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ABSTRACT

Taxes on sweetened beverages have been widely adopted in response to increases in diet-related chronic disease. An episode of particular interest occurred in Cook County, Illinois, where a beverage tax was announced, implemented, and then repealed. This paper is the first to estimate the effects of this tax using household-level data on purchases. We estimate difference-in-differences models that compare the change in beverage purchases over time in Cook County to that in comparison areas. The results indicate that consumer purchases did not detectably respond to the announcement of the tax. Implementation of the tax reduced purchases by 22.5% for all taxed beverages, 16.5% for high-calorie taxed beverages and a 33% for low-calorie (e.g. diet) taxed beverages. This implies a price elasticity of demand of -0.66 for all taxed beverages, -0.48 for high-calorie taxed beverages and -0.97 for low-calorie taxed beverages. The impact of the tax did not vary by household income, and there is no detectable impact of the tax on purchases of possible substitutes (bottled water, fruit juice, milk). After repeal of the tax, purchases of taxed beverages returned to their baseline quantities; there was no evidence of habit formation.

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Introduction

Sugar-sweetened beverages or SSBs (such as colas, energy drinks, and sweetened fruit juices) are responsible for over 40% of American adults' daily intake of added sugars (USDA and HHS, 2020) and their consumption is associated with weight gain (Keller & Bucher Della Torre, 2015). This is a concern in light of increases in diet-related chronic diseases such as diabetes and obesity (NCD-RisC, 2016, 2017).

The U.S. Dietary Guidelines recommend that intake of SSBs be limited to small amounts and replaced with water (USDA and HHS, 2020). Numerous medical and public health organizations have called for fiscal policies to incentivize such changes and improve diets (WHO, 2024; Bleich et al., 2015; Frieden et al., 2010; Fletcher et al., 2011). Perhaps the most common policy response worldwide is to enact taxes on sweetened beverages. These taxes have been enacted in many cities, regions, and countries (Cawley & Frisvold, 2023), so their effects are of great interest for health policy. In this paper, we estimate the impact of the beverage tax of one cent per ounce in Cook County, Illinois, USA, which is home to Chicago. This tax was announced, implemented, and then repealed, allowing us to study the effects of each event separately to better understand how and why consumers respond to diet-related fiscal policies.

The Cook County tax was passed on November 10, 2016, and took effect August 2, 2017. It applied to sugar-sweetened beverages (SSBs) and diet beverages (sometimes called artificially sweetened beverages or ASBs). The Cook County tax was controversial and passed the county legislature only through a tie-breaking vote; ongoing controversy led to its repeal effective December 1, 2017 (Chriqui et al., 2020). We estimate Poisson difference-in-differences models that are well-suited to the nature of our data. The results of the models, which compare the change in beverage purchases over time in Cook County to that in comparison areas, indicate

that consumer purchases did not significantly respond to the announcement of the tax. In contrast, implementation of the tax reduced purchases by 22.5% for all taxed beverages, by 16.5% for high-calorie taxed beverages and by 33% for low-calorie taxed beverages. After repeal of the tax, purchases returned to their baseline levels, yielding no evidence of habit formation.

This is the first paper to study the Cook County tax using data on household-level purchases.[2] As a result, this research contributes to the literature by providing new evidence based on household purchases from all locations, which includes purchases from small independent stores and from stores outside of Cook County, and by testing for heterogeneous responses to the tax based on household characteristics. Prior research has studied the effect of the Cook County tax using store-level sales data (Powell et al., 2020; Powell & Leider, 2020; Powell et al., 2020) and found that the tax significantly reduced sales of taxed beverages in Cook County stores, and that sales rebounded to pretax levels after repeal of the tax. Store-level data and household-level data each have their own strengths. A strength of store-level data is that it captures all beverage sales by the stores included in the data. However, a weakness is that the samples tend to include only large chain stores and exclude small independent stores at which low-income households are more likely to shop (Bleich et al., 2020). A strength of household-level data is that it includes all purchases by the household, including at smaller stores not included in retail scanner data. In addition, household-level data include purchases from all locations, including outside the taxing jurisdiction, allowing one to take into account any cross-border shopping to avoid paying the tax. Another strength of household-level data is that it enables testing for differential effects by household characteristics such as income, education, race, or the presence of children. A limitation of household-level data is that it includes only a

[2] Other studies to use household-level scanner data to study SSB taxes in locations other than Cook County include Knox & Jones-Smith (2024), Barker et al. (2022), and Cawley, Frisvold, and Jones (2020).

small percentage of consumers in the city. Thus, both types of data provide valuable information, and it is an important contribution to add what can be learned about the Cook County tax from household-level data to the existing evidence that is based on store-level data.

Another contribution of this paper is that it has a larger sample size of treated households than the previous papers to use household-level scanner data to study the effects of SSB taxes (Cawley et al., 2020; Barker et al., 2022; Knox & Jones-Smith, 2024). To clarify, all such previous papers studied SSB taxes in communities other than Cook County; the present paper is the first to use household-level data to study the Cook County tax.

Another important additional contribution of this paper is that it separately estimates the effects on beverage purchases arising from three events: announcement of the tax, its implementation, and its repeal. Understanding the impact of these separate events yields insights into how the tax policy influences consumers' behavior. The announcement of the tax could influence behavior by providing information or causing consumers to stockpile before the tax, the implementation of the tax could influence behavior through prices, and how consumers respond to repeal of the tax could be influenced by habit formation.

The announcement of the upcoming tax, even before it is effective, could impact demand if it is seen by consumers as confirmation that such beverages are unhealthy. A study of the SSB tax in Berkeley CA found that sales decreased on the campus of the University of California at Berkeley even before the tax was implemented there (Taylor et al., 2019). A study of the UK's SSB tax found that the announcement of the upcoming two-tiered tax led to no change in the purchases of beverages that would be taxed at the higher level, a reduction in purchases of beverages that would be taxed at the lower level, and an increase in purchases of beverages that would be untaxed (Rogers et al., 2023).

We also study how beverage purchases responded to the repeal of the beverage tax. There could be durable effects after repeal if there is habit formation in SSB consumption (Zhen et al., 2011). This paper contributes to the literature on whether behavior change persists after the repeal of policies or removal of incentives (e.g., Schmacker & Smed, 2020; Ozturk et al., 2020; Brewer and Cameron, 2023; Bechtel et al., 2018). For example, Schmacker & Smed (2020) estimated the impact on consumer purchases of Denmark increasing its SSB tax and then soon thereafter reducing it by half and then eliminating it altogether. Using household scanner data, they estimate that the price elasticities of demand for the increase and decrease in taxes were equal. They did not have a geographic control group given that their tax was at a national level; because our tax is at the county level we are able to identify comparison areas and estimate difference-in-difference models.

Data

We analyze data from the NielsenIQ Homescan Panel, which documents the details of participating households' shopping trips. Participants scan in their grocery purchases after returning home, so a limitation of the Homescan data (as well as retail scanner data) is that they do not include consumption away from home, such as at restaurants or from vending machines. Despite this limitation, Homescan and retail scanner data have been used to study the effects of SSB taxes (e.g. Knox and Jones-Smith, 2024; Powell, Leider, and Leger, 2020; Cawley, Frisvold, and Jones, 2020). Moreover, because the majority of U.S. soft drink sales by volume take place in retail outlets rather than in restaurants or vending machines, the Homescan data capture the predominant share of household beverage purchases. According to Statista Market

Insights, about 80% of soft drink volume in the United States (and 73–75% of carbonated soft drink volume) is purchased from retailers for at-home consumption (Statista, 2025a, 2025b).

Our dependent variable is the number of ounces of specific types of beverages purchased per household per month. Aggregating individual shopping trips to the monthly level balances the priorities of granularity of time and smoothness of purchase data.

To study the tax in Cook County, which was passed in 2016 and implemented and then repealed in 2017, we use data from January 1, 2016 through December 31, 2018, which includes 10 months of data prior to the announcement (the baseline period), 9 months of data after the announcement but prior to the implementation of the tax, 4 months of data during which the tax was in effect, and 13 months of data after the repeal of the tax.

The NielsenIQ panel is a rotating panel with approximately 60,000 households each year, and annual attrition of approximately 15%, with new households added each year to replace those that stop participating in the program. To avoid any compositional bias stemming from households entering and leaving the panel, we use the balanced panel of households that were included in the NielsenIQ Homescan data continuously from January 2016 through December 2018.

There are 1,311 households in our sample, which includes 712 households in the treatment community of Cook County and 599 households in the comparison areas, which are explained in the next section. A strength of this paper is that, despite limiting the sample to a balanced panel, the data include more treated households in Cook County (712) than the three previous studies to use household-level scanner data to study the effect of SSB taxes in other U.S. cities had in their pooled analyses of multiple taxing cities (which ranged from approximately 400 to 583); see Knox & Jones-Smith (2024), Barker et al. (2022), and Cawley,

Frisvold and Jones (2020). The 712 households treated by the Cook County tax is also larger than the sample of 553 treated households in the study of the Danish SSB tax (Schmacker & Smed, 2020).

The total sample size (households * months) is 47,196. For any given regression, the number of households used to estimate the model varies, because any households with zero purchases of that category of beverages in *every* month of the three-year period are dropped. (To clarify, all households that are ever observed buying that category of beverages remain in the sample; the only households that are dropped are those that are never observed buying any beverages in that category during the three years.)

Methods

Our outcome of interest is the number of ounces of specific types of beverages purchased per household. Consumer response to the tax may have differed for high-calorie beverages[3] (such as cola, soda, and energy drinks) and low-calorie[4] and diet beverages (such as diet soda and flavored waters). The two types of drinks may have different price elasticities of demand (Haeck et al., 2022) for a variety of reasons, such as being purchased by different types of consumers (e.g. if youth drink more high-calorie drinks and adults drink more low-calorie drinks) or because there is greater advertising of high-calorie than low-calorie drinks (Eisenberg et al., 2021). For this reason, we estimate not only the overall impact of the tax on all taxed beverages, but also the impact on high-calorie and low-calorie beverages separately.

[3] The category of taxed high-calorie beverages includes beverages classified by NielsenIQ in the Carbonated Beverages group, excluding Low Calorie Soft Drinks. We also include all packaged fruit drinks and all non-carbonated soft drinks, which include fruit punches, and cocktail mixes, among others. We exclude ice pops, which is also included in this category, but is not a beverage. We exclude products described as low calorie or diet.
[4] The category of taxed low-calorie beverages includes beverages classified by NielsenIQ as Low Calorie Soft Drinks, as well as products in the Carbonated Beverages, Non-Carbonated beverages, and packaged fruit drinks categories that are described as low calorie or diet.

There may also be nonzero *cross-price* elasticities; consumers may not only buy less of the taxed beverages but buy more of certain untaxed beverages. To examine this possibility, we estimate models of purchases of three categories of beverages that were untaxed but are possible substitutes for the taxed beverages: bottled water, 100% fruit juice, and milk.

To estimate the effect of the tax, we compare the changes in beverage purchases over time in the treated community of Cook County, IL to those in comparison communities. We used as comparison areas other midwestern counties also dominated by large metropolitan areas: St. Louis City and County, MO; Hennepin County, MN (home to Minneapolis); and Ramsey County, MN (home to St. Paul). Past studies of the Cook County beverage tax using store-level data also used St. Louis City and County as their comparison area (Powell et al., 2020; Powell & Leider 2020; Powell et al., 2020). Table 1 provides a comparison of the treatment and comparison counties for the analysis sample from NielsenIQ Homescan. Households in Cook County purchased an average of 426.8 ounces of taxed beverages each month, which includes 284.5 ounces of high-calorie beverages and 142.3 ounces of low-calorie beverages. Households also purchased a monthly average of 231.9 ounces of water, 49.6 ounces of 100% fruit juice, and 199.2 ounces of milk, all of which are exempt from the SSB tax. Appendix Table 1 compares the treatment and comparison counties using data from the U.S. Census (Panel A), County Health Rankings (Panel B), and NielsenIQ Ailments Panel (Panel C). Since households in Cook County purchase fewer ounces of beverages than households in the comparison counties and the demographic characteristics differ to some extent across counties, we utilize methods that control for these fixed demographic characteristics and consider the trends in purchases across counties.

Appendix Figure A.1 shows the monthly time series of the share of Cook County households with positive purchases across beverage categories in our data. Panel A includes the

two taxed beverage categories and Panel B includes the three untaxed beverage categories. On average in any given month, 60% of households have positive purchases of the taxed high-calorie beverages. There are 14 households that, in the entire three-year period, never buy any taxed high-calorie beverages in the entire sample, 5 of which are from Cook County. It is less common for households to buy taxed low-calorie beverages; on average in any given month, about 31% of households have positive purchases of such beverages in any given month, and 202 households (102 from Cook County) never reported a positive purchase of these beverages.[5]

We estimate the change in purchases over time in Cook County relative to that in comparison areas using a difference-in-differences regression model. This is based upon the assumption of parallel trends: in the absence of the tax, purchases of beverages in Cook County would have exhibited the same time trend as those in the comparison communities. We examine the validity of this assumption using event study models that show the month-by-month trend in purchases of the treatment versus comparison groups.

We estimate a Poisson model, following the recommendations of Chen & Roth (2024) and Mullahy & Norton (2024), because of the nature of the outcome data: the quantity of beverages purchased by the household. They are count data (number of ounces of a specific category of beverages purchased per month), which are non-negative, skewed (some households buy a lot of beverages), and contain a non-trivial percentage of households buying zero ounces of a given category of beverages in a given month. Additionally, the use of the Poisson model has the advantage of comparability with a past study of the Cook County tax based on retail scanner data (Powell et al., 2020).

[5] For all taxed beverages combined, there are 7 households that never buy any in each month of our three-year period, 3 of which are in Cook County. The number of households that never buy any untaxed beverages during that period is: for water, 140 (59 of which are in Cook County); for 100% fruit juice, 72 (28 of which are in Cook County), and for milk, 26 (10 of which are in Cook County).

The specification of the Poisson difference-in-difference model allows us to estimate how each stage of the tax process differed from the pre-announcement baseline: a) the announcement of the upcoming tax (a possible effect from information); b) when the tax was effective (a possible effect from the increase in price); and c) post-repeal (a possible effect from the reduction in price and perhaps habit formation).

Our main regression specification, the Poisson difference-in-difference model, is:

$$y_{ht} = \exp\left[\beta_{ann} \cdot TP_{ann(ht)} + \beta_{eff} \cdot TP_{eff(ht)} + \beta_{rep} \cdot TP_{rep(ht)} + \eta_h + \eta_t\right] \cdot \epsilon_{ht} \quad (1)$$

Our dependent variable (y_{ht}) is the number of ounces of a given type of beverage purchased by household h in month t. $TP_{ann(ht)}$ is an indicator variable that equals one when the household resides in Cook County and the month in question is during the announcement period; i.e. after the tax was announced (November 9, 2016) but before it was implemented (July 2017). Analogously, $TP_{eff(ht)}$ is an indicator variable that equals one when the household resides in Cook County and the month in question is during the time the tax was effective (August through November of 2017). Finally, $TP_{rep(ht)}$ is an indicator variable that equals one when the household resides in Cook County and the month in question is after the repeal of the tax (i.e., after December 1, 2017). We control for fixed effects for household (η_h) and month (η_t). We cluster standard errors at the level of household h to account for any correlation in error terms within households over time.

We transform the Poisson coefficients and report results as percent changes from baseline (Chen and Roth, 2024). For example, for the coefficient for when the tax was in effect, the percent change is $100 * \left(\exp\left[\beta_{eff(ht)}\right] - 1\right)$.

The choice of the Poisson model affects the number of households/clusters used in the regression because this method does not use households with zero variation in the outcome (e.g.,

households with zero purchases in *every* month across the entire three years). For example, the model for high-calorie taxed beverages is estimated using 1,297 households, which excludes the 14 households which had zero purchases in *every* month of the sample.

In addition to the Poisson difference-in-differences model, we estimate Poisson event study models that show how household purchases of beverages evolved, month-by-month, during each stage of the tax:

$$y_{ht} = \exp\left[\sum_{t \neq Oct2016} \beta_t \cdot T_{[t=1]} \quad + \eta_h + \eta_t\right] \cdot \epsilon_{ht} \quad (2)$$

We use the last month prior to the announcement (October 2016) as the reference period. We interact each month with an indicator variable for residence in Cook County; this allows us to test the similarity of the trends in beverage purchases for the treatment and control groups. Similarity of trends in purchases prior to the announcement of the tax are informative about whether the comparison counties are a valid counterfactual for the treatment county. The transformation $100 * \left(\exp\left[\beta_{t(ht)}\right] - 1\right)$ establishes the percent change with respect to the reference period of October 2016, which is the last month before the announcement.

We then undertake several extensions and robustness checks: 1) we take advantage of the household-level data to conduct subgroup analyses and test for heterogeneous effects by income, education, race, and presence of children in the household; 2) we re-estimate our models using NielsenIQ sample weights; 3) we re-estimate our models using the larger but unbalanced panel; 4) we re-estimate the models eliminating the treatment indicator for the announcement of the tax, which increases the length of the baseline period; and 5) we estimate a two-part model in order to explore how the tax separately affected the extensive margin (probability of buying any taxed beverages) and the intensive margin (the amount purchased conditional on purchasing any).

Empirical Results

Summary Statistics

Table 1 provides summary statistics for the treatment group (those living in Cook County, Illinois) and the comparison group (those living in St. Louis County, MO, Hennepin County, MN, or Ramsey County, MN). In the NielsenIQ data, households living in the treated area of Cook County are more likely to be African American and less likely to be white than the control group. Household income is similar in the two groups. The quantity of taxed high-calorie beverages purchased per capita is very similar and the null hypothesis of equality of means is not rejected. The treatment group tends to buy more water, and less low-calorie taxed beverages and milk, than the control group.

Evidence Regarding the Parallel Trends Assumption

An identifying assumption of the difference-in-difference design is that, in the absence of the tax, the time trends in beverage purchases would have been parallel between the treatment group (households in Cook County) and control group (households in St. Louis, Hennepin, and Ramsey Counties).

We first examine the evidence regarding the identifying assumption of parallel trends. Event study graphs are provided for the purchases of all taxed beverages, high-calorie taxed beverages, and low-calorie taxed beverages in Figure 1. The graphs display, month-by-month, the difference in purchases between treatment and control households, compared to the difference between the treatment and control households in the omitted reference month (October 2016). Ninety-five percent confidence intervals are also provided. For both taxed high-calorie beverages and taxed low-calorie beverages, there is no visual evidence of a pre-existing

trend prior to the announcement of the tax (the first vertical dotted line), and we cannot reject the null hypothesis that the coefficients on pre-announcement time periods are jointly equal to zero (p=.204 for high-calorie beverages and p=.102 for low-calorie beverages, the second of which we note is close to being significant at the 10% level.)

When we combine the two categories into all taxed drinks, however, there is a curious result. Despite the absence of any visual pre-trend, the test that all pre-announcement time periods are jointly equal to zero is p=0.0162, which is a rejection of the null hypothesis of no pre trend. We investigated this result and found that it is driven by the earliest data points; if we drop the first and second months of pre-trend data, the p-value rises to .1392, and if we drop the first three months (still leaving 7 months of pre-announcement data), the p value is .3851. In summary, we reject the null hypothesis of no pre-trends for all taxed drinks combined, but we note that there is no visual evidence of a directional trend, the p value is driven by the earliest data and not that closest to the event, and we do not reject the null for high-calorie taxed drinks, which may be of the greatest public health and policy interest.

Figure 2 provides the event studies for untaxed beverages. There is no evidence of a pre-existing trend for any of the three categories of untaxed beverages.

Evidence of Consumer Awareness of the Announced Tax

Our Poisson difference-in-differences model tests whether there was an impact of the announcement of the tax, whether there was an impact of the tax being in place, and whether the tax continued to affect purchases after its repeal. This raises the question of whether Cook County households were aware that the tax had been announced and were aware of it when it was in place. We provide suggestive evidence regarding their awareness from Google Trends search data. Specifically, we graph the relative intensity of Google searches for the term “soda

tax" in the Chicago metro area (which contains Cook County) as well as for the entire state of Illinois. The time series represents search interest relative to the point of highest interest during the timeframe. In other words, the maximum search intensity during that time is indexed at 100, and all other values are relative to that. Appendix Figure 2 presents the results. For both geographic areas, the peaks of Google searches for "soda tax" occurred in November of 2016, following the announcement, and in August 2017, when the tax became effective. The peak in searches across the ten-year period occurred in August 2017, when the tax took effect. These results, while suggestive, are consistent with Cook County residents being aware that a soda tax had been announced and were aware of the tax while it was in place.

Estimates of the Impact of the Announcement, Effective Period, and Repeal of the Tax

We next present results from the Poisson difference-in-differences model. Table 2 presents results for purchases of all taxed beverages (column 1), taxed high-calorie beverages (column 2), taxed low-calorie beverages (column 3), and the untaxed possible substitutes water (column 4), 100% fruit juice (column 5) and milk (column 6).

The estimates in Table 2 indicate that there was no detectable impact on the purchases of taxed beverages (all combined, or high-calorie or low-calorie taxed beverages separately) from simply announcing the upcoming tax (i.e., after its passage but before implementation).

The second row of Table 2 indicates that the implementation of the tax led to a 22.5% reduction in the purchase of all taxed beverages. This includes a 16.5% reduction in the purchase of high-calorie beverages and a 33.0% decline in the purchases of low-calorie taxed beverages; each is statistically significant at the 1 percent level. Despite the large decrease in purchases of taxed beverages, the tax did not result in a detectable change in the purchases of any of the untaxed potential substitutes: bottled water, 100% fruit juice, or milk.

Previous research estimated that the Cook County beverage tax increased the price of taxed beverages by 34% (Powell et al., 2020). This price increase, combined with our estimates of the decrease in purchases, implies a price elasticity of demand of roughly -0.66 for all taxed beverages, -0.48 for high-calorie taxed beverages and -0.97 for low-calorie taxed beverages.

Prior to the tax, Cook County households purchased an average of 215 ounces of taxed beverages per person per month, of which 145.6 ounces were high-calorie beverages and 79.6 ounces were low-calorie beverages. Combined with our estimates of the effect of the tax on purchases, this implies that the tax reduced purchases by approximately four 12-ounce cans of taxed beverages per person per month, of which two 12-ounce cans were high-calorie beverages and two 12-ounce cans were low-calorie beverages.

The third row of Table 2 shows that the purchases after repeal of the tax are not significantly different from their pre-announcement levels. In other words, after the tax was repealed, purchases of taxed beverages rebounded to their baseline quantities.

The estimates from Table 2 are consistent with the patterns shown in the event study estimates in Figure 1. In the event study graphs, we do not find evidence that households stockpile beverages; there is little change in purchases the month before the tax is imposed. The event study graphs in Figure 1 show a spike in purchases of high-calorie beverages and low-calorie taxed beverages, but it occurs two months before the tax is imposed, and is not statistically significant. Figure 1 also shows that, immediately after the tax is effective, consumer purchases of high-calorie and low-calorie taxed beverages decrease, and this decrease is sustained while the tax is in place. As further shown in Figure 1, purchases rebound immediately following the repeal of the tax. Thus, there is no evidence that the tax, through habit formation, led to a lasting reduction in purchases.

Testing for Heterogeneous Effects

We take advantage of the household-level data to conduct subgroup analyses and test for heterogeneous effects. For example, households with children might respond differently to the tax if it signals to parents the unhealthiness of the beverages or if youth demand is differentially elastic than that of adults. (Lozano-Rojas, 2024) Also, there may be particular interest in how the tax affects the consumption of youth. Lower-income households might respond differently if the tax is particularly regressive and has a large income effect (Knox & Jones-Smith, 2024; Barker et al., 2022).

To investigate the possibility of heterogeneous treatment effects, we estimate models that include interaction terms for whether: a) there are children in the household; b) household income is above (versus below) $35,000 per year; c) the household head is white (versus non-white); and d) the household head has completed college. The results, presented in Table 3, reveal some differences in the magnitude of response of subgroups; for example, households with children decrease their purchases by 29 ounces per month compared to 14 ounces per month by households without children. However, none of the differences are statistically significant; we do not find any conclusive evidence of heterogeneous effects by these household characteristics.

Robustness Checks

We conduct numerous robustness checks. Because we examine only a subset of national data, the national sample weights provided by NielsenIQ do not have a logical interpretation, and we do not use them in our main models (Solon et al., 2015). However, as an extension we re-estimate our Poisson difference-in-difference models using NielsenIQ weights. The results, provided in Table 4, are very similar.

We estimated our main models using a balanced panel of households who remained in the data throughout the period of interest (January 2016 through December 2018). This was done to avoid composition bias that could arise from households entering and leaving the panel. As a second robustness check, we re-estimate our models using the larger but unbalanced panel that includes all NielsenIQ households observed at any point during January 2016 to December 2018. Doing so increases the sample size from 46,944 to 64,368, or by 37.1%. The results based on the unbalanced panel are presented in Table 5 and are extremely similar to those from the balanced panel.

In our primary model, we allowed for there to be an anticipatory effect that occurred after the tax was announced but before it was implemented. We did not find any detectable effect during that period, so as a fourth extension we re-estimate the models eliminating the anticipation period. The revised empirical model compares the baseline (i.e., pre-tax-implementation) period to the period that the tax was in place and the post-repeal period. Note that the omitted reference month in the main model is the month prior to announcement, whereas in this revised model it is the month before the tax takes effect. The results of the revised model with only two treatment periods (effective and post-repeal), shown in Table 6, are very similar to those of our main model.

Our primary model, the Poisson difference-in-difference model, uses variation across both the extensive and intensive margin. As an extension, we separately examine the effect of the tax on those two margins by estimating a two-part model in which the first part (for the extensive margin) is a probit model of buying any positive quantity of that category of beverages and the second part (for the intensive margin) is a GLM model of the quantity purchased conditional on buying any. The results, shown in Table 7, indicate that much of the effect of the tax operates

through the extensive margin. During the time the tax was in place, households in Cook County were 37.6% less likely to buy taxed beverages in a given month; the probability of buying taxed high-calorie beverages fell 31.9% and the probability of buying low-taxed beverages fell by 25.4%. Each of those reductions is statistically significant at the 1% level. On the intensive margin, among those who bought such beverages the quantity of taxed beverages purchased fell by 9.04% (statistically significant at the 5% level) but the reduction in high-calorie and low-calorie taxed beverages specifically was not statistically significant.

Discussion

Difference-in-differences models estimated using household-level purchase data indicate that the Cook County sweetened beverage tax reduced the purchases of all taxed beverages by 22.5%, high-calorie taxed beverages by 16.5% and low-calorie taxed beverages by 33.0%. This is equivalent to an average reduction in purchases of four 12-ounce cans of taxed beverages per person per month, of which two were high-calorie taxed beverages and two were low-calorie taxed beverages. We estimate a price elasticity of demand of -0.66 for all taxed beverages, -0.48 for high-calorie taxed beverages and -0.97 for low-calorie taxed beverages. Much of the impact of the tax occurred at the extensive margin; for example, it reduced the probability that households bought any high-calorie taxed beverages by 31.9 percentage points, but had no detectable impact on the amount of high-calorie taxed beverages purchased conditional on buying any. The tax does not result in any detectable increase in purchases of possible substitutes (bottled water, fruit juice, milk).

An important point of comparison for these results are the results for Cook County that are based on store-level sales data, which found that the tax reduced sales of taxed beverages by

27%, corresponding to a price elasticity of demand of -0.8 (Powell et al., Mar. 2020). Our estimates derived from household-level data are somewhat smaller, which may be due to household data including cross-border purchases. If the tax increases cross-border shopping, then the decrease in sales at stores in the taxing jurisdiction will be greater than the decline in households' purchases from all locations. Other differences in results could be due to differences in the representativeness of the stores and households.

Other useful comparisons for our results are those derived from consumer household-level data to study SSB taxes in other cities. (To clarify, this is the first study to use household-level scanner data to examine the beverage tax in Cook County, but such data have been used to study beverage taxes in other cities.) One study (Cawley, Frisvold, and Jones, 2020) examined consumer data for four US cities that implemented beverage taxes: Philadelphia, San Francisco, Seattle, and Oakland. (All four taxed caloric SSBs but Philadelphia also taxed diet drinks.) The study found that a beverage tax of one cent per ounce was associated with a decrease in SSB purchases of 12.2%. This decline was concentrated in Philadelphia, where the tax decreased purchases by 27.7%. Another study (Barker et al., 2022) of seven taxing cities generally does not find a detectable impact on sales of carbonated soft drinks in most cities but does find a substantial impact in Philadelphia. This study also finds evidence that consumers responded by increasing purchases of bottled water, particularly in Philadelphia. A third study that examined four U.S. cities with beverage taxes estimated that the taxes reduced beverage purchases by 26% (Knox & Jones-Smith, 2024). A strength of the current paper is that, despite limiting the sample to a balanced panel, the data include more treated households in Cook County (712) than the three previous studies had in their pooled analyses of multiple taxing cities (which ranged from approximately 400 to 583).

Some of these previous studies using household-level data tested for heterogeneity in responses by household income.[6] One multi-city study found that lower-income households decreased beverage purchases twice as much as higher-income households in response to the tax (Knox & Jones-Smith, 2024), while another found few income-related differences (Barker et al., 2022). Our results are closer to the latter; we find no significant difference between the response of low- and high-income households.

Our results can also be compared to those from studies of other cities' SSB taxes that were based on store-level retail scanner data. A meta-analysis of 26 studies of SSB taxes in 5 U.S. cities, most of which are based on retail scanner data, estimated that the implied price elasticity of demand was -1.47 (Powell et al., 2021).

One motivation for beverage taxes is to encourage consumers to substitute towards healthier beverages, such as water. We found no evidence that the Cook County beverage tax increased purchases of bottled water, 100% fruit juice, or milk. This is generally consistent with past findings; a review of the literature found that 18 studies had tested for such substitution in response to U.S. beverage taxes, of which 13 failed to detect any such effect (Leider et al., 2021).

In addition to estimating the effect of the beverage tax while it was in place, we also estimate the effect of its announcement and repeal. Although previous studies found that sales of SSBs fell in response to the announcement of the SSB tax in Berkeley (Taylor et al., 2019) and the announcement of the two-tiered soft drink levy in the U.K. (Rogers et al., 2023), we did not find a detectable response to the announcement of the Cook County beverage tax. The difference

[6] Sharma et al. (2014) use NielsenIQ Homescan data from Victoria, Australia to simulate the effect of two types of SSB taxes (ad valorem sales tax and volumetric excise tax) on the purchases by households of various income levels. Estimating an Almost Ideal Demand System, they conclude that higher-income households are less price elastic than middle- and low-income households. Cawley et al. (2020) find in store audit data for Philadelphia that stores in higher-poverty neighborhoods have higher pass-through of the tax to consumers in the form of higher retail prices.

in results may be due in part to differences in the study population or tax design. The Taylor et al. (2019) study focused on sales on the University of California at Berkeley campus rather than at stores throughout the city. The rollout of the U.K.'s two-tiered soft drink levy was specifically intended to have anticipatory effects, in particular by giving soft drink manufacturers the time and incentive to reformulate their products, which may have affected demand (Rogers et al., 2023).[7]

Our finding that sales rebounded to pre-tax levels after repeal is consistent with what was found in store-level data in Cook County (Powell & Leider, 2020).[8] Another important comparison for our results is a jurisdiction that also implemented and then repealed a beverage tax: Denmark. Denmark increased its long-standing tax on SSBs in January 2012, cut it in half in July 2013, and then repealed it entirely in January 2014. A study of household purchase data found that the price elasticity of demand was equal (at -1.3) for both the tax hike and the tax reductions, and even this long-standing tax did not change long-run habits after its repeal (Schmacker & Smed, 2020). A limitation of the study is that, because the tax was national, there was no control group available. The lack of a durable effect of the Cook County and Denmark taxes after their repeal represents an absence of support for a habit formation model of sweetened beverage purchases (Zhen et al., 2011).

Our finding that the short-term tax did not alter longer-term purchasing behavior relates to a broader literature on habit formation. Ozturk et al. (2020) conducted a field experiment in a dozen elementary schools, in which the treatment was increasing the salience and prominence of

[7] In a different context, Chiou and Muehlegger (2014) find evidence that consumers respond to future increases in cigarette excise taxes by stockpiling cigarettes.

[8] Another study based on an SSB tax that was repealed is Ching and Goetz (2024), who study Washington State's 2010 small (one-sixth of a cent per ounce) tax on SSBs that was repealed through a ballot referendum. Their focus is not on estimating the effect of the repeal on sales, but on using the precinct-level variation in support for repeal to examine how the impact of the tax while it was in place differed for stores patronized by those who later voted for or against repeal of the tax.

the healthy entrée in the cafeteria. While the nudge was in place, it significantly increased children's selection of the healthy option, but after the treatment was removed, effects disappeared and the authors conclude there was no evidence of habit formation. Brewer and Cameron (2023) examine the impact on longer-term recycling rates when New York City ceased collecting recycling for three years due to budgetary pressures. In the first full year after recycling resumed, the recycling rate fully recovered, which the authors interpret as a failure of consumers to develop a habit in response to even multi-year shocks. Bechtel et al. (2018) examine the effect of compulsory voting in a Swiss canton. Under compulsory voting, which was in place for 23 years, those who failed to vote had to pay a sizable fine. The authors estimate that the compulsory voting law massively increased voter turnout (by 30 ppts) but that when the long-standing policy was repealed it had no long-term impact on voting. Given the lack of persistent behavior change in response to multi-year recycling policies and multi-decade voting policies, it may not be surprising that there was not a persistent effect of a four-month tax.

Limitations of this study include the following: household scanner data have limited sample size (in this case, 1,311 households observed monthly for three years for 47,196 total observations) and the possibility that the households observed in the data are not representative of their communities. In addition, household scanner data do not observe beverages purchased in restaurants or from vending machines; this limitation applies to retail scanner data as well. Categories of beverages were based on NielsenIQ product groups and modules; we acknowledge that there may be some degree of misclassification error. We reject the null hypothesis of no pre-trends for all taxed drinks combined, but we note that there is no visual evidence of a directional trend, the p value is driven by the earliest data and not that closest to the event, and we do not reject the null for high-calorie taxed drinks, which may be of the greatest interest. With only one

treated and two comparison communities, we are unable to cluster standard errors by community; this is a limitation shared by most studies of beverage taxes.

Despite these limitations, this paper contributes to the literature on the impact of beverage taxes on purchases of taxed beverages and untaxed substitutes, heterogeneity in tax response by income, whether consumers respond in anticipation of future policy changes, and whether behavior change in response to policies is sustained after the repeal of the policy.

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TABLES AND FIGURES

Table 1 – Comparison of Characteristics across Treatment and Comparison Counties

	Cook County, IL	**St Louis, MO***	**Twin Cities, MN****	**All Comparison Counties**
Total No. Households	712	306	293	599
All Taxed Beverages (Lq.Oz. / HH)	426.8	441.3	465.8	453.4
All Taxed (Lq.Oz. / Per Capita)	224.9	239.9	254.8	247.2
Taxed High Cal (Lq.Oz. / HH)	284.5 †	282.6	274.8	278.8
Taxed High Cal (Lq.Oz. / Per Capita)	147.0 †	149.9	146.8	148.4
Taxed Low Cal (Lq.Oz. / HH)	142.3	158.8	191.0	174.6
Taxed Low Cal (Lq.Oz. / Per Capita)	77.8	90.0	108.0	98.8
Water (Lq.Oz. / HH)	231.9	184.4	153.8	169.4
Water (Lq.Oz. / Per Capita)	116.8	96.5	99.7	98.0
Fruit Juice (Lq.Oz. / HH)	49.6	42.7	45.7	44.2
Fruit Juice (Lq.Oz. / Per Capita)	26.3	23.5	25.4	24.4
Milk (Lq.Oz. / HH)	199.2	242.3	260.4	251.2
Milk (Lq.Oz. / Per Capita)	101.9	122.0	140.2	130.9
Household Size (No. people)	2.2	2.1	2.0	2.1
Household Income (USD)	89,182	85,454	84,708	83,396
HH race - White (%)	68.0	81.1	87.9	84.8
HH race - Black (%)	22.5	16.3	4.2	10.4
HH ethnicity - Hispanic (%)	7.3	1.5	3.0	2.3
Head Age	59.8	64.0	61.8	62.3
Head Education (years)	14.7	15.0	14.8	14.8

Note: NielsenIQ Panelist information for households in the balanced panel from 2016 to 2018.
* Includes St. Louis City, MO and St Louis County, MO.
** Includes Ramsey, MN and Hennepin, MN counties.
† Indicates that the t-test comparing the mean for the variable across Cook County and All control counties does not reject the null hypothesis of equal means ($p > 0.1$)

Table 2 – Main Estimates of the Effect of the Cook County Beverage Tax on Purchases of Selected Beverages

	(1) All Taxed Beverages	(2) Taxed High Calorie Beverages	(3) Taxed Low Calorie Beverages	(4) Water	(5) 100% Fruit Juice	(6) Milk
Treatment Announcement	2.659	4.112	0.633	-0.801	-9.354**	2.024
	(3.032)	(3.925)	(5.023)	(5.833)	(4.319)	(2.403)
Treatment Effective	-22.51***	-16.45***	-32.95***	-0.965	-9.418	-1.738
	(3.576)	(4.958)	(5.129)	(8.487)	(6.638)	(3.224)
Treatment Repeal	-1.821	1.328	-5.209	-4.663	-3.325	2.410
	(4.054)	(5.125)	(6.427)	(7.696)	(6.425)	(3.394)
Chg. lq.oz/person	-48.431***	-23.956***	-26.231***	-1.137	-2.288	-1.646
	(7.695)	(7.221)	(4.083)	(10.002)	(1.612)	(3.054)
Cook Per Person (t-1 lq.oz./month)	215.18	145.64	79.61	117.85	24.29	94.73
N	46,944	46,692	39,924	42,156	44,604	46,260
No. Clusters	1,304	1,297	1,109	1,171	1,239	1,285
Treated Clusters	709	707	610	653	684	702
Control Clusters	595	590	499	518	555	583
No Variation Clusters	7	14	202	140	72	26
No Variation in Cook County	3	5	102	59	28	10
R2 (pseudo)	0.5731	0.5544	0.6358	0.5514	0.5056	0.6963
F- test Pre-period (p-value)	0.0162	0.2039	0.1020	0.2137	0.2751	0.1424

Notes: Estimates from Equation 1 using Poisson difference-in-difference regression models. Coefficients are transformed to percent treatment effects; for instance, for Treatment Effective, 100*(exp[β_{eff}]-1) is the percent treatment effect. Standard errors are clustered at the household level and shown in parentheses. All regressions include household and month fixed effects for a balanced sample of households followed from Jan 2016 to Dec 2018. The outcome variable of each regression is the purchases of the different beverages measured in liquid ounces (lq.oz.) for a given household in a given month. Treatment Announcement is a variable that captures the interaction between the residence of the household in Cook County and the two 4-month periods after approval. The approval date is Nov 10, 2017. Analogously, Treatment Effective, captures the interaction between Cook County residence, and the period that the tax was effective from August to November of 2017. Finally, Treatment Repeal interacts Cook County household residence with the period after the repeal, which began on Dec 1, 2017. *p < 0.1, **p < 0.05, ***p < 0.01.

Table 3 – Estimates of the Effect of the Cook County Beverage Tax on Purchases of Taxed High Calorie Beverages for Households with Different Characteristics

	(1)		(2)		(3)		(4)	
	Race White	Race Non-White	Income Over $35K	Income Under $35K	Head Educ.: College	Head Educ: No College	Children: No	Children: Yes
Announcement	6.435	-0.0050	3.032	8.762	-1.786	4.974	6.341	-7.006
	(4.643)	(4.680)	(4.102)	(5.617)	(7.969)	(4.040)	(4.175)	(5.395)
Effective	-18.06***	-13.61*	-18.24***	-8.734	-20.93*	-15.79***	-13.98**	-29.06***
	(5.578)	(7.016)	(5.119)	(8.618)	(9.603)	(5.191)	(5.257)	(8.302)
Repeal	2.095	-0.0202	0.45	5.111	1.188	1.349	2.957	-8.543
	(5.673)	(6.786)	(5.334)	(7.106)	(8.704)	(5.301)	(5.355)	(7.500)
R2 (pseudo)	0.5544		0.5544		0.5544		0.5544	
N	46,692		46,692		46,692		46,692	
No. Clusters	1,297		1,297		1,297		1,297	

Notes: Estimates from an extended version of Equation 1 allowing heterogeneous treatment effects using Poisson difference-in-difference regression models. Coefficients are transformed to percent treatment effects; for instance, for Treatment Effective, 100*(exp[β_{eff}]-1) is the percent treatment effect. Standard errors are clustered at the household level and shown in parentheses. All regressions include household and month fixed effects for a balanced sample of households followed from Jan 2016 to Dec 2018. The outcome variable of each regression is the purchases of the different beverages measured in liquid ounces (lq.oz.) for a given household in a given month. Treatment Announcement is a variable that captures the interaction between the residence of the household in Cook County and the two 4-month periods after approval. The approval date is Nov 10, 2017. Analogously, Treatment Effective, captures the interaction between Cook County residence, and the period that the tax was effective from August to November of 2017. Finally, Treatment Repeal interacts Cook County household residence with the period after the repeal, which began on Dec 1, 2017. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 4 – Estimates of the Effect of the Cook County Beverage Tax on Purchases of Selected Beverages using NielsenIQ Weights

	(1) All Taxed Beverages	(2) Taxed High Calorie Beverages	(3) Taxed Low Calorie Beverages	(4) Water	(5) 100% Fruit Juice	(6) Milk
Treatment Announcement	-6.166*	-4.483	-8.499	-8.029	-4.771	0.372
	(3.539)	(4.331)	(6.295)	(7.634)	(6.495)	(3.250)
Treatment Effective	-26.93***	-18.84***	-41.16***	-0.561	-5.613	1.799
	(4.717)	(6.169)	(7.024)	(10.12)	(9.526)	(5.241)
Treatment Repeal	-7.913	-4.512	-10.47	-16.47*	6.649	4.214
	(5.481)	(6.443)	(9.118)	(9.092)	(10.29)	(4.868)
Chg. lq.oz/person	-57.811***	-28.845***	-29.244***	-0.669	-1.228	1.609
	(10.126)	(9.445)	(4.990)	(12.071)	(2.084)	(4.685)
Cook Per Person (t-1 lq.oz./month)	214.66	153.11	71.05	119.24	21.87	89.40
N	46,944	46,692	39,924	42,156	44,604	46,260
No. Clusters	1,304	1,297	1,109	1,171	1,239	1,285
Treated Clusters	709	707	610	653	684	702
Control Clusters	595	590	499	518	555	583
No Variation Clusters	7	14	202	140	72	26
No Variation in Cook County	3	5	102	59	28	10
R2 (pseudo)	0.5831	0.5538	0.6643	0.5609	0.4945	0.6973
F- test Pre-period (p-value)	0.7049	0.5053	0.4418	0.3657	0.1996	0.7055

Notes: Estimates from Equation 1 using Poisson difference-in-difference regression models including household weights from NielsenIQ. Coefficients are transformed to percent treatment effects; for instance, for Treatment Effective, $100*(\exp[\beta_{eff}]-1)$ is the percent treatment effect. Standard errors are clustered at the household level and shown in parentheses. All regressions include household and month fixed effects for a balanced sample of households followed from Jan 2016 to Dec 2018. The outcome variable of each regression is the purchases of the different beverages measured in liquid ounces (lq.oz.) for a given household in a given month. Treatment Announcement is a variable that captures the interaction between the residence of the household in Cook County and the two 4-month periods after approval. The approval date is Nov 10, 2017. Analogously, Treatment Effective, captures the interaction between Cook County residence, and the period that the tax was effective from August to November of 2017. Finally, Treatment Repeal interacts Cook County household residence with the period after the repeal, which began on Dec 1, 2017. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 5 – Estimates of the Effect of the Cook County Beverage Tax on Purchases of Selected Beverages using All Households participating on the NielsenIQ Homescan survey

	(1) All Taxed Beverages	(2) Taxed High Calorie Beverages	(3) Taxed Low Calorie Beverages	(4) Water	(5) 100% Fruit Juice	(6) Milk
Treatment Announcement	1.302	2.492	0.0353	-1.116	-7.331*	0.956
	(2.877)	(3.667)	(4.492)	(5.373)	(4.153)	(2.330)
Treatment Effective	-21.99***	-17.99***	-29.12***	-3.727	-9.952	-4.339
	(3.292)	(4.394)	(4.896)	(7.400)	(5.960)	(3.213)
Treatment Repeal	-2.267	0.200	-4.216	-5.911	-3.959	0.598
	(3.863)	(4.889)	(6.042)	(7.129)	(5.971)	(3.186)
Chg. lq.oz/person	-43.166***	-24.431***	-21.365***	-4.407	-2.286*	-3.941
	(6.463)	(5.969)	(3.591)	(8.750)	(1.369)	(2.918)
Cook Per Person (t-1 lq.oz./month)	196.32	135.82	73.36	118.25	22.97	90.83
N	64,368	63,864	52,824	55,644	59,964	63,168
No. Clusters	2,317	2,292	1,845	1,926	2,112	2,265
Treated Clusters	1,283	1,268	1,027	1,102	1,183	1,251
Control Clusters	1,034	1,024	818	824	929	1,014
No Variation Clusters	26	51	498	417	231	78
No Variation in Cook County	15	30	271	196	115	47
R2 (pseudo)	0.5670	0.5487	0.6360	0.5460	0.4948	0.6857
F- test Pre-period (p-value)	0.1121	0.2871	0.2656	0.0231	0.4675	0.6120

Notes: Estimates from Equation 1 using Poisson difference-in-difference regression models. Coefficients are transformed to percent treatment effects; for instance, for Treatment Effective, 100*(exp[β_{eff}]-1) is the percent treatment effect. Standard errors are clustered at the household level and shown in parentheses. All regressions include household and month fixed effects for the complete sample of households followed by NielsenIQ Homescan program from Jan 2016 to Dec 2018. The outcome variable of each regression is the purchases of the different beverages measured in liquid ounces (lq.oz.) for a given household in a given month. Treatment Announcement is a variable that captures the interaction between the residence of the household in Cook County and the two 4-month periods after approval. The approval date is Nov 10, 2017. Analogously, Treatment Effective, captures the interaction between Cook County residence, and the period that the tax was effective from August to November of 2017. Finally, Treatment Repeal interacts Cook County household residence with the period after the repeal, which began on Dec 1, 2017. *p < 0.1, **p < 0.05, ***p < 0.01.

Table 6 – Estimates of the Effect of the Cook County Beverage Tax on Purchases of Selected Beverages without an Anticipation period

	(1) All Taxed Beverages	(2) Taxed High Calorie Beverages	(3) Taxed Low Calorie Beverages	(4) Water	(5) 100% Fruit Juice	(6) Milk
Treatment Effective	-23.45***	-17.98***	-33.15***	-0.591	-5.157	-2.637
	(3.192)	(4.362)	(4.682)	(7.358)	(5.992)	(2.726)
Treatment Repeal	-3.010	-0.532	-5.491	-4.302	1.223	1.473
	(3.416)	(4.338)	(5.485)	(6.658)	(5.893)	(2.937)
Chg. lq.oz/person	-50.451***	-26.190***	-26.390***	-0.696	-1.253	-2.498
	(6.868)	(6.353)	(3.727)	(8.671)	(1.455)	(2.583)
Cook Per Person (t-1 lq.oz./month)	215.18	145.64	79.61	117.85	24.29	94.73
N	46,944	46,692	39,924	42,156	44,604	46,260
No. Clusters	1,304	1,297	1,109	1,171	1,239	1,285
Treated Clusters	709	707	610	653	684	702
Control Clusters	595	590	499	518	555	583
No Variation Clusters	7	14	202	140	72	26
No Variation in Cook County	3	5	102	59	28	10
R2 (pseudo)	0.5731	0.5544	0.6358	0.5514	0.5055	0.6963
F- test Pre-period (p-value)	0.0001	0.2943	0.0000	0.3670	0.2639	0.0376

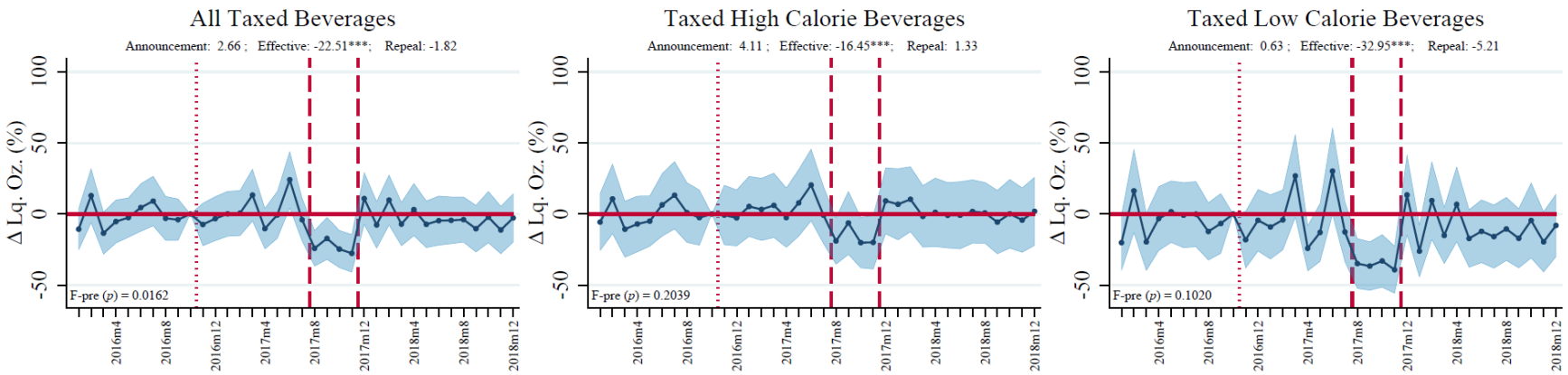
Notes: Estimates from Equation 1 using Poisson difference-in-difference regression models and without considering a post-announcement response. Coefficients are transformed to percent treatment effects; for instance, for Treatment Effective, 100*(exp[β_{eff}]-1) is the percent treatment effect. Standard errors are clustered at the household level and shown in parentheses. All regressions include household and month fixed effects for a balanced sample of households followed from Jan 2016 to Dec 2018. The outcome variable of each regression is the purchases of the different beverages measured in liquid ounces (lq.oz.) for a given household in a given month. Treatment Effective, is an interaction that captures the interaction between Cook County residence, and the period that the tax was effective from August to November of 2017. Finally, Treatment Repeal interacts Cook County household residence with the period after the repeal, which began on Dec 1, 2017. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 7 – Two-part Model Estimates of the Effect of the Cook County Beverage Tax on Purchases of Selected Beverages without an Anticipation period

	(1) All Taxed Beverages	(2) Taxed High Calorie SSB	(3) Taxed Low Calorie SSB	(4) Water	(5) 100% Fruit Juice	(6) Milk
Probit - Extensive Margin						
Announcement	0.044	0.015	0.061	0.031	-0.035	0.022
	(0.0468)	(0.0440)	(0.0494)	(0.0478)	(0.0462)	(0.0524)
Effective	-0.376***	-0.319***	-0.254***	-0.015	-0.099*	-0.044
	(0.0624)	(0.0610)	(0.0741)	(0.0668)	(0.0599)	(0.0719)
Repeal	0.015	-0.029	0.103*	0.037	-0.044	-0.042
	(0.0523)	(0.0502)	(0.0613)	(0.0582)	(0.0518)	(0.0615)
GLM – Intensive Margin (%)						
Announcement	1.432	4.119	-4.121	1.209	-2.743	0.440
	(2.773)	(3.344)	(3.749)	(4.448)	(3.119)	(1.898)
Effective	-9.010**	-2.037	-8.056	-0.784	-5.940	-0.461
	(3.433)	(4.358)	(4.830)	(5.643)	(4.032)	(2.442)
Repeal	-2.835	1.463	-8.803**	-6.337	1.727	3.984
	(3.076)	(3.678)	(4.255)	(4.608)	(3.836)	(2.548)
Change in lq.oz/person	-33.277***	-15.168***	-14.884***	-1.578	-2.483**	-1.179
(Aggregate Effective)	(6.739)	(5.402)	(4.523)	(6.346)	(1.150)	(2.298)
Implied Aggregate Change (%)	15.46	10.41	18.7	1.34	10.22	1.24
Cook Per Person (t-1 lq.oz./month)	215.18	145.64	79.61	117.85	24.29	94.73
N (Probit)	42,012	43,848	38,880	41,436	43,812	38,016
N (GLM)	32,906	27,792	15,225	13,697	15,862	33,592
No. Clusters (Probit)	1,167	1,218	1,080	1,151	1,217	1,056
Treated Clusters (Probit)	640	665	603	644	671	599
Control Clusters (Probit)	527	553	477	507	546	457
Never Purchase (Not in probit/GLM)	7	14	202	140	72	26
Always Purchase (Not in probit)	137	79	29	20	22	229
No. Control Clusters (GLM)	1,304	1,297	1,109	1,171	1,239	1,285
Treated Clusters (GLM)	709	707	610	653	684	702
Control Clusters (GLM)	595	590	499	518	555	583
Probit - F-test Pre-period (p)	0.4907	0.6733	0.0363	0.5684	0.0666	0.1328
GLM - F-test Pre-period (p)	0.5572	0.4403	0.3948	0.9229	0.8391	0.8090
Aggregate F- test Pre-period (p)	0.2666	0.5533	0.0790	0.6046	0.2007	0.2467

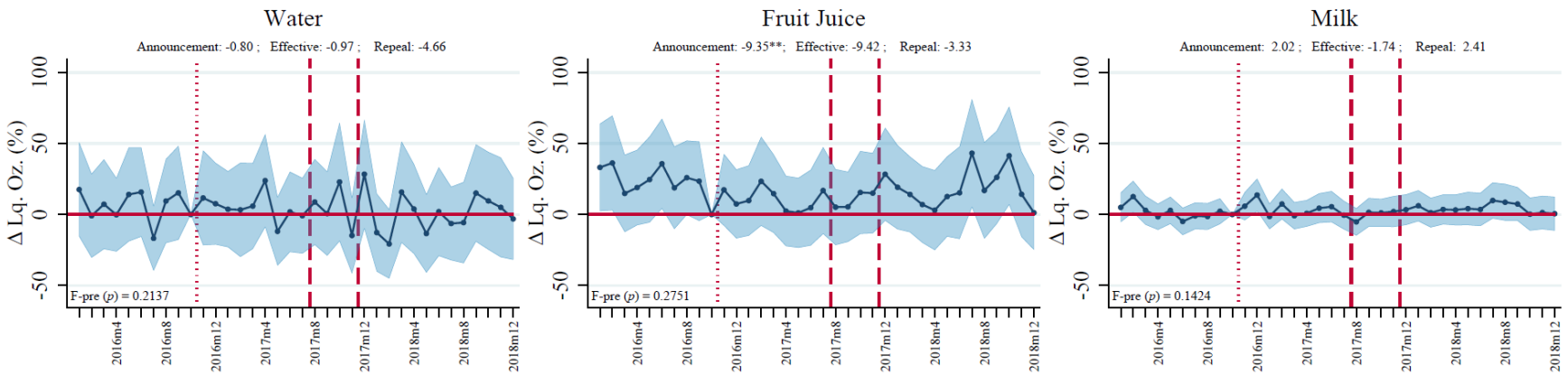
Notes: Estimates from a Two-Part model where in the first part an effect over the extensive margin is estimated to assess changes in the probability of a beverage purchase (extensive margin) and in the second part, a GLM model with a log-link over beverage quantities (intensive margin). The aggregate coefficient represents the level changes of the dependent variable (lq.oz.), and we report the Aggregate Effective coefficient. Standard errors are clustered at the household level and shown in parentheses. All regressions include household and month fixed effects for a balanced sample of households followed from Jan 2016 to Dec 2018. Treatment Effective, is an interaction that captures the interaction between Cook County residence, and the period that the tax was effective from August to November of 2017. Finally, Treatment Repeal interacts Cook County household residence with the period after the repeal, which began on Dec 1, 2017. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Figure 1 – Event-Study Estimation of the Effect of the Cook County Beverage Tax on Household Purchases of Taxed Beverages



Notes: Estimates from Equation 2 using Poisson difference-in-difference regression models. Coefficients are transformed to percent treatment effects, for each month *t*, using 100*(exp[β_t]-1). The figure reports coefficients on the interaction between household residence in Cook County and the specific month. Confidence intervals reported at the 95% level. All regressions include household and month fixed effects. The outcome variable of each regression is the purchases of taxed high-calorie beverages measured in liquid ounces (lq.oz.) for a given household in a given month. The dotted line marks the announcement of the approval of the tax on Nov 10, 2017. The two dashed lines showcase the effective period of the tax, between August 02 to November 30, 2017. The tax was repealed on Dec 1, 2017. The bottom-left of the graph reports the p-value of the F-test of joint significance for all the coefficients before the announcement, testing how different were the treatment and control series in the pre-intervention period. Finally, the top of each panel reports coefficients from Table 2, estimated using Equation 1, for reference.

Figure 2 – Event-Study Estimation of the Effect of the Cook County Beverage Tax on Household Purchases of Untaxed Beverages



Notes: Estimates from Equation 2 using Poisson difference-in-difference regression models. Coefficients are transformed to percent treatment effects, for each month *t*, using 100*(exp[β_t]-1). The figure reports coefficients on the interaction between household residence in Cook County and the specific month. Confidence intervals reported at the 95% level. All regressions include household and month fixed effects. The outcome variable of each regression is the purchases of taxed high-calorie beverages measured in liquid ounces (lq.oz.) for a given household in a given month. The dotted line marks the announcement of the approval of the tax on Nov 10, 2017. The two dashed lines showcase the effective period of the tax, between August 02 to November 30, 2017. The tax was repealed on Dec 1, 2017. The bottom-left of the graph reports the p-value of the F-test of joint significance for all the coefficients before the announcement, testing how different were the treatment and control series in the pre-intervention period. Finally, the top of each panel reports coefficients from Table 2, estimated using Equation 1, for reference.

APPENDIX TABLES AND FIGURES

Appendix Table A1 – Additional Comparison of Characteristics across Treatment and Comparison Counties

Panel A – Census Quick Facts

Census/ACS 5Y Estimates as of Jul 2023	Cook County, IL	St. Louis County, MO	St. Louis City, MO	Hennepin County, MN	Ramsey County, MN
Pop. under 5 years (%)	5.4	5.6	5.7	5.8	6.2
Pop. under 18 years (%)	20.9	21.7	18.0	21.3	22.8
White (non-hisp) (%)	41.1	64.3	45.8	67.2	59.4
Black (%)	23.6	25.2	43.7	14.5	13.6
Hispanic (%)	26.3	3.3	4.5	7.2	7.8
Foreign born (%)	21.0	7.7	6.3	13.7	15.6
Educ - BA or higher (25+ years) (%)	41.3	46.1	38.6	52.6	44.7
Pop. with a disability (-65 years) (%)	7.1	8.0	11.7	7.1	8.9
Pop. w/o health insurance (-65 years) (%)	10.1	7.7	12.6	5.2	6.0
Civilian labor force (16+ years) (%)	66.1	64.8	65.9	71.7	68.5
Pop. in poverty (%)	13.7	10.5	21.3	10.8	13.8
Median HH income 18-22 (USD)	78,304	78,067	52,941	92,595	78,108
Mean Travel time to work (mins)	32.3	23.5	23	22.9	22.9
Population - (000) (Jul 2022)	5,087	987	282	1,259	536

Panel B – County Health Rankings

County Health Rankings (2023)	Cook County, IL	St. Louis County, MO	St. Louis City County, MO	Hennepin County, MN	Ramsey County, MN
Diabetes Prevalence (%)	10	8	12	8	9
Obesity (%)	30	28	39	28	31
Life Expectancy (years)	78.6	77.2	73.1	80.6	79.3
Physical Inactivity (%)	26	22	26	16	20
Poor Physical Health Days	2.8	3	3.9	2.4	2.9
Food Insecurity (%)	11	10	16	8	10
Limited Access to Healthy Foods (%)	2	5	4	4	5

Panel C - NielsenIQ Ailments Panel

NielsenIQ Balanced Panel Sample (16-18)	Cook County, IL	St Louis, MO*	Twin Cities, MN**	All Comparison Counties
Any Diabetes (T1, T2, Pre) (%)	24.9 †	28.6	21.8	25.3
Diabetes T2 (%)	17.6 †	19.8	13.8	16.9
Obesity Overweight	38.3	44.6	41.1	42.9
Not in Ailments (Unknown)	8.0	7.2	10.9	9.0

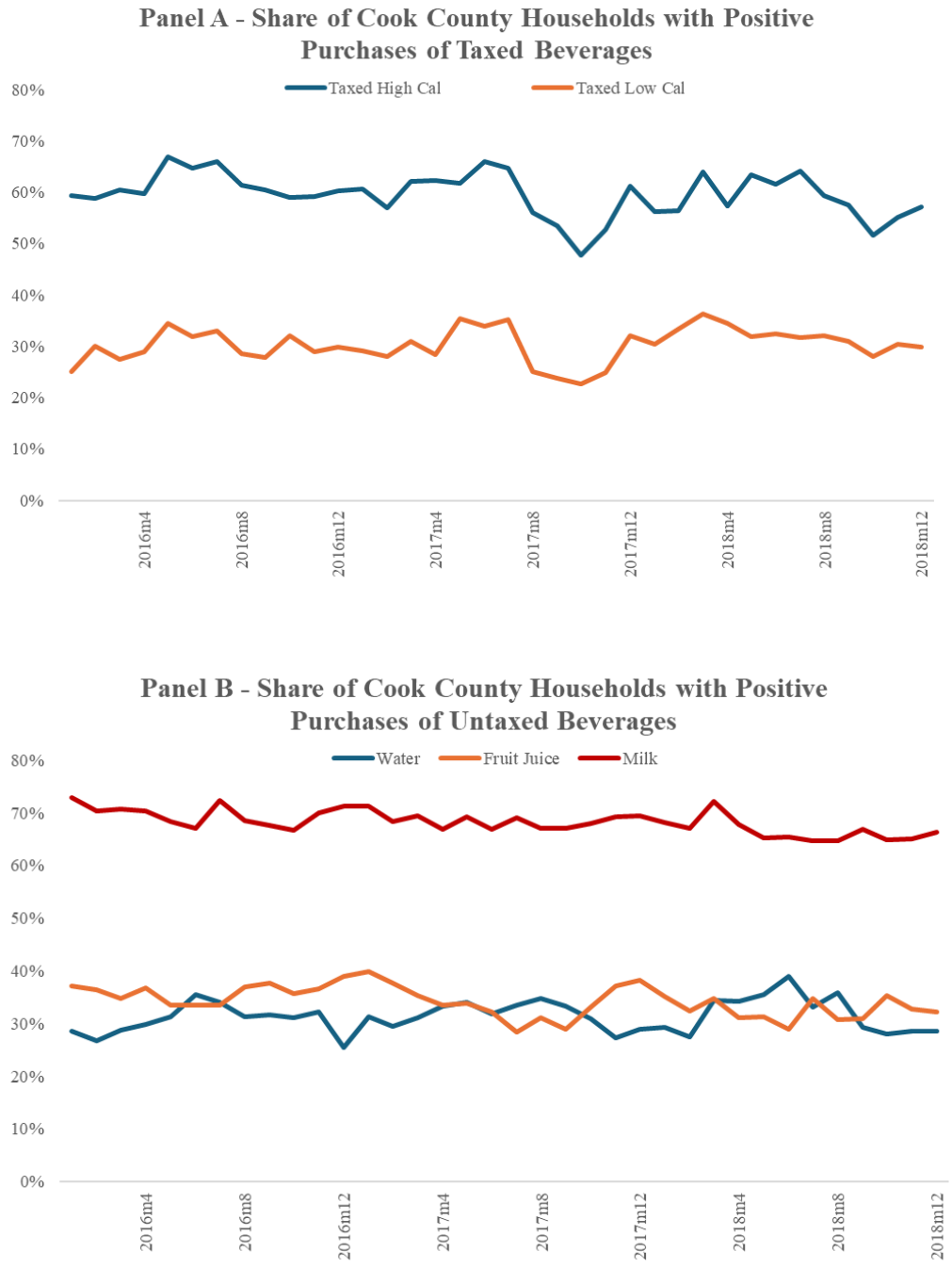
* Includes St. Louis City, MO and St Louis County, MO.

** Includes Ramsey, MN and Hennepin, MN counties.

† Indicates that the t-test comparing the mean for the variable across Cook County and All control counties does not reject the null hypothesis of equal means ($p > 0.1$)

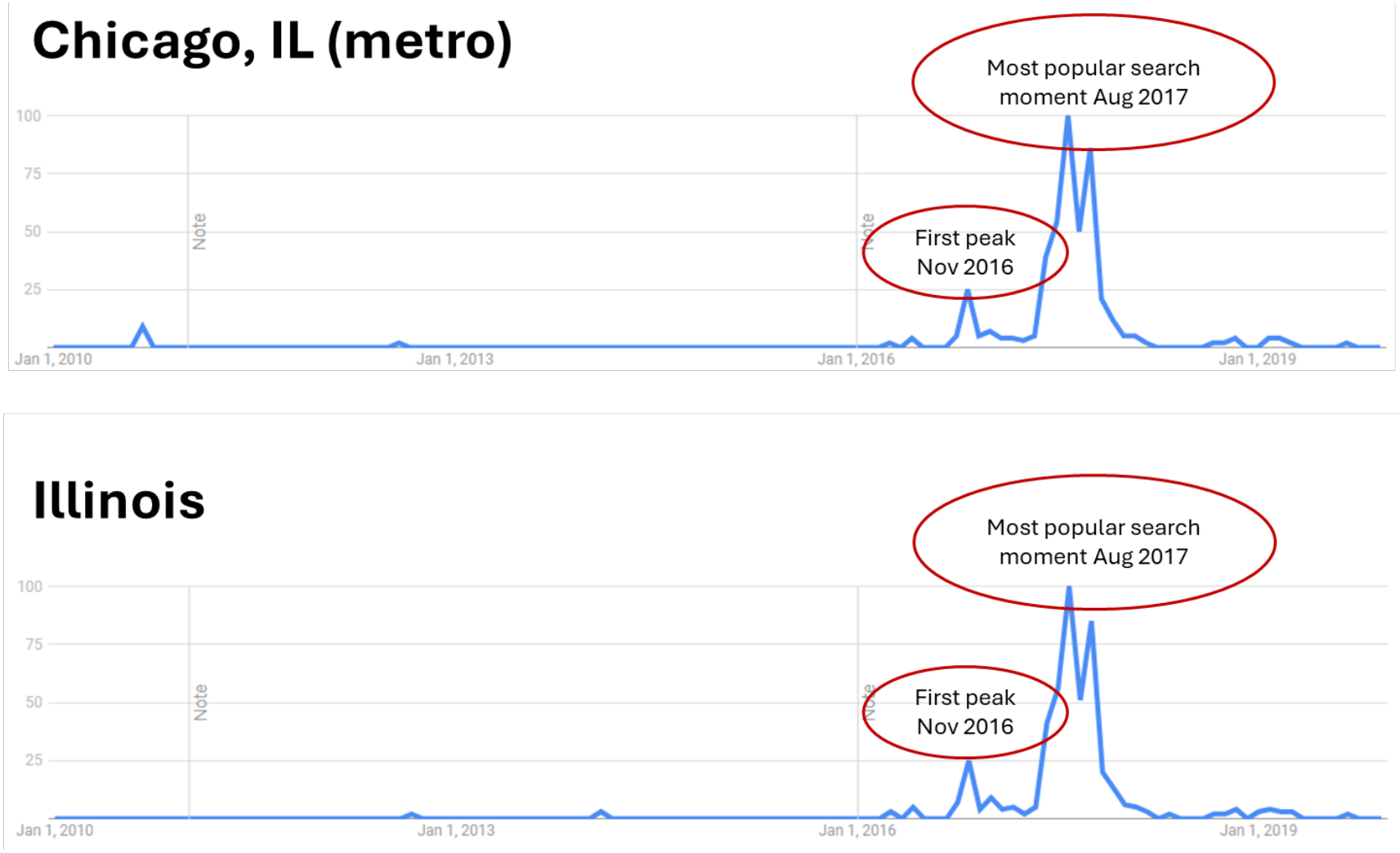
Note: Census Quick Facts and County Health Rankings queried in June 2024. ACS 5Y averages as of Jul 2023. NielsenIQ Panelist information from different sources within the NielsenIQ information system for households in the balanced panel from 2016 to 2018.

Appendix Figure A1 - Share of Cook County Households with Positive Purchases across Taxed and Untaxed Beverages



Note: Authors' calculations based on NielsenIQ Homescan data. The graphs report the number of households with positive purchases from the different beverages. Panel A includes the taxed beverages: high calorie and low calorie. Panel B includes the untaxed beverage categories: water, fruit juice, and milk. The percentage is calculated for each beverage class as the ratio of households with purchases over the total. The remaining households have zero purchases each month.

Appendix Figure A2 - Google Trends Interest Over Time – "Soda Tax" Search



Note: Google Trends – Interest over time for the term "Soda Tax" using Chicago, IL (metro) and Illinois as different geographic areas.