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

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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
- ↑ E-cigarette tax → ↑ e-cigarette price → ↓ 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 ↓ when prices are exogenously increased through taxes
- 3. Traditional cigarette sales ↑ 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
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
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
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
- $0.044 = 1 \text{ percentage point of ad valorem tax}$
- 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
- $0.05 \text{ per ml in Kansas & Louisiana}$
- $1.85 \text{ per ml in Minnesota}$

Sources: CDC, Public Health Law Center, Vapor Tax Database, & state statutes
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
Changes over the study period
Data

- 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, ≈ 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
- $1.00 \uparrow$ in taxes $\rightarrow$ $1.49$ dollar $\uparrow$ in price
- Average price $3.79$ in adopting localities, pre-tax
- Taxes are more than fully passed on the consumers
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
Instrumental variable model

E-cigarette sales ↓ following a price ↑

Traditional cigarette sales ↑ following a price ↑
Heterogeneity by e-cigarette flavor
Instrumental variable model
Flavored e-cigarettes may be more responsive to price $\uparrow$
Flavored e-cigarettes may capture youth
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
- \[ HHI = \sum_{i=1}^{n} s_i^2 \]
- 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 ↑ prices → ↑ 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!!
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