

A Review and Meta-analysis of Tax Pass-through of Local Sugar-Sweetened Beverage Taxes in the United States

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Key Findings

- **Based on a meta-analysis of 26 estimates from 22 studies that examined seven of the eight U.S. local sugar-sweetened beverage taxes implemented to date, this review found that, on average, tax pass-through was 70%, although there was substantial variation across studies.**
- **Estimates of tax pass-through based on retail scanner data compared to audit data were similar on average, with overlapping confidence intervals.**
- **Additionally, estimates of tax pass-through in jurisdictions with lower (i.e., one cent per ounce) compared to higher (i.e., greater than one cent per ounce) tax rates were similar on average.**

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Introduction

Sugar-sweetened beverage (SSB) taxation is used as a policy instrument aimed at reducing SSB consumption given its linkage to numerous health risks.¹⁻³ Since 2015, SSB taxes have been introduced in eight local city/county jurisdictions in the U.S. (Albany, Berkeley, Oakland, and San Francisco, California; Boulder, Colorado; Cook County, Illinois; Philadelphia, Pennsylvania; and Seattle, Washington) with one having since been repealed (Cook County). The taxes have ranged in terms of the products included in their tax bases (i.e., SSBs only versus both SSBs and artificially sweetened beverages (ASBs)), the point of levy (i.e., distributor versus retail at the point-of-sale), and tax rate (i.e., from 1 to 2 cents per ounce).

For taxes to achieve the public health goal of reducing SSB consumption, they must increase prices faced by consumers. The extent to which taxes are passed on to consumers in the form of higher prices depends on several factors including consumer price responsiveness (referred to as price elasticity of demand) and market structure. For example, in competitive markets where consumers are relatively price-insensitive (i.e., inelastic demand) or in markets with limited competition, taxes tend to be more fully passed on to consumers. However, in competitive settings with elastic demand, taxes tend to be only partially passed through to consumers, where the level of pass-through is decreasing in consumer price sensitivity.

The extent to which taxes are passed on to consumers in the form of higher prices affects the extent to which they reduce demand. In this research brief, we provide a review of study findings on tax pass-through from U.S. SSB taxes (referring hereafter to taxes on both SSBs and ASBs as well as taxes on SSBs alone). The review includes peer-reviewed journal articles and governmental reports published between January 2015 and April 2021 that evaluated the impact of a U.S. SSB tax on prices of taxed beverages. Based on searches in four bibliographic electronic databases, we summarize 26 estimates from 22 unique studies. The tax pass-through estimates reported on in this review represent seven of the eight jurisdictions (sans Albany) implementing taxes since 2015. We conducted a meta-analysis to provide an overall estimate of tax pass-through and undertook separate meta-analyses to assess differences based on studies' data sources (retail audit data versus scanner data) and tax rate (one cent per ounce versus greater than one cent per ounce).

Methods

The meta-analysis was based on peer-reviewed journal articles and governmental reports published between January 2015 and April 2021 that evaluated the impact of a U.S. SSB tax on prices of taxed beverages. Searches were undertaken in the following four bibliographic electronic databases: PubMed, Web of Science, EconLit and Google Scholar. To meet inclusion criteria, only study estimates with reported uncertainty were considered; where that was missing, we made attempts to obtain a confidence interval or standard error from the study authors.

For each study, the broadest summary estimate of tax pass-through for taxed beverages was extracted. If a study only provided estimates stratified by store or beverage type,⁴⁻⁸ the highest-level estimates were extracted (e.g., estimates for taxed beverages for each store type; or estimates by beverage type) and a sub-analysis was conducted to obtain a single estimate and confidence interval for taxed beverages overall from these stratified estimates. These sub-analyses were conducted using the same random-effects meta-analysis methodology used for the main analysis. Estimated pass-through over the entire post-tax period was extracted where possible; otherwise, pass-through at the latest post-tax period was extracted. Where estimates were reported from multiple models, the authors' primary model was used to extract estimates; when not specified, models with balanced data were selected over those with unbalanced data, weighted models were selected over unweighted models, and the most fully controlled model was chosen. If a single study evaluated taxes in multiple jurisdictions or conducted analyses using multiple distinct datasets (e.g., store audit and scanner data), separate estimates were extracted for each jurisdiction and dataset. Estimates were converted from absolute changes in price to tax pass-through (i.e., change in price as a percentage of the tax rate) based on the size of the tax. Extractions were undertaken by two authors and coding differences were reviewed and resolved with a third author.

The final analysis sample included 26 estimates from 22 studies. Because true effect sizes were expected to vary across studies (e.g., due to different store types, tax rates, and time periods), effect sizes were pooled in an inverse-variance weighted meta-analysis using a random effects model.^{9,10} Analyses were conducted based on extracted estimates and 95% confidence intervals for all studies. Standard errors were computed from the confidence intervals under the assumption that the confidence intervals were from a standard normal distribution. In the case of two studies, where confidence intervals were computed by bootstrapping and were asymmetric as a result,^{7,8} this assumption was violated, which is acknowledged as a limitation. Heterogeneity variance was estimated using the DerSimonian-Laird estimator, with associated confidence interval computed using the Jackson method. For the main meta-analysis study findings (Figure 1) the between-study heterogeneity variance was 0.15 (95% CI 0.06, 0.33) and the percentage of variation across studies that was due to heterogeneity (I^2) was 99.2% (95% CI 99.1%, 99.3%). Analyses were conducted in R version 4.1.0 using the *meta* package version 4.18-1.¹¹

Results

The meta-analysis results shown in Figure 1 reveal that based on 26 estimates of tax pass-through from 22 studies of SSB taxes in the U.S., on average, 70% (0.70, 95% CI 0.53, 0.86) of the tax was passed on to consumers.

As a sensitivity analysis, the overall tax pass-through meta-analysis was re-estimated excluding the two Cook County tax estimates, given that was the only tax levied at the retail rather than the distributor level. Results from this meta-analysis revealed a tax pass-through rate of 65% (0.65, 95% CI 0.50, 0.79), which was within the confidence interval range of our primary analysis.

FIGURE 1 Tax Pass-through Estimates and Meta-analysis Results

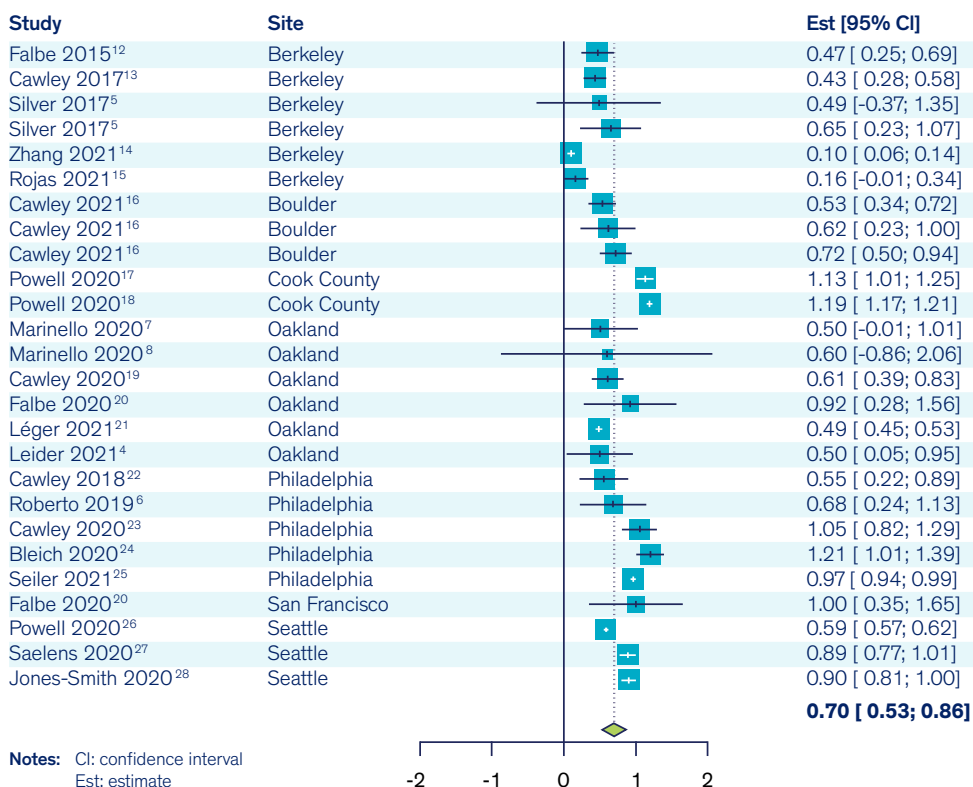
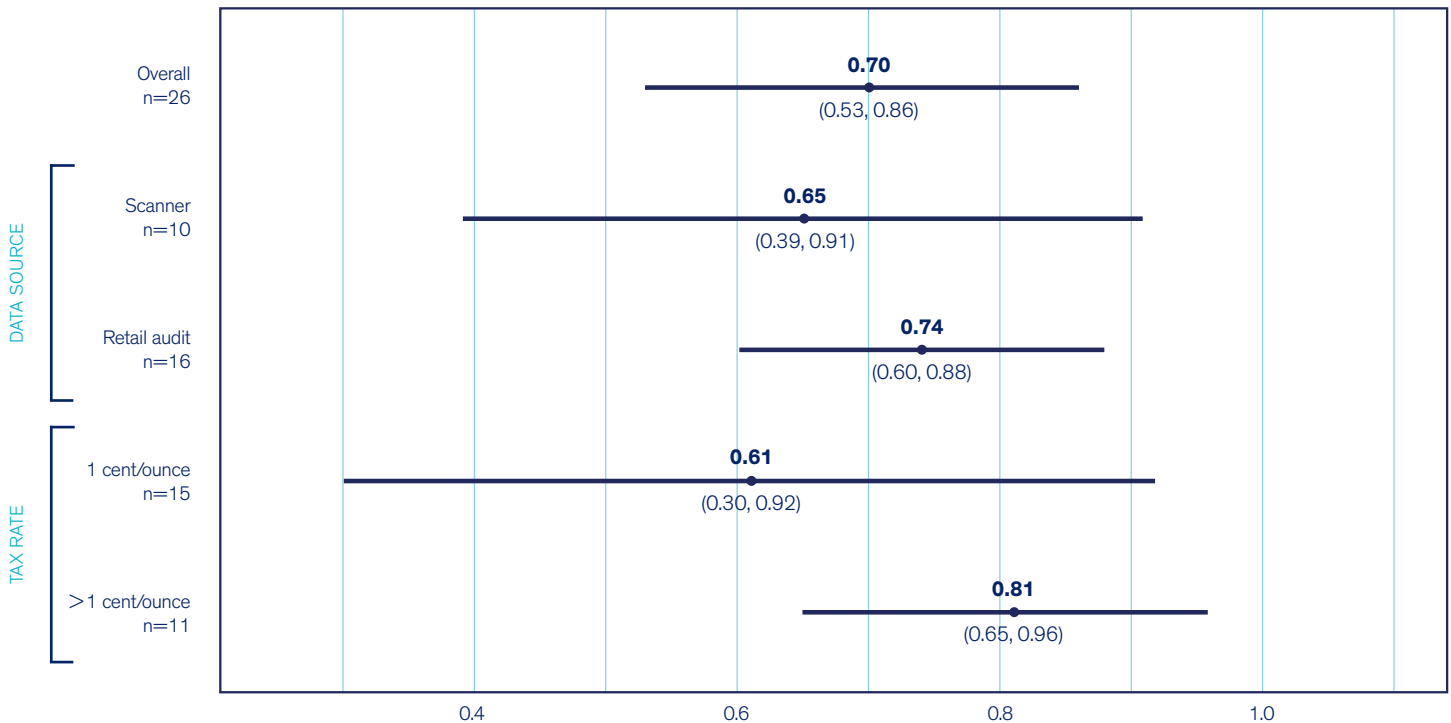


FIGURE 2 Tax Pass-through Meta-analysis Results by Study Data Source and Tax Rate



Notes: Estimates shown with 95% confidence intervals.

Figure 2 summarizes the results from separate meta-analyses that examine potential differences in tax pass-through based on studies' data sources and the tax rate. The results show that the tax pass-through estimates from these separate meta-analyses all overlap with the overall estimate of 70% tax pass-through.

- By data source: average tax pass-through is estimated to be 65% (0.65, 95% CI 0.39, 0.91) based on 10 estimates^{5,6,14-18,21,25,26} that used scanner data and 74% (0.74, 95% CI 0.60, 0.88) based on 16 estimates^{4,5,7,8,12,13,16,19,20,22-24,27,28} that used store/restaurant audit data.
- By tax rate: average tax pass-through is estimated to be 61% (0.61, 95% CI 0.30, 0.92) based on 15 estimates^{4,5,7,8,12-15,17-21} from tax jurisdictions with a one cent per ounce tax and 81% (0.81, 95% CI 0.65, 0.96) based on 11 estimates^{6,16,22-28} from jurisdictions with taxes greater than one cent per ounce.

Conclusions

The results from this review showed that, on average, tax pass-through of local U.S. SSB taxes (including two taxes that were also applied to ASBs) was 70%, although there was substantial variation across studies. Separate sub-group meta-analyses showed similarities in tax pass-through estimates across study data sources (i.e., retail audit data versus scanner data) and jurisdictional tax rates (i.e., one cent per ounce tax compared to larger taxes). The results were also found to be robust to the exclusion of the only retail point-of-sale tax, which was imposed in Cook County. While the two estimates for the Cook County retail tax revealed an over-shifting of the tax, it should be noted that retail taxes applied at the point-of-sale may not be as salient to consumers, because tax-related price increases may be less likely to be incorporated into the shelf price (on which consumers may mostly base purchase decisions) unless mandated in the ordinance and enforced. Finally, continued monitoring of tax pass-through is important for understanding whether pass-through increases over time; 22 of the 26 estimates included in this review were for one year or less post-tax implementation. Overall, the results of this review revealed that, on average, the majority of the SSB tax amount was passed on to consumers in the form of higher prices for taxed beverages, and thus local U.S. SSB taxes can be expected to impact demand.

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