Using Retail Scanner Data to Evaluate the Economic Impacts of Local Sales Restrictions on Tobacco Products

ECONOMIC IMPACT ANALYSIS PROJECT

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EXECUTIVE SUMMARY

Study purpose

This study sought to evaluate the impacts of two types of local policies in California that restrict the sale of tobacco products: local sales restrictions on flavored tobacco products and local tobacco sales bans. To do so, the study combines a custom data set of NielsenIQ retail scanner sales data from April 28, 2018, to December 31, 2022, drawn from more than 3,000 California stores with state-of-the-art quasi-experimental methods that can reliably estimate the effects of the local policies. Outcomes include changes in the sale of tobacco product categories restricted under the policy, any tobacco product categories not restricted under the policy, smoking cessation products, non-tobacco products that reflect the broader economic impact on retailers, and tobacco products in border areas to assess cross-border shopping.

Overview of findings

Our findings indicate that flavored tobacco sales restrictions in 109 California cities led to a substantial decrease in the sale of all tobacco products by 8.4% on average, with a notable 27.7% reduction in flavored tobacco sales. While there was some substitution towards unflavored tobacco products (3.7% increase), it did not compensate for the decline in flavored tobacco sales. Moreover, there was no increase in tobacco product sales in nearby border areas, on average. Tobacco retailers did not experience a detectable decline in the sale of non-tobacco products.

First-in-the-nation policies that banned the sale of all tobacco products in Beverly Hills and Manhattan Beach resulted in cessation of tobacco sales in sample stores within six months, demonstrating high compliance rates with the policies. Our analysis reveals that the policies did not lead to significant cross-border shopping, indicating that the policies curtailed local sales without displacing it to neighboring areas. We observed no significant impacts on sales of non-tobacco products in Beverly Hills but a not statistically significant decrease in sales in Manhattan Beach, alleviating concerns about potential negative economic impacts on local retailers while also highlighting the potential variation in impacts of these policies across cities.

Conclusion

This study contributes valuable insights into the efficacy of local tobacco prevention and control policies, supporting their potential to significantly reduce tobacco consumption, often without displacing sales to nearby areas or negatively impacting the sale of other retail products. These findings are crucial for policymakers and public health officials as they consider the adoption and design of future tobacco prevention and control measures.

1. INTRODUCTION

A. Policy context

Across the United States (US), an increasing number of local and state governments are enacting sales restrictions on tobacco products, responding to public health concerns about the products' appeal to youth and their possible role in escalating rates of youth tobacco use nationally. California has been at the forefront of this movement. More than one-third of all US localities that had enacted restrictions on the sale of flavored tobacco products by 2022 were in California,[1] and in December 2022, California became the second state after Massachusetts to prohibit the sale of most flavored tobacco products, including flavored electronic nicotine devices (ENDS) and menthol cigarettes. Further, California is home to the first two cities in the US to prohibit the sale of any tobacco products: Beverly Hills and Manhattan Beach.

The imposition of local flavor sales restrictions often reflects two primary public health aims: 1) to curb the initiation of tobacco use among youth and young adults and 2) to reduce use of menthol cigarettes that may contribute to racial disparities in smoking.[2, 3] Flavored e-cigarettes may attract new, younger individuals and sustain nicotine addiction.[4, 5] These flavors, often mimicking fruits, candies, and menthol, diminish the harshness of tobacco and have been aggressively marketed as less harmful alternatives to traditional cigarettes, making them particularly enticing to adolescents.[6, 7] By restricting these products, communities aim to reduce the incidence of smoking initiation among youths, a crucial step in long-term tobacco control. While a number of studies have evaluated the effects of flavor restrictions and menthol bans on single states of jurisdictions and one national study, there have not been any comprehensive studies evaluating the effects of local sales restrictions in California using causal inference methodologies.[8-10] This evidence would be timely as California policymakers contemplate how to improve the effectiveness of the statewide restriction on flavored tobacco products.

Laws that restrict the sale of all tobacco products are a recent policy innovation in the US. In January 2021, Beverly Hills and Manhattan Beach became the first cities in the US to enact local tobacco sales bans. Studies have documented that affected retailers have generally opposed the law and have expressed concern about the anticipated impacts on their business.[11, 12] Despite the opposition, compliance in the two cities has been shown to be relatively high based on secret shoppers.[13] Yet, the economic impacts of the policies on policy-affected retailers and on policy evasion through cross-border shopping are not yet known.

B. Study objectives and overview

Because local and state policies that restrict the sale of tobacco products are an important component in the overall state effort to reduce tobacco use and the burden of tobacco-related disease, the California Department of Public Health (CDPH) is interested in tracking and evaluating the economic impacts of these policies. Policymakers and program administrators are also interested in understanding whether different program parameters and specific policies may modify the effectiveness of these policies, because this information can help the state and local government to develop or refine their tobacco prevention and control strategies.

To achieve these objectives, CDPH needs rigorous evidence on the impacts of tobacco policies. This study aimed to evaluate the effects of local sales restrictions on flavored tobacco products and local tobacco sales bans in California, analyzing changes in market dynamics in the lead-up to the statewide flavor policy, from April 2018 through December 2022. The research focuses on the resultant shifts in sales of both policy-affected flavored tobacco products and potential substitute products, as well as broader economic effects such as cross-border shopping and changes in the sale of non-tobacco products in policy-affected areas.

The study evaluates the effectiveness of local flavored tobacco and tobacco sales ban policies using a robust analytical framework that leverages a unique data set of retail sales from a wide array of retail establishments across California and employs advanced econometric models, including difference-in-differences analyses, to accurately quantify the impacts of these policies. Our analysis covers five critical areas to understand the broader impact of the local policies on consumer behavior and market shifts. These include: 1) the effect over time on unit sales of flavored tobacco product categories directly targeted by the sales restrictions, 2) the potential increase in sales of tobacco product categories not covered by the sales restrictions, 3) changes in the purchasing patterns of smoking cessation products, namely nicotine replacement therapy (NRT) products, 4) the propensity for cross-border shopping in neighboring areas without such sales restrictions, and 5) the overall effect on dollar sales of non-tobacco products within the local economies.

By quantifying the direct and indirect effects of the local policies, this study fills a crucial gap in the literature and offers valuable insights for policymakers seeking to enhance the efficacy of tobacco prevention and control measures. The findings not only contribute to the understanding of how local regulations affect tobacco sales patterns but also help in assessing the broader economic impacts, aiding in the formulation of more comprehensive public health policies that can effectively reduce tobacco use among vulnerable populations.

C. Plan for the report

Chapter II of this report introduces the data sources and methods of integrating and analyzing the data. Chapter III describes findings from the analysis of local policies that prohibited the sale of flavored tobacco products prior to the statewide policy, Senate Bill 793. Chapter IV describes the findings from the analysis of local policies that prohibit the sale of all tobacco products. The final chapter summarizes the main findings and discusses the implications for state and local policymakers and administrators.

2. DATA AND METHODS

A. Data sources

The integrated database for our analysis includes store-level data and geocoded policy and demographic data by ZIP code and city.

The store-level data were drawn from a custom retail scanner data set from NielsenIQ. Nielsen retail scanner data consist of weekly pricing, volume, and store merchandising conditions generated by participating retail store point-of-sale systems in US markets. Nationwide, Nielsen collects data from approximately 35,000 participating grocery, drug, mass merchandising, and other stores. Products from Nielsen-tracked categories include food, non-food grocery items, and select general merchandise.

The University of California, San Francisco, licensed a custom store-level data set for all available stores located in California. It contains monthly item-level data on all items within each of the tobacco and tobacco alternatives supercategories from April 1, 2018, through December 31, 2022. Thus, each row in the data set includes information about a single item sold at a given store during a given quad-week (month). Stores primarily consist of convenience stores (including those with gas stations), grocery stores, and drug stores. The tobacco supercategory includes items in the following categories: cigarettes, cigars, smokeless tobacco, and pipe tobacco. The tobacco alternatives supercategory includes items in the following categories: ENDS (including e-cigarettes) and NRT products (including nicotine gum, lozenge, and patch).

Nielsen monitors weekly sales from barcode scans of thousands of products sold from a panel of retailers nationwide, including drug stores, mass merchandisers, convenience stores, and grocery stores. Nielsen's retail scanner data include approximately 60% of all cigarette sales in California, calculated from a tax gap analysis [14]. Our data include a subset of California retailers that granted prior approval for Nielsen to share their store-level data, which constitute approximately 16% of all cigarette sales in California. The analytic data set excludes sales that occur at independent retailers, including tobacco specialty stores (e.g., smoke shops and vape shops), as well as sales made online. We use the exact address of stores to identify those located in border areas, as described below. Data are provided at the individual product level based on each product's unique universal product code (UPC) and contained quad-weekly, hereafter "monthly," store-level unit and dollar sales of each product purchased.

In addition to the UPC-level tobacco data, Nielsen provided total sales for each store department, except alcohol and pet supplies, from each retailer in our sample. Departments are the highest level of the product hierarchy and include 12 different categories, such as general merchandise, health and beauty care, and frozen food (details in Section B.3). We used the 3 totals to assess whether the local policies affected non-tobacco sales at policy-exposed retailers.

Policy exposure data were drawn from the Policy and Evaluation Tracking System (PETS) database, maintained by the American Nonsmokers' Rights Foundation.[15] Demographic data by ZIP code and city were drawn from the Decennial Census and the American Community Survey, both maintained by the US Census Bureau.

B. Measures

Tobacco product classification

Tobacco and nicotine-containing products were classified into five categories: 1) cigarettes, 2) cigars, including big cigars, little cigars, and cigarillos, 3) smokeless tobacco, 4) ENDS, including e-cigarettes and other nicotine vaping products, and 5) NRT, such as nicotine gum. Each UPC is further classified as a flavored or unflavored product based on product information provided by Nielsen. "Flavored" tobacco products include menthol cigarettes, sweet cigar, fruit flavored cigar, alcohol flavored cigar, menthol e-cigarette, fruit flavored e-cigarette, menthol smokeless tobacco, fruit flavored smokeless tobacco, as well as concept flavors that do not fit within the aforementioned categories. "Unflavored" tobacco products refer to any tobacco products that are listed as unflavored or tobacco flavored. Flavor attributes were coded by NielsenIQ from external product packaging and then hand-coded into the categories above by the research team. In the local flavor policy analysis, we separately analyzed the effect on menthol products and non-menthol products. We note that newer non-menthol products, such as synthetic coolants, were not commonly marketed until after the end of our study period in November 2022.

Policy exposure

Local flavored tobacco sales restrictions in California were obtained from the PETS database, maintained by the American Nonsmokers' Rights Foundation and funded by CDPH. PETS provided information for the municipality and effective date of each local policy, and whether the local ordinance covered menthol products, menthol cigarettes, combustibles (including cigarettes and cigars), non-combustibles (including smokeless tobacco), and ENDS. We used this information to classify policies into four categories: 1) any policy that restricted flavored tobacco products, regardless of tobacco product type, 2) policies restricting flavored ENDS only, 3) policies restricting flavored ENDS, combustibles (including cigarettes and cigars), and smokeless tobacco, and 4) policies restricting menthol flavored tobacco products. Categories 2-4 are each a subset of Category 1, and Categories 2 and 3 may have also restricted menthol products. Category 4 includes any policy that restricted menthol cigarettes, which always included restrictions on other menthol tobacco products too (87% restricted all menthol products, 9 restricted some other menthol products, and 3 restricted all menthol products except at certain locations). The local policies were heterogeneous in nature, and may include exemptions for certain subsets of products.

Details about local tobacco sales bans were drawn from the existing literature.[11-13] Beverly Hills' ordinance was enacted in June 4, 2019, and was effective January 1, 2021. It provided for temporary exemptions for retailers demonstrating economic hardship and permanent exemptions for hotel concierges and existing cigar bars. Manhattan Beach's ordinance was enacted February 18, 2020, and was effective January 1, 2021. It similarly offered temporary hardship exemptions, which expired on or before December 31. 2021.

For assessing cross-border shopping, we define border areas as areas that are adjacent to a city with a local sales restriction of interest. For the local flavor analysis, border areas refer to border cities. For the local tobacco sales ban analysis, border areas refer to border ZIP codes, because Manhattan Beach and Beverly Hills are adjacent to Los Angeles, and using all of Los Angeles as a potentially exposed border area would have resulted in substantial misclassification.

Outcomes

The main analyses of local flavor policies focus on unit sales of all tobacco products in "targeted" product categories, as well as unit sales of flavored products in the targeted categories, unit sales of unflavored products in targeted categories, unit sales of substitute tobacco product categories, and unit sales of NRT products. Targeted product categories refer to product categories for which flavored products are restricted under the local policy. In the case of any policy or a comprehensive policy, targeted products correspond to tobacco products across all product categories. In the case of ENDS-only policies, targeted products correspond to ENDS only.

The main analyses of local tobacco sales ban policies focus on unit sales of all tobacco products, as well as unit sales by tobacco product category and unit sales of NRT products.

In investigating sales of non-tobacco outcomes, we analyze total non-tobacco dollar sales and dollar sales for each of 12 departments: baby care, bakery, dairy, deli, frozen, general merchandise, grocery, health and beauty care, household care, meat, produce, and seafood. Total non-tobacco dollar sales are calculated as the sum of the above non-tobacco categories.

Covariates

We collected demographic characteristics of each city from the 2010 Census, including population, race and ethnicity (coded as the percentage non-Hispanic White, non-Hispanic Black, Asian, and Hispanic), and median household income.

C. STATISTICAL METHODS

Analysis of local flavor sales restrictions

Main analysis of tobacco sales

We use a difference-in-differences regression framework to examine the effects of local flavored tobacco sales restrictions in California on the sale of tobacco products. Difference-in-difference estimation compares the average change in outcomes in the treated group and that in the comparison (control) group. The treated group is comprised of cities that have a local flavored tobacco sales restriction, while the control group consists of cities that do not have a flavored tobacco sales restriction. We leverage the variation across cities and over time in the presence of flavored tobacco sales restrictions using the following two-way fixed effects setup:

$$Y_{ct} = \beta_0 + \beta_1(Policy_c \times Post_t) + \phi_t + \alpha_c + \varepsilon_{ct} \tag{1}$$

where Y_{ct} indicates the outcome for city c in month t. Outcomes, as described above, include total unit sales of all targeted tobacco products, total unit sales of targeted flavored and unflavored products, and total unit sales by product category. $Policy_c$ equals one if the city c has a local flavored tobacco sales restriction in effect and zero otherwise. $Post_t$ equals one if it is after the effective date of the policy. ϕ_t represents month-year fixed effects, and α_c denotes city fixed effects. The month-year fixed effects account for secular trends (period-specific events) that are common to all cities (e.g., the COVID-19 pandemic and state tobacco taxes), and the city fixed effects account for all city characteristics that do not vary during the study period. Thus, a main threat to validity of this approach would be other factors (e.g., other tobacco policies) that vary over time differentially among cities in the treated group. The coefficient of interest is β_1, which identifies the difference-in-differences estimate of the effect of local flavor policies. Standard errors are clustered at the city level to account for correlated outcomes within each city over time.

For estimates of cross-border shopping, Equation 1 is modified to define the policy exposure as cities that border a city with a local flavored sales restriction policy. Border cities that themselves adopt a flavor policy are retained in the data until the month in which their policy is implemented. Other cities with a flavor policy are dropped from the analysis.

Event study difference-in-differences

To examine how the effects of local flavor policies change over time, we estimated event study difference-in-differences analyses of the time-varying relationship between policy exposure and our outcomes of interest. An important assumption of difference-in-differences is that before-after differences in outcomes would be the same in the intervention and comparator groups in the absence of the policy. While this “parallel trends” assumption is not directly testable, we followed the literature to assess whether pre-policy outcome trends were parallel between treated and control groups by testing the significance of pre-policy coefficients in the event studies.[16, 17]

We generated event study plots of the treatment effects at each time point (vertical axis) versus month centered relative to time of treatment such that the month of first treatment equals zero (horizontal axis). The event study plots allow for visual inspection of parallel trends and dynamic treatment effects.[18] We restricted this analysis to 20 months prior to and 34 months after the policy's effective date, in order to improve comparability between policies implemented at different dates and thus with a different pre- and post-period duration.

Callaway-Sant'Anna difference-in-differences

Growing economics literature suggests that standard difference-in-differences models may suffer from bias in the presence of variation in treatment timing, such as staggered adoption of policies.[19-23] The difference-in-differences approach developed by Callaway and Sant'Anna is one of the leading, recently developed methods to address the potential biases that occur with standard difference-in-differences in the presence of treatment timing variation. The Callaway-Sant'Anna approach has also been shown to require weaker assumptions than certain alternatives.[22] Further, the Callaway-Sant'Anna difference-in-differences estimator is able to incorporate a "doubly robust" approach with inverse probability weighting that can help meet the so-called parallel trends assumption of difference-in-differences analysis.[24, 25] We, therefore, use the doubly robust version of the Callaway-Sant'Anna estimator as our estimation strategy, adjusting for several city-level characteristics drawn from the 2010 Census: total population, mean household income, percent Hispanic, percent non-Hispanic Black, percent non-Hispanic White, percent non-Hispanic Asian, and percent "other" race/ethnicity. To make this more computationally intense model tractable, we estimate it using quarterly data.

As with standard difference-in-differences models, the Callaway-Sant'Anna model assumes parallel outcome trends between treated and control units. We conducted event study difference-in-difference models, described above, to test parallel pre-policy outcome trends as suggestive evidence of this assumption.

<u>Analysis of local tobacco sales ban policies</u>

We used sales data from April 1, 2018, through December 31, 2022, which covered 32 months prior and 24 months subsequent to the tobacco sales ban policy effective dates in Beverly Hills and Manhattan Beach. To assess cross-border shopping, border areas were creating using the zip codes contiguous with Beverly Hills and Manhattan Beach. The border area for Beverly Hills included 90024, 90035, 90046, 90048, 91423, 91604, and 90069. The border area for Manhattan Beach included 90245, 90250, 90254, 90261, and 90278. For cities with at least one zip code classified as a border area, the remaining zip codes in that city contributed data to the untreated unit. Sales data were aggregated quarterly for each geographic unit of analysis. Tobacco unit sales were categorized as cigarettes, cigars, smokeless tobacco, ENDS, and the sum of all tobacco products included in these four categories. We also analyzed the sale of NRT products. To increase the comparability of outcomes in the treated cities with those in the donor pool of control cities, we calculated the tobacco and NRT outcomes as the store average within each city or border area.

We analyzed the dollar sales of non-tobacco products as an indicator of the broader impacts of the local policies on the retail environment.

We used American Community Survey five-year estimates from 2017–2022 for population size, median income, and racial and ethnic composition.

Synthetic difference-in-differences analysis

The analysis uses the recently developed synthetic difference-in-differences (SDID) estimation approach.[26] SDID brings together the strengths of difference-in-differences and synthetic control methods. Similar to synthetic control analysis, SDID is a data-driven approach that applies weights to control units in order to construct a weighted average of all potential control (non-treated) localities that best match the treated area on both the pre-treatment outcome and a set of prognostic factors.[27] SDID thereby constructs a counterfactual outcome for what would have happened to the treated area in the absence of treatment. Doing so relaxes the parallel trends assumption required under a standard difference-in-differences approach. SDID adds time weights that align pre-exposure trends in the outcome of unexposed units with those for exposed units. SDID has been shown to have excellent performance compared with synthetic control and alternative approaches in terms of bias and root-mean-squared error,[26] is feasible when the parallel trends assumption is not met, and relaxes the "convex hull condition" for synthetic control analyses that requires mean outcomes of treated units to be within the distribution of the control data. Our SDID model includes fixed effects (i.e., indicators) for geographic area (city or border ZIP code) and year-month, thereby adjusting for all time-invariant city characteristics and secular trends.

Synthetic control methods have previously been used to evaluate tobacco control programs and policies in California, including Proposition 99 and the 2017 cigarette tax increase.[27, 28] SDID is a state-of-the-art approach that has yet to be used in the tobacco prevention and control literature, to our knowledge.

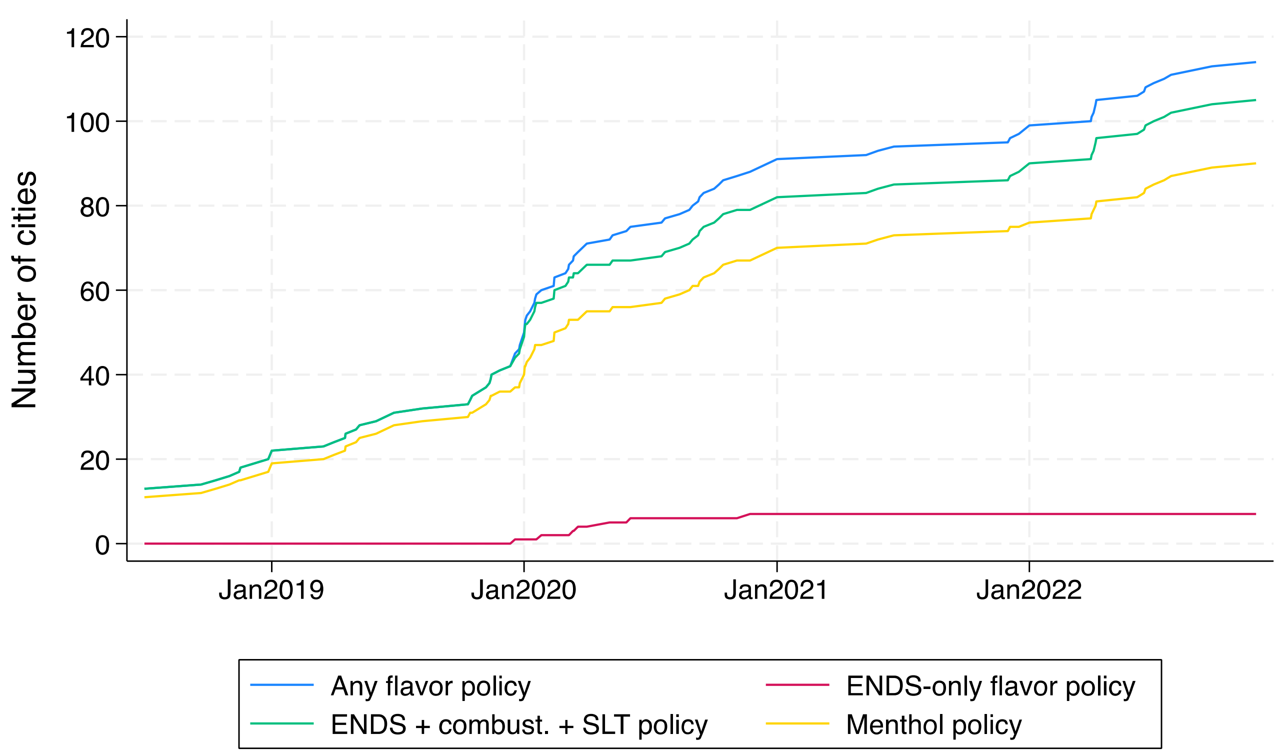
Statistical inference for SDID can be done in several ways. However, with only two treated units, only the permutation-based approach is feasible. Under this approach, placebo estimates were generated for randomly sampled cities in the donor pool of control cities as if that sampled city had been subject to a tobacco sales ban policy. The placebo estimate factors in the unit and time weights used to construct the synthetic control according to the algorithm specified by Arkhangelsky and colleagues.[26] We repeated this procedure for 50 iterations. A standard deviation of the placebo estimates is used to generate 95% confidence intervals and corresponding event study plots. In sensitivity testing, we tested the robustness of the estimates to use of 250 iterations.

3. RESULTS FOR LOCAL FLAVOR SALES POLICIES

A. Summary statistics

Figure 1 shows the change in the total number of California cities that had implemented a local flavor restriction from April 2018 through November 2022. We show this change over time in count for: (1) cities with any flavor sales restriction policy (in blue), (2) cities with a flavor sales restriction of ENDS products only (in red), (3) cities with a flavor sales restriction of ENDS, combustible tobacco, and smokeless tobacco products (in green), and (4) cities with a flavor sales restrictions of menthol tobacco products. By November 2022, 114 cities in California had put into effect a flavored tobacco sales restriction, seven of which restricted ENDS only, 105 of which restricted ENDS, combustibles, and smokeless tobacco, and 90 of which restricted menthol products. Thus, most cities with a flavor policy regulated ENDS, combustibles, and smokeless tobacco products, including menthol products. Only a handful of policies focused on flavored ENDS only. There was a steady increase in implementation of local flavor policies over this time period.

Figure 1. Cumulative number of cities with local flavor policies in effect, 2018-2022



Note: Data provided by PETS (https://pets.tcspartners.org/).

The total number of stores overall and by store type (convenience, grocery, drug) used in the analysis of local flavor sales restrictions are shown in Figure 2. Overall, the analysis includes 3,248 stores, including convenience stores, grocery stores, and drug stores. Most stores in the analytic sample (n = 2,284) are located in a city without a local flavor policy during the study period, including 1,220 convenience stores, 726 grocery stores, and 338 drug stores. The treated group (with a local flavor policy) constitutes 964 stores, including 458 convenience stores, 359 grocery stores, and 147 drug stores. Thus, convenience stores, including those at a gas station were the most common store type, followed by grocery stores and then drug stores.

Figure 2. Count of stores used in the local flavor policy analysis by store type

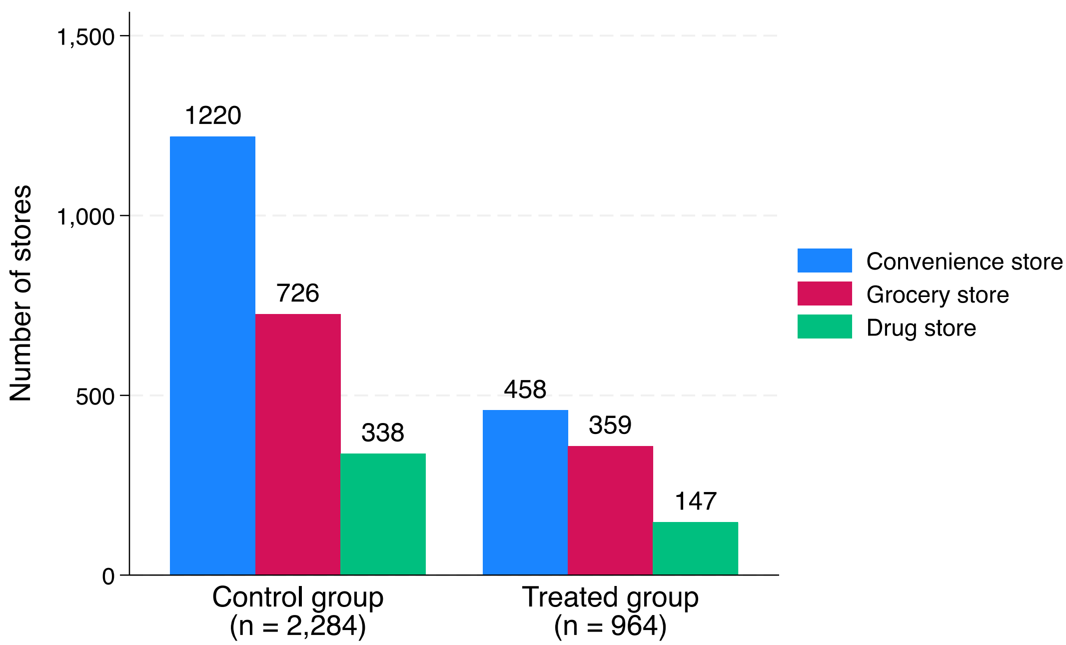
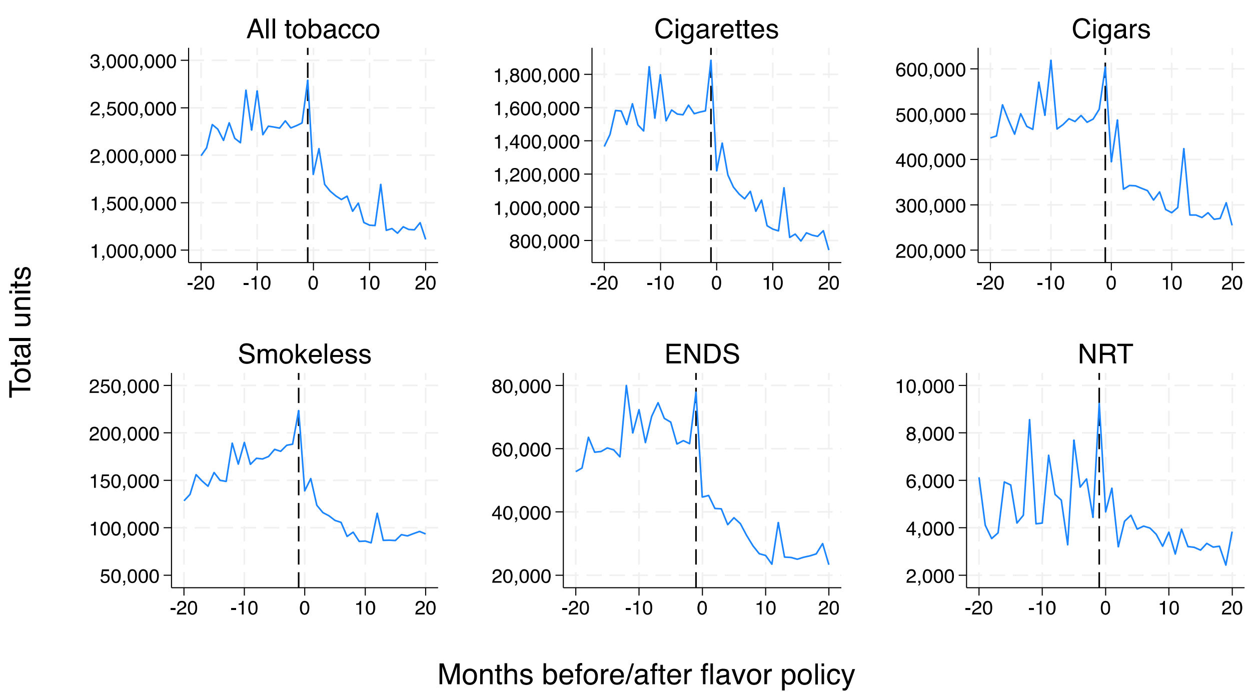


Figure 3 displays the trends in unit sales of tobacco product categories (the sum of all tobacco products, cigarettes, cigars, smokeless tobacco, and ENDS) and NRT products among cities that adopted a local flavor policy from 20 months prior to and 20 months following implementation of each local policy. Because sales in the control group are not shown, these trends are descriptive, not causal. The dashed vertical line represents the effective date for the flavor policy. The horizontal axis is scaled to be in "event time," such that month zero was the date that the flavor policy took effect. The vertical axis represents total unit sales for each tobacco category. For each tobacco product category except NRT, there is a sharp decline immediately after the flavor policy went into effect. Sales then continued to decline slowly and stabilize at a lower level than before the policy took effect. NRT products shows a slightly different trend, such that sales remain relatively constant after the policy took effect. Flavored NRT products were not subject to any restrictions under the local flavor policies.

Table 1 presents descriptive statistics for the main outcome variables and demographic variables across the whole sample, control group and treated group. The treated group, on average, shows higher unit sales for total tobacco products and for each tobacco category when compared to the control group. This likely reflects the fact that many of the most populous cities in California—including six of the top seven (all but Fresno)—had adopted a local flavor sales restriction policy. For example, the average unit sales of total tobacco products for the treated group was 25,932 per month, compared with 21,246 for the control group. The racial/ethnic composition of cities in the treated and control groups were somewhat similar, although treated cities had more Asian people (14.1% vs. 10.2%) and fewer Hispanic people (28.2% vs. 36.5%). Median household income was, on average, higher in the treated group ($111,823) than in comparison to the control group ($88,364).

The analysis included 5,077 unique tobacco or NRT products, drawn from 3,248 stores located in 528 cities. The treated group was comprised of 110 cities.

Figure 3. Trend in unit sales of tobacco and NRT products in treated cities, by month



Note: This figure shows trends in unit sales of tobacco and NRT products over time among cities that had a local flavor sales restriction policy. Time is rescaled to be zero in the month that the policy went into effect.

Table 1. Summary statistics

	Control	Treated	Total
Mean monthly unit sales, all tobacco	21,246 (22,631)	25,932 (57,964)	22,437 (35,209)
Mean monthly unit sales, by category			
Cigarettes	12,646 (14,636)	15,899 (36,417)	13,435 (22,036)
Cigars (big, little)	3,920 (5,740)	5,388 (15,516)	4,281 (9,188)
Smokeless tobacco	2,312 (2,449)	2,026 (3,816)	2,239 (2,866)
ENDS	546 (680)	629 (1,553)	568 (991)
NRT	64 (79)	130 (262)	81 (153)
Race/ethnicity (%)			
Non-Hispanic White	46.0 (23.0)	49.9 (24.7)	47.0 (23.5)
Non-Hispanic Black	4.4 (5.4)	4.8 (7.0)	4.5 (5.8)
Asian	10.2 (12.2)	14.1 (13.2)	11.2 (12.5)
Hispanic	36.5 (22.8)	28.2 (21.9)	34.4 (22.8)
Median household income ($)	2.9 (1.3)	3.1 (1.2)	2.9 (1.3)
Population	88,364 (29,587)	111,823 (40,319)	94,246 (34,160)
Number of UPCs	4,914	3,998	5,077
Number of stores	2,284	964	3,248
Number of cities	418	110	528

Note: Standard deviations are shown in parentheses. The control group is composed of cities that do not have local flavored tobacco sales restrictions, while the treated group includes cities that have such restrictions on local flavored tobacco sales. Mean monthly unit sales refers to the monthly average of all sales that occurred from April 1, 2018, through December 31, 2022. Race/ethnicity is presented as percentages of the total population.

B. Policy effects on tobacco and NRT product sales

Table 2 shows the effects of local flavored tobacco sales restrictions on the sale of tobacco and NRT products from the main two-way fixed effects models. We find that any local flavor policy going into effect significantly reduced the sale of all tobacco products by 8.4% on average (95% CI: -11.6 to -5.3). There was a significant 27.7% decline in flavored tobacco products (95% CI: -36.9 to -18.5) and a smaller, partially offsetting 3.7% increase in unflavored tobacco products that was also statistically significant (95% CI: 0.6 to 6.8). Thus, it appears that some consumers substituted from flavored products to unflavored products post-policy, although this was outstripped by the decrease in sale of flavored products by approximately 2,500 units per store per month, on average. Following any local flavor policy going into effect, sales significantly decreased for all tobacco product categories, including a 6.7% decline for cigarettes (95% CI: -10.4 to -3.0), 8.9% decline for cigars (95% CI: -14.3 to -3.5), 23.2% decline for smokeless tobacco (95% CI: -30.0 to -16.4), and a 25.1% decline for ENDS (95% CI: -32.2 to -17.9). NRT product sales increased by a non-significant 0.4% (95% CI: -9.5 to 10.3), implying that local flavor policies did not lead large numbers of consumers to seek out smoking cessation aids.

Table 2. Effects of any local flavor policy on unit sales of tobacco and NRT products

	Among targeted product categories			By product category				
	All	Flavored	Unflavored	Cigarettes	Cigars	SLT	ENDS	NRT
ATT	-2479.0***	-3150.7***	665.2**	-1392.4***	-548.3***	-483.3***	-211.4***	0.4
	(473.0)	(532.5)	(284.3)	(395.5)	(171.0)	(72.5)	(30.8)	(5.2)
No. obs.	31,608	31,442	31,605	31,454	29,962	27,663	27,703	6,086
Mean DV	29,377.9	11,360.9	18,029.5	20,803.0	6,160.3	2,084.6	842.8	102.0
ATT as % change	-8.4	-27.7	3.7	-6.7	-8.9	-23.2	-25.1	0.4
	[-11.6, -5.3]	[-36.9, -18.5]	[0.6, 6.8]	[-10.4, -3.0]	[-14.3, -3.5]	[-30.0, -16.4]	[-32.2, -17.9]	[-9.5, 10.3]

Note: This table shows the effect of cities implementing any policy restricting flavored tobacco products (n=109), compared with cities without one (n=417). Targeted products refer to product categories regulated by the flavor policy. Estimates are derived from two-way fixed effects models with fixed effects for city and month. Data from April 2018 through November 2022 are collapsed to the city-by-month level. Robust standard errors, clustered at city level, are shown in parentheses below estimates. ATT = average treatment effect on the treated. Mean DV = mean dependent variable of the treated group during the pre-policy period. ATT as % change = the ATT expressed as a percent change relative to the mean DV, with its 95% CI in brackets below. SLT = smokeless tobacco. Significance: * p<0.10 ** p<0.05 *** p<0.01

Table 3 shows the effects of local flavor policies that restricted the sale of ENDS only. As noted in Figure 1, this constitutes only six cities. Thus, these models have lower statistical power, and arise from a small, potentially nonrepresentative group of treated cities. Among treated cities with a local ENDS-only flavor policy, we find substantial, non-significant decreases in the sale of ENDS products (the targeted category) of 43.6% (95% CI: -97.9 to 10.6). Both flavored and unflavored ENDS decreased, with flavored ENDS decreasing by a significant 49.0% (95% CI: -102.7 to 4.6), suggesting that consumers in these communities did not switch to unflavored or tobacco-flavored ENDS. The coefficients on cigarettes, cigars, and smokeless tobacco are positive, implying some degree of substitution, although none of the coefficients are statistically significant. In further analyses, we found that the increase in sales of cigarettes, cigars, and smokeless tobacco occurred among both flavored and unflavored products, with somewhat larger effect sizes among flavored products. Counterintuitively, NRT product sales in treated cities had a statistically significant decline following a local ENDS-only policy going into effect.

Table 4 shows the effects of more comprehensive local policies that regulated the sale of flavored ENDS, combustible products, and smokeless tobacco. These cities, which constitute the vast majority of all local flavor policies (n=101), therefore follow a similar pattern of results as cities that put into effect any type of flavor policy. Following a more comprehensive policy going into effect, the sale of all tobacco products fell by a significant 9.0% (95% CI: -11.9 to -6.2), slightly larger than the effect found for any flavor policy. The sale of flavored tobacco products decreased by 28.1% (95% CI: -35.9 to -20.3) and the sale of unflavored tobacco products increased by 2.9% (95% CI: 0.1 to 5.7), both coefficients statistically significant. As observed for any flavor policy, the decline in flavored tobacco products is greater than the increase in unflavored products. Estimates by tobacco and NRT product categories are very similar to those in Table 2.

Table 3. Effects of local ENDS-only flavor policies on unit sales of tobacco and NRT products

	Among targeted product categories			By product category				
	All	Flavored	Unflavored	Cigarettes	Cigars	SLT	ENDS	NRT
ATT	-272.5	-225.1*	-51.8	853.3	435.5	394.0	-272.5	-13.6***
	(172.9)	(125.7)	(56.8)	(1160.4)	(560.5)	(280.0)	(172.9)	(3.2)
No. obs.	21,589	20,936	21,417	25,327	24,126	22,293	21,589	4,752
Mean DV	624.7	459.0	165.7	9,258.3	2,105.9	1,347.5	624.7	22.4
ATT as % change	-43.6	-49.0	-31.3	9.2	20.7	29.2	-43.6	-60.6
	[-97.9, 10.6]	[-102.7, 4.6]	[-98.4, 35.9]	[-15.3, 33.8]	[-31.5, 72.8]	[-11.5, 70.0]	[-97.9, 10.6]	[-88.5, -32.7]

Note: This table shows the effect of cities implementing a policy restricting flavored ENDS only (n=6), compared with cities without one (n=411). Targeted products refer to product categories regulated by the flavor policy. Estimates are derived from two-way fixed effects models with fixed effects for city and month. Data from April 2018 through November 2022 are collapsed to the city-by-month level. Robust standard errors, clustered at city level, are shown in parentheses below estimates. ATT = average treatment effect on the treated. Mean DV = mean dependent variable of the treated group during the pre-policy period. ATT as % change = the ATT expressed as a percent change relative to the mean DV, with its 95% CI in brackets below. SLT = smokeless tobacco. Significance: * p<0.10 ** p<0.05 *** p<0.01

Table 5 shows the effects of local policies that restricted the sale of menthol tobacco products. This, too, follows a similar pattern to the results for any flavored policy going into effect. We disaggregate the change in sales for menthol products, flavored non-menthol products, and unflavored products. We find that sales significantly decreased for both menthol products (-30.9%, 95% CI: -43.2 to -18.6) and flavored non-menthol products (-27.7%, 95% CI: -36.1 to -19.3) following policy adoption, due in part to the fact that the policies restricting menthol often regulated other flavored products too. Unflavored products significantly increased by a partially offsetting 3.4% (95% CI: 0.1 to 6.6). When we break down the estimates for menthol policies by flavored and unflavored products across different product categories (
Table 6), we find that sales of menthol cigarettes decreased by 30.5% (95% CI: -43.3 to -17.6) and sales of non-menthol cigarettes increased by 1.8% (95% CI: -0.5 to 4.2), leading to the overall decline in cigarette sales of 7.7% reported in Table 5; only the first and third coefficients are statistically significant.

Figure 4 shows the change over time in the effect of having any local flavor policy on tobacco and NRT product sales. These estimates are expressed as percent changes relative to the sales in the treated group during the month prior to a policy going into effect and were derived from event study difference-in-differences models. The event study estimates are consistent with the overall effects described above. In particular, the difference in overall tobacco sales grows between the treated and control groups over time. This overall decline is driven by a decline in the sale of flavored tobacco products that were targeted by the policy. The sale of unflavored products increased somewhat following a policy going into effect, though by a smaller magnitude than the decline in targeted flavored products, hence resulting in an overall decline. All tobacco product categories experienced a decline in sales following the effective date of any local flavored policy, although the decline is not significant in most months for cigarettes and cigars. The sales decline is greatest for smokeless tobacco products, such that sales declined by approximately 30-40% two years after a flavor policy's effective date. ENDS sales declined by a magnitude of approximately 20%. In contrast, NRT product sales remained flat following the effective date of any flavor policy.

Table 4. Effects of local flavor policies restricting ENDS, combustible tobacco, and smokeless tobacco on unit sales of tobacco and NRT products, by policy type

	Among targeted product categories			By product category				
	All	Flavored	Unflavored	Cigarettes	Cigars	SLT	ENDS	NRT
ATT	-2678.2***	-3209.4***	523.9**	-1369.1***	-705.4***	-576.8***	-211.5***	0.9
	(428.8)	(453.4)	(262.3)	(326.5)	(171.9)	(65.1)	(30.5)	(5.3)
No. obs.	31,120	30,954	31,117	30,966	29,474	27,175	27,219	6,001
Mean DV	29,606.8	11,424.5	18,195.9	20,928.9	6,267.5	2,116.9	852.0	105.4
ATT as % change	-9.0	-28.1	2.9	-6.5	-11.3	-27.2	-24.8	0.8
	[-11.9, -6.2]	[-35.9, -20.3]	[0.1, 5.7]	[-9.6, -3.5]	[-16.6, -5.9]	[-33.3, -21.2]	[-31.8, -17.8]	[-9.0, 10.7]

Note: This table shows the effect of cities implementing a policy restricting flavored ENDS, combustible tobacco, and smokeless tobacco products (n=101), compared with cities without one (n=417). Targeted products refer to product categories regulated by the flavor policy. Estimates are derived from two-way fixed effects models with fixed effects for city and month. Data from April 2018 through November 2022 are collapsed to the city-by-month level. Robust standard errors, clustered at city level, are shown in parentheses below estimates. ATT = average treatment effect on the treated. Mean DV = mean dependent variable of the treated group during the pre-policy period. ATT as % change = the ATT expressed as a percent change relative to the mean DV, with its 95% CI in brackets below. SLT = smokeless tobacco. Significance: * p<0.10 ** p<0.05 *** p<0.01

Table 5. Effects of local flavor policies restricting menthol products on unit sales of tobacco and NRT products

	Among targeted product categories				By product category				
	All	Menthol	Other flavored	Unflavorec	Cigarettes	Cigars	SLT	ENDS	NRT
ATT	-1568.3***	-2278.8***	-1659.7***	704.9**	-1863.9***	-698.5***	-616.6***	-218.7***	-2.7
	(391.9)	(463.4)	(256.0)	(351.3)	(490.0)	(214.4)	(68.2)	(34.3)	(4.6)
No. obs.	30,144	29,973	28,613	30,141	29,990	28,563	26,416	26,253	5,765
Mean DV	28,337.0	7,371.8	5,988.3	20,983.6	24,336.1	7,342.6	2,342.7	965.1	122.2
ATT as % change	-5.5	-30.9	-27.7	3.4	-7.7	-9.5	-26.3	-22.7	-2.2

	[-8.2, -2.8]	[-43.2, -18.6]	[-36.1, -19.3]	[0.1, 6.6]	[-11.6, -3.7]	[-15.2, -3.8]	[-32.0, -20.6]	[-29.6, -15.7]	[-9.7, 5.2]

Note: This table shows the effect of cities implementing a policy restricting menthol products (n=85), compared with cities without one (n=417). Targeted products refer to product categories regulated by the flavor policy. Estimates are derived from two-way fixed effects models with fixed effects for city and month. Data from April 2018 through November 2022 are collapsed to the city-by-month level. Robust standard errors, clustered at city level, are shown in parentheses below estimates. ATT = average treatment effect on the treated. Mean DV = mean dependent variable of the treated group during the pre-policy period. ATT as % change = the ATT expressed as a percent change relative to the mean DV, with its 95% CI in brackets below. SLT = smokeless tobacco. Significance: * p<0.10 ** p<0.05 *** p<0.01

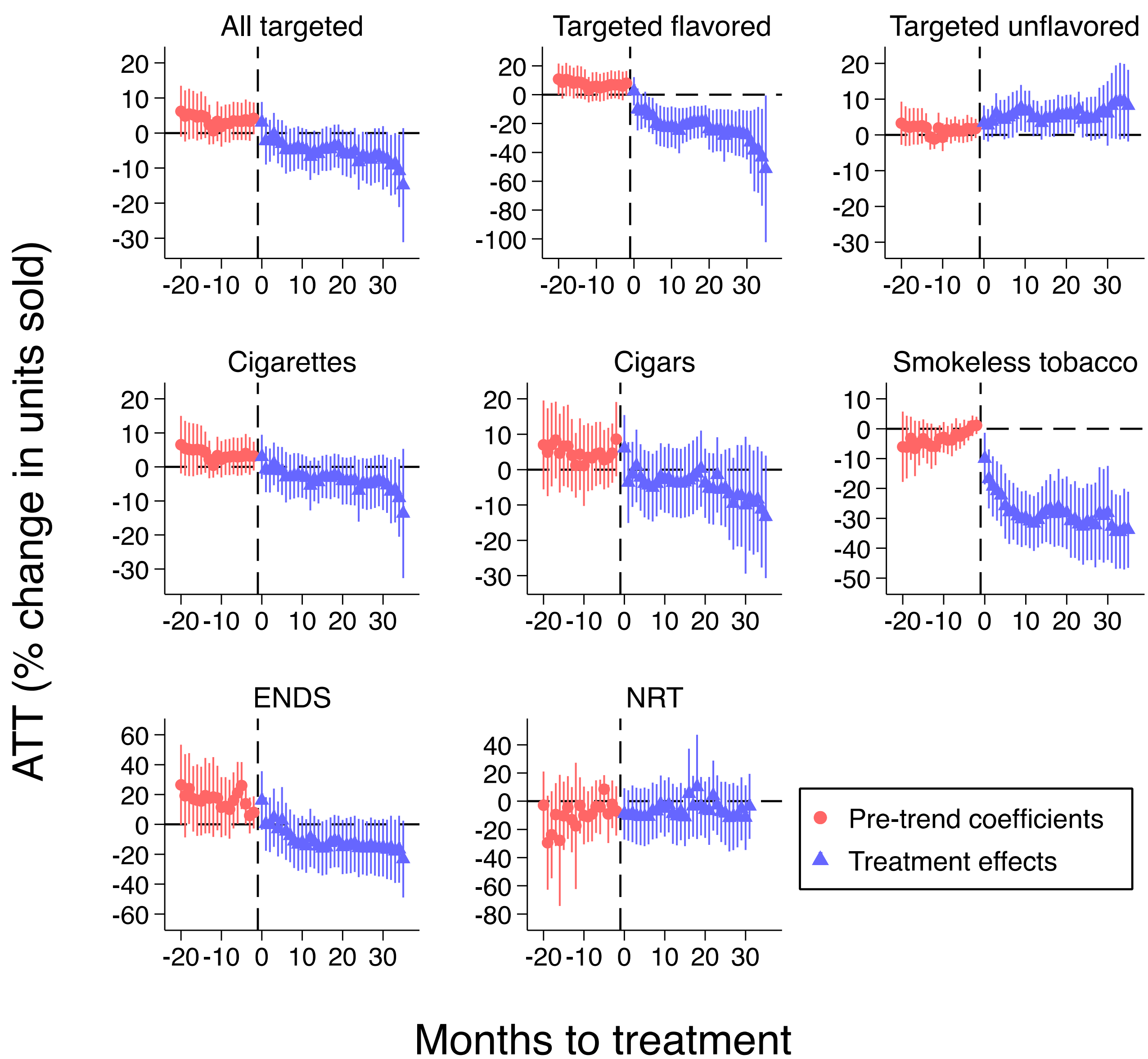
Table 6. Effects of local policies restricting menthol products on unit sales of flavored and unflavored tobacco products across different product categories

	Cigarettes		Smokeless tobacco			ENDS		
	Menthol	Unflavored	Menthol	Other flavored	Unflavored	Menthol	Other flavored	Unflavored
ATT	-2187.3***	311.1	-31.9*	165.5***	-816.8***	-174.7***	3.5	-58.0
	(471.1)	(206.3)	(16.3)	(40.9)	(69.0)	(22.3)	(32.8)	(40.1)
No. obs.	29,927	29,987	7,390	26,003	25,083	24,691	26,051	24,233
Mean DV	7,181.6	17,169.6	15.6	454.6	1,990.3	262.5	380.3	335.0
ATT as % change	-30.5	1.8	-205.0	36.4	-41.0	-66.6	0.9	-17.3
	[-43.3, -17.6]	[-0.5, 4.2]	[-410.7, 0.6]	[18.8, 54.0]	[-47.8, -34.2]	[-83.2, -49.9]	[-16.0, 17.9]	[-40.7, 6.1]

Note: This table shows the effect of cities implementing a policy restricting menthol products (n=85), compared with cities without one (n=417). Estimates are derived from two-way fixed effects models with fixed effects for city and month. Data from April 2018 through November 2022 are collapsed to the city-by-month level. Robust standard errors, clustered at city level, are shown in parentheses below estimates. ATT = average treatment effect on the treated. Mean DV = mean dependent variable of the treated group during the pre-policy period. ATT as % change = the ATT expressed as a percent change relative to the mean DV, with its 95% CI in brackets below. SLT = smokeless tobacco. Significance: * p<0.10 ** p<0.05 *** p<0.01

The event study plots also provide information about the extent to which there might be violations of the so-called parallel trends assumption upon which difference-in-differences estimates rest. This assumption requires that outcome trends are similar across groups in the counterfactual scenario in which cities were not treated (conditional on the fixed effects and any covariates). Violations of parallel trends would be visible through significant differences between the treated and control groups prior to a flavor policy going into effect, indicated in the figure by the red "pre-trend coefficients." The pre-trend coefficients overlap zero and thus are not significantly different across any of the product categories, suggesting that we did not detect any violations of the parallel trends assumption. This increases our credence in the appropriateness of the empirical model.

Figure 4. Percent change in unit sales over time due to any local flavor policy going into effect



Note: This figure displays event-study coefficients and 95% confidence intervals for the effects of any local flavor policy going into effect. The vertical axis displays the average treatment effect on the treated (ATT), representing the difference in units sold between cities with a local flavor policy (treated group) and cities without (control group), scaled as a percentage change compared with the units sold in the month prior to policy adoption. Estimates are derived from event-study difference-in-differences models that include city and month-year fixed effects.

C. Policy effects on cross-border shopping

A key concern of local flavor policies is that some consumers will seek to evade the policy by shopping for tobacco products in a nearby jurisdiction. To investigate cross-border shopping, we estimate the same difference-in-differences models using sales in cities bordering a treated city as the policy-exposed group. Border cities that had a local flavor policy were dropped from this analysis.

Table 7 presents results for the effect of any flavor policy on cross-border shopping. Cross-border shopping would be indicated by an increase in sales in the border areas. We find that overall tobacco sales increased by a non-significant 1.0% (95% CI: -3.3 to 5.3) in border areas following any flavor policy going into effect. We find a larger, though still not statistically significant increase in sales for flavored products (4.9%, 95% CI: -1.0 to 10.8) and a non-significant decrease in sales of unflavored products (-1.6%, 95% CI: -5.8 to 2.7). There are not any significant changes when we investigate tobacco or NRT product categories, although there are small, non-significant increases in cigars (3.8%, 95% CI: -3.2 to 10.9), smokeless tobacco (8.2%, 95% CI: -1.2 to 17.7), and ENDS (2.0%, 95% CI: -6.2 to 10.1). NRT product sales also increased by a non-significant 5.9% (95% CI: -31.6 to 43.3). Thus, we do not find evidence that individuals are shopping for tobacco in nearby border areas in any large number after a local flavored tobacco sales restriction goes into effect, although the positive coefficient suggests that a small degree of cross-border shopping could be occurring.

Table 7. Effects of any flavor policy on cross-border shopping in unit sales

	Among targeted product categories			By product category				
	All	Flavored	Unflavored	Cigarettes	Cigars	Smokeless	ENDS	NRT
ATT	181.0	359.6	-178.5	-103.8	134.9	146.7*	11.9	3.6
	(409.2)	(219.6)	(244.9)	(297.2)	(126.9)	(86.2)	(25.0)	(11.6)
No. obs.	25,150	25,130	25,150	25,144	23,942	22,004	21,407	4,759
Mean DV	18,624.9	7,302.0	11,325.3	13,021.8	3,521.8	1,780.2	601.1	61.0
ATT, % change	1.0	4.9	-1.6	-0.8	3.8	8.2	2.0	5.9
	[-3.3, 5.3]	[-1.0, 10.8]	[-5.8, 2.7]	[-5.3, 3.7]	[-3.2, 10.9]	[-1.2, 17.7]	[-6.2, 10.1]	[-31.6, 43.3]

Note: This table shows the effect for cities bordering a city with any local flavor policy (n=100), compared with non-border cities without a local flavor policy (n=320). Targeted products refer to product categories for which flavored products were regulated by the policy. Estimates are derived from two-way fixed effects models with fixed effects for city and month. Data are collapsed to the city-by-month level. The treated group is composed of never-treated cities bordering a city with a flavor policy, and the control group is composed of never-treated cities not bordering a city with a flavor policy. Cities with a flavor policy are dropped from the analysis. Robust standard errors, clustered at city level, are shown in parentheses below estimates. ATT = average treatment effect on the treated. Mean DV = mean dependent variable of the treated group during the pre-policy period. ATT, % change = the ATT expressed as a percent change relative to the mean DV, with its 95% CI below. SLT = smokeless tobacco. Significance: * p<0.10 ** p<0.05 *** p<0.01

D. Policy effects on the sale of non-tobacco products

Table 8 demonstrates the effects of local flavored tobacco sales restrictions on the sale of non-tobacco products, such as general merchandise or dairy products. The results show that cities with any flavor policy had a small, not statistically significant increase in total sales of non-tobacco products of 1.0% on average ($46,214 per month, 95% CI: -2.2 to 4.2) following policy effective dates. This suggests that stores did not experience a detectable decline in the sale of non-tobacco products due to fewer transactions with tobacco purchases. However, the uncertainty of our estimates imply that we cannot rule out small declines in non-tobacco sales. We observe similar patterns following ENDS-only policies going into effect, ENDS plus combustibles plus SLT policies, and menthol policies, such that tobacco retailers in cities with one of these policies experienced small increases—not declines—in the sale of non-tobacco products, on average.

Table 8. Effects of local flavor policies on dollar sales of non-tobacco products, by policy type

	Policy type			
	Any flavor policy	ENDS flavor policy	ENDS + combustibles + SLT flavor policy	Menthol policy
Total non-tobacco sales				
ATT	46,214	26,511	22,086	53,348
	(79,152)	(154,791)	(82,302)	(103,643)
ATT as % change	1.0	1.2	0.4	1.0
	[-2.2, 4.2]	[-12.3, 14.6]	[-2.8, 3.7]	[-2.8, 4.7]
Sales by store department				
Baby care				
ATT	-688	608	-983	-923
	(618)	(1,882)	(653)	(791)
ATT as % change	-1.7	3.6	-2.3	-2.0
	[-4.6, 1.3]	[-18.4, 25.6]	[-5.3, 0.7]	[-5.3, 1.3]
Bakery				
ATT	392	870	30	602
	(1,161)	(3,137)	(1,219)	(1,494)
ATT as % change	0.7	3.0	0.0	0.9
	[-3.1, 4.5]	[-18.1, 24.0]	[-3.8, 3.9]	[-3.5, 5.3]
Dairy				
ATT	8,405	-3,979	5,872	11,065
	(11,600)	(21,257)	(12,005)	(15,258)
ATT as % change	1.1	-1.2	0.8	1.3
	[-1.9, 4.2]	[-13.8, 11.4]	[-2.3, 3.9]	[-2.3, 5.0]
Deli				
ATT	-1,723	-2,853	-2,627	-1,742
	(3,997)	(10,441)	(4,226)	(5,165)
ATT as % change	-0.9	-3.1	-1.3	-0.8
	[-4.9, 3.1]	[-25.1, 19.0]	[-5.4, 2.8]	[-5.5, 3.9]
Frozen				
ATT	8,166	4,205	5,713	8,714

	(9,114)	(18,118)	(9,443)	(11,876)
ATT as % change	1.8	1.9	1.2	1.7
	[-2.2, 5.8]	[-14.4, 18.3]	[-2.8, 5.2]	[-2.9, 6.4]
General merchandise				
ATT	-1,599*	-1,097	-2,068**	-1,338
	(896)	(2,738)	(860)	(1,121)
ATT as % change	-1.8	-2.3	-2.2	-1.3
	[-3.7, 0.2]	[-13.3, 8.8]	[-4.1, -0.4]	[-3.5, 0.9]
Grocery				
ATT	28,349	11,217	19,208	35,108
	(34,749)	(58,250)	(36,492)	(45,701)
ATT as % change	1.4	1.2	0.9	1.5
	[-2.0, 4.7]	[-11.0, 13.4]	[-2.5, 4.3]	[-2.4, 5.4]
Health & beauty care				
ATT	-5,879*	2,856	-8,266***	-8,723**
	(2,993)	(8,189)	(3,036)	(3,669)
ATT as % change	-1.7	1.6	-2.3	-2.2
	[-3.4, -0.0]	[-7.4, 10.6]	[-4.0, -0.6]	[-4.1, -0.4]
Household care				
ATT	-1,657	149	-3,361	-1,976
	(3,280)	(7,499)	(3,320)	(4,262)
ATT as % change	-0.5	0.1	-1.0	-0.6
	[-2.6, 1.5]	[-9.8, 10.0]	[-3.0, 1.0]	[-2.9, 1.8]
Meat				
ATT	635	1,965	-888	584
	(5,101)	(8,988)	(5,392)	(6,709)
ATT as % change	0.3	1.8	-0.4	0.2
	[-3.9, 4.5]	[-14.5, 18.2]	[-4.7, 3.9]	[-4.7, 5.1]
Produce				
ATT	6,622	5,522	4,465	6,760
	(8,307)	(18,309)	(8,628)	(10,596)
ATT as % change	1.9	3.8	1.2	1.7
	[-2.8, 6.6]	[-20.8, 28.3]	[-3.4, 5.9]	[-3.6, 7.1]
Seafood				
ATT	175	-38	165	293
	(228)	(333)	(243)	(297)
ATT as % change	2.5	-1.6	2.2	3.6
	[-3.9, 8.8]	[-28.3, 25.2]	[-4.2, 8.7]	[-3.6, 10.9]

Note: Coefficients, in dollars, represent the average treatment effect on the treated (ATT) of the change in sales in the treated group relative to the change in the control group following any flavor policy going into effect. Robust standard errors, clustered at city level, are shown below the ATT estimates in parentheses. The ATT as % change is the ATT expressed as a percent change relative to the pre-policy mean dependent variable in the treated group, with 95% CI shown in brackets. Estimates are derived from two-way fixed effects models with fixed effects for city and month. Data are collapsed to the city-by-month level.
Significance: * p<0.10 ** p<0.05 *** p<0.01

Any flavor policy going into effect is associated with a non-statistically significant slight increase in sales for most store departments selling non-tobacco products. Only general merchandise and health and beauty care products decreased by an amount that is significant at the 10% level. Specifically, there is a significant reduction in general merchandise of -1.8% (95% CI: -3.7 to 0.2) and a reduction in health and beauty products of 1.7% (95% CI: -3.4 to 0.0). ENDS + combustibles + SLT flavor policies and menthol flavor policies have the same pattern as any flavor policy, although the impacts are not significant for any of the departments.

E. Sensitivity analysis

Effects by policy enforcement

Local flavor policies may have larger impacts if they are more strongly enforced. While the strength of enforcement cannot be directly measured for all cities, we use the existence of a local ordinance that establishes tobacco retail licensing (TRL) ordinance as a proxy for cities with stronger enforcement. Table 9 displays the impacts of having any flavored policy on the sale of tobacco and NRT products among treated cities with a TRL ordinance, and Table 10 displays the impacts among treated cities without a TRL ordinance. The results do not fully conform with the hypothesis. While we observe declines in the sale of flavored tobacco products across both sets of cities, the magnitudes of the declines are counterintuitively larger among cities that did not have a TRL ordinance (-13.3%, 95% CI: -22.9 to -3.6) than in cities that did have a TRL ordinance (-8.0, 95% CI: -11.2 to -4.8). We do note that there is substantial overlap in the confidence intervals between the two sets of estimates. Moreover, there is not much variation in TRL status, such that 85% of treated cities (n=93) had a TRL and 15% (n=16) did not, and this may have limited the power of this test.

Table 9. Effects of any flavor policy on unit sales of tobacco and NRT products in cities with a TRL

	Among targeted product categories			By product category				
	All	Flavored	Unflavored	Cigarettes	Cigars	SLT	ENDS	NRT
ATT	-2662.1***	-3388.1***	718.0**	-1471.6***	-601.0***	-478.7***	-220.3***	2.4
	(543.5)	(619.8)	(323.6)	(453.9)	(202.2)	(80.2)	(35.3)	(5.6)
No. obs.	30,633	30,467	30,630	28,988	26,809	26,733	5,918	28,988
Mean DV	33,313.9	12,943.5	20,387.7	7,148.1	2,223.2	960.0	110.5	7,148.1
ATT as % change	-8.0	-26.2	3.5	-8.4	-21.5	-22.9	2.2	-8.4
	[-11.2, -4.8]	[-35.6, -16.8]	[0.4, 6.6]	[-14.0, -2.9]	[-28.6, -14.5]	[-30.1, -15.7]	[-7.7, 12.1]	[-14.0, -2.9]

Note: This table shows the effect of cities with a tobacco retail licensing (TRL) ordinance implementing any policy restricting flavored products (n=93), compared with cities without a policy (n=417). Targeted products refer to product categories for which flavored products were regulated by the policy. Estimates are derived from two-way fixed effects models with fixed effects for city and month. Data for April 2018 through November 2022 are collapsed to the city-by-month level. Robust standard errors, clustered at city level, are shown in parentheses. ATT = average treatment effect on the treated. Mean DV = mean dependent variable of the treated group during the pre-policy period. ATT as % change = the ATT expressed as a percent change relative to the pre-policy mean dependent variable in the treated group, with 95% CI shown in brackets.
Significance: * p<0.10 ** p<0.05 *** p<0.01

Effects by store type

One potential source of heterogeneity of effects is store type. Different types of stores carry different types of products and may have been more or less likely to comply with the policy. Further, any differential impacts may have implications for how flavor policies are designed, how they affect the broader retail environment, and whether any specific supports should be targeted to specific types of retailers.

Table 10. Effects of any flavor policy on unit sales of tobacco and NRT products in cities without a TRL

	Among targeted product categories			By product category				
	All	Flavored	Unflavored	Cigarettes	Cigars	SLT	ENDS	NRT
ATT	-1652.6***	-1954.9***	302.3	-1066.7***	-295.4***	-528.3***	-181.4***	-16.2
	(614.6)	(497.0)	(406.8)	(381.0)	(81.9)	(119.8)	(43.8)	(10.1)
No. obs.	25,942	25,922	25,942	25,908	24,734	22,781	22,196	4,847
Mean DV	12,459.1	4,557.7	7,901.4	9,242.9	2,053.5	1,428.1	344.2	71.8
ATT as % change	-13.3	-42.9	3.8	-11.5	-14.4	-37.0	-52.7	-22.6
	[-22.9, -3.6]	[-64.3, -21.5]	[-6.3, 13.9]	[-19.6, -3.5]	[-22.2, -6.6]	[-53.4, -20.6]	[-77.6, -27.8]	[-50.1, 5.0)

Note: This table shows the effect of cities without a tobacco retail license (TRL) ordinance implementing any policy restricting flavored products (n=16), compared with cities without a policy (n=417). Targeted products refer to product categories for which flavored products were regulated by the policy. Estimates are derived from two-way fixed effects models with fixed effects for city and month. Data for April 2018 through November 2022 are collapsed to the city-by-month level. Robust standard errors, clustered at city level, are shown in parentheses. ATT = average treatment effect on the treated. Mean DV = mean dependent variable of the treated group during the pre-policy period. ATT as % change = the ATT expressed as a percent change relative to the pre-policy mean dependent variable in the treated group, with 95% CI shown in brackets.
Significance: * p<0.10 ** p<0.05 *** p<0.01

To explore effect heterogeneity across different store types, we estimate stratified models by store type: convenience stores, drug stores, and grocery stores. The results indicate that any flavor policy going into effect decreased tobacco product sales across all store types (Table 11). However, the larger declines occur in drug stores (a significant -9.5%, 95% CI: -20.0 to 1.0), followed by convenience stores (a significant -9.2%, 95% CI: -13.5 to -4.9), and grocery stores (a non-significant -1.9%, 95% CI: -7.5 to 3.7). We also estimated the effect any flavor policy going into effect on total non-tobacco dollar sales (Table 12). While overall dollar sales of non-tobacco products increased by a non-significant 1.0% (95% CI: -2.2 to 4.2), we did observe small declines across the individual store types, none of which were statistically significant, ranging from -0.3% in convenience stores to -1.1% in drug stores. The uncertainty around our estimates suggest that we can rule out with 95% confidence that retailers experienced sales declines greater than 3% in drug stores and grocery stores and 9% in convenience stores. However, these would represent meaningful sales declines for many stores, suggesting that our estimates carry enough uncertainty that the lack of a decline in non-tobacco sales should be interpreted with a degree of caution.

Table 11. Effects of any flavor policy effect on unit sales of tobacco products by store type

	(1) All stores	(2) Convenience stores	(3) Drug stores	(4) Grocery stores
ATT	-2465.7***	-2496.6***	-257.6*	-34.0
	(475.2)	(591.0)	(145.4)	(50.4)
No. obs.	31,105	12,364	8,032	10,709
Mean DV	28,804.2	27,140.4	2,718.1	1,760.4
ATT as % change	-8.6	-9.2	-9.5	-1.9
	[-11.8, -5.3]	[-13.5, -4.9]	[-20.0, 1.0]	[-7.5, 3.7]

Note: This table shows the effects of any local flavor policy going into effect on unit sales of tobacco products, by store type. Estimates are derived from two-way fixed effects models with fixed effects for city and month. Data are collapsed to the city-by-month level. ATT = average treatment effect on the treated. Mean DV = mean dependent variable of the treated group during the pre-policy period. ATT as % change = the ATT expressed as a percent change relative to mean DV, with 95% CI shown in brackets.
Significance: * p<0.10 ** p<0.05 *** p<0.01

Table 12. Effects of any flavor policy on dollar sales of non-tobacco products by store type

	(1) All stores	(2) Convenience stores	(3) Drug stores	(4) Grocery stores
ATT	46,214	-476	-3,968	-37,739
	(79,152)	(7,026)	(2,417)	(48,963)
No. obs.	32,133	11,865	7,975	12,293
Mean DV	4,843,991.0	143,804.5	366,830.0	4,021,603.1
ATT as % change	1.0	-0.3	-1.1	-0.9
	[-2.2, 4.2]	[-9.9, 9.2]	[-2.4, 0.2]	[-3.3, 1.4]

Note: This table shows the effects of any local flavor policy going into effect on dollar sales of non-tobacco products (in dollars), by store type. Estimates are derived from two-way fixed effects models with fixed effects for city and month. Data are collapsed to the city-by-month level. ATT = average treatment effect on the treated. Mean DV = mean dependent variable of the treated group during the pre-policy period. ATT as % change = the ATT expressed as a percent change relative to mean DV, with 95% CI shown in brackets.
Significance: * p<0.10 ** p<0.05 *** p<0.01

Alternative estimation (Callaway-Sant'Anna)

Recent research has shown that the two-way fixed effects approach used in our main analysis can be biased in the case of staggered policy adoption, as in our setting.[19, 21, 23] Economists have developed several alternative approaches to difference-in-differences estimation that are robust to biases that occur in two-way fixed effects. To address this potential limitation, we implement one of the leading alternative difference-in-differences approaches developed by Callaway and Sant'Anna.[24]

Table 13 shows the results of the Callaway-Sant'Anna difference-in-differences estimation for the effects of any local flavor policy going into effect. The results tended to be larger in magnitude compared to the results from the main analysis. The overall decline in tobacco sales was a statistically significant 10.8% (95% CI: -17.1 to -4.5), compared with 8.4% in the main analysis. The decline in flavored products (-47.5%, 95% CI: -64.3 to -30.7) and increase in unflavored products (9.0%, 95% CI: 0.2 to 17.9) were also larger in magnitude, as was the decline in smokeless tobacco products (-27.7%, 95% CI: -38.2 t o-17.3) and ENDS (-35.2%, 95% CI: -47.5 to -22.8), with all coefficients statistically significant. In contrast with the main analysis and event study estimates, the Callaway-Sant'Anna model indicates that NRT product sales increased by 9.7% in treated areas (95% CI: -1.0 to 20.4), a coefficient that was significant at the 10% level.

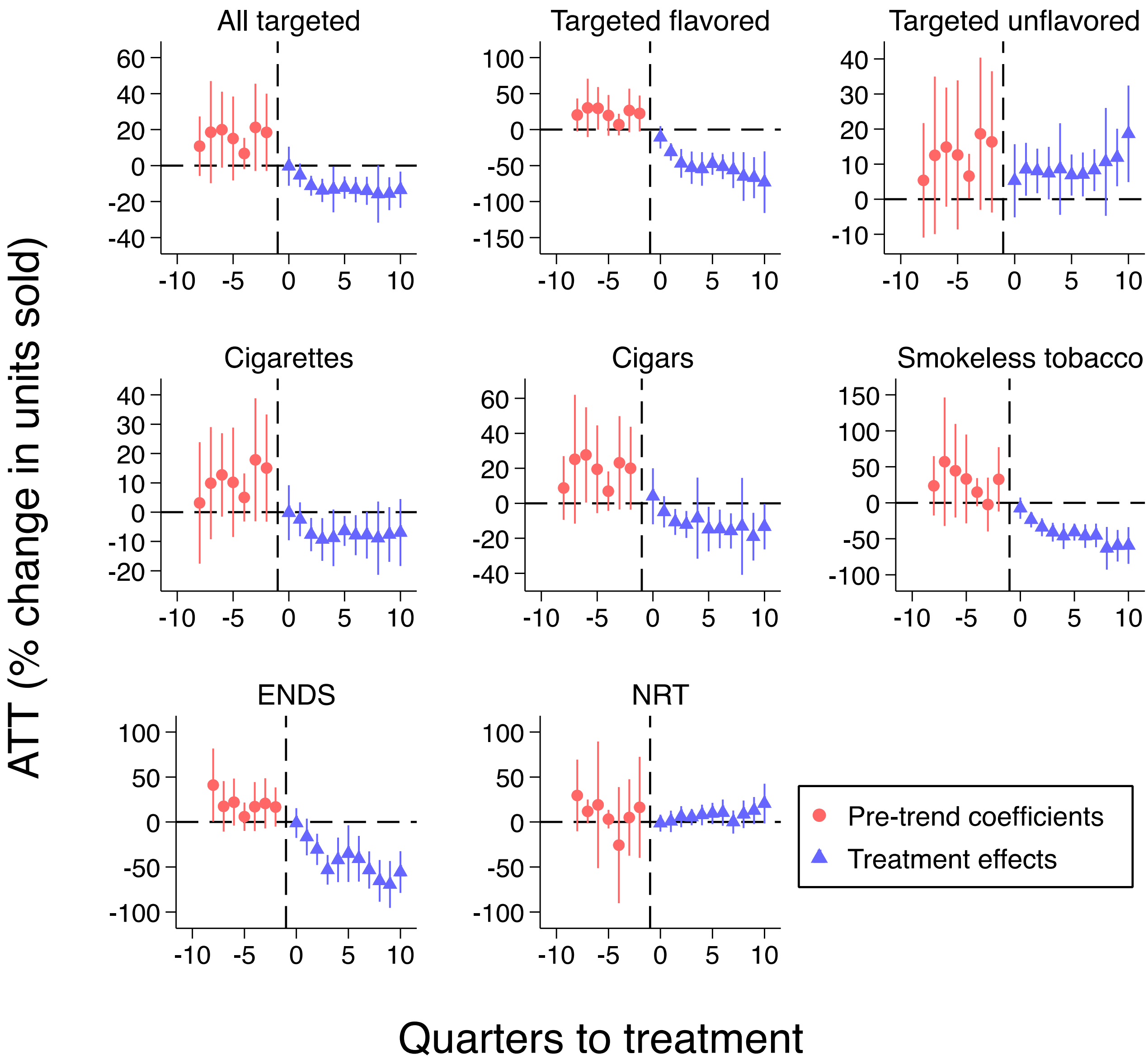
The event study plots from the Callaway-Sant'Anna model of the effects of any flavor policy going into effect is shown in Figure 5. It follows a similar pattern as the event study from the main analyses.

Table 13. Effects of any flavor policy on unit sales of tobacco and NRT products using Callaway-Sant'Anna estimation

	Among targeted product categories			By product category				
	All	Flavored	Unflavored	Cigarettes	Cigars	SLT	ENDS	NRT
ATT	-6522.4***	-10159.6***	3525.7**	-3105.4***	-1805.2*	-1499.9***	-635.9***	30.2*
	(1944.10)	(1834.26)	(1760.68)	(1062.14)	(966.66)	(288.07)	(113.64)	(16.92)
No. obs.	9,681	9,655	9,681	9,624	9,275	8,775	8,691	3,863
Mean DV	60,403.75	21,385.96	39,017.79	40,800.57	15,065.28	5,405.85	1,808.67	310.90
ATT as % change	-10.8	-47.5	9.0	-7.6	-12.0	-27.7	-35.2	9.7
	[-17.1, -4.5]	[-64.3, -30.7]	[0.2, 17.9]	[-12.7, -2.5]	[-24.6, 0.6]	[-38.2, -17.3]	[-47.5, -22.8]	[-1.0, 20.4]

Note: This table shows the effects of any local flavor policy going into effect on tobacco and NRT product sales, based on a Callaway-Sant'Anna difference-in-differences model with doubly-robust estimation. Data are collapsed to the city-by-quarter level. The treated group is composed of never-treated cities bordering a city with a flavor policy, and the control group is composed of never-treated cities not bordering a city with a flavor policy. Cities that had a flavor policy prior to the start of the study period were removed from the analysis. Robust standard errors are clustered at city level. Standard errors are shown below the estimates in parentheses. ATT = average treatment effect on the treated. Significance: * p<0.10 ** p<0.05 *** p<0.01

Figure 5. Callaway-Sant'Anna estimation of the percent change in unit sales over time due to any local flavor policy going into effect



Note: This figure shows event-study coefficients and 95% confidence intervals for the effects of any local flavor policy going into effect. The vertical axis displays the average treatment effect on the treated (ATT), representing the difference in units sold between cities with a local flavor policy (treated group) and cities without (control group), scaled as a percentage change compared with the units sold in the month prior to a policy's effective date. Estimates are derived from Callaway-Sant'Anna difference-in-differences models using doubly-robust estimation adjusting for the city population, mean household income, percent Hispanic, percent non-Hispanic Black, percent non-Hispanic White, percent non-Hispanic Asian, and percent "other" race/ethnicity.

4. RESULTS FOR LOCAL TOBACCO SALES BAN POLICIES

A. Descriptive statistics

Table 14 shows the characteristics of the treated cities and the donor pool of control cities. There are large differences in mean tobacco sales and demographics between the groups in these unadjusted data. This supported the empirical strategy of forgoing the entire pool of comparison cities as a control group and instead turning to a synthetic control-like approach that can provide a better match to the treated groups, which are themselves somewhat different from each other.

In total, the data contain two stores in Beverly Hills (one grocery store and one drug store) and five stores in Manhattan Beach (one grocery store and four convenience stores). In total, 481 cities contributed to the synthetic control donor pool. The Beverly Hills border area consisted of seven contiguous ZIP codes which included 15 stores (two grocery stores, three drug stores, and 10 convenience stores). The Manhattan Beach border area consisted of five contiguous ZIP codes which included 17 stores (three grocery stores, two drug stores, and 10 convenience stores).

Table 14. Tobacco and NRT product unit sales prior to a local sales ban policy's effective date

	Beverly Hills	Manhattan Beach	Donor pool of control cities
Mean unit sales, all tobacco	285.9 (38.7)	776.4 (77.7)	519.6 (2.2)
Mean unit sales, by category			
Cigarettes	202.4 (25.4)	223.6 (18.0)	260.6 (0.8)
Cigars (big, little)	71.0 (5.3)	98.7 (14.2)	126.8 (0.8)
Smokeless tobacco	6.5 (1.5)	370.7 (61.7)	136.9 (1.1)
ENDS	44.7 (19.8)	40.6 (8.0)	52.3 (0.4)
NRT	151.0 (10.4)	2.5 (0.6)	16.8 (0.2)
Population	39,269	35,123	140,850
Race/ethnicity (%)			
Non-Hispanic White	74.3	71.5	41.0
Non-Hispanic Black	1.8	0.4	4.3
Hispanic	7.2	8.0	38.8
Asian and Pacific Islander	11.0	15.3	12.2
Median HH income ($)	68,419	100,283	42,848
Number of UPCs	441	803	5,564
Number of stores	2	5	3,179
Number of cities	1	1	481

Note: Demographic data are derived from the American Community Survey 5-year estimates, 2017-2022.

B. Policy effects on tobacco and NRT product sales in treated cities

The SDID procedure constructs a weighted average of potential control cities to match each treated city. The 20 donor pool cities that received the most weight for each treated city are listed in Table 15. No single city contributed more than 5% to the synthetic control for Beverly Hills or more than 15% for Manhattan Beach. A total of 151 cities contributed to the synthetic control for Beverly Hills and 23 to the synthetic control for Manhattan Beach for the analysis of unit sales of all tobacco products.

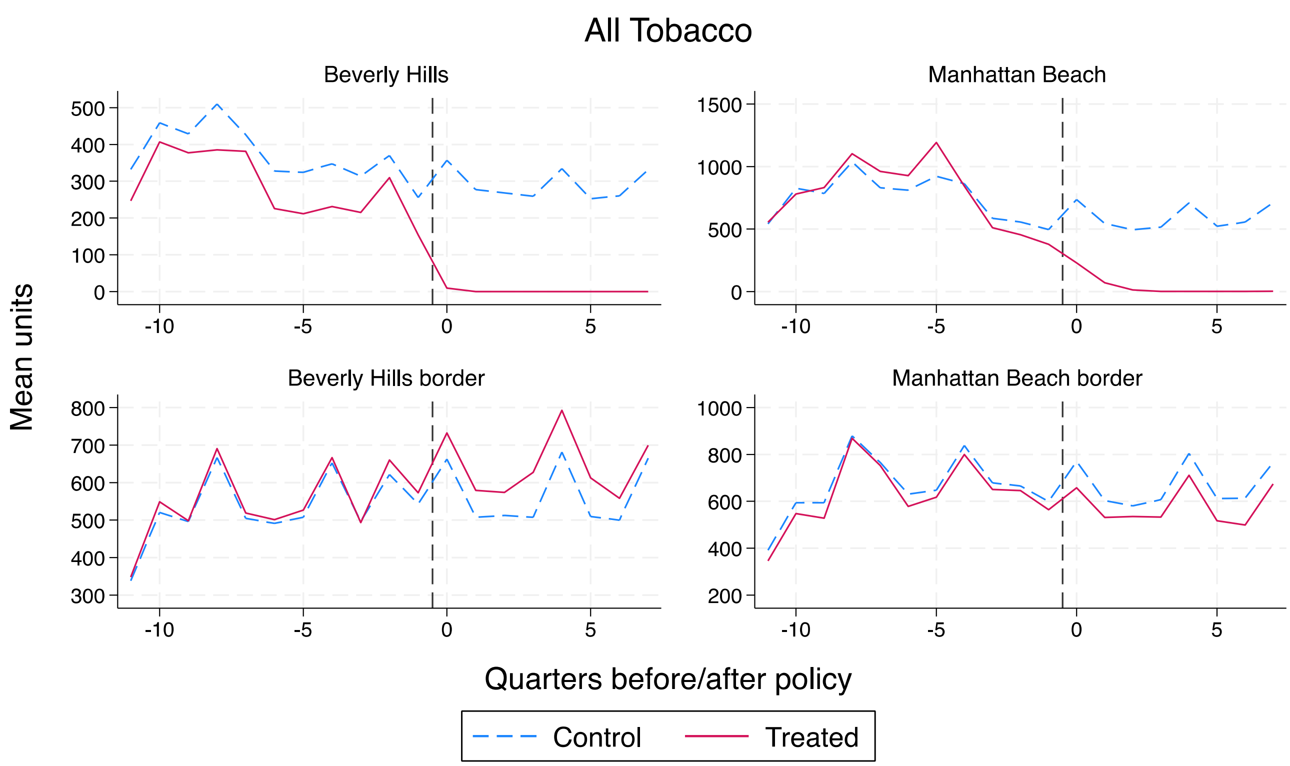
Table 15. Cities receiving the most weight in constructing the synthetic control for each treated city in the model of all tobacco sales

	Beverly Hills		Manhattan Beach	
Rank	City	% weight	City	% weight
1	Jamul	5.0	Imperial	13.6
2	Bonsall	3.3	Salida	9.8
3	Cloverdale	3.1	Acton	7.7
4	National City	2.4	Boron	7.6
5	Paradise	2.1	Albany	7.6
6	Aptos	2.0	Corte Madera	7.4
7	Burlingame	2.0	Woodland	7.1
8	Felton	1.9	National City	5.0
9	Richmond	1.7	Castaic	4.5
10	Winters	1.6	Freedom	4.5
11	Shasta Lake	1.6	West Sacramento	4.0
12	Magalia	1.6	Scotts Valley	3.7
13	Windsor	1.5	Burlingame	3.3
14	Pollock Pines	1.5	Marina del Rey	2.9
15	Modesto	1.5	Diamond Springs	2.4
16	Soquel	1.5	Soquel	2.2
17	Glendora	1.4	Oroville	1.4
18	Corte Madera	1.4	Winters	1.4
19	Lafayette	1.4	Calabasas	1.4
20	American Canyon	1.4	Signal Hill	0.9
21+		59.9		1.4

Note: This table shows the unit-specific weights assigned to control cities in constructing the synthetic control for each treated city for estimation of the SDID model of all tobacco sales. The last row displays the sum of weights for all other cities.

Figure 6 shows the outcome trends for all tobacco products between the treated cities and their synthetic control based on the SDID analysis. Whereas synthetic control methods attempt to minimize the distance between the treated group and its synthetic control, the SDID procedure merely seeks to satisfy the parallel trends assumption. In some cases, this leads to close overlap between the treated and synthetic control groups during the pre-policy period, as in the figure for Beverly Hills. In other cases, the SDID procedure allows for different levels of the groups but relatively parallel trends during the pre-policy period.

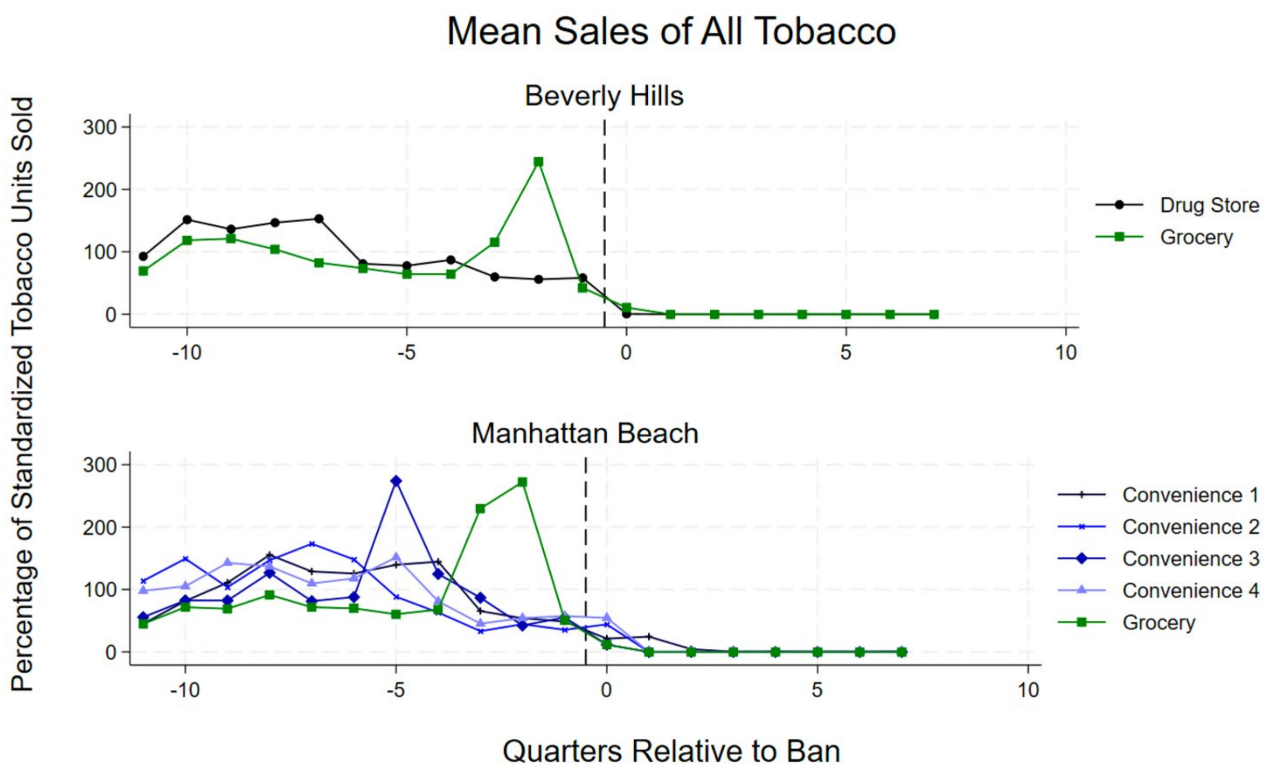
Figure 6. Trends in unit sales of all tobacco products between treated and border areas with their synthetic control before and after a local sales ban policy's effective date



Note: This figure shows trends over time in mean unit sales for the treated or border area and its synthetic control. Estimates are derived from synthetic difference-in-differences models that include geographic and month-year fixed effects.

Beverly Hills and Manhattan Beach each experienced large reductions in tobacco sales. Sales started to decline just prior to the ban in Beverly Hills. Tobacco sales in Beverly Hills ceased within the first three months after its policy took effect. Manhattan Beach took slightly longer to come into compliance with the law, likely because the city granted temporary financial hardship exemptions to several businesses for six months after the policy took effect (until end of June 2021).[12] Tobacco sales in Manhattan Beach decreased to <1% of pre-ban sales within three months; one convenience store that had received a temporary hardship exemption continued to sell a small number of tobacco units for six months post-ban (Figure 7). Tobacco sales in Manhattan Beach reached zero by the end of 2021.A recent study also documented high compliance in the two cities (87.5%) based on purchase attempts from secret shoppers.[13] Whereas sales zeroed out in the treated cities, their synthetic control groups had relatively flat sales following the law going into effect.

Figure 7. Tobacco unit sales over time as a percent of pre-ban mean sales



Note: This figure shows mean unit sales of all tobacco products by store in Beverly Hills (top) and Manhattan Beach (bottom). Sales are expressed as a percent of tobacco units sold during the pre-ban period.

Next, we quantify the policy's effect in Beverly Hills and Manhattan Beach and their border areas using the SDID analysis. In Beverly Hills, all tobacco sales decreased 66.7% (–190.7 mean units, 95% CI: –125.4% to –8.1%, p=0.03) post-ban, compared with the trend in its synthetic control (Table 16). In Manhattan Beach, all tobacco sales decreased 65.2% (–506.1 mean units, 95% CI: –86.8% to –43.6%, p<0.001) post-ban, compared with the trend in its synthetic control (Table 17). This is also confirmed by Figure 8, which shows event study plots of the quarter-by-quarter estimates of the policy effects in Beverly Hills and Manhattan Beach. The event studies show that a steep decline in sales begins immediately after the policy went into effect and persisted through the end of the study period. In both cities, the 95% confidence intervals around the coefficients overlap with 100%.

After the tobacco sales bans, NRT product sales significantly decreased in Beverly Hills (-5.1%, or 7.7 mean units, 95% CI: –9.5% to –0.7%, *p*=0.02) (Table 16), and did not significantly change in Manhattan Beach (21.5%, or –0.5 mean units, 95% CI: –286.3% to 243.3%, *p*=0.87) (Table 17). An important caveat is that the Manhattan Beach store sample did not include any drug stores, where NRT products are commonly purchased.

Table 16. Effect of local sales ban policies on unit sales in Beverly Hills, by tobacco and NRT product category

		By product category				
	All Tobacco	Cigarettes	Cigars	SLT	ENDS	NRT
ATT	-190.7**	-115.4***	-65.6**	-28.8	0.4	-7.7**
	(-358.4, -23.1)	(-182.3, -48.4)	(-120.0, -11.2)	(-148.1, 90.5)	(-28.3, 29.1)	(-14.3, -1.0)
No. obs.	9,025	8,949	8,683	8,512	8,854	8,702
Mean DV	285.9	202.4	71.0	6.6	44.7	151.0
ATT as % change	-66.7	-57.0	-92.4	-439.8	0.9	-5.1
	(-125.4, -8.1)	(-90.1, -23.9)	(-169.0, -15.8)	(-2262.5, 1382.9)	(-63.3, 65.1)	(-9.5, -0.7)

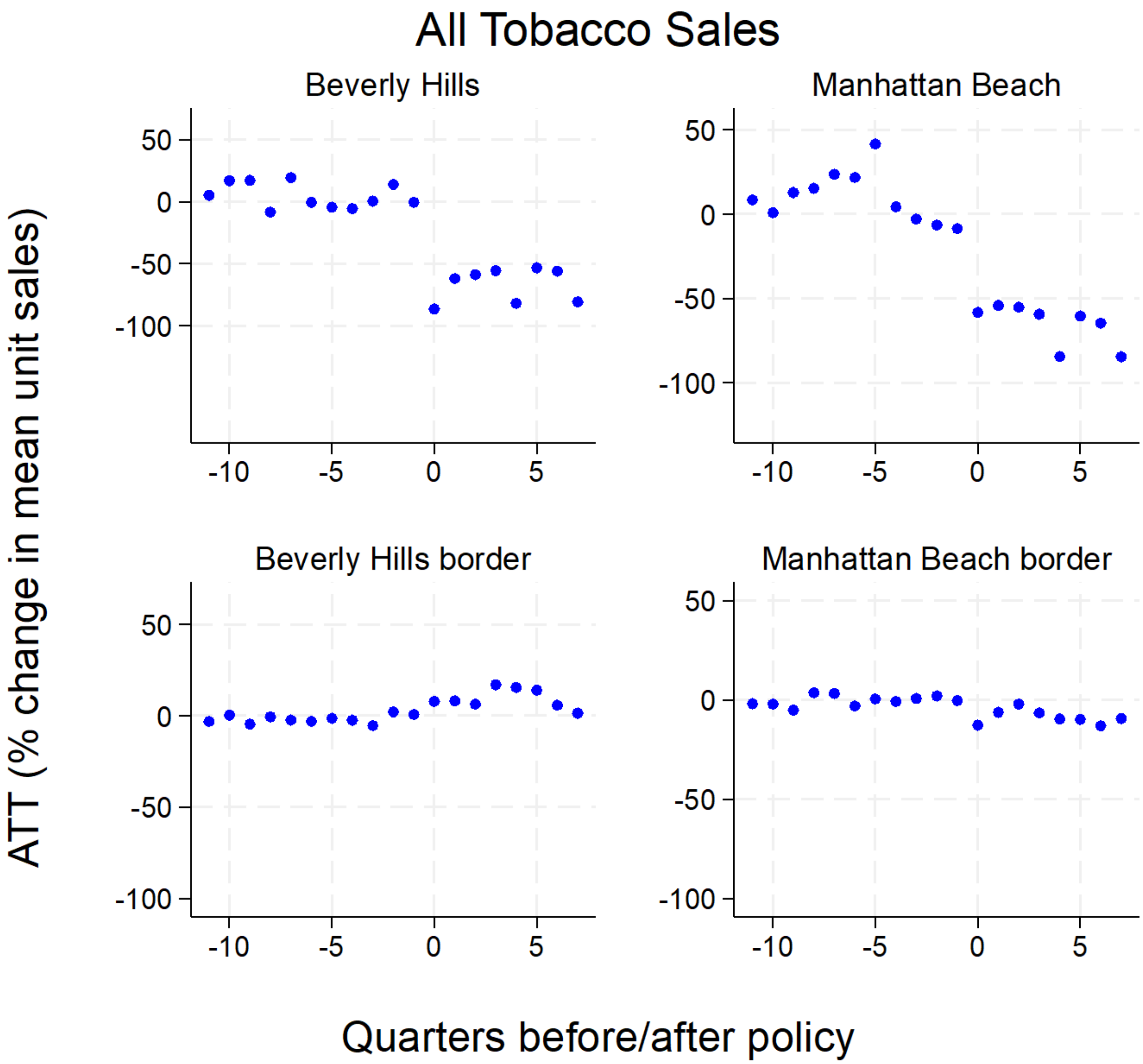
Note: This table shows estimates from synthetic difference-in-differences models of the change in mean units sold per store for each product category. 95% confidence intervals are provided in parentheses. ATT = average treatment effect on the treated. Mean DV = mean dependent variable of the treated group during the pre-policy period. SLT = smokeless tobacco. Significance: * p<0.10 ** p<0.05 *** p<0.01

Table 17. Effect of local sales ban policies on unit sales in Manhattan Beach, by tobacco and NRT product category

		By product category				
	All Tobacco	Cigarettes	Cigars	SLT	ENDS	NRT
ATT	-506.1***	-154.6***	-114.9***	-333.9***	-6.6	-0.5
	(-673.7, -338.5)	(-221.5, -87.6)	(-169.3, -60.5)	(-453.2, -214.6)	(-35.3, 22.2)	(-7.2, 6.1)
No. obs.	9,025	8,949	8,683	8,512	8,854	8,702
Mean DV	776.4	264.0	120.2	459.4	48.7	2.5
ATT as % change	-65.2	-58.5	-95.6	-72.7	-13.4	-21.5
	(-86.8, -43.6)	(-83.9, -33.2)	(-140.8, -50.4)	(-98.6, -46.7)	(-72.4, 45.5)	(-286.3, 243.3)

Note: This table shows estimates from synthetic difference-in-differences models of the change in mean units sold per store for each product category. 95% confidence intervals are provided in parentheses. ATT = average treatment effect on the treated. Mean DV = mean dependent variable of the treated group during the pre-policy period. SLT = smokeless tobacco. Significance: * p<0.10 ** p<0.05 *** p<0.01

Figure 8. Change over time in the effects of a local sales ban policy on unit sales of all tobacco products in treated and border areas



Note: This figure displays event-study coefficients and 95% confidence intervals for the effects of local tobacco sales bans relative to the quarter when the policy went into effect. The vertical axis displays the average treatment effect on the treated (ATT), representing the difference in mean unit sales per store between cities with a tobacco sales ban (treated group) and cities without (control group), expressed as a percent change relative to the outcome in the pre-policy period. Estimates are derived from synthetic difference-in-differences models that include geographic and month-year fixed effects.

C. Policy effects on cross-border shopping

The average treatment effect estimates for cross-border shopping are presented in Table 18 and Table 19. Sales of all tobacco products in the area surrounding Beverly Hills increased, on average, by a non-statistically significant 9.5% (52.0 mean units, 95% CI: –21.1% to 40.1%, *p*=0.54); this implies sales did not significantly shift to the Beverly Hills border area. Individual tobacco product categories in the Beverly Hills border also showed non-statistically significant increases for all product categories.

Table 18. Effect of local sales ban policies on unit sales in Beverly Hills border area, by tobacco and NRT product category

		By product category				
	All Tobacco	Cigarettes	Cigars	SLT	ENDS	NRT
ATT	52.0	1.0	27.4	18.3	21.4	2.0
	(-115.5, 219.6)	(-66.0, 67.9)	(-27.0, 81.8)	(-101.0, 137.6)	(-7.3, 50.1)	(-4.6, 8.7)
No. obs.	9,025	8,949	8,683	8,512	8,854	8,702
Mean DV	547.74	273.41	114.12	121.22	55.15	51.88
ATT as % change	9.5	0.4	24.0	15.1	38.8	3.9
	(-21.1, 40.1)	(-24.1, 24.8)	(-23.6, 71.6)	(-83.3, 113.5)	(-13.3, 90.8)	(-8.9, 16.7)

Note: This table shows estimates from synthetic difference-in-differences models of the change in mean units sold per store for each product category. 95% confidence intervals are provided in parentheses. ATT = average treatment effect on the treated. Mean DV = mean dependent variable of the treated group during the pre-policy period. SLT = smokeless tobacco. Significance: * p<0.10 ** p<0.05 *** p<0.01

Table 19. Effect of local sales ban policies on unit sales in Manhattan Beach border area, by tobacco and NRT product category

		By product category				
	All Tobacco	Cigarettes	Cigars	SLT	ENDS	NRT
ATT	-54.5	2.2	9.4	-51.1	-17.3	-0.3
	(-222.0, 113.1)	(-64.7, 69.2)	(-45.0, 63.7)	(-170.4, 68.2)	(-46.0, 11.4)	(-6.9, 6.4)
No. obs.	9,025	8,949	8,683	8,512	8,854	8,702
Mean DV	627.4	277.9	157.4	177.0	59.7	22.6
ATT as % change	-8.7	0.8	5.9	-28.9	-29.0	-1.1
	(-35.4, 18.0)	(-23.3, 24.9)	(-28.6, 40.5)	(-96.3, 38.5)	(-77.1, 19.1)	(-30.5, 28.3)

Note: This table shows estimates from synthetic difference-in-differences models of the change in mean units sold per store for each product category. 95% confidence intervals are provided in parentheses. ATT = average treatment effect on the treated. Mean DV = mean dependent variable of the treated group during the pre-policy period. SLT = smokeless tobacco. Significance: * p<0.10 ** p<0.05 *** p<0.01

Sales of all tobacco products in the border area surrounding Manhattan Beach decreased by a non-statistically significant 8.7% (–54.5 mean units, 95% CI: –35.4% to 18.0%, *p*=0.52) compared with its counterfactual trend following implementation of the Manhattan Beach policy. Individual tobacco product categories also showed non-significant changes in the Manhattan Beach border area.

NRT product sales exhibited a 3.9% increase in the Beverly Hills border area (2.0 mean units, 95% CI: –8.9% to 16.7%, *p*=0.55) and 1.1% decrease in the Manhattan Beach border area (–0.3 mean units, 95% CI: –30.5% to 28.3%, *p*=0.94) following the bans. Nether coefficient was statistically significant.

D. Policy effects on non-tobacco sales

We investigated the effect of the local tobacco sales bans on dollar sales of all non-tobacco products sold at stores within the treated cities as well as within the border areas (Table 16). Estimates are provided in thousands of dollars (k).

In Beverly Hills, non-tobacco purchases increased by a non-statistically significant 6.2% ($192k per store, 95% CI: –39.4% to 51.7%, *p*=0.79) following implementation of its policy. The tobacco sales ban did not appear to negatively impact retailers' revenues from non-tobacco products there, and it is possible that a small number of tobacco consumers shifted their purchases away from tobacco products and toward other types of products. There is also no observed displacement in sales to the Beverly Hills border area; the coefficient is negative, indicating a non-statistically significant decline in sales in the border area of 3.0% (–$450k per store, 95% CI: –12.5% to 6.5%, *p*=0.54).

Manhattan Beach stores experienced a non-statistically significant decline in non-tobacco sales of 14.0% (–$231k, 95% CI: –100.0% to 72.0%, *p*=0.75). The Manhattan Beach border area also had a non-statistically significant decline of 5.9% (–$637k, 95% CI: –19.2% to 7.3%, *p*=0.38) in sales of non-tobacco products.

Table 20. Estimates of change in dollar sales, in thousands, of non-tobacco products following a local sales ban's effective date

	Beverly Hills	Manhattan Beach	Beverly Hills border	Manhattan Beach border
ATT	192	-231	-450	-637
	(-1229, 1614)	(-1653, 1191)	(-1871, 972)	(-2058, 785)
No. obs.	9,766	9,766	9,766	9,766
Mean DV	3,121	1,653	14,972	10,722
ATT as % change	6.2	-14.0	-3.0	-5.9
	(-39.4, 51.7)	(-100.0, 72.0)	(-12.5, 6.5)	(-19.2, 7.3)

Note: This table shows changes in dollar sales, in $1000s, of all non-tobacco products following a tobacco sales ban going into effect, based on synthetic difference-in-differences estimates. 95% CIs are in parentheses. ATT = average treatment effect on the treated. Mean DV = mean dependent variable of the treated group during the pre-policy period. ATT as % change = the ATT expressed as a percent change relative to the mean DV. Significance: * p<0.10 ** p<0.05 *** p<0.01.

5. DISCUSSION

A. Summary of major findings

This report details the evaluation of two distinct types of local tobacco prevention and control policies in California: flavored tobacco sales restrictions and comprehensive tobacco sales bans. The study provides detailed insights into their respective impacts on tobacco and non-tobacco product sales. The study leveraged retail scanner data encompassing a wide array of retail establishments across California from 2018 to 2022 and utilized advanced econometric models to measure the policy effects accurately.

For the local flavored tobacco sales restrictions, the findings are compelling. These policies led to a significant reduction in the sales of all tobacco products by an average of 8.4%, with flavored tobacco products experiencing a substantial, statistically significant decline of 27.7%. While there was a statistically significant 3.7% increase in unflavored tobacco product sales, suggesting some substitution by consumers, it was insufficient to offset the overall decrease in tobacco sales. In addition, the local flavor policies did not significantly change the sales of NRT products, indicating that these sales restrictions did not directly drive consumers towards smoking cessation products. This pattern of sales decline was consistent across different tobacco product categories, including cigarettes, cigars, smokeless tobacco, and ENDS. We failed to detect significant cross-border shopping in the neighboring areas of cities with a local flavor policy, although the results suggest a small degree of displacement may have occurred. Similarly, we found small, but not statistically significant, decreases in sales of non-tobacco products (1.0%) among retailers located in a city with a local flavor policy. Thus, our findings do not point toward retailers incurring broader adverse impacts to their bottom line as a result of the local flavor policies, although we cannot rule out small shifts.

The analysis of tobacco sales bans in Beverly Hills and Manhattan Beach revealed a dramatic reduction in tobacco sales in a sample of grocery, pharmacy, and convenience stores. With the exception of one convenience store in the Manhattan Beach sample, tobacco product sales decreased to zero units within three months of the policies going into effect. This decrease aligns with the high compliance rates observed in these areas during a secret shopper study.[13] Notably, the policies did not lead to significant cross-border shopping. This finding suggests that the policies may have effectively curtailed local tobacco consumption without displacing it to neighboring areas. Furthermore, the analysis extended to the sale of non-tobacco products, revealing no significant impacts on these sales within Beverly Hills but a not statistically significant decrease in non-tobacco sales in Manhattan Beach. This outcome suggests that there may be local variation in the extent to which the decrease in tobacco sales impacts overall store revenues from other product categories. If clusters of cities adopt tobacco sales bans, as occurred with local flavor policies, it would be expected to diminish any potential negative economic impacts from such tobacco control policies.

In summary, these policies reduced tobacco sales substantially within the jurisdictions where they were put into effect and, in most cases, did so without displacing sales to nearby areas or harming the sale of non-tobacco products, thereby supporting their effectiveness and viability as public health measures. These analyses provide compelling evidence for the potential broader adoption of such measures. These insights also offer valuable guidance for policymakers aiming to craft impactful public health strategies without detrimental economic outcomes. The findings from the analysis of local flavor policies may be particularly useful in the context of California's statewide policy, Senate Bill (SB) 793. The local experience would indicate that following implementation of SB 793, we would not anticipate large shifts in sales to bordering states, nor a significant impact on sales of non-tobacco products. Future research can assess these trends.

B. Strengths and limitations

This study has notable strengths. It draws data from a large set of retailers statewide and uses advanced econometric methods. The study provides the first estimates of the economic effects of local flavored tobacco sales restrictions and local tobacco sales bans in California. Findings from the flavor policy analyses provide an indication of the anticipated impacts from California's statewide flavored tobacco restriction. Findings from the sales ban analyses offer a first look at the local economic effects for an innovative policy approach being considered by other California localities.

This study has several limitations. First, the retail sales data identified purchasing behavior and not direct consumption. It is possible, though unlikely, that policy-affected populations consumed a different share of purchased tobacco products than did policy-unaffected control populations (e.g., sharing with others). Second, the retail sales data contain only a sample of stores in each city, and thus do not include all sales. The custom Nielsen data set's sales coverage of approximately 16% could introduce bias into our estimates, especially if sales coverage shifted differentially over time in treated versus control cities or if excluded stores experienced different customer responses than included stores. Moreover, the sales data were primarily drawn from a sample of large chain stores. These results may not extend to independent stores, including tobacco specialty stores (smoke shops and vape shops) nor to online sales, and the results may not generalize to cities with different socio-demographic profiles, tobacco retail landscapes, and policy environment from the treated cities. Third, our primary outcomes are measured using unit sales. If consumers switch package sizes over time, this may be overlooked by a count of unit sales, as opposed to volume sales. However, we did not observe any substantial or systematic substitution toward larger or smaller package sizes, suggesting that this is unlikely to be a major concern. Fifth, we used ZIP codes to define cross-border stores, although ZIP codes are not polygons. Thus, the defined border area included some stores that are closer to the boundary of treated cities, and some that are farther away. This may introduce a degree of misclassification, to the extent that stores closer or farther from the boundary have different sales patterns.

C. Conclusion

This report details the effectiveness of two types of local tobacco sales restrictions in achieving significant reductions in tobacco product sales across California. By considering substitution to other products, cross-border shopping, and sales of non-tobacco tobacco products, the analyses aimed to characterize more comprehensively the impacts of these policies. This report also points to some of the opportunities and challenges of using retail scanner data for policy evaluation. Retail scanner data can help to address some evaluation questions that other data sources cannot, such as the broader retailer impacts, although the data source does not lend itself to documenting health equity impacts for priority populations. Further research may take advantage of the strengths of retail scanner data to evaluate other local and state tobacco policies, such as California's statewide flavored tobacco sales restriction.

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