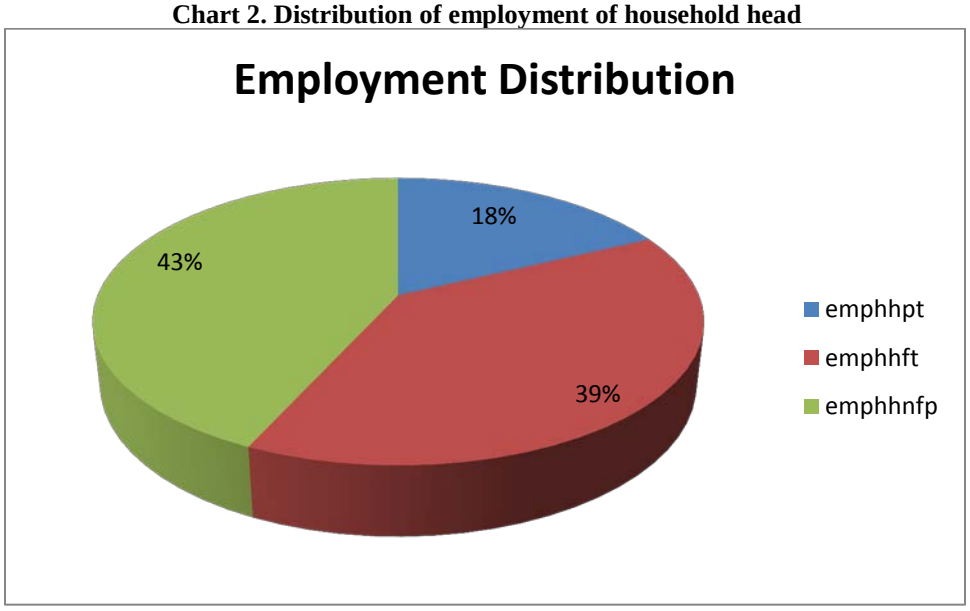
Source: U.S. Census Bureau

Chart 1. Distribution of age of household head



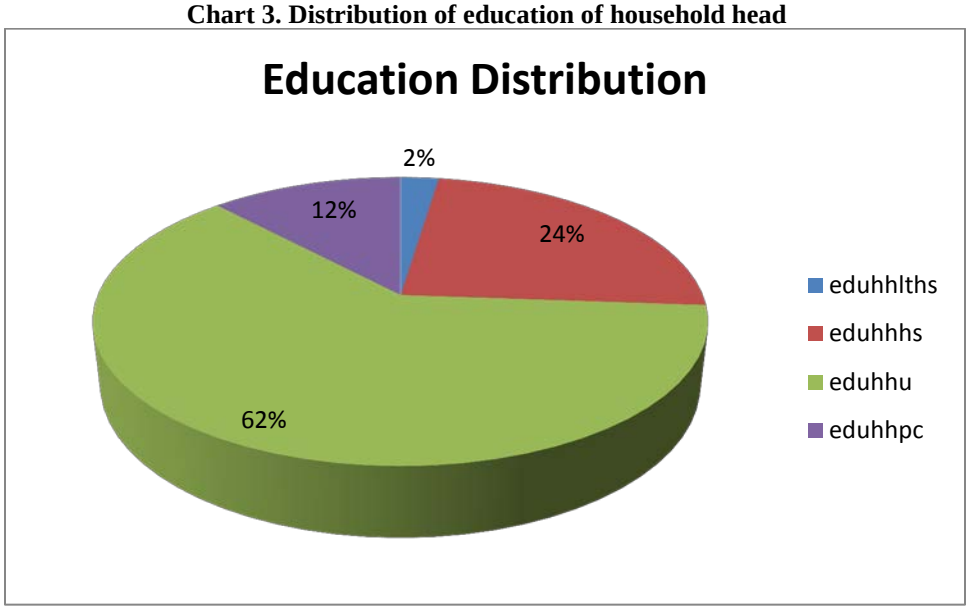
Source: Nielsen Homescan Panel for Calendar Year 2011

Chart 2. Distribution of employment of household head



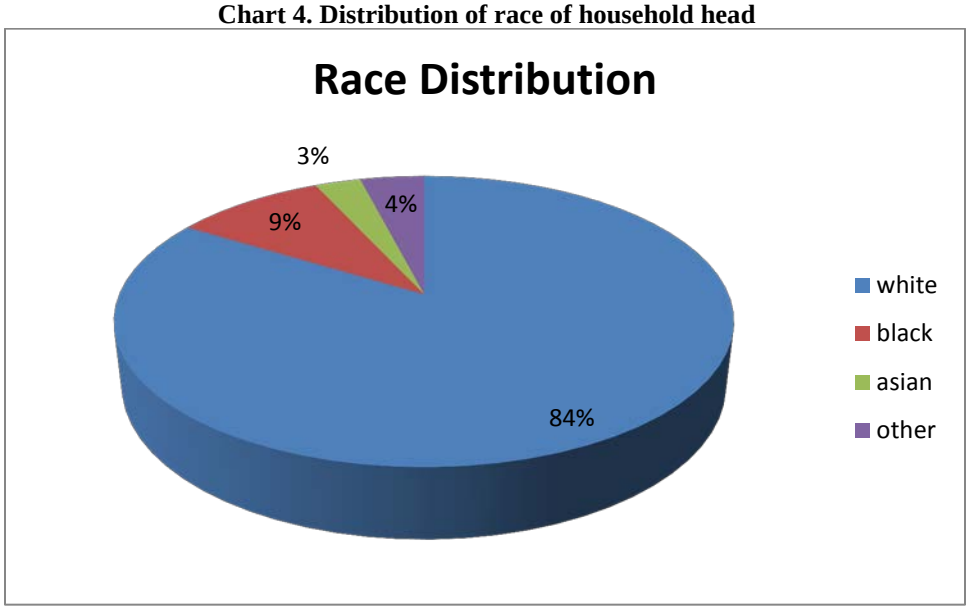
Source: Nielsen Homescan Panel for Calendar Year 2011

Chart 3. Distribution of education of household head



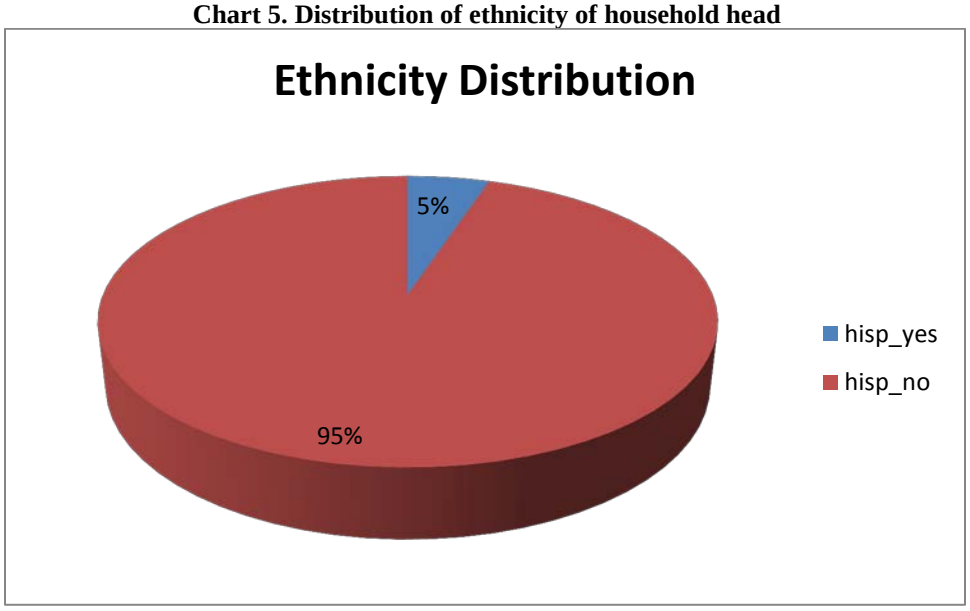
Source: Nielsen Homescan Panel for Calendar Year 2011

Chart 4. Distribution of race of household head



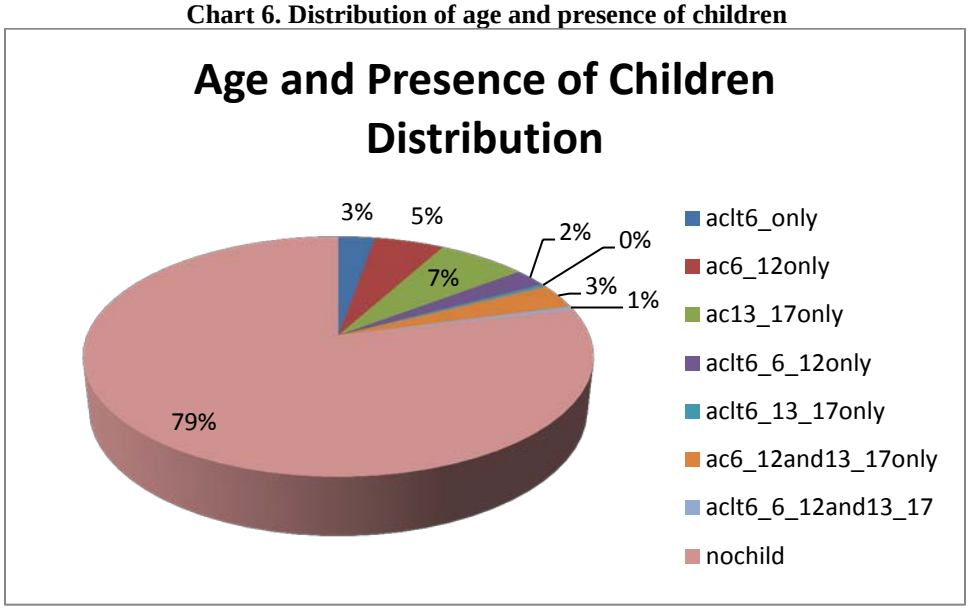
Source: Nielsen Homescan Panel for Calendar Year 2011

Chart 5. Distribution of ethnicity of household head



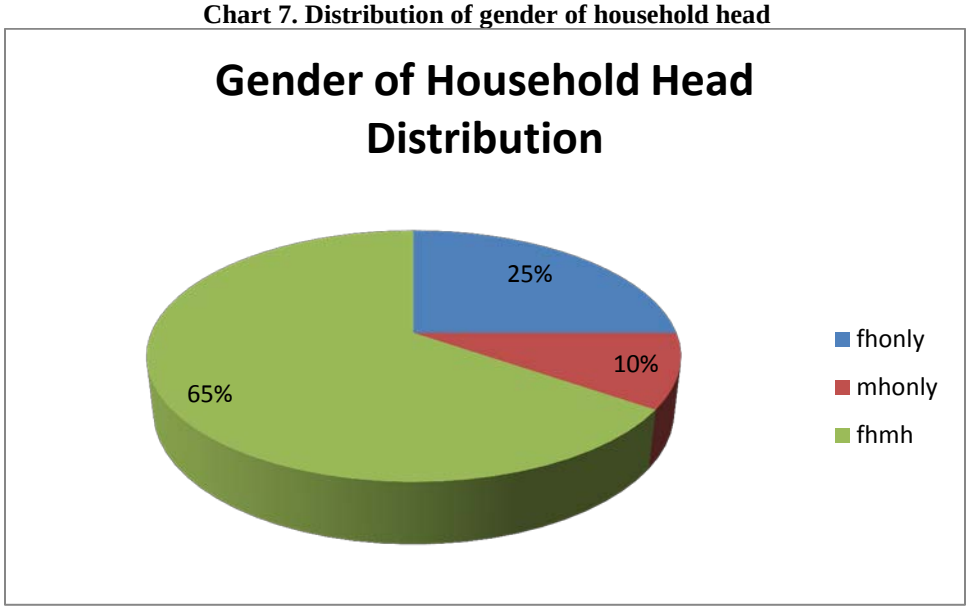
Source: Nielsen Homescan Panel for Calendar Year 2011

Chart 6. Distribution of age and presence of children



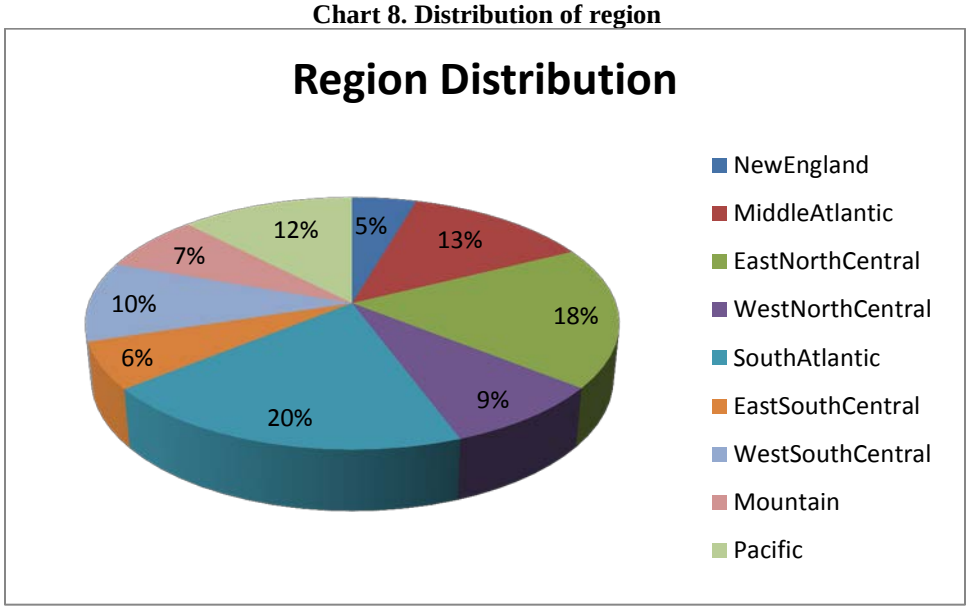
Source: Nielsen Homescan Panel for Calendar Year 2011

Chart 7. Distribution of gender of household head



Source: Nielsen Homescan Panel for Calendar Year 2011

Chart 8. Distribution of region



Source: Nielsen Homescan Panel for Calendar Year 2011

IV EMPIRICAL ESTIMATION

Table 3 presents summary statistics of price, quantity and market penetration in the U.S. beverage market for non-sparkling bottled water, sparkling bottled water, carbonated soft drink, fruit drink, coffee, tea, 1% milk, 2% milk, whole milk and isotonic for the calendar year 2011. The vast majority bought fruit drink (95% market penetration), carbonated soft drink (94% market penetration) and whole milk (90% market penetration). Only 15% of the households purchased isotonic and 1% purchased sparkling bottled water. Sparkling bottled water has the highest average price (10.54 dollars per gallon), followed by isotonic, fruit drink and carbonated soft drink. Tea has the highest average quantity purchased (33.15 fluid gallons per household per year), followed by carbonated soft drink, whole milk, coffee and non-sparkling bottled water. Sparkling bottled water and isotonic have the least average quantity purchased.

Table 3. Summary statistics of price , quantity and market penetration of non-sparkling bottled water, sparkling bottled water, carbonated soft drink, fruit drink, coffee, tea, 1% milk, 2% milk, whole milk and isotonic consumption in U.S. beverage market in 2011.

	Market Penetration	Average Price	Average conditional quantity	Average unconditional quantity
Non-sparkling bottled water	0.74	3.68	16.44	12.12
Sparkling bottled water	0.01	10.54	1.61	0.01
Coffee	0.72	4.10	20.61	14.80
Fruit drink	0.95	7.40	11.80	11.18
Isotonic	0.15	8.19	1.53	0.23
1% milk	0.40	4.18	8.91	3.60
2% milk	0.57	4.11	12.04	6.91
Whole milk	0.90	4.16	21.41	19.34
Tea	0.77	3.20	33.15	25.72
Carbonated soft drink	0.94	6.49	22.51	21.21

Source: Nielsen Homescan Panel for Calendar Year 2011. Note: Average price is in dollar per gallon. Average conditional quantity and average unconditional quantity are in gallon per household per year.

Table 4 represents the Tobit regressions results for non-sparkling bottled water and sparkling bottled water. For non-sparkling bottled water demand, household income and the price of non-sparkling bottled water, fruit drinks, coffee, tea, whole milk and isotonic are significant economic determinants. Significant demographic drivers of demand of non-sparkling bottled water are household size, employment status, education, race, Hispanic origin and gender and of the household head ; region and the presence and age of children. Age of household head is not significant demographic determinants for the demand of non-sparkling bottled water.

For sparkling bottled water demand, household income and price of non-sparkling bottled water, carbonated soft drink, fruit drink, coffee and whole milk have significant positive effects. Price of sparkling bottled water and isotonic have significant negative effects. Race, Hispanic origin and region of household head; presence and age of children are significant demographic determinants for the demand

of sparkling bottled water. Age of household head, employment status, education and gender have no significant influence on the sparkling bottled water demand.

Table 4. Tobit Regression Results for Non-sparkling bottled water and Sparkling bottled water

Variable	Non-sparkling bottled water			Sparkling bottled water		
	Estimate	Std Error	P-value	Estimate	Std Error	P-value
Intercept	**8.591**	3.852	0.026	**-6.206**	3.105	0.046
Price of non-sparkling bottled water	**-10.760**	0.140	<.0001	**0.385**	0.127	0.003
Price of sparkling bottled water	-1.521	1.373	0.268	**-7.636**	0.379	<.0001
Price of carbonated soft drink	0.357	0.196	0.069	**0.923**	0.162	<.0001
Price of fruit drink	**1.053**	0.259	<.0001	**0.906**	0.222	<.0001
Price of coffee	**0.689**	0.206	0.001	**0.439**	0.186	0.019
Price of tea	**1.150**	0.118	<.0001	-0.014	0.111	0.897
Price of whole milk	**3.774**	0.499	<.0001	**2.258**	0.456	<.0001
Price of 1% milk	0.581	0.541	0.283	0.238	0.518	0.646
Price of 2% milk	0.140	0.539	0.796	-0.310	0.493	0.529
Price of isotonic	**-3.434**	0.399	<.0001	**-1.251**	0.345	0.000
Household Income	**1.833**	0.272	<.0001	**1.571**	0.187	<.0001
Household Size	**2.366**	0.159	<.0001	-0.156	0.131	0.232
Age of household head 25-29	-0.912	2.686	0.734	0.096	2.834	0.973
Age of household head 30-34	1.223	2.625	0.641	0.850	2.760	0.758
Age of household head 35-44	2.249	2.585	0.384	0.753	2.730	0.783
Age of household head 45-54	2.769	2.579	0.283	0.400	2.725	0.883
Age of household head 55-64	0.189	2.578	0.942	0.586	2.723	0.830
Age of household head 65 or older	-4.669	2.583	0.071	0.274	2.729	0.920
Employment status part-time	**-0.828**	0.312	0.008	0.311	0.284	0.272
Employment status full-time	0.353	0.277	0.202	0.185	0.251	0.462
Education high school	-0.779	0.731	0.287	-0.624	0.682	0.361
Education undergraduate	**-2.999**	0.718	<.0001	-0.388	0.662	0.557
Education post-college	**-6.154**	0.784	<.0001	-0.183	0.707	0.796
Black	**5.801**	0.373	<.0001	**0.718**	0.310	0.021
Asian	-0.531	0.654	0.417	-0.841	0.577	0.145
Other	**1.768**	0.591	0.003	0.157	0.452	0.728
Hispanic	**2.336**	0.525	<.0001	**1.283**	0.376	0.001
Children less than 6 years	**-3.371**	0.735	<.0001	-1.159	0.717	0.106
Children 6-12 years	-0.059	0.554	0.915	**-1.079**	0.554	0.051
Children 13-17 years	**2.203**	0.494	<.0001	-0.187	0.444	0.673
Children under 6 and 6-12 years	**-4.728**	0.829	<.0001	-1.414	0.817	0.084
Children under 6 and 13-17 years	**-4.168**	1.698	0.014	-0.072	1.410	0.959
Children 6-12 and 13-17 years	-1.352	0.728	0.063	-0.934	0.694	0.179
Children under 6, 6-12,and 13-17	**-3.353**	1.626	0.039	-15.718	106.100	0.882
Female head only	**-1.750**	0.321	<.0001	0.068	0.287	0.813
Male head only	**-6.493**	0.435	<.0001	-0.070	0.375	0.853
New England	**2.169**	0.655	0.001	**-1.945**	0.651	0.003
Middle Atlantic	0.775	0.752	0.303	0.470	0.413	0.255
East North Central	-0.776	0.475	0.102	-0.076	0.335	0.820
West North Central	**-5.489**	0.686	<.0001	-0.053	0.480	0.913
South Atlantic	-0.608	0.476	0.201	**-0.626**	0.316	0.048
East South Central	-0.630	0.545	0.248	**-2.481**	0.557	<.0001
West South Central	0.530	0.464	0.254	**-1.670**	0.372	<.0001
Mountain	0.575	0.531	0.279	**-1.359**	0.395	0.001
Sigma	**25.370**	0.086	<.0001	**5.641**	0.196	<.0001

Source: Nielsen Homescan Panel for Calendar Year 2011. Note: Numbers below the estimated elasticities represent p-values. Estimated elasticities in bold font indicate statistical significance at the 0.1- level

Coefficients of Tobit model are used to generate the unconditional marginal effects (equation 6) and conditional marginal effects (equation 7). Unconditional marginal effects measure the marginal effects for all households while conditional marginal effects measure the marginal effect for households who bought the beverage only. The sign of marginal effects is the same as the sign of coefficients of Tobit model. The result of unconditional marginal effects is shown in Table 5. The result of conditional marginal effects is shown in Table 6.

Table 5. Average Unconditional Marginal Effects of each Demographic Variable for Non-sparkling bottled water and Sparkling bottled water.

Variable	Non-sparkling bottled water	Sparkling bottled water
Household Size	1.416	-0.001
Age of household head 25-29	-0.546	0.001
Age of household head 30-34	0.732	0.007
Age of household head 35-44	1.345	0.006
Age of household head 45-54	1.656	0.003
Age of household head 55-64	0.113	0.005
Age of household head 65 or older	-2.793	0.002
Employment status part-time	-0.495	0.003
Employment status full-time	0.211	0.001
Education high school	-0.466	-0.005
Education undergraduate	-1.794	-0.003
Education post-college	-3.682	-0.001
Black	3.471	0.006
Asian	-0.318	-0.007
Other	1.057	0.001
Hispanic	1.397	0.010
Children less than 6 years	-2.017	-0.009
Children 6-12 years	-0.036	-0.009
Children 13-17 years	1.318	-0.002
Children under 6 and 6-12 years	-2.829	-0.011
Children under 6 and 13-17 years	-2.494	-0.001
Children 6-12 and 13-17 years	-0.809	-0.008
Children under 6, 6-12,and 13-17	-2.006	-0.127
Female head only	-1.047	0.001
Male head only	-3.885	-0.001

New England	1.298	-0.016
Middle Atlantic	0.463	0.004
East North Central	-0.464	-0.001
West North Central	-3.284	0.000
South Atlantic	-0.364	-0.005
East South Central	-0.377	-0.020
West South Central	0.317	-0.013
Mountain	0.344	-0.011

Source: Nielsen Homescan Panel for Calendar Year 2011

Table 6. Average Conditional Marginal Effects of each Demographic Variable for Non-sparkling bottled water and Sparkling bottled water.

Variable	Non-sparkling bottled water	Sparkling bottled water
Household Size	1.081	-0.022
Age of household head 25-29	-0.417	0.013
Age of household head 30-34	0.559	0.119
Age of household head 35-44	1.027	0.105
Age of household head 45-54	1.265	0.056
Age of household head 55-64	0.086	0.082
Age of household head 65 or older	-2.133	0.038
Employment status part-time	-0.378	0.044
Employment status full-time	0.161	0.026
Education high school	-0.356	-0.087
Education undergraduate	-1.370	-0.054
Education post-college	-2.812	-0.026
Black	2.651	0.101
Asian	-0.243	-0.118
Other	0.808	0.022
Hispanic	1.067	0.180
Children less than 6 years	-1.540	-0.162
Children 6-12 years	-0.027	-0.151
Children 13-17 years	1.007	-0.026
Children under 6 and 6-12 years	-2.161	-0.198
Children under 6 and 13-17 years	-1.905	-0.010
Children 6-12 and 13-17 years	-0.618	-0.131
Children under 6, 6-12,and 13-17	-1.532	-2.200
Female head only	-0.799	0.010
Male head only	-2.967	-0.010
New England	0.991	-0.272
Middle Atlantic	0.354	0.066
East North Central	-0.355	-0.011

West North Central	-2.508	-0.007
South Atlantic	-0.278	-0.088
East South Central	-0.288	-0.347
West South Central	0.242	-0.234
Mountain	0.263	-0.190

Source: Nielsen Homescan Panel for Calendar Year 2011

Table 7 reports average change in the probability of consumption of non-sparkling bottled water and sparkling bottled water in each demographic variable. For non-sparkling bottled water, the average change in probability of consumption for household size is 0.047, which means that if increase one household family number, the household is 4.7% more likely to consume non-sparkling bottled water. A household head who is 65 years old or older are 9.3% less likely to consume non-sparkling bottled water compared with the base case of a household head younger than 25. Full time employment increases the probability of consume non-sparkling bottled water relative to the base case of neither part time or full time. Higher education decreases the probability of non-sparkling bottled water consumption compared with the base case of less than high school education. Households classified as black consume significantly more non-sparkling bottled water (2.7 gallons more with 11.5% greater probability) than the base case of white. Hispanic origin households consume 1.1 more gallons with 4.6% greater probability than the base case of not Hispanic origin. Households have female head only or male head only decrease the probability of consuming non-sparkling bottled water compared with the base case of household has both female head and male head. Overall, the presence of children decrease the probability of non-sparkling bottled water consumption. Regionally, households in New England, Middle Atlantic, West South Central and Mountain are slightly less likely to purchase non-sparkling bottled water. Households in

West North Central consumes 2.5 gallons less non-sparkling bottled water than the base case Pacific and are 11% less likely to purchase non-sparkling bottled water.

For sparkling bottled water, larger household size decreases the probability of sparkling bottled water consumption. Overall, larger age of household head slightly increase the probability of sparkling bottled water consumption. Employment increases both the amount and the probability of sparkling bottled water purchase. Higher education slightly decreases the probability of sparkling bottled water consumption relative to less than high school education. Similar to the findings for non-sparkling bottled water, households have black household head are more likely to consume sparkling bottled water. Hispanic households purchase more sparkling bottled water than non-Hispanic households and also have higher probability to purchase. The presence of children decreases the probability of sparkling bottled water consumption. Gender doesn't have significant effect on the amount or the probability of sparkling bottled water consumption. Households located Middle Atlantic are 2% more likely to purchase sparkling bottled water than in Pacific. Households located in other regions are less likely to consume sparkling bottled water relative to Pacific region.

Table 7. Average Change in the Probability of being above the Limit for Change in each Demographic Variable for Non-sparkling bottled water and Sparkling bottled water Demand.

Variable	Non-sparkling bottled water	Sparkling bottled water
Household Size	0.047	-0.006
Age of household head 25-29	-0.018	0.004
Age of household head 30-34	0.024	0.032
Age of household head 35-44	0.045	0.028
Age of household head 45-54	0.055	0.015
Age of household head 55-64	0.004	0.022
Age of household head 65 or older	-0.093	0.010
Employment status part-time	-0.016	0.012
Employment status full-time	0.007	0.007

Education high school	-0.015	-0.024
Education undergraduate	-0.059	-0.015
Education post-college	-0.122	-0.007
Black	0.115	0.027
Asian	-0.011	-0.032
Other	0.035	0.006
Hispanic	0.046	0.048
Children less than 6 years	-0.067	-0.044
Children 6-12 years	-0.001	-0.041
Children 13-17 years	0.044	-0.007
Children under 6 and 6-12 years	-0.094	-0.053
Children under 6 and 13-17 years	-0.083	-0.003
Children 6-12 and 13-17 years	-0.027	-0.035
Children under 6, 6-12,and 13-17	-0.066	-0.593
Female head only	-0.035	0.003
Male head only	-0.129	-0.003
New England	0.043	-0.073
Middle Atlantic	0.015	0.018
East North Central	-0.015	-0.003
West North Central	-0.109	-0.002
South Atlantic	-0.012	-0.024
East South Central	-0.012	-0.094
West South Central	0.010	-0.063
Mountain	0.011	-0.051

Source: Nielsen Homescan Panel for Calendar Year 2011

Based on the coefficient estimates, we calculated unconditional and conditional own-price and cross-price elasticities and income elasticities for non-sparkling bottled water and sparkling bottled water. The result is shown in table 8 and table 9. Price elasticity is the percentage change in the quantity demanded brought by a 1% change in price. The unconditional elasticity estimates are consistently larger than the conditional elasticities for the same variable. This means that when taking households who buy a beverage and households who didn't buy that beverage into account, the demand and income elasticities are more elastic than only taking households who buy that beverage into account.

For non-sparkling bottled water, the own-price elasticity is -0.299, which implies that consumers are highly insensitive to own-price changes. The cross-price elasticities of coffee, fruit drink, whole milk, tea and carbonated soft drink are 0.019, 0.029, 0.105, 0.032 and 0.010 respectively, indicating that these beverages are substitutes for non-sparkling bottled water. The cross-price elasticity of isotonic is -0.095, implying complementarity between non-sparkling bottled and isotonic. The cross-price elasticities of sparkling bottled water, 1% milk, 2% milk are not statistically significant. The income elasticity of non-sparkling bottled water is 0.051.

For sparkling bottled water, the own-price elasticity is -0.664, indicating that sparkling bottled water is more elastic than non-sparkling bottled water. The cross-price elasticities of non-sparkling bottled water, coffee, fruit drink, whole milk and carbonated soft drinks are 0.033, 0.038, 0.079, 0.196, and 0.080 respectively, indicating that these beverages are substitutes for non-sparkling bottled water. The cross-price elasticities of isotonic is -0.109, meaning that isotonic is complement of sparkling bottled water. The cross-price elasticities of 1% milk, 2% milk and tea are not statistically significant. The income elasticity of sparkling bottled water is 0.137, which is higher than the income elasticity of non-sparkling bottled water.

Table 10 illustrates the own-price elasticities of isotonic, coffee, fruit drink, 1% milk, 2% milk, whole milk, tea and carbonated soft drink. Isotonic has the highest own-price elasticity (-1.936), carbonated soft drink has the lowest own-price elasticity (-0.128). Therefore carbonated soft drink demand is most inelastic. All own-price elasticities are statistically different from zero.

Table 8. Estimated Unconditional own-price, cross-price elasticities and income elasticities with associated p-values from Tobit model

	Non-sparkling bottled water	Sparkling bottled water	Isotonic	coffee	Fruit Drink	1% Milk	2% Milk	Whole Milk	Tea	Carbonated soft drink	Income
Non-sparkling bottled water	**-0.531**	-0.075	**-0.169**	**0.034**	**0.052**	0.029	0.007	**0.186**	**0.057**	**0.018**	**0.090**
p-value	**<.0001**	0.268	**<.0001**	**0.001**	**<.0001**	0.283	0.796	**<.0001**	**<.0001**	**0.069**	**<.0001**
Sparkling bottled water	**0.220**	**-4.363**	**-0.715**	**0.251**	**0.518**	0.136	-0.177	**1.290**	-0.008	**0.527**	**0.897**
p-value	**0.003**	**<.0001**	**0.000**	**0.019**	**<.0001**	0.646	0.529	**<.0001**	0.897	**<.0001**	**<.0001**

Source: Nielsen Homescan Panel for Calendar Year 2011. Note: Numbers below the estimated elasticities represent p-values. Estimated elasticities in bold font indicate statistical significance at the 0.1- level.

Table 9. Estimated Conditional own-price, cross-price elasticities and income elasticities with associated p-values from Tobit model

	Non-sparkling bottled water	Sparkling bottled water	Isotonic	coffee	Fruit Drink	1% Milk	2% Milk	Whole Milk	Tea	Carbonated soft drink	Income
Non-sparkling bottled water	**-0.299**	-0.042	**-0.095**	**0.019**	**0.029**	0.016	0.004	**0.105**	**0.032**	**0.010**	**0.051**
p-value	**<.0001**	0.268	**<.0001**	**0.001**	**<.0001**	0.283	0.796	**<.0001**	**<.0001**	**0.069**	**<.0001**
Sparkling bottled water	**0.033**	**-0.664**	**-0.109**	**0.038**	**0.079**	0.021	-0.027	**0.196**	-0.001	**0.080**	**0.137**
p-value	**0.003**	**<.0001**	**0.000**	**0.019**	**<.0001**	0.646	0.529	**<.0001**	0.897	**<.0001**	**<.0001**

Source: Nielsen Homescan Panel for Calendar Year 2011. Note: Numbers below the estimated elasticities represent p-values. Estimated elasticities in bold font indicate statistical significance at the 0.1- level.

Table 10. Estimated Conditional own-price elasticities with associated p-values from Tobit model

	Isotonic	coffee	Fruit Drink	1% Milk	2% Milk	Whole Milk	Tea	Carbonated soft drink
Unconditional elasticity	**-1.936**	**-0.611**	**-0.246**	**-1.022**	**-0.749**	**-0.230**	**-1.100**	**-0.128**
Conditional elasticity	**-0.485**	**-0.330**	**-0.177**	**-0.355**	**-0.326**	**-0.162**	**-0.686**	**-0.089**
p-value	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**	**<.0001**

Source: Nielsen Homescan Panel for Calendar Year 2011. Note: Numbers below the estimated elasticities represent p-values. Estimated elasticities in bold font indicate statistical significance at the 0.1- level.

V. Effects of the proposed tax on bottled water and implications

Based on the finding of the own-price and cross-price elasticities and the conditional demographic marginal effects, several retail pricing strategies could be made for different retail target.

For non-sparkling bottled water, the unconditional own-price elasticity is -0.521 and the conditional own-price elasticity is -0.299. This implies that consumers of non-sparkling bottled water are relatively insensitive to changes is price. Coffee, fruit drink, whole milk, tea and carbonated soft drink are substitutes for non-sparkling bottled water. If holding all else constant, since non-sparkling bottled water demand is not price sensitive, a raise in retail price of non-sparkling bottled water could result in a raise in revenue.

For sparkling bottled water, the conditional own-price elasticity is -0.664, which also implies sparkling bottled water demand is inelastic. If holding all else constant, an increase in the price of sparkling bottled water could increase the retail revenue. However, the market penetration of sparkling bottled water is quite small (1%), and the unconditional own-price elasticity of sparkling bottled water is -4.363, indicating that the unconditional demand for sparkling bottled water is elastic. Therefore, an increase in the price of sparkling bottled water could result in loss of potential buyers of sparkling bottled water. If the retailers' target is to enlarge the sparkling bottled water market and

to attract more consumers, the retail strategy should incorporate price promotions to incentive the demand of sparkling bottled water. Since non-sparkling bottled water, coffee, fruit drink, whole milk and carbonated soft drinks are competitors of sparkling bottled water, an increase of the price of these beverages also could promote the demand of sparkling bottled water.

One of the most popular criticisms on bottled water is that bottled water creates plastic garbage and therefore causes negative environmental effects. Until 2014, 17 states and the District of Columbia (D.C.) applied sales taxes to bottled water sold through food stores and the average tax in taxing states was 3.949% and across all states was 1.316% (Bridging the Gap Program, 2014). Since we have generated the own-price and cross-price elasticities for non-sparkling bottled water and sparkling bottled water, we can use these elasticities to predict the direct and indirect effects of the proposed tax of 10% on bottled water. As a result of the 10% tax on bottled water, the price of non-sparkling bottled water and sparkling bottled water will increase by 10%.

Using unconditional own-price and cross-price elasticities, the direct, indirect and total effects in terms of percentage changes in quantities of bottled water attributed to a proposed 10% tax on bottled water are illustrated in table 11. Direct effects relate only to the use of own-price elasticities. Indirect effects relate only to the use of cross-price elasticities. Total effects correspond to the use of both own-price and cross-price elastitities (Dharmadena et al., 2011). The 10% increase in price result in 5.31% reduction in non-sparkling bottled water consumption and 43.63% in sparkling bottled water consumption. Furthermore, sparkling bottled water is complement of non-sparkling bottled water; increase in price of sparkling bottled water further strengthen the reduction

of non-sparkling bottled water consumption. In total, the tax policy would reduce the non-sparkling bottled water consumption by 6%. For sparkling bottled water, non-sparkling bottled water is competitor, a rise in non-sparkling bottled water compensate a little on the sparkling bottled water consumption reduction. In total, the tax policy reduces the sparkling bottled water consumption by 41%. Therefore, we could conclude that the 10% tax policy is effective in reducing the consumption of bottled water.

Table 11. Direct, indirect and total effects in terms of percentage changes in quantities of bottled water attributed to a proposed 10% tax on bottled water

	Direct effects percentage change in per capita quantities	Indirect effects percentage change in per capita quantities	Total effects percentage change in per capita quantities
Non-sparkling bottled water	-5.31	-0.75	-6.06
Sparkling bottled water	-43.63	2.20	-41.43

Source: Calculations by the author

VI. CONCLUSION

Using household-level purchase data for sparkling water, non-sparkling water, carbonated soft drinks, fruit drink, coffee, tea, milk, 1% milk, 2% milk, and isotonic and related demographic characteristics from the 2011 Nielsen Homescan data, the finding from the Tobit analysis indicate that household income and price of non-sparkling bottled water, fruit drink, coffee, tea, whole milk, and isotonic are significant economic determinants of demand for non-sparkling bottled water. Employment status, race, Hispanic origin, presence and age of children and gender of the household head are significant determinants of demand for non-sparkling bottled water. As of region, consumers located in New England and West North Central consumes more non-sparkling bottled water. From these demographic profiles, we find that variables such as household size, age of children, employment status, education, gender, ethnicity and region have a significant effect on the likelihood of purchasing non-sparkling bottled

water. For sparkling bottled water, non-sparkling bottled water, coffee, fruit drink, whole milk, carbonated soft drinks, isotonic and tea are significantly affect the demand of sparkling bottled water. Race, Hispanic origin and region are significant determinants of demand for sparkling bottled water. Once the decision to purchase sparkling bottled water has been made, our findings indicate that household size; age, education, employment, race and Hispanic origin of household head; region and the presence of children are significantly affect the probability of purchasing sparkling bottled water.

From the estimated elasticities, we find that non-sparkling bottled water demand is inelastic. Coffee, fruit drink, whole milk, tea and carbonated soft drink are substitutes for non-sparkling bottled water. Isotonic and non-sparkling bottled water are complements. Finally, non-sparkling bottled water is a necessary good. Sparkling bottled water have larger unconditional own-price elasticity (-4.363) and smaller conditional own-price elasticity (-0.664), meaning that sparkling bottled water demand is more elastic for all households including households who buy and households who don't buy. For sparkling bottled water, non-sparkling bottled water, coffee, fruit drink, whole milk and carbonated soft drinks are substitutes of non-sparkling bottled water, and isotonic is complements of sparkling bottled water. The income elasticity of demand demonstrates that sparkling bottled water is a normal good.

Regarding the proposed 10% tax on bottled water, the tax policy is effective in reducing the consumption of both non-sparkling and sparkling bottled water. Since sparkling bottled water demand is quite elastic, the tax policy would dissuade potential buyers and thereby reduce potential consumption and retail revenue.

The result from our work will enhance marketing efforts of bottled water in making market strategy and targeting particular demographic groups. Owing our finding, retailers should raise price of non-sparkling bottled water, but lower the price of sparkling bottled water to increase sales revenue, holding all other factors constant.

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