

Flavored E-cigarette Sales Restrictions and Young Adult Tobacco Use in the United States

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Agenda

- Background
- Research Questions
- Data
- Methods
- Findings
- Discussion, Limitations, & Implications

Background

- Vaping rates have risen rapidly while cigarette smoking fell over the past two decades → increased regulatory focus on ENDS
- Review of quasi-experimental analyses of ENDS restrictions' effects: 16 of 18 found ENDS restrictions *increased* conventional cigarette smoking relative to nonadopting states (Pesko, 2023)
- Varying risk profiles (e.g., NASEM, Allcott & Rafkin 2022) → need to understand ENDS policies' cross-product effects
- Particular concerns about youth use → Regulatory interest in flavor restrictions

Research Question

How do policies restricting sales of flavored electronic nicotine delivery systems (ENDS) affect young adult vaping and cigarette smoking in the United States?

Prior Peer-Reviewed, Quasi-experimental Analyses

- **Quasi-experimental Analyses = Quasi-experimental Research Design + formal tests of key assumptions**
- **Prior Quasi-experimental Analyses of ENDS Flavor Policies**
 - Restrictions on flavored ENDS sales *reduced* retail sales of ENDS but *increased* cigarette sales (Friedman, 2024)
 - Scoping review of 30 studies found moderate quality evidence ENDS restrictions *decreased* ENDS sales and availability but low quality evidence they *increased* cigarette sales (Cadham et al., 2022)

Preview

- Collected comprehensive data on state and local restrictions on sales of flavored ENDS, flavored cigars, and menthol cigarettes
- Match to survey data on 18-29 year-olds, from the 2016-2023 Behavioral Risk Factor Surveillance System
- Two-way fixed effects: Compare states which did vs did not adopt ENDS flavor restrictions, before vs. after they went into effect
 - Test for parallel trends & bias from staggered implementation
- Preview of results: ENDS flavor restrictions yield reductions in young adult vaping but increases in young adult smoking

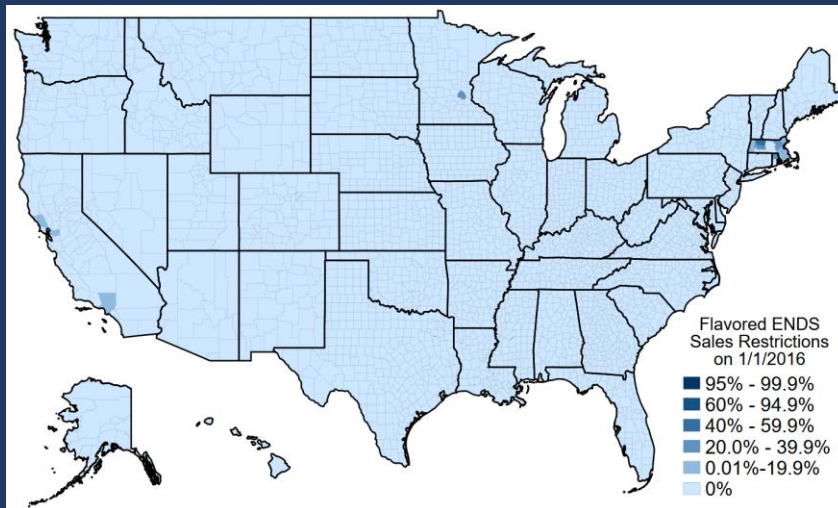
Data

- Behavioral Risk Factor Surveillance System: annual, cross-sectional survey of non-institutionalized US civilian adults, nationally and state-representative
- Analytic sample: balanced panel from 2016-2023, omitting states that:
 1. Dropped e-cigarette questions in ≥ 1 of the years these were optional, or
 2. Did not collect sufficient data for inclusion in a particular BRFSS year (4 states)
- Matched to policy and environmental variables by state & interview timing
- Outcomes
 - Indicators for current and daily ENDS use
 - Indicators for current and daily cigarette use (predicated on having smoked ≥ 100 cigarettes)

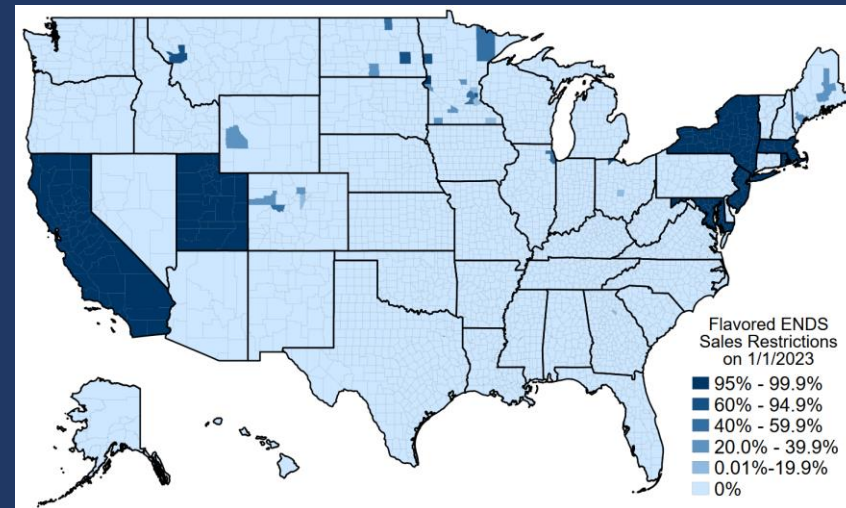
Flavor Policy Data

- Original comprehensive flavor policy dataset compiled by our team
 - Obtained signed ordinances and regulations for all state and local US flavor restrictions. Each text reviewed by two coders to determine key dates, products and flavors covered, any exemptions, and other policy details. Where these coders differed, a doctoral-level coder performed tertiary review to resolve discrepancies.

Flavored ENDS Map Q1 2016



Flavored ENDS Map Q3 2023



Methods: Specifications

$$Y_{isq} = \beta_0 + \beta_1 \text{Flv}_{isq} + \beta_2 \text{LocFlv}_{isq} + \lambda \overrightarrow{X_{isq}} + \gamma_s + \delta_q + \varepsilon_{isq} \quad (1)$$

$$Y_{isq} = \beta_0 + \beta_1 \text{Flv}_{isq} + \beta_2 \text{LocFlv}_{isq} + \beta_3 \text{MDFlv}_{isq} + \lambda \overrightarrow{X_{isq}} + \gamma_s + \delta_q + \varepsilon_{isq}. \quad (2)$$

- γ_s state fixed effects
- δ_q quarter-year fixed effects
- X_{isq} controls
- Flv_{isq} state-level flavored ENDS restriction
- LocFlv_{isq} partial coverage from municipal ENDS restriction

Assumptions Required for Causal Inference

- **Assumption 1:** Covariates adjust for other time-varying policies/events related to both the exposure and outcome
- **Assumption 2:** States that did versus did not adopt flavor restrictions exhibit parallel trends in their outcome variable before policies went into effect (adjusting for covariates)
 - Test via event study
- **Assumption 3:** With staggered adoption, either comparisons between early-versus-late adopters do not drive effect estimates, or estimates use a method robust to dynamic treatment effects.
 - Test via Goodman-Bacon decomposition.

Table 1: Summary Statistics, 2016-2023 BRFSS participants ages 18-29 years				
Waves	2016-2023	2016-2023,	2016	2023
Sample	Full Data	Balanced Panel	Balanced Panel	Balanced Panel
Outcome Variables				
Current ENDS Use	13.4%	13.6%	8.4%	16.9%
Daily ENDS Use	5.9%	6.0%	2.5%	9.5%
Current Cigarette Use	12.1%	12.5%	16.4%	6.9%
Daily Cigarette Use	7.1%	7.4%	10.2%	3.5%
Any Current Use (Cigarettes or ENDS)	19.5%	20.3%	21.1%	20.5%
Flavor Restrictions				
State Restriction on Flavored ENDS sales	8.8%	10.6%	0.0%	22.2%
% Covered by Substate-Restrictions-only on Flavored ENDS sales	2.6%	2.1%	1.5%	1.0%
Flavored Cigar sales restriction coverage	8.2%	9.9%	7.4%	10.9%
Menthol Cigarette sales restriction coverage	5.5%	5.1%	0.2%	10.1%
Proportion of Residents Covered by Ban on Unflavored ENDS sales	0.4%	0.1%	0.0%	0.0%
Proportion of Residents in Interim between passage and effective date of ENDS Flavor Policy	1.0%	0.9%	0.2%	0.9%

TWFE Results: Current Vaping

ENDS Flavor Policies & Current Vaping among 18-29 year-olds

A) Simplified Specification's State Flavor Policy Coefficient, unweighted

B) Baseline Specification, unweighted

State Policy Indicator, - MD

Maryland Policy Indicator

C) Balanced Panel, unweighted

State Policy Indicator, - MD

Maryland Policy Indicator

D) Balanced Panel, sample-weighted

State Policy Indicator, - MD

Maryland Policy Indicator

E) Balanced Panel, sample-weighted: Drop first 6 months of COVID-19

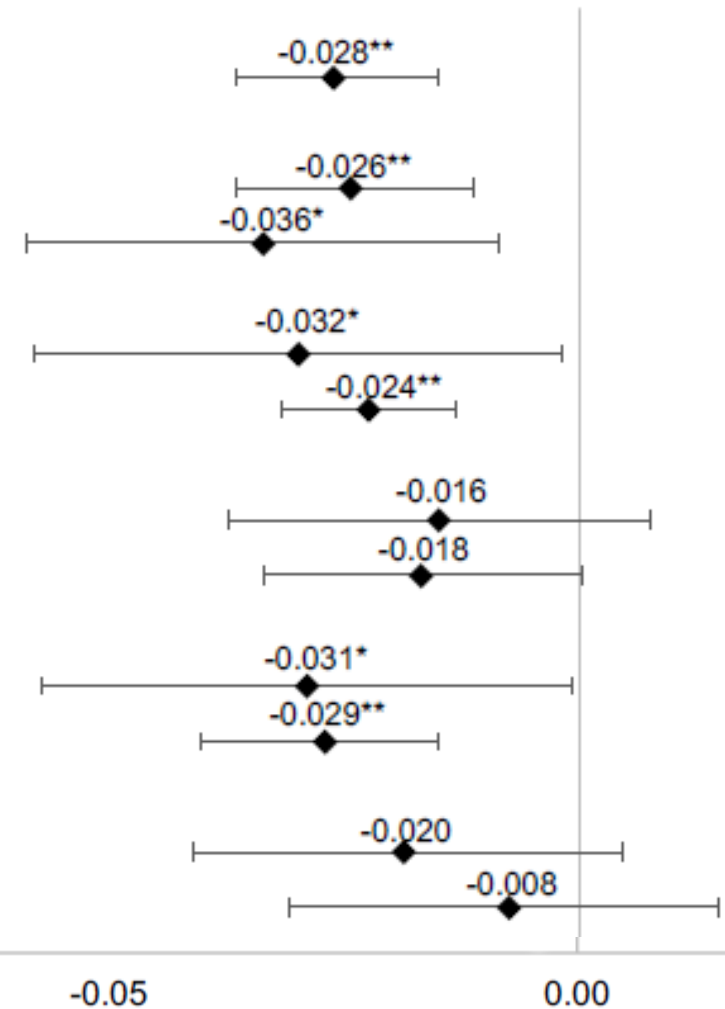
State Policy Indicator, - MD

Maryland Policy Indicator

F) Balanced Panel, sample-weighted: Drop 10 Highest Smoking States

State Policy Indicator, - MD

Maryland Policy Indicator



TWFE Results: Daily Vaping

ENDS Flavor Policies & Daily Vaping among 18-29 year-olds

G) Simplified Specification's State Flavor Policy Coefficient, unweighted

H) Baseline Specification, unweighted

State Policy Indicator, - MD

Maryland Policy Indicator

I) Balanced Panel, unweighted

State Policy Indicator, - MD

Maryland Policy Indicator

J) Balanced Panel, sample-weighted

State Policy Indicator, - MD

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K) Balanced Panel, sample-weighted: Drop first 6 months of COVID-19

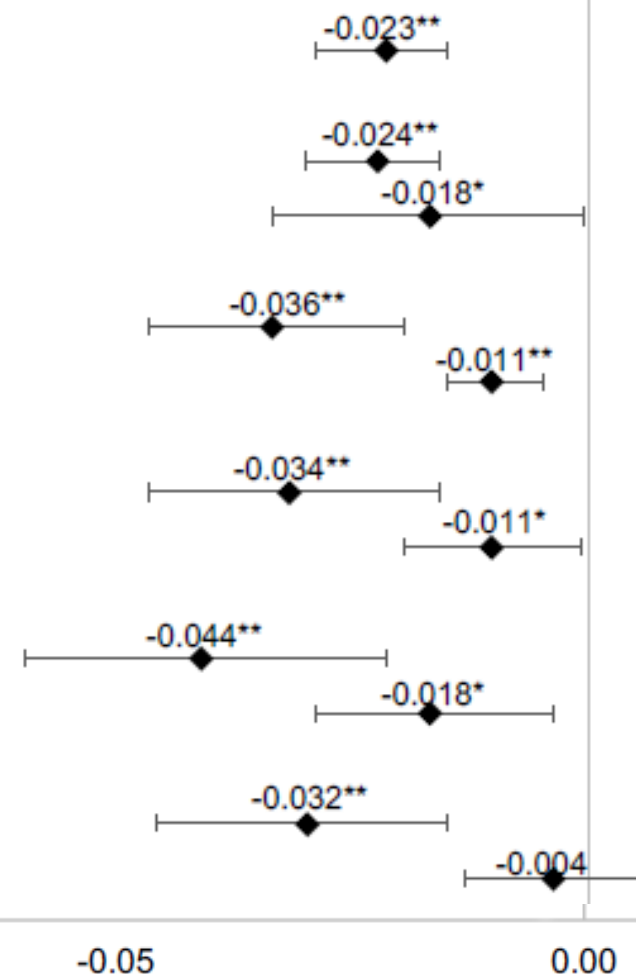
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L) Balanced Panel, sample-weighted: Drop 10 Highest Smoking States

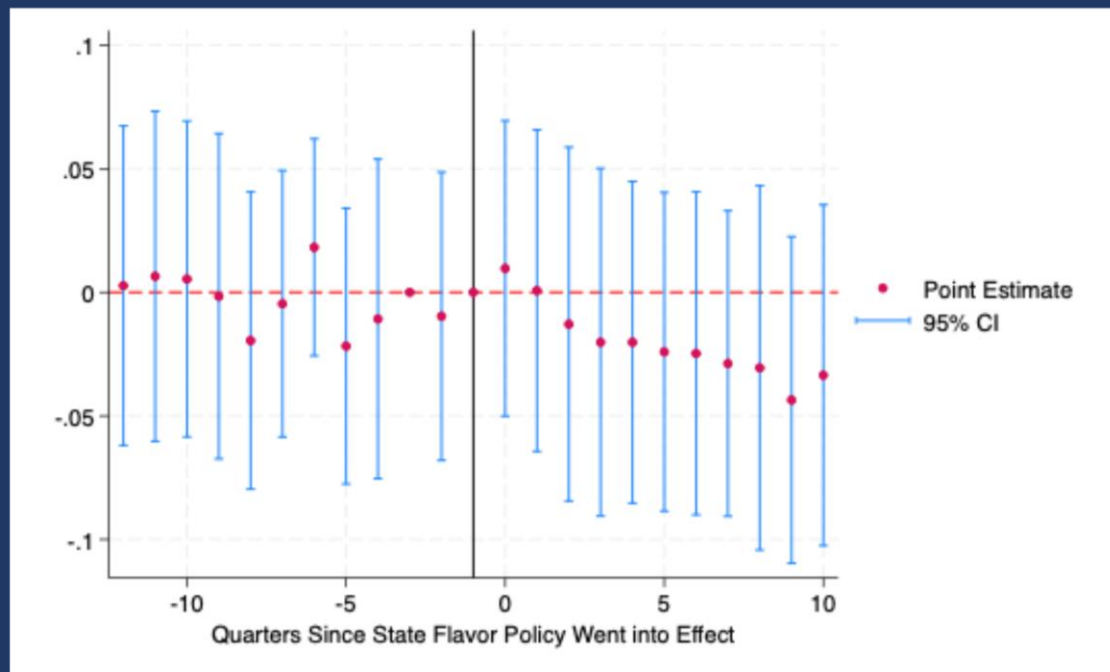
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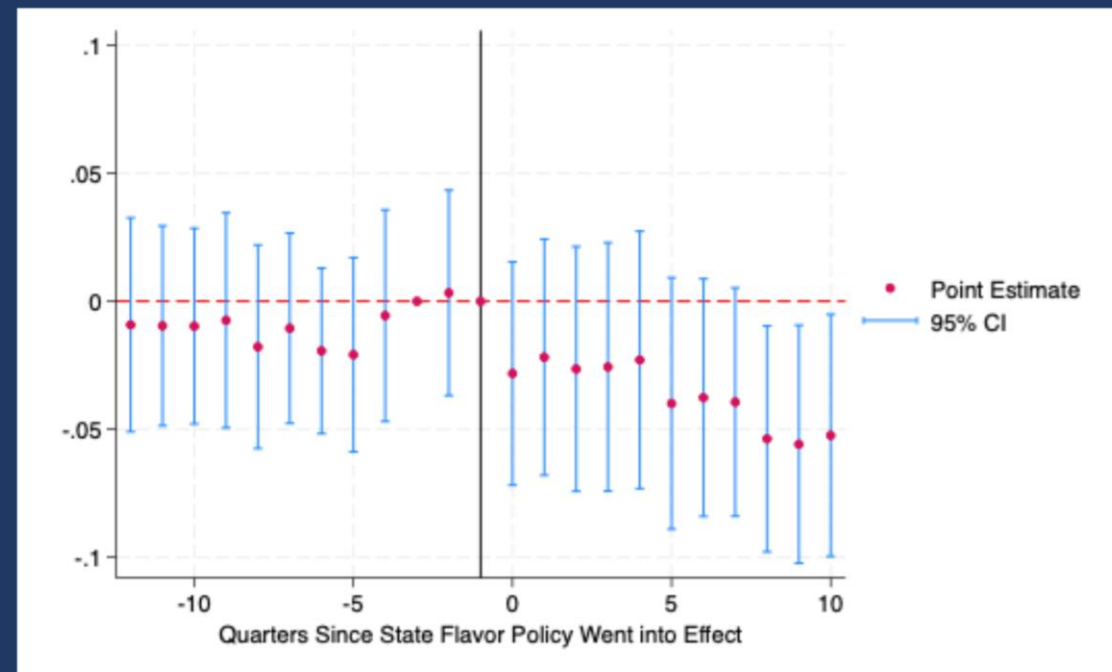


TWFE Event Studies

Current Vaping



Daily Vaping



Goodman Bacon Decompositions in Brief

	Current Vaping		Daily Vaping	
	Beta	Weight	Beta	Weight
A) Early vs. Later Adopters & vice-versa	-0.0122	0.0205	0.0115	0.0205
B) Adopters vs Never-adopters	-0.0527	0.4998	-0.0416	0.4998
C) Within-adopter (i.e., pre- vs. post-adoption)	-0.0143	0.4797	-0.0343	0.4797

TWFE Results: Current Smoking

ENDS Flavor Policies & Current Smoking among 18-29 year-olds

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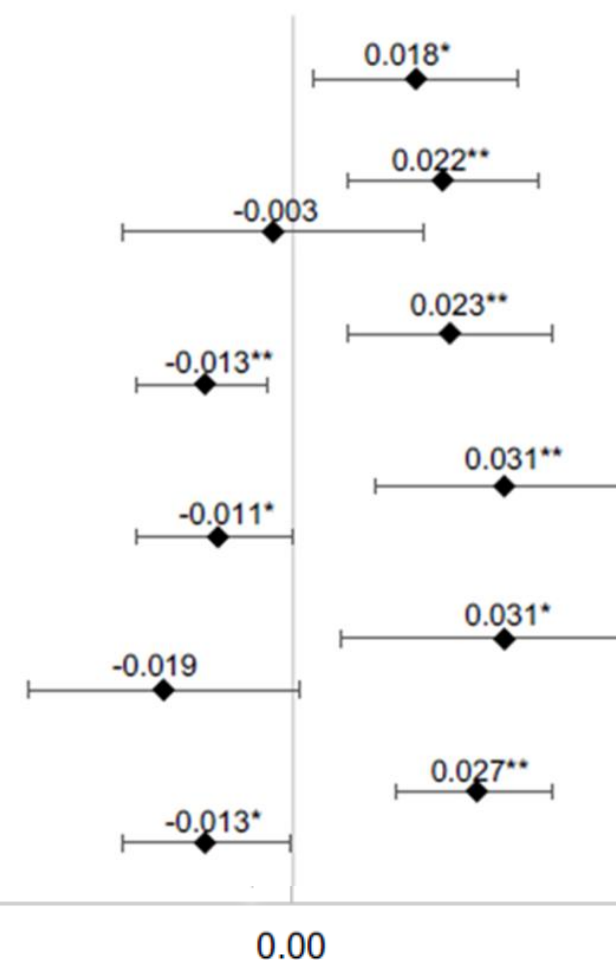
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TWFE Results: Daily Smoking

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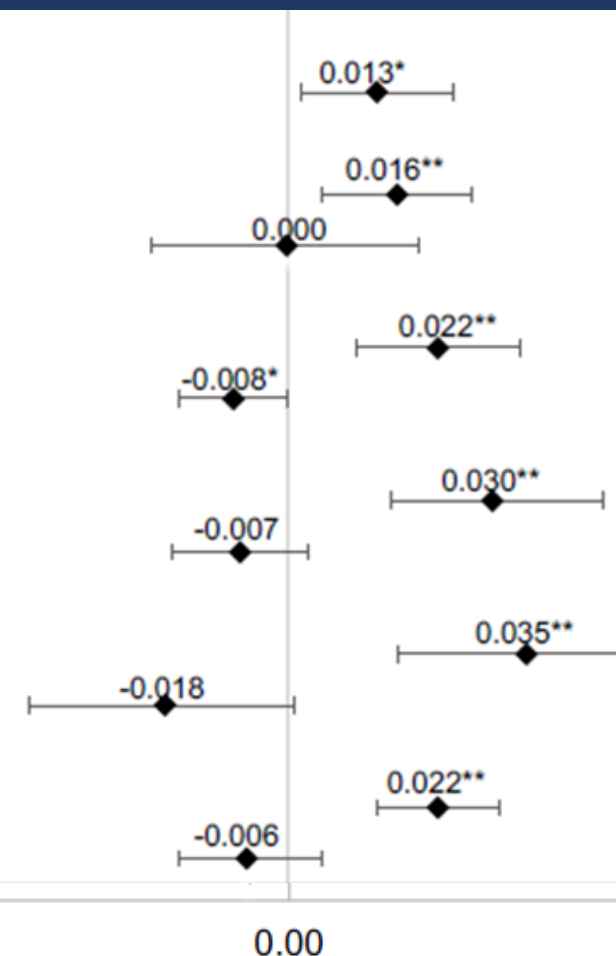
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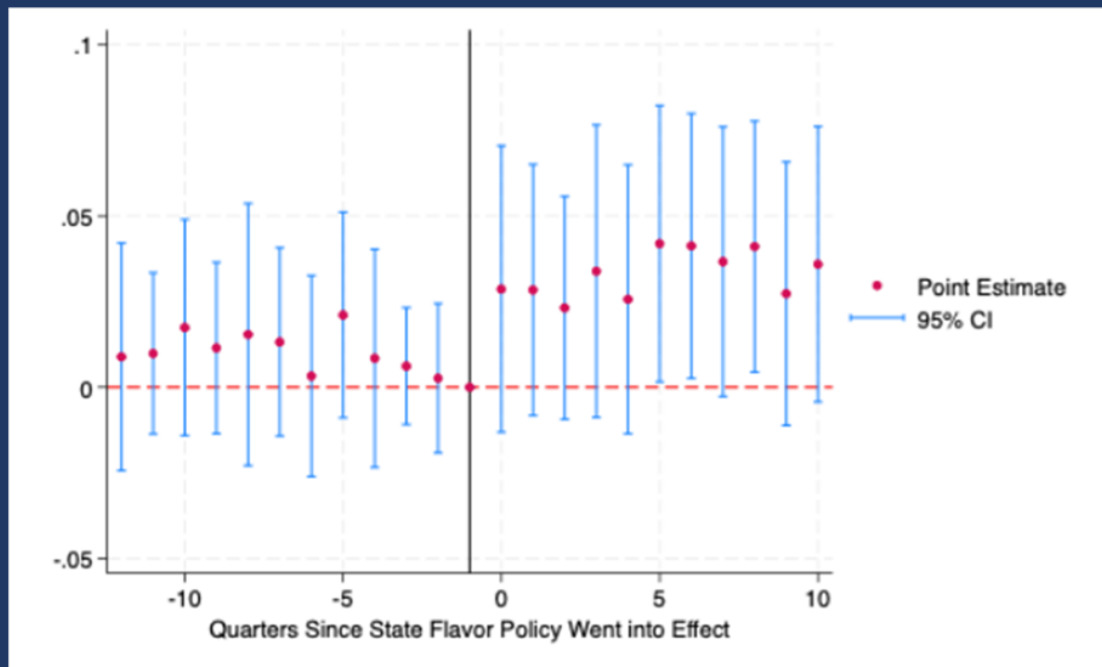
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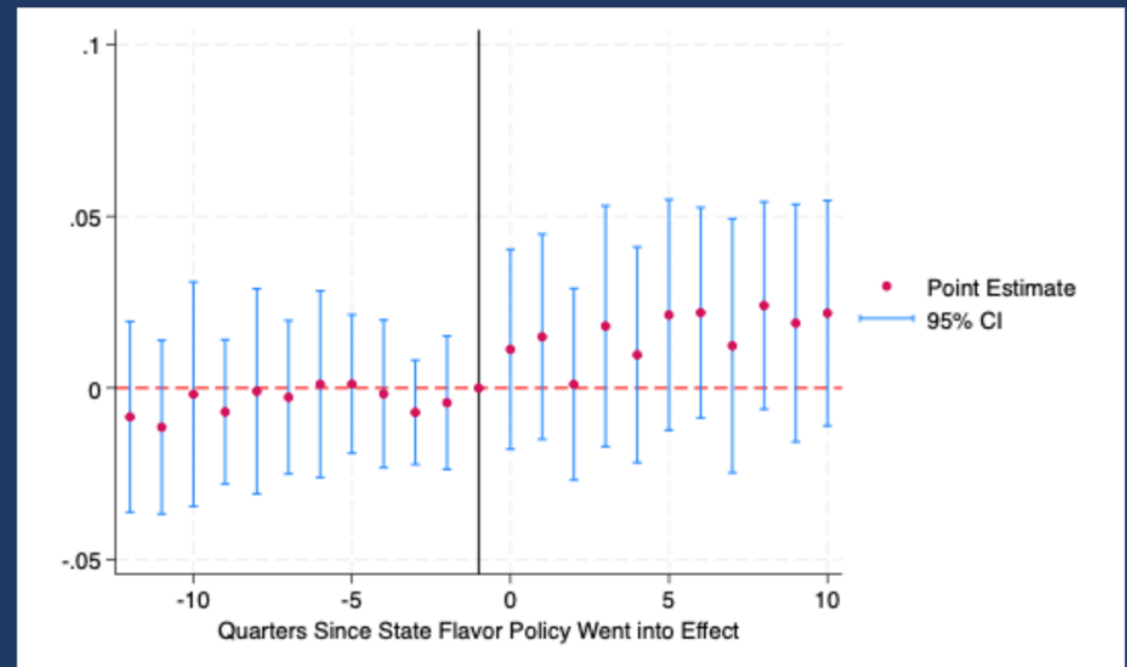


TWFE Event Studies

Current Smoking



Daily Smoking



Summary of Results

- ENDS flavor restrictions are associated with *decreases* in vaping but *increases* in cigarette smoking
 - Equivalent to a 22-30% increase in daily smoking & 76-80% reduction in daily vaping relative to 2018 rates
 - 3 – 4.4 additional daily smokers for every 5 fewer daily vapers
- Consistent with economic substitutes for young adults
 - i.e., making ENDS more expensive / less appealing → increased smoking
- Caveat: Maryland

Possible explanations for Maryland?

- Maryland is a flavor policy outlier
 - Regulation not law
 - Exempts open-system devices (used more by adults than youth)
 - Exempts menthol flavors
- Future research should further investigate cross-product effects of more nuanced ENDS flavor restrictions

Limitations

- Data is self-reported and gaps in BRFSS data coverage for vaping
 - Flavored ENDS sales restrictions would need to increase reporting of cigarette use for social desirability bias to effect estimates
- Unable to test for shifts in frequent to nondaily use
- Cannot distinguish specific mechanisms, such as retailer compliance, changes in manufacturing behaviors, and/or changes in risk perception

Implications

- There is a substitution effect between vaping and smoking for US young adults
- Care must be given when designing policy which restricts ENDS and consider the cost of substitution into smoking
- Possibility that more nuanced policy approach, can achieve reduction in vaping initiation without increasing smoking rates

Any Questions?