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Short communication

The impact of the Oakland sugar-sweetened beverage tax on bottled soda and fountain drink prices in fast-food restaurants

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ABSTRACT

Beverage taxes are increasingly being implemented as an intervention aimed at reducing the consumption of sugar-sweetened beverages (SSBs) and their associated adverse health outcomes. Whether these taxes achieve public health objectives depends, in part, on the extent to which beverage prices increase, known as tax pass-through. Fast-food restaurants are a significant source of SSBs and an environment where the effect of beverage taxes is less understood. This study evaluates the impact of an SSB tax on prices of beverage products sold in fast-food restaurants in Oakland, CA, which implemented a 1-cent per ounce excise tax on SSBs containing 25 or more calories per 12 fluid ounces in 2017. A pre-post intervention difference-in-differences (DID) research design with Sacramento, CA, serving as a comparison site was used to estimate the effect of the tax on fast-food restaurant beverage prices. A panel of fast-food restaurants were audited 1-month pre-tax and 6- and 12-months post-tax. DID regression models with restaurant and product fixed effects were used to estimate tax pass-through to prices of bottled regular (N = 150 observations from 39 restaurants) and diet (N = 106 observations from 32 restaurants) soda and fountain drinks (N = 501 observations from 73 restaurants). Statistically significant ($p < 0.05$) pass-through of 82% was found for bottled regular soda one year after the tax was implemented. This effect represents an 8% increase in prices from baseline. No statistically significant changes in prices were found in either time period for taxed and untaxed fountain drinks and untaxed bottled diet soda.

1. Introduction

In the U.S., obesity prevalence among adults has continued to climb, increasing from 22.9% in 1988–1994 to 38.8% in 2013–2016 (National Center for Health Statistics, 2017). Obesity increases the risk for chronic illnesses such as type 2 diabetes, cardiovascular disease, hypertension, and some cancers. Comprehensive prevention strategies recommended by public health leaders include economic incentives such as the taxation of sugar-sweetened beverages (SSBs). SSBs are targeted because they have no nutritional value, are the largest source of added sugar in the U.S. diet (Johnson et al., 2009), and have low satiety (von Philipsborn et al., 2016). SSBs are also associated with weight gain, type 2 diabetes, and cardiovascular disease (Hu, 2013). Evidence on consumer SSB price sensitivity suggests that taxation can discourage consumption (Powell et al., 2013). However, its effectiveness also depends on tax pass-through or the extent to which the tax raises consumer prices.

Several cities in the U.S. have implemented sweetened beverage taxes. Evaluations of tax pass-through to beverage prices in food stores have found heterogeneous effects from partial pass-through (Falbe et al., 2015) to full pass-through (Cawley et al., 2018b) to over-shifting of the tax (Leider et al., 2018), including variation by store type (Roberto et al., 2019). To date, only one study from Boulder, CO, has investigated the impact of SSB taxes in fast-food restaurants. A pass-through rate of 49% and 69% to fountain drink prices were found at 1- and 3-months post-tax, respectively (Cawley et al., 2018a). Fast-food restaurants are of particular interest because they are a significant source of SSBs outside of the home. On a given day, an estimated 36.6% of American adults consume fast food (Fryar et al., 2018) and 33.7% of fast-food restaurant purchases, on average, include an SSB (Moran, 2019). One study suggests that among adult SSB consumers, 15.5% of SSB calories consumed, on average, are from fast-food restaurants (An & Maurer, 2016). Bottled beverages and fountain drinks are highly lucrative in the restaurant industry, with profit margins that range from 50–60% and 85–90%, respectively ("Downsizing Supersize", 2005). To increase beverage sales, some restaurants employ strategies that may

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increase consumption, such as offering free refills (John et al., 2017) and discounting larger portion sizes (Flood et al., 2006).

This study is the first to estimate tax pass-through to prices of beverages sold in fast-food restaurants in Oakland, CA. On July 1st, 2017 Oakland implemented a 1-cent-per-ounce excise tax on beverages with added caloric sweeteners containing ≥25 calories per 12 fluid ounces, including fountain drink syrup. To assess short- and longer-term effects, beverage prices were collected 1-month pre-tax and 6- and 12-months post-tax in Oakland as well as Sacramento, CA, which served as a comparison site.

2. Methods

2.1. Study sample

A sample of fast-food restaurants was selected for each site using geographically representative random sampling. Sacramento was chosen based on Mahalanobis distance matching using characteristics such as population size, racial composition, income, and voting behavior. Each site was divided into 16 areas composed of census tracts or block groups in ArcGIS 10.4, using manual allocation. A random seed point was selected within each area. Using Google Maps and Yelp, we sought to sample two chain and two non-chain restaurants closest to each area's seed point. Where one fast-food restaurant type (chain or non-chain) was absent, the other type was selected. If there were no additional fast-food restaurants to sample, the closest area seed point was selected. At baseline, closed restaurants or those where data collectors were asked to leave were replaced. Fast-food restaurants were defined as those where customers ordered and paid at the counter and were classified as a chain if they offered franchise opportunities or had a corporate headquarters.

2.2. Measures

Data were collected in-person using the Beverage Tax Fast-Food Restaurant Observation Form on a panel of fast-food restaurants 1-month pre-tax (May/June 2017), 6-months (January 2018), and 12-months post-tax (June 2018). The tool includes 27 taxed and 29 untaxed beverage products. An inter-rater reliability study of the audit form found a high level of agreement between data collectors. For categorical variables, the average kappa statistic was 0.88 ("almost perfect" agreement) and the average percent agreement was 0.99; the average intraclass correlation coefficient for the two continuous variables was 0.91 (Li et al., 2019). The price measure used for analyses reflected each product's posted price, and was computed to equal its regular price if not on sale and its sale price if on sale (only reduced-price sales were considered, as other sales generally do not have a constant price per unit).

2.3. Data collection and analytical sample

The baseline audit was conducted at 65 fast-food restaurants within each site. At 6-months post-tax, 59 and 60 restaurants were audited in Oakland and Sacramento, respectively; at 12-months, 59 audits were completed per site. Restaurants were not observed if they were closed or if data collectors were asked to leave. The analysis was limited to bottled regular and diet soda and fountain drinks, which had the largest sample sizes. The audit form included 5 distinct beverage products for bottled regular and diet soda: 12-, 16.9-, and 20-ounce Coke, and 12- and 20-ounce Pepsi. Fountain drinks consisted of 6 categories: children's, small, medium, large, XL, and XXL. The number of ounces for each size category was recorded and used to calculate price per ounce.

A total of 253, 197, and 612 beverages products were indicated as available for bottled regular soda, bottled diet soda, and fountain drinks, respectively, of which 69, 53, and 42 were excluded because the price or sales data, needed to compute the analytical price measure, were missing. Of the 164 excluded observations, 112 (68%) were classified as missing because the prices were not shown and 52 (32%) were missing for unknown reasons. For fountain drinks, 34 additional observations were excluded because ounces were missing. If fountain drink ounce data were missing in one time period, but available in another for the same restaurant and size, the value was carried over to the missing value. If ounces were missing in all time periods, attempts to collect data were made via telephone. Ounce data were collected by telephone for 230 observations where ounce data were otherwise missing. The sample was balanced by beverage type such that only restaurants with price data at baseline and at least one follow-up period were used in the analysis. Balancing excluded 34, 38, and 35 observations for bottled regular soda, bottled diet soda, and fountain drinks, respectively. Across all time points, the analytical sample consisted of 150 observations of bottled regular soda from 39 restaurants, 106 observations of bottled diet soda from 32 restaurants, and 501 observations of fountain drinks from 73 restaurants. Characteristics of restaurants in the analytical samples are shown in Table 1.

2.4. Statistical analysis

This study used a pre-post intervention difference-in-differences (DID) research design with a matched comparison site to estimate the effect of the tax on fast-food restaurant beverage prices. A key assumption of the analysis is that in the absence of the tax, the difference in prices between Oakland and Sacramento would have remained the same in the post-tax period (i.e., parallel trends). Although this assumption cannot be tested directly, Nielsen price data for soda sold in food stores were used to assess whether one-year pre-tax price trends were similar across sites. Linear regression models with robust standard errors were used to test the joint significance of month by site interactions. Wald tests revealed no significant differences in price trends of taxed ($p = 0.84$) or untaxed ($p = 0.87$) soda across sites.

The unit of analysis was beverage product prices in cents per ounce. Separate linear regression models were run for three beverage types: bottled regular soda, bottled diet soda, and fountain drinks. These models included time indicators for the 6- and 12-month post-tax periods as well as interactions between time and site, which were used to estimate tax pass-through. Models also included restaurant and product fixed effects, which controlled for potential unobserved factors related to restaurants or products within the sample. Because the range of ounces per fountain drink category varied widely, 3 fountain drink product categories were generated: ≤25 oz. ($n = 281$), 25–34 oz. ($n = 159$), and ≥35 oz. ($n = 61$). Standard errors were bootstrapped and clustered on restaurant, and bias-corrected confidence intervals were computed. The data were analyzed in Stata/SE 15.0.

3. Results

Mean price per ounce by beverage type, site, and data collection period are summarized in Table 1. Table 2 provides DID regression model estimates for tax pass-through. The model for regular soda revealed a price increase of 0.69 (95% CI: −0.18, 1.60) and 0.82 (95% CI: 0.14, 1.61) cents per ounce in Oakland relative to Sacramento, at 6- and 12-months post-tax, respectively. These estimates represent a 69% and 82% tax pass-through of the 1-cent-per-ounce tax. However, only the 12-month post-tax estimate was statistically significant at the 5% level. Similar estimates were found for untaxed diet soda (49% at 6-months; 80% at 12-months), but they were not statistically significant. In every case where price data were available for the same varieties of both regular and diet soda (e.g., 12 oz. Coke and Diet Coke) within the same restaurant, the prices were equal. The estimates of pass-through to prices of fountain drinks were smaller compared to bottled drinks (55% at 6-months; 29% at 12-months) and were not statistically significant.

Table 1
Mean price per ounce of beverages in fast-food restaurants in Oakland, CA, and Sacramento, CA, and characteristics of fast-food restaurants before and after implementation of the Oakland sugar-sweetened beverage tax.

	Oakland, CA			Sacramento, CA		
	Pre-Tax	6-Months Post-Tax	12-Months Post-Tax	Pre-Tax	6-Months Post-Tax	12-Months Post-Tax
Product characteristics						
Mean price per oz.						
Bottled regular soda	10.55 (1.66)	11.11 (1.89)	11.55 (2.24)	9.56 (1.91)	9.33 (1.82)	9.34 (1.86)
Bottled diet soda	10.64 (1.77)	11.14 (2.02)	11.81 (2.34)	9.82 (1.78)	10.02 (1.79)	9.86 (1.79)
Fountain drinks	7.90 (2.87)	8.35 (3.04)	8.04 (2.93)	8.59 (2.43)	8.52 (2.58)	8.40 (2.51)
Restaurant characteristics						
Chain restaurant	24 (63%)	21 (62%)	23 (68%)	30 (54%)	29 (54%)	29 (56%)
Restaurant type						
Burger and fries	12 (32%)	10 (29%)	12 (35%)	14 (25%)	14 (26%)	13 (25%)
Mexican/Latin American	5 (13%)	3 (9%)	5 (15%)	10 (18%)	9 (17%)	10 (19%)
Fried chicken/fried fish	7 (18%)	7 (21%)	7 (21%)	2 (4%)	1 (2%)	2 (4%)
Sandwich	7 (18%)	7 (21%)	4 (12%)	15 (27%)	15 (28%)	14 (27%)
Pizzeria/Italian	4 (11%)	4 (12%)	3 (9%)	8 (14%)	8 (15%)	6 (12%)
Chinese/Pan-Asian	3 (8%)	3 (9%)	3 (9%)	3 (5%)	3 (6%)	3 (6%)
Other	0 (0%)	0 (0%)	0 (0%)	4 (7%)	4 (7%)	4 (8%)
Free water accessible to customers	17 (46%)	12 (36%)	14 (41%)	42 (75%)	35 (66%)	33 (63%)
Has fountain machine	27 (71%)	23 (68%)	26 (76%)	48 (86%)	47 (87%)	45 (87%)
Free refills offered	18 (67%)	18 (78%)	17 (65%)	41 (87%)	40 (85%)	40 (89%)
Self-serve machine	18 (67%)	15 (65%)	17 (65%)	43 (91%)	43 (91%)	41 (91%)

Mean prices per ounce in cents are shown with standard deviations in parentheses. The number of bottled regular soda products (with number of restaurants in parentheses) was 23 (16), 24 (16), and 17 (13) in Oakland and 29 (23), 28 (21), and 29 (20) in Sacramento at baseline, 6-months post-tax, and 12 months post-tax, respectively. The number of bottled diet soda products (with number of restaurants in parentheses) was 17 (14), 15 (14), 13 (10) in Oakland and 21 (18), 20 (17), and 20 (17) in Sacramento at baseline, 6-months post-tax, and 12 months post-tax, respectively. The number of fountain drink products (with number of restaurants in parentheses) was 68 (27), 56 (23), and 65 (26) in Oakland and 105 (46), 103 (45), and 104 (41) in Sacramento at baseline, 6-months post-tax, and 12 months post-tax, respectively. Summary statistics on restaurant characteristics are shown for restaurants included in any of the three analyses: 38, 34, 34 in Oakland and 56, 54, 52 in Sacramento at baseline, 6-months post-tax, and 12 months post-tax, respectively. Due to some missing data on restaurant characteristics, denominators are lower for some items. Restaurants were defined as a chain if they offered franchise opportunities or had corporate headquarters. An example of a restaurant type that is classified as “other” is Hawaiian barbeque.

Table 2
Difference-in-differences tax pass-through estimates in cents per ounce in fast-food restaurants with 95% confidence intervals.

	N Products	N Restaurants	6-Months Post-Tax	12-Months Post-Tax
Bottled regular soda	150	39	0.69 (−0.18, 1.60)	0.82* (0.14, 1.61)
Bottled diet soda	106	32	0.49 (−0.42, 1.47)	0.80 (−0.02, 1.60)
Fountain drinks	501	73	0.55 (−0.16, 1.67)	0.29 (−0.25, 0.90)

* indicates estimates are significant at the $p < 0.05$ level. Each row contains results and sample sizes from separate difference-in-differences linear regressions by beverage category, controlling for restaurant and product fixed effects. Standard errors were bootstrapped and clustered on restaurant, and bias-corrected confidence intervals are shown.

4. Discussion

Across the U.S., taxation of SSBs has gained support as a policy-level strategy for reducing SSB consumption and curbing health-related risks. This study contributes to the literature as the first to estimate the impact of the Oakland SSB tax on fast-food beverage prices and is just the second U.S. study in fast-food restaurants.

At 12-months post-tax, this study found an 82% tax pass-through to regular bottled soda. Although not statistically significant, the estimated impact was similar in magnitude for diet bottled soda, which suggests that restaurants may be raising prices of both taxed and untaxed bottled soda. Findings from studies based on store data, however, in jurisdictions where regular soda is taxed and diet soda is untaxed have found moderate to full pass-through to regular soda prices and no to moderate pass-through to diet soda prices (Cawley et al., 2018a; Public Health-Seattle and King County, 2019; Falbe et al., 2015). One explanation for the differences in findings across these settings is that restaurants may post a single price for soda to simplify the menu, while food stores typically label and price differentiate each product on the shelf. The effective price increase of regular soda was 8%, which is much lower than the 20% suggested by the World Health Organization to meaningfully improve health outcomes (World Health Organization, 2016). Using an estimated average price elasticity of demand of −1.2 for SSBs, a price increase of 8% is expected to reduce demand by just under 10% (Powell et al., 2013).

The relatively small and statistically insignificant estimated impact on fountain drink prices may be because the tax is being spread across taxed and untaxed fountain drinks or other menu items, such as combination meals. Additionally, restaurants may absorb part of the tax because syrup is inexpensive, resulting in high profit margins (85–90%) for fountain drinks ("Downsizing Supersize", 2005). These findings are not consistent with Cawley et al., 2018a, which estimated partial tax pass-through to fountain drinks sold in fast-food restaurants and overshifting to fountain drinks sold in food stores.

5. Strengths and limitations

Strengths of this study include the use of a matched comparison site and multiple data collection periods to assess short-and longer-term effects. The study was limited to evaluating bottled soda and fountain drinks because there were insufficient data to analyze price changes of other taxed and untaxed beverages. The diet soda sample size may have limited the ability to detect statistically significant price changes. Additionally, we could not test whether restaurants increased meal prices because we only collected prices of beverages.

6. Conclusion

In summary, nearly full tax pass-through to prices of bottled regular soda was found in fast-food restaurants one year after the Oakland, CA, SSB tax was implemented. The estimated effects indicate that the tax impact on prices is gradual and may not be effective at deterring SSB consumption in fast-food restaurants because restaurants do not appear to be price differentiating between taxed and untaxed bottled soda or increasing prices of fountain drinks. Additionally, the magnitude of the price increase may not be sufficient to improve nutrition and reduce obesity and other non-communicable diseases. Further research is needed to evaluate the impact of SSB taxes on beverage and meal prices in fast-food restaurants and how this effect is modified by restaurant and neighborhood characteristics.

CRediT authorship contribution statement

Samantha Marinello: Formal analysis, Data curation, Writing - original draft. **Andrea A. Pipito:** Writing - review & editing, Supervision, Project administration. **Julien Leider:** Methodology, Data curation, Writing - review & editing. **Oksana Pugach:** Methodology, Writing - review & editing. **Lisa M. Powell:** Conceptualization, Methodology, Writing - review & editing, Supervision, Financial acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

An, R., Maurer, G., 2016. Consumption of sugar-sweetened beverages and discretionary foods among US adults by purchase location. Eur. J. Clin. Nutr. 70 (12), 1396–1400. https://doi.org/10.1038/ejcn.2016.136.

Cawley, J., Crain, C., Frisvold, D., Jones, D., 2018a. The pass-through of the largest tax on sugar-sweetened beverages: the case of Boulder, Colorado. NBER Working Paper No. 25050. https://doi.org/10.3386/w25050.

Cawley, J., Willage, B., Frisvold, D., 2018b. Pass-through of a tax on sugar-sweetened beverages at the Philadelphia International Airport. JAMA 319 (3), 305–306. https://doi.org/10.1001/jama.2017.16903.

Centers for Disease Control and Prevention, National Center for Health Statistics, 2017. Normal weight, overweight, and obesity among adults aged 20 and over, by selected characteristics: United States, selected years 1988–1994 through 2013–2016. Retrieved from https://www.cdc.gov/nchs/data/hus/2017/058.pdf.

Downsizing Supersize. (2005). CSP Daily News. Retrieved from https://www.cspdailynews.com/beverages/downsizing-supersize.

Falbe, J., Rojas, N., Grummon, A.H., Madsen, K.A., 2015. Higher retail prices of sugar-sweetened beverages 3 months after implementation of an excise tax in Berkeley California. Am. J. Public Health 105 (11), 2194–2201. https://doi.org/10.2105/AJPH.2015.302881.

Flood, J.E., Roe, L.S., Rolls, B.J., 2006. The effect of increased beverage portion size on energy intake at a meal. J. Am. Diet Assoc. 106 (12), 1984–1990. https://doi.org/10.1016/j.jada.2006.09.005.

Fryar, C.D., Hughes, J.P., Herrick, K.A., Ahluwalia, N., 2018. Fast food consumption among adults in the United States, 2013–2016. NCHS Data Brief (322). Retrieved

from https://www.cdc.gov/nchs/products/databriefs/db322.htm.
Hu, F.B., 2013. Resolved: There is sufficient scientific evidence that decreasing sugar-sweetened beverage consumption will reduce the prevalence of obesity and obesity-related diseases. Obes. Rev. 14 (8), 606–619. https://doi.org/10.1111/obr.12040.
John, L.K., Donnelly, G.E., Roberto, C.A., 2017. Psychologically informed implementations of sugary-drink portion limits. Psychol. Sci. 28 (5), 620–629. https://doi.org/10.1177/0956797617692041.
Johnson, R.K., Appel, L.J., Brands, M., Howard, B.V., Lefevre, M., Lustig, R.H., Sacks, F., Steffen, L., Wylie-Rosett, J., 2009. Dietary sugars intake and cardiovascular health: A scientific statement from the American Heart Association. Circulation 120 (11), 1011–1020. https://doi.org/10.1161/CIRCULATIONAHA.109.192627.
Leider, J., Pipito, A.A., Powell, L.M., 2018. The Impact of the Cook County, Illinois, Sweetened Beverage Tax on Prices, 2017. Illinois Prevention Research Center, University of Illinois at Chicago (Research Brief No. 105). Retrieved from https://illinoisprc.org/publications/.
Li, Y., Leider, J., Pipito, A.A., Pugach, O., Zenk, S.N., Powell, L.M., 2019. Development and Reliability Testing of a Fast-Food Restaurant Observation Form for Use in Beverage Tax Evaluations. Illinois Prevention Research Center, University of Illinois at Chicago (Research Brief No. 112). Retrieved from https://illinoisprc.org/publications/.
Moran, A.J., Subramanian, S.V., Rimm, E.B., Bleich, S.N., 2019. Characteristics associated with household purchases of sugar-sweetened beverages in US restaurants. Obesity 27 (2), 339–348. https://doi.org/10.1002/oby.22380.
Powell, L.M., Chriqui, J.F., Khan, T., Wada, R., Chaloupka, F.J., 2013. Assessing the potential effectiveness of food and beverage taxes and subsidies for improving public health: A systematic review of prices, demand and body weight outcomes. Obes. Rev. 14 (2), 110–128. https://doi.org/10.1111/obr.12002.
Public Health-Seattle and King County, 2019. 6 Month Report: Store Audits – The Evaluation of Seattle's Sweetened Beverage Tax. Retrieved from https://www.seattle.gov/Documents/Departments/CityAuditor/auditreports/6%20Month%20Store%20Audit%20Report%20.pdf.
Roberto, C.A., Lawman, H.G., LeVasseur, M.T., Mitra, N., Peterhans, A., Herring, B., Bleich, S.N., 2019. Association of a beverage tax on sugar-sweetened and artificially sweetened beverages with changes in beverage prices and sales at chain retailers in a large urban setting. JAMA 321 (18), 1799–1810. https://doi.org/10.1001/jama.2019.4249.
von Philipsborn, P., Stratil, J.M., Burns, J., Busert, L.K., Pfadenhauer, L.M., Polus, S., Holzapfel, C., Hauner, H., Rehfuess, E., 2016. Environmental interventions to reduce the consumption of sugar-sweetened beverages and their effects on health. Cochrane Database Syst. Rev. 7. https://doi.org/10.1002/14651858.CD012292.
World Health Organization, 2016. Fiscal policies for diet and prevention of non-communicable diseases: technical meeting report, 5–6 May 2015, Geneva, Switzerland. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/250131/9789241511247-eng.pdf?sequence=1.