Cigarette Taxes, Smoking, and Health in the Long Run

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Will pause for questions at end of background and after discussing methods

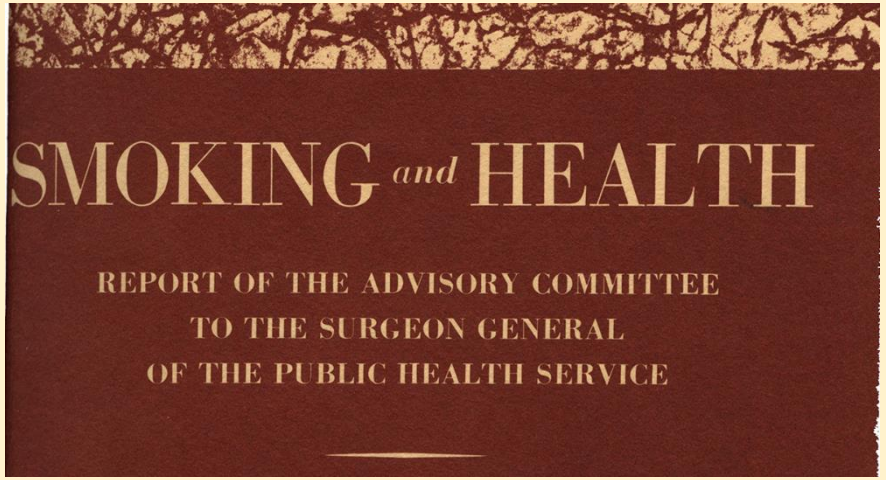
Health hazards of cigarettes

1964 Surgeon General's report

- Evidence consistent with severe health costs of smoking

Subsequent aggressive tobacco control effort

- Cigarette taxes among the most important



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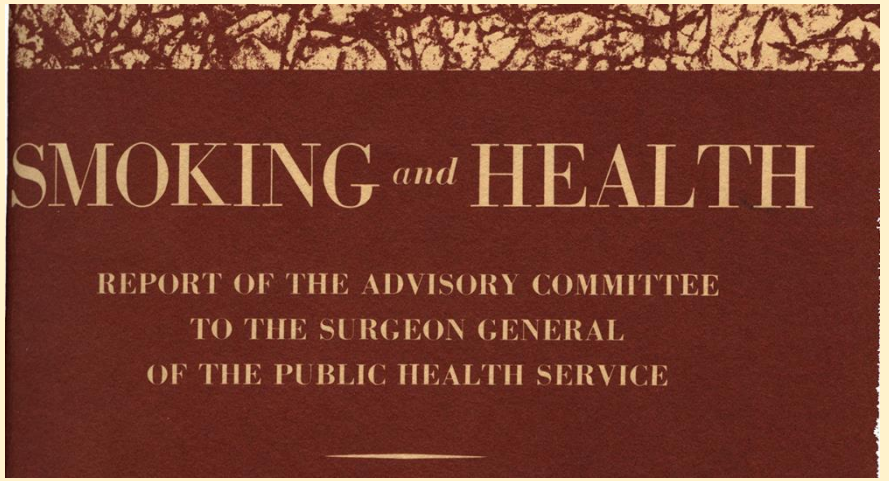

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Yet evidence on long-run effects of smoking potentially confounded

- Most studies compare smokers to non-smokers, with limited controls
- Smokers different in hard-to-observe ways (less risk averse, worse health)
- Estimates using economic models to correct for selection find smaller mortality effects

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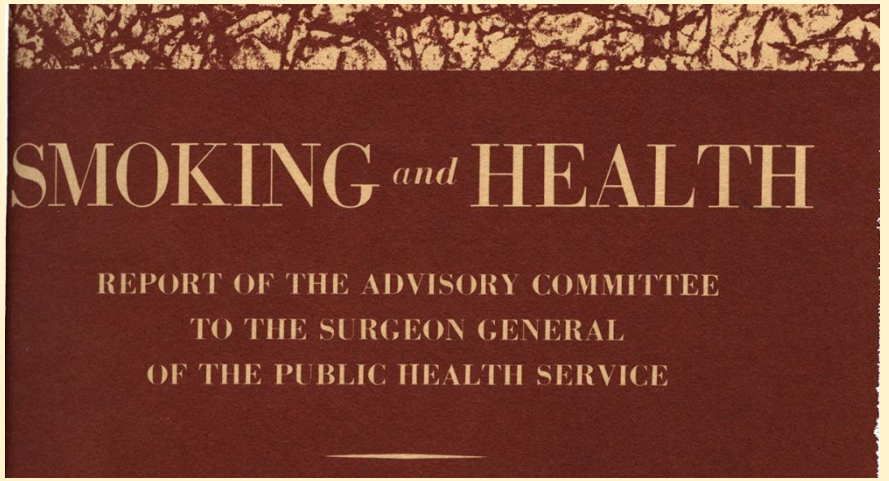

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This paper: quasi-experimental evidence on long-run effects of tobacco control policy on smoking and health

Long-run effects of cigarette taxes

Research question: What is the effect of *teenage* cigarette taxes on *adult* smoking and mortality?

- Teenage taxes clearly influence teenage smoking
- Smoking initiation typically begins by age 20
- Teenage smoking correlated with adult smoking
- Adult smoking and mortality are key long-run health outcomes

We use quasi-experimental variation in cigarette taxes

- Comparisons involve state-by-year birth cohorts facing higher vs. lower teen taxes
- Avoid the confounding from comparing smokers and non-smokers

Data and approach

Combine data from several sources

- State cigarette taxes: Tax Burden on Tobacco, 1950-2018
- Death certificate data: US Vital Statistics, 1990-2018
- Adult smoking: 1992-2018 Tobacco Use Supplement of Current Population Survey

Estimation approach compares people subject to different teenage taxes

- Adjusts for cross-state heterogeneity, general trends in mortality, as well as rich set of additional controls
- Key assumption: state-specific timing of teenage taxes uncorrelated with pre-existing trends in adult smoking and mortality

Teenage taxes reduce adult smoking

Adult smoking is sensitive to teenage taxes

- Each $1 higher taxes at ages 14-17 reduces adult smoking by 1.8 percentage points

Teenage taxes reduce adult smoking, mortality

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Adult mortality is also sensitive to teenage taxes

- Each $1 higher taxes reduces mortality by 20 per 100,000 (4%)
- Reductions concentrated among men, "smoking related" causes of death
- Teenage years special: no effect of taxes at ages 1-10 or 20-24

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Implications

- Rising cigarette taxes over the 20th century produced long-lasting gains
- Potentially important long-run health benefits of controlling teenage smoking

Background

Background, or
why we think there's something left to learn about cigarettes and health

Main evidence on smoking and health

Early evidence: smoking associated with cancer and mortality

- Case-control studies compare smoking of lung cancer and other cancer patients (e.g. Wynder and Graham, 1950; Doll and Hill, 1950)
- Short-run prospective studies following smokers and non-smokers
- (Doll and Hill, 1954; Hammond and Horn, 1958)

Large scale, long-running cohort studies confirm smoking-mortality association

- British Doctor's Study (Hill et al., 2004)

Recent work links health interview surveys to death certificate data

- Jha et al. (2013), Pirie et al. (2013), Carter et al. (2015)
- Adjustment for age, urbanicity, adiposity, some health behaviors

The problem of unobservable confounders

Main evidence compares smokers to non-smokers, with adjustments for observed differences in mortality predictors

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Leaves open the possibility of *unobserved* confounding factors

- Risk tolerance
- Baseline health beyond comorbidities
- Expectations of future health and life expectancy

The problem of unobservable confounders

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Unobserved confounding seems plausible from prior literature

- People with greater genetic exposure to disease smoke more (Fang et al. 2007)
- Smokers less healthy on multiple dimensions *at initiation* (Add and Lechene 2013)
- Model-based efforts to addressing unobserved confounding → smaller effects (Darden, 2017; Darden et al. 2018)

Our contribution

We show long-run effects of tobacco taxes on adult smoking and mortality

Evidence on health consequences of smoking that avoids confounding from comparing smokers and non-smokers

- Complements large-scale, long-running studies
- Complements model-based approaches to addressing unobserved confounding

First evidence on long-run effects of tobacco taxes on health

- Short-run evidence on mortality: Moore (1996), Bowser et al. (2016)
- Teen taxes and smoking through 20s: Gruber and Zinman (2001), Glied (2002), Auld (2015)

Data

Chronology and data sources

State cigarette taxes
Tax Burden on Tobacco

1950 — 2018

Chronology and data sources

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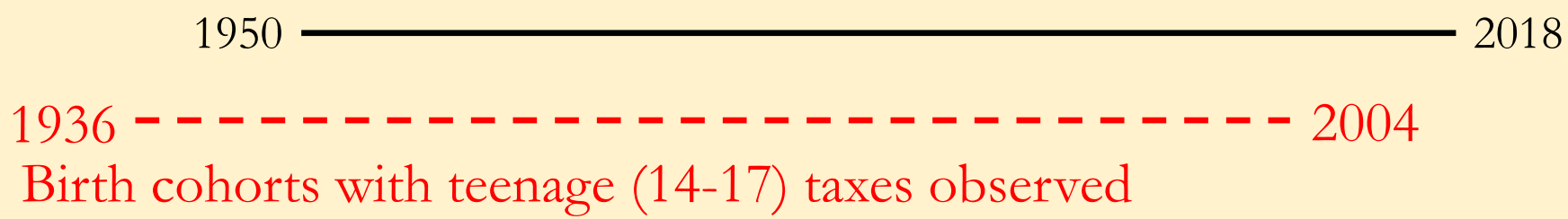
Tax Burden on Tobacco



Chronology and data sources

State cigarette taxes
Tax Burden on Tobacco

1950 — 2018

1936 - 2004

Birth cohorts with teenage (14-17) taxes observed

Deaths
Death certificates

1990 — 2018

Adult smoking
TUS-CPS

1992 — 2018

Additional sources for state-level covariates

Chronology and data sources

State cigarette taxes
Tax Burden on Tobacco

1950 — 2018

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Birth cohorts with teenage (14-17) taxes observed

Deaths
Death certificates

1990 — 2018

Adult smoking
TUS-CPS

1992 — 2018

1936 - 1998

Birth cohorts with teenage (14-17) taxes, adult smoking, deaths observed

Additional sources for state-level covariates

Defining teenage taxes

Teenage tax: inflation-adjusted average state cigarette tax, ages 14 and 17

Ideally match teenage taxes to adult outcomes using teenage residence

- Teenage residence unobserved

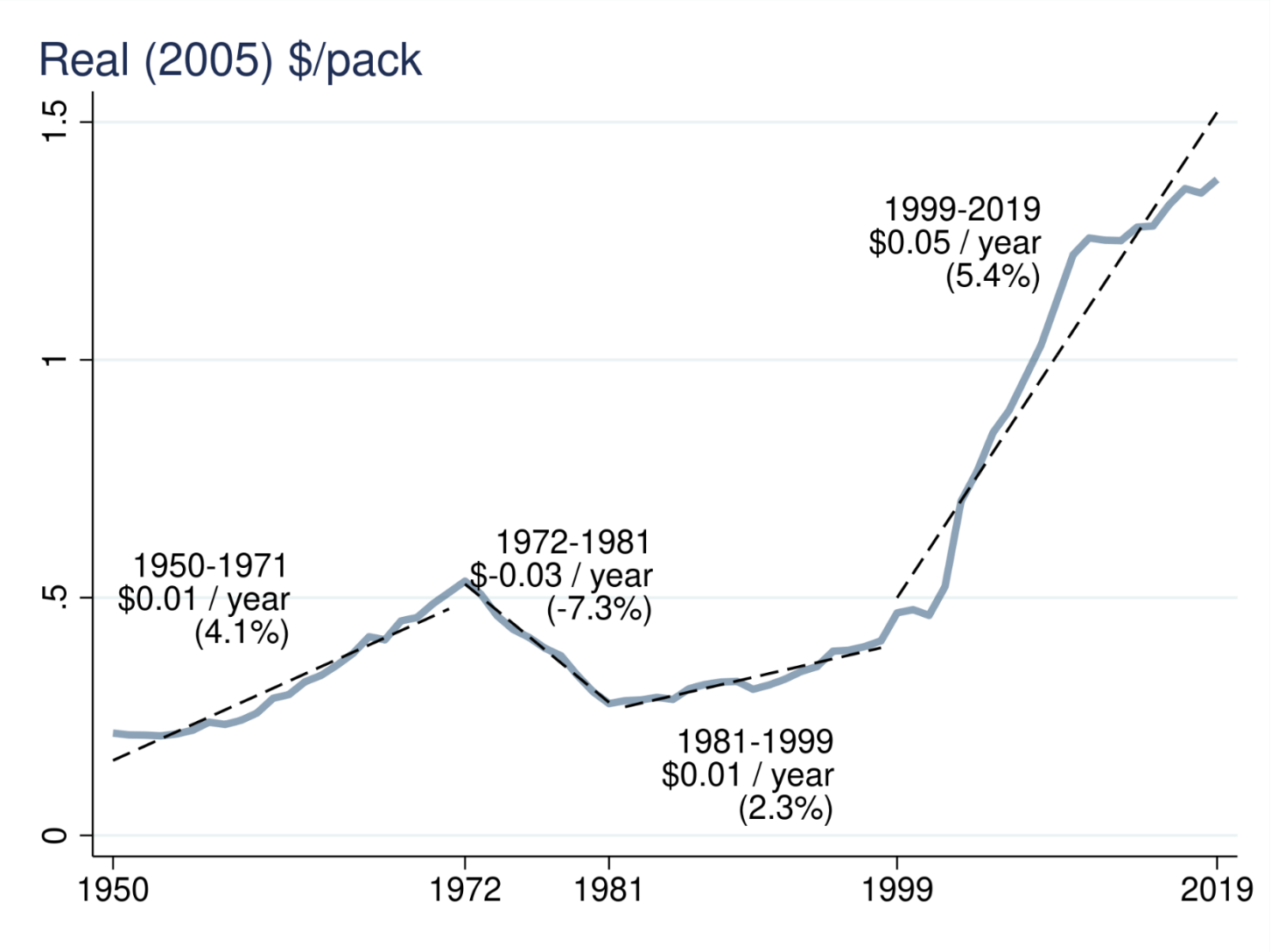
Instead match on adult residence

- Impute teenage (and lifecycle) taxes assuming no mobility
- Born in MA in 1986, live in IN now, impute my tax as 2000-2003 IN values:

$$\frac{1}{4}(.63 + .61 + 1.15 + 1.12)$$

Introduces measurement error, likely attenuates our estimates

State cigarette taxes across four eras



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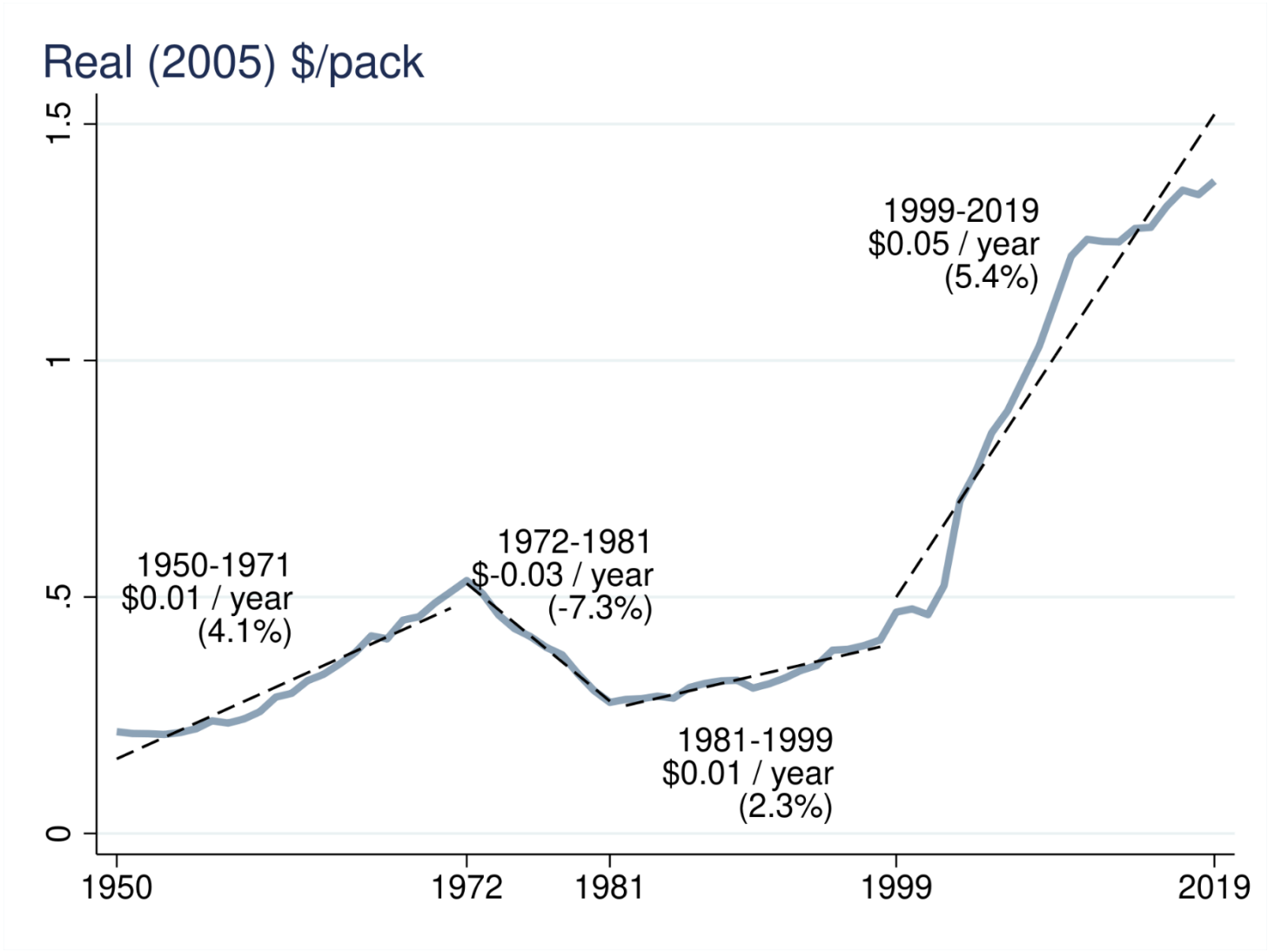
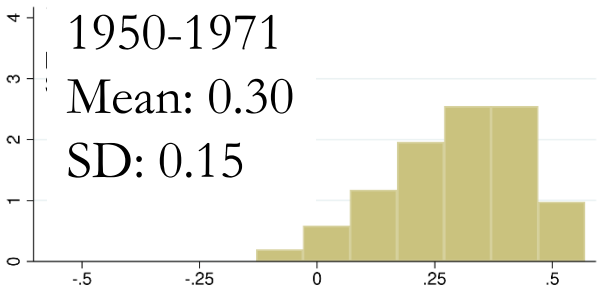
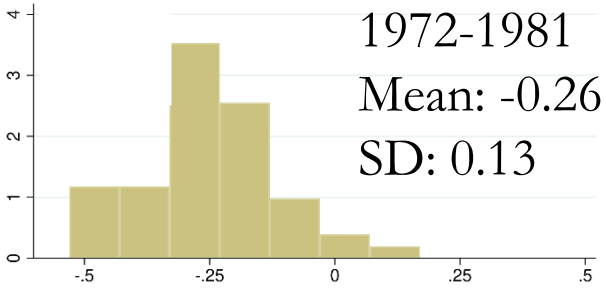
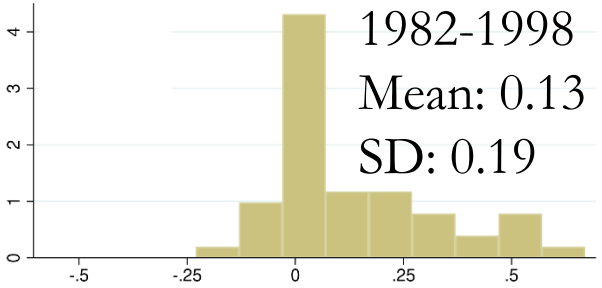
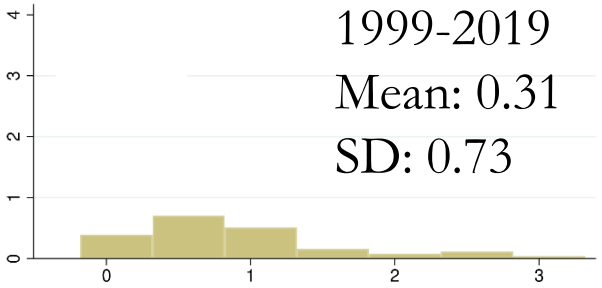


Distribution of tax changes









Sample formation

Both samples: Born 1936-1998, age 20+, US Born

Smoking: 1992-1998 Tobacco Use Supplement of CPS

- Work with micro data
- Main outcome: indicator for "smoke some day or everyday"

Mortality data: 1990-2018 death certificates

- Aggregate to state-birth year-death year(-sex) cells
- Get 1990 population counts for state-birth year cells(-sex) cells
- Main outcome: deaths per 100,000, denominated by 1990 population

Methods

Isolating quasi-experimental variation

Goal is to compare people facing different teen taxes, otherwise similar

Regression specification

$$Y_{it} = \alpha_1 TeenTax_{s(i)} + \epsilon_{it}$$

α_1: Effect of \$1 of teen taxes on adult outcome Y

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Regression specification

$$Y_{it} = \alpha_1 TeenTax_{s(i)} + \mu_{s(i)} + Trend + \epsilon_{it}$$

α_1: Effect of \$1 of teen taxes on adult outcome Y

State fixed effect control for permanent, cross-state differences in Y_{it}

Trend: birth year-age fixed effects, state-by-birth linear trends

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Control for adult taxes because autocorrelation in taxes

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Goal is to compare people facing different teen taxes, otherwise similar

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State fixed effect control for permanent, cross-state differences in Y_{it}

Trend: birth year-age fixed effects, state-by-birth linear trends

Control for adult taxes because autocorrelation in taxes

Control for individual characteristics (race, birth year-age FE) for power, state-policies dated at time of teenage years and current-time dated

Potential concerns and solutions

Confounding from anti-tobacco sentiment

- States with higher taxes have more general opposition to tobacco
- Addressed by (1) state fixed effects, (2) controls for other tobacco legislation

Confounding from trends in smoking or mortality

- Taxes increasing over time, as mortality and smoking generally decline
- Addressed by fixed effects for age-by-birth year and state-specific linear trends

Attenuation bias from measurement error

- Likely bias α_1 towards zero, so if anything our estimates are too small

Many adult smokers try to quit, or quit but relapse

- Estimates from representative samples, average over current/former/never smokers

Results

Teenage taxes reduce adult **smoking**

	Men and women	Men only	Women only
Coef. on *teen tax*	-0.017	-0.018	-0.017
	(0.007)	(0.009)	(0.008)
Observations	1,180,499	521,257	659,242
Mean smoking rate	0.227	0.244	0.215
Mean *teen tax*	0.77	0.77	0.77
Implied teen tax elasticity	-0.06	-0.06	-0.06

Notes: Table reports coefficient on teen tax. Dependent variable is an indicator for "smokes some or every day." Many additional controls. Robust standard errors, clustered on state, in parentheses.

Teenage taxes reduce adult **mortality**

	Men and women
A. All mortality	
Coef. on *teen tax*	-20.0
	(9.9)
Mean mortality rate	479.3

Notes: Table reports coefficient on teen tax from regression of deaths per 100,000. Many additional controls. Robust standard errors, clustered on state, in parentheses.

Teenage taxes reduce adult **mortality**

	Men and women	Men only	Women only
A. All mortality			
Coef. on *teen tax*	-20.0	-34.6	-7.2
	(9.9)	(12.3)	(6.8)
Mean mortality rate	479.3	577.9	239.5

Notes: Table reports coefficient on teen tax from regression of deaths per 100,000. Many additional controls. Robust standard errors, clustered on state, in parentheses.

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Mean mortality rate	479.3	577.9	239.5
B. "Smoking-related" mortality			
Coef. on teen tax	-16.2	-27.7	-6.3
	(6.8)	(8.7)	(5.7)
Mean mortality rate	239.5	294.6	184.5

Notes: Table reports coefficient on teen tax from regression of deaths per 100,000. Many additional controls. Robust standard errors, clustered on state, in parentheses.

No effect on "placebo" causes of death

	Men and women	Men only	Women only
Coef. on *teen tax*	-0.3	-1.4	0.9
	(1.5)	(2.1)	(1.1)
Mean mortality rate	45.9	66.0	25.8

Notes: "Placebo" causes include homicides and non-fire accidents. Table reports coefficient on teen tax from regression of deaths per 100,000. Many additional controls. Robust standard errors, clustered on state, in parentheses.

Teenage taxes especially important for mortality

Y=deaths/100k	Men and women	Men only	Women only
Taxes, age 11 to 19	-30.0	-43.2	-17.5
	(12.3)	(16.5)	(9.4)
Taxes, ages 20 to 24	-6.1	-11.5	-2.7
	(6.2)	(9.1)	(4.2)
Taxes, ages 1 to 10	-10.1	-22.9	1.1
	(18.5)	(25.8)	(13.7)
Mean mortality rate	325	488	243

Notes: Table reports coefficient on teen tax from regression of deaths per 100,000. Many additional controls. Robust standard errors, clustered on state, in parentheses.

Robustness

- Alternative controls
  - Drop adult-dated controls
  - Drop teen-dated controls
  - Add education controls (available only in smoking data)
- Alternative teenage definition: 11-19, 14-20
- Log specification (mortality only)
- Alternative data sets (Smoking only)
  - PSID
  - BRFSS
  - Gallup polls (good coverage throughout 20th century)

Conclusions

State cigarette taxes enacted over the last 70 years

- Reduced smoking at the time they went into effect
- Continued to reduce smoking decades later among people exposed as teenagers
- Reduced mortality among those cohorts also
- Taxes at other ages have less pronounced long-run health effects

Long-lasting consequences of cigarette taxes, tobacco control policy

- Potential health benefits from reducing teenage cigarette use
- Though average taxes are high, many states currently have low tax rates