Use of Diversion Ratios in Addressing the Consequences of Tax Policies Associated with Non-alcoholic Beverages

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Abstract

Monthly data derived from the Nielsen HomeScan Panel for calendar years 1998 through 2003 are used to estimate quantity-wise and calorie-wise effects of a tax on sugar-sweetened beverages and bottled water. Quantity diversion ratios and caloric diversion ratios are provided identifying where the volumes and calories respectively, of the sugar-sweetened beverages and bottled water are directed as a result of the tax policy.

As far as the movement in terms of volume, a tax on isotonics, regular soft drinks, and fruit drinks would increase the consumption of coffee, likely leading to increases of caffeine intake, a potentially unintended consequence. Moreover, a tax on those sugar-sweetened beverages would increase the consumption of fruit juices, also an unintended consequence because of the calories associated with beverages containing natural sugars. Also, the reduction in bottled water consumption is mainly replaced by an increase in consumption of tea and diet soft drinks, potentially increasing caffeine intake.

As far as the movement in terms of calories is concerned, a loss of calories due to reduction of intake of isotonics, regular soft drinks and fruit drinks through this tax policy is replaced by calories from consumption of fruit juices and milk, thereby contributing more calories to the diet.

Therefore, it is desirable to consider quantity-wise and calorie-wise movement of non-alcoholic beverage consumption when evaluating the consequences of tax policies on beverages, not only dealing with health related-issues but also environmental concerns.

JEL Classification: D11, D12, I18

Keywords: Non-alcoholic beverages, beverage taxes, Nielsen data, sugar-sweetened beverages, bottled water, diversion ratios

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1. Background Information

In recent times, non-alcoholic beverages have been considered and subjected to various kinds of taxes to deal with health and obesity related policies, environmental concerns as well as a revenue generating mechanism for government programs. Excise or sales tax on sugar-sweetened non-alcoholic beverages[1] to combat the U.S. obesity epidemic was given much attention in the past decade (see Jacobson and Brownell, 2000; Brownell *et al*., 2009; Chaloupka *et al.*, 2009; Zhen *et al.*, 2010; Smith *et al*., 2010; Dharmasena and Capps, 2010). This issue received attention most notably after the publication of year 2000 and 2005 USDA Dietary Guidelines for Americans, which advocated cutting back on sugary soft drinks to deal with the U.S. overweight and obesity problem (Dietary Guidelines for Americans, 2000; Dietary Guidelines for Americans, 2005).

The American Beverage Association (ABA) opposes a tax on sugar-sweetened beverages, arguing that obesity is a very complex problem which should be addressed by way of a comprehensive plan such as nutrition education on balancing calories and not just a plain tax on sugar-sweetened beverages. Furthermore, the ABA states that this proposed excise tax would “harm hard-working middle-income Americans” (American Beverage Association, 2009).

[1] Gortmaker *et al*., (2009) defined the sugar-sweetened beverages category to include all sodas, fruit drinks, sport drinks, low-calorie drinks and other beverages that contain added caloric sweeteners (sweet tea, rice drinks, bean beverages, sugar cane beverages, horchata and non-alcoholic wines and malt beverages).

A sales tax on bottled water was considered in the state of Florida to generate revenue for the state government, which ultimately was not approved (Tampa Bay Online, 2010). The city of Chicago was the first major U.S. city to implement a tax on bottled water. It implemented five cents per bottle sales tax in January 2008 to raise revenue for city programs as well as to maintain a clean city with fewer plastic water bottles disposed into landfills, opening a new era of eco-sin taxes (Sustainablog, 2010). Now the state of Washington is considering a sales/excise tax on bottled water (one cent per ounce of bottled water) to raise revenue for state programs as well as to combat environmental damage caused by the accumulation of bottles that are thrown away after consuming water (Environment Change, 2010).

On the flip side, the International Bottled Water Association (IBWA), a trade association comprised of bottled water manufactures, opposes the tax on bottled water. The IBWA claims that a tax on bottled water will have a disproportionate impact on low-income households, persons with compromised immune systems, as well as on the elderly and infants (International Bottled Water Association, 2010).

Indeed a tax on a sugar-sweetened beverage or bottled water would decrease the consumption of that particular beverage, all other factors invariant. However, one should not dismiss the interrelationships between these beverages in consumption. These interrelationships and their ramifications on reduction on body weight as a result of a beverage tax were studied in various demand system frameworks recently (see Dharmasena and Capps, 2010; Smith *et al*, 2010; Zhen *et al*, 2010). Conventionally, demand systems analysis would give rise to substitutability and complementarity among beverages as a result of a tax on sugar-sweetened beverage or bottled water; nevertheless they fail to shed light on volume-wise or calorie-wise movement of sugar-sweetened beverage or bottled water as a result of a tax. In other words, if a consumer is deprived of a unit of a sugar-sweetened beverage as a result of a tax, to where would that consumption in terms of volume or calories be diverted?

Given this background information, the specific objective of this study is to ascertain volume-wise and calorie-wise movement of the consumption of non-alcoholic beverages as a result of tax policies. In this study we use monthly data derived from the Nielsen Homescan panels for calendar years 1998 through 2003 to ascertain the volume-wise and calorie-wise movement of consumption of non-alcoholic beverages due to a tax on sugar-sweetened beverages or bottled water. We use own-price and cross-price elasticities pertaining to ten selected non-alcoholic beverages calculated in a demand system-wide framework by Dharmasena and Capps (2010) to generate diversion ratios (see Werden, 1998; Abere *et al.*, 2002; Yuan *et al*., 2009) in terms of volume and calories.

Overall, we show that the reduction in consumption of sugar-sweetened beverages can be offset by the increase in the consumption of non-taxed beverages, particularly those which have relatively high caloric content. Also, the reduction in consumption of bottled water is replaced by moderately high-calorie and high caffeine non-taxed beverages.

2. Analytical Framework and Model

In this section we develop the analytical framework used to assess the impact of a tax on sugar-sweetened beverages or bottled water on the change in the movement in terms of volume and calories. In terms of caloric movement, if a calorie derived from sugar-sweetened beverage is taken away from the consumer as a result of a tax, how would that calorie be replaced?

This calculation is achieved as follows. First we obtain the own-price and cross-price elasticities for the ten selected non-alcoholic beverages estimated by Dharmasena and Capps (2010). Next, these own-price and cross-price elasticities are used to generate volume-wise and calorie-wise movement of non-alcoholic beverages as a result of a tax. Specific categories of non-alcoholic beverages considered in this study are isotonics (sports drinks); regular soft drinks (non-diet soft drinks); diet soft drinks; high-fat milk (whole and 2% milk); low-fat milk (1% and skim milk); fruit drinks; fruit juices; bottled water; coffee and tea. In this study, the tax on sugar-sweetened beverages is applied to isotonics (sports drinks), regular soft drinks, and fruit drinks, three of the ten non-alcoholic beverages under consideration. A tax on bottled water also is considered in a separate analysis.

Mathematically, the volume-wise diversion ratio(DR_{ji}^{Vol}), the change in quantity *j* due to a unit change is quantity *i*, is expressed as follows (Werden, 1998; Abere *et al.*, 2002; Yuan *et al*., 2009):

$$(1) \qquad DR_{ji}^{Vol} = \frac{e_{ji}}{e_{ii}}\frac{q_j}{q_i} = \frac{\Delta q_j}{\Delta q_i},$$

where e_{ji} is the uncompensated cross-price elasticity of demand between goods *j* and i; e_{ii} is the uncompensated own-price elasticity of demand of good i; q_j represents the volume of good *j*; and q_i represents the volume of good i.

Mathematically, the calorie-wise diversion ratio(DR_{ji}^{Cal}), the change in caloric intake in good *j* due to a unit change in caloric intake in good *i*, is expressed as follows:

(2) $$DR_{ji}^{Cal} = \frac{e_{ji}}{e_{ii}}\frac{q_j}{q_i}\frac{\mu_j}{\mu_i} = \frac{\Delta\mu_j}{\Delta\mu_i} = \frac{\mu_j}{\mu_i}DR_{ji}^{Vol},$$

where e_{ij}, e_{ii}, q_j, and q_i correspond to the cross-price elasticity of demand, own-price elasticity of demand, quantity consumed in good *j* and quantity consumed in good *i*, respectively. Calories consumed per gallon of the *i*th good and the *j*th good respectively are denoted by μ_i and μ_j.

Negative signs associated with the diversion ratios delineate the decrease (increase) in the volume or calorie of one good due to a unit increase (decrease) in the volume or calorie of another good, hence substitutability between goods and calories. On the other hand, a positive sign associated with the diversion ratios describes the decrease (increase) in the volume or calorie of one good due to a unit decrease (increase) in the volume or calorie of another good, hence complementarity between goods and calories.

3. Data

The source of the data for this analysis is the Nielsen Homescan Panel data for calendar years 1998 through 2003. These data are taken from a sample of households that are demographically representative from various cities and rural markets within four regions of the United States (East, Midwest, South, and West). The Nielsen Homescan data include purchases of all consumer items bought by a household during a specified period of time. For our analysis, we used these nationally representative data for at-home purchases of non-alcoholic beverage products only.

Dharmasena and Capps (2010) used monthly purchase data of real expenditure (in dollars), real price (dollars per gallon) and quantity (in gallons) to estimate a quadratic almost ideal demand system of ten non-alcoholic beverage categories. Caloric intake per gallon of each non-alcoholic beverage considered was gathered from Smith *et al.*, (2010).

Table 1 shows some descriptive statistics pertaining to the data. Table 2 shows the amount of calories consumed per gallon of non-alcoholic beverage consumed (extracted from Smith *et al.,* (2010)).

The most heavily consumed non-alcoholic beverage per month at home was coffee on per-capita basis (0.93 gallons per person per month). Coffee was followed by regular soft drinks (non-diet type) where 0.91 gallons per person per month was consumed. At-home per capita high-fat and low-fat milk consumption per month on average was 0.53 gallons and 0.38 gallons respectively. On average, per capita bottled water consumption at home was 0.35 gallons per month. Isotonics (for example Gatorade) was the least consumed non-alcoholic beverage at home, with only about 0.03 gallons per person per month.

Out of the sugar-sweetened non-alcoholic beverages considered, fruit drinks contain the highest amount of calories per gallon, 1,856 calories. Regular soft drinks is the next highest at 1,456 calories per gallon, and isotonics contains 1,008 calories per gallon. High-fat milk is the most calorie dense non-alcoholic beverage accounting for 2,168 calories per gallon. Fruit juices with only naturally occurring sugars account for 1,840 calories per gallon. Diet soft drinks, coffee and tea account for 80, 32 and 32 calories per gallon respectively.

4. Empirical Results

We first present estimates of the set of uncompensated elasticities gleaned from the linear approximated quadratic almost ideal demand system (LA/QUAIDS) model estimated by Dharmasena and Capps (2010). Second, we shed light on a health-related social policy using calculated volume-wise and calorie-wise diversion ratios based on the uncompensated own-price and cross-price elasticity estimates. Third, we discuss an environmental social policy using calculated quantity diversion ratios based on uncompensated own-price and cross-price elasticities.

4.1 Uncompensated Elasticity Estimates

In Table 3, the uncompensated own-price and cross-price elasticities calculated by Dharmasena and Capps (2010) are exhibited for each non-alcoholic beverage category. Own-price elasticity of demand ranges from -0.69 (fruit drinks) to -3.87 (isotonics). Elastic demands are evident for isotonics, regular soft drinks, diet soft drinks, fruit juices, and coffee, while inelastic demands are evident for high-fat milk, low-fat milk, fruit drinks, bottled water, and tea. All own-price elasticities are statistically different from zero. The number of statistically significant cross-price elasticities is 36, evenly split between gross substitutes and gross complements.

4.2 Tax on Sugar-Sweetened Beverages: A Health-related Public Policy

In Table 4, we exhibit the calculated quantity diversion ratios (volume-wise diversion ratios) and in Table 5, we show the calculated caloric diversion ratios (calorie-wise diversion ratios) associated with the respective non-alcoholic beverage categories. Interest is centered on the sugar-sweetened beverages, namely isotonics, regular soft drinks, and fruit drinks.

Let us assume the consumer is responding to the proposed tax by consuming less regular soft drinks. For every one gallon of regular soft drinks taken away from the consumer, increases in consumption would occur in high-fat milk, low-fat milk, fruit juices, coffee, bottled water, and tea by 0.05 gallons, 0.11 gallons, 0.29 gallons, 0.32 gallons, 0.01 gallons, and 0.06 gallons respectively. Also, the consumption of diet soft drinks and fruit drinks would be reduced by 0.26 gallons and 0.05 gallons as a result of the reduction in consumption of regular soft drinks. The change in consumption of isotonics as a result of the tax on regular soft drinks is negligible. The reduction in consumption of fruit drinks supports the proposed tax on sugar-sweetened beverages. However, the decrease in consumption of diet soft drinks is not supportive of beverage companies that are promoting diet soft drinks in lieu of regular soft drinks as a low-calorie alternative. On the other hand, the increase in the consumption of high-fat milk and fruit juices as a result of the decrease in consumption of regular soft drinks would add more calories to the diet, defeating the goal of reducing calorie intake and subsequently combating obesity as a result of a tax on sugar-sweetened beverages.

If as a result of the tax, the consumption of isotonics is reduced by a gallon, the consumption of fruit drinks, high-fat milk, and regular soft drinks also is reduced by 0.81 gallons, 0.31 gallons, and 0.08 gallons respectively. Reduction in consumption of fruit drinks, high-fat milk and regular soft drinks supports tax on sugar-sweetened beverages to reduce the intake of calories derived from beverages. However, the consumption of coffee, diet soft drinks, low-fat milk, fruit juices, bottled water, and tea is increased by 1.18 gallons, 0.97 gallons, 0.21 gallons, 0.50 gallons, 0.29 gallons and 0.01 gallons, respectively. This increase in the consumption of fruit juices would add more calories to the diet, even though fruit juices contain only naturally occurring sugars. The increase in the consumption of coffee would trigger a potential health-related issue due to the unintended consequence of the increase in caffeine intake.

A decrease in the consumption of a gallon of fruit drinks as a result of a tax reduces the consumption of isotonics, regular soft drinks, high-fat milk, low-fat milk, bottled water and tea by 0.34 gallons, 0.82 gallons, 0.66 gallons, 0.29 gallons, 0.94 gallons and 0.24 gallons respectively. On the other hand, a decrease in the consumption of fruit drinks results in a rise in the consumption of diet soft drinks, fruit juices, and coffee by 1.26 gallons, 0.l7 gallons, and 2.52 gallons respectively.

Over all, we see that a tax on isotonics, regular soft drinks and fruit drinks would increase the consumption of coffee, likely leading to increases in caffeine intake, a potentially health-related unintended consequence. Moreover, a tax on these sugar-sweetened beverages would increase the consumption of fruit juices, also an unintended consequence because of the calories associated with beverages containing natural sugars. Also, because the diversion ratios do not sum to zero, the tax policy on non-alcoholic beverages is not a zero-sum game. The tax on isotonics increases the consumption of non-alcoholic beverages in total by 0.97 gallons, all other factors invariant, while the tax on regular soft drinks and fruit drinks results in lowering the consumption of non-alcoholic beverages in total by 0.47 gallons and 0.34 gallons, respectively, all other factors invariant.

As far as implementation of nutrition policy is concerned, the caloric diversion ratio is more important compared to its quantity counterpart. In particular, the caloric diversion ratio helps to explain the replacement of calories through the consumption of alternative non-alcoholic beverages as a result of lowering calorie intake from the consumption of taxed beverages. In this study, we pay attention to taxing sugar-sweetened (calories added through added sugars or high fructose corn syrup) non-alcoholic beverages, in particular, isotonics, regular soft drinks, and fruit drinks.

A calorie taken away from consumption of isotonics as a result of a tax would be replaced by calories taken in from diet soft drinks, low-fat milk, fruit juices, coffee and tea. The highest caloric contribution is from fruit juices (0.92 calories for each calorie of isotonics taken away). Low-fat milk stands at the number two caloric replacement as a result of reduction of calories taken from isotonics. Also for every calorie taken away from isotonics 0.11 calories of regular soft drinks, 0.66 calories of high-fat milk, and 1.49 calories of fruit drinks would be added.

A calorie taken away from consumption of regular soft drinks would be replaced by 0.36 calories of fruit juice, 0.10 calories of low-fat milk, 0.07 calories of high-fat milk, and small amounts of coffee and tea.

A calorie taken away from fruit drinks as a result of a tax would be replaced by 0.05 calories from diet soft drinks, 0.17 calories from fruit juices and 0.04 calories from coffee. This calorie taken away from fruit drinks as a result of tax on fruit drinks would also trigger reduction of calories ingested from isotonics, regular-soft drinks, high-fat milk, low-fat milk, and very small amount of tea. in particular, it will take away 0.76 calories from high-fat milk, 0.64 calories of regular soft drinks, 0.20 calories from low-fat milk and 0.18 calories from isotonics. Overall, for every calorie reduction in isotonics, regular soft drinks and fruit drinks, the caloric contribution from all non-alcoholic beverages taken together would decrease.

4.3 Tax on Bottled Water: Environmental Social Policy

Now, let us assume the consumer is responding to an environmental tax levied on bottled water to reduce the consumption of plastic bottles. As a result of the tax, obviously there is a reduction in consumption of bottled water, all other factors invariant. According to the quantity diversion ratios calculated (see Table 4 for quantity diversion ratios), every gallon of bottled water taken away from the consumer as a result of the tax is replaced by 0.40 gallons of diet soft drinks and 0.24 gallons of tea. Even through bottled water has zero calories; it is replaced by low-calorie beverages like tea and diet soft drinks, thereby adding some calories to the diet. On the other hand, there is a reduction in consumption of low-fat milk and fruit drinks by 0.15 gallons and 0.24 gallons respectively, for every gallon of bottled water taken away. Since the diversion ratio calculation is not a zero-sum game, for every gallon of bottled water taken away, it would decrease the total consumption of non-alcoholic beverages by 0.99 gallons.

5. Conclusions and Limitation

Monthly data derived from the Nielsen Homescan Panel for calendar years 1998 through 2003 are used to estimate quantity-wise and calorie-wise effects of a tax on sugar-sweetened beverages and bottled water. Quantity diversion ratios and caloric diversion ratios are provided identifying where the volumes and calories respectively, of the sugar-sweetened beverages and bottled water are directed as a result of the tax policy.

Overall, as far as the movement in terms of volume, we see a tax on isotonics, regular soft drinks, and fruit drinks would increase the consumption of coffee, likely leading to increases of caffeine intake, a potentially unintended consequence. Moreover, a tax on those sugar-sweetened beverages would increase the consumption of fruit juices, also an unintended consequence because of the calories associated with beverages containing natural sugars. Also, reduction in bottled water consumption is mainly replaced by the increase in consumption of tea, and increase in consumption of diet soft drinks, potentially increasing caffeine intake.

In sum, as far as the movement in terms of calories is concerned, loss of calories due to reduction of intake of isotonics, regular soft drinks and fruit drinks through tax policy is replaced by calories from consumption of fruit juices and milk, thereby contributing more calories to the diet.

Therefore, it is desirable to consider quantity-wise and calorie-wise movement of non-alcoholic beverage consumption when evaluating the consequences of tax policy on beverages, not only dealing with health related-issues, but also in dealing with environmental concerns.

While the tax policy gives rise to intended consequences in reducing the consumption of sugar-sweetened beverages or bottled water, this effect is offset partially by a rise particularly in the consumption of fruit juices and coffee. Thus, the tax policy yields unintended consequences of increases in caffeine intake through the consumption of coffee and increases in calories from fruit juices which contain natural sugars.

Owing to the nature of Nielsen Homescan Panel data, our study is limited in that it concentrates only on the at-home consumption of various non-alcoholic beverages. However, ours is the first attempt in the literature to use measures like quantity diversion ratio and caloric diversion ratio to ascertain consequences of tax policies on food and beverage consumption.

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Table 1. Descriptive statistics of quantities (per capita gallons/month), of the various non-alcoholic beverages for the period January 1998 through December 2003

	Mean	Standard Deviation	Minimum	Maximum
Isotonics	0.03	0.01	0.01	0.06
Regular soft drinks	0.91	0.13	0.66	1.24
Diet soft drinks	0.56	0.06	0.45	0.72
High-fat milk	0.53	0.06	0.39	0.67
Low-fat milk	0.38	0.07	0.26	0.53
Fruit drinks	0.23	0.04	0.15	0.29
Fruit juice	0.45	0.05	0.34	0.55
Bottled water	0.35	0.07	0.19	0.52
Coffee	0.93	0.13	0.67	1.15
Tea	0.34	0.03	0.28	0.42

Source: Nielsen HomeScan Panel 1998 to 2003, calculations by the authors

Table 2. Calories per Gallon for each Non-alcoholic Beverage considered in the Study

Beverage	**Calories/Gallon**
Isotonics	1008
Regular soft drinks	1456
Diet soft drinks	80
High-fat milk	2168
Low-fat milk	1328
Fruit drinks	1856
Fruit juice	1840
Bottled water	0
Coffee	32
Tea	32

Note: These calories per gallon consumed numbers are extracted from Smith *et al*., (2010)

Table 3. Estimated uncompensated own-price and cross-price elasticities with associated p-values gleaned from the linear approximated quadratic almost ideal demand system model (LA/QUAIDS) estimated by Dharmasena and Capps (2010)[a]

	isotonics	Regular soft drinks	Diet soft drinks	High-fat milk	Low-fat milk	Fruit drinks	Fruit juices	Bottled water	Coffee	Tea
Isotonics	**-3.8650**	-0.1216	2.2073	-0.8598	0.5235	**-2.4720**	**1.9803**	0.3722	1.0631	-0.0021
	0.0000	0.9268	0.1168	0.3375	0.5092	0.0016	0.0740	0.6279	0.1749	0.9960
Regular soft drinks	-0.0088	**-2.2552**	**-0.6208**	0.0424	**0.2373**	**-0.1663**	**1.0338**	-0.0543	**0.2181**	0.0555
	0.8852	0.0000	0.0020	0.7146	0.0218	0.0847	0.0000	0.6143	0.0632	0.4083
Diet soft drinks	0.1509	**-0.8550**	**-1.2721**	**0.3856**	-0.1722	**0.3726**	-0.0963	**0.2475**	-0.0051	-0.0121
	0.1205	0.0037	0.0002	0.0171	0.2117	0.0063	0.6101	0.0661	0.9707	0.8727
High-fat milk	-0.0544	0.1964	**0.4359**	**-0.7591**	0.2989	**-0.2219**	**-0.5556**	0.0173	-0.0185	**-0.1452**
	0.3641	0.2549	0.0065	0.0009	0.1350	0.0077	0.0000	0.8388	0.8378	0.0056
Low-fat milk	0.0558	**0.6358**	-0.2009	0.4435	**-0.9237**	-0.1448	**-0.4669**	-0.1537	-0.0209	-0.0793
	0.4916	0.0068	0.3279	0.1444	0.0027	0.1549	0.0039	0.1441	0.8501	0.1894
Fruit drinks	**-0.2934**	-0.3659	**0.6436**	**-0.4501**	**-0.2044**	**-0.6892**	0.0786	**-0.3446**	**0.4709**	-0.0912
	0.0017	0.1368	0.0063	0.0023	0.0821	0.0005	0.6925	0.0358	0.0119	0.3270
Fruit juices	**0.1069**	**1.2844**	-0.0141	**-0.4326**	**-0.2370**	0.0683	**-1.1731**	-0.0769	**-0.2526**	-0.0775
	0.0730	0.0000	0.9250	0.0000	0.0049	0.4559	0.0000	0.4681	0.0258	0.2437
Bottled water	0.0566	0.0318	**0.5864**	0.0721	-0.1784	**-0.3424**	-0.1532	**-0.7540**	-0.0455	0.1965
	0.5842	0.9199	0.0282	0.6687	0.1876	0.0680	0.5589	0.0119	0.8329	0.1310
Coffee	0.1203	**0.6977**	0.0962	0.0166	0.0128	**0.4856**	**-0.4584**	-0.0312	**-1.6459**	**0.2442**
	0.1571	0.0138	0.6620	0.9091	0.9120	0.0055	0.0431	0.8580	0.0000	0.0274
Tea	0.0019	0.3359	0.0117	**-0.4200**	-0.1524	-0.1192	-0.2967	0.2448	**0.3893**	**-0.9104**
	0.9804	0.2207	0.9552	0.0037	0.1607	0.4184	0.1915	0.1724	0.0395	0.0000

Source: Dharmasena and Capps (2010)

[a] Numbers below the estimated elasticities represent *p*-values. Estimated elasticities in bold font indicate statistical significance at the 0.10 level.

Table 4. Quantity Diversion Ratios (Volume-wise diversion ratios) calculated from LA/QUAIDS Model

	Isotonics	Regular soft drinks	Diet soft drinks	High-fat milk	Low-fat milk	Fruit drinks	Fruit juices	Bottled water	Coffee	Tea
isotonics	1	0.0015	-0.0699	0.0523	-0.0390	0.3379	-0.0926	-0.0246	-0.0170	0.0002
Regular soft drinks	0.0829	1	0.7136	-0.0935	-0.6417	0.8252	-1.7537	0.1302	-0.1269	-0.1509
Diet soft drinks	-0.9690	0.2593	1	-0.5816	0.3185	-1.2641	0.1117	-0.4062	0.0020	0.0225
High-fat milk	0.3053	-0.0520	-0.2993	1	-0.4829	0.6576	0.5630	-0.0248	0.0064	0.2361
Low-fat milk	-0.2097	-0.1128	0.0924	-0.3915	1	0.2876	0.3170	0.1477	0.0049	0.0864
Fruit drinks	0.8057	0.0475	-0.2164	0.2904	0.1617	1	-0.0390	0.2419	-0.0801	0.0726
Fruit juices	-0.5046	-0.2862	0.0082	0.4794	0.3222	-0.1702	1	0.0927	0.0738	0.1059
Bottled water	-0.2935	-0.0078	-0.3725	-0.0879	0.2666	0.9387	0.1437	1	0.0146	-0.2956
Coffee	-1.1797	-0.3231	-0.1154	-0.0382	-0.0363	-2.5160	0.8120	0.0782	1	-0.6941
Tea	-0.0073	-0.0601	-0.0054	0.3739	0.1664	0.2387	0.2031	-0.2371	-0.0914	1
Column Sum	-0.9699	0.4663	0.7353	1.0033	1.0355	0.3354	1.2652	0.998	0.7863	0.3831

Source: Quantity Diversion ratios are calculated by the authors. They are column measures, and the sum of column entries do not add to zero.

Table 5. Caloric Diversion Ratios calculated from LA/QUAIDS Model

	Isotoncs	Regular soft drinks	Diet soft drinks	High-fat milk	Low-fat milk	Fruit drinks	Fruit juices	Bottled water	Coffee	Tea
Isotonics	1	0.0010	-0.8810	0.0243	-0.0296	0.1835	-0.0507	-0.0246	-0.5368	0.0050
Regular soft drinks	0.1198	1	12.9877	-0.0628	-0.7036	0.6473	-1.3877	0.1302	-5.7737	-6.8668
Diet soft drinks	-0.0769	0.0142	1	-0.0215	0.0192	-0.0545	0.0049	-0.4062	0.0050	0.0563
High-fat milk	0.6566	-0.0775	-8.1103	1	-0.7883	0.7682	0.6634	-0.0248	0.4365	15.9955
Low-fat milk	-0.2763	-0.1029	1.5347	-0.2398	1	0.2058	0.2288	0.1477	0.2020	3.5855
Fruit drinks	1.4835	0.0605	-5.0201	0.2486	0.2259	1	-0.0393	0.2419	-4.6476	4.2085
Fruit juices	-0.9211	-0.3617	0.1876	0.4069	0.4464	-0.1688	1	0.0927	4.2462	6.0920
Bottled water	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1	0.0000	0.0000
Coffee	-0.0375	-0.0071	-0.0462	-0.0006	-0.0009	-0.0434	0.0141	0.0782	1	-0.6941
Tea	-0.0002	-0.0013	-0.0022	0.0055	0.0040	0.0041	0.0035	-0.2371	-0.0914	1
Column Sum	1.9478	0.5253	1.6503	1.3607	0.1731	2.5423	0.4369	0.9979	-5.1599	23.3819

Source: Caloric Diversion ratios are calculated by the authors. They are column measures, and the sum of column entries do not add to zero.