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Does Limited Access at School Result in Compensation at Home? The Effect of Soft Drink Bans in Schools on Purchase Patterns Outside of Schools

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Abstract

This paper investigates the effects of banning soft drinks in schools on purchases outside of school. We utilize unique household-level and store-level data sources in combination with time-series and cross-sectional variation of state-level regulations in a difference-in-differences(DD) approach. We detect a decrease in the overall trend in sales, but observe this downward trend in households with and without children, as well as in states with and without regulation. Controlling for advertising allows us to further reject that leading brands intensify their advertising efforts and target children to potentially offset their reduced presence at schools. Finally, we find no evidence of substitution effects among possible beverage product alternatives. Our analysis therefore suggests that soft drink bans at school reduce overall soft drink consumption as school age children do not compensate for this limited availability at home.

1 Introduction

The prevalence of overweight and obesity among children has risen dramatically over the last decades, resulting in the occurrence of related health problems at a young age (e.g. type 2 diabetes, cardiovascular diseases, and asthma). Increases in total caloric intake play a critical role in the growth of obesity, with soft drink consumption identified as a major contributor (Brownell and Frieden, 2009; Vartanian, Schwartz, and Brownell, 2007). Fueled by these concerns, the school food environment has become a focus in the public policy debate. A number of states introduced mandatory guidelines addressing soft drink sales in schools as their main nutritional consideration (CSPI, 2009), and national mandatory guidelines are currently considered. Possibly in anticipation of these regulatory changes, the beverage industry and the Alliance for a Healthier Generation reached a voluntary agreement, setting guidelines to shift to lower-calorie, more nutritious beverages for children's consumption during the entire school day. And even though, the progress report following full implementation during the 2009-2010 school year indicates a shift towards a reduction in calories from beverages consumed in schools, effects on overall consumption and calorie intake remain largely unclear (American Beverage Association, 2010). Our study investigates the effects of soft drink bans at schools on out of school consumption.

Federally reimbursable school breakfast and lunch programs must meet stringent nutrition standards under the National School Lunch Program (NSLP). Yet, two thirds of states have weak or no nutrition standards for competitive foods.[1] Proponents of regulation beyond the NSLP state that providing healthy snacks and limiting access to foods of minimal nutritional standard will improve children's diets because they consume foods and beverages that are most easily available to them. This position is supported by existing research indicating that people eat more when they are provided with easy access and increased portion sizes (e.g. see Wansink, 2004; Rolls, Roe, and Meengs, 2006; Geier, Rozin, and Doros, 2006). Op-

[1] Competitive foods, often of little or no nutritional value, are those which compete with, and are sold in vending machines, school stores, cafeteria a la carte lines, and at fund raisers, separately from the federally-regulated school meals programs.

ponents fear a loss in school revenues and argue that children will compensate by consuming these foods and beverages at home. In this context, dietary restraint models and research on the effects of food restrictions are cited (e.g. see Heatherton, Polivy, and Herman, 1990, Fischer and Birch, 1999; Francis and Birch, 2005).

The existing literature provides little direct evidence for either position (Rudd Center, 2009). Studies on the effect of improved nutritional choices and/or educational campaigns rely mainly on survey responses, small sample sizes and primarily focus on elementary schools (e.g. Fernandes, 2008; Blum et al., 2005; James, Thomas, Cavan, and Kerr, 2004). While these studies report moderate decreases in soft drink consumption at school, a study addressing high school consumption in Maine for instance finds very limited effects on beverage choice of students (Blum, et al., 2008). With the exception of Schwartz, Novak, and Fiore (2009), these studies do not address overall consumption effects. Their analysis of student surveys detects decreased consumption at school and no compensation effects at home after a removal of foods with low nutritional value in three middle schools. Our study contributes to this literature by adding the first analysis of actual out of school purchases to specifically test whether banning soft drinks at schools results in compensation through increased purchases outside of schools.

We utilize unique household-level and store-level purchase data allowing comparisons across states with and without stringent regulations, across households with and without school age children, and across different types of regulation. Our reduced-form econometric approach builds on difference-in-differences (DD) and difference-in-difference-in-differences (DDD) specifications in a treatment framework commonly used in the policy evaluation literature (see Meyer, 1995; Gruber, 1994; Bertrand, Duflo, and Mullainathan, 2004). We take advantage of time-series and cross-sectional variation of currently implemented regulations. In Connecticut for instance, where we observe household purchases before and after the state bans, our treatment group consists of households with school age children affected by the regulations. The control group includes households without school age children in the regulated state, as well as households with school age children in other states not affected by regulations. We are further able to control for potential differences in age-specific advertising exposure. Finally, we use store-level data to support our analysis at the household level.

Overall, our analysis detects no significant changes in purchase patterns of soft drinks, both in the household-level and the store-level data. We do detect a slight decrease in the overall trend in sales, but observe this downward trend in soft drink consumption in households with and without children, as well as in states with and without regulation. Controlling for advertising targeted to school age children allows us further reject that leading brands intensify their advertising efforts as a result of the decreased presence of soft drinks at schools. We further find no evidence of substitution effects among possible product alternatives, such as sweetened sports drinks. Previous research suggests that soft drinks bans decreased soft drink consumption and overall caloric intake from beverage consumption at school. Our analysis of out of school consumption therefore suggests that school age children do not compensate for this decrease at home and concludes that overall consumption of soft drinks has decreased as a result of soft drink bans at school. However, as we are not able to detect significant differences between mandatory state-level regulations, school district level regulations, or voluntary agreements, limiting our policy recommendations regarding further legislation in this context.

We discuss the complex regulatory environment and the implementation of soft drink bans and our empirical setting, data and econometric specifications in the next section of this paper. Our results and robustness checks are summarized in section 3 and the paper concludes and introduces further research directions in section 4.

2 Soft Drink Bans and Empirical Setting

Soft drink consumption and its role as a major contributor to childhood obesity has become a highly publicized public health and policy issue. Successfully preventing and reducing overweight in children can decrease obesity rates in children and adults and therefore reduces the risk of related health concerns such as type 2 diabetes, heart disease, asthma, sleep apnea, and psychosocial effects such as decreased self-esteem (American Health Association, 2008). The school environment—its physical, social, and educational surroundings—plays a crucial role in this process. While schools participating in federally reimbursable school breakfast and lunch programs must meet stringent nutrition standards under the National School Lunch Program (NSLP), including restricted availability of soft drinks during breakfast and lunch, two thirds of states have weak or no nutrition standards for competitive foods (foods that are sold in vending machines, school stores, cafeteria a la carte lines, and at fund raisers, competing with federally-regulated school meals programs).

2.1 The Regulatory Environment

In order to correctly define a treatment and control group and credibly estimate a treatment effect of soft drink bans in our econometric analysis, we conducted a comprehensive review of existing policies. Using the yearly update and overview provided by the National Conference of State Legislators as a starting point (NCSL, 2010), we cross-checked available local government and school district information. And finally, we searched local and national media to detect potential related interventions at the city, school district, or school level.

California was the first state to introduce and pass state-level regulation, banning soft drinks on school grounds (except for special events) in 2004. Senate Bill 677 modified the beverage restrictions from an earlier, not enacted bill first introduced in 2001 (SB19) and removed soft drinks from elementary, middle, and junior high schools. SB 965 further modified the beverage restrictions to include high schools. Elementary and middle schools already covered under SB677 followed SB965 as of January 1, 2006, with high schools compliance reaching at least 50% by July 1, 2007 and 100% by July 1, 2009. Connecticut introduced regulation in 2005. While SB1309 was vetoed, SB373 passed in 2006, banning soft drinks sold to students in all schools as of July 2006. A number of other states further considered or implemented less consistent bills over the time period of 2004-2008. Washington State passed regulation requiring each school district to develop wellness policies regarding access to nutritious foods by Jan 2005 and fully implemented by August 2005. A number of schools districts directly restrict access to soft drinks, while others develop more general nutritional guidelines only. Louisiana (SB871) and Tennessee (HB2783) also introduced bills to develop nutritional standards, while Arizona (HB2544), Kansas (SB154), Maine (LD 796, SP 263), Maryland (SB473), New Mexico (HB61), North Carolina (HB855), Texas (SB42), South Carolina (HB3499), Utah (HJR11), and Rhode Island (HB5563, SB565) passed similar bills in 2005. Illinois (SB162) also introduced nutrition guidelines for food sold at school campuses and Kentucky (SB172) limited fast food at schools, requiring schools to print nutritional information in school menus. Louisiana (SB146) limited students access to certain foods and beverages, while Oklahoma (SB265) prohibited access to foods with minimal nutritional value in elementary, middle and junior high schools (but excluded diet soda). High schools were required to offer healthy beverages, rather than restricting less healthy options. West Virginia (HB2816) encouraged healthy beverages in schools and Indiana (SB11) implemented regulations requiring at least 50% of food items sold in schools to qualify as "better food choices".[2] New Jersey (SB1218, AB883) established nutrition restrictions for food and beverages served, sold or given in public and certain non-public schools following the definition of foods of minimal nutritional value defined by USDA[3], and implemented school nutrition standards through its Department of Agriculture, effective by the 2007-2008 school year. Rhode Island (HB6968) places guidelines on the sale of sweetened beverages in schools and promotes nutritional, healthy snack choices sold in elementary, middle, and junior high schools beginning in January 1, 2007. Mississippi (HB319), and New Jersey (AB370) developed and establish nutrition guidelines. In 2007, Mississippi (SB2369) enacted the Mississippi Healthy Students Act in support of school wellness policies. Beginning

[2]Not more than 35 percent of their weight is from sugars that do not occur naturally in fruits, vegetables, or dairy products.

[3]Foods of minimal nutritional value include all foods and beverages listing sugar as their first ingredient.

with the 2008-2009 school year, local school wellness plans additionally promoted increased physical activity, healthy eating habits and abstinence from use of tobacco or illegal drugs. These provisions include healthy beverage choices. In North Carolina (HB1473), nutrition standards promoted gradual changes to increase fruits and vegetables, increase whole grain products, and decrease foods high in total fat, trans fat, saturated fat, and sugar, effective in 2008-2009 for elementary schools, and later extended to middle and high schools. Oregon (HB2650) specified minimum standards for food and beverages sold in public schools, prohibited trans fat in school foods, and allowed school district boards to adopt more restrictive standards. Rhode Island (HB5050, SB81) required all high schools that sell or distribute beverages and snacks on their premises (including those sold through vending machines) to offer only healthier beverages and snacks effective January 1, 2008. In 2008, Colorado (SB129) required each school district board and the State Charter Institute to adopt and implement a beverage policy that prohibits the sale of certain beverages to students, creates an exception for beverages sold during specified school events, and specifies maximum portion sizes for beverages sold at elementary, middle, and high schools by September 1, 2008. In the same year, Massachusetts (HB4900) appropriated $150,000 for the Childhood Obesity School Nutrition Project to initiate or maintain school lunch programs that can help diminish childhood obesity (NCSL, 2010). In addition to these mandatory state-level regulations, the Alliance for a Healthier Generation (a partnership of the American Heart Association and the William J.Clinton Foundation) and beverage industry representatives reached an agreement for voluntary guidelines to shift to lower-calorie, more nutritious beverages for children's consumption during the regular and extended school day. The industry fully implemented these guidelines on a voluntary basis by the 2009-2010 school year. And finally, regulation was also implemented at the city and school district level. Baltimore, and Detroit for instance prohibited sales of foods and beverages with minimal nutritional standard (including soda) starting in September 2006, while carbonated beverages were not sold in school vending machines in Detroit starting in December 31, 2005. Furthermore, the Philadelphia school district approved a soft drink ban, effective July 1, 2004 for K-12th grade levels. Table 1 summarizes this regulatory environment.

Based on California's and Connecticut's leading role and due to the nature of our data described below, we will focus our analysis on state-level regulations in these two states to identify an average treatment effect of soft drink bans on out of school purchases. We will also explore differences in wellness policies across school districts in Washington State to contrast state-level mandatory guidelines with guidelines developed at the school district level. And finally, the effect of the nationwide voluntary guidelines will be considered.

2.2 Household-level Data

Our primary data source consists of a geographically and demographically representative sample of household panel purchases (Nielson Homescan) covering three years from January 2006 to December 2008, and 16 national geographical markets. The data contain price, quantity and promotional information on transaction-level household purchases of soft drink products at the universal product code (UPC) level from all shopping outlets (e.g. grocery stores, drug stores, vending machines, and on-line stores)[4] The data also include demographic information available, such as income, race, household size, education, employment and occupation of household heads, and age and presence of children. In addition, the Nielsen Media dataset contains brand-level television advertising information for each of the 16 DMAs and all soft drink products covered by the Homescan data (taken at weekly intervals). The advertising data set is unique in that it does not only include brand-level advertising expenditures, but also advertising exposure measures for each brand and five age groups at the DMA level. Specifically, advertising exposure is measured by a Gross Rating Point (GRP) on cable, syndicated, network, and spot television for the following five age groups:

[4]The Nielson HomeScan instructs its panel lists to use in-home scanners to record all purchases from any outlet that are intended for personal consumption by any household members. Although adults are generally very good at following these instructions, children are not consistent in recording single serve items such as a can of coke they purchase on their own. We acknowledge that we might lose some of such soft drink purchases in the data.

2-5, 6-11, 12-17, 18-24, and over 25 years old.[5]

The household-level analysis focuses on identifying the impacts of state-level mandatory soda bans in schools on out of school soft drink purchases by households with and without school age children. As described above, California expanded the bans implemented in elementary and middle school to high schools during our data period, and Connecticut implemented soft drink bans in all public schools. Hartford, Los Angeles and San Francisco are defined as our treatment DMAs for our reduced-form econometric approach. We also selected Atlanta, Houston, Miami and Kansas City as control DMAs. We were not able to assign the remaining DMAs included in the data, due to the described diverse regulation environment.

2.3 Store-level Data

The store-level data used to support the household-level analysis is made available through the SIEPR-GIANINI Data Center.[6] It consists of a random sample of 250 grocery stores of one of the largest U.S. grocery store chains in 20 states throughout the US (and the District of Columbia) covering a time period between January 1, 2004 and June 30, 2007 (180 weeks). 3,675 unique universal product codes (UPCs) for beverage products such as soft drinks, juice and juice sweetened beverages, sports and energy drinks, new age drinks, and bottled water are included in this data set.[7] For 2,580 of these products, we were able to match unique product descriptions (e.g. whether the product is regular versus diet soda, package size, etc.). We grouped all products into five categories: (1) carbonated soft drinks (e.g., Coca-Cola, Pepsi, Sprite); (2) diet carbonated soft drinks; (3) sports drinks (e.g.,

[5]GRP is the percentage of an audience in a given population reached by a specific advertisement over a specific week. It is the sum of all rating points, where a rating point of an advertisement is the percentage of households watching a particular program, relative to the total number of households with television sets in a DMA. That is, if the commercial has a rating of 7, then 7% of all households who have television sets in this DMA tune into this commercial. If a commercial is aired twice during a week, and has a rating of 7 and 10 respectively, then its GRP for that week is 17.

[6]For further information about the center, see: http://www.are.berkeley.edu/SGDC/.

[7]This number of products is large because each product appears in a variety of sizes and containers (e.g. 12 oz cans, 2 liter bottles) and packages (e.g. 6 packs, 12 packs, cases, etc.).

Gatorade, PowerAde, Vitamin Water, Sobe fruit drinks)[8]; (4) juices; and (5) bottled water (e.g. Dasani, Poland Spring, Ozarka). For each observation identified by UPC, we have information about the store and promotional week in which the product was purchased, net and gross sales volume (in dollars). We calculate average weekly product prices using this information.[9] Corresponding store-level information is also available and includes overall store size (building and selling area in square feet), pricing division, and exact store address.

Based on the regulation environment described, we select two states, California (primary treatment state) and Texas (primary control state)for our analysis. We also selected three additional states, Maryland, Illinois, and Washington State to address varying state-level regulations as additional controls. 49 of the stores included in our original data set are located in California, with one store opening after the the starting date of our data.[10] Illinois and Maryland, states with less restrictive state-level policies in place than California, are represented with 25 stores and 9 stores. Finally, as Washington State requires each district to develop their own policy, we matched the 21 store included to 16 school districts, 8 of which have strict soft drink bans in place.[11] The final data set includes 14,672,224 observations and 1951 unique products. 893 of these products are classified as regular soda, and 439 as diet soda. 255 products fall within the juice category and 364 are defined as sports drinks. The initial analysis focuses on aggregating product sales within each defined category. Preliminary results provide a graphical comparison and an additional robustness check for the econometric analysis of the household-level data described next.

[8] This category includes new age drinks and energy drinks.

[9] Previous analyses reveal this measure to be highly sensitive to price variation across stores and weeks (e.g. Kiesel and Villas-Boas, 2010)

[10] One limitation of this data is that the implementation at high schools in California falls outside of our available time period. We recently received additional store-level data for all California stores covering a time period from January 2007 to April 2010 and discuss research extensions in section 4.

[11] This data was collected by visiting their school district web sites, and calling to verify the information provided.

2.4 Household-level Analysis

The household-level analysis focuses on a comparison of out of school soft drink purchases by households with and without school age children. If we find that banning soft drinks in schools leads to no change or even a decrease in out of school purchases by households with children, we can not only reject the argument that children compensate for reduced soft drink availability at home, we also provide indirect support for an overall reduction in soft drink consumption by children. If, however, we find that the bans increase out of school soft drink purchases by households with school age children, the overall soft drink consumption effect is ambiguous. Our research design exploits differences in the implementation of mandatory bans by two states during our data period and the fact that these bans affect only a particular group of households, namely, the households with school age children. Our reduced-form econometric approach therefore builds on difference-in-differences (DD) and difference-in-difference-in differences (DDD) specifications commonly used in the policy evaluation literature (see Meyer, 1995; Gruber, 1994; Bertrand, Duflo, and Mullainathan 2004) for identifying average treatment effects of soft drink bans at schools. As described above, California expanded the bans implemented in elementary and middle school to high schools during our data period, and Connecticut implemented soft drink bans in all public schools. Identification of the effect of these bans (the treatment) requires controlling for any systematic shocks to the out-of-school household soft drink purchases made by households with school children (the treatment group) that are correlated with but not due to the bans. Following Gruber's (1994) language, our implementation of the DDD model does so in three ways. First, we use pre-treatment and post-treatment period fixed effects, as well as month and year fixed effects to capture any trend in soft drink purchases that are common to all DMAs. Second, we use DMA fixed effects to control for any time-invariant differences between the DMAs in the two states that implemented the bans (the experimental DMAs) and the other DMAs (the non-experimental DMAs). However, controlling for the time and DMA fixed effects is imperfect if there are time-varying factors within DMAs correlated with soft drink consumption in the experimental DMAs. For example, if an earthquake hits California post the ban and people have to be evacuated from California and thus no one buys any soda in California, then the estimation will be biased downward. Another concern is the potential endogeneity of the bans. That is, Connecticut and California introduce the bans to try to reinforce or reverse some particular state-specific trend in soft drink consumption in school children in these states. To address these concerns, we use the fact that only households with children of particular ages are affected by the bans. This setup provides a third difference, allowing us to cancel out time-varying DMA specific effects. Put differently, we compare the households with school age children (the treatment group) in the experimental DMAs with households without school age children (the control group) in the same DMAs and measure the change in the treatments' relative soft drink purchases, relative to the non-experimental states.

The identification assumption of DDD is fairly weak. It only requires that there is no contemporaneous shock in the experimental DMAs that affects the relative outcomes of the treatments in the same DMA and in the same time period as the ban. Soft drink manufacturers might attempt to compensate for the loss of sales due to the bans by intensifying local advertising campaigns directed at school age children in Connecticut, and as a result, households with children might increase their purchase of soft drink relative to households without children. Such setup would violate the identification assumption. Another example is that if there are changes in DMA specific soft drink prices post the ban, and treatment and control group experience different price promotions, changes in relative soft drink purchases could not be separated from the effect of the bans even when we control for the triple differences. Fortunately, our data allow us test both of these scenarios as we are also able to control for DMA-specific time-varying advertising exposure that is age group specific as well as for DMA-specific time-varying prices.

Hartford, Los Angeles and San Francisco are selected as the experimental DMAs in our reduced form model. We also select Atlanta, Houston, Miami, and Kansas City as the non-experimental DMAs. For other DMAs included in the data, we were not able to determine the exact regulation status due to school district or school specific variation discussed in the above section. Connecticut banned soft drink in all public schools, effective July 1, 2006. California enacted a soft drink ban in elementary, middle, and junior high schools in 2004, and extended the ban to high schools requiring 50% compliance by July 1, 2007. Because bans implemented in the two states affected children of different ages during our data period, we conduct two separate analyses. In one analysis we include Hartford and the four non-experimental DMAs, and in the other, we include the two California DMAs and the four non-experimental DMAs. In the former, the treatment group consists of households with school age children aged 6 to 18, the typical age range of children enrolling in elementary till the 12th grade. In the latter, the treatment group are the households with children aged 15 to 18, the typical age range of high school students. The control group consists of households without children and households with children younger than 6 in both analyses.

2.4.1 DDD Regression Model

We implement the DDD model by estimating the following equation:

$$y_{ijt} = \beta_1 x_{ijt} + \beta_2 \tau_t + \beta_3 \delta_j + \beta_4 Treat_i + \beta_5 \delta_j \times \tau_t + \beta_6 \tau_t \times Treat_i + \beta_7 \delta_j \times Treat_i + \beta_8 \tau_t \times \delta_j \times Treat_i + \beta_9 \mu_i \tag{1}$$

where i indexes household, j indexes DMA (where one stands for Hartford DMA, and zero for other DMAs) and t indexes time period (where it takes the value of one if it is in the post-enactment period, and zero otherwise). y_{ijt} is the monthly soft drink volume purchase made by household i in DMA j at time t. $Treat_i$ is an indicator that takes one if a household is in the treatment group, and zero otherwise. τ_t is a time period fixed effect that takes one if it is in the post-ban period and zero otherwise. δ_j are DMA fixed effects. x_{ijt} is a vector of observable control variables such as prices and advertising. μ_i is a time-invariant household fixed effect. The time period fixed effect controls for trends in monthly volume soda purchase that are common to all households in all DMAs (β_2). The DMA and treatment group fixed effect controls for time-invariant characteristics of the experimental DMA (β_3) and for that of the treatment group (β_4). The second level interactions control for changes in volume purchase trend over time (β_5), changes in trend over time for treatment group households in all DMAs (β_6), and time-invariant characteristics of the treatment group in the experimental DMA (β_7). The third-level interaction (β_8) is the DDD estimate of the effect of the soft drink ban on out-of-school monthly soda volume purchase for treatment group households in the experimental DMA. It captures the change in volume purchase by treatment households (relative to control households) in the experimental DMAs (relative to non-experimental DMAs) during the post-ban period (relative to pre-ban period).

The model is estimated first differencing the data:

$$\Delta y_{ijt} = \beta_1 \Delta x_{ijt} + \beta_2 \tau_t + \beta_4 Treat_i + \beta_5 \delta_j \times \tau_t + \beta_6 \tau_t \times Treat_i + \beta_7 \delta_j \times Treat_i + \beta_8 \tau_t \times \delta_j \times Treat_i \quad (2)$$

where ΔX indicate difference in the variable X. We note that the household fixed effects and DMA fixed effects are differenced out because they do not change over time for a given household. On the other hand, the treatment group fixed effect is not differenced out. This is because the treatment group are defined by age band of children in a household and each of the sample contains two years, so a household that is in treatment group one year (that is, one with children in certain age) might not belong in the group in the next year.

We estimate three variations of equation (2). In the first case we include only the main effects and interaction terms. In the second case we include the regressors in the first case, as well as lagged month volume purchase, month and year dummies, and a set of household characteristics such as household income, household size, household heads' education and employment, race and home ownership. The third case includes all the regressors from the second case, and a set of marketing variables including differences in price, promotion, and advertising exposure. We aggregate the household level information to DMA level to get weekly price and promotion information. Prices are computed by dividing total dollars expended by all the households in a specific DMA in a given week over total volume purchases by these households. We compute the percentage of soda volume purchased with promotions by obtaining the percentage of transactions where some sort of promotion was available in a given DMA during a given week. Nielson Media Research data contain the advertising exposure data measured in age-group specific GRPs at DMA levels. We then interact the indicator dummies of whether a household has household members in a certain age group with the DMA level age-group specific GRPs to proxy for advertising exposure that is specific to each household.

3 Results and Robustness Checks

Overall, our analysis at the household-level and store-level does not detect distinct changes in soft drink consumption due to implemented soft drink bans. Our preliminary regression results and graphical comparisons are described and discussed in the next subsections. We conclude by discussing implications, limitations and further research directions in the next section.

3.1 Household-level Results

An advantage of the DDD approach is that a straightforward graphical analysis can reveal the existence (or the lack of) treatment effect. In Figure 1 we show the aggregated monthly soft drink purchase (in volume) of the treatment and control group households in Hartford and in the non-experimental DMAs respectively. For each of the DMA, we plot aggregated monthly volume purchase from February 2006 to December 2008 by households with children aged 6-18, households with children younger than 6, and those without children. The black vertical line indicates July 1, 2006, the effective date of the ban on soft drink in all public schools in

Connecticut. All the households included in the analyses stayed in the dataset throughout the entire data period.[12] We notice that there is a common downward trend overtime in soft drink volume purchase for all three types of households in all DMAs. Although there are some differences in trends across different DMAs, the trends in volume purchases by three types of households are similar in a same DMA. By using the volume purchase by a control group within a same DMA we can therefore effectively control for time-varying DMA-specific shocks. We do not see any noticeable change in the relative volume purchase by households with school age children to households without children or with younger children in Hartford, however that appears to be different than the relative volume purchase in other DMAs after the CT ban became effective. Therefore, it seems that the CT ban did not have a visible impact on out of school purchase by households with school age children. Similarly, in Figure 2 we depict aggregated volume purchases by households with high school age children, households with children below 6, and households without children over the data period in two Californian DMAs and in the non-experimental DMAs. The black vertical line here indicates July 1, 2007, the date when the CA ban in high schools required 50% compliance. Similarly, we observe no visible change in the relative volume purchase in the two Californian DMAs that are different than in the other DMAs. Hence, the Californian soft drink ban in high schools also did not seem to impact out of school purchases by households with high school age children.

As shown in Figure 1 and 2, soft drink purchase is seasonal and peaks in summer and holidays and it is not sensible to compare purchase in different seasons. Since our research focuses on school bans, it is also important that we compare periods when school is in session. We focus on the periods consisting of same months that roughly corresponding to school semesters before and post the bans. Specifically, for the Connecticut ban study where the ban became effective July 1 2006, the pre-treatment period covers a four-month

[12]There is no indicator for when a household enters and drops out of the data set. In order to track the transactions of a consistent panel of households, we only keep households for whom we observe some purchases in both the first and the last month.

period from February to May in 2006, and the post-treatment period is February to May in 2007. For the California ban study where the ban effective date falls on July 1 2007, the pre-treatment period is a three-month period from September to November 2007 and the post-treatment period, from September to November 2008.[13] Illustrated in the first two panels of Figure 3 are the trends in volume purchase by treatment and control group households in Hartford in the specified pre- and post-ban period respectively. In the last two panels we show the volume purchase aggregated across all the treatment or control group households in the non-experimental DMAs in the same pre- and post-ban period respectively. Similarly, shown in the panels of Figure 4 are the trends in the two Californian DMAs and in the non-experimental DMAs during the specified pre- and post-ban period. Examination of the trends reveals no significant relative change in volume purchase of the treatment and control group households between the experimental and non-experimental DMAs from the pre- to post-ban period.

In order to test our identification assumption with regard to shocks in advertising, the panels in Figure 5 show weekly DMA level advertising exposure as measured by GRP over the entire data period for all soft drink products for each of the experimental and non-experimental DMAs. In each panel, GRP for all five age group, that is, children aged 2-5, 6-11, 12-17, adults aged 18-24 and those above 25, are exhibited. There are large variations in these GRPs, but the trends are similar across all DMAs. This might be due to the fact that the major advertisers are the leading soft drink producers such as Coca-cola Company, Pepsi Co., and their advertising campaigns are largely operated on a national basis. There are also considerable differences in levels of advertising exposure that consumers in different age groups are exposed to. Most of the advertising is directed to children above 12 and adults. There are no visible discontinuities in the advertising exposure of any age group in the experimental DMAs around the effective dates of the bans. And finally, in Figure 6, we

[13] A high school semester usually goes from September to early January. We decide not to include December in the estimation because soft drink purchase during the holiday season might reflect consumption shocks due to holiday visits.

show the weekly average price per ounce in the Connecticut and Californian DMAs as well as in the non-experimental DMAs. We compute these average weekly DMA level prices by dividing total expenditure all households in a specific DMA paid in a week over their total volume of soft drink purchases. Although the price levels are different across DMAs, price trends seem quite similar.

Table 2A reports the additional summary statistics for Connecticut and California. In Table 2B we report further summary statistics on the household composition. Because the Connecticut ban applied to all school children and the Californian ban applied to just the high school children in our data period, we focus on how the bans affect high school children, the overlapped target of the two bans. Therefore, the treatment group in this specification constitutes of households with children aged 15-18, while the control groups are still households with children below 6 and households without children. The independent variable, difference in monthly volume purchase by a household, varies across the three samples. The variation stems from the fact that the three samples contain different set of households and different months. The households demographic characteristics are quite similar across these samples, suggesting that there are no systematic differences or sample selection. The differences in prices and price promotions are similar across the samples as well. However, the interaction terms between age-group specific advertising exposure and indicators of whether a household has a household member in a specific age group vary significantly across samples, reflecting different advertising intensity in different time periods.

Table 3 reports the DDD regression results for the Connecticut ban study where we include Hartford as the experimental DMA and Atlanta, Houston,Miami, Kansas City, as the non-experimental DMAs. The three columns in Table 3 correspond to the three specifications, increasing in added variables as described above. In all specifications, standard errors are clustered at the DMA level. The clustering at DMA levels is an adjustment for potential serial correlation of outcomes over time, that can potentially overstate the precision of the estimates (Bertrand, Duflo and Mullainathan, 2004). The DDD coefficient estimate that identifies the effect of the Connecticut ban on out-of-school soft drink volume purchase of households with school age children in Hartford (Average treatment effect on the treated or ATT) is the coefficient of the three-level interaction term of Hartford, households with children aged 6-18 and the post-ban period dummy. This coefficient is not statistically significant in any of the specifications. The insignificance of the treatment effect is consistent with the graphical analysis. In contrast, the coefficient of the three-level interaction of Hartford, households with children below 6 and the post-ban period is consistently positive and statistically significant in all the three specifications, reflecting an upward post-ban trend in these households who were not affected by the ban in Hartford. If our research design did not distinguish households with children targeted by the law and those with children that are not targeted by the law, then we will mistakenly overestimate the treatment effect. The coefficient of the post-ban period is consistently negative and statistically significant, reflecting the national downward trend in monthly soda volume purchase common to all households. The coefficient on the household's volume purchase in the previous month is also consistently negative and significant, suggesting a reversion to a long-term average of the monthly purchase by the household. Failing to control for this mean aversion can potentially bias the estimate of the treatment effect. Among the set of household characteristics control variables, larger household size and being white increases monthly volume purchase. If the male head of a household has some high school education or has post college education, monthly volume purchases decrease, suggesting that better educated households drink less soda. Among the marketing condition control variables, only advertising exposure by children 2-5 is statistically significant and negative.

We conduct similar analysis for the California ban with the two Californian DMAs as the experimental DMAs, and Atlanta, Detroit, Houston,Miami, Kansas City as the non-experimental DMAs. Table 4 reports the results from DDD regressions, with each of the three columns corresponding to the three specifications described before. The results are qualitatively similar to the results for Connecticut. The ATT coefficient is not statistically in any of the three specifications. We do observe the same positive trend among households with children below 6 who were not the target of the ban in California during the post-ban period. The interaction term between California and post-ban period dummy is significant and positive, indicating a upward trend in volume purchase in California DMAs in the post-ban period that are common to all households. Again, monthly volume in the previous month, post-ban period indicator, household size and being white are significant. The male head being employed, either part-time or full-time, seems to increase household soda volume purchases in this specification, possibly a proxy for an income effect. In addition, the DMA level price and promotion are positively related with soda purchase.

Finally, we combine the California and Connecticut ban and report the DDD regression results in Table 5. The ATT effect is measured by a dummy, taking on a value of 1 if a household is in CT or CA, and regulation is in place, and zero otherwise. The controls include all interaction terms between year and DMA fixed effects, the interaction terms between the indicator of whether the household have high school age children or children under six and DMA fixed effects. Table 6 reports the results for three specifications and the results are consistent with the previous two analysis. The ATT effect is only significant in the first specification, but not in the other two specifications where more controls are included. Lagged monthly volume is negative and statistically significant, again suggesting of the existence of mean reversion. An increase in DMA promotions increases soda purchase.

Overall, we find little evidence that state mandatory soft drink bans in schools have any effects on out of school soft drink purchase. Our results therefore suggest a reduction in total soda consumption by school children affected by these regulations, provided that these bans are enforced and remove accessibility of soda to these children on campus.

3.2 Household-level Robustness Checks

Soda bans could potentially affect children that are heavy soda drinkers differently than those that are not. To see whether this is the case, we separate households into two groups.

Based on their purchase history, we define households as heavy soda and light soda drinkers. We use the year 2006 as the initialization period and compute per capita monthly volume purchase for each of the households. Then we classify the households as heavy drinkers if their average monthly per capita volume purchase in 2006 is above a certain percentile of average monthly per capita volume purchase across all households, and light drinkers otherwise. We experiment with 50% and 70% percentiles. For the California study, we examine whether heavy drinker households with high school children are affected by the Californian ban differentially than their light drinker counterparts.[14] However, we fail to find any significant effect of the ban on out of school volume purchase for households with school age children among those groups.

We also hypothesize that a soda ban in schools restricts mostly national brand soft drink products (i.e., Coke, Pepsi and Dr. Pepper, etc.). Minor national brands and store brands should not be affected in the same way. Therefore, the ban might affect only the out-of-school purchases of the biggest national brands. We break down soda purchases into main name brand purchase and minor or private label purchases and examine whether purchases of soft drink products of the top three manufacturers (Coca-cola, Pepsi Co., and Dr. Pepper) are affected. Once more, we do not find any significant differences.

3.3 Store-level Results

The analysis of the store-level data focuses on aggregated sales within each defined product category. Table 6 summarizes key features of this data and indicates no structural differences in terms of average quantities, prices observed in the data across the selected states. The preliminary results reported for the store-level analysis rely on graphical comparisons of observed trends in aggregated sales across product categories summarized in Figure 7-13. In Figure 7, we compare aggregated weekly sales of regular and diet soda against observed purchase trends for bottled water in California. The blue vertical line marks the implementation

[14]We cannot do this for the Connecticut ban study because we do not have an initialization period with our data starting from 2006 and the CT ban became effective in July 2006.

of the soft drink ban at elementary, middle, and junior high schools. The effective date of July 1, 2004 translates into week 27 in 2004 in our data. We also marked the week during which the voluntary agreement between beverage industry representatives and the Alliance for a Healthier Generation was reached. This potential break in the data is indicated by a red vertical line.

Looking at Figure 7-9, we observe the same seasonal variations as in the household-level data. Including purchases of bottled water as a reference point allows us to pay particular attention to these seasonal variations. Figure 7 plots sales of soda and diet soda, as well as bottled water. For both of the highlighted events, we do not observe any significant deviations from trends compared to purchase patterns prior to these implementations. We do seem to observe a slight break and reduction in soda and diet soda sales around week 26 in 2006 (beginning of July). Figure 8 also plots trends in category sales of potential substitutes to soft drinks. Here again, we observe seasonal variation. We also observe an upward trend in sports drinks, but a similar trend seems visible for juices and water as well.[15] Figure 9-11 indicate that trends observed in California do not seem to differ substantially from trends observed in the control states. It is worth noting, however, that we observe a seemingly distinct drop in sales around July, 2006 in these states. While we were not able to link this drop directly to any regulatory changes, it could potentially be a delayed response to the reached voluntary agreement and increased media coverage in the following months. Finally, Figure 12 and 13 summarize trends observed in Washington State. Figure 12 looks at overall category purchases in the 21 stores included in our data, while Figure 13 differentiates between school districts that implemented soft drink bans and school districts with less stringent wellness policies. Both of these figures seem to indicate a slight downward trend after the requirement of wellness policies in August 2005. However, these reductions seem also present in the purchasing trend for water, as well as trends in school districts with less strict beverage restrictions. They are further not offset by increasing sales in alternative

[15] High school regulations do not address sport drinks and we will be able to further investigate these potential substitution effects in an research extension.

categories.[16] In addition, we once more observe a slight, but less pronounced downward trend following the voluntary agreement around July 2006.

Overall, this preliminary graphical analysis supports our findings from the household-level data. If anything, we were only able to detect a delayed response to the voluntary agreement between beverage industry representatives and the Alliance for a Healthier Generation and an overall gradual reduction in purchases of soft drinks. Yet, we do not detect significant changes in consumption patterns due to banning soft drinks a schools, both for state-level and school district-level regulations.

4 Conclusions and Future Research Directions

Soft drink consumption and its role as a major contributor to childhood obesity has become a highly visible public health and public policy issue as the prevalence of overweight and obesity among children has risen dramatically over the last decades. The school environment can play an important role in successfully preventing and reducing overweight in children in this regard. This study investigates the effects of banning soft drinks in schools on purchases outside of school. It informs the debate of whether limited availability at schools will induce compensation at home, and adds the first study that analyzes actual purchase data to the existing literature.

Our primary data source consists of a random sample of household panel purchase data (A.C. Nielson) covering three years from January 2006 to December 2008, and 16 national markets. This data is accompanied with market-level information on weekly brand-level television advertising exposure directed at different age groups. In addition, we have access to a secondary store-level data set of randomly selected grocery stores of a large U.S. grocery store chain. This data set covers a time period between January 1, 2004 and June 30, 2007, and consists of weekly aggregated product sales at the UPC level for carbonated soft

[16]Purchase trends for alternative drinks in the selected states show similar patterns as in Figure 6 for California and are therefore not included.

drinks, diet carbonated soft drinks, sport and energy drinks, juices, and bottled water. We combine these data with information on state-level regulations on soft drink availability in schools. Our analysis focuses on California and Connecticut, two leading states in implementing stringent and comprehensive state-level regulations for all school levels. California was the first state to implement soft drink bans in elementary and middle schools in 2004, adding regulation for high schools in 2006 (with 50% compliance by July 1, 2007, and 100% compliance by July 1, 2009). Connecticut instituted a soft drink ban in all public schools in July 2006. Other states included in the data serve as controls as they have no state-level regulations (e.g. Texas, Georgia, Missouri, and Florida), limited regulations for meal times only (e.g. Maryland), exclude high schools from any regulatory efforts (e.g. Illinois), or allow each school district to draft their own welfare policies (e.g. Washington State). Utilizing these unique data sources allows us to compare purchases across states with and without stringent regulations and across households with and without school age children. We can further differentiate between mandatory state-level regulations, school district-level wellness policies and voluntary agreements, as well as across regulations targeting elementary, middle, and high schools.

Our econometric approach builds on difference-in-differences (DD)and difference-in-difference-in-differences (DDD) specifications in a treatment framework commonly used in the policy evaluation literature and is supported by a graphical analysis of the store-level data. Overall, we find little evidence of significant changes on out of school purchases due to soft drink bans at school. Households with school age children seem to not be affected differently in states with mandatory regulations. We do detect a slight decrease in the overall trend in sales, but observe this downward trend in households with and without children, as well as in states with and without regulation. Further differentiating between heavy and light soda consumers also fails to detect significant changes in purchase behavior due to state-level regulations for these consumer segments. Controlling for advertising targeted to school age children allows us to additionally reject that leading brands intensify their advertising efforts as a result of soft drink bans to potentially offset their reduced presence in the school environment. One possible explanation might be that diet and sports drinks are not affected by stringent regulations in some cases or school types and are targeted by the beverage industry to offset their losses. We do not detect significant substitution effects for these categories in our preliminary analysis.If anything, our results indicate a delayed response to the voluntary agreement between beverage industry representatives and the Alliance for a Healthier Generation in 2006 and an overall gradual reduction in purchases of soft drinks.

Previous research suggests that banning soft drinks decreased calorie consumption at schools. Our results indicate that school age children do not compensate for the limited availability of soft drinks at school in observed out of school purchases. Therefore, our results suggest that overall calorie consumption from beverages and soft drinks has decreased as a result of banning soft drinks at schools. However, as we are not able to detect significant differences in out of school purchases to mandatory state-level soft drink bans, school district-level regulations, or voluntary agreements. We therefore cannot provide policy recommendations in light of currently proposed national-level regulations as it is unclear, if and to what extend the regulatory approaches have contributed to an overall decreasing trend in soft drink consumption.

Another limitation of our study relates to a concern previously addressed in the literature. While we carefully reviewed the regulatory environment, little is known about the adherence with either state-level or school district-level regulation, as well as voluntary guidelines. Failure to detect significant effects could be a result of voluntary bans of soft drinks at schools prior to implemented regulations. Alternatively, failure to adhere with these policies would also result in no effects on out of school purchases. Samuels et al. (2009) collected information on competitive foods and beverages available in schools for a representative sample of 56 public high schools in California in 2006 and 2007. Focusing on the adherence of mandatory nutritional standards, they report that California schools are making progress towards full implementation. While beverage standards seemed easier to achieve than standards for food items, soft drink availability still varied significantly across their investigated schools. We are planning to combine their collected unique data set with store-level data for all California stores covering a time period from January 2007 to April 2010. Matching stores to neighboring schools with diverse adherence measures will allow us to directly address this important aspect in our proposed future research extension.

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Table 1: Regulations addressing soft drink availability at schools

Year	**Stringent regulation (soft drink ban) implemented**	**Less stringent regulation (addressing soft drink availability) introduced**
2004	California (Elementary and Middle school); *Philadelphia*	Washington State; Louisiana; Tennessee
2005		Arizona; Kansas; Maine; Maryland; New Mexico; North Carolina; Texas; South Carolina; Utah; Rhode Island; Louisiana; Oklahoma; West Virginia
2006	California (50% compliance in High schools); Connecticut (all schools); *Baltimore; Detroit*	Indiana; New Jersey; Rhode Island; Mississippi
2007		Mississippi; North Carolina; Oregon; Rhode Island
2008		Colorado; Massachusetts
2009	California (100% compliance in High schools)	
2009	Beverage industry voluntary guidelines to shift to lower calorie options (all schools nationwide)	

Table 2A. Summary Statistics for Household-level Analysis

	CT ban study		CA ban study	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Difference in monthly soda volume purchase	75.78	603.60	3.16	564.18
Post ban period	0.50	0.50	0.50	0.50
Experimental DMAs: CT/CA	0.13	0.34	0.42	0.49
CT/CT*post ban period	0.07	0.25	0.21	0.41
Treatment group: households with childre 6-18/15-18	0.26	0.44	0.13	0.34
Control group: households with children below 6	0.04	0.20	0.06	0.23
Experimental DMAs*treatment group	0.04	0.20	0.05	0.23
Experimental DMAs*control group	0.01	0.10	0.03	0.17
Post ban period*treatment group	0.13	0.34	0.07	0.25
Post ban period*control group	0.02	0.14	0.03	0.16
Experimental DMAs*post ban period*treatment group	0.02	0.14	0.03	0.16
Experimental DMAs*post ban period*control group	0.00	0.07	0.01	0.12
Lagged monthly volume purchase	500.40	669.16	465.52	672.10
Household size	2.78	1.17	2.59	1.06
Hispanic	1.89	0.32	1.86	0.34
White	0.79	0.41	0.72	0.45
Homeowner	0.92	0.27	0.90	0.30
Household 2008 annual income<$35,000	0.14	0.35	0.14	0.34
Household 2008 annual income b/w $35.000 & $99,999	0.61	0.49	0.59	0.49
Female head some high school or high school graduate	0.27	0.44	0.26	0.44
Female head some college or college graduate	0.60	0.49	0.62	0.49
Female head post-college	0.12	0.33	0.12	0.32
Male head some high school or high school graduate	0.25	0.44	0.23	0.42
Male head some college or college graduate	0.60	0.49	0.61	0.49
Male head post-college	0.14	0.34	0.15	0.35
Female head part-time employed	0.16	0.37	0.16	0.37
Female head full-time employed	0.44	0.50	0.40	0.49
Male head part-time employed	0.08	0.26	0.10	0.29
Male head full-time employed	0.64	0.48	0.58	0.49
Household heads not married, living with related/unrelated	0.07	0.25	0.07	0.26
Household heads married	0.00	0.00	0.00	0.00
Difference in DMA level price	-0.02	0.06	-0.01	0.08
Difference in DMA level % deal	2.90	3.18	2.32	4.27
Difference in (DMA level GRP for children 2-5* 1(household members of age 2-5))	2.47	32.97	-4.01	38.34
Difference in (DMA level GRP for children 6-11* 1(household members of age 6-11))	7.65	69.01	-3.30	42.23
Difference in (DMA level GRP for children 12-17* 1(household members of age 12-17))	17.80	140.13	-20.33	114.24
Difference in (DMA level GRP for audience 18-24* 1(household members of age 18-24))	12.90	100.32	-16.83	118.61

Difference in (DMA level GRP for audience 25+* 1(household members of age 25+))	79.78	261.79	-129.01	270.60
# treatment households in experimental DMA(s)	81		142	
# treatment households in non-experimental DMAs	468		212	
# control households in experimental DMA(s)	260		1384	
# control households in non-experimental DMAs	1941		1879	
#observations	10110		8480	

Note. Samples are from the Nielsen HomeScan data for the soft drink category between February 2006 and December 2008. Sample means and standard deviations are reported for each variable. In the CT ban study, the treatment group includes households who have children aged 6-18. In the CA ban study, the treatment group includes households who have children aged 15-18. The pre-treatment period spans February to May 2006 and September to November 2007, and the post-treatment period covers February to May 2007 and September to November 2007 for the CT ban study and for the CA ban study respectively. The control group for both analyses includes households with children younger than 6 or households without children. The "Post ban period" binary dummy variable (1/0) equals 1 if it is post the ban effective dates (July 1 2006 for CT ban study, and July 1 2007 for CA ban study), and 0 otherwise. The "1(households members of age x1-x2" binary dummy variable (1/0) equals 1 if there are any children between x1-x2 in a household, and 0 otherwise.

Table 2B. Summary Statistics for Household-level Analysis
CA/CT Ban Study

Variable	Mean	Std. Dev.
Difference in monthly soda volume purchase	39.86	573.38
Households with children 15-18	0.15	0.36
Households with children below 6	0.06	0.24
Ban * households with children 15-18	0.02	0.15
Ban * households with children below 6	0.01	0.10
CA* households with children below 6	0.03	0.17
CT* households with children below 6	0.01	0.09
CA* households with children 15-18	0.06	0.23
CT* households with children 15-18	0.01	0.11
Households with children 15-18*year 2007	0.08	0.27
Households with children 15-18*year 2006	0.07	0.26
Households with children below 6*year 2007	0.03	0.17
Households with children below 6* year 2006	0.03	0.18
Lagged monthly volume purchase	444.85	653.33
Household size	2.64	1.08
Hispanic	1.87	0.34
White	0.73	0.44
Homeowner	0.90	0.30
Household 2008 annual income<$35,000	0.13	0.34
Household 2008 annual income b/w $35.000 & $99,999	0.60	0.49
Female head some high school or high school graduate	0.26	0.44
Female head some college or college graduate	0.62	0.49
Female head post-college	0.12	0.33
Male head some high school or high school graduate	0.23	0.42
Male head some college or college graduate	0.61	0.49
Male head post-college	0.15	0.36
Female head part-time employed	0.17	0.37
Female head full-time employed	0.41	0.49
Male head part-time employed	0.09	0.29
Male head full-time employed	0.60	0.49
Household heads not married, living with related/unrelated	0.07	0.26
Household heads married	0.00	0.00
Difference in DMA level price	-0.01	0.07
Difference in DMA level % deal	2.43	3.71
Difference in (DMA level GRP for children 2-5* 1(household members of age 2-5))	-0.10	35.58
Difference in (DMA level GRP for children 6-11* 1(household members of age 6-11))	-0.20	39.02
Difference in (DMA level GRP for children 12-17* 1(household members of age 12-17))	-0.38	122.24
Difference in (DMA level GRP for audience 18-24* 1(household members of age 18-24))	1.48	121.12
Difference in (DMA level GRP for audience 25+* 1(household members of age 25+))	0.50	290.68
# treatment households in experimental DMA(s)	262	

# treatmeng households in non-experimental DMAs	303
# control households in experimental DMA(s)	1891
# control households in non-experimental DMAs	2117
#observations	25496

Table 3. Estimated CT Soda Ban Effects on Soda Volume Purchase

	(1)	(2)	(3)
Dependent variable: difference in a household's monthly soda volume purchase			
Post ban period	-22.12*	-56.56***	-66.87***
	(8.670)	(11.23)	(12.87)
CT	0	0	0
	(0)	(0)	(0)
CT*Post ban period	4.840	19.72	10.31
	(8.670)	(11.26)	(8.877)
Households with school age children (6-18)	25.85**	3.218	6.030
	(8.276)	(24.35)	(23.69)
Households with children below 6	28.81	38.49	42.17
	(27.36)	(38.83)	(38.72)
CT * households with children 6-18	-0.519	2.613	5.493
	(8.276)	(11.04)	(11.51)
CT * households with children below 6	-63.02*	-124.9**	-134.5**
	(27.36)	(34.65)	(33.65)
Post ban period * households with children 6-18	-22.32	2.527	-0.491
	(10.72)	(5.989)	(8.590)
Post ban period * households with children below 6	-49.10	-28.26	-9.852
	(27.35)	(22.79)	(23.00)
CT*post ban period*households with children 6-18	16.10	2.970	-1.245
	(10.72)	(5.908)	(6.265)
CT*post ban period*households with children below 6	92.84**	87.13**	99.38**
	(27.35)	(22.70)	(23.23)
Lagged monthly volume purchase		-0.303***	-0.303***
		(0.0122)	(0.0122)
Household size		17.33**	15.33*
		(5.879)	(5.703)
Hispanic		26.19	26.00
		(14.23)	(14.54)
White		77.87***	77.64***
		(3.905)	(3.762)
Homeowner		-7.466	-8.038
		(18.83)	(17.96)
Household 2008 annual income<$35,000		-1.529	-2.003
		(31.49)	(31.51)
Household 2008 annual income b/w $35.000 & $99,999		0.697	0.725
		(15.29)	(15.38)
Female head some high school or high school graduate		7.468	6.872
		(80.30)	(80.46)
Female head some college or college graduate		-28.11	-29.09
		(80.12)	(80.33)
Female head post-college		-42.10	-43.18
		(91.17)	(91.14)
Male head some high school or high school graduate		-98.15*	-98.28*
		(44.97)	(45.18)
Male head some college or college graduate		-112.6	-113.0
		(57.33)	(57.46)

Male head post-college		-141.2* (54.48)	-141.7* (54.93)
Female head part-time employed		17.29 (22.48)	17.03 (22.60)
Female head full-time employed		4.205 (8.177)	3.980 (8.363)
Male head part-time employed		-53.74 (28.63)	-53.53 (28.43)
Male head full-time employed		-0.795 (13.81)	-1.515 (14.34)
Household heads not married, living with related/unrelated		-6.179 (17.05)	-4.928 (16.62)
Mar		0 (0)	10.51 (20.26)
April		-46.90* (19.12)	-48.72 (30.30)
May		44.82** (14.25)	0 (0)
Difference in DMA level price			33.58 (208.1)
Difference in DMA level % deal			7.193 (4.036)
Difference in (DMA level GRP for children 2-5*1(household members of age 2-5))			-0.293** (0.0739)
Difference in (DMA level GRP for children 6-11*1(household members of age 6-11))			0.0642 (0.0463)
Difference in (DMA level GRP for children 12-17*1(household members of age 12-17))			0.0104 (0.0554)
Difference in (DMA level GRP for audience 18-24*1(household members of age 18-24))			0.116 (0.0618)
Difference in (DMA level GRP for audience 25+*1(household members of age 25+))			0.0621 (0.0326)
Constant	69.03*** (4.065)	232.4* (90.84)	231.2* (98.32)
Observations	16,500	10,110	10,110
R-squared	0.001	0.115	0.117

Note. *** p<0.01, ** p<0.05, * p<0.1. Reported in parentheses are Robust standard errors clustered at DMA level. Samples are from the Nielsen HomeScan data for the soft drink category. The treatment group includes households who have children aged 6-18. The control group includes households with children younger than 6 or households without children. The pre-treatment period spans February to May 2006, and the post-treatment period covers February to May 2007. The "Post ban period" binary dummy variable (1/0) equals 1 if it is post the ban effective dates (July 1 2006), and 0 otherwise. The "1(households members of age x1-x2" binary dummy variable (1/0) equals 1 if there are any children between x1-x2 in a household, and 0 otherwise. The marketing variables, price paid, and % deal, are averages across all transactions made by households residing in a Designated Market Area (DMA).

Table 4. Estimated CA Soda Ban Effects on Soda Volume Purchase

	(1)	(2)	(3)
Dependent variable: difference in a household's monthly soda volume purchase			
Post ban period	-9.443	-35.68***	-39.68**
	(9.808)	(3.310)	(14.03)
CA	0	0	0
	(0)	(0)	(0)
CA*Post ban period	17.98	42.53***	46.38**
	(10.16)	(6.822)	(15.24)
Households with high school age children (15-18)	-1.122	-5.213	-3.460
	(20.77)	(26.30)	(36.34)
Households with children below 6	30.06	1.449	7.448
	(23.92)	(36.40)	(48.30)
CA * households with children 15-18	-26.57	3.070	-0.934
	(26.32)	(27.73)	(29.30)
CA* households with children below 6	-135.7**	-75.11	-75.98
	(43.81)	(39.18)	(43.01)
Post ban period * households with children 15-18	16.06	15.89	13.16
	(43.64)	(31.73)	(35.51)
Post ban period * households with children below 6	-82.88*	-61.82***	-63.07***
	(32.77)	(12.02)	(11.40)
CA*post ban period*households with children 15-18	8.212	5.950	6.257
	(44.00)	(31.85)	(32.81)
CA*post ban period*households with children below 6	220.9**	134.2***	136.8***
	(64.55)	(31.54)	(28.77)
Lagged monthly volume purchase		-0.384***	-0.383***
		(0.0205)	(0.0202)
Household size		19.99**	21.65***
		(4.958)	(4.645)
Hispanic		-14.65	-14.62
		(15.40)	(15.19)
White		47.36***	47.30***
		(4.171)	(4.194)
Homeowner		-7.701	-7.822
		(17.89)	(17.46)
Household 2008 annual income<$35,000		18.88	19.30
		(18.86)	(19.11)
Household 2008 annual income b/w $35.000 & $99,999		5.659	6.080
		(10.60)	(10.59)
Female head some high school or high school graduate		-54.73	-54.25
		(70.89)	(71.32)
Female head some college or college graduate		-79.08	-78.67
		(67.73)	(68.17)
Female head post-college		-81.30	-80.65
		(73.35)	(73.70)
Male head some high school or high school graduate		42.79	43.08
		(37.54)	(36.96)

		38.50	38.87
Male head some college or college graduate		(36.57)	(36.10)
		2.666	3.112
Male head post-college		(37.90)	(37.55)
		7.010	6.823
Female head part-time employed		(26.32)	(26.10)
		5.239	4.962
Female head full-time employed		(15.36)	(15.51)
		36.77*	36.72*
Male head part-time employed		(15.15)	(15.06)
		28.39**	28.41**
Male head full-time employed		(7.492)	(7.580)
		1.365	1.138
Household heads not married, living with related/unrelated		(9.987)	(9.900)
		-23.34	27.29
Oct		(28.55)	(25.28)
			307.7**
Difference in DMA level price			(82.68)
			11.25***
Difference in DMA level % deal			(2.223)
Difference in (DMA level GRP for children 2-5*1(household members			0.147
of age 2-5))			(0.199)
Difference in (DMA level GRP for children 6-11*1(household			0.165
members of age 6-11))			(0.193)
Difference in (DMA level GRP for children 12-17*1(household			-0.0167
members of age 12-17))			(0.0666)
Difference in (DMA level GRP for audience 18-24*1(household			-0.00158
members of age 18-24))			(0.0548)
Difference in (DMA level GRP for audience 25+*1(household			0.00596
members of age 25+))			(0.0319)
	1.929	161.6*	109.3
Constant	(2.829)	(74.05)	(82.07)
Observations	14,468	8,480	8,480
R-squared	0.001	0.204	0.207

Note. *** p<0.01, ** p<0.05, * p<0.1. Reported in parentheses are Robust standard errors clustered at DMA level. Samples are from the Nielsen HomeScan data for the soft drink category. The experimental DMA is Hartford, CT. The non-experimental DMAs include Atlanta, Houston, Miami and Kansas City. The pre-treatment period spans September to November 2007, and the post-treatment period covers September to November 2008. The treatment group includes households who have children aged 15-18. The control group includes households with children younger than 6 or households without children. The “Post ban period” binary dummy variable (1/0) equals 1 if it is post the ban effective dates (July 1 2007), and 0 otherwise. The “1(households members of age x1-x2” binary dummy variable (1/0) equals 1 if there are any children between x1-x2 in a household, and 0 otherwise. The marketing variables, price paid, and % deal, are averages across all transactions made by households residing in a Designated Market Area (DMA).

Table 5. Estimated CA and CT Soda Ban Effects on Soda Volume Purchase

	(1)	(2)	(3)
Dependent variable: difference in a household's monthly soda volume purchase			
Households with high school age children (15-18)	15.29*	-25.06***	-23.59**
	(7.714)	(5.851)	(7.676)
Households with children below 6	36.39**	17.40*	16.17
	(12.14)	(8.396)	(8.913)
Ban * households with children 15-18	-57.47***	1.212	6.836
	(10.61)	(14.50)	(12.25)
Ban * households with children below 6	-14.14	35.72	42.08
	(25.39)	(26.32)	(28.65)
CA* households with children below 6	-25.83***	-16.25	-17.70
	(4.597)	(12.80)	(13.01)
CT* households with children below 6	-64.18***	-136.4***	-141.0***
	(17.08)	(22.34)	(23.93)
CA* households with children 15-18	40.18***	24.37***	22.81***
	(1.874)	(3.016)	(2.625)
CT* households with children 15-18	48.91***	41.30***	36.58***
	(7.085)	(9.997)	(8.469)
Atlanta*households with children 15-18	-18.61***	-8.412**	-9.394**
	(0.624)	(2.566)	(3.561)
Miami*households with children 15-18	-8.131***	20.52***	20.64***
	(0.138)	(3.202)	(2.991)
Houston*households with children 15-18	-9.380***	35.00***	35.00***
	(0.384)	(2.016)	(2.274)
Los Angeles* households with children 15-18	-49.45***	0	0
	(0.523)	(0)	(0)
San Francisco*households with children 15-18	0	50.87***	50.82***
	(0)	(3.038)	(3.098)
Atlanta*households with children below 6	-49.71***	-90.76***	-91.54***
	(0.272)	(8.775)	(9.148)
Kansas City*households with children below 6	-111.0***	-97.95***	-98.22***
	(0.215)	(11.05)	(10.89)
Houston*households with children below 6	-18.84***	-4.537	-4.075
	(0.627)	(8.169)	(8.617)
Los Angeles*households with children below 6	0	-25.88**	-25.68**
	(0)	(8.160)	(8.323)
San Francisco*households with children below 6	20.72***	0	0
	(0.0969)	(0)	(0)
Year 2007*households with children 15-18	13.65	7.714	5.648
	(15.77)	(5.507)	(8.813)
Year 2006* households with children below 6	-0.00866	6.664	9.380
	(22.23)	(11.45)	(14.03)
Atlanta*year 2007	-28.12***	0	0
	(2.274)	(0)	(0)
Miami*year 2007	0	-5.930**	-17.49***
	(0)	(2.314)	(4.490)

	0	-11.77***	-8.476**
Kansas City*year 2007	(0)	(2.713)	(2.851)
	0	-32.65***	-32.14***
Houston*year 2007	(0)	(2.315)	(2.866)
	-1.427	19.35***	4.454
Los Angeles*year 2007	(2.097)	(1.155)	(4.654)
	0	22.37***	19.61***
Atlanta*year 2006	(0)	(2.434)	(2.661)
	9.995***	0	0
Miami*year 2006	(2.163)	(0)	(0)
	4.633*	0	0
Hartford*year 2006	(2.347)	(0)	(0)
	22.08***	0	0
Kansas City*year 2006	(3.512)	(0)	(0)
	19.45***	0	0
Houston*year 2006	(2.235)	(0)	(0)
	-14.87***	-37.36***	-33.55***
San Francisco*year 2006	(1.763)	(1.424)	(3.658)
		-0.338***	-0.338***
Lagged monthly volume purchase		(0.0123)	(0.0123)
		22.27***	22.22***
Household size		(1.894)	(1.903)
		-16.00	-15.98
Hispanic		(16.66)	(16.62)
		56.41***	56.33***
White		(4.462)	(4.441)
		-11.34	-11.25
Homeowner		(14.93)	(14.87)
		-10.76	-10.75
Household 2008 annual income<$35,000		(19.34)	(19.33)
		-0.668	-0.660
Household 2008 annual income b/w $35.000 & $99,999		(7.199)	(7.217)
		42.34	42.25
Female head some high school or high school graduate		(53.42)	(53.36)
		13.86	13.81
Female head some college or college graduate		(51.87)	(51.82)
		1.335	1.309
Female head post-college		(52.67)	(52.57)
		-21.90	-21.84
Male head some high school or high school graduate		(35.56)	(35.44)
		-31.68	-31.62
Male head some college or college graduate		(34.21)	(34.13)
		-57.53	-57.45
Male head post-college		(33.78)	(33.67)
		3.813	3.832
Female head part-time employed		(20.92)	(20.90)
		-2.828	-2.819

Female head full-time employed		(9.854)	(9.830)
		9.685	9.690
Male head part-time employed		(30.73)	(30.73)
		12.20	12.15
Male head full-time employed		(11.43)	(11.44)
		-4.687	-4.683
Household heads not married, living with related/unrelated		(10.58)	(10.56)
		0	0
Household heads married		(0)	(0)
		62.31***	67.48***
Mar		(7.525)	(4.295)
		21.28	30.44*
April		(13.10)	(12.76)
		106.4***	87.67***
May		(12.88)	(10.38)
		26.95***	25.70***
year 2006		(2.427)	(4.481)
			74.69
Difference in DMA level price			(39.56)
			6.297***
Difference in DMA level % deal			(1.372)
Difference in (DMA level GRP for children 2-5*1(household			0.0319
members of age 2-5))			(0.0798)
Difference in (DMA level GRP for children 6-11*1(household			0.0431
members of age 6-11))			(0.0371)
Difference in (DMA level GRP for children 12-17*1(household			-0.00299
members of age 12-17))			(0.0242)
Difference in (DMA level GRP for audience 18-24*1(household			0.0180
members of age 18-24))			(0.0352)
Difference in (DMA level GRP for audience 25+*1(household			-0.00623
members of age 25+))			(0.0199)
	29.26***	89.64	78.78
Constant	(0.205)	(54.96)	(55.44)
Observations	44,194	25,496	25,496
R-squared	0.001	0.149	0.150

Note.*** p<0.01, ** p<0.05, * p<0.1. Reported in parentheses are Robust standard errors clustered at DMA level. Samples are from the Nielsen HomeScan data for the soft drink category. The experimental DMAs are Los Angeles and San Francisco, CA. The non-experimental DMAs include Atlanta, Houston, Miami and Kansas City. The pre-treatment period spans February to May 2006, and the post-treatment period covers February to May 2007. The treatment group includes households who have children aged 15-18. The control group includes households with children younger than 6 or households without children. The DDD estimate of the soda ban effects is the coefficient of the variable “Ban*households with children 15-18”. This variable equals 1 if it is in the post-ban period in CA (CT), the household lives in CA (CT) and the household has children aged 15-18, and 0 otherwise. The ban effective dates are July 1 2006 for CT, and July 1 2007 for CA. The “1(households members of age x1-x2” variable equals 1 if there are any children between x1-x2 in a household, and 0 otherwise.

Table 6. Summary Statistics for Store-level Analysis

	Combined		CA		TX		MD		IL		WA	
Variable	mean	st. dev.	mean	st. dev.	mean	st. dev.	mean	st. dev.	mean	st. dev.	mean	st. dev.
Regular soda	0.27	0.44	0.26	0.44	0.27	0.44	0.27	0.44	0.28	0.45	0.28	0.45
Diet soda	0.19	0.39	0.19	0.39	0.20	0.40	0.19	0.39	0.21	0.40	0.19	0.39
Juice	0.07	0.25	0.07	0.25	0.07	0.25	0.07	0.26	0.07	0.26	0.06	0.24
Sports drink	0.14	0.35	0.15	0.35	0.15	0.35	0.14	0.34	0.12	0.33	0.14	0.35
Water	0.23	0.42	0.23	0.42	0.23	0.42	0.24	0.42	0.21	0.41	0.20	0.40
Regular product price	2.95	3.82	3.02	3.58	2.92	3.57	2.95	5.18	3.02	2.57	2.87	4.73
Net product price	2.53	3.68	2.53	3.41	2.57	3.48	2.51	5.06	2.57	2.36	2.52	4.65
Product quantity sold	15.60	37.11	17.36	38.37	13.28	33.42	16.51	39.84	37.54	0.50	33.58	0.25
Category quantity sold												
Regular soda	378394	71870	125535	26151	48767	10485	22042	4927	69528	16148	55617	11570
Diet soda	273436	40769	90159	15410	39981	7059	14535	2545	47000	8527	35890	6990
Sports drinks	184477	76790	97025	40748	21989	10322	8839	4488	25672	12431	28706	11767
Juice	53320	17817	18739	6523	6331	2329	2627	1009	10005	3612	6477	2506
water	401158	68283	147070	27189	45103	8502	18716	3730	60408	11316	46687	10950
# weeks	180		180		180		180		180		180	
# stores	129		49		25		9		25		21	
# obs	14672224		4681940		2139889		816128		2724011		2085572	

Note. Samples are from a large U.S. grocery store chain between January 1, 2004 and June 30, 2007 provided through SIEPR-GIANINI Data Center. The variables "regular soda", "diet soda", "juice", "sports drink", and "water" are all binary dummy variables that equal one if the product is in regular soft drinks, diet soft drinks, sports drinks which includes energy and new age drinks, juices, and bottled water respectively, and zero otherwise. The variable "net product price" is average price per week after accounting for sales and promotions.

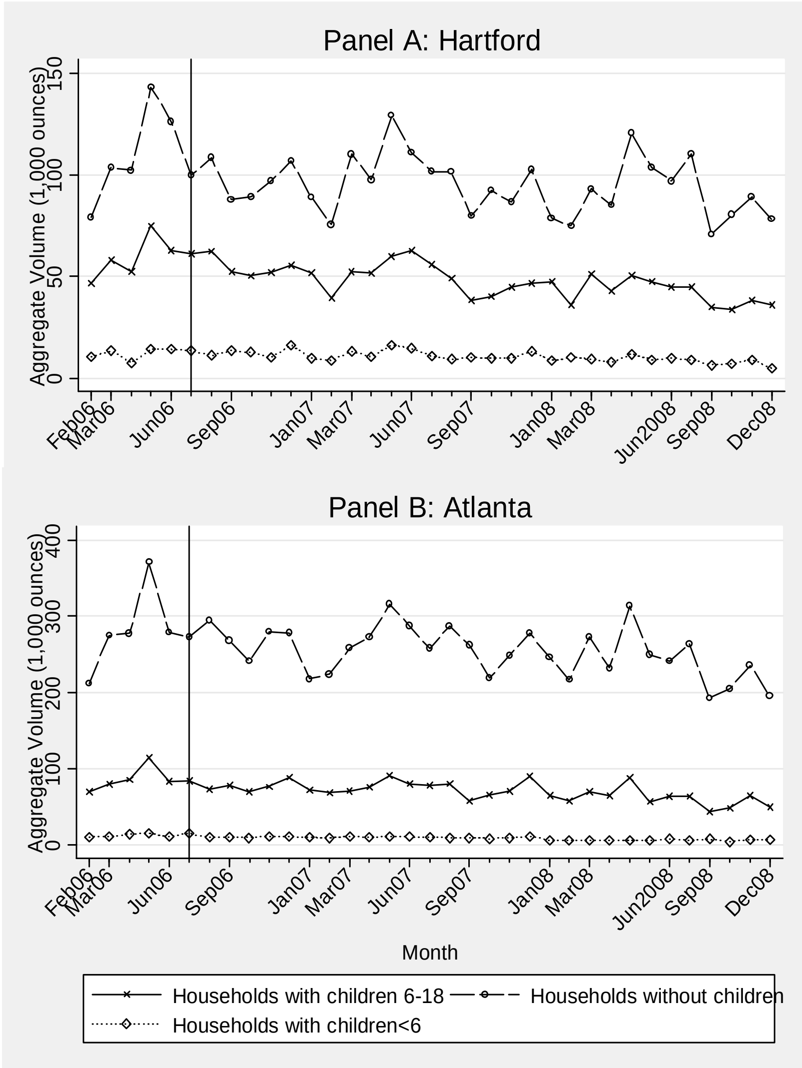
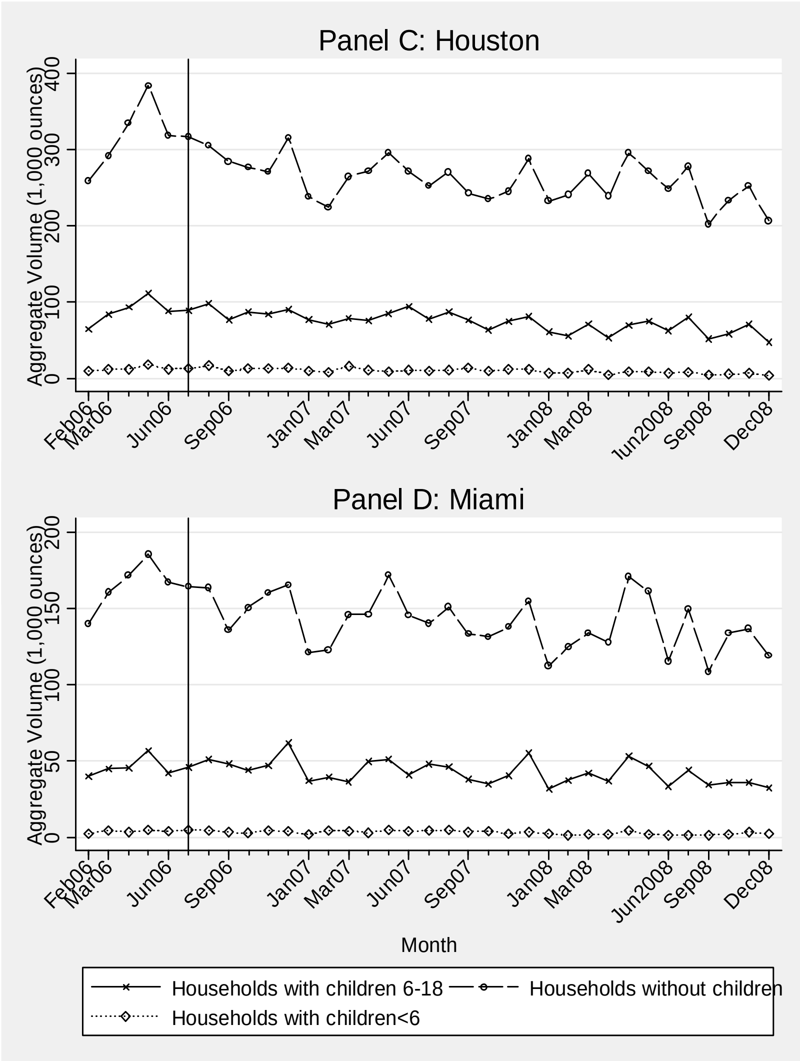


Figure 1. CT Ban Study: Aggregate Monthly Volume by Age of Children and by DMA

Note. Depicted in the panels are the series of aggregated monthly out-of-school soft drink volume purchase by age and presence of children for each of the DMA used in the CT ban analysis over the entire data period from February 2006 to December 2008. The experimental DMA is Hartford, CT. The non-experimental DMAs include Atlanta, Houston, Miami and Kansas City, where there were no state level soft drink bans during the data period. The vertical black line indicates July 1 2006, the effective date of the ban on soft drink in all public schools in Connecticut. The treatment group consists of households with children between 6 and 18, the typical age of children enrolling in elementary, middle and high schools. The control group consists of households with children younger than 6 and households without children.



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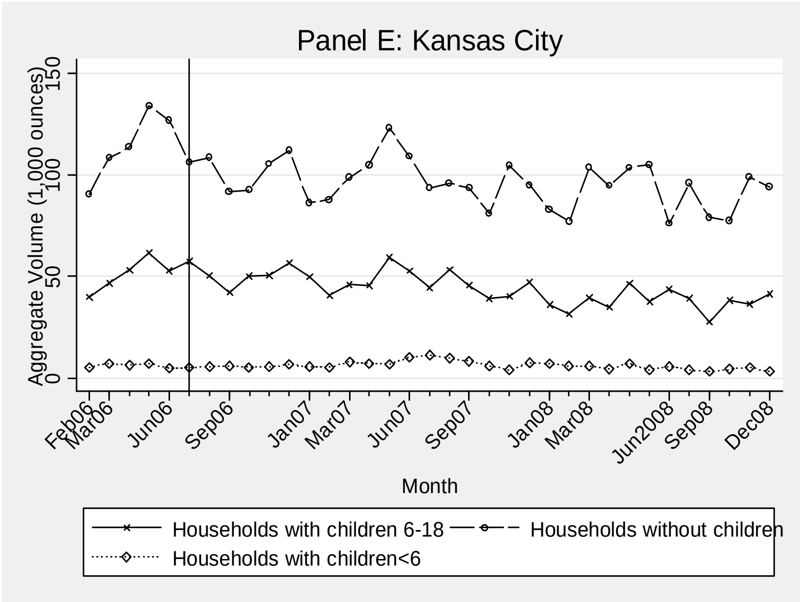

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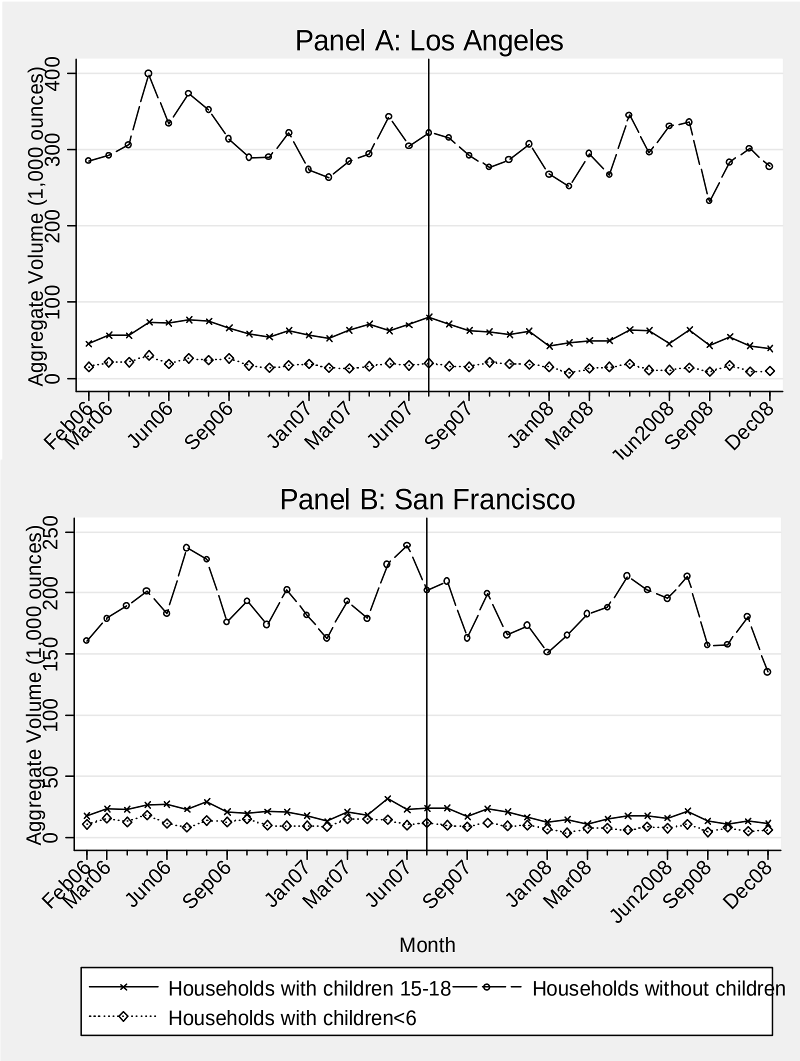
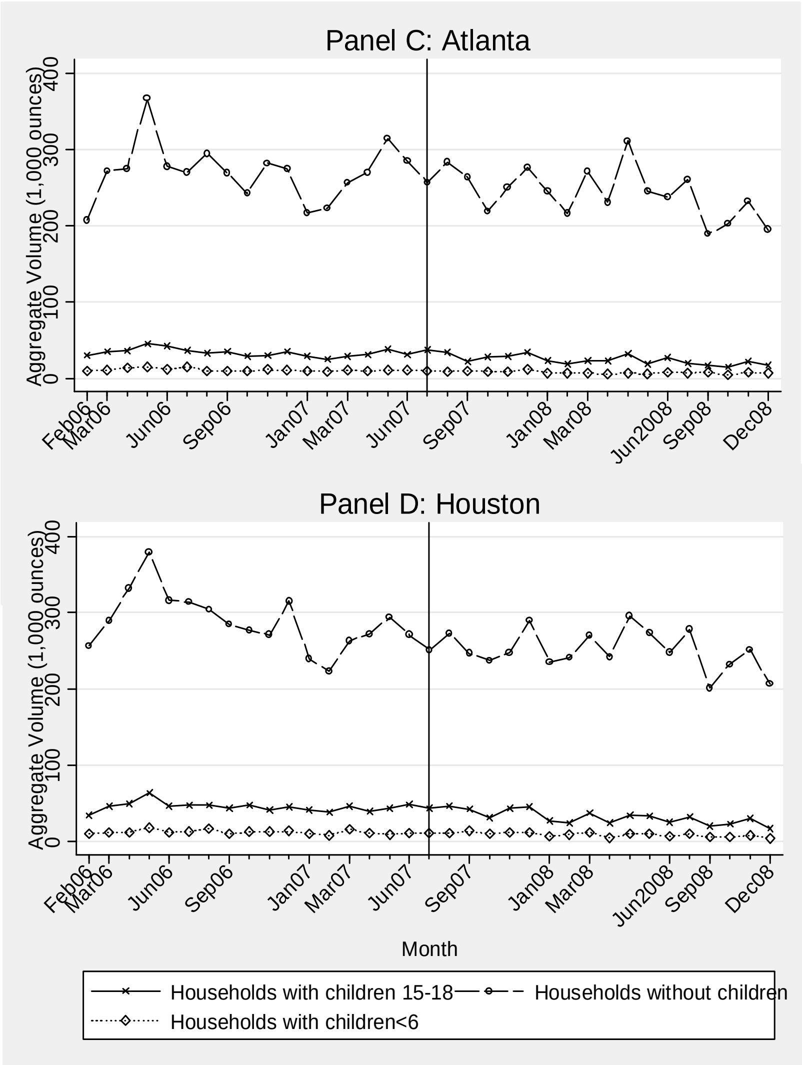


Figure 2. CA Ban Study: Aggregate Monthly Volume by Age of Children and by DMA

Note. Depicted in the panels are the series of aggregated monthly out-of-school soft drink volume purchase by age and presence of children for each of the DMA used in the CA ban analysis over the entire data period from February 2006 to December 2008. The experimental DMAs include Los Angeles and San Francisco. The non-experimental DMAs include Atlanta, Houston, Miami and Kansas City, where there were no state level soft drink bans during the data period. The vertical black line indicates July 1 2007, the date when Californian high schools were required for at least 50% compliance to the Californian soft drink ban. The treatment group consists of households with children between 15 and 18, the typical age of children enrolling in high schools. The control group consists of households with children younger than 6 and households without children.



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Note. Depicted in the panels are the series of aggregated monthly out-of-school soft drink volume purchase by age and presence of children for each of the DMA used in the CA ban analysis over the entire data period from February 2006 to December 2008. The experimental DMAs include Los Angeles and San Francisco. The non-experimental DMAs include Atlanta, Houston, Miami and Kansas City, where there were no state level soft drink bans during the data period. The vertical black line indicates July 1 2007, the date when Californian high schools were required for at least 50% compliance to the Californian soft drink ban. The treatment group consists of households with children between 15 and 18, the typical age of children enrolling in high schools. The control group consists of households with children younger than 6 and households without children.

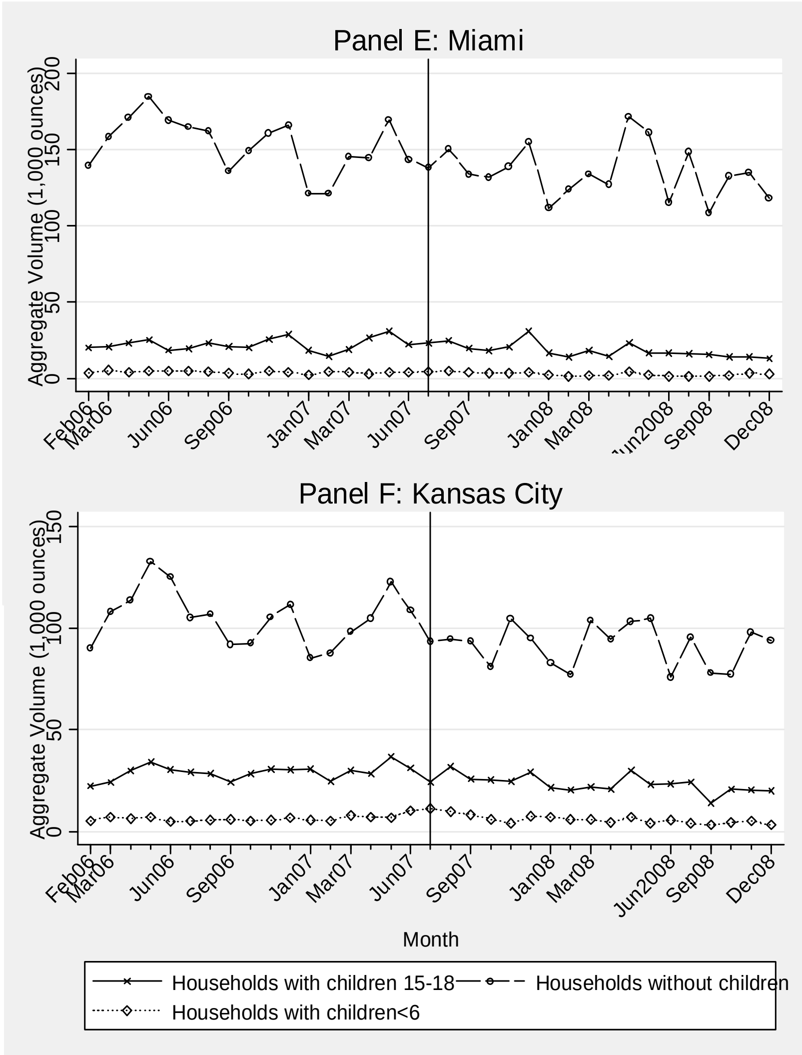


Figure 2. CA Ban Study: Aggregate Monthly Volume by Age of Children and by DMA

Note. Depicted in the panels are the series of aggregated monthly out-of-school soft drink volume purchase by age and presence of children for each of the DMA used in the CA ban analysis over the entire data period from February 2006 to December 2008. The experimental DMAs include Los Angeles and San Francisco. The non-experimental DMAs include Atlanta, Houston, Miami and Kansas City, where there were no state level soft drink bans during the data period. The vertical black line indicates July 1 2007, the date when Californian high schools were required for at least 50% compliance to the Californian soft drink ban. The treatment group consists of households with children between 15 and 18, the typical age of children enrolling in high schools. The control group consists of households with children younger than 6 and households without children.

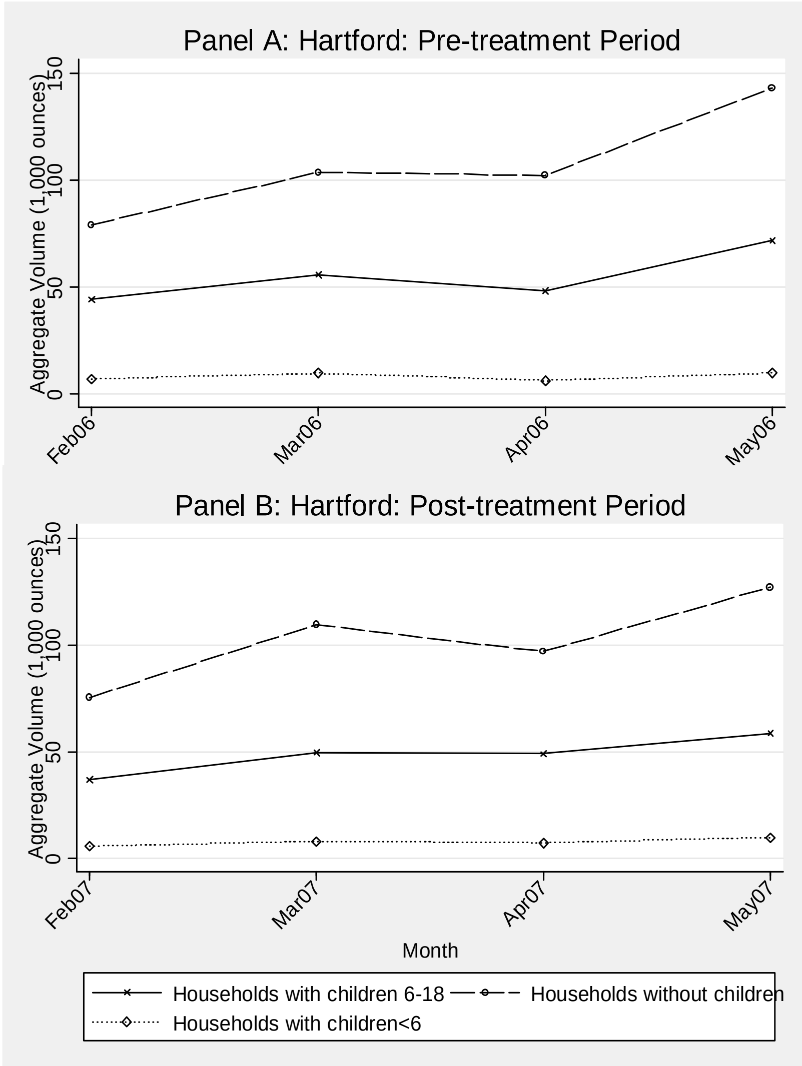


Figure 3. CT Ban Study: Aggregated Monthly Volume in Pre- and Post-ban Period

Note. Depicted in Panel A and B are aggregated monthly out-of-school soft drink volume purchase by age and presence of children in the pre- and post-ban period in Hartford, CT. In Panel C and D are aggregated monthly out-of-school soft drink volume purchase by age and presence of children, aggregated across all four non-experimental DMAs (Atlanta, Houston, Miami and Kansas City), in the same pre- and post-ban period. he treatment group consists of households with children between 15 and 18, the typical age of children enrolling in high schools. The control group consists of households with children younger than 6 and households without children. Connecticut soft drink ban in all public schools came into effect on July 1, 2006. The pre-ban period is defined as February to May 2006, while the post-ban period is February to May 2007.

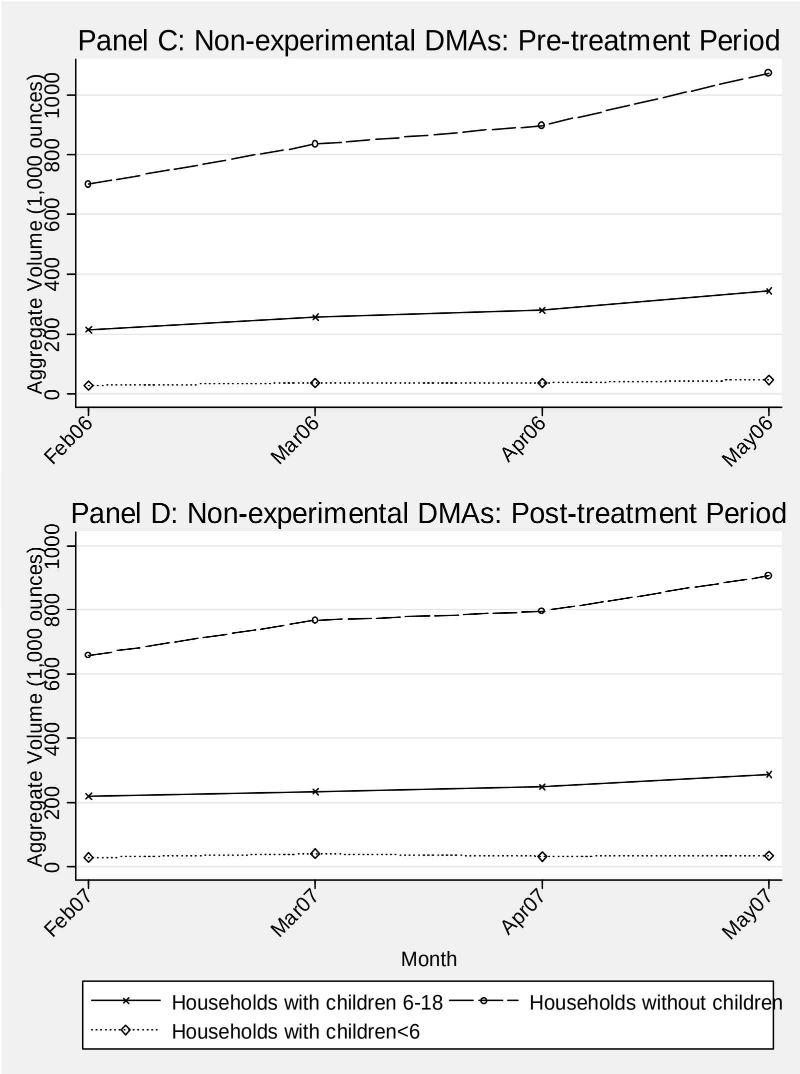


Figure 3. CT Ban Study: Aggregated Monthly Volume in Pre- and Post-ban Period

Note. Depicted in Panel A and B are aggregated monthly out-of-school soft drink volume purchase by age and presence of children in the pre- and post-ban period in Hartford, CT. In Panel C and D are aggregated monthly out-of-school soft drink volume purchase by age and presence of children, aggregated across all four non-experimental DMAs (Atlanta, Houston, Miami and Kansas City), in the same pre- and post-ban period. he treatment group consists of households with children between 15 and 18, the typical age of children enrolling in high schools. The control group consists of households with children younger than 6 and households without children. Connecticut soft drink ban in all public schools came into effect on July 1, 2006. The pre-ban period is defined as February to May 2006, while the post-ban period is February to May 2007.

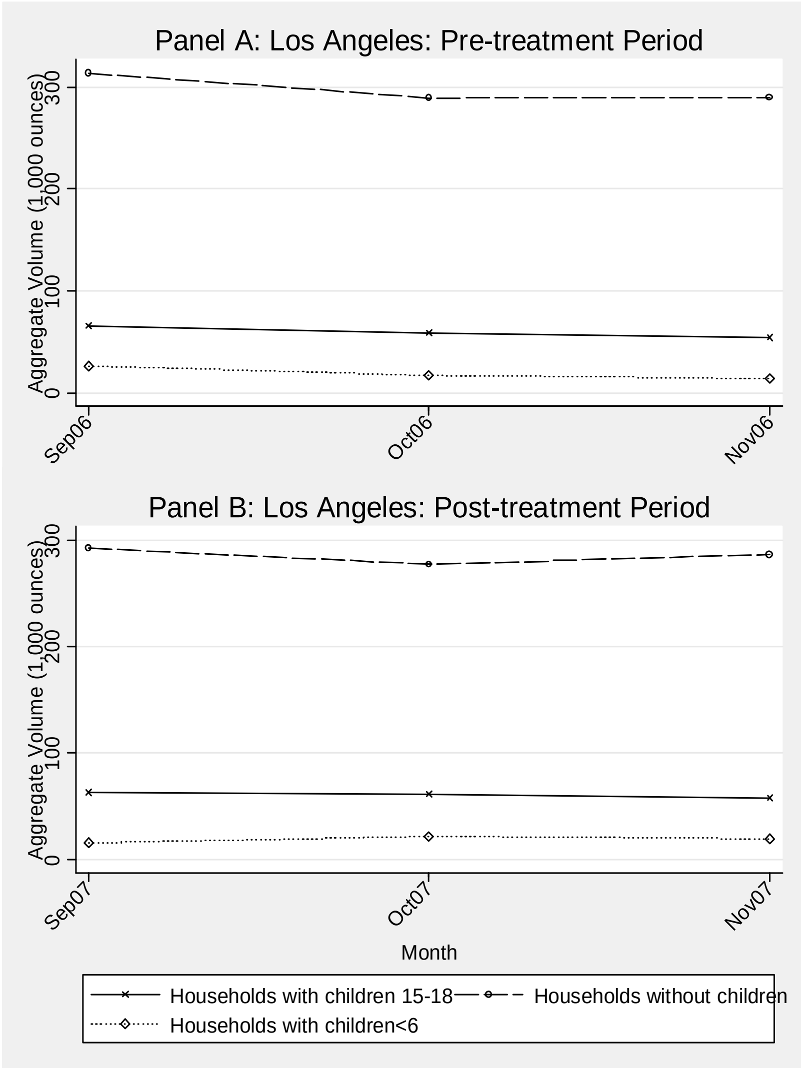
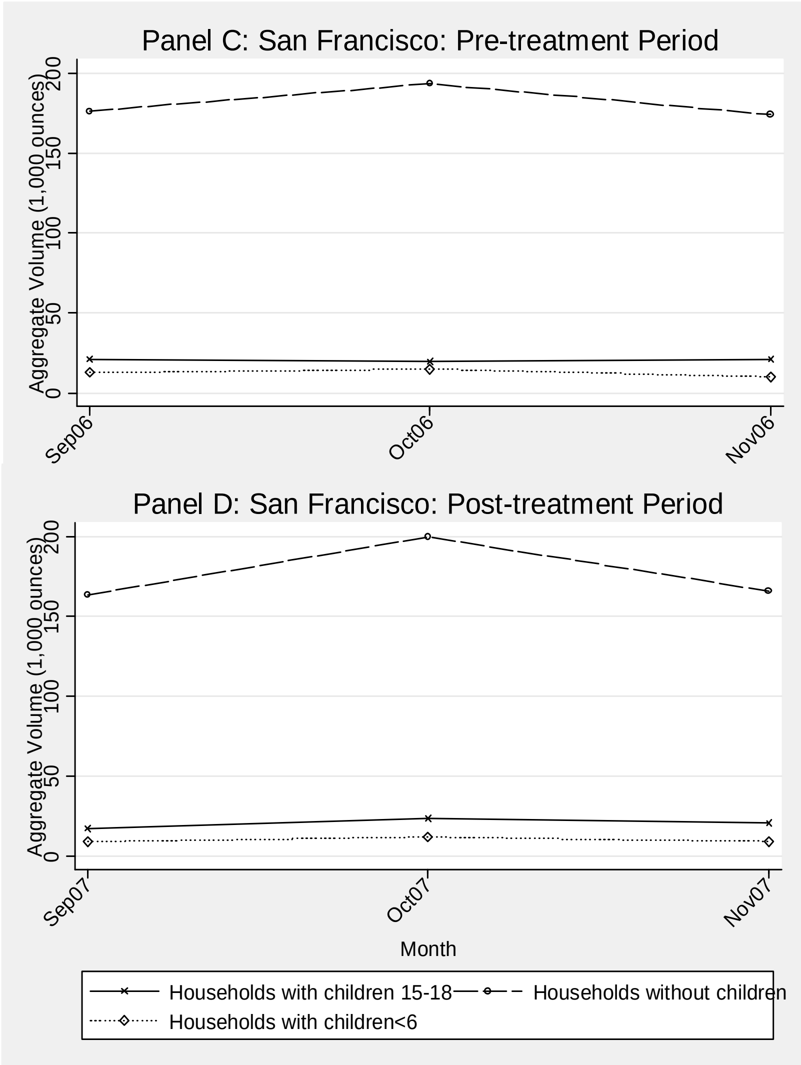


Figure 4. CA Ban Study: Aggregated Monthly Volume in Pre- and Post-ban Period

Note. Depicted in Panel A, B, C and D are aggregated monthly out-of-school soft drink volume purchase by age and presence of children in the pre- and post-ban period in Los Angeles and San Francisco respectively. In Panel E and F are aggregated monthly out-of-school soft drink volume purchase by age and presence of children, aggregated across all four non-experimental DMAs (Atlanta, Houston, Miami and Kansas City), in the same pre- and post-ban period. he treatment group consists of households with children between 15 and 18, the typical age of children enrolling in high schools. The control group consists of households with children younger than 6 and households without children. Connecticut soft drink ban in all public schools came into effect on July 1, 2006. The pre-ban period is defined as February to May 2006, while the post-ban period is February to May 2007.



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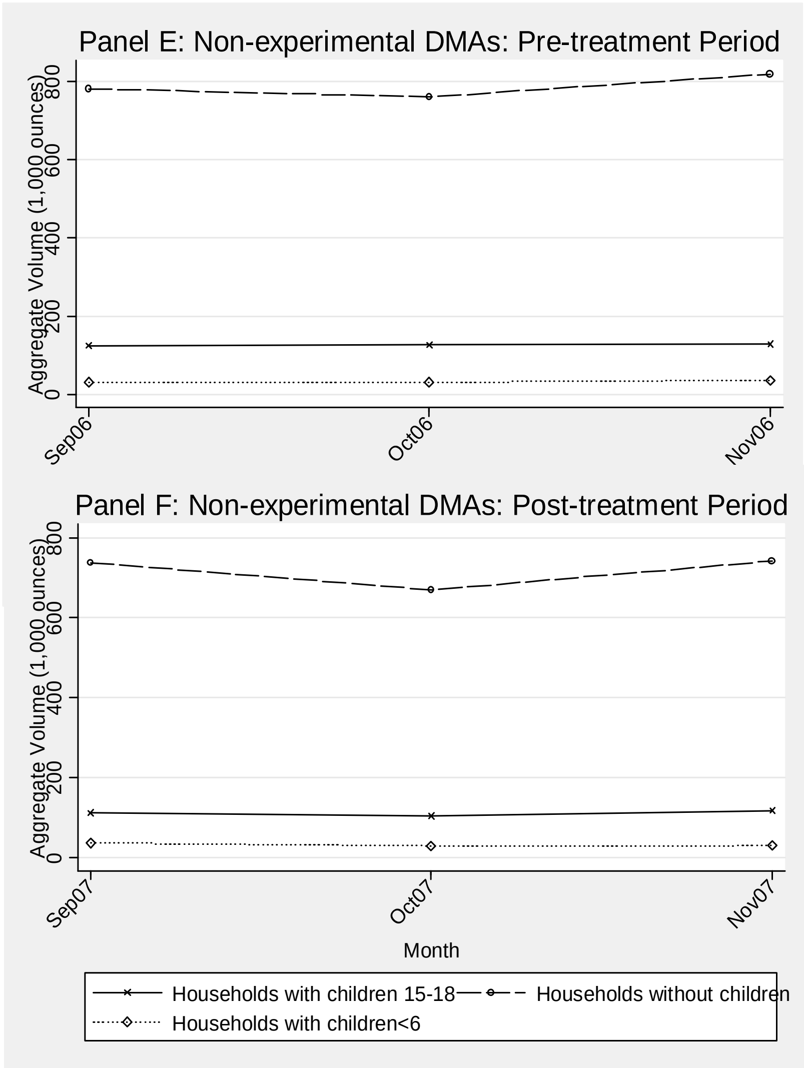

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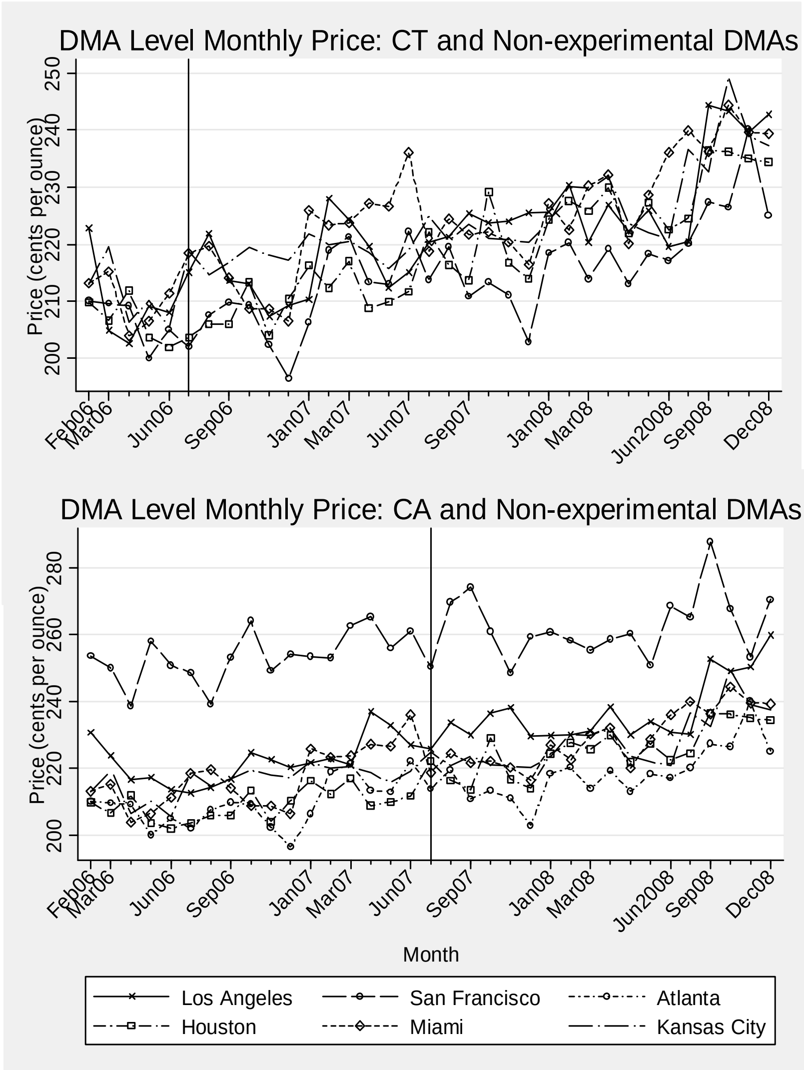


Figure 5. DMA Level Average Soft Drink Price

Note. Depicted in the panels are the series of average price by DMAs for DMAs used in the CT and CA ban study respectively. The average prices are computed by dividing the sum of weekly expenditure by all households in the data by their total volume purchase. The vertical black line in top panel indicates July 1 2006, the effective date of CT ban. The vertical black line in the bottom panel indicates July 1 2007, the date when California high schools were required to comply at least 50% with the soda ban.

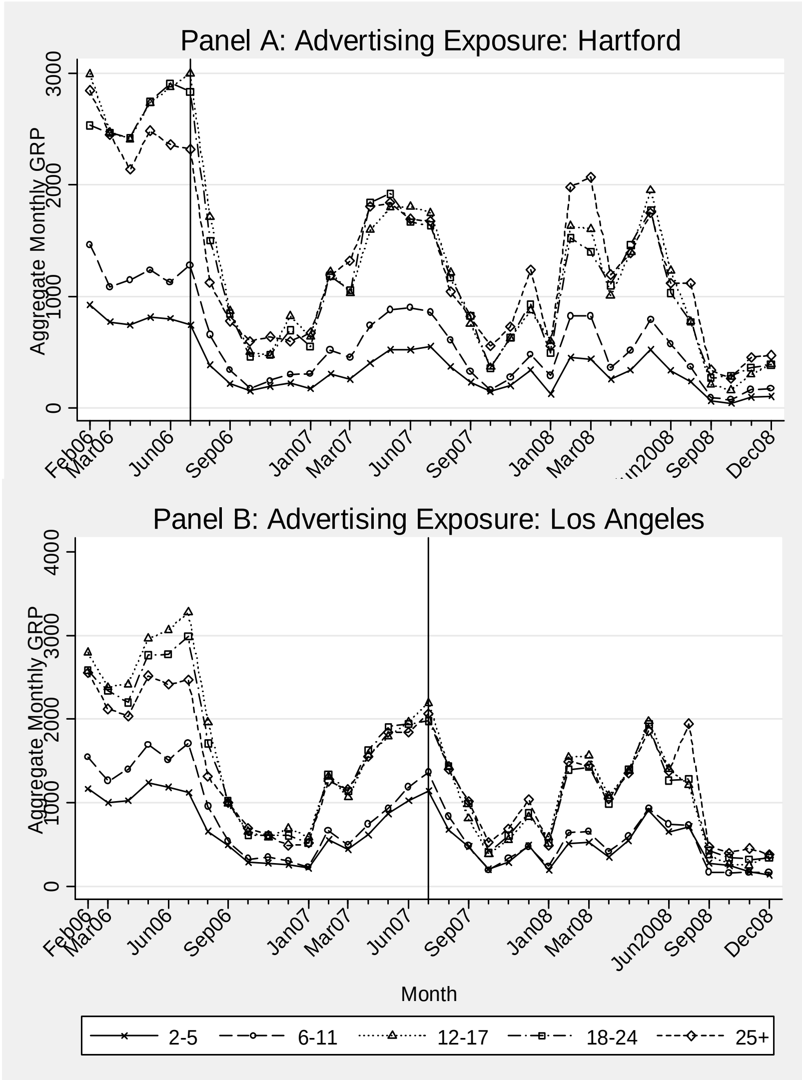
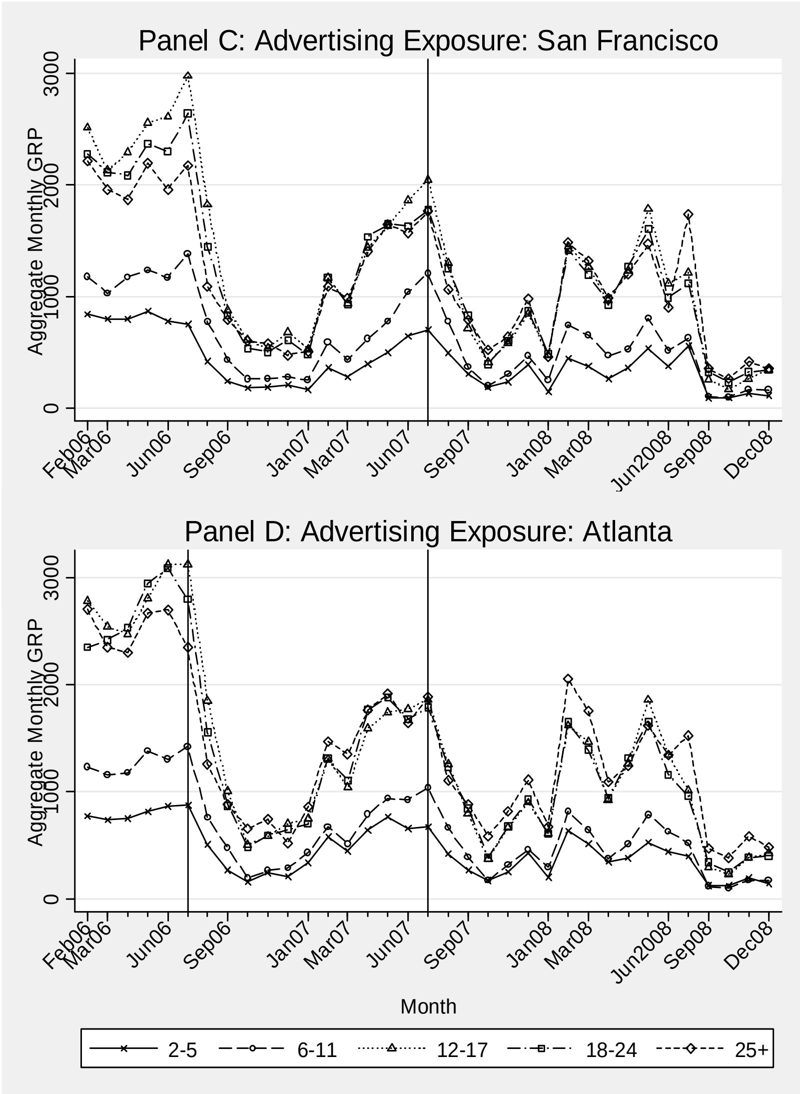


Figure 6. DMA Level Advertising Exposure by Age Group of Audience

Note. Depicted in the panels are the series of aggregated monthly Gross Rating Points (GRP) for audience of the following five age groups: 2-5, 6-11, 12-17, 18-24, and over 25 by DMA. Aggregated monthly GRP is the sum of GRP from advertising aired on cable, network, syndicated, and spot television in the national market for all soft drink products. The vertical black lines indicate July 1 2006, the effective date of CT ban and July 1 2007, the date when California high schools were required to comply at least 50% with the soda ban.



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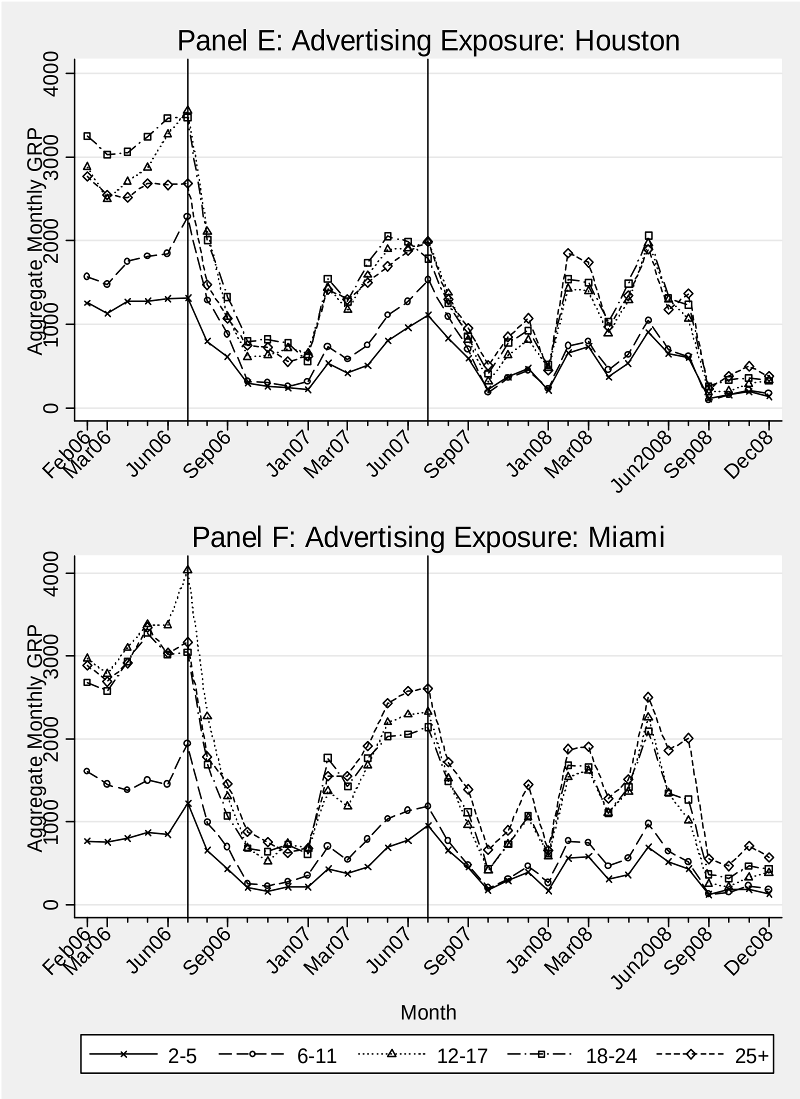

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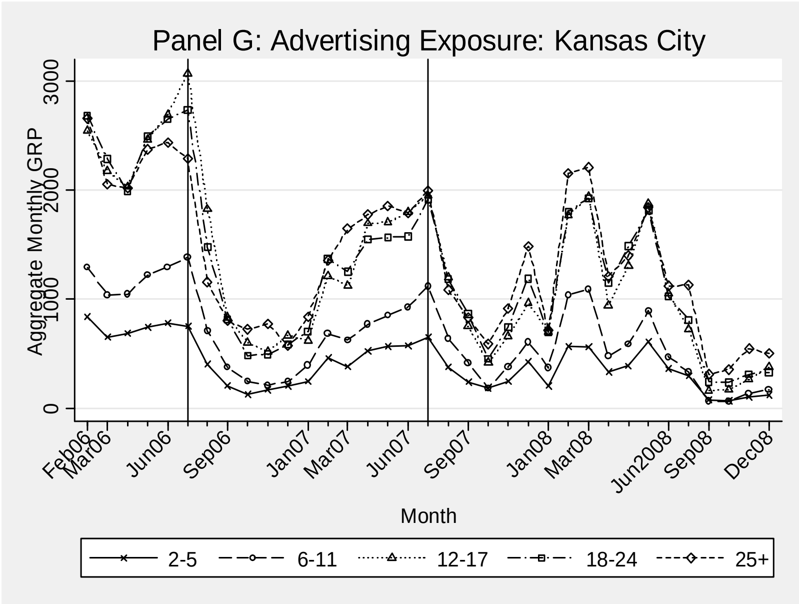

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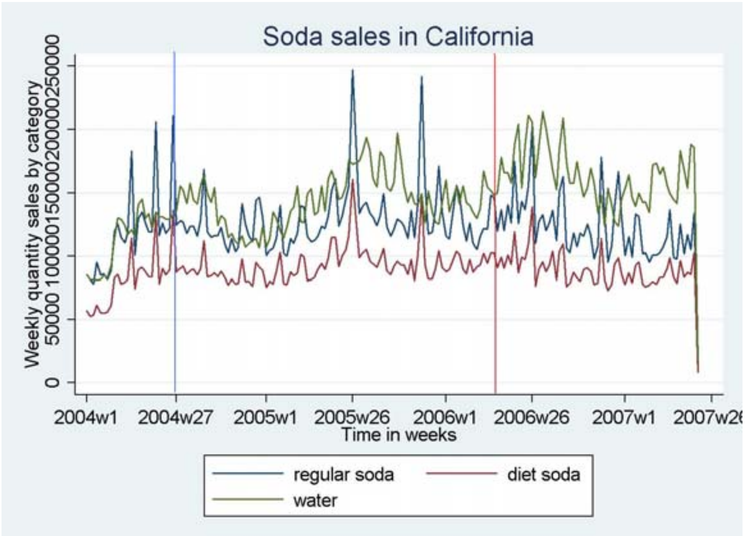

Figure 7. California: Aggregate Weekly Soda Sales by Product Category

Note. Depicted are the series of aggregated weekly sales by product categories for 49 stores located in California. Overall category sales for regular soda products and diet soda products are plotted against sales of bottled water. Vertical lines mark the introduction of soft drink bans in elementary, middle, and junior high schools, as well as the voluntary agreement reached with the beverage industry.

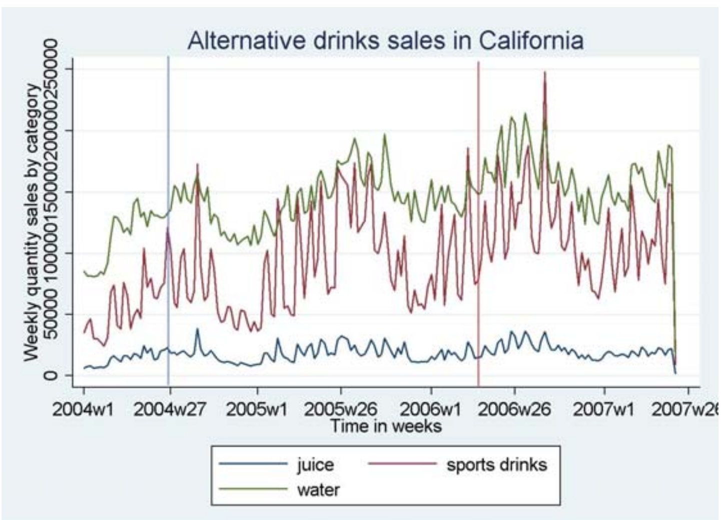

Figure 8. California: Aggregate Weekly Sales for Alternative Product Categories

Note. Depicted are the series of aggregated weekly sales by product categories for 49 stores located in California. Overall category sales for alternative drinks, juice and juice sweetened beverages, sports and energy drinks are plotted against sales of bottled water. Vertical lines mark the introduction of soft drink bans in elementary, middle, and junior high schools, as well as the voluntary agreement reached with the beverage industry.

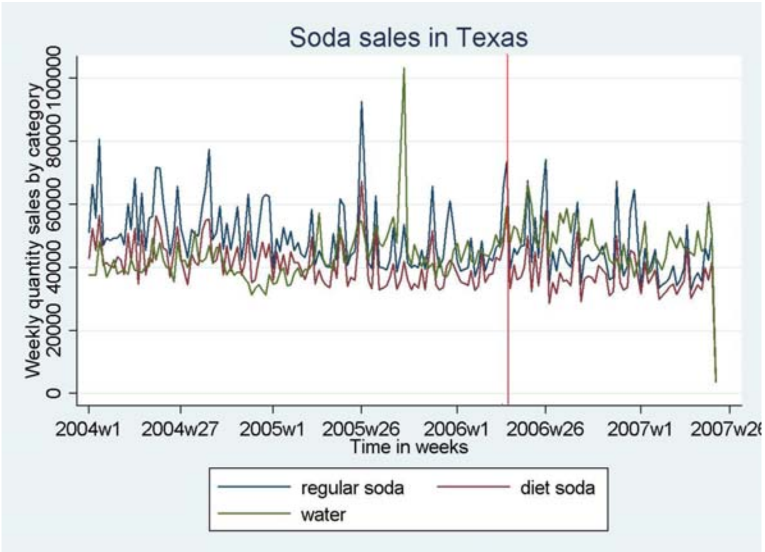

Figure 9. Texas: Aggregate Weekly Soda Sales by Product Category

Note. Depicted are the series of aggregated weekly sales by product categories for 25 stores located in Texas. Overall category sales for regular soda products and diet soda products are plotted against sales of bottled water. Vertical lines mark the voluntary agreement reached with the beverage industry.

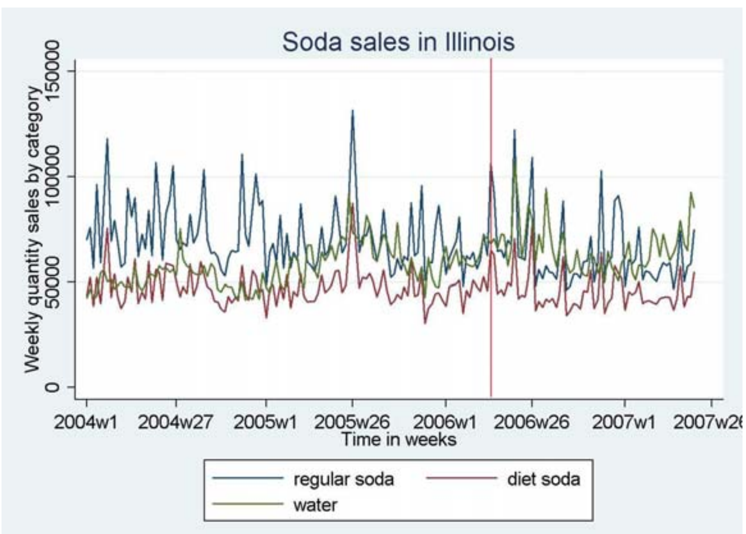

Figure 10. Illinois: Aggregate Weekly Soda Sales by Product Category

Note. Depicted are the series of aggregated weekly sales by product categories for 25 stores located in Illinois. Overall category sales for regular soda products and diet soda products are plotted against sales of bottled water. Vertical lines mark the voluntary agreement reached with the beverage industry.

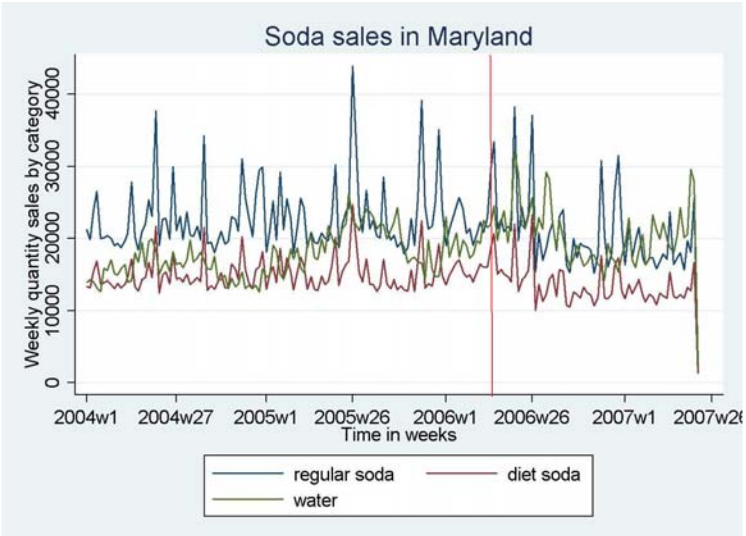

Figure 11. Maryland: Aggregate Weekly Soda Sales by Product Category

Note. Depicted are the series of aggregated weekly sales by product categories for 9 stores located in Maryland. Overall category sales for regular soda products and diet soda products are plotted against sales of bottled water. Vertical lines mark the voluntary agreement reached with the beverage industry.

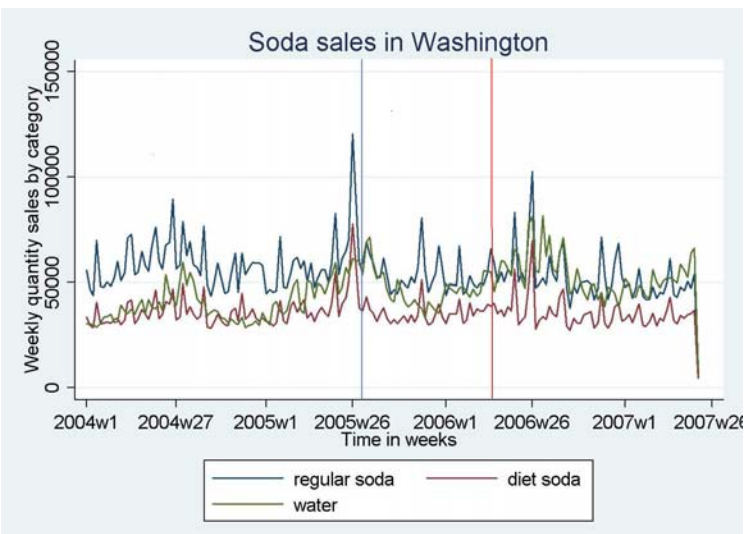

Figure 12. Washington State: Aggregate Weekly Soda Sales by Product Category

Note. Depicted are the series of aggregated weekly sales by product categories for 21 stores located in Washington State. Overall category sales for regular soda products and diet soda products are plotted against sales of bottled water. Vertical lines mark the introduction of wellness policies and the voluntary agreement reached with the beverage industry.

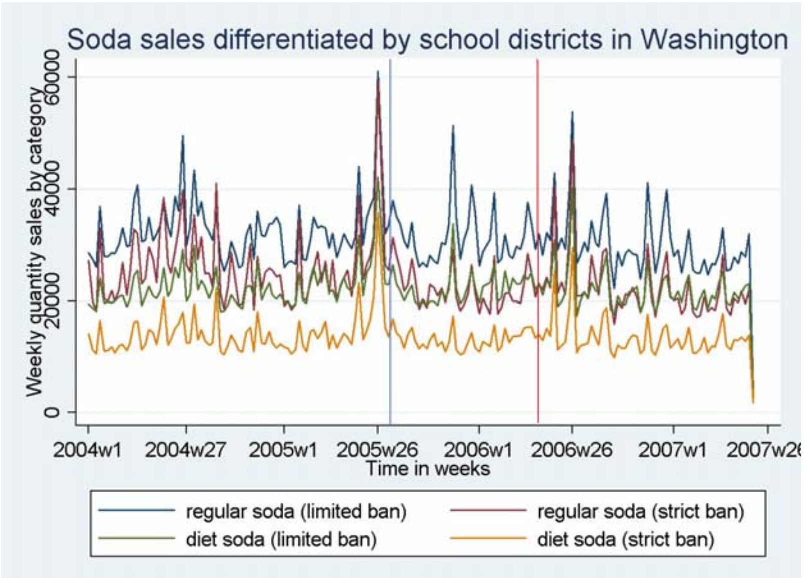

Figure 13. Washington State: Aggregate Weekly Soda Sales by Product Category and School Districts

Note. Depicted are the series of aggregated weekly sales by product categories for 21 stores located in Washington State, differentiated by strict versus limited soda bans at the school district level. Overall category sales for regular soda products and diet soda products are plotted against sales of bottled water. Vertical lines mark the introduction of wellness policies and the voluntary agreement reached with the beverage industry.