How do Tax Policies Impact Health-Relevant Purchasing? Evidence from a Temporary Soda Tax

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Abstract

Soda taxes have been proposed and used as levers to encourage healthy consumption behavior. While the existing literature has examined whether soda taxes change behavior, less is known on *how* they work. Moreover, do they work as intended by impacting unhealthier individuals or do they work primarily on healthy consumers? To answer these questions, we use a unique setting in Cook County, Illinois where a soda tax was introduced and repealed soon after. Using this natural experiment combined with household-level shopping data, we first observe a reduction in sugar-sweetened beverages during the tax. We also find that purchasing largely reverted to pre-tax levels after the tax was terminated. However, examining heterogeneous responses reveals that the tax reduced purchasing in diabetic households, including after the tax was repealed. Taken together, we find that the tax in this case was not only impactful in the short-run, but had longer-run effects on a susceptible population.

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1 Introduction

Soda taxes have been used as a policy lever to improve consumers' health outcomes by reducing consumption of sugary beverages. Taxes can change behavior for multiple reasons: by exerting a direct demand effect through raised prices, by signaling that the taxed good is harmful, by causing consumers to search for more information leading to heightened understanding of health risks and awareness of healthier alternatives or by making the new taxed price seem costlier (over and above the direct price effect). With a one-time change in tax regime, as is typical in most empirical settings that have studied taxes, identifying which of these effects is at work is challenging. However, while all the stated reasons would lead to a decline in purchases during the tax, they generate somewhat different predictions for what will happen once the tax is terminated. Using a setting where a tax was implemented and terminated shortly thereafter, our first research question tests post-tax behavior to shed more light on *how* soda taxes work.

Second, the goal of most "sin" tax policies is to have an impact on the most susceptible populations. However, it is unclear if unhealthier consumers respond most to the tax. Research in the context of other sin taxes, such as cigarettes and alcohol[1], suggests that healthier people or light users are more likely to decrease consumption in response to a tax. From a policymaker's perspective, a soda tax that would impact those who are already healthy would be less impactful than if the policy were to change the behavior of those who would benefit the most, i.e., at-risk populations, such as individuals with diabetes. Our second research question aims to understand if taxes work as intended by impacting the more susceptible populations.

Sugar sweetened beverages (SSBs) have been targeted by policymakers because excessive consumption can contribute to diabetes and obesity (Hu and Malik, 2010). Multiple municipalities have instituted soda taxes (e.g., Berkeley, Philadelphia), which has been justified

[1]For example, Nesson (2017); Adda and Cornaglia (2006) in the context of cigarette taxes and a review article by Nelson (2016) on alcohol taxes.

by the goal of reducing the negative health effects of SSBs. However, it is unclear if the tax necessarily impacts the most susceptible populations whose health would presumably benefit the most. Proponents (e.g., CHOICESProject, 2021) have argued that soda taxes would improve health outcomes and reduce health costs while increasing revenue. Another proposed benefit is that taxes could serve as a signal to disrupt habits, especially for those with self-control issues, or prompt people with incorrect beliefs to become better informed (e.g., Allcott et al., 2019*a*; Gruber and Kőszegi, 2004). Opponents, however argue that taxes might not change the behavior of diabetic individuals, and that these consumers end up paying higher prices but with no direct benefit (e.g., see opinion article by Kiesel and Sexton (2024)).

To answer our research questions we use the setting of Cook County, where a sugar sweetened beverage (SSB) tax was implemented in August 2017. Facing pressure from multiple fronts including consumers and lobbyists, the Cook County SSB tax was repealed after four months on December 2017. This setting enables us to measure behavior after the tax policy was implemented and after it was repealed. We combine this setting with a comprehensive dataset from NielsenIQ that allows us to observe detailed household-level purchases as well as whether each household has a diabetic member or not. Unlike prior research on the effects of soda taxes that has examined aggregate store-level sales (e.g., Seiler et al. 2021*a*; Roberto et al. 2019; Powell et al. 2020*a*), we focus on household-level behavior contrasting during tax vs. post-tax behavior *within* an individual allowing us to better understand changes in consumer responses. Because we also directly observe the health conditions and ailments of each household we can identify differences, if any, in healthy vs. susceptible populations. This individual-level focus helps us address a question that is of interest to policymakers, i.e., can the intervention impact different groups of people differently.

Our empirical analysis uses a differences-in-differences-in-differences approach where purchases of SSBs at the individual-level after the tax was terminated is compared to purchase

levels during the tax and before the tax was levied, relative to control regions and relative to a control year. Because the tax was implemented only in Cook County, all adjacent counties (DuPage, Kane, Lake, McHenry, Will) serve as controls. The previous year, 2016, is used as a control year to control for time trends and seasonality, e.g., SSB purchases might be higher in summer.

In addition to the tax implementation and termination, our setting allows us to understand the role of information as well. Because the tax was announced before it was implemented, it received news coverage and public awareness a few weeks before the implementation date. Similarly, the repeal was announced before the tax was terminated. Such information about the upcoming tax policy and its termination allows us to understand if consumers respond to the mere presence of the information.

First, examining overall responses, we find that purchases decrease during the tax, but return to pre-tax levels once the tax is terminated. We estimate that the purchases of taxed beverages declined by 17.9%-24.2% during the tax[2]. At the aggregate level, this finding rules out healthy habit formation, i.e., although consumers purchase fewer SSBs during the tax they do not hold on to this healthier behavior after the tax is lifted. We also do not find evidence supporting over-consumption (either because of curbed demand during the tax or the SSBs appearing cheaper once the tax is lifted) after the termination of the tax.

However this overall conclusion masks some important differences across different populations. Examining diabetic households, we find that purchases after the tax was terminated does not revert to pre-tax levels, and this behavior is sustained even over the longer-term (16 weeks). During the tax regime, weekly purchases of diabetic households drop by 58 - 73 oz, equivalent to 53%-66% reduction in purchases. These figures are statistically and economically significant relative to the non-diabetic households, amounting to an additional

[2]These results are in line with the findings in the literature on soda taxes in the US. Seiler et al. (2021*b*) find a 18% reduction after controlling for cross-border shopping, studies of the Berkeley tax (Bollinger et al., 2011; Rojas and Wang, 2021; Falbe et al., 2016) find insignificant effects, although Taylor et al. (2019) show that most of the decline occurred pre-tax suggesting that information about the tax had an effect in reducing soda purchases, studies using the Washington tax show a decline of 5% (Rojas and Wang, 2021; Ching and Goetz, 2024)

40 - 50 oz, or an additional 36%-46% decrease relative to non-diabetic households.

More importantly, post-tax purchase levels for diabetic households continue to see a decline. In the shorter 9-week period, this decline is 26.5% (not statistically significant) relative to the baseline, and in the longer 16-week period this decline is 33.6% (significant at the 10% level). This finding is promising and suggests long-term positive health consequences for populations that are presumably the most likely to benefit from reducing sugar consumption.

In addition, we find that non-diabetic households respond to the information about the upcoming tax by *increasing* their purchases prior to the tax implementation date, presumably stockpiling before the tax comes into effect. However, in stark contrast, diabetic households do not exhibit such a response. In fact, relative to non-diabetic households, diabetic households decrease their purchases by 44 oz (a 40% decline) prior to the tax. This finding is also promising and suggests that the tax might serve as a signal leading diabetic households to change their purchase behavior or prompts them to gather new information about SSBs. We do not find any statistically significant additional impact of the announcement of the tax repeal on either groups.

We note that our goal is to measure the total effect of the tax and its termination which includes responses over and above the price change. Multiple changes often accompany a policy change, especially one as controversial as a SSB tax. For example, media coverage accompanying the tax and its termination, public interest, lobbying efforts, price changes affected by manufacturers in response to the tax are all likely to be different around the policy implementation (Rees-Jones and Rozema, 2023; Taylor et al., 2019; Allcott et al., 2019*b*). We consider all of these to be effects of the tax and do not aim to separately measure the effect of each of these.

1.1 Consumer Behavior and Empirical Predictions

1.1.1 Response to Tax Termination

In this section, we highlight various purchase behaviors that might arise once the tax ends. When the tax is lifted, consumer purchases can increase, stay the same, or decrease relative to the pre-tax levels. Below we delineate reasons why each of these scenarios might occur.

Reversion to pre-tax behavior can occur for two main reasons. First, if taxes work by exerting a pure demand effect, such a demand response to an increase in price will manifest as a reversion once the price increase no longer exists. Rojas and Wang (2021) document a 5% decline in purchases due to the Washington soda tax where the price increase due to the tax was likely to be the main factor; other factors such as media coverage, publicity and awareness were unlikely due to the swift enforcement of the tax which took the industry by surprise. Second, if the tax creates negative associations with SSBs, similar to "sin" tax designations, then removal of the tax might signal to the consumer there is no such negative association leading to a reversion. Such a negative response has been documented in Taylor et al. (2019) where the decline occurred immediately after the tax was voted in by a majority, months before the tax was implemented, a finding consistent with consumers updating their beliefs, making inferences and learning about adverse health outcomes that otherwise might have been unknown to the consumer.

Decline in purchases relative to the pre-tax period. A decline in the post-tax period can occur if consumers learn healthy behavior and continue that learned behavior even in the absence of the tax. Such behavior is consistent with models of rational addiction (Becker and Murphy, 1988) where sustained price changes might be needed to effect behavior change in addictive goods. Evidence for sustained preferences and preference formation has been shown to occur in Bronnenberg et al. (2012) and Bronnenberg et al. (2022) in the context of consumer packaged goods and beer respectively. In the context of soda taxes, groups that might have the strongest incentives to change behavior (e.g., those with diabetes) might

benefit the most from soda taxes. Allcott et al. (2019*b*) suggest that consumers might be unable to understand the long-term consequences of consuming SSBs or may have imperfect information about its harmful effects in which case a policy such as soda tax can help.

Increase in purchases relative to the pre-tax period. An increase in purchases can occur if sodas, after the tax is lifted, appear much cheaper relative to the taxed price. Such behavior is consistent with asymmetric responses to price decreases relative to a price increase by the same amount and is in line with the predictions of prospect theory (Kahneman and Tversky, 1979). Such asymmetric responses have been documented for example in Bell and Lattin (2000) and Krishnamurthi et al. (1992). An increase is also consistent with intertemporal substitution, for example if consumers consumed from their beverage inventory during the tax and make up for the resulting reduced inventory after the withdrawal of the tax.

These different accounts may make similar predictions about what happens when the tax is implemented, but make different predictions about what happens when the tax ends. The goal of the empirical exercise is not to test these various mechanisms, but to recover the net effect of these mechanisms and understand if taxes are able to sustain longer-term changes in behavior or if all effects disappear once the tax is lifted.

1.1.2 Response to Tax Implementation and Termination Announcements

Our setting allows us to additionally test the role of information. The Cook County tax was announced before it was implemented, and received reasonable media coverage a few weeks before it was implemented. The termination was also announced before it went into effect.

Three possible behaviors can emerge in the period leading up to the tax implementation: consumers increase their purchases in this period anticipating a higher price once the policy is implemented (stockpiling), consumers decrease their purchases as this information sends a signal that the taxed good is harmful and should be avoided (signaling and inference), or consumers ignore or do not respond to the information leading to no change in their

behavior.

Similarly, the announcement of the termination can lead consumers to strategically postpone their purchases (i.e., wait for the cheaper price once the tax is terminated), increase their purchases (e.g., if the signal that SSBs are bad is no longer credible) or have no impact on purchases.

1.2 Contribution

We contribute to the literature in three ways. First, a vast literature has studied soda taxes and their effect on consumer purchases finding an overall decrease due to the tax (see Teng et al., 2019, for a review). Some studies have shown that information even before the tax is implemented can be sufficient (e.g., Taylor et al., 2019), while others have shown there can be a strong behavioral response by opposers of the tax (e.g., Ching and Goetz, 2024). We extend this literature by documenting how such taxes might work by analyzing behavior when the tax is lifted, which enables us to understand whether the behavior is sustained, reverts to pre-tax behavior, or worsens. Aprioi it is unclear which of these effects will manifest.

Second, most research that comments on policy implications of soda taxes has examined purchases at the aggregate store level (e.g., Seiler et al. 2021*a*; Roberto et al. 2019; Powell et al. 2020*a*), and not at the individual household-level. However, health policy effects of taxes are related to individuals rather than stores. While store-level analysis is of interest to retailers it does not shed light on how individual consumers change their behavior.

Unlike the existing literature that has used aggregate store-level sales data with strong assumptions on individual shopping patterns, using individual level data enables observing the complete purchase pattern at the individual shopper's level. Moreover, likely because of the aggregate or cross-sectional nature of the data used in the existing literature, we see mixed findings documented. On one hand, some studies have shown that taxes are successful at reducing consumers' sugar consumption (e.g., Falbe et al., 2016; Lee et al., 2019, both of which use repeated cross-sectional surveys). On the other hand, other studies have found

that while sales at taxed locations decline, the sales at nearby non-taxed locations increase (e.g., Seiler et al. 2021*a*; Roberto et al. 2019; Powell et al. 2020*a* all of which use store-level sales data). With aggregate store-level data alone, it is hard to distinguish if individuals at the taxed locations increased purchases at the non-taxed locations, or if individuals at the non-taxed locations shopped more[3] at those non-taxed locations. Using individual-level data helps keep the unit of analysis at the individual, enabling measurement of changes in the individual's purchase levels. Moreover, while cross-border shopping is of interest to retailers, individuals' purchase behavior of sugar/soda is of primary concern to policy makers.

In addition, all these papers study a one-time change in tax policy that persisted over time[4], and cannot speak to the various behavioral responses delineated in Section 1.1 that can result from a tax policy.

Third, analysing individuals has the added benefit of helping understand how specific groups of individuals are impacted by the tax. While it has been purported that soda taxes are aimed at improving public health outcomes and consuming SSBs are linked to obesity and diabetes, to our knowledge very little empirical work has examined the behavior of these specific populations. In the context of other sin taxes, mixed findings have been reported on whether relatively healthy or vulnerable users are impacted more by the tax. Alcohol and cigarette taxes were found to impact moderate and not heavy users, making it a less effective policy because the heavy users are the ones most vulnerable to liver disease and lung cancer respectively(Nelson, 2016; Nesson, 2017). In contrast, Anand and Kadiyali (2024) find, using vaping-related Instagram posts, that e-cigarette taxes in California reduced consumption of younger (more vulnerable) consumers. In the context of soda taxes, most work has relied on simulations or calibrations to assess the impact of the tax on vulnerable populations (e.g., CHOICESProject, 2021). The lack of empirical work in this domain is largely due to

[3]For example, one theory, in line with the reference price literature, that would support such behavior is if individuals at the non-taxed locations feel that their prices are cheaper because they do not face the tax unlike their neighboring locations.

[4]Two exceptions are Ching and Goetz (2024) and Rojas and Wang (2021) who study the short-lived Washington state tax, but unlike our setting which examines and quantifies post-tax behavior changes, they examine behavior during the tax.

limited data availability on households' health conditions. Using a novel dataset where we can observe households' ailments we contribute to the literature by understanding if there exists any heterogeneity across various sub-groups of interest.

2 Data and Empirical Setting

2.1 Tax Implementation, Timeline and Termination

The Sweetened Beverage Tax (SBT or SSB tax) was implemented in Cook County on August 2, 2017. The tax imposed a 1.00 cent per fluid ounce tax on the retail sale of all sweetened beverages.[5] On October 10, 2017, Cook County announced the repeal of the tax and the SSB tax was terminated two months later on December 1, 2017. Figure 1 provides the timeline of all events that we go over in detail below.

Although the tax went into effect on August 2, 2017, and was terminated on December 1, 2017 both these events received press coverage prior to the actual implementation and termination dates. Therefore, we define five distinct periods: the pre-tax baseline, transition (aligning with press coverage of the upcoming tax), during tax, during tax and post-repeal announcement and post tax periods, in close accordance with these events.

Pre-Tax As the baseline period, we use the 9 week period starting April 1, 2017. This period was free of press coverage of the upcoming tax which started in late June (AssociatedPress, 2017*a*; Tribune, 2017). Because there was no press coverage in the period between April and late May of 2017, this pre-tax period serves as a good baseline because consumer behavior is unlikely to be impacted by any soda tax related information in this period. We verify this to be the case using purchase behavior during this period relative to the preceding months and find no change in behavior (See Online Appendix A).

[5] https://www.cookcountyil.gov/service/sweetened-beverage-tax, Accessed May 2022

Transition As mentioned above, press coverage of the upcoming tax started in late June. Moreover, although the tax was set to be implemented on July 1, retailers filed lawsuits (AssociatedPress (2017*b*)) aimed at blocking the tax leading to an ultimate implementation date of August 2, 2017. All of this coverage could have led to public awareness of the tax before its actual implementation. A Google search volume trends chart confirms this: Figure A1 in Appendix A shows that starting late June 2017 the search intensity for the search term "soda tax" increased in Chicago with almost no activity in the weeks before. Information about the upcoming tax might in itself be sufficient to change consumers' purchase behavior (see Section 1.1.2). To account for this possibility, we treat the 9 weeks immediately preceding the tax implementation as a transition period.

During Tax The tax was implemented on August 2, 2017 and was in effect until December 1, 2017 when it was repealed. However, the termination of the tax was announced on October 10, 2017. We therefore divide this period into two distinct phases: a pre-announcement and a post-announcement phase. Both periods are during the tax, but the post-announcement phase might have an additional impact on consumer behavior (as delineated in Section 1.1.2)

- **During Tax and pre-repeal announcement** This period, comprising 9 weeks, refers to the period between August 2,2017 and October 10, 2017 before the termination of the tax was publicly announced.

- **During Tax and post-repeal announcement** This period, comprising 6 weeks, refers to the period between October 10,2017 and December 1, 2017 after the announcement of the termination of the tax was made public.

Post Tax Finally, of primary interest to the research question posed in this paper, the 9 weeks following tax termination comprise the Post Tax period. This 9-week duration was chosen to closely match the duration of the other four periods. Because the SSB tax was terminated in December, the post-tax period continues into the following year.

Additionally, we include a longer post-tax period in our analysis to account for any long-term changes in consumption behavior. This extended post-tax period covers 16 weeks after the termination of the SSB tax. We limit the long-term analysis to 16 weeks to ensure the placebo year (previous year's post-tax period) does not overlap with the pre-tax period. In other words, a longer post-tax, say 20 weeks, period would make the placebo post-tax period end in April 2017 which would overlap with our treated pre-tax period which begins April 2017. To avoid any noise during the dates of the actual policy changes, weeks pertaining to the implementation, announcement of the repeal, and termination are excluded.

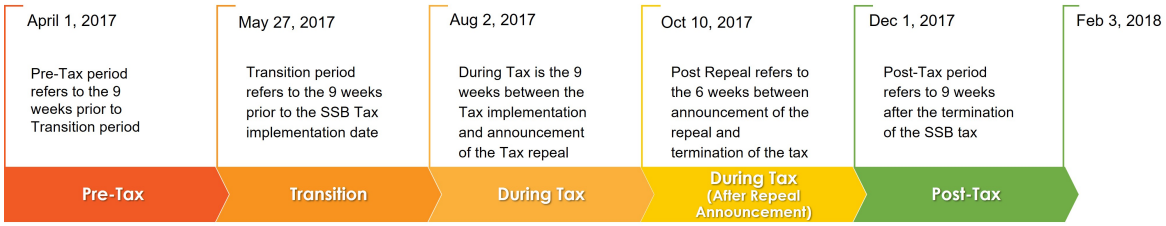


Figure 1: Timeline of SSB tax-related events in Cook County

2.2 Tax is reflected at checkout and is not passed-through

Unlike most soda taxes, which are levied at the distributor/bottler level which is in turn passed through to the end consumer, the Cook County tax was collected at the register, at the point of purchasing the basket of goods. The images below show how the tax was imposed. Figure 2 shows receipt images in Cook county for taxed beverages. Note that the tax is a separate line-item in each of these receipts and is not included in the price of the beverage. Figure 3 highlights the messaging that some retailers used stating "This item is applicable for the Cook County sweetened beverage tax, one penny per ounce, tax amount will be available on receipt at checkout".

As a result, any price increases observed in the NielsenIQ data cannot be interpreted

as a tax pass-through, but an indirect effect of the tax (e.g., retailers increasing prices). Therefore, we present two sets of results: one that does not control for any changes in prices and another that does, through a price index. The first set of results should be interpreted as the overall effect of the tax policy. The second set of results which controls for prices showcases how much of the effect is due to factors related to the tax had prices not changed.



Figure 2: Cook County Tax Implemented at Checkout

2.3 Impacted Products

The tax impacted sugar sweetened beverages (SSBs) and artificially sweetened beverages (ASBs). The four main categories under SSBs are Soda Drinks, Juice Drinks, Coffee and Tea Drinks and Cocktail Mixes, and the primary category under ASB is Diet Soda.

It is unclear whether artificially sweetened beverages have similar health repercussions as sugar sweetened beverages. While SSBs are directly relevant from a policy perspective, given the linkage between consumption of additional sugars and various adverse health outcomes, it is unclear whether diet sodas should be taxed (see for example WorldBank 2023). On one hand, studies have shown that SSBs (and not ASBs) are more closely linked to diabetes (e.g., Ma et al. 2016; Imamura et al. 2015). On the other hand, it has also been suggested



Figure 3: Cook County Tax Shelf Messaging

that diet sodas are not entirely harmless (PennMedicine 2022). Therefore, understanding how consumers respond to the tax policy for SSBs as well as ASBs, provides a relevant input to policy makers aiming to understand what kinds of products should be taxed. We examine consumer responses to the tax and its termination for these two sub-categories separately in Appendix C. Our overall findings across the sub-categories are similar implying that consumers respond to the tax similarly for sodas and diet sodas.

Categories that are not subject to the tax include Water, Sparkling Water and 100% Juices, all of which contain no added sugar.

2.4 Natural Experiment

The SSB tax was implemented in Cook Country. Adjacent counties (DuPage, Kane, Lake, McHenry, Will) serve as controls. These counties geographically border Cook County (Figure 4) but are not subject to the SSB tax. As a robustness check, we use Milwaukee, which is comparable to Cook County due to its large population and metropolitan nature, as an alternative control.

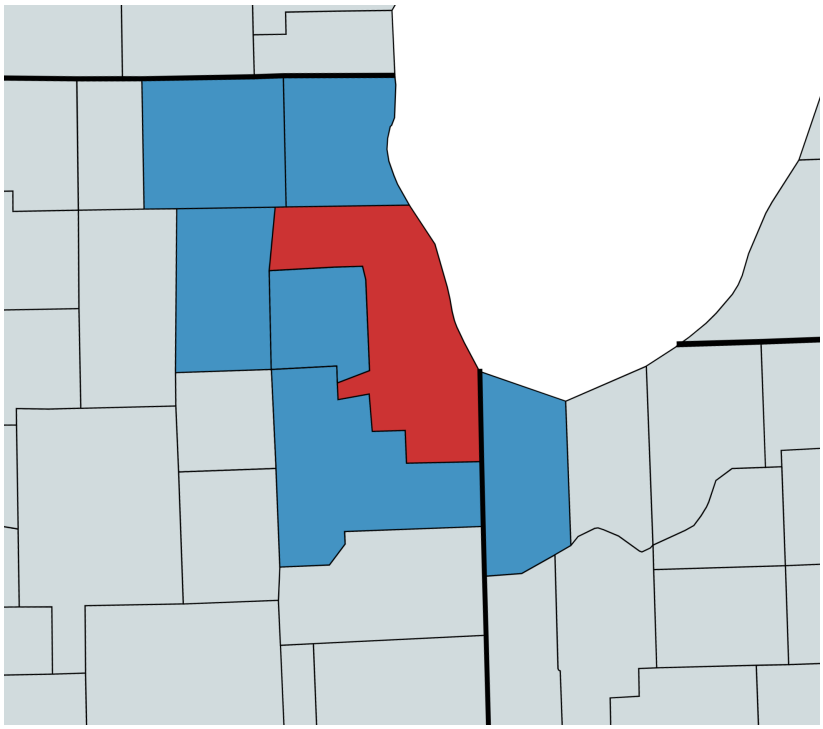


Figure 4: Adjacent Counties (blue) that border Cook County (red)

Using data from NielsenIQ's HMS panel, we restrict attention to households in the treated region (Cook County) and households in the control regions (adjacent counties). We keep only purchases in the categories of interest (SSBs, ASBs, water, sparkling water and 100% Juices) that occurred between April 2016 - February 2017 and April 2017 – February 2018. While the period from April 2017- February 2018 is directly relevant to the tax period and provides a description of what happened during the tax and after the tax relative to the pre-tax period, the previous year (April 2016 - February 2017) serves as a placebo helping

capture any seasonality or time trends in demand.[6] Only households that have purchased at least once during the timeframe are included. Weeks where a household did not make any purchase are also included and the volume purchased is recorded as a zero. Inclusion of such zero-purchases helps ensure we capture all types of reductions in consumption including complete reductions. Household purchases within a category (e.g., All Taxed Bervages, SSBs) are aggregated to the weekly level.

2.5 Empirical Specification

The main dependent variable is the weekly volume (in ounces) of SSBs purchased by a household. Using a differences-in-differences-in-differences design, we compare weekly volume of soda purchased in a period of interest (e.g. post-tax) to the weekly volume purchased before the tax, i.e., in the pre-tax period, relative to the same periods in a control year (2016) and the control region (adjacent counties). Using the pre-tax period as the reference, allows us to test directly how behavior at various periods changed in response to the tax.

For each category considered (e.g., All Taxed Beverages, Sugar Sweetened Beverages, Soda, Diet Soda), we estimate the following regression separately:

$$\begin{aligned} y_{it} = \beta_1 \text{Cook}_i + \beta_2 \text{TaxYr}_t + \beta_3 \text{Cook}_i \times \text{TaxYr}_t + \sum_{Period} \gamma_{0,Period} Period_t + \\ \sum_{Period} \gamma_{1,Period} Period_t \times \text{Cook}_i + \sum_{Period} \gamma_{2,Period} Period_t \times \text{TaxYr}_t + \\ \sum_{Period} \gamma_{3,Period} Period_t \times \text{Cook}_i \times \text{TaxYr}_t + \alpha_i + \epsilon_{it} \end{aligned} \tag{1}$$

where $Period \in \{Transition, DuringTax, DuringTaxPostRepealPublic, PostTax\}$

In equation 1, y_{it} is the weekly volume of beverage purchased by household i in week t; $\text{Cook}_i = 1$ if household i lives in Cook county and $\text{TaxYr}_t = 1$ if week t corresponds to

[6] For analysis considering a longer Post Tax period we use April 2016 – April 2017 and April 2017 – April 2018. The longer Post Tax period helps test whether the long-term purchase behavior is different from the short-term purchase behavior once the SSB tax was terminated.

the year the tax was implemented, i.e. 2017. The four distinct time periods are captured by $Period \in \{Transition, DuringTax, DuringTaxPostRepealPublic, PostTax\}$ which are indicator functions for the time periods corresponding to the transition, during tax but before the announcement of the tax repeal, during tax and post repeal announcement and Post-Tax periods as defined in Figure 1. These are indicators for the respective weeks in both the treated and untreated years. The additional effects corresponding to the year the tax was implemented are therefore captured by the coefficients $\gamma_{2,Period}$ corresponding to $Period_t \times \text{TaxYr}_t$. The main coefficients of interest are $\gamma_{3,Period}$ corresponding to the treatment effects of the transition, during tax, during tax and post repeal announcement and tax termination, respectively, in Cook County in 2017 relative to the baseline (relative to adjacent counties and the placebo year 2016).

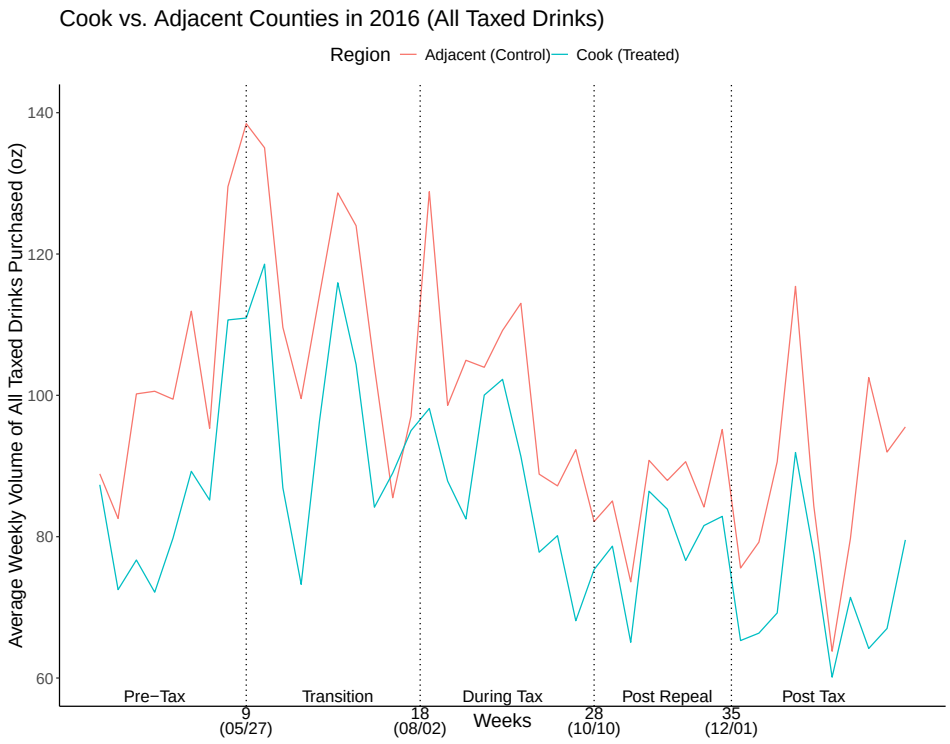
The regression controls for household fixed-effects, α_i, to account for varying consumption levels of different households and clusters at the individual household level.

The differences-in-differences-in-differences specification is illustrated in Figure 5. Figure 5 shows the average weekly volume of SSBs purchased for consumers in Cook County and the adjacent counties in 2016 (Figure 5a) and 2017 (Figure 5b) in the five periods of interest: pre-tax, transition, during tax, During Tax (After Repeal Announcement) and post tax.

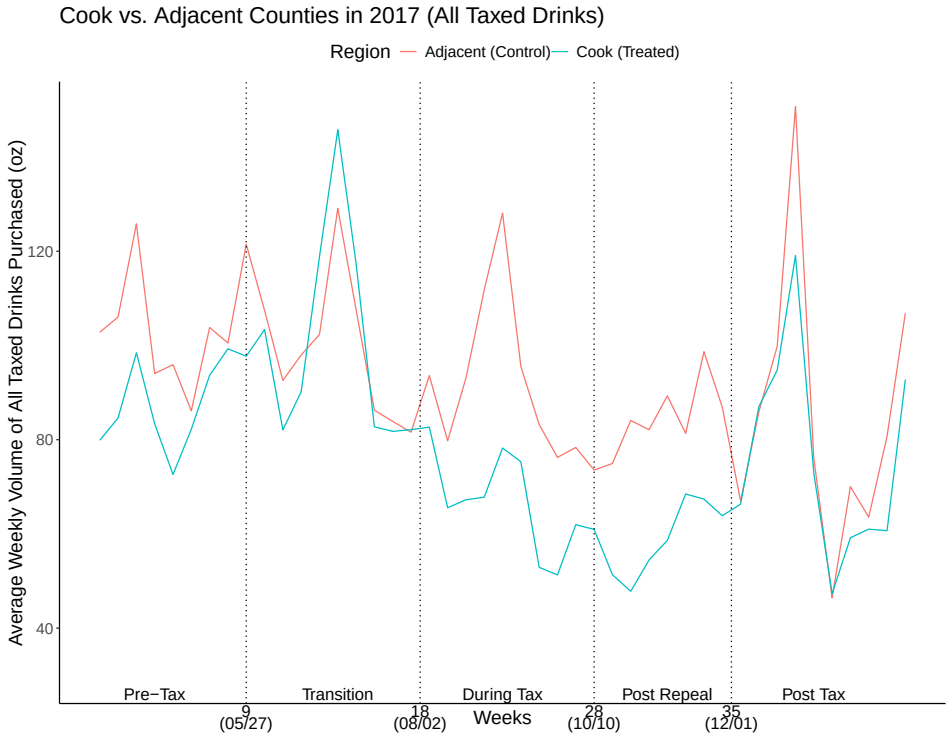
Three patterns are worth noting in these figures. First, Figure 5a, which shows SSB consumption levels in the control year of 2016, shows that adjacent counties serve as a good control for Cook county - the trends are largely parallel. Second, Figure 5b shows that, in the treated year of 2017, the period during the tax (including the post-repeal announcement period) sees a decline in consumption relative to both the pre-tax period and the adjacent counties in 2017. This pattern does not exist in 2016 (control year) suggesting the soda tax had a negative impact on SSB purchases. Last, it can be seen that after the tax is terminated, Cook county consumption levels revert to pre-tax and parallel the patterns in the adjacent counties in 2017.

In the next section, we account for differences in household-level purchase levels by esti-

mating the full specification with household-level fixed effects (Equation 1) to quantify the magnitude and statistical significance of these effects.



(a) Cook and the adjacent counties: Placebo Year (2016)



(b) Cook and the adjacent counties: The year the tax was implemented (2017)

Figure 5: The averaged weekly volume of All Taxed Beverages purchased for consumers in (a) 2016 and (b) 2017

3 Results

Table 1 presents the results of the regression specified in Equation 1. We report the results for all taxed beverages, as well as only the sugar-sweetened beverages which excludes Diet Sodas. The baseline is the pre-tax period (Figure 1), and all behavior is measured relative to purchases in the pre-tax period.

First, focusing on the transition period, we see a statistically significant *increase* of 14.71 oz in weekly purchases. Note that to account for possible consumer response to the news of the upcoming tax we explicitly treat this period as a transition period, and not as a baseline. This increase during the transition period is consistent with strategic consumer behavior, such as stockpiling to avoid higher taxed prices at a later date, in response to the tax announcement.

Second, during the tax period we see weekly purchases decline by 15.81 oz and 21.42 oz respectively in the two distinct phases we define (during tax and during tax but after the repeal announcement). These figures amount to a 17.9% and 24.2% weekly reduction in purchases relative to the pre-tax baseline of 88.42 oz for the overall sample.

Finally, and of direct relevance to our research question, we see that after the tax was terminated, the purchases revert to the baseline pre-tax level: purchases in the post-tax period are 5.86 oz higher but statistically indistinguishable from the baseline period. In other words, we do not see evidence for either a sustained decline or a significant increase in purchases after the tax ended.

We note that some of the decline during the tax and after the repeal announcement can come from strategic postponement of purchases, with consumers choosing to wait until the tax is lifted. If so, we should have seen a rebound in purchases after the tax ends, but we see a near-zero change in purchases post-tax. This combined with the fact that the estimate after the repeal announcement is not significantly different from the estimate before the announcement, it is likely that such strategic postponement is minimal.

The results for SSBs, reported in Table 1, column (b) are qualitatively and quantitatively

similar.

Finally, we note that our goal is to measure the net effect of the tax policy, which includes all events surrounding the tax policy. These events include media coverage, salience of the tax at stores, as well as any manufacturer-implemented changes. One such manufacturer-implemented change we observe is an increase in prices of taxed beverages during the tax period (Section B). Our estimates reflect the impact of all changes resulting from the tax policy and our goal is not to separate the impact of each of these events.

Table 1: Effects of the tax relative to the pre-tax period: D-D-D Estimates

	(a)	(b)
	All Taxed Beverages	SSBs
2017 X Cook X Transition	14.71**	9.71*
	(6.15)	(5.05)
2017 X Cook X During Tax	-15.81***	-8.5*
	(6.08)	(4.94)
2017 X Cook X During Tax (Post Repeal Public)	-21.42***	-16.13***
	(6.55)	(5.48)
2017 X Cook X Post-Tax	5.86	1.92
	(6.83)	(5.73)
Pre-Tax Cook Mean (oz)	88.42	64.53
N Observations	165,858	161,196
N households	2,249	2,216
Controls	2016 + Adj. Counties	
Fixed Effect	Household	
Clustering Level	Household	

*p<0.1; **p<0.05; ***p<0.01

Notes: The dependent variable is volume of beverage purchased in oz. All Taxed Beverages include all SSBs and Diet Soda. SSBs include all sugar-sweetened beverages but not Diet Soda. All estimates are relative to the baseline Pre-Tax period consisting of the 9 weeks before the transition period. During Tax refers to the period during the tax before the announcement of the tax termination, while During Tax (Post Repeal Public) refers to the period after the announcement. The duration of the Post Tax period is 9 weeks after the termination of the SSB tax. Clustered standard errors in parentheses.

3.1 Quantifying the Net Impact of the Tax

To understand the overall effect of the tax we run another regression, similar to the main specification, with the only difference being that we combine all four periods (transition, during tax, during tax and post-repeal announcement, and post-tax) into one period. This specification enables us to measure the net effect relative to the baseline. We also include a longer-term post-tax period to understand if there are any significant differences considering a shorter- relative to a longer- period.

Table 2 reports the results. We see that for the overall population, while there is a decline of around 2 oz, this is not statistically significant. In sum, the changes attributable to the tax are not statistically different from zero. We will contrast this to the net effect for the diabetic population in Section 4.

Table 2: D-D-D Estimates: Net Impact of the Tax

	Short-term		Long-term	
	(a) All Taxed Beverages	(b) SSBs	(a) All Taxed Beverages	(b) SSBs
2017 X Cook X All Periods	-2.6	-2.08	-2.71	-1.75
	(5.02)	(4.3)	(5.12)	(4.36)
Pre-Tax Cook Mean (oz)	88.42	64.53	86.03	62.36
N Observations	165,858	161,196	199,675	194,677
N households	2,249	2,216	2,288	2,257
Controls	2016 + Adj. Counties			
Fixed Effect	Household		Household	
Clustering Level	Household		Household	

*p<0.1; **p<0.05; ***p<0.01

Notes: The dependent variable is volume of beverage purchased in oz. All Taxed Beverages include all SSBs and Diet Soda. SSBs include all sugar-sweetened beverages but not Diet Soda. All estimates are relative to the baseline Pre-Tax period consisting of the 9 weeks before the transition period. All periods includes the Transition, During Tax, During Tax (Post Repeal Public) and Post-Tax period combined into one period. The duration of the Post Tax period is 9 weeks in Column (a)-(b) and 16 weeks in Column (c)-(d). Clustered standard errors in parentheses.

3.2 Robustness Checks

In this section, we present three main robustness checks. First, we show that our results hold using Milwaukee as an alternative control. Second, we show that our results are robust including a longer-term window (16 weeks). Finally, we examine purchases of Untaxed Beverages as a placebo check.

Milwaukee as a Control Our main analysis uses adjacent counties as a control group. Another potential control is Milwaukee, which being a larger city, is closer in size and characteristics to Cook County. Table D1, Columns (c) and (f) corresponding to All Taxed Beverages and SSBs respectively, in Appendix D present the results, showing our results are robust to this alternative control.

Longer post-tax period Our main analysis uses a 9-week period after the termination of the tax to estimate post-tax effects. Here, we test whether the effects are sustained in a longer period. We use 16 weeks as our chosen duration for the longer post-tax period, because any duration longer than that (in the placebo year) would begin overlapping with the pre-tax period in the treated (tax) year. More specifically, the 16 week post-tax period ends on April 2017 in the placebo year and on April 2018 in the treated (tax) year. The pre-tax period in the treated year begins April 2017. A longer post-tax duration would end after April 2017 in the placebo year overlapping with the pre-tax period in the treated year. Table D1, Columns (b) and (e) in Appendix D shows the impact of the tax for a longer post-tax period showing that purchases revert to pre-tax periods even in the longer-term.

Untaxed Beverages In this robustness, we check to see if untaxed beverages experienced any change as a placebo check. Specifically, if we see a decline similar to taxed beverages, one might be concerned that other factors (and not just the tax) might be influencing beverage consumption of taxed beverages in Cook county. An increase in purchases of untaxed beverages or no change are both reasonable expectations. We might expect to see

an increase if consumers substitute to these beverages in the presence of the tax on sugary beverages.

Table D2 in Appendix D presents these results. Overall, we do not see evidence for an increase in purchases of untaxed beverages. These results are in line with the findings of Seiler et al. (2021*a*), Allcott et al. (2019*a*) and Powell et al. (2020*a*). This lack of evidence for substitution to untaxed beverages could be driven by a total reduction in beverage purchases. It could also be driven by substitution to non-store purchases (e.g., restaurants, vending machines) or consumption of non-purchased beverages (e.g., water at home), both of which are unobserved in the data.

4 Heterogeneity

One of the reasons soda taxes are levied is to improve health outcomes. Diabetes is one of the most important health conditions that policymakers aim to address with the soda tax (Peñalvo, 2024). Studies have indirectly suggested that because soda taxes are likely to impact lower-income households more, they will likely have a positive impact on diabetes which disproportionately affects the poor (e.g., Allcott et al. 2019*a*; Peñalvo et al. 2017). However, to our knowledge, there is very little empirical work that directly measures the impact of the tax on people with diabetes. The main reason for this lack of empirical work is the unavailability of granular data on households' health conditions.

In this section we investigate the implications of the SSB tax on households with medical conditions, specifically diabetes, using the NielsenIQ Annual Ailments, Health, and Wellness Survey data.[7] Our analysis includes only households that participated in the NielsenIQ Annual Ailments, Health, and Wellness Survey in 2016 or 2017. About 50% of households in our sample completed this survey.

[7]We also similarly examined households with at least one member suffering from obesity, an oft-cited precursor to diabetes. While the results are qualitativey similar to our results from the diabetes analysis, we do not detect statistically significant differences between households with obesity vs not (Table B1 in Online Appendix B).

Table 3 reports the mean purchase volume in Cook county before the tax was levied in the pre-tax period. Two points are worth noting. First, the NielsenIQ Annual Ailments, Health, and Wellness survey sample is comparable to the main NielsenIQ sample in terms of the mean purchase volume of taxed beverages. Second, diabetic households purchase meaningfully more SSBs relative to non-diabetic households. Across all taxed beverages, diabetic households purchase 110.38 oz, 30% more than their non-diabetic counterparts, and across all SSBs this is even higher constituting 46% more purchases.

Table 3: Pre-Tax purchases of taxed beverages in Cook county

Pre - Tax Cook Mean (oz)	All Taxed Beverages	SSBs
NielsenIQ Sample		
All households	88.42	64.53
NielsenIQ Annual Ailments, Health, and Wellness Survey Sample		
All households	90.62	64.46
Households without diabetes	85.71	59.22
Households with diabetes	110.38	86.28

4.1 Households with Diabetes

Approximately 20% of the households in our sample have at least one member of the household who suffers from diabetes. We run the same specification presented in Equation 1 but separately for the sample of households with atleast one diabetic member and households without a diabetic member. For ease of comparison, we also interact this ailment indicator (households with diabetes or not) with our coefficients in Equation 1 to examine if households with diabetes respond significantly differently from households without diabetes. We report results considering both the short-term (9 weeks) post-tax as well as the long-term (16 weeks) post-tax periods. We do so to understand if behavior is sustained in the longer term, especially for diabetic households, or if behavior is more likely to revert to baseline levels.

4.1.1 Net Impact of the Tax for Households with Diabetes

First, similar to the exercise in Section 3.1, we quantify the net impact of the tax for the two separate populations: those without diabetes and those with diabetes. Table 4 reports the results. We find that the tax has a statistically and economically meaningful impact on the more vulnerable diabetic population leading to a net decline of of 40.88 oz (37% of the mean pre-tax purchase level) in the short-term and a 41.91 oz (37% of the mean pre-tax purchase level) decline when considering the longer 16-week post-tax period.

Table 4: D-D-D Estimates: Net Impact of the Tax for Households With and Without Diabetes

	Short-term		Long-term	
	(a) All Taxed Beverages	(b) SSBs	(a) All Taxed Beverages	(b) SSBs
2017 X Cook X All Periods	-2.23	-2.01	-1.58	-1.42
	(8.03)	(6.75)	(8.06)	(6.71)
2017 X Cook X All Periods X Diabetes	-40.88**	-29.5**	-41.91**	-29.82**
	(16.68)	(14.21)	(17.07)	(14.43)
Pre-Tax Cook Mean (oz)	90.62	64.46	89.21	63.25
Pre-Tax Cook Mean, hh with diabetes (oz)	110.38	86.28	109.25	84.42
N Observations	82,110	79,884	96,677	93,933
N households	1,073	1,062	1,076	1,062
Controls	2016 + Adj. Counties			
Fixed Effect	Household			
Clustering Level	Household			

*p<0.1; **p<0.05; ***p<0.01

Notes: The dependent variable is volume of beverage purchased in oz. Data includes only the sample of households with atleast one diabetic member. All Taxed Beverages include all SSBs and Diet Soda. SSBs include all sugar-sweetened beverages but not Diet Soda. All estimates are relative to the baseline Pre-Tax period consisting of the 9 weeks before the transition period. All periods includes the Transition, During Tax, During Tax (Post Repeal Public) and Post-Tax period combined into one period. The duration of the Post Tax period is 9 weeks in Column (a)-(b) and 16 weeks in Column (c)-(d). Clustered standard errors in parentheses.

4.1.2 Impact of the Tax in Each Period for Households with Diabetes

We next evaluate the four separate periods to understand how taxes might impact households with diabetes. Tables 5-7 presents the results of the analysis. The impact of the tax on

diabetic households stands in stark contrast with the average effect documented in Section 3. Specifically, the tax has a beneficial effect on diabetic households in *all* four periods of interest.

First, considering only the diabetic households (Table 5) we see a *decline* in purchases during the transition period. This decline is in contrast with the significant increase (behavior consistent with stockpiling in anticipation of the tax) for the overall population documented in Section 3 as well as the increase seen for non-diabetic households (Table 6). Moreover, this difference in purchase behavior in the transition period between the diabetic and non-diabetic households is significantly different as reported in Table 7. This finding for diabetic households suggests that the announcement and news of the tax policy either serves as a nudge leading them to change their behavior or signals negative information about SSBs prompting them to correct their beliefs or acquire new information.

Second, during the tax period, diabetic households see a significant decline in their purchases. Although the non-diabetic households also see a decline during the tax period, the decline for diabetics is both statistically and economically significantly different from non-diabetics. Diabetic households see a decline of 58.11 oz and 72.61 oz in the two distinct phases we define during the tax. These figures amount to a weekly reduction of 53% and 66% in purchases relative to the pre-tax baseline of 110.38 oz for this group. The decline for non-diabetic households in the same two periods is 21% and 25.3%.

Third and more importantly, the decline appears to be sustained for diabetic households. In the 9-week post-tax period we see a decline of 29.32 oz. Although this number is statistically insignificant it is economically large. We therefore examine the longer 16-week post-tax period to see if this decline is sustained in the longer term or reverts to the baseline. In the longer post-tax period (Table 5, column (c)), we see that the purchases of diabetic households continue to remain low, and is statistically significantly lower relative to the baseline (36.78 oz lower). This decline is sizable at approximately 50%-65% (36.78/57.67 - 36.78/72.19) of the decline during the tax. This evidence is promising because it suggests that the policy

led to a sustained change in behavior for diabetic households.

It would be natural to assume that the decline occurs because behavior persisted for the few weeks immediately after the tax termination. Instead we see stronger evidence in the longer 16-week period relative to the shorter 9-week period indicating the behavior is sustained over the longer term.

Our results are promising for policy makers for two reasons. First, unlike the overall population we do not see evidence for an increase in purchases during the transition period, and in fact see a decline in purchases during this period, suggesting the tax provides the right signal to this susceptible population. Second, the decline in purchases is sustained even after the tax is lifted, especially in the longer period.

Table 5: Estimates: Households With Diabetes

	Short-term		Long-term	
	(a)	(b)	(c)	(d)
	All Taxed Beverages	SSBs	All Taxed Beverages	SSBs
2017 X Cook X Transition	-22.26	-15.22	-22.1	-13.88
	(20.79)	(16.28)	(20.58)	(16.14)
2017 X Cook X During Tax	-58.11***	-31.25*	-57.67***	-29.52*
	(19.47)	(15.9)	(19.38)	(16.01)
2017 X Cook X During Tax (Post Repeal Public)	-72.61***	-61.35***	-72.19***	-60.33***
	(20.7)	(17.42)	(20.56)	(17.44)
2017 X Cook X Post-Tax	-29.32	-28.16*	-36.78*	-31.07**
	(19.58)	(15.36)	(19.08)	(15.26)
Pre-Tax Cook Mean, hh with diabetes (oz)	110.38	86.28	109.25	84.42
N Observations	15,750	14,994	18,522	17,493
N households	202	198	202	196
Controls	2016 + Adj. Counties			
Fixed Effect	Household			
Clustering Level	Household			

*p<0.1; **p<0.05; ***p<0.01

Notes: The dependent variable is volume of beverage purchased in oz. Data includes only the sample of households with atleast one diabetic member. All Taxed Beverages include all SSBs and Diet Soda. SSBs include all sugar-sweetened beverages but not Diet Soda. Pre-Tax refers to the 9 weeks before the transition period. During Tax refers to the period during the tax before the announcement of the tax termination, while During Tax (Post Repeal Public) refers to the period after the announcement. The duration of the Post Tax period is 9 weeks in Column (a)-(b) and 16 weeks in Column (c)-(d). Clustered standard errors in parentheses.

Table 6: Estimates: Households Without Diabetes

	Short-term		Long-term	
	(a)	(b)	(c)	(d)
	All Taxed Beverages	SSBs	All Taxed Beverages	SSBs
2017 X Cook X Transition	21.9**	16.19**	20.98**	15.29*
	(10.06)	(8.13)	(9.95)	(8.04)
2017 X Cook X During Tax	-18.02*	-10.46	-17.71*	-10.49
	(10.24)	(8.07)	(10.14)	(7.99)
2017 X Cook X During Tax (Post Repeal Public)	-21.77*	-16.83*	-21.28*	-16.35*
	(11.16)	(9.22)	(11.05)	(9.12)
2017 X Cook X Post-Tax	2.44	-1.88	2.19	-0.12
	(10.17)	(8.29)	(9.72)	(7.89)
Pre-Tax Cook Mean, hh without diabetes (oz)	85.71	59.22	84.25	58.13
N Observations	66,360	64,890	78,155	76,440
N households	871	864	874	866
Controls	2016 + Adj. Counties			
Fixed Effect	Household			
Clustering Level	Household			

*p<0.1; **p<0.05; ***p<0.01

Notes: The dependent variable is volume of beverage purchased in oz. Data includes only the sample of households without a diabetic member. All Taxed Beverages include all SSBs and Diet Soda. SSBs include all sugar-sweetened beverages but not Diet Soda. Pre-Tax refers to the 9 weeks before the transition period. During Tax refers to the period during the tax before the announcement of the tax termination, while During Tax (Post Repeal Public) refers to the period after the announcement. The duration of the Post Tax period is 9 weeks in Column (a)-(b) and 16 weeks in Column (c)-(d). Clustered standard errors in parentheses.

Table 7: Interaction Estimates: Households With and Without Diabetes

	Short-term		Long-term	
	(a) All Taxed Beverages	(b) SSBs	(c) All Taxed Beverages	(d) SSBs
2017 X Cook X Transition	21.9**	16.19**	20.98**	15.29*
	(10.06)	(8.13)	(9.95)	(8.04)
2017 X Cook X During Tax	-18.02*	-10.46	-17.71*	-10.49
	(10.24)	(8.07)	(10.14)	(7.99)
2017 X Cook X During Tax (Post Repeal Public)	-21.77*	-16.83*	-21.28*	-16.35*
	(11.16)	(9.22)	(11.05)	(9.12)
2017 X Cook X Post-Tax	2.44	-1.88	2.19	-0.12
	(10.17)	(8.29)	(9.72)	(7.89)
2017 X Cook X Transition X Diabetes	**-44.16***	**-31.4***	**-43.08***	**-29.17**
	(23.05)	**(18.16)**	**(22.82)**	**(18)**
2017 X Cook X During Tax X Diabetes	**-40.09***	**-20.79**	**-39.96***	**-19.04**
	(21.96)	**(17.8)**	**(21.83)**	**(17.86)**
2017 X Cook X During Tax (Post Repeal Public) X Diabetes	**-50.84****	**-44.52****	**-50.91****	**-43.99****
	(23.47)	**(19.67)**	**(23.3)**	**(19.65)**
2017 X Cook X Post-Tax X Diabetes	**-31.76**	**-26.28**	**-38.96***	**-30.95***
	(22.03)	**(17.42)**	**(21.37)**	**(17.15)**
Pre-Tax Cook Mean (oz)	90.62	64.46	89.21	63.25
Pre-Tax Cook Mean, hh with diabetes (oz)	110.38	86.28	109.25	84.42
N Observations	82,110	79,884	96,677	93,933
N households	1,073	1,062	1,076	1,062
Controls	2016 + Adj. Counties			
Fixed Effect	Household			
Clustering Level	Household			

*p<0.1; **p<0.05; ***p<0.01

Notes: The dependent variable is volume of beverage purchased in oz. Data include all households in the sample that took the NielsenIQ Annual Ailments, Health, and Wellness Survey. All Taxed Beverages include all SSBs and Diet Soda. SSBs include all sugar-sweetened beverages but not Diet Soda. Pre-Tax refers to the 9 weeks before the transition period. During Tax refers to the period during the tax before the announcement of the tax termination, while During Tax (Post Repeal Public) refers to the period after the announcement. The duration of the Post Tax period is 9 weeks in Column (a)-(b) and 16 weeks in Column (c)-(d). Clustered standard errors in parentheses.

5 Conclusion

This paper investigates how soda taxes might impact behavior, and whether it impacts vulnerable groups more. Using a natural experiment where a tax was not only implemented, but lifted soon after, we find that in the absence of the tax behavior reverts to pre-tax levels overall. However, for more susceptible populations, we find evidence of sustained healthy purchase behavior: specifically, for households with at least one diabetic member we find purchases drop starkly during the tax but do not return to pre-tax levels after the tax is lifted. From a policymaker's standpoint, such sustained behavior is promising in improving individuals' health outcomes.

We note that we cannot comment on beverage purchases or consumption outside the store setting (e.g., at restaurants, tap water at home). Nonetheless, by observing purchases at the individual household level, we can focus on the household as a unit of analysis observing their complete purchase pattern. As a result, we do not have to rely on assumptions of substitution patterns that are often required when using store-level sales data or cross-sectional survey data.

This paper examines the overall effect of the policy and its reversal on households. Our approach of examining total beverage consumption of the household using the natural experiment helps address our research question and enables us to comment on the health policy implications of such policies. However, we acknowledge there are multiple questions that could be of interest to future researchers. For example, understanding changes in price sensitivity due to the tax, as well as differential changes in price sensitivity during the tax and after the tax was lifted, which would require estimating a household-level choice model, would be interesting questions to explore.

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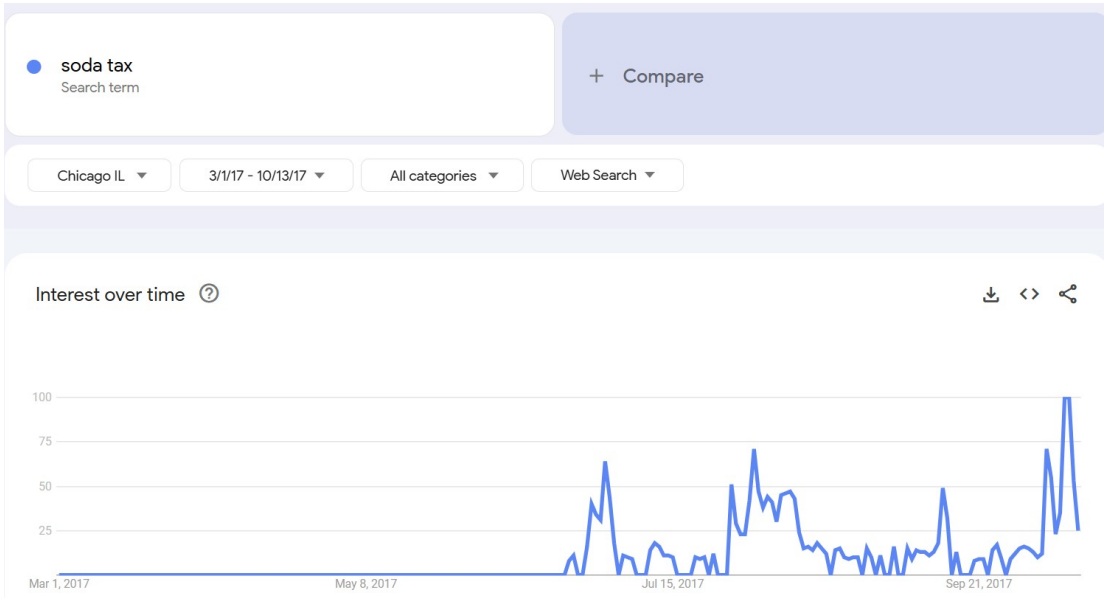
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Appendix

A Google Search Volume



Notes: Figure presents the Google Search Volume for the term Soda Tax in Chicago, IL. The tax went into effect on August 2, 2017. Interest via google searches appear to start aroun June 2017.

Figure A1: Google Search Volume in Chicago for term "Soda Tax"

B Price Changes During the Tax

In this section, we evaluate whether there were price changes in each of the periods of interest. Recall that the tax itself is not passed-through but is paid by the consumer at the register at the time of billing (Section 2.2). In addition, price data recorded in NielsenIQ corresponds to shelf prices and does not reflect taxes applied at the checkout counter. Therefore, any price changes observed are firm-driven changes to the shelf price in response to the tax.

We estimate the same D-D-D specification as before, with the previous year (2016) and adjacent counties as controls, but with price per oz as the dependent variable.

Table B1 presents the coefficient estimates for the impact of the SSB tax on beverage prices, focusing on the top 50 best-selling beverages, which account for approximately 37% of total beverage sales.[8]

Examining the same four periods of interest, we see that prices increased during the tax and revert to the baseline period once the tax is terminated. The prices of all taxed beverages are 0.18 cents per oz higher during the tax, and 0.15 cents per oz higher for SSBs (all taxed beverages except Diet Soda). These results are consistent with Powell et al. (2020*b*) who, using store-level price data from NielsenIQ, find a price increase of 0.21 cents per oz across all taxed beverages.[9]

These findings highlight that the implementation of the SSB tax was accompanied by an increase in beverage prices, potentially making sugary drinks less affordable. One reason for such an increase could be that retailers or manufacturers, knowing that prices paid by consumers are going to increase because of the tax, increase the list price as well.

[8] We also replicate our price analysis using the NielsenIQ RMS data and find a similar increase in prices, amounting to 19 cents across all taxed beverages.

[9] They include the additional 1 cent per oz tax in their analysis, leading to a 1.21 cent increase; but for our purposes the additional increase in list prices amounts to 0.21 cents. Note the taxed amount was available to the shopper only at checkout as a line-item in their receipt, and the tax was not passed-through unlike most soda taxes.

Table B1: Change in Prices (cents per oz) for the Top 50 UPCs

	(a)	(b)
	All Taxed Beverages	SSBs
2017 X Cook X Transition	-0.0451	-0.069
	(0.0777)	(0.0687)
2017 X Cook X During Tax	0.1764**	0.1481*
	(0.0839)	(0.0747)
2017 X Cook X During Tax (Post Repeal Public)	0.1306	0.14
	(0.0807)	(0.0871)
2017 X Cook X Post-Tax	-0.0019	-0.0709
	(0.0677)	(0.0703)
N Observations	6537	5929
N UPC	50	50
Controls	2016 + Adj. Counties	
Fixed Effect	Household	
Clustering Level	Household	

Notes: The dependent variable is price in cents per oz of the beverage in USD. All Taxed Beverages include the top 50 UPCs across all SSBs and Diet Soda. SSBs include the top 50 UPCs across all sugar-sweetened beverages but not Diet Soda. The baseline pre-Tax consists of the 9 weeks before the transition period. The duration of the Post Tax period is 9 weeks after the termination of the SSB tax.

C Sub-categories of Taxed Beverages

In this section, we examine individual categories: sodas, diet sodas and all sugar-sweetened drinks comprising Juice Drinks, Coffee and Tea Drinks and Cocktail Mixes. Table C2 presents these results.

The overall results across categories appear to be similar. In all three categories, after the tax, purchase volume reverts to the pre-tax levels.

Table C2: D-D-D estimates by subcategories of Taxed Beverages

	(a)	(b)	(c)
	Sodas	Diet Sodas	All Other
2017 X Cook X Transition	7.77*	7.86	3.49
	(4.62)	(5.3)	(3.2)
2017 X Cook X During Tax	-1.66	-12.54**	-8.15**
	(4.19)	(5.3)	(3.4)
2017 X Cook X During Tax (Repeal Public)	-11.85**	-10.1*	-7.23**
	(5.01)	(5.74)	(3.42)
2017 X Cook X Post-Tax	1.78	6.02	0.23
	(4.97)	(5.65)	(3.68)
Pre-Tax Cook Mean (oz)	44.33	41.61	30.74
N Observations	133,266	103,656	145,404
N households	1,938	1,584	2,073
Controls	2016 + Adj. Counties		
Fixed Effect	Household		
Clustering Level	Household		

*p<0.1; **p<0.05; ***p<0.01

Notes: The dependent variable is volume of beverage purchased in oz. All Other Taxed Beverages include Juice Drinks, Coffee and Tea Drinks and Cocktail Mixes. All estimates are relative to the baseline Pre-Tax period consisting of the 9 weeks before the transition period. During Tax refers to the period during the tax before the announcement of the tax termination, while During Tax (Repeal Public) refers to the period after the announcement. The duration of the Post Tax period is 9 weeks after the termination of the SSB tax. Clustered standard errors in parentheses.

D Robustness Checks

Table D1: D-D-D Estimates: Robustness Checks

	All Taxed Beverages			SSBs		
	(a) Original Estimates	(b) Longer Post-Tax	(c) Milwaukee Control	(d) Original Estimates	(e) Longer Post-Tax	(f) Milwaukee Control
2017 X Cook X Transition	14.71**	13.91**	8.15	9.71*	9.24*	-2.15
	(6.15)	(5.95)	(10.76)	(5.05)	(4.88)	(8.03)
2017 X Cook X During Tax	-15.81***	-15.31***	-16.92	-8.5*	-8.16*	-24.11***
	(6.08)	(5.89)	(10.94)	(4.94)	(4.77)	(7.44)
2017 X Cook X During Tax (Post Repeal Public)	-21.42***	-20.8***	-18.71*	-16.13***	-15.35***	-14.64*
	(6.55)	(6.34)	(11.28)	(5.48)	(5.29)	(8.37)
2017 X Cook X Post-Tax	5.86	1.82	5.71	1.92	0.76	-6.17
	(6.83)	(6.84)	(12.15)	(5.73)	(5.75)	(8.28)
Pre-Tax Cook Mean (oz)	88.42	86.03	88.05	64.53	62.36	64.56
N Observations	165,858	199,675	106,176	161,196	194,677	102,312
N households	2,249	2,288	1,446	2,216	2,257	1,410
Fixed Effect	Household					
Clustering Level	Household					

*p<0.1; **p<0.05; ***p<0.01

Notes: The dependent variable is volume of beverage purchased in oz. All Taxed Beverages include all SSBs and Diet Soda. SSBs include all sugar-sweetened beverages but not Diet Soda. All estimates are relative to the baseline Pre-Tax period consisting of the 9 weeks before the transition period. Columns (a), (d) present the original estimates from Table 1. Columns (b), (e) present estimates using a longer post-tax period of 16 weeks. Columns (c), (f) present estimates using Milwaukee as a control.

Table D2: D-D-D Estimates: Untaxed Beverages

	Untaxed Beverages
2017 X Cook X Transition	-5.64
	(7.08)
2017 X Cook X During Tax	-1.72
	(7.19)
2017 X Cook X During Tax (Post Repeal Public)	-7.84
	(8.11)
2017 X Cook X Post-Tax	3.1
	(7.73)
Pre-Tax Cook Mean (oz)	64.78
N Observations	143,262
N households	2,039
Controls	2016 + Adj. Counties
Fixed Effect	Household
Clustering Level	Household

*p<0.1; **p<0.05; ***p<0.01 Notes: The dependent variable is volume of beverage purchased in oz. Untaxed Beverages include water, sparkling water and untaxed juices. All estimates are relative to the baseline Pre-Tax period consisting of the 9 weeks before the transition period. The duration of the Post Tax period is 9 weeks after the termination of the SSB tax. Clustered standard errors in parentheses.

Online Appendix

A Verifying the Baseline Period

In this Appendix, we verify if our baseline period serves as a reasonable benchmark. To do so, we go back one more period or 9-weeks. If there are any changes in behavior in our chosen baseline period, we should see such behavior present itself when comparing our chosen baseline to the 9-weeks period before it.

As reported in Table A1 we do not see any significant effects during the Baseline period, while all other period exhibit similar effects as in our Main analysis. Although absence of a significant effect does not rule out the presence potential spillovers, it is one measure that reaffirms the choice of the baseline period and showcases that our results are robust.

Table A1: Verifying that our chosen Baseline is free of any spillovers

	All Taxed Beverages	SSBs
	(a)	(b)
2017 X Cook X Chosen Baseline	-2.06	-0.28
	(5.44)	(4.3)
2017 X Cook X Transition	11.99*	9.29*
	(6.29)	(4.94)
2017 X Cook X During Tax	-20.88***	-10.33**
	(6.51)	(4.98)
2017 X Cook X During Tax (Post Repeal Public)	-25.31***	-18.31***
	(7.03)	(5.66)
2017 X Cook X Post-Tax	5.6	4.15
	(9.12)	(7.22)
Pre-Tax Cook Mean (oz)	88.42	64.53
N Observations	180,222	176,008
N households	2,180	2,151
Controls	2016 + Adj. Counties	
Fixed Effect	Household	
Clustering Level	Household	

*p<0.1; **p<0.05; ***p<0.01

Notes: The dependent variable is volume of beverage purchased in oz. All Taxed Beverages include all SSBs and Diet Soda. SSBs include all sugar-sweetened beverages but not Diet Soda. All estimates are relative to the 9-weeks before our chosen baseline period. The Chosen Baseline refers to the period consisting of the 9 weeks before the transition period. During Tax refers to the period during the tax before the announcement of the tax termination, while During Tax (Post Repeal Public) refers to the period after the announcement. The duration of the Post Tax period is 9 weeks after the termination of the SSB tax. Clustered standard errors in parentheses.

B Heterogeneity: Households with Obesity

Table B1: Interaction Estimates: Households With and Without Obesity

	Short-term		Long-term	
	(a) All Taxed Beverages	(b) SSBs	(c) All Taxed Beverages	(d) SSBs
2017 X Cook X Transition	19.37*	9.79	18.47*	8.96
	(10.42)	(8.69)	(10.3)	(8.59)
2017 X Cook X During Tax	-24.98**	-13.29	-24.64**	-13.21
	(10.24)	(8.15)	(10.13)	(8.07)
2017 X Cook X During Tax (Post Repeal Public)	-29.57***	-21.72**	-29.08***	-21.11**
	(11.2)	(9.31)	(11.08)	(9.21)
2017 X Cook X Post-Tax	-4.41	-6.38	-4.92	-4.27
	(10.3)	(8.21)	(9.92)	(7.86)
2017 X Cook X Transition X Obesity	**-23.26**	**1.92**	**-22.55**	**3.45**
	(21.42)	**(16.1)**	**(21.27)**	**(16.02)**
2017 X Cook X During Tax X Obesity	**-2.81**	**-4.55**	**-2.9**	**-3.73**
	(22.1)	**(17.46)**	**(21.95)**	**(17.44)**
2017 X Cook X During Tax (Post Repeal Public) X Obesity	**-8.44**	**-14.18**	**-8.42**	**-14.17**
	(23.7)	**(19.62)**	**(23.52)**	**(19.57)**
2017 X Cook X Post-Tax X Obesity	**3.44**	**-1.43**	**-1.7**	**-6.74**
	(21.65)	**(18.07)**	**(20.66)**	**(17.54)**
Pre-Tax Cook Mean (oz)	90.62	64.46	89.21	63.25
Pre-Tax Cook Mean, hh with obesity (oz)	101.11	66.85	100.26	66.27
N Observations	82,110	79,884	96,677	93,933
N households	1,073	1,062	1,076	1,062
Controls	2016 + Adj. Counties			
Fixed Effect	Household			
Clustering Level	Household			

*p<0.1; **p<0.05; ***p<0.01 Notes: The dependent variable is volume of beverage purchased in oz. All Taxed Beverages include all SSBs and Diet Soda. SSBs include all sugar-sweetened beverages but not Diet Soda. Pre-Tax refers to the 9 weeks before the transition period. The duration of the Post Tax period is 9 weeks in Column (a)-(b) and 16 weeks in Column (c)-(d). Clustered standard errors in parentheses.