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RESEARCH ARTICLE

Changes in Beverage Marketing at Stores Following the Oakland Sugar-Sweetened Beverage Tax

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Introduction: In July 2017, Oakland, California implemented a 1 cent/ounce sugar-sweetened beverage tax. This study examined changes in store marketing practices—advertising and price promotions—for sugar-sweetened beverages, artificially sweetened beverages, and unsweetened beverages following the introduction of the tax.

Methods: The study employed a quasi-experimental research design and included Oakland as the intervention site and Sacramento, California as a comparison site. Based on data collected pretax (May–June 2017), 6 months post-tax (January 2018), and 12 months post-tax (June 2018) at 249 stores across the 2 sites, exterior and interior advertising for 4 taxed sugar-sweetened beverage subtypes and 6 untaxed artificially sweetened and unsweetened beverage subtypes, as well as price promotions for 59 specific taxed products and 69 untaxed products were examined. In 2019, difference-in-differences logistic regressions estimated pre–post changes in Oakland relative to Sacramento.

Results: At 6 months post-tax, the odds of sugar-sweetened beverage price promotions fell 50% in Oakland but only 22% in Sacramento. Price promotions for regular soda in particular declined in Oakland post-tax, by 47% at 6 months and 39% at 12 months (versus no change in Sacramento). Moreover, the odds of artificially sweetened beverage price promotions fell by a similar magnitude as sugar-sweetened beverages in Oakland, 55% at 6 months and 53% at 12 months, which differed significantly from Sacramento. No significant post-tax changes were found in sugar-sweetened or artificially sweetened beverage exterior or interior advertising.

Conclusions: Rather than increasing marketing, retailers and manufacturers may have tried to offset revenue losses by reducing price promotions for sugar-sweetened beverages, particularly regular soda, and artificially sweetened beverages.

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INTRODUCTION

Sugar-sweetened beverages (SSBs) are a major contributor to added sugar intake,[1] and their consumption is associated with numerous chronic health conditions.[2–5] Sweetened beverage taxes may be a useful public health strategy to reduce consumption and ultimately improve population health. More than 40 countries have implemented SSB taxes.[6] In the U.S. alone, 8 local jurisdictions have implemented sweetened beverage taxes,[7] although Cook County, Illinois repealed its tax a few months later.[8] All of these taxes included SSBs and some also included artificially sweetened beverages (ASBs).

Evaluations are beginning to shed light on beverage tax impacts on sales and consumption, as well as factors altering tax impacts.[9,10] One factor is tax pass-through, or the amount of tax that is passed along to customers

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through higher retail prices.[11] Full pass-through maximizes the tax effect. Evaluations of U.S. sweetened beverage taxes found a range of partial to full tax pass-through.[12–17] A second factor is the extent of cross-border shopping, or tax avoidance by purchasing taxed beverages outside of the taxing jurisdiction, which dampens the tax effect. One recent study showed that the tax impact on sweetened beverage sales was partially offset by increased cross-border shopping.[17] A third factor is change in firm (i.e., retailer, distributor, or manufacturer) beverage marketing. Currently, little is known about whether marketing strategies at stores changed after the introduction of sweetened beverage taxes.[9,18] Beverage advertising (i.e., promoting the sale of a good) and price promotions (i.e., offering discounted prices for a good) are 2 relevant store marketing practices.

There is considerable evidence that food and beverage marketing influences purchasing, consumption, and even obesity outcomes.[19–25] Though less is known empirically about effects of marketing at stores and the available evidence is not entirely consistent, indirect and growing direct evidence suggests marketing at stores influences purchasing. Food and beverage manufacturers spend billions of dollars per year and a large percentage of their marketing budgets on in-store trade-promotion fees.[26–30] This suggests store marketing strategies are effective. Moreover, research has linked price promotions at stores to increased purchasing, particularly of unhealthy foods and beverages.[21–23,31,32] Research has also found evidence that in-store product advertising, such as end-aisle displays and other prominent placements, affects purchasing.[20,22,33]

Competing hypotheses for how firms may alter their marketing practices in response to SSB taxes are equally plausible. On the one hand, firms might intensify SSB advertising and price promotions to bolster customer demand. Similarly, they might increase marketing of ASBs and unsweetened beverages (USBs) to encourage substitution to these untaxed beverages. By contrast, firms may reduce SSB price promotions to offset revenue losses from a fall in demand. On July 1, 2017, a 1 cent per ounce SSB tax was implemented in Oakland, California. The purpose of this study is to examine pre–post tax changes in store marketing practices—exterior and interior advertising and price promotions—for taxed SSBs and untaxed ASBs and USBs.

METHODS

This study used a difference-in-differences (DID) estimation model with Oakland, California as the intervention site and Sacramento, California as the comparison site. Sacramento was selected based on Mahalanobis distance matching for population size, economic characteristics, racial/ethnic composition, and voting behavior. Marketing data were from in-person store audits conducted in late May–June 2017, pre–tax implementation; January 2018, 6 months post-tax implementation; and June 2018, 12 months post-tax implementation. These data were linked to American Community Survey 5-year estimate data on demographics of census tracts in which the stores were located.[34]

Study Sample

Trained data collectors audited 7 store types including general merchandise stores, supermarkets, grocery stores, chain and non-chain convenience stores, small discount stores (e.g., dollar stores), and drug stores or pharmacies. To help ensure comprehensive geographic coverage across each city, stores were sampled in proximity to 16 random spatially balanced seed points. For each of the 7 store types, the closest store to the seed point was selected.[35]

A total of 736 audits were conducted at 129 stores in Oakland and 124 stores in Sacramento, but 4 stores in Oakland could only be audited at baseline, leaving 732 store audits conducted at 125 stores in Oakland and 124 stores in Sacramento. The analytic sample for each exterior and interior marketing analysis was balanced on the specific marketing measure (e.g., exterior marketing for regular soda) at baseline and at least 1 other time point. Owing to balancing and missing data on specific measures, advertising analyses included 704–725 observations. The price promotion analytic sample was balanced on the specific product (e.g., 12-ounce Coca-Cola) at a given store at baseline and at least 1 other time point. The audit form included 59 taxed SSB products and 69 untaxed ASB and USB products, for a total of 128 products that contributed 30,377 available observations across time, sites, and stores (availability information was missing for 2,638 observations). Data on whether the product was on sale were missing for 699 observations and another 4,295 observations were excluded because of balancing. This left 25,383 observations in the final analytical sample for price promotions.

Measures

Stores were audited using the Beverage Tax Food Store Observation Form,[36] developed based on previous audit tools.[37,38] The audit tool included multiple items on both exterior and interior advertising as well as price promotions, with reliability testing of the audit tool generally showing strong agreement.[39] On the form, SSBs, ASBs, and USBs were differentiated based on the sweeteners they contained: sugar, artificial sweetener, or no added sweetener, respectively. One exception was milk, which included unflavored and flavored. For advertising, 4 taxed SSB subtypes (regular soda, regular sports drink, regular energy drink, and juice drinks), 3 untaxed ASB subtypes (diet soda, diet sports drink, and diet energy drink), and 3 untaxed USB subtypes (plain bottled water, 100% fruit juice, and milk) were assessed. For exterior advertising, data collectors assessed advertisements on the building exterior and property. Exterior advertising had to be at least 8.5″ × 11″ in size and visible from the parking lot or bordering street and included signs, posters, flags, decals, stickers, marquees, and sandwich boards. For interior advertising, data collectors assessed end-aisle displays and special floor displays inside the store. End-aisle displays or end-caps were shelves at the end of an aisle, whereas special floor displays were located in areas or aisles and forced a customer to navigate around the display. Special floor displays

included product displays on the floor (e.g., stacked products), racks, tables, and other temporary shelving units. For analysis, separate exterior and interior advertising measures were constructed indicating whether any SSB, any ASB, and any USB advertising was present (versus none) outside or inside the store, respectively. For both exterior and interior advertising, measures for presence of each of the 4 SSB subtypes were also developed.

For price promotions, data collectors reviewed signage, shelf tags, and advertisements to assess whether 59 specific taxed SSB products, 37 specific untaxed ASB products, and 32 untaxed USB products were on sale or had a promotional price, including standard price reductions, reduced price per quantity, and buy 1 get 1 free. Consistent with the threshold of a taxable product in the Oakland ordinance, all SSBs had at least 25 kilocalories/12 fluid ounces. For SSBs and ASBs, selected products encompassed multiple subtypes (specifically soda, sports drinks, energy drinks, and ready-to-drink coffees/teas) and included those from different manufacturers and varieties (e.g., cola and orange) and an assortment of package sizes. SSBs also included juice drinks. Similarly, for USBs, products from various manufacturers and package sizes were included for each selected subtype, milk, bottled and sparkling water, 100% juice, and unsweetened ready-to-drink tea/coffee. For analysis, dichotomous product-level measures were used for whether or not the product was on sale.

Covariates included store type (limited service stores [convenience, small discount, and pharmacy] versus supermarkets [including general merchandise and grocery]), census tract racial/ethnic composition (most [≥50%] white, non-Hispanic versus other), and census tract median household income. Price promotion analyses also controlled for beverage subtype and package size (individual-sized [≤1 liter] versus family-sized [>1 liter or multipack]).

Statistical Analysis

In 2019, descriptive statistics for store and census tract characteristics were estimated at the store level, and the prevalence of exterior advertising, interior advertising, and price promotions was estimated for each site and wave: baseline or pretax, 6 months post-tax, and 12 months post-tax. DID logistic regressions with robust SEs clustered on store estimated pre–post changes in each of these beverage marketing outcomes in Oakland, adjusting for changes in the control site of Sacramento. The unit of analysis for the advertising models was at the store level, whereas the unit of analysis for the price promotion models was at the product level. In the models, the term for site showed differences between Oakland and Sacramento at baseline, the terms for each wave showed differences over time in Sacramento, and the site X wave interaction terms showed differences over time in Oakland relative to Sacramento. Exponentiated coefficients and 95% CIs are reported. For site and wave these correspond to ORs, whereas for site X wave interactions, these correspond to ratios of ORs (RORs), which allow tests for whether changes over time in Oakland were significantly different from changes over time in Sacramento. Estimated changes over time in Oakland itself were computed from the models by adding the terms for wave and corresponding site X wave interaction terms. All regressions controlled for the aforementioned covariates. For price promotions, descriptive statistics and regressions were weighted to reflect the distribution of volume sold by sweetener status (SSB, ASB, or USB); beverage subtype; and beverage size in Oakland, Sacramento, and the 2-mile buffer areas surrounding them from June 2016 to May 2017, based on authors' calculations using Nielsen scanner data on store beverage volume sold. Analyses were conducted in Stata/SE, version 13.1.

RESULTS

Of the 249 audited stores, 76 (30.5%; Oakland, 30.4% and Sacramento, 30.6%) were supermarkets, and 173 (69.5%; Oakland, 69.6% and Sacramento, 69.4%) were limited service stores. Of all stores, 25% were located in majority white census tracts (Oakland, 19.2%; Sacramento, 30.6%). Half of all the stores were in census tracts with a median household income ≥$44,926 (Oakland, $47,717; Sacramento, $42,459).

Table 1 shows the baseline (pretax), 6-month, and 12-month prevalence of exterior advertising, interior advertising, and price promotions by site for SSBs and its subtypes, ASBs, and USBs. At baseline, all 3 forms of marketing were prevalent, and SSBs were generally more commonly promoted than ASBs or USBs. In Oakland, 33.9% of stores had exterior SSB advertising compared with 6.7% and 19.7% for exterior ASB and USB advertising, respectively. In Oakland, 63.7% of stores had interior SSB advertising compared with 43.5% and 46.8% of stores with interior ASB and USB advertising, respectively. An estimated 34.4% of SSB products and 40.2% of ASB products, but only 11.3% of USB products, in Oakland stores were price promoted. Patterns were similar in Sacramento. Among SSBs, exterior and interior advertising were most common for regular soda (25.8% and 55.6% in Oakland, respectively), whereas the prevalence of price promotions was similar across SSB subtypes.

Table 2 includes DID regression results for changes in exterior advertising (top panel) and interior advertising (middle panel) for SSBs, ASBs, and USBs at 6- and 12-months post-tax. No significant differences in the changes in exterior or interior advertising prevalence by site were found for SSBs or ASBs at 6- or 12-months post-tax. For USBs, a significant difference in the change in exterior advertising prevalence in Oakland versus Sacramento was observed at 6 months post-tax (ROR=0.46, 95% CI=0.22, 0.94). Specifically, at 6 months, there was no change in USB exterior advertising prevalence in Oakland (OR=0.77, 95% CI=0.43, 1.37), whereas the odds of USB exterior advertising in Sacramento increased by 69% (OR=1.69, 95% CI=1.09, 2.63). The changes in USB exterior advertising were no longer significantly different by site at 12 months (ROR=0.56, 95% CI=0.29, 1.09).

Table 3 reports results from models that assessed whether exterior advertising (top panel) or interior

Table 1. Prevalence (%) and Number of Observations (*n*) for Exterior Advertising, Interior Advertising, and Price Promotions for SSBs, ASBs, and USBs

	Oakland						Sacramento					
	Pretax/ baseline		6 months post-tax		12 months post-tax		Pretax/ baseline		6 months post-tax		12 months post-tax	
Variable	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**	***n***
Exterior advertising												
SSB	33.9	121	26.6	109	31.9	119	37.1	124	35.0	120	38.3	120
Regular soda	25.8	120	19.6	107	25.4	118	28.2	124	19.2	120	30.0	120
Regular sports drink	5.0	120	7.5	106	5.9	118	11.3	124	7.5	120	9.2	120
Regular energy drink	16.0	119	14.3	105	16.9	118	21.8	124	24.2	120	24.2	120
Juice drink	9.1	121	3.8	105	5.0	119	4.8	124	5.8	120	5.0	120
ASB	6.7	119	5.8	103	11.0	118	14.5	124	13.3	120	19.2	120
USB	19.7	122	15.6	109	21.7	120	15.3	124	22.5	120	25.8	120
Interior advertising												
SSB	63.7	124	54.2	118	64.8	122	91.1	123	85.7	119	88.2	119
Regular soda	55.6	124	44.1	118	50.8	122	86.1	122	79.7	118	72.0	118
Regular sports drink	22.8	123	14.7	116	22.3	121	55.7	122	44.9	118	55.1	118
Regular energy drink	22.1	122	17.4	115	22.5	120	64.2	123	46.2	119	64.7	119
Juice drink	31.5	124	30.5	118	30.3	122	60.2	123	50.4	119	60.5	119
ASB	43.5	124	42.4	118	43.4	122	73.8	122	75.4	118	78.0	118
USB	46.8	124	41.5	118	47.5	122	77.0	122	76.3	118	80.5	118
Price promotions												
SSB	34.4	1,962	23.2	1,449	28.9	1,678	38.3	2,979	33.3	2,672	35.5	2,651
Regular soda	29.5	903	19.7	649	21.2	785	35.3	1,367	34.8	1,187	37.0	1,209
Regular sports drink	39.3	321	30.6	252	29.8	286	53.5	449	31.5	415	43.3	421
Regular energy drink	29.9	390	17.1	279	18.2	337	38.7	642	23.9	600	25.9	591
Juice drink	38.6	135	24.4	106	40.7	100	37.4	166	36.4	147	31.2	127
Regular tea/coffee	39.7	213	25.2	163	35.4	170	33.1	355	25.3	323	31.1	303
ASB	40.2	844	24.4	645	25.1	692	42.1	1,535	36.8	1,379	39.9	1,343
USB	11.3	828	6.3	609	5.7	693	13.3	1,233	12.5	1,092	12.0	1,099

Note: For exterior advertising and interior advertising, % is the unweighted prevalence and *n* is the total number of stores. For price promotions, % is the weighted prevalence and *n* is the total number of observed products across stores. Sample sizes vary by wave because of missing data. Prevalence estimates for price promotions are weighted to be representative of volume sold by beverage sweetener status (sugar-sweetened/artificially sweetened/unsweetened), subtype, and size in Oakland, Sacramento, and the 2-mile buffers surrounding both sites in June 2016 – May 2017.
ASB, artificially sweetened beverage; SSB, sugar-sweetened beverage; USB, unsweetened beverage.

advertising (middle panel) changed for SSB subtypes. For regular soda, the change in interior advertising prevalence in Oakland differed significantly from that in Sacramento at 12 months post-tax (ROR=2.02, 95% CI=1.13, 3.61). Specifically, no change in the odds of regular soda interior advertising was observed in Oakland (OR=0.81, 95% CI=0.57, 1.16), whereas the odds of regular soda interior advertising fell in Sacramento by 60% (OR=0.40, 95% CI=0.26, 0.63).

The DID regression results for changes in price promotions for SSB, ASB, and USB products at 6- and 12-months post-tax are shown in the bottom panel of Table 2. For SSBs, changes in the prevalence of price promotions differed significantly between Oakland and Sacramento at 6 months following the introduction of the Oakland SSB tax (ROR=0.64, 95% CI=0.42, 0.98). That is, the odds of SSB price promotions fell at 6 months post-tax in Oakland by 50% (OR=0.50, 95% CI=0.34, 0.72) and in Sacramento only by 22% (OR=0.78, 95% CI=0.63, 0.96). For ASBs, changes in the prevalence of price promotions differed significantly between Oakland and Sacramento at 6 months following the Oakland SSB tax introduction (ROR=0.57, 95% CI=0.34, 0.95). Specifically, the odds of ASB price promotions fell at 6 months post-tax in Oakland by 55% (OR=0.45, 95% CI=0.28, 0.71) and in Sacramento only by 22% (OR=0.78, 95% CI=0.63, 0.97). The changes in the prevalence of ASB price promotions also differed significantly between Oakland and Sacramento at 12 months post-tax (ROR=0.53, 95% CI=0.33, 0.84) and were similar in magnitude to the 6-month changes. For USBs, no significant differences in the changes in price

Table 2. Adjusted Odds of SSB, ASB, and USB Marketing Outcomes at 6- and 12-Months Post-Tax

Variable	SSB OR (95% CI)	ASB OR (95% CI)	USB OR (95% CI)
Exterior advertising			
N	713	704	715
Site			
Sacramento	ref	ref	ref
Oakland	1.12 (0.61, 2.05)	0.43 (0.17, 1.11)	1.69 (0.83, 3.45)
Wave			
Pretax/baseline	ref	ref	ref
6 months post-tax	0.92 (0.66, 1.29)	0.92 (0.50, 1.69)	**1.69* (1.09, 2.63)**
12 months post-tax	1.08 (0.72, 1.61)	1.46 (0.87, 2.47)	**2.04*** (1.34, 3.11)**
Interactions of site by wave			
Oakland by 6 months post-tax	0.75 (0.43, 1.29)	0.95 (0.30, 3.02)	**0.46* (0.22, 0.94)**
Oakland by 12 months post-tax	0.84 (0.49, 1.45)	1.20 (0.44, 3.26)	0.56 (0.29, 1.09)
Computed: change in Oakland			
6 months post-tax	0.69 (0.45, 1.06)	0.87 (0.33, 2.34)	0.77 (0.43, 1.37)
12 months post-tax	0.90 (0.63, 1.30)	1.76 (0.75, 4.13)	1.14 (0.68, 1.92)
Interior advertising			
N	725	722	722
Site			
Sacramento	ref	ref	ref
Oakland	**0.17*** (0.08, 0.36)**	**0.23*** (0.13, 0.41)**	**0.21*** (0.11, 0.40)**
Wave			
Pretax/baseline	ref	ref	ref
6 months post-tax	**0.58* (0.35, 0.97)**	1.08 (0.73, 1.60)	0.94 (0.58, 1.53)
12 months post-tax	0.73 (0.43, 1.23)	1.26 (0.82, 1.93)	1.23 (0.72, 2.09)
Interactions of site by wave			
Oakland by 6 months post-tax	1.13 (0.60, 2.13)	0.87 (0.52, 1.45)	0.82 (0.44, 1.55)
Oakland by 12 months post-tax	1.43 (0.75, 2.74)	0.79 (0.45, 1.39)	0.84 (0.44, 1.59)
Computed: change in Oakland			
6 months post-tax	**0.66* (0.45, 0.95)**	0.94 (0.68, 1.31)	0.78 (0.52, 1.15)
12 months post-tax	1.04 (0.72, 1.52)	0.99 (0.69, 1.43)	1.03 (0.72, 1.48)
Price promotions			
N	13,391	6,438	5,554
Site			
Sacramento	ref	ref	ref
Oakland	0.72 (0.46, 1.12)	0.84 (0.53, 1.35)	0.74 (0.39, 1.40)
Wave			
Pretax/baseline	ref	ref	ref
6 months post-tax	**0.78* (0.63, 0.96)**	**0.78* (0.63, 0.97)**	0.91 (0.66, 1.25)
12 months post-tax	0.83 (0.69, 1.01)	0.89 (0.69, 1.15)	0.88 (0.59, 1.32)
Interactions of site by wave			
Oakland by 6 months post-tax	**0.64* (0.42, 0.98)**	**0.57* (0.34, 0.95)**	0.54 (0.26, 1.12)
Oakland by 12 months post-tax	0.86 (0.59, 1.26)	**0.53** (0.33, 0.84)**	0.52 (0.27, 1.01)
Computed: change in Oakland			
6 months post-tax	**0.50*** (0.34, 0.72)**	**0.45*** (0.28, 0.71)**	**0.49* (0.25, 0.95)**
12 months post-tax	0.72 (0.51, 1.00)	**0.47*** (0.31, 0.70)**	**0.46** (0.27, 0.78)**

Note: Boldface indicates statistical significance (*$p<0.05$; **$p<0.01$; ***$p<0.001$). For exterior advertising and interior advertising, ORs are from logistic regressions at the store level controlling for store type, census tract racial/ethnic composition, and census tract median household income, with robust SEs clustered on store. For price promotions, ORs are from logistic regressions at the product level controlling for beverage subtype, product size, store type, census tract racial/ethnic composition, and census tract median household income, with robust SEs clustered on store, weighted to be representative of volume sold by beverage sweetener status (sugar-sweetened/artificially sweetened/unsweetened), subtype, and size in Oakland, Sacramento, and the 2-mile buffers surrounding both sites in June 2016–May 2017. The term for site shows differences between Oakland and Sacramento at baseline, the terms for each wave show differences over time in Sacramento, and the site by wave interaction terms show differences over time in Oakland relative to Sacramento. The last 2 rows in each panel of the table show the estimated ORs for wave if Oakland, rather than Sacramento, was used as the reference group.
ASB, artificially sweetened beverage; SSB, sugar-sweetened beverage; USB, unsweetened beverage.

Table 3. Adjusted Odds of Marketing Outcomes for SSB Subtypes at 6 Months and 12 Months Post-Tax

Variable	Regular soda OR (95% CI)	Regular energy drinks OR (95% CI)	Regular sports drinks OR (95% CI)	Juice drinks OR (95% CI)	Ready-to-drink tea/coffee OR (95% CI)
Exterior advertising					
N	709	706	708	709	
Site					
Sacramento	ref	ref	ref	ref	—
Oakland	1.09 (0.58, 2.05)	0.83 (0.39, 1.76)	0.54 (0.19, 1.48)	2.33 (0.78, 7.01)	—
Wave					
Pretax/baseline	ref	ref	ref	Ref	—
6 months post-tax	**0.59* (0.35, 0.98)**	1.19 (0.86, 1.66)	0.64 (0.35, 1.16)	1.25 (0.46, 3.34)	—
12 months post-tax	1.11 (0.73, 1.70)	1.18 (0.78, 1.79)	0.79 (0.37, 1.71)	1.05 (0.39, 2.85)	—
Interactions of site by wave					
Oakland by 6 months post-tax	1.17 (0.58, 2.36)	0.74 (0.36, 1.51)	2.53 (0.86, 7.43)	0.32 (0.08, 1.24)	—
Oakland by 12 months post-tax	0.88 (0.49, 1.58)	0.91 (0.46, 1.81)	1.52 (0.47, 4.87)	0.49 (0.15, 1.67)	—
Computed: change in Oakland					
6 months post-tax	0.69 (0.43, 1.11)	0.88 (0.46, 1.66)	1.61 (0.66, 3.93)	0.39 (0.15, 1.01)	—
12 months post-tax	0.98 (0.64, 1.48)	1.08 (0.62, 1.86)	1.20 (0.50, 2.87)	0.52 (0.26, 1.03)	—
Interior advertising					
N	722	718	718	725	
Site					
Sacramento	ref	ref	ref	ref	—
Oakland	**0.17*** (0.09, 0.35)**	**0.16*** (0.09, 0.29)**	**0.21*** (0.12, 0.38)**	**0.23*** (0.13, 0.42)**	—
Wave					
Pretax/baseline	ref	ref	ref	ref	—
6 months post-tax	**0.62* (0.39, 0.99)**	**0.48*** (0.32, 0.71)**	**0.63** (0.45, 0.89)**	**0.63* (0.40, 0.99)**	—
12 months post-tax	**0.40*** (0.26, 0.63)**	1.02 (0.66, 1.59)	0.97 (0.68, 1.38)	1.00 (0.63, 1.59)	—
Interactions of site by wave					
Oakland by 6 months post-tax	0.97 (0.54, 1.73)	1.55 (0.85, 2.82)	0.90 (0.47, 1.72)	1.46 (0.76, 2.80)	—
Oakland by 12 months post-tax	**2.02* (1.13, 3.61)**	1.00 (0.53, 1.89)	1.00 (0.57, 1.76)	0.93 (0.47, 1.84)	—
Computed: change in Oakland					
6 months post-tax	**0.60** (0.42, 0.86)**	0.74 (0.47, 1.17)	**0.57* (0.33, 0.99)**	0.93 (0.58, 1.48)	—
12 months post-tax	0.81 (0.57, 1.16)	1.02 (0.65, 1.62)	0.97 (0.63, 1.50)	0.94 (0.57, 1.54)	—
Price promotions					
N	6,100	2,839	2,144	781	1,527
Site					
Sacramento	ref	ref	ref	ref	ref
Oakland	0.64 (0.38, 1.06)	**0.58* (0.38, 0.89)**	**0.46* (0.26, 0.84)**	0.97 (0.47, 1.98)	1.17 (0.65, 2.12)
Wave					
Pretax/baseline	ref	ref	ref	ref	ref
6 months post-tax	0.96 (0.75, 1.23)	**0.49*** (0.38, 0.63)**	**0.32*** (0.21, 0.47)**	0.92 (0.51, 1.68)	**0.67* (0.45, 0.99)**
12 months post-tax	1.06 (0.82, 1.35)	**0.55*** (0.40, 0.76)**	**0.58*** (0.43, 0.78)**	0.65 (0.37, 1.16)	0.89 (0.65, 1.20)
Interactions of site by wave					
Oakland by 6 months post-tax	**0.55* (0.32, 0.95)**	0.93 (0.58, 1.50)	1.68 (0.79, 3.56)	0.45 (0.19, 1.06)	0.70 (0.30, 1.60)
Oakland by 12 months post-tax	**0.58* (0.37, 0.91)**	0.94 (0.57, 1.56)	0.96 (0.46, 1.98)	1.43 (0.65, 3.15)	0.93 (0.42, 2.05)
Computed: change in Oakland					
6 months post-tax	**0.53* (0.32, 0.87)**	**0.46*** (0.31, 0.69)**	**0.53* (0.28, 1.00)**	**0.41** (0.22, 0.76)**	**0.46* (0.22, 0.96)**
12 months post-tax	**0.61* (0.41, 0.90)**	**0.52*** (0.35, 0.76)**	0.56 (0.29, 1.08)	0.93 (0.54, 1.60)	0.82 (0.40, 1.70)

Note: Boldface indicates statistical significance (*$p<0.05$; **$p<0.01$; ***$p<0.001$). For exterior advertising and interior advertising, ORs are from logistic regressions at the store level controlling for store type, census tract racial/ethnic composition, and census tract median household income, with robust SEs clustered on store. For exterior advertising and interior advertising, information on ready-to-drink tea/coffee was not collected and thus is not shown. For price promotions, ORs are from logistic regressions at the product level controlling for product size, store type, census tract racial/ethnic composition, and census tract median household income, with robust SEs clustered on store, weighted to be representative of volume sold by beverage sweetener status (sugar-sweetened/artificially sweetened/unsweetened), subtype, and size in Oakland, Sacramento, and the 2-mile buffers surrounding both sites in June 2016 – May 2017. The term for site shows differences between Oakland and Sacramento at baseline, the terms for each wave show differences over time in Sacramento, and the site by wave interaction terms show differences over time in Oakland relative to Sacramento. The last 2 rows in each panel of the table show the estimated ORs for wave if Oakland, rather than Sacramento, was used as the reference group.
SSB, sugar-sweetened beverage.

promotion prevalence were found at 6- or 12-months post-tax.

The bottom panel of Table 3 shows changes in price promotions for SSB subtypes at 6- and 12-months post-tax. The only changes that were significantly different between sites were for regular soda (6 months: ROR=0.55, 95% CI=0.32, 0.95; 12 months: ROR=0.58, 95% CI=0.37, 0.91). At 6 months post-tax, the odds of regular soda price promotions in Oakland fell 47% (OR=0.53, 95% CI=0.32, 0.87), whereas there was no significant change in Sacramento (OR=0.96, 95% CI=0.75, 1.23). The magnitude of the changes was similar at 12 months post-tax (Oakland: OR=0.61, 95% CI=0.41, 0.90; Sacramento: OR=1.06, 95% CI=0.82, 1.35).

No evidence was found to indicate that the changes over time in price promotions by site differed by store type and product size (Appendix Table 1, available online).

DISCUSSION

Identifying how sweetened beverage taxes affect beverage marketing is important to develop a more complete understanding of the effects of such taxes and industry responses to taxes. This evaluation of the 2017 Oakland, California SSB tax found reductions in SSB price promotions at 6 months post-tax and regular soda price promotions at 6- and 12-months post-tax in Oakland compared with Sacramento. Moreover, ASB price promotions also fell 6- and 12-months post-tax by a greater extent in Oakland than in Sacramento. These findings are consistent with the hypothesis that firms may reduce beverage price promotions to offset losses in revenue associated with the tax. There was little evidence consistent with the possibility that firms intensified exterior or interior advertising of SSBs to bolster customer demand or the advertising of ASBs or USBs to encourage substitution. In general, beverage advertising in Oakland at 6 months and 12 months post-tax was similar to its pretax levels, and any changes did not differ significantly from Sacramento.

This is one of the first studies to examine changes in beverage marketing practices in stores following an SSB tax introduction. Strengths of the study include the quasi-experimental design; assessment of multiple marketing practices related to SSBs, ASBs, and USBs; price promotion data for a large number of beverage products; and the evaluation of marketing changes at 2 timepoints post-tax, 6 months and 12 months.

This study suggests that firms may have adjusted their marketing strategies after implementation of the SSB tax by reducing price promotions in Oakland for not only SSBs but also ASBs, potentially to offset revenue losses associated with the tax. In contrast to these findings, one study pointed to anecdotal evidence of more aggressive in-store price promotions and marketing in Mexico following their 2014 SSB tax.[18] Studies of tobacco taxes have observed that companies may use price promotions to blunt tax impacts.[40]

Little evidence of increased SSB advertising and a reduction in SSB price promotions following the Oakland SSB tax are promising findings, given that food and beverage marketing at stores is widespread and influences purchasing.[19–33] Foods and beverages high in sugar or fat are more likely to be price promoted than other products,[21] with 1 U.S. study showing that SSBs were the most frequently price-promoted products at supermarkets.[41] Additionally, reductions in SSB price promotions will effectively increase tax pass-through, which may help to maximize the reduction in purchasing and consumption. The extent to which a reduction in price promotions affected the amount of pass-through estimated from U.S. beverage tax evaluations is unclear.[12–17] However, reductions in ASB price promotions could also deter consumers from substituting to ASBs.

Limitations

This study has limitations, including lack of information on pretax marketing trends; use of a single comparison site, which might have resulted in underestimated SEs[12]; and the inability to distinguish between the marketing practices of beverage manufacturers or retailers (i.e., whether price promotions were initiated by manufacturers or retailers is unclear). Another limitation is that the balancing for price promotion analyses excluded products that were not available both before and after the tax. The effect of SSB taxes on product offerings warrants research.

CONCLUSIONS

Follow-up beyond 12 months will be important to assess long-term changes in beverage marketing after the Oakland SSB tax. Nonetheless, this study's findings for 6- and 12-months post-tax suggest that although advertising levels in Oakland remained fairly consistent, price promotions fell in Oakland for not only SSBs (particularly regular soda) but also for ASBs, which were not taxed. The findings underscore that industry may try to curb the impact of lower sales by reducing beverage price promotions, which raises retail prices for not only taxed but also untaxed low-calorie beverage alternatives. This warrants further investigation.

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SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at https://doi.org/10.1016/j.amepre.2019.12.014.

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