

# The Effects of E-cigarette Taxes on E-cigarette Prices and Consumption: Evidence From Retail Panel Data

Chad Cotti <sup>1</sup> Charles Courtemanche <sup>2</sup> Catherine Maclean <sup>3</sup> Erik Nesson  
<sup>4</sup> Michael Pesko <sup>5</sup> & Nathan Tefft <sup>6</sup>

University of Wisconsin, Oshkosh <sup>1</sup>University of Kentucky & NBER <sup>2</sup>Temple University &  
NBER <sup>3</sup>Ball State University & NBER <sup>4</sup>Georgia State University <sup>5</sup>& Bates College <sup>6</sup>

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# Research questions

- Three related questions:
  - ① Do e-cigarette taxes affect e-cigarette prices?
    - 'Pass-through' rate
  - ② Do exogenous changes in e-cigarette prices affect e-cigarette sales?
  - ③ Do exogenous changes in e-cigarette prices affect sales of other tobacco products?
- Sales at retail stores in the U.S. 2011 to 2017
  - Proxy for consumption
- E-cigarette taxes adopted by eight states & three counties
- Two-way fixed-effects & instrumental variable methods
- Develop a method to standardize e-cigarette taxes

# Results preview

- 'Deep theory'
- E-cigarette taxes & prices & sales
  - $\uparrow$  E-cigarette tax  $\rightarrow$   $\uparrow$  e-cigarette price  $\rightarrow$   $\downarrow$  e-cigarette sales
  - Direction seems clear, but we want to quantify the effect
- E-cigarette taxes & sales of other tobacco products
  - Less clear
  - Determined by relationships between goods
  - Economic substitutes, complements, or unrelated?
- Findings
  - 1 E-cigarette prices are passed on to consumers
  - 2 E-cigarette sales  $\downarrow$  when prices are exogenously increased through taxes
  - 3 Traditional cigarette sales  $\uparrow$  when prices are exogenously increased through taxes

# Overview

- 1 Background
- 2 Data & methods
- 3 Results
- 4 Conclusion

# Background on e-cigarettes

- Product details
  - E-cigarettes entered the U.S. market in 2006
  - Heat a liquid containing flavors, nicotine, etc. that is inhaled
  - Vaping generally believed to be less harmful than smoking
  - Quickly became popular: 4.5% of adults & 27.5% of youth vaped in 2019 (CDC, 2019; FDA, 2019)
- Controversial
- Benefits
  - 1 Harm reduction
  - 2 Cessation
- Harms
  - 1 Re-normalize smoking
  - 2 Health benefits overstated

# Related literature - 1

- Allcott & Rafkin (2020)
  - Shift-share strategy to examine how e-cigarette use impacts smoking
  - Comparable price pass-through & own-price elasticity of e-cigarettes in some specifications
- Pesko et al (2020)
  - Study the effect of e-cigarette taxes on adult e-cigarette & traditional cigarette use in survey data
  - Similar methods to ours
  - Find that higher e-cigarette taxes ↓ daily e-cigarette use & ↑ daily traditional cigarette use
- Saffer et. al (2020)
  - Use a synthetic control approach & survey data to study Minnesota's e-cigarette tax
  - Higher e-cigarette tax ↑ adult smoking & ↓ adult smoking cessation
  - Establish a comparable estimate of tax pass-through

## Related literature - 2

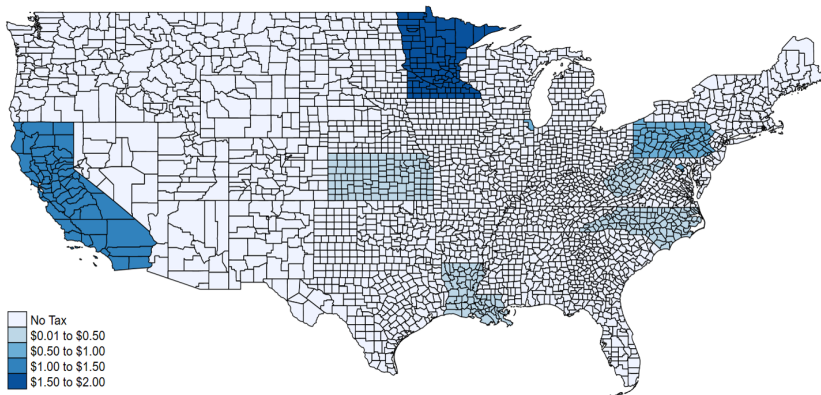
- Caveat: massive tobacco control literature
- Take-aways
  - ① E-cigarette taxes are passed on to consumers in the form of higher prices
  - ② Vaping ↓ when e-cigarette prices ↑
  - ③ Higher e-cigarette tax ↑ adult smoking & ↓ adult smoking cessation
- Our contributions
  - ① Retail sales data, less concern regarding reporting error in survey data
  - ② Develop a method to standardize e-cigarette taxes
  - ③ Consider a wide range of tobacco products
  - ④ Examine effect of exogenous price changes on tobacco product use
  - ⑤ Longer study period, arguably allows for better testing of the design
  - ⑥ Leverage the experiences of a broader set of localities



# E-cigarettes taxes - 1

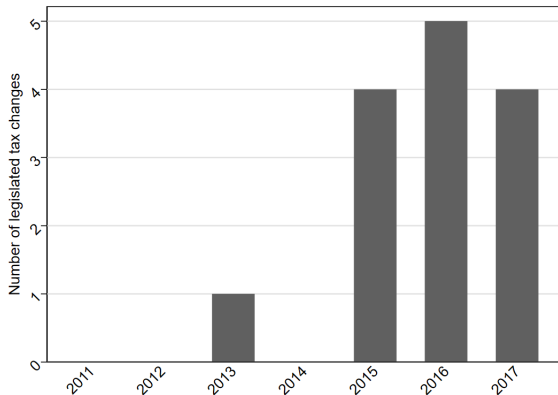
- Localities have adopted e-cigarette taxes in heterogenous ways
  - Some use ad valorem taxes on wholesalers, others use excise taxes at the point of purchase
  - Complicates empirical analysis of these taxes
- We develop a way to standardize the taxes
  - DC equalizes the e-cigarette ad valorem tax with the traditional cigarette excise tax
  - 67% ad valorem tax = \$2.92 → 1 percentage point of ad valorem tax = \$0.044
  - We use this relationship to convert all ad valorem taxes to an excise tax per ml of vaping liquid
- Standardized magnitudes of e-cigarette taxes vary widely
  - \$0.05 per ml in Kansas & Louisiana
  - \$1.85 per ml in Minnesota
- Sources: CDC, Public Health Law Center, Vapor Tax Database, & state statutes

# E-cigarettes taxes - 2



- Standardized e-cigarette taxes in 4Q 2017 (\$/ml of vaping liquid)
- Wholesale: CA, DC, MN, PA, & Montgomery Co MD
- Per vaping ml: KS, LA, NC, WV, Chicago IL, & Cook Co IL

## E-cigarettes taxes - 3



- Changes over the study period

- Nielsen Retail Scanner Data (NRSD)
  - Sample of 30,000 to 35,000 retailers
- In 2017, NRSD includes:
  - 15% to 26% of food store, mass merchandiser, dollar store, & club store sales
  - > 50% of drug store sales
  - 2% of convenience & liquor stores sales
  - Include Juul purchases,  $\approx 1/3$  of the market by the end of 2017
- NRSD records weekly volume & average price (including all taxes except sales taxes) of each UPC purchased
- Calculate mls of vaping liquid in each e-cigarette UPC
  - 94.5% match rate
  - Cotti, Nesson, & Tefft (2018)

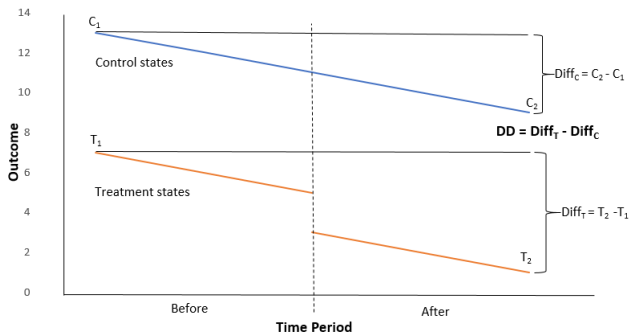
# Methods 1 - Pass-through rate analysis

- **Research question:** Are e-cigarette taxes passed on to consumers in the form of higher prices?
- Two-way fixed-effects (TWFE) methods:
- $P_{i,l,t} = \delta_0 + \delta_1 Etax_{l,t} + \delta_2 Ttax_{l,t} + W_{l,t}\delta_3 + \lambda_{l,t} + \gamma_t + \mu_{l,l,t}$
- Variables
  - $P_{i,l,t}$ : E-cigarette price
  - $Etax_{l,t}$ : E-cigarette tax (standardized)
  - $Ttax_{l,t}$ : Tobacco cigarette tax (\$ per pack)
  - $W_{l,t}$ : Locality tobacco control & other policies
  - $\lambda_{l,t}$ : UPC-by-locality fixed-effects
  - $\gamma_t$ : Quarter-by-year fixed-effects

## Methods 2 - Pass-through rate analysis

- N=90,730 UPC-locality-quarters
- Weighted least squares regression
  - Weight data by share of e-cigarette sales in localities that do not adopt an e-cigarette tax
- 48 states, DC, & 2 counties = localities
  - Combine Chicago & Cook Co IL
  - Alaska & Hawaii are not included in the NSRD
- Cluster standard errors by locality
  - Allows for correlation over time within locality

## Methods 3 - Pass-through rate analysis



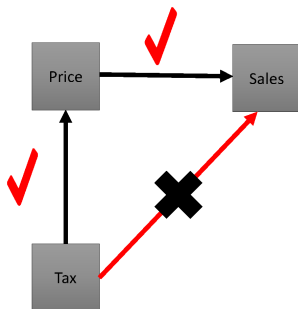
- Model uses within-locality over-time variation in taxes for identification of pass-through

## Methods 3 - Sales analysis

- **Research questions:**
  - ① Do e-cigarettes sales ↓ when their price is exogenously ↑ through taxes?
  - ② Do tobacco product sales change when e-cigarette prices exogenously ↑ through taxes?
- Combine TWFE methods with an instrumental variable (IV) approach
- Aggregate data to the locality-year level (N=1,428)
- Instruments: Taxes
  - E-cigarette prices instrumented with e-cigarette taxes
  - Traditional cigarette prices instrumented with traditional cigarette taxes
- Leverage changes in prices induced by taxes to identify price effects

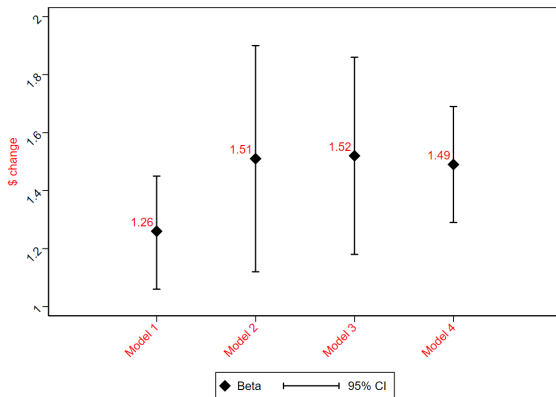


## Methods 4 - Sales analysis



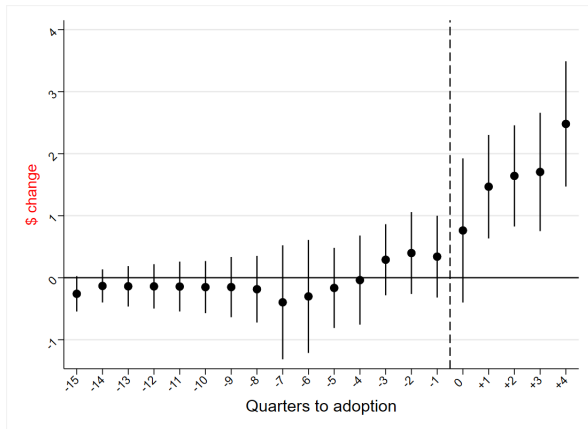
- Key assumption of the IV approach
  - Exclusion restriction
  - Taxes impact sales **only** through price effects

# Pass-through analysis - 1



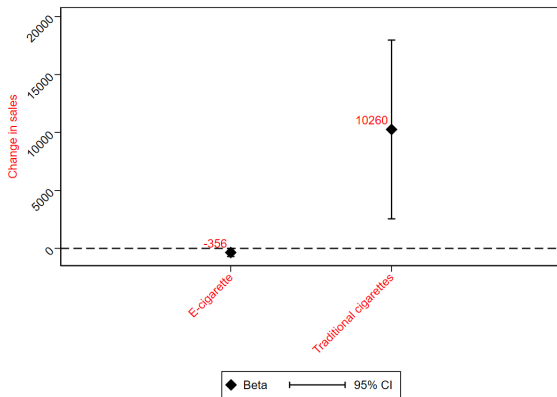
- TWFE model
- \$1.00 ↑ in taxes → \$1.49 dollar ↑ in price
- Average price \$3.79 in adopting localities, pre-tax
- Taxes are more than fully passed on the consumers

## Pass-through analysis - 2



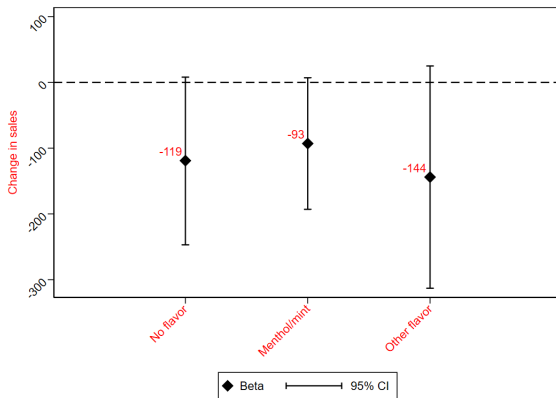
- Average price \$3.79 in adopting localities, pre-tax
- Event-study model
- Policy leads not statistically distinguishable from zero
- Suggestive evidence that data satisfy parallel trends

# Sales analysis - 1



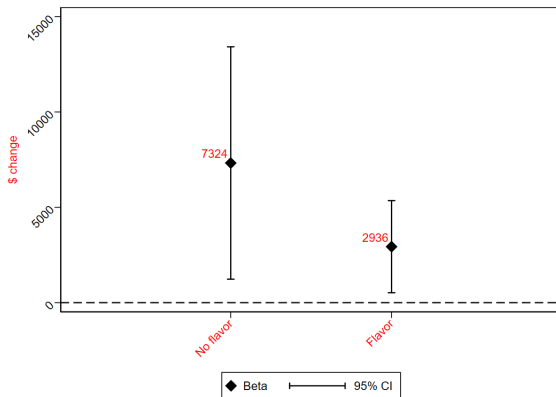
- Instrumental variable model
- E-cigarette sales ↓ following a price ↑
- Traditional cigarette sales ↑ following a price ↑

# Sales analysis - 2



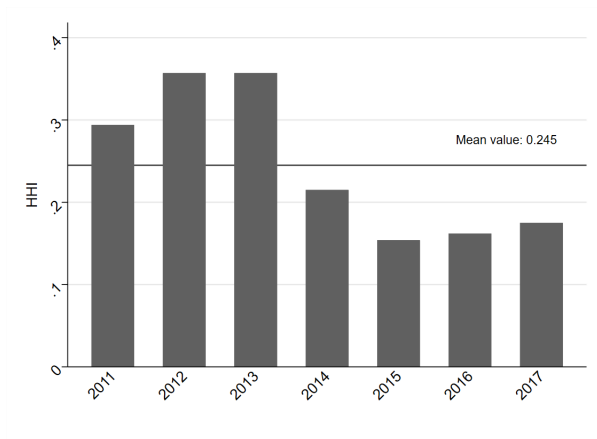
- Heterogeneity by e-cigarette flavor
- Instrumental variable model
- Flavored e-cigarettes may be more responsive to price ↑
- Flavored e-cigarettes may capture youth

# Sales analysis - 3



- Heterogeneity by traditional cigarette flavor
- Instrumental variable model

## Extension: Exploring market structure



- Herfindahl-Hirschman Index (HHI) for retail sales of e-cigarettes of 0.245
- $$HHI = \sum_{i=1}^n s_n^2$$
- Implication: retail-based e-cigarette industry in the U.S. is moderately to highly concentrated

# Robustness checks

- Leave one out analysis
- Alternative weighting schemes
- Alternative samples
- Alternative specifications
- Alternative e-cigarette tax measure
- Falsification testing
- Tests of balance
- Stratify by tax schema
  
- Results are robust
  
- Examine product characteristics



# Summary of the findings

- Taxes are over-shifted, with 149% pass-through
  - \$1.00 tax  $\uparrow$  prices  $\rightarrow$   $\uparrow$  by \$1.49
  - Suggestive that the market is not perfectly competitive
  - Supported by HHI calculation
- Demand for e-cigarettes is elastic
  - Elasticity is: -1.3
- E-cigarettes & traditional cigarettes economic substitutes
  - Traditional cigarette cross-price elasticity is: 1.4
  - E-cigarette cross-price elasticity is: 0.8
- Demand for traditional cigarettes is inelastic
  - Elasticity is: -0.8

# Conclusion

- Offer new evidence on
  - ① E-cigarette market
  - ② Relationships between tobacco products
  - ③ Empirically studying e-cigarette taxes
- One limitation is the generalizability of e-cigarettes purchased in retail locations
- Add to our understanding of e-cigarette taxes & the dynamic tobacco product market
  - ① In particular, tobacco products are related, effective policy should consider relationships
  - ② Regulating one market can have spillovers for other markets
  - ③ Challenging when risk levels may differ across products

Thank you!!  
catherine.maclean@temple.edu