The Effect of E-Cigarette Flavor Bans on Tobacco Use

Chad Cotti, Michigan State University
Charles Courtemanche, University of Kentucky, NBER & IZA
Yang Liang, San Diego State University
Catherine Maclean, George Mason University, NBER & IZA
Erik Nessen, Wake Forest University & NBER
Joseph J. Sabia, Center for Health Economics & Policy Studies,
San Diego State University & IZA

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Chad D. Cotti, Charles J. Courtemanche, Yang Liang, Johanna Catherine Maclean, Erik T. Nesson & Joseph J. Sabia

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Advocates for sales restrictions on flavored e-cigarettes argue that flavors appeal to young people and lead them down a path to nicotine addiction. This study is among the first to examine the effect of state and local restrictions on the sale of flavored electronic nicotine delivery system (ENDS) products on youth and young adult tobacco use. Using data from the State and National Youth Risk Behavior Surveys, we find that the adoption of an ENDS flavor restriction reduces frequent and everyday youth ENDS use by 1.2 to 2.5 percentage points. Auxiliary analyses of the Behavioral Risk Factor Surveillance System show similar effects on ENDS use for young adults ages 18-20. However, we also detect evidence of an unintended effect of ENDS flavor restrictions that is especially clear among 18-20-year-olds: inducing substitution to combustible cigarette smoking. Finally, there is no evidence that ENDS flavor restrictions affect ENDS use among adults aged 21 and older or non-tobacco-related health behaviors such as binge drinking and illicit drug use.

Disclosure

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Motivation

- Electronic Nicotine Delivery Systems (ENDS) are devices in which nicotine and other ingredients (such as flavors) are heated into a vapor and inhaled
  - Introduced to the US tobacco market in 2006

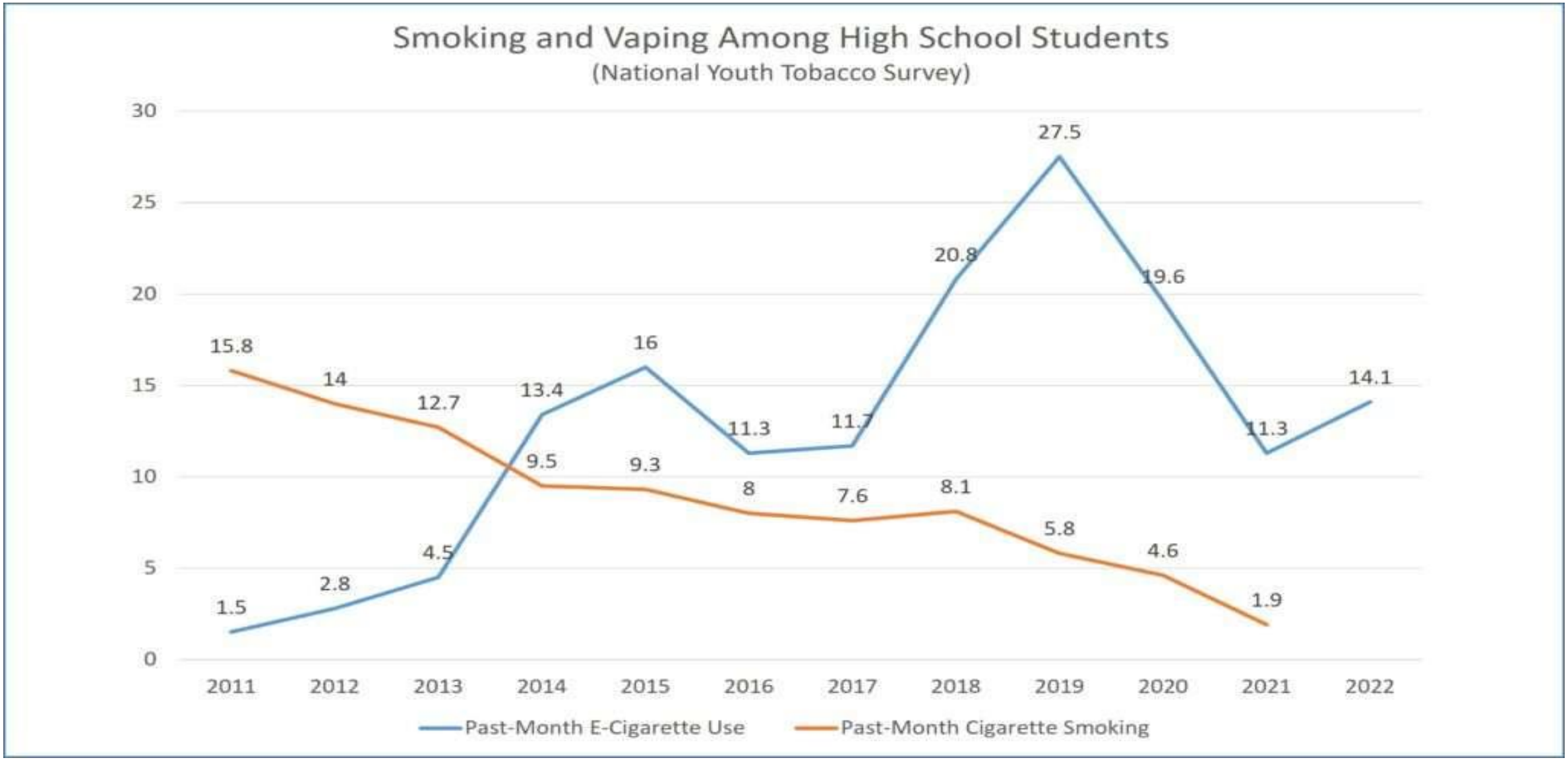
- If ENDS and combustible cigarettes are substitutes, ENDS could aid in smoking cessation among adults and serve as a harm reduction tool
  - National Academies of Sciences (2018) report concludes that:

    "…e-cigarettes appear to pose less risk to an individual than combustible tobacco cigarettes …[E]-cigarette aerosol contains fewer numbers and lower levels of toxicants than smoke from combustible tobacco cigarettes."

  - Allcott and Rafkin (2022): survey of experts – e-cigs 37% as harmful as cigarettes
  - Public Health England (2015): expert review found e-cigs are 5% as harmful as cigarettes

- On the other hand, there is concern among some tobacco control advocates that access to ENDS could serve as a "gateway" to combustible tobacco for youth
  - Are e-cigarettes and combustible tobacco complements or substitutes for teenagers?
  - In absence of ENDS, would youth ENDS users abstain from tobacco or use another tobacco product?

Trends in US Youth Tobacco Use



Common US Policy Strategies to Curb Youth ENDS Use

- ENDS taxes
- Extension of clean indoor air laws to cover e-cigarette aerosol
- Minimum legal purchasing ages for e-cigarettes
  - first ENDS-specific MLPA (of age 18), then Tobacco-21
- Online sales delivery bans
- ENDS licensure laws
- Restrictions on sales of flavored ENDS

Are flavors luring teenagers to vape nicotine?

"The tobacco industry is well aware that flavors appeal to and attract kids, and that young people are uniquely vulnerable to nicotine addiction… [W]e all must work with even greater urgency to protect our nation's youth from all flavored e-cigarettes, including disposables."

-Truth Initiative (2023)

ENDS Flavor Restrictions

- According to the 2023 National Youth Tobacco Survey, 89% of youths who vape report using flavors
  - Most common are fruit (63%), candy, desserts, or other sweets (35%), mint (28%), and menthol (20%) (Birdsey et al., 2023)

- Cigarette flavors (other than menthol) have been banned since 2009 under Family Smoking Prevention and Tobacco Control Act (TCA)
  - A number of states have adopted bans on menthol flavored cigarettes

- Research Question: Do flavored ENDS products attract (or “lure”) teens into using ENDS?
  - In the absence of access to flavored ENDS, what would teens do?

Additional health risks of inhaling flavors?

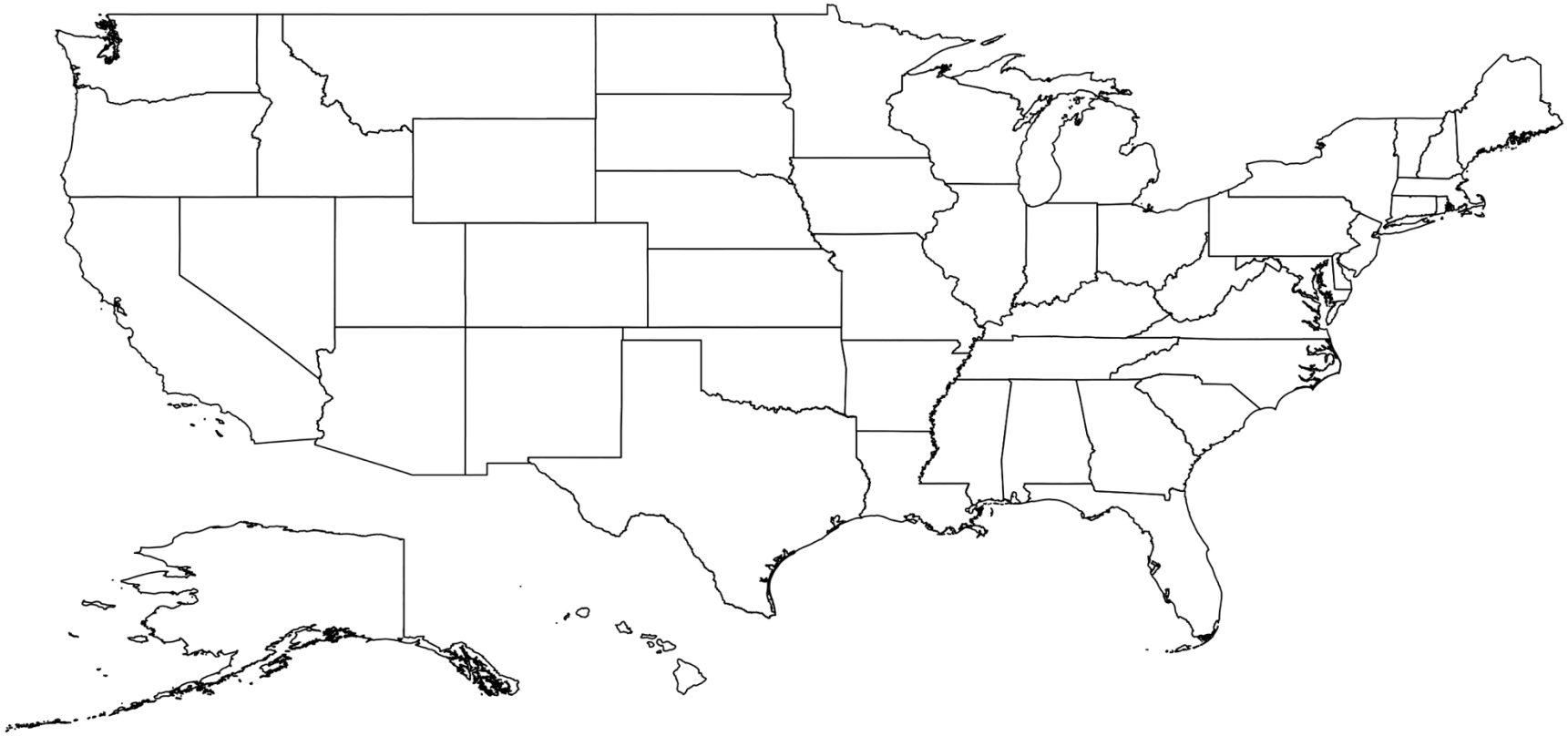
- Diacetyl (DA) and acetyl propionyl (AP) chemicals are most commonly used for the flavoring of e-cigarette products

- While generally recognized as safe when ingested, exposure through inhalation linked to respiratory function decline (Clark & Winter, 2015; Egilman et al., 2011)
  - Inhalation of DA is associated with (1) fixed obstructive lung disease in affected individuals (Chaisson et al., 2010), and (2) the onset of bronchiolitis obliterans, an irreversible respiratory ailment (“popcorn lung disease”) (Harber et al., 2006)
  - Some evidence that AP may cause airway epithelial damage upon acute inhalation exposure (Hubbs et al., 2012)

- The presence of these chemicals in e-cigarettes appears to be substantially lower than in combustible cigarettes (Farsalinos et al. 2015)

- As of July 2024, 9 states and over 390 localities had adopted restrictions on the sales of flavored e-cigarettes

2015



ENDS Flavor Restrictions

Entire state and year

50% to 99% of adjusted pop-year

<50% of adjusted state pop-year

No restriction in effect for large jurisdiction

2017

ENDS Flavor Restrictions

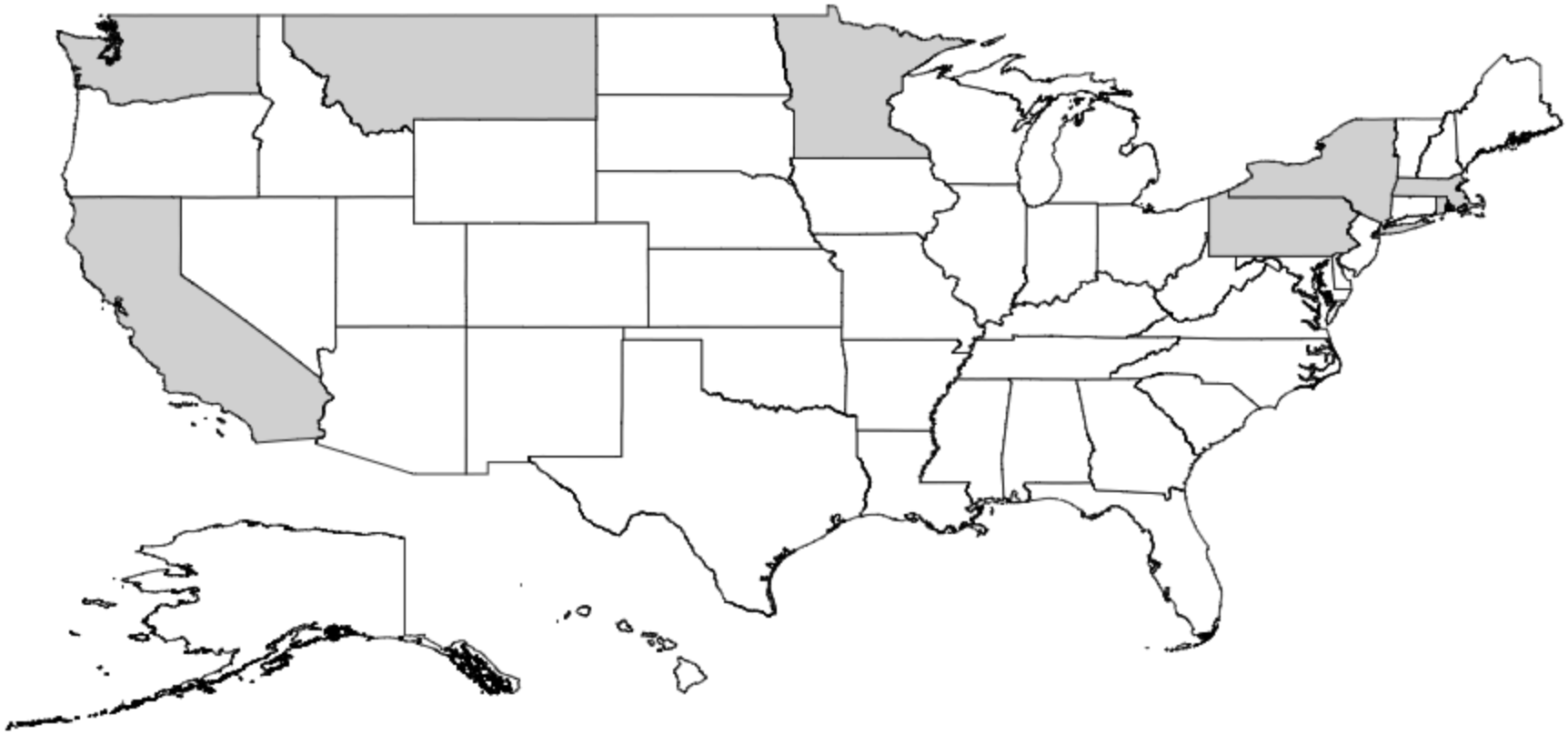
- Entire state and year
- 50% to 99% of adjusted pop-year
- <50% of adjusted state pop-year
- No restriction in effect for large jurisdiction

2018

ENDS Flavor Restrictions

- Entire state and year
- 50% to 99% of adjusted pop-year
- <50% of adjusted state pop-year
- No restriction in effect for large jurisdiction

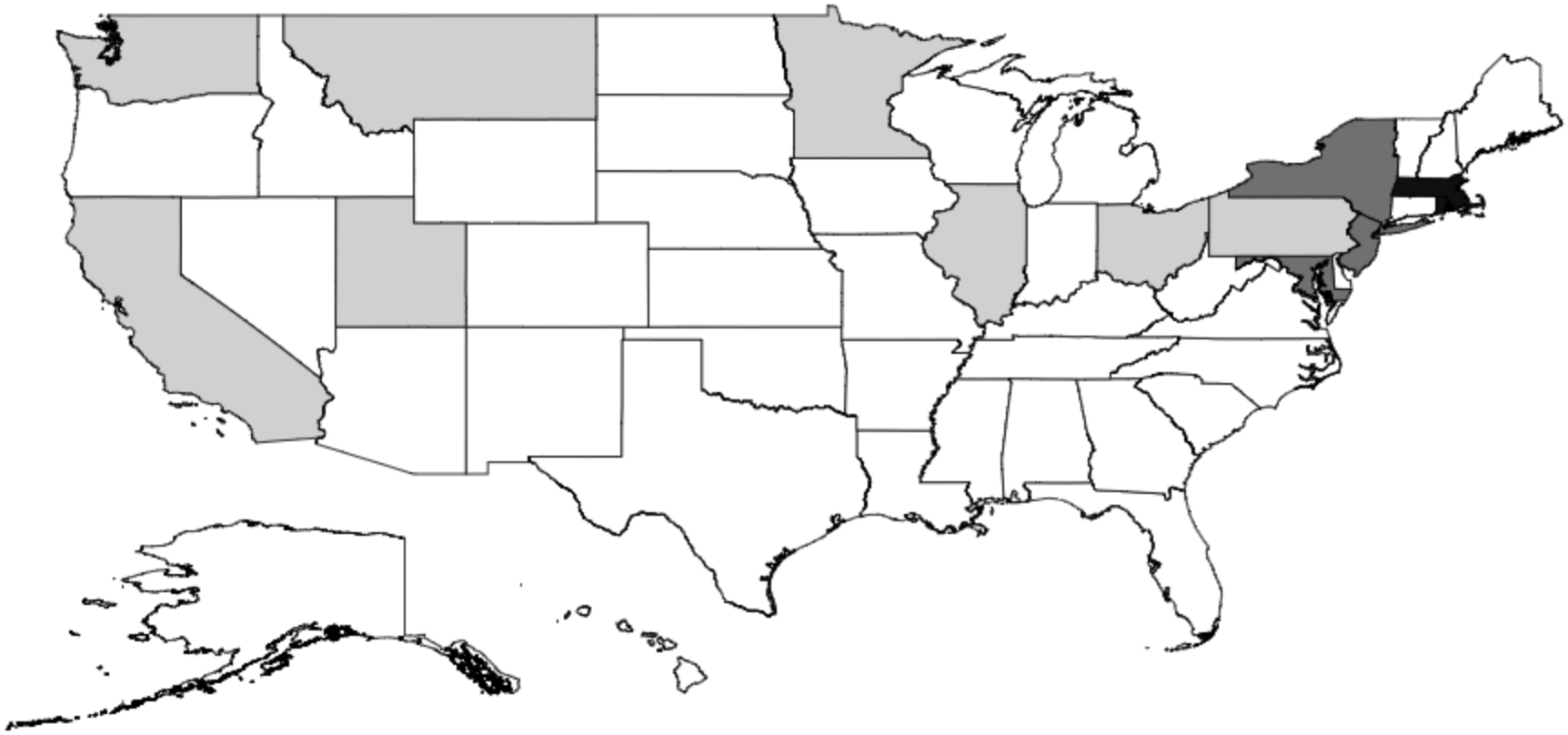
2019



ENDS Flavor Restrictions

- Entire state and year
- 50% to 99% of adjusted pop-year
- <50% of adjusted state pop-year
- No restriction in effect for large jurisdiction

2020



ENDS Flavor Restrictions

- Entire state and year
- 50% to 99% of adjusted pop-year
- <50% of adjusted state pop-year
- No restriction in effect for large jurisdiction

2021

ENDS Flavor Restrictions

- Entire state and year
- 50% to 99% of adjusted pop-year
- <50% of adjusted state pop-year
- No restriction in effect for large jurisdiction

How might ENDS flavor restrictions affect ENDS use?

- To the extent that individuals gain utility from flavors, restrictions on flavored ENDS sales would be expected to reduce ENDS use
  - These effects may be larger for youths and young adults who are more likely to use ENDS for utility gains from flavors (while adults often use ENDS for smoking cessation)

- On the other hand, if flavored ENDS and unflavored ENDS are substitutes, this might mute the effect of ENDS flavor restrictions on overall ENDS use

- Effect might also be muted because JuuL voluntarily removed mango, creme, fruit, mint, and cucumber flavored (pre-filled) cartridges from retail stores in November 2018 and online in October 2019
  - Some evidence of substitution to menthol in response
  - Still, flavors still widely available for disposable cartridges; other firms' pre-filled cartridges

- Spillover effects of ENDS flavor restrictions on combustible tobacco
  - There is growing evidence that ENDS and combustible cigarettes are substitutes for youths

Contributions

- While prior studies have explored (1) case studies of individual city or state flavor bans (Asare et al. 2022; Gammon et al. 2021) or (2) the effect of flavor restrictions in early-adopting jurisdictions on aggregate e-cigarette sales (Ali et al. 2022; Friedman et al. 2023), **this is the first study to comprehensively examine the impact of statewide and large sub-state ENDS flavor restrictions adopted across the US on youth and young adult tobacco use**

- Use nationally representative survey data that allows us to examine heterogeneity in treatment effects by age, gender, race/ethnicity

- Explore both intended effects (on ENDS) and unintended effects (on combustible cigarette and cigar use)

Data

- **National and State Youth Risk Behavior Surveys (YRBS)**
  - Biennial School-based surveys (2015 -2021) coordinated by CDC
  - Representative of tobacco behaviors among US high school students at state and national levels
  - Outcomes: prior-month e-cigarette and combustible tobacco use (any, frequent, everyday)

- **Behavioral Risk Factor Surveillance Survey (BRFSS)**
  - Telephone-based survey of adults aged 18 and older (2016-2021) coordinated by CDC
  - Nationally representative survey of adults (examine young adults 18-20 years and 21+ years)
  - Outcomes: prior-month e-cigarette and combustible cigarette use

- **Public Health Law Center; Campaign for Tobacco Free Kids**
  - Measure of ENDS Flavor Restrictions
  - Construct population-weighted flavor restriction measure at the state-by-year-quarter level
  - Based on statewide restrictions and 23 restrictions in large localities (> 200k population)

Empirical Approach

- Two-way fixed-effects model estimated via logit and OLS:

$$\mathbf{Y}_{ist} = \beta_0 + \beta_1 \mathbf{FlavorBan}_{st} + \mathbf{X'}_{ist}\beta_2 + \mathbf{P'}_{st}\beta_3 + \alpha_s + \lambda_p + \varepsilon_{ist}$$

- $\mathbf{Y}_{ist}$: tobacco use (prior-month e-cigarette use, combustible cigarette smoking)
- $\mathbf{FlavorBan}_{st}$: ENDS Flavor Restriction
- $\mathbf{X}_{ist}$: Individual characteristics (e.g., gender, age, race, ethnicity, grade)
- $\mathbf{P}_{st}$: State Combustible tobacco and ENDS policy controls (Tobacco-21 Laws, ENDS Tax, Cigarette Tax, Menthol Cigarette Ban, ENDS Licensure Laws, ENDS Online Sales Delivery Ban, Clean Indoor Air Laws, MLPAs), Unemployment Rate, COVID-19 Death Rate, Beer Taxes, Medical and Recreational MJ Laws
- $\boldsymbol{\alpha_s}$: State fixed effects
- $\boldsymbol{\tau_t}$: Year-semester fixed effects
- Standard errors clustered at state level and regressions are weighted

- Machine learning (LASSO) approach to select controls

ENDS Flavor Bans & Prior-Month Youth ENDS Use

	(a) Current ENDS Use				
ENDS Flavor Restriction	-0.0091	-0.0159	-0.0107	-0.0065	-0.0160
	(0.0100)	(0.0201)	(0.0196)	(0.0216)	(0.0228)
Pre-Treatment Mean DV	*0.2128*	*0.2128*	*0.2128*	*0.2128*	*0.2128*
N	676563	676563	676563	676563	676563
Control Variables:					
Demographic Controls?	Yes	Yes	Yes	Yes	Yes
Macroeconomic Controls?	No	Yes	Yes	Yes	Yes
COVID-19 Controls?	No	Yes	Yes	Yes	Yes
Tobacco Policy Controls?	No	No	Yes	Yes	Yes
Substance Policy Controls?	No	No	No	Yes	Yes
Double-selection LASSO	No	No	No	No	Yes

*$p<.1$, **$p<.05$, ***$p<.01$

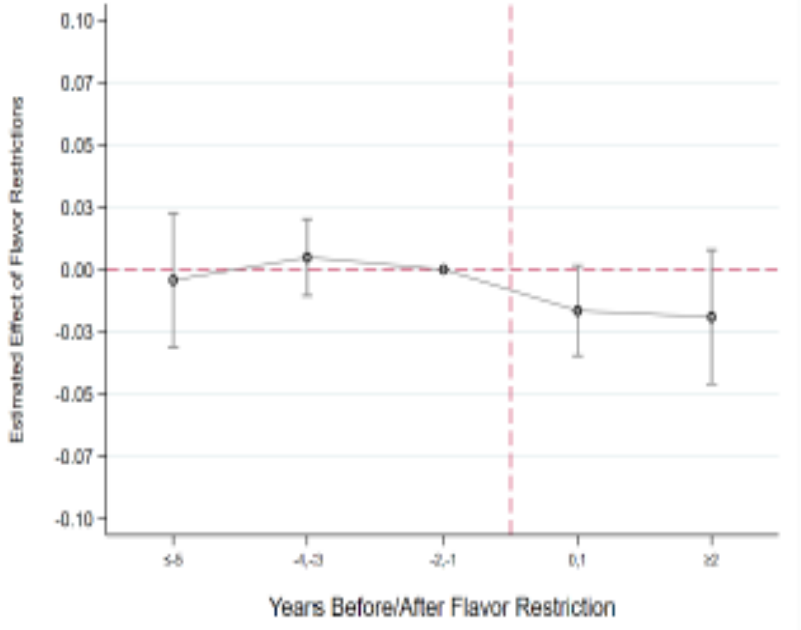
ENDS Flavor Bans & Habitual Youth ENDS Use

	(b) Frequent ENDS Use				
ENDS Flavor Restriction	-0.0130*	-0.0204**	-0.0205**	-0.0180*	-0.0186*
	(0.0075)	(0.0087)	(0.0096)	(0.0094)	(0.0095)
Pre-Treatment Mean DV	*0.0407*	*0.0407*	*0.0407*	*0.0407*	*0.0407*
N	676563	676563	676563	676563	676563
	(c) Everyday ENDS Use				
ENDS Flavor Restriction	-0.0120**	-0.0139**	-0.0131*	-0.0136**	-0.0129*
	(0.0054)	(0.0058)	(0.0072)	(0.0069)	(0.0068)
Pre-Treatment Mean DV	*0.0267*	*0.0267*	*0.0267*	*0.0267*	*0.0267*
N	676563	676563	676563	676563	676563
Control Variables:					
Demographic Controls?	Yes	Yes	Yes	Yes	Yes
Macroeconomic Controls?	No	Yes	Yes	Yes	Yes
COVID-19 Controls?	No	Yes	Yes	Yes	Yes
Tobacco Policy Controls?	No	No	Yes	Yes	Yes
Substance Policy Controls?	No	No	No	Yes	Yes
Double-selection LASSO	No	No	No	No	Yes

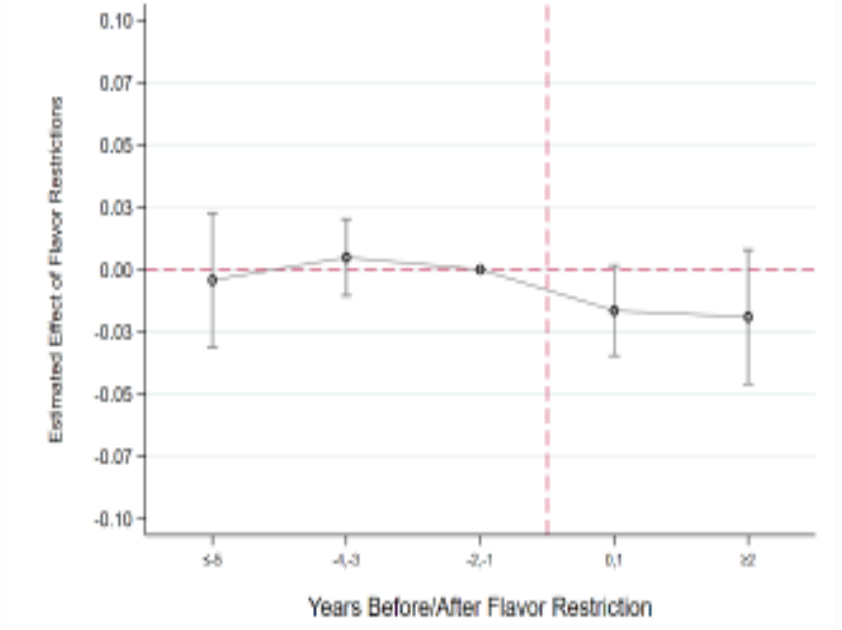
* $p<.1$, ** $p<.05$, *** $p<.01$

Event-Study Analysis: Habitual ENDS Use

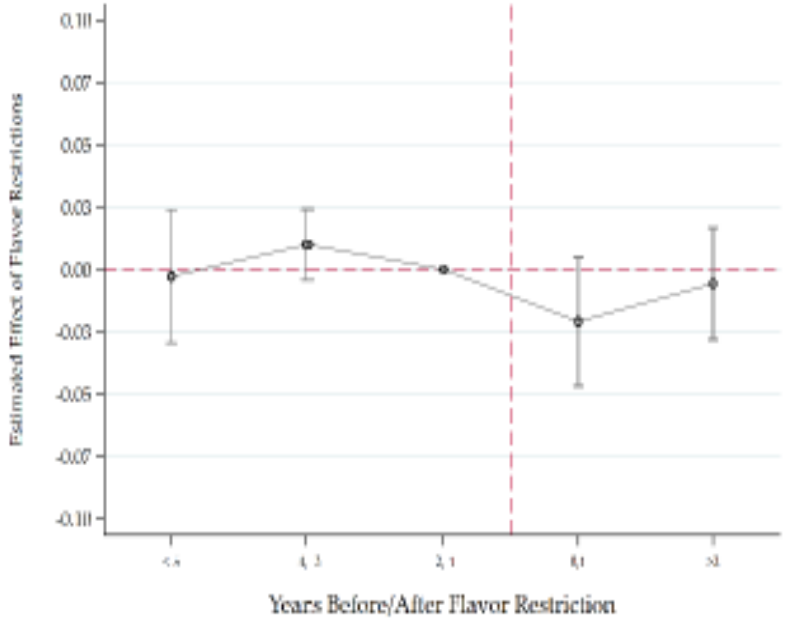
(a): Demographic Controls



(b): Demographic, Macro, and COVID Controls



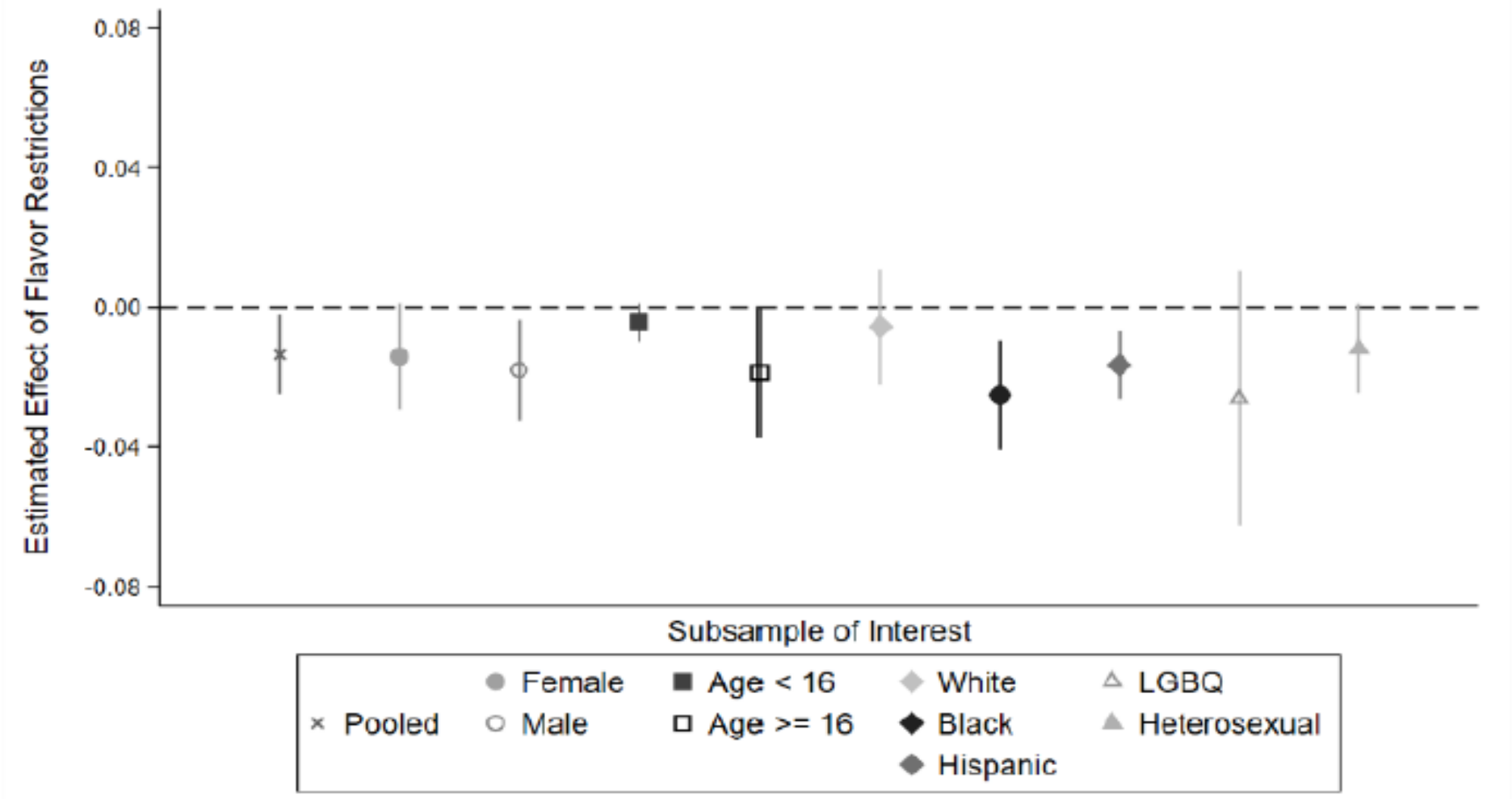
(c): LASSO Controls



	Current ENDS Use	Frequent ENDS Use	Everyday ENDS Use
	Panel I: Census Region-by-Year (Year) FE		
ENDS Flavor Restriction	0.0072	-0.0201	-0.0213**
	(0.0313)	(0.0129)	(0.0098)
Pre-Treatment Mean DV	*0.2128*	*0.0407*	*0.0267*
N	676563	676563	676563
	Panel II: Census Division-by-Year (Year) FE		
ENDS Flavor Restriction	-0.0003	-0.0220*	-0.0228**
	(0.0272)	(0.0131)	(0.0111)
Pre-Treatment Mean DV	*0.2128*	*0.0407*	*0.0267*
N	676563	676563	676563
	Panel III: State-Specific Linear Time Trends		
ENDS Flavor Restriction	-0.0402	-0.0209	-0.0162
	(0.0315)	(0.0151)	(0.0121)
Pre-Treatment Mean DV	*0.2128*	*0.0407*	*0.0267*
N	676563	676563	676563

	(1)	(2)	(3)
	Baseline Logistic Estimate	**Gardner Two-Step**	**Stacked DD**
		Panel I: Current ENDS Use	
ENDS Flavor Res.	-0.0069	-0.0079	-0.0287
	(0.0216)	(0.0294)	(0.0231)
Pre-Treatment Mean	*0.2128*	*0.2128*	*0.2117*
N	676563	676563	1527991
		Panel II: Frequent ENDS Use	
ENDS Flavor Res.	-0.0181*	-0.0145	-0.0224**
	(0.0094)	(0.0175)	(0.0097)
Pre-Treatment Mean	*0.0407*	*0.0407*	*0.0434*
N	676563	676563	1527991
		Panel III: Everyday ENDS Use	
ENDS Flavor Res.	-0.0136**	-0.0188*	-0.0181**
	(0.0069)	(0.0111)	(0.0079)
Pre-Treatment Mean DV	*0.0267*	*0.0267*	*0.0282*
N	676563	676563	1527991

Heterogeneity in Habitual Use Effects



Spillovers to Youth Combustible Tobacco Use

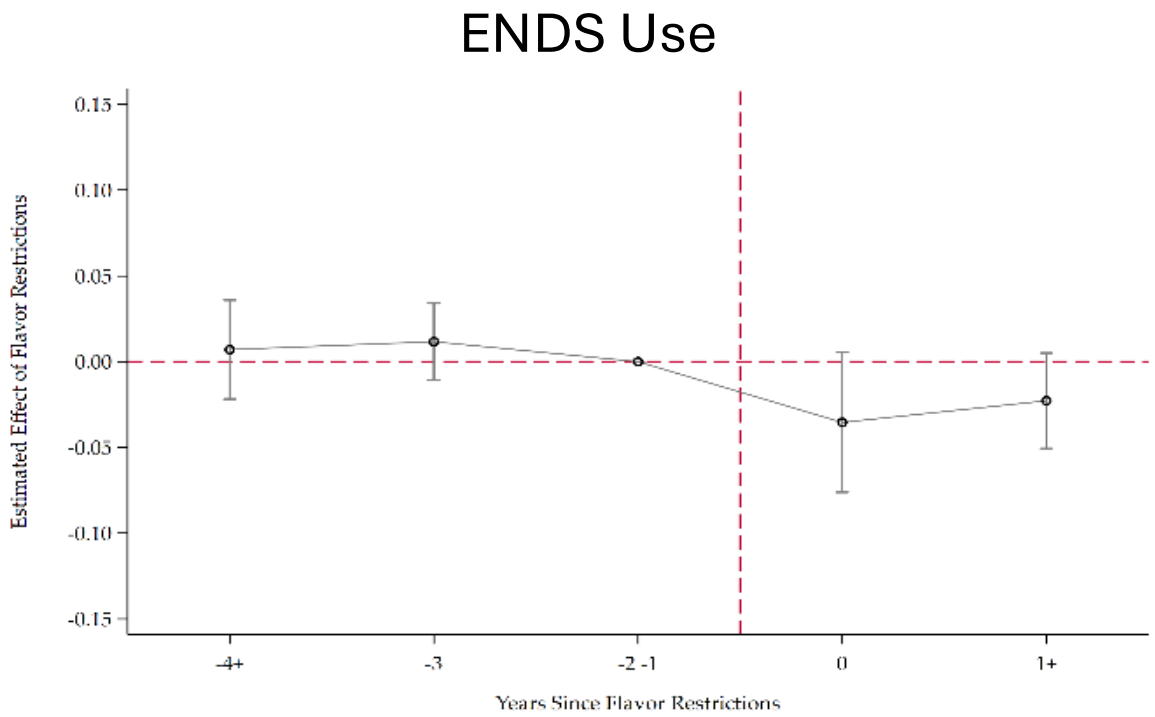
	Cigarettes			Cigarettes or Cigars		
ENDS Flavor Restriction	0.0110	0.0074	0.0191*	0.0127	0.0214**	0.0181
	(0.0087)	(0.0079)	(0.0105)	(0.0107)	(0.0103)	(0.0128)
Pre-Treatment Mean DV	*0.0758*	*0.0758*	*0.0758*	*0.1059*	*0.1059*	*0.1059*
N	716481	716481	716481	622014	622014	622014
Control Variables:						
Observable Controls?	Yes	Yes	Yes	Yes	Yes	Yes
Double-Selection LASSO	No	Yes	No	No	Yes	No
Cen. Region-by-Year FE?	No	No	Yes	No	No	Yes

ENDS Flavor Restrictions & Adult ENDS Use

	Aged 18-20			Aged 21+		
Panel I: Current ENDS Use						
ENDS Flavor Restriction	-0.033**	-0.036*	-0.048**	-0.006	-0.002	-0.0002
	(0.014)	(0.019)	(0.019)	(0.004)	(0.003)	(0.003)
Pre-Treatment Mean DV	*0.116*	*0.116*	*0.116*	*0.041*	*0.041*	*0.041*
N	38086	38086	38086	1548893	1548893	1548893
Panel II: Everyday ENDS Use						
ENDS Flavor Restriction	-0.021	-0.025	-0.034	-0.004	-0.001	0.001
	(0.013)	(0.020)	(0.021)	(0.002)	(0.002)	(0.001)
Pre-Treatment Mean DV	*0.037*	*0.037*	*0.037*	*0.015*	*0.015*	*0.015*
N	38086	38086	38086	1548891	1548891	1548891
Specification	OLS	OLS	Logit	OLS	OLS	Logit
Control Variables:						
Observable Controls?	Yes	Yes	Yes	Yes	Yes	Yes
Region-by-Year Fixed Effects?	No	Yes	Yes	No	Yes	Yes

*$p<.1$, **$p<.05$, ***$p<.01$

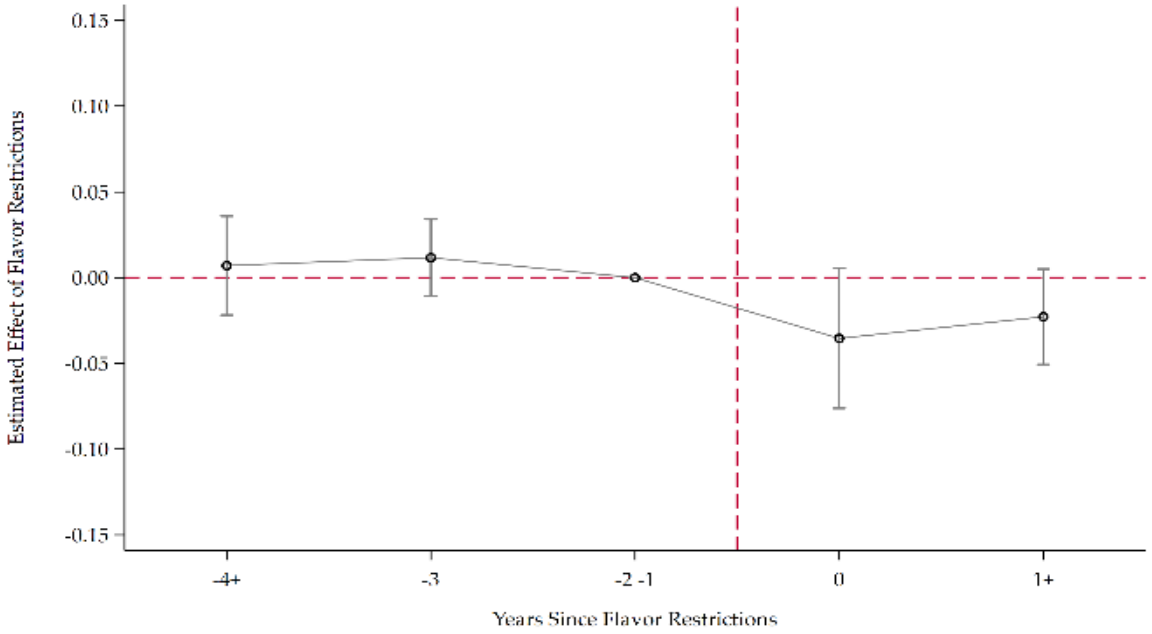
Event-Study Analysis, 18-20-Year Olds



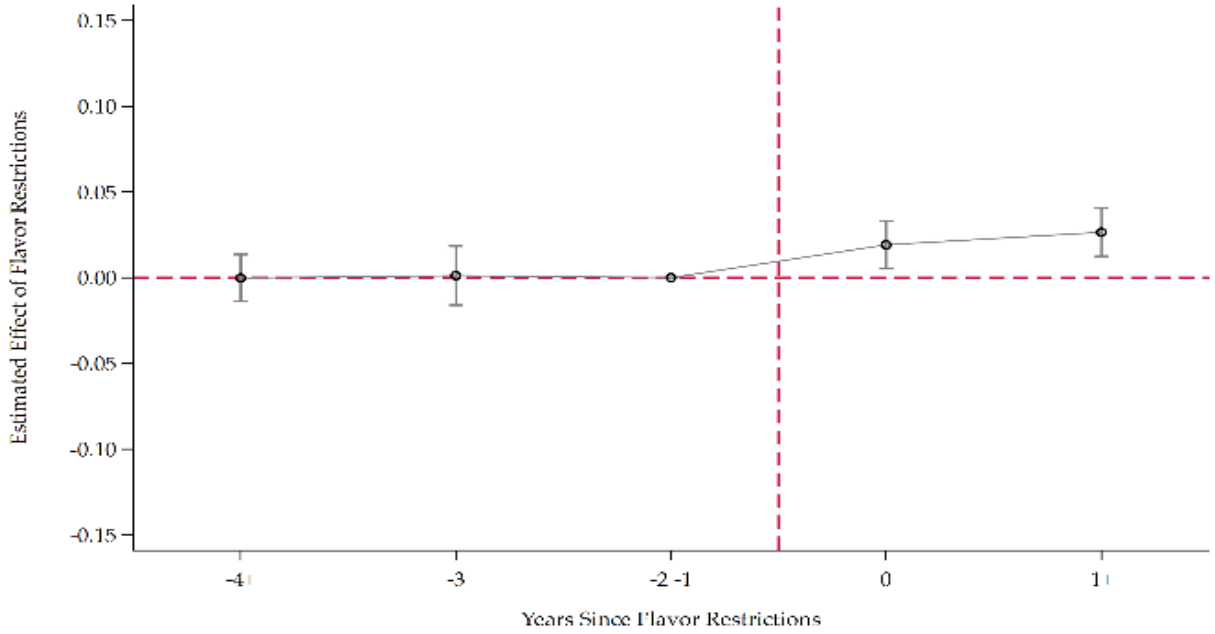
Adoption of an ENDS flavor restriction is associated with a 3-5 percentage-point reduction in young adult ENDS use

Event-Study Analysis, 18-20-Year Olds

ENDS Use



Cigarette Smoking



Adoption of an ENDS flavor restriction is associated with a 3-5 percentage-point reduction in young adult ENDS use, but a **1-2 percentage-point increase in cigarette smoking**

Summary of Findings

- Findings suggest that ENDS flavor restrictions are associated with a reduction in more intensive measures of vaping among youth by at least 32% in all specifications, average of 52%
  - Do not clearly influence smoking among younger teens
  - But do increase the smoking rate among young adults by more than half of the amount of the drop in the vaping rate

- These results illustrate that policies related to e-cigarettes can have both benefits and unintended consequences, with the net effect being difficult to ascertain without more certainty about the relative harms

- Could there be other supply-side restrictions that curb youth tobacco use?

Do E-Cigarette Retail Licensure Laws Reduce Youth Tobacco Use?

[Forthcoming, Journal of Health Economics]

Charles Courtemanche, University of Kentucky, NBER & IZA

Yang Liang, San Diego State University

J. Catherine Maclean, George Mason University, NBER & IZA

Caterina Muratori, San Diego State University & University of Barcelona

Joseph J. Sabia, San Diego State University & IZA

E-Cigarette Retail Licensure Laws

- Since 2011, 33 states and the District of Columbia have adopted ELLs, which require tobacco sellers to obtain a state license to sell e-cigarettes over the counter (Public Health Law Center, 2023)

- Minimum license fees range from trivial amounts (e.g., $5 in Montana) to more substantial fees (e.g., $800 in Connecticut), and penalties for noncompliance include suspension or revocation of a firm's license to sell e-cigarettes, fines up to $25,000, even criminal sanctions

What are ELLs designed to do?

- ELLs are designed to regulate sales, increase compliance with state tobacco regulations (i.e., minimum legal purchasing ages, scanner ID laws), and reduce the supply of e-cigarettes available to local consumers, in particular youth

- ELLs also offer “support” to retailers, with some ELLs encouraging vendors to meet with onsite inspectors to ask questions about selling e-cigarettes and ensuring proper signage

- Many public health advocates see ELLs as a vital anti-vaping policy tool (Tobacco Control Legal Consortium, 2016)
  - In 2018, the U.S. Surgeon General issued an advisory recommending that states and localities adopt ELLs as part of a comprehensive approach to curbing youth vaping (U.S. Surgeon General, 2018)

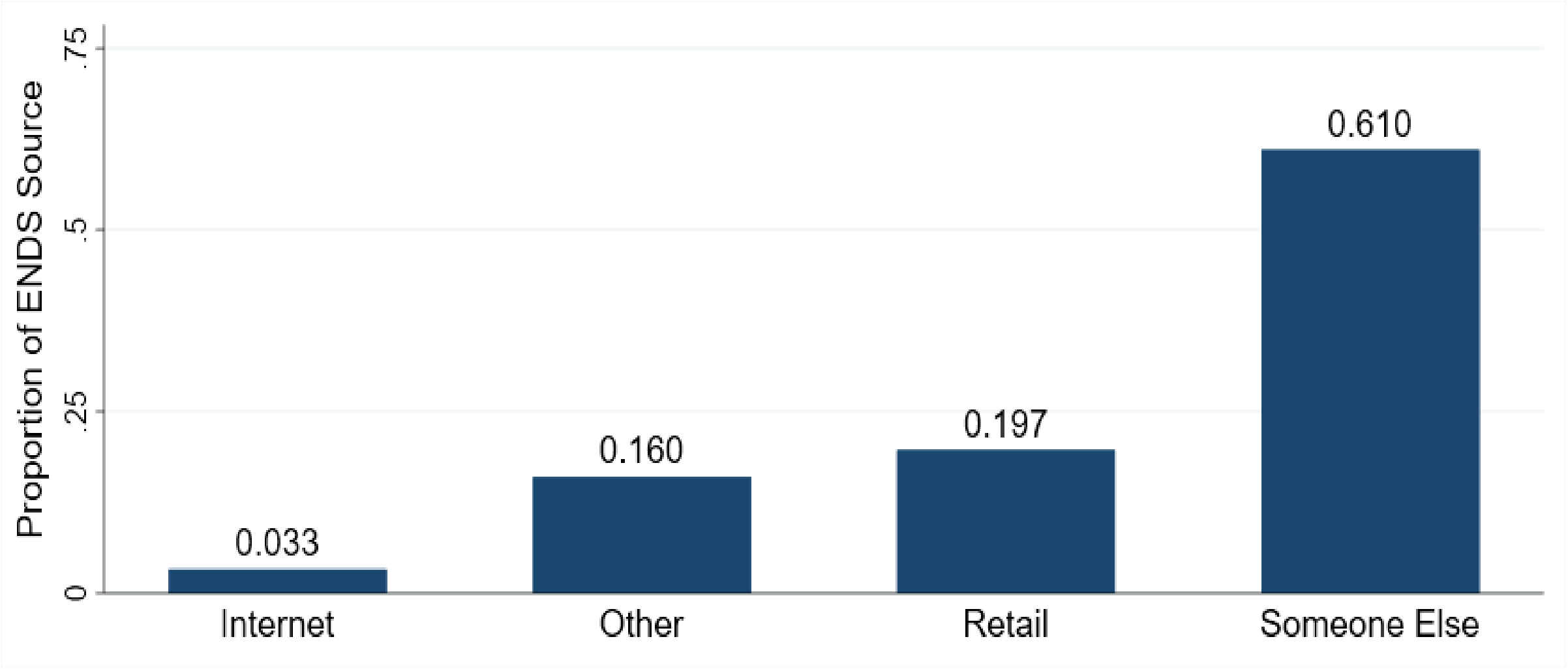
Theoretical Channels

- ELLs could reduce youth ENDS use either (1) by enabling better enforcement of other e-cigarette laws (such as MLPAs), or (2) by influencing key market variables such as price and availability

- On the other hand, if the cost of obtaining a license is relatively low (Patel et al., 2020) or if the ELL does not promote better enforcement of e-cigarette law provisions, ELLs may have little effect on local access to e-cigarettes.
  - Renewable licensure fees are relatively small (typically $25 to $50 per year, occasionally $100 or more)
  - Compliance checks may be “spotty” and infrequent
  - Youths typically do not rely on direct purchase from retailers
    - Informal social markets, online markets, or illicit market may insulate youths from the effects of ENDS regulations

Usual Source of E-Cigarettes for Youth Vapers

[State and National Youth Risk Behavior Surveys, 2017-2021]



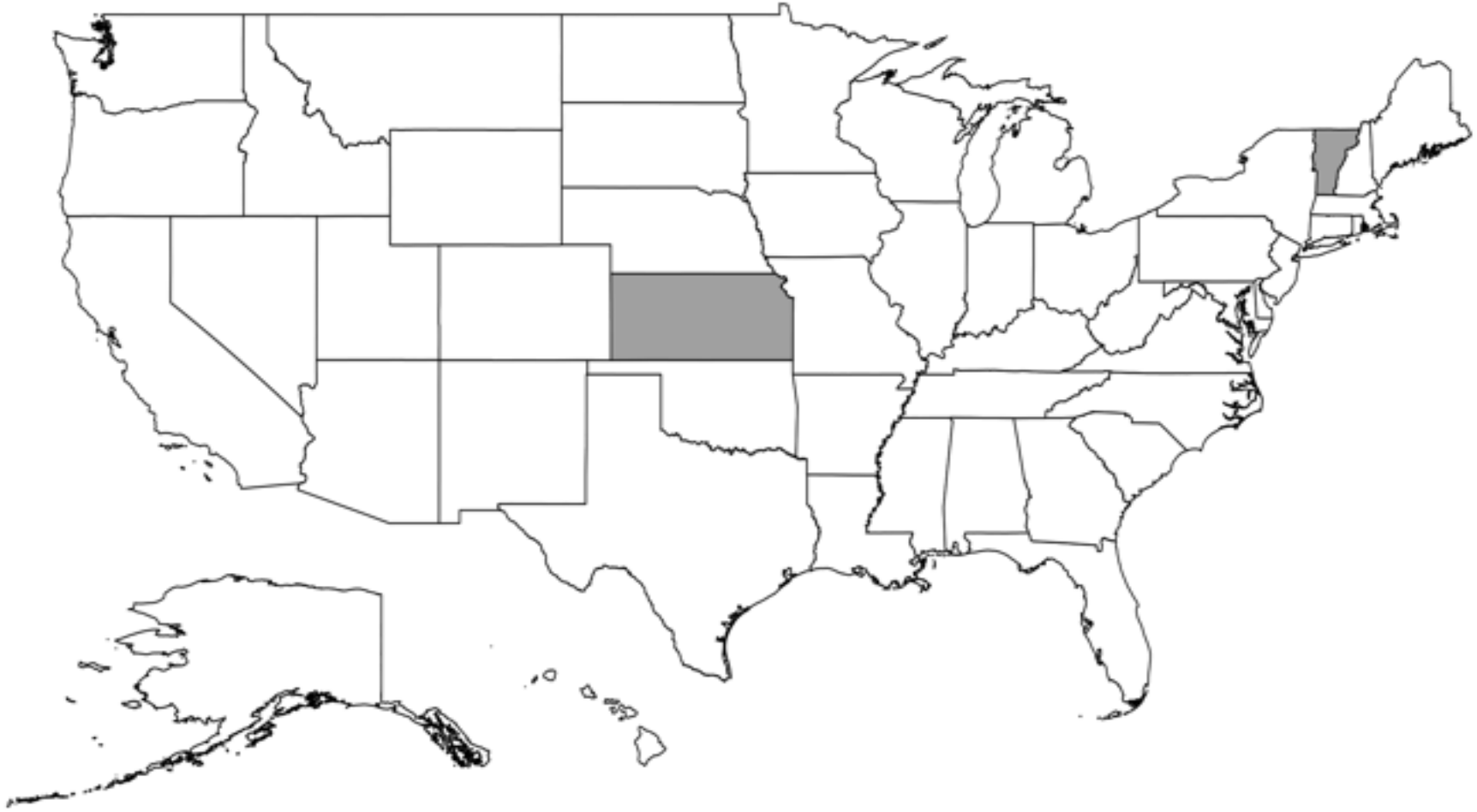
Contributions

- First study to explore the effect of ENDS licensure laws on nicotine vaping
  - Estimate the effect of state laws adopted nationwide in staggered adoption DD framework
  - Use both TWFE and alternative dynamic DD estimators
- Examine heterogeneity in the impacts of laws by harshness of penalty for non-compliance and renewable license fees
- Spillover effects of ELLs on consumption of combustible tobacco products

2011

ENDS Licensure Laws

2013

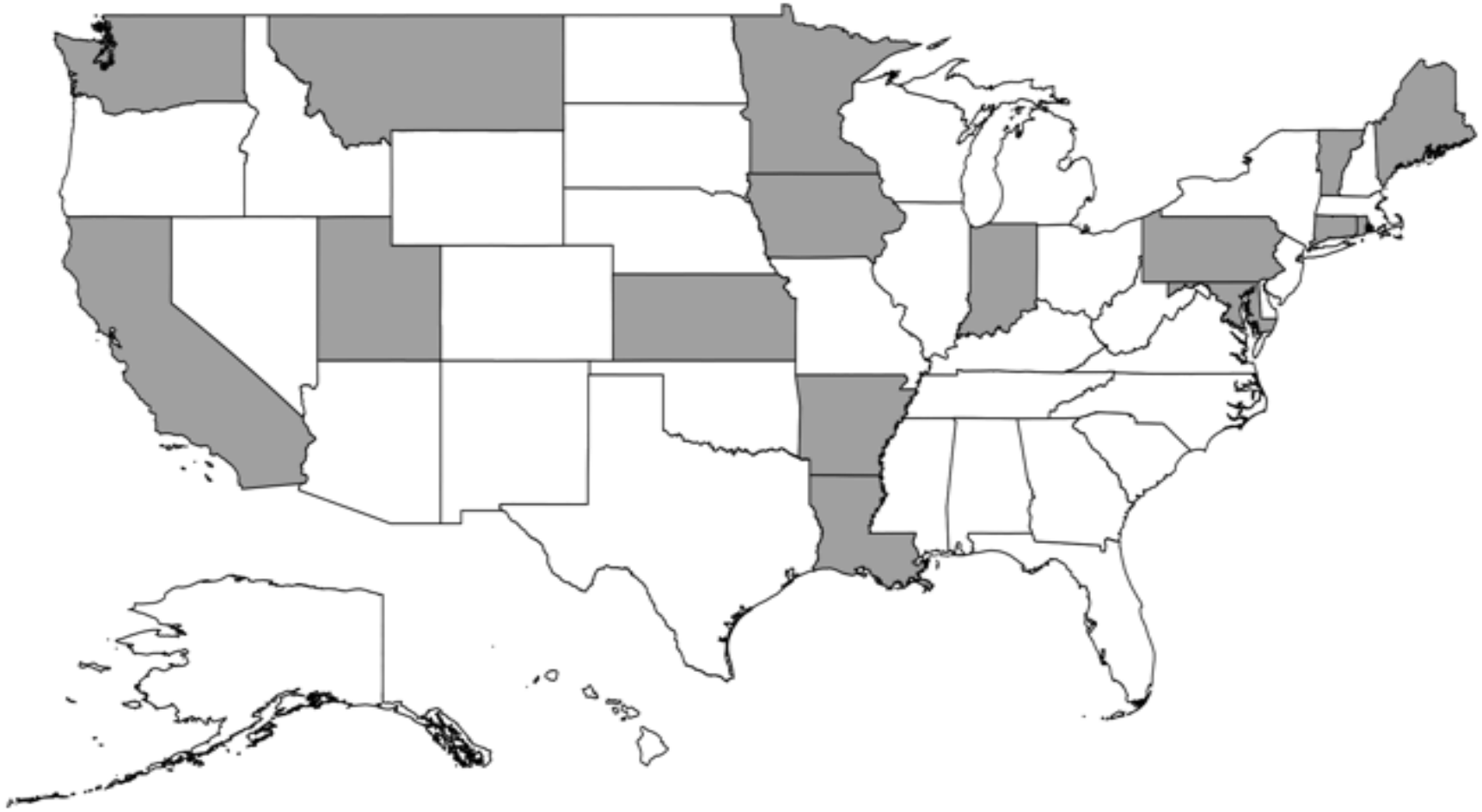


ENDS Licensure Laws

2015

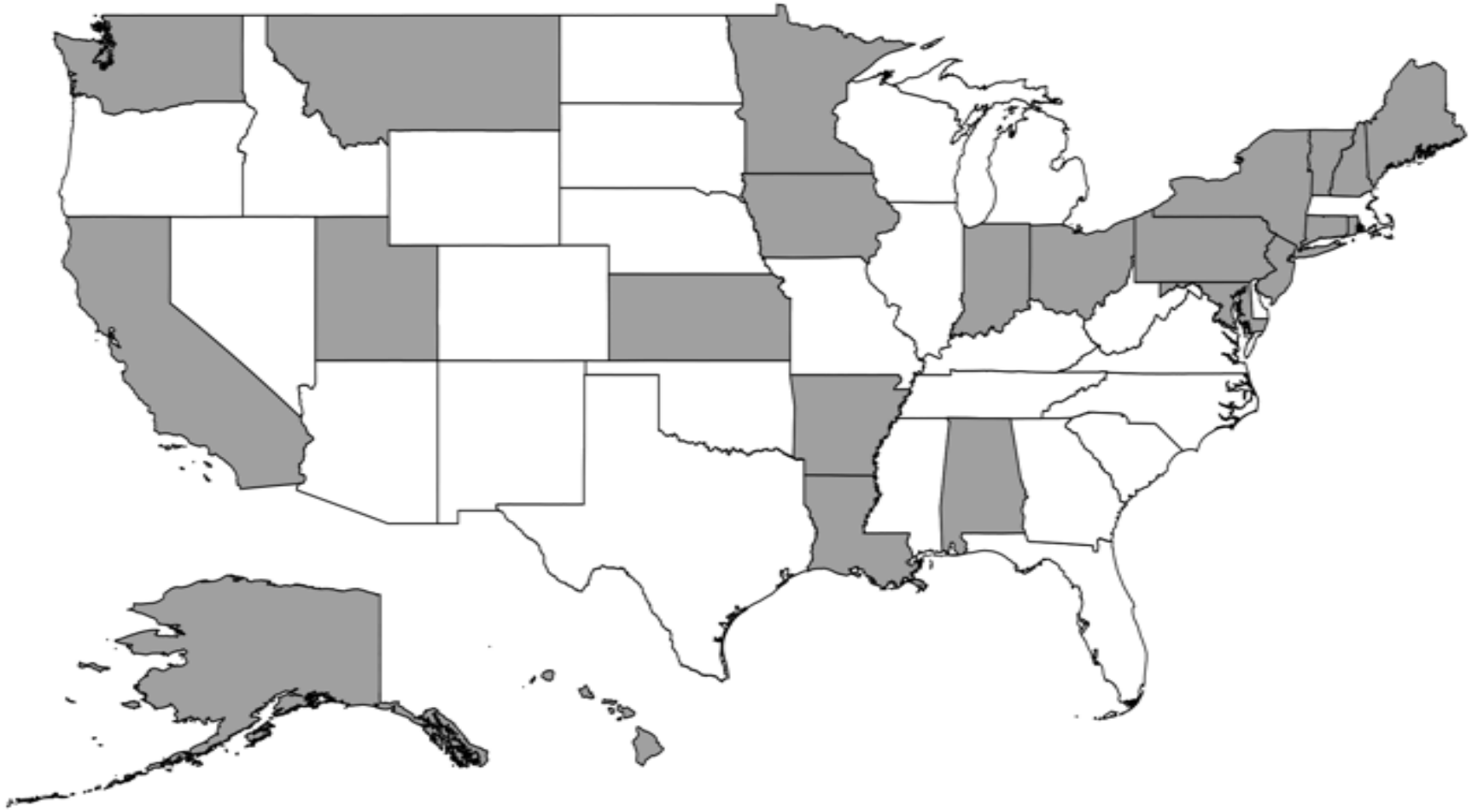
ENDS Licensure Laws

2017



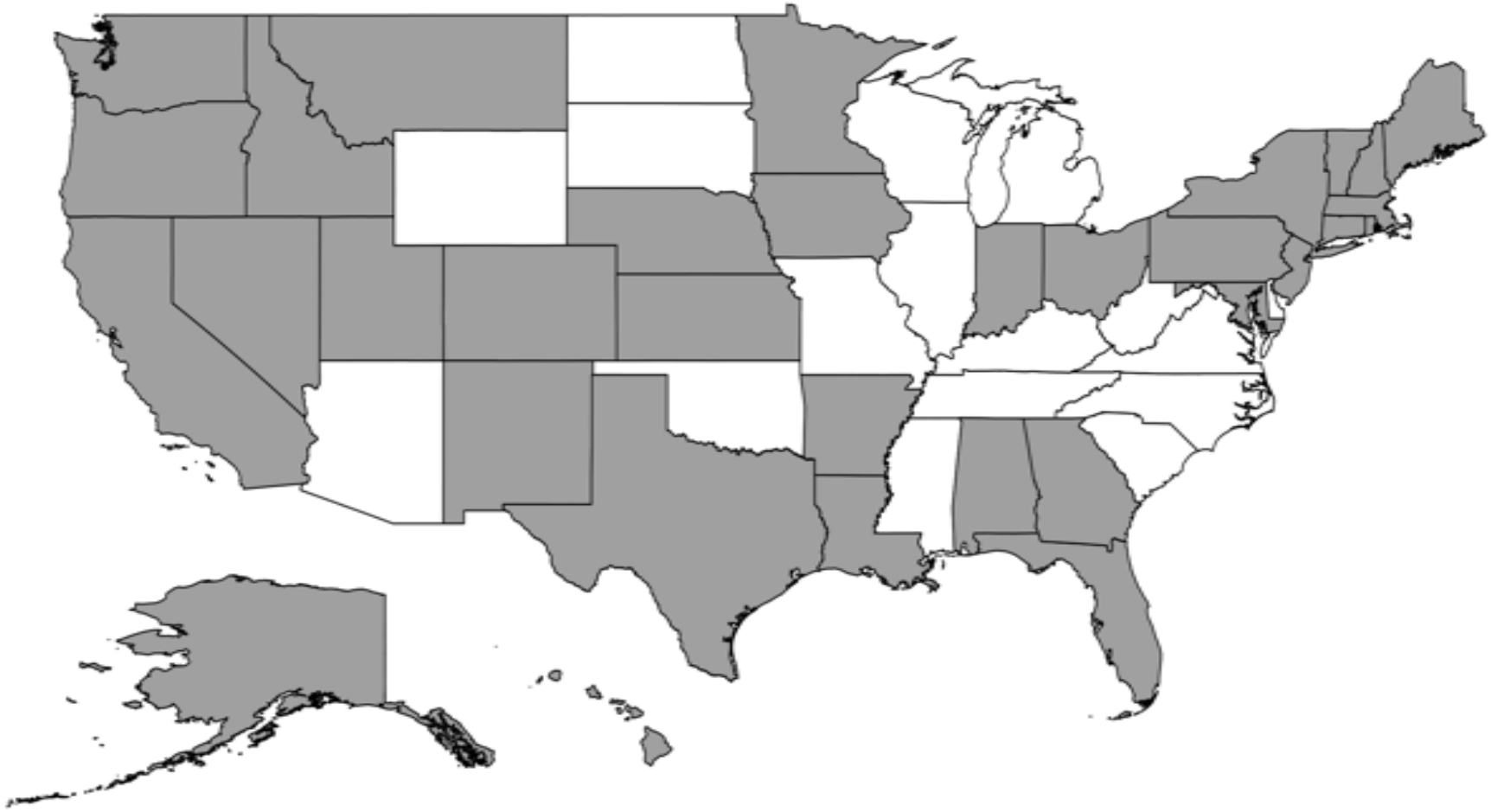
ENDS Licensure Laws

2019



ENDS Licensure Laws

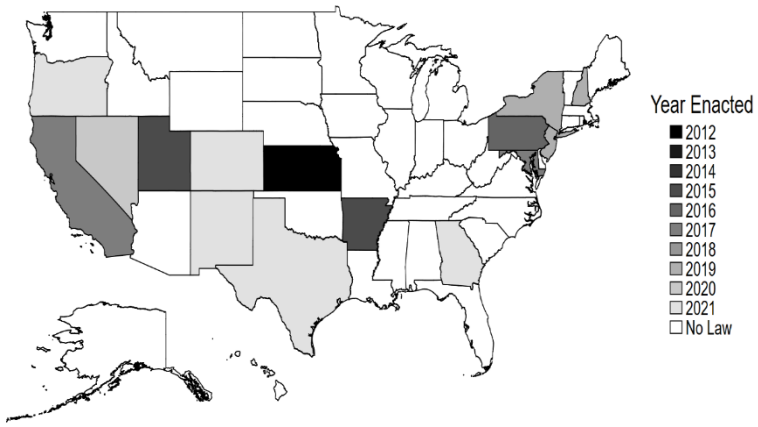
2021



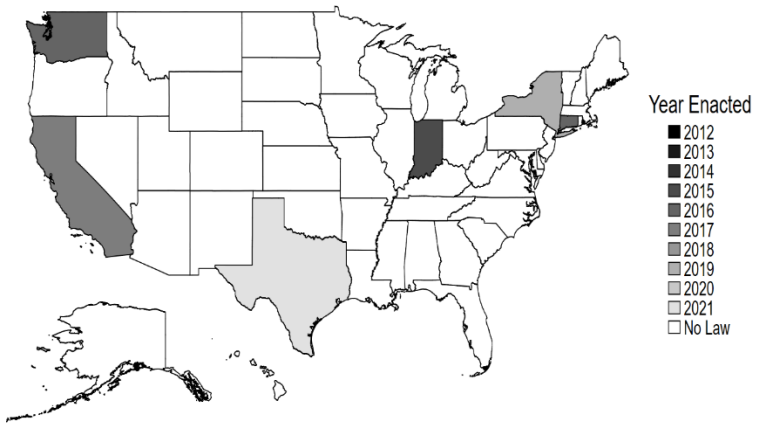
ENDS Licensure Laws

Heterogeneity by Law Intensity

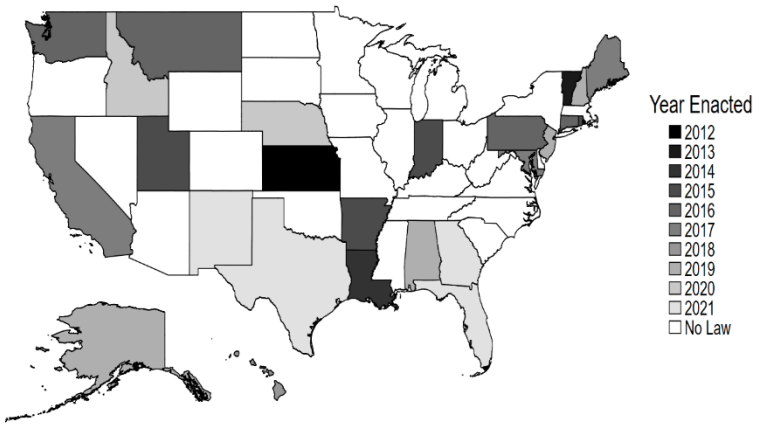
Higher Fines



Higher Renewable Fees



C riminal Penalty



Datasets

- Main: State Youth Risk Behavior Survey (State YRBS)
  - State representative surveys of 9th through 12th grade high school students
  - Can be made nationally representative of 14-18-year-olds
  - Information from 2015-2021 on prior-month ENDS use (including number of days of nicotine vaping)
  - Also includes information on combustible cigarette or cigar smoking
  - Supplement analysis using National YRBS

- Auxiliary: Behavioral Risk Factor Surveillance System Survey (BRFSS)
  - Includes information on ENDS and combustible cigarette use among adults
  - Explore effects for teens ages 18-20 and 21+ (at or above MLPA)

Estimation Strategy

- Begin with TWFE Estimation

$$Y_{ist} = \gamma_0 + \gamma_1 E\,L\,L_{st} + X_{ist}\,\beta + Z_{st}\,\delta + \alpha_s + \Theta_{rt} + \epsilon_{ist}$$

Y_{ist}: ENDS use

$E\,L\,L_{st}$: ENDS licensure law

X_{imt}: Vector of individual demographic controls: gender, age, grade and race dummies

Z_{smt}: Vector of state-level covariates

Macroeconomic conditions & COVID-19: unemployment rate, per capita income, COVID-19 cumulative death rate (experimented with Oxford COVID-19 indexes)

Tobacco policies: Tobacco-21 law, cigarette tax, e-cigarette tax, ENDS MLPA, indoor smoking/ENDS restrictions, combustible tobacco licensure law, ENDS flavor restrictions, menthol cigarette ban, online sales delivery ban

Substance use policies: recreational marijuana law, medical marijuana law, beer tax

		Panel I: Any ENDS Use		
ELL	0.009	0.014	0.014	0.013
	(0.011)	(0.011)	(0.011)	(0.010)
Pre-Treat. Mean of DV	*0.198*	*0.198*	*0.198*	*0.198*
		Panel II: Frequent ENDS Use		
ELL	-0.001	0.002	0.008	0.007
	(0.006)	(0.005)	(0.005)	(0.005)
Pre-Treat. Mean of DV	*0.040*	*0.040*	*0.040*	*0.040*
		Panel III: Daily ENDS Use		
ELL	-0.002	0.001	0.005	0.004
	(0.004)	(0.004)	(0.004)	(0.004)
Pre-Treat. Mean of DV	*0.028*	*0.028*	*0.028*	*0.028*
N	622122	622122	622122	622122
Controls:				
State and Wave FE?	Yes	Yes	Yes	Yes
Demographic Controls?	Yes	Yes	Yes	Yes
State and Census Region-by-wave FE?	No	Yes	Yes	Yes
Macroecon, COVID-19 & Spatial Controls?	No	Yes	Yes	Yes
Tobacco Policy Controls?	No	No	Yes	Yes
Other Substances Policy Controls?	No	No	No	Yes

How precise are these null results?

- With 95 percent confidence, the precision of our estimates allows us to rule out ELL-induced declines in ENDS use of greater than 0.66 percentage-points
  - 3.3 percent relative to the pre-treatment mean

- With respect to frequent use, we can rule out ELL-induced declines in frequent ENDS use of greater than 0.29 percentage-points
  - About 7 percent relative to the pre-treatment mean

0 is a number too!

Editorial Statement on Negative Findings

The Editors of the health economics journals named below believe that well-designed, *well-executed empirical studies that address interesting and important problems in health economics, utilize appropriate data in a sound and creative manner, and deploy innovative conceptual and methodological approaches compatible with each journal's distinctive emphasis and scope* have potential scientific and publication merit regardless of whether such studies' empirical findings do or do not reject null hypotheses that may be specified. As such, the Editors wish to articulate clearly that the submission to our journals of studies that meet these standards is encouraged.

We believe that publication of such studies provides properly balanced perspectives on the empirical issues at hand. Moreover, we believe that this should reduce the incentives to engage in two forms of behavior that we feel ought to be discouraged in the spirit of scientific advancement:

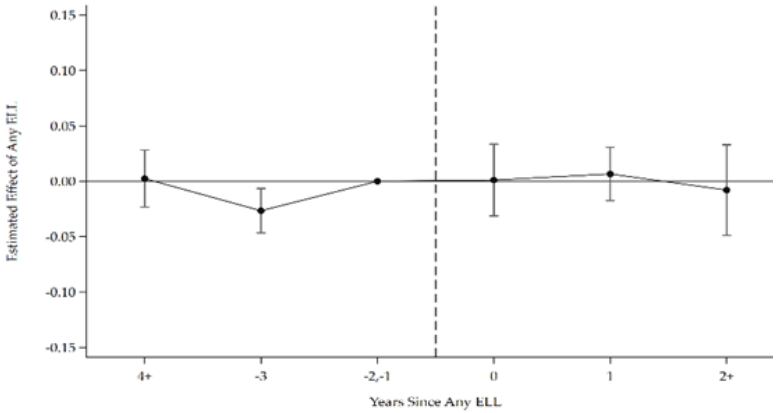
1. Authors withholding from submission such studies that are otherwise meritorious but whose main empirical findings are highly likely "negative" (e.g. null hypotheses not rejected).
2. Authors engaging in "data mining," "specification searching," and other such empirical strategies with the goal of producing results that are ostensibly "positive" (e.g. null hypotheses reported as rejected).

Henceforth we will remind our referees of this editorial philosophy at the time they are invited to review papers. As always, the ultimate responsibility for acceptance or rejection of a submission rests with each journal's Editors.

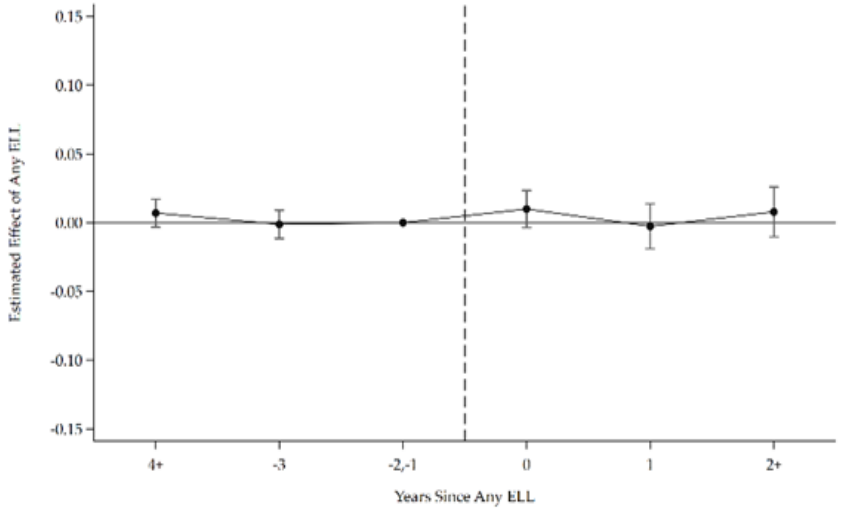
American Journal of Health Economics
European Journal of Health Economics
Forum for Health Economics & Policy
Health Economics Policy and Law
Health Economics Review
Health Economics
International Journal of Health Economics and Management
Journal of Health Economics

Event-Study Analysis, TWFE Estimates

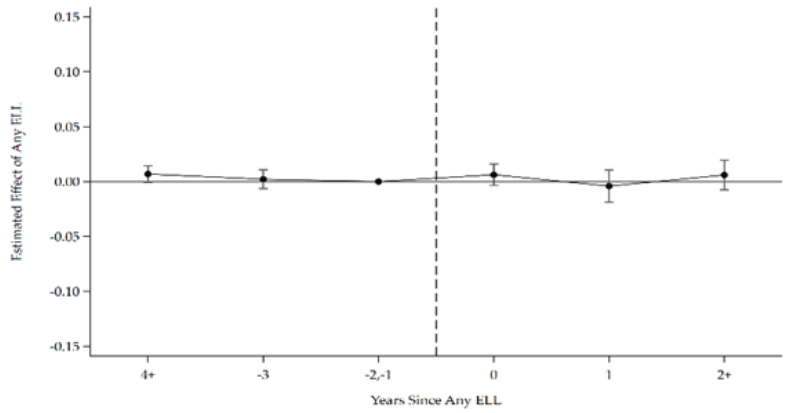
Current ENDS Use



Frequent ENDS Use



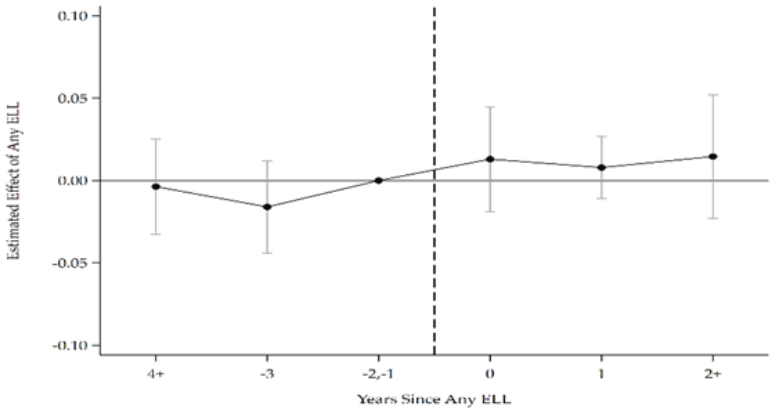
Everyday ENDS Use



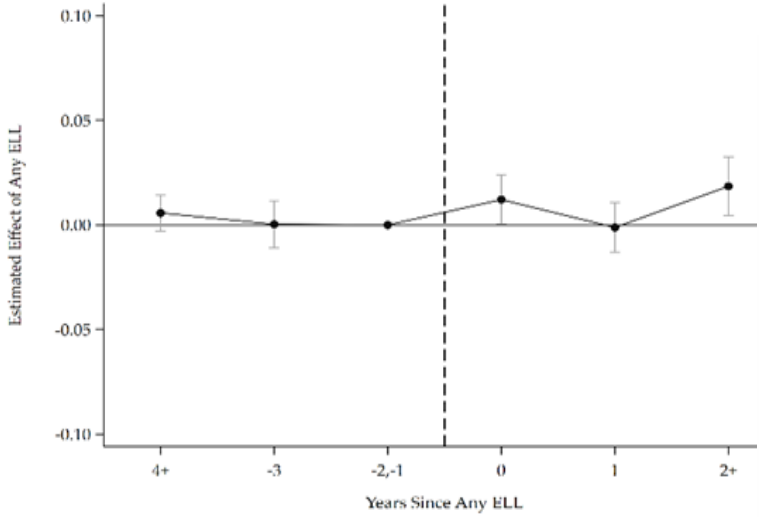
Sun and Abraham (2021) Estimates

[Use never-adopters as counterfactuals]

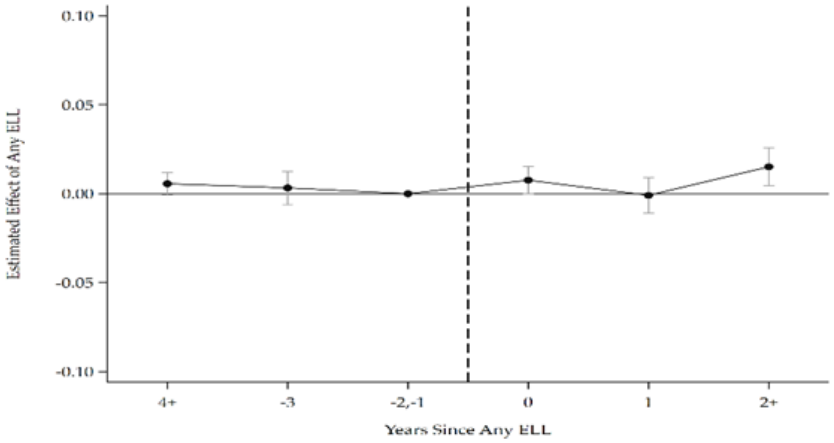
Current ENDS Use



Frequent ENDS Use

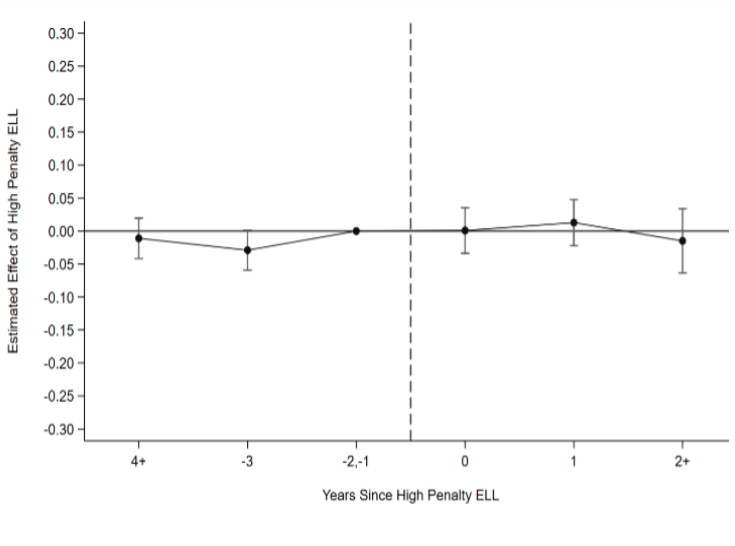


Everyday ENDS Use

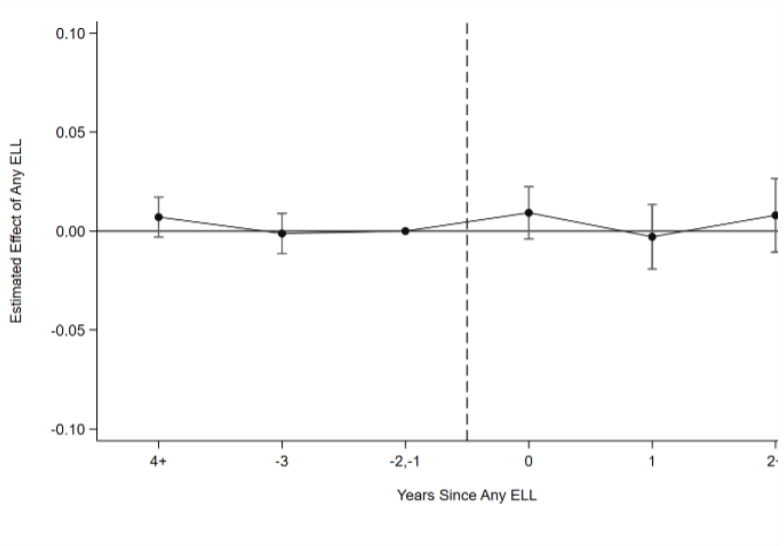


Higher Penalty Licensure Laws

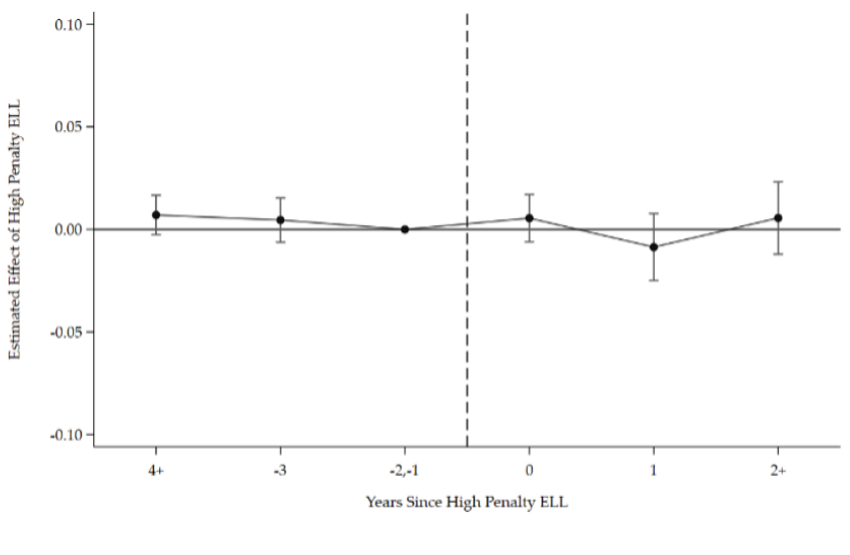
Current ENDS Use



Frequent ENDS Use

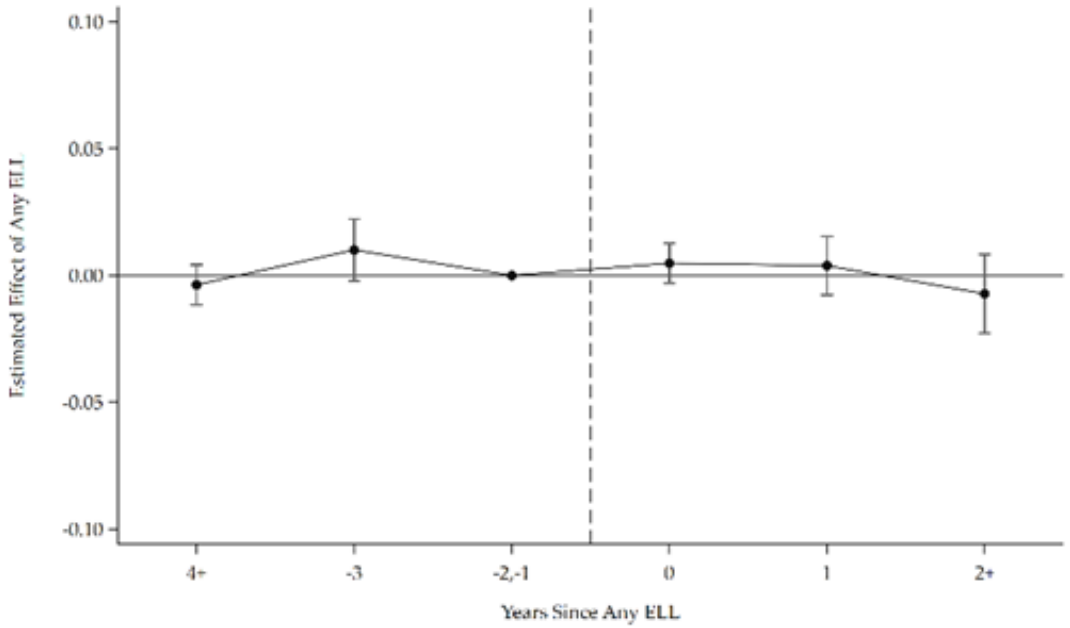


Everyday ENDS Use

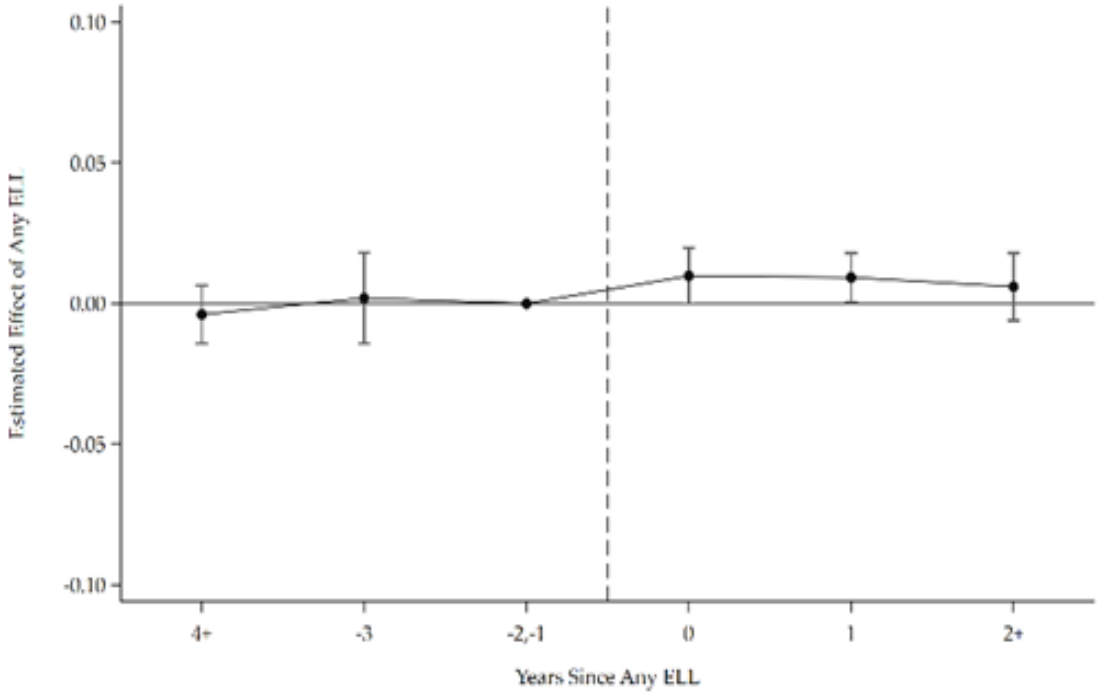


No Spillovers to Combustibles (Unsurprising!)

Cigar Smoking



Cigarette Smoking



Auxiliary Findings on Adults (BRFSS)

	(1)	(2)	(3)	(4)
	Aged 18-20	Aged 21+	Aged 18-20	Aged 21+
	Any ENDS Use		Daily ENDS Use	
ELL	.021	-.002	-.005	-.0003
	(.021)	(.002)	(.007)	(.001)
Pre-Treat. Mean of DV	*0.135*	*0.048*	0.043	*0.019*
N	38086	1548893	38086	1548891

Conclusions

- No evidence that ELL adoption is associated with a statistically significant or economically important changes in the probability of youth ENDS use
  - True for higher penalty laws as well as ELLs with higher renewable fees
  - Precision of our estimates allows us to rule out ELL-induced declines in ENDS use that are relatively small for prior-month ENDS use
    - For more habitual ENDS use, effects are positive, small, and statistically distinguishable from zero

- Informal social sources, including the illicit market, could help to insulate youths from licensure laws

Heterogeneity in ENDS Flavor Restrictions

- **New York** exempts ENDS products that have received a marketing order from the FDA, though at present, no flavored e-cigarettes have received such an order

- **Maryland's** statute prohibits the sale of all flavored cartridge-based and disposable e-cigarettes except for menthol-flavored products

- **Utah** prohibits the sale of flavored e-cigarettes in non-retail tobacco specialty businesses, except mint- and menthol-flavored products (Campaign for Tobacco-Free Kids, 2023)

- **Massachusetts** exempts certain types of retailers, including tobacco/smoking bars, tobacco retailers that receive a high proportion of their total revenues from tobacco products, e-cigarette establishments, adult-only retailers, and liquor stores