The Long-Run Impacts of Cigarette Taxes on Smoking

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Preview

- **Motivation and Research Question**: How does life course cigarette tax policy affect long-term adult smoking behaviors in the United States?
- **Data**: Smoking behaviors of respondents aged 18 to 64 from pooled 1984-2010 BRFSS linked to state cigarette excise taxes.
- **Empirical Strategy**: Fixed-effects strategy that exploits current and historical variation in cigarette taxes within states.
- **Results**: Cigarette tax hikes over the life course prevent smoking initiation, causes adults who smoke to reduce smoking intensity and leads to quitting in the long-run.
- **Policy Implications**: Modern tax hike of $1.25 translates into 40-70k fewer deaths from smoking-related causes in 20 years.

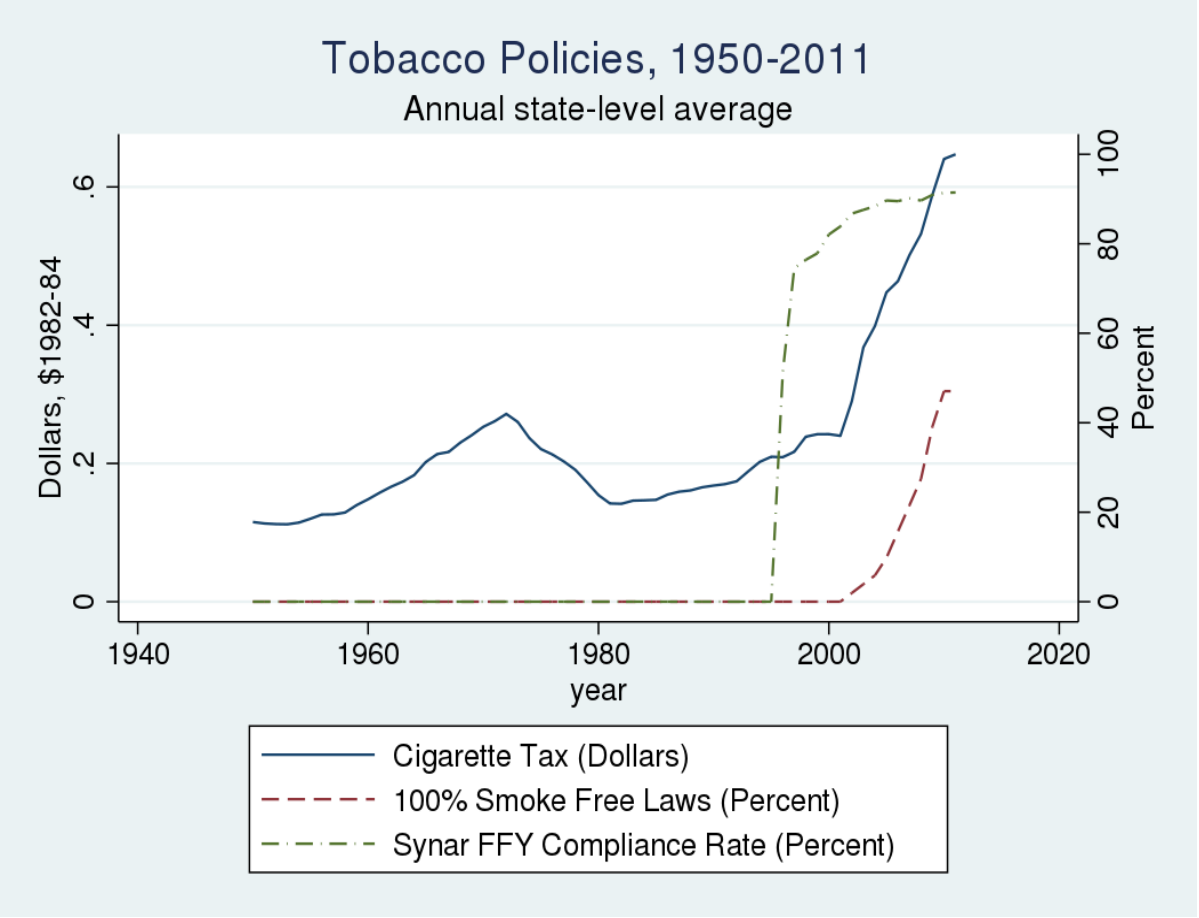
Motivation

- Cigarettes are the main cause of preventable mortality in the U.S. (CDC).
  - Responsible for almost half of a million deaths each year, including deaths from lung and other cancers, heart disease, and respiratory conditions.
  - Due to cumulative exposure to the chemicals in cigarette smoke.
  - Many policies have been implemented to prevent or reduce tobacco use, including increases in **state cigarette excise taxes**.
- Cigarette tax hikes have a limited impact on current smoking behaviors...
  - (Callison & Kaestner, 2014; DeCicca, Kenkel, & Lovenheim, 2020)

Motivation

- … but the effects of these tax hikes may develop over the long-run.
  - Previous research focuses on the long-run effects of cigarette tax hikes during the **teenage years**.
    - Find that teenage tax hikes decrease later adult smoking.
      - (Friedson, Li, Meckel, Rees, & Sacks, 2021; Glied, 2002; Gruber & Zinman, 2001)
  - The long-term effects of cigarette tax hikes that occur during **adulthood** are uncertain.
    - Exposure to tax increases may limit long-term smoking.
    - Tax hikes may fail to alter the established smoking behaviors of adults who smoke.
- This analysis examines the impacts of life course cigarette tax policies on long-term adult smoking in the U.S.

Data – Cigarette Taxes



- **State cigarette excise taxes** (tax per pack of cigarettes in real $1982-84 dollars) - Orzechowski and Walker (2014)
- **100 percent smokefree laws** (indicator for bans in workplaces, restaurants, and bars) - American Nonsmokers' Rights Foundation
- **Compliance with Synar regulation** (percent) - SAMHSA

Data – Analytic Sample

- Respondents from pooled 1984-2010 BRFSS data.

- Outcomes:
  1. Ever having smoked (indicator for having smoked 100 cigarettes in life).
  2. Current smoking (indicator).
  3. Smoking intensity (avg. num. of cigarettes consumed each day conditional on current smoking, available 1984-2000).

- Linked to state cigarette excise taxes by **current state & current year**, and **current state & past year at specific ages**.
  - Past ages: 17, 30, 40, and 50 years-old.
  - Assumes current state of residence is also past state of residence.
    - State of past residence (e.g. at age 17) is not available in BRFSS data.

Empirical Strategy

- Focus on approximate decade-interval subgroups aged 18 to 64.

$$Y_{isbym} = \beta_0 + \boldsymbol{CURR\_POL}_{sy}\beta_1 + \beta_2 EL\_TAX_{sb} + \beta_3 GSP_{sy}$$

$$+ \boldsymbol{X}_{isbym}\beta_4 + \gamma_s + \pi_b + \tau_y + \eta_m + \varepsilon_{isbym}$$

- Y: smoking outcome for individual *i* living in state *s* with year of birth *b* in the current year *y* and current month *m*.

- *CURR_POL*: current tobacco policies, including cigarette tax.
- *EL_TAX*: "earlier life" cigarette tax, at a past age.

- β_1 and β_2 capture effects of current and past state cigarette tax hikes on adult smoking outcomes.

Empirical Strategy

- Identifying assumptions:

  1. Absent tax hikes, smoking trends in “tax hike states” would be parallel to those in “non-tax hike states.”

     - “Generalized” difference-in-differences parallel trends assumption (DeCicca, Kenkel, & Lovenheim, 2020).
       - Challenging to examine with event study in this setting (multiple - current and historical - tax changes in each state).
       - Inclusion of state-specific linear time trends may absorb long-term effects of tax hikes.

  2. No unaccounted-for state-level shocks that simultaneously affect cigarette taxes and smoking.

Results – Ever Smoked

- Teenage and later life cigarette tax hikes decrease the long-term probability of ever having smoked.

Effect of Life Course Taxes on Smoked 100 Cigarettes in Life by Age Group

	Aged 18 to 24	Aged 25 to 34	Aged 35 to 44		Aged 45 to 54			Aged 55 to 64			
Cigarette tax	-0.00855	-0.00260	-0.00611	0.000480	0.000428	-0.00357	0.00455	0.0119	0.0100	0.00883	0.0138
	(0.0110)	(0.0110)	(0.0114)	(0.00984)	(0.00990)	(0.00950)	(0.00885)	(0.0112)	(0.0111)	(0.0108)	(0.0109)
Age 17 cigarette tax	-0.0836***	-0.0544**	-0.0321		-0.0976***			-0.0613			
	(0.0248)	(0.0254)	(0.0439)		(0.0334)			(0.0495)			
Age 30 cigarette tax				-0.0538**		-0.0715*			-0.0107		
				(0.0209)		(0.0360)			(0.0385)		
Age 40 cigarette tax							-0.0637**			-0.0958***	
							(0.0250)			(0.0349)	
Age 50 cigarette tax											-0.0418*
											(0.0220)
100% smokefree laws indicator	-0.00543	-0.0119**	0.00275	0.00591	0.00576	0.00557	0.00888	0.00445	0.00428	0.00503	0.00711
	(0.0100)	(0.00539)	(0.00569)	(0.00576)	(0.00725)	(0.00669)	(0.00658)	(0.00638)	(0.00629)	(0.00596)	(0.00610)
Synar compliance rate	-0.0225	-0.0208	0.0276*	0.0268*	-0.00170	-0.00183	-0.00221	0.0401	0.0404	0.0397	0.0392
	(0.0222)	(0.0168)	(0.0142)	(0.0141)	(0.0170)	(0.0157)	(0.0153)	(0.0266)	(0.0270)	(0.0264)	(0.0263)
Observations	308,682	716,121	903,804			925,350			769,153		

Notes: Standard errors are in parentheses. * p<0.10, ** p<0.05, *** p<0.01. All cigarette taxes are annual and in real $1982-84.

Results – Current Smoking Participation

- The age 17 cigarette tax decreases smoking amongst young adults, but the effect dissipates with age.
- Adult cigarette taxes decrease smoking over the long-term.

Effect of Life Course Taxes on Current Adult Smoking by Age Group

	Aged 18 to 24	Aged 25 to 34	Aged 35 to 44		Aged 45 to 54			Aged 55 to 64			
Cigarette tax	-0.0110	-0.0104	-0.00660	-0.00309	-0.0154**	-0.0176**	-0.0135**	-0.00671	-0.00690	-0.00821	-0.00395
	(0.00835)	(0.00830)	(0.00694)	(0.00613)	(0.00690)	(0.00754)	(0.00579)	(0.00575)	(0.00562)	(0.00515)	(0.00479)
Age 17 cigarette tax	-0.0670***	-0.0326	-0.0183		-0.0585*			-0.0134			
	(0.0139)	(0.0227)	(0.0339)		(0.0297)			(0.0281)			
Age 30 cigarette tax				-0.0286**		-0.0277			0.0384		
				(0.0116)		(0.0215)			(0.0322)		
Age 40 cigarette tax							-0.0331			-0.0862***	
							(0.0240)			(0.0218)	
Age 50 cigarette tax											-0.0350**
											(0.0162)
100% smokefree laws indicator	-0.0130	-0.00749	-0.000450	0.00122	0.00630	0.00607	0.00786	0.00358	0.00325	0.00428	0.00597
	(0.00892)	(0.00533)	(0.00399)	(0.00408)	(0.00528)	(0.00510)	(0.00561)	(0.00370)	(0.00387)	(0.00366)	(0.00381)
Synar compliance rate	-0.00520	-0.00963	-0.00250	-0.00291	-0.0122	-0.0120	-0.0124	0.0117	0.0124	0.0110	0.0106
	(0.0202)	(0.0114)	(0.0101)	(0.0101)	(0.0151)	(0.0148)	(0.0145)	(0.0100)	(0.0101)	(0.0106)	(0.00960)
Observations	308,682	716,121	903,804		925,350			769,153			

Notes: Standard errors are in parentheses. * p<0.10, ** p<0.05, *** p<0.01. All cigarette taxes are annual and in real $1982-84.

Results – Smoking Intensity

- The current cigarette tax decreases smoking intensity amongst current adults who smoke.

Effect of Life Course Taxes on the Average Number of Cigarettes Each Day (Conditional on Current Smoking) by Age Group

	Aged 18 to 24	Aged 25 to 34	Aged 35 to 44		Aged 45 to 54			Aged 55 to 64			
Cigarette tax	-0.494	-2.786***	-4.233***	-4.036***	-2.557**	-2.894***	-2.684**	-3.675*	-3.650*	-3.746*	-3.475*
	(1.402)	(0.879)	(0.860)	(0.862)	(1.020)	(1.061)	(1.089)	(2.048)	(2.088)	(2.055)	(1.976)
Age 17 cigarette tax	-3.041**	0.306	-0.913		-3.969***			-1.099			
	(1.299)	(1.762)	(1.497)		(1.357)			(4.329)			
Age 30 cigarette tax				-2.803		2.765			3.219		
				(1.848)		(2.510)			(2.531)		
Age 40 cigarette tax							-1.828			2.122	
							(1.759)			(4.141)	
Age 50 cigarette tax											-7.918***
											(1.897)
Any 100% smokefree laws indicator	0.316	-0.298	-0.0481	0.0810	-0.645***	-0.738***	-0.669***	0.810*	0.754	0.789*	1.167**
	(0.358)	(0.234)	(0.309)	(0.352)	(0.182)	(0.202)	(0.200)	(0.459)	(0.456)	(0.444)	(0.449)
Synar compliance rate	0.656	-0.899	-0.558	-0.534	-1.222	-1.262	-1.272	-1.829	-1.873	-1.802	-1.694
	(0.827)	(0.548)	(0.535)	(0.513)	(0.743)	(0.775)	(0.780)	(1.147)	(1.139)	(1.151)	(1.149)
Observations	38,780	86,603	94,564		63,771			27,400			

Notes: Standard errors are in parentheses. * p<0.10, ** p<0.05, *** p<0.01. All cigarette taxes are annual and in real $1982-84.

Results – Young Adults and Non-Tax Interventions

- The age 17 cigarette tax and the age 17 Synar compliance rate decrease young adult smoking on the extensive margin.

Subgroup Analysis - Young Adults (Aged 18 to 24)

	Smoked 100 Cigarettes in Life	Current Smoking	Average Number of Daily Cigarettes (Conditional on Current Smoking)
Current cigarette tax	-0.00951	-0.0116	-0.555
	(0.0106)	(0.00829)	(1.345)
Age 17 cigarette tax	-0.0861***	-0.0684***	-2.933**
	(0.0257)	(0.0143)	(1.219)
Current 100% smokefree laws indicator	-0.00677	-0.0140	0.394
	(0.00904)	(0.00844)	(0.399)
Age 17 100% smokefree laws indicator	0.0145*	0.00876	0.984**
	(0.00801)	(0.00757)	(0.411)
Current Synar compliance rate	-0.0222	-0.00485	0.664
	(0.0221)	(0.0198)	(0.853)
Age 17 Synar compliance rate	-0.0450**	-0.0301**	-1.036
	(0.0221)	(0.0140)	(0.833)
Observations	308,682		38,780

Notes: Standard errors are in parentheses. * p<0.10, ** p<0.05, *** p<0.01. All cigarette taxes are annual and in real $1982-84.

Results – Robustness Tests

- Identification threats and potential limitations:

1. Tobacco policy may be endogenous to other factors that affect smoking behaviors.
   - E.g. - Cigarette tax revenue is immediately invested into health interventions that decrease smoking prevalence.
   - E.g. - Policy shifts are endogenous to changing factors within a state.
   - Robustness tests: include controls for health-related personal transfer receipts and lagged demand for cigarettes in analysis.
     - (Gruber & Zinman, 2001; Simon, 2016)

2. Assumes no migration.
   - Likely understates effects (migration negatively correlated with smoking).
   - Subgroup analyses: respondents with high school completion or less educational attainment.

Results – Robustness Tests

- Identification threats and potential limitations:

3. Strategic response to policy changes or cross-border shopping.
   - Extensive margin outcomes unlikely to be affected.
   - Geographic boundaries are states.

4. Differential timing of tax changes may bias estimates (Goodman-Bacon, 2021).
   - Further complicated in this setting since treatment is non-binary/continuous.

Policy Implications

- Simulate the long-term effects of a hypothetical current tax increase of $1.25.

- Calculate differential impacts of lagged tax increases at different ages on smoking outcomes ten years later.

  1. Use data from the 2018 IPUMS National Health Interview Survey to represent current smoking in the U.S. population.

  2. Project the smoking behaviors of each age group forward ten years by applying statistically significant estimates.
     - Represents changes in smoking behaviors due to a 2018 tax hike for each age group in 2028.

Policy Implications

- Results: in 10 years, decreased ever smoking (-2.1pp), current smoking (-1.2pp), and smoking intensity (-2 cigarettes/day).

Percent current smokers				
Age in 2018	Age in 2028	No tax increase	$0.41 tax increase	Percentage point difference
5 to 54	15 to 64	13.0%	11.8%	-1.2
5 to 14	15 to 24	7.8%	5.0%	-2.7
15 to 24	25 to 34	7.8%	7.8%	0.0
25 to 34	35 to 44	16.2%	15.0%	-1.2
35 to 44	45 to 54	16.8%	16.0%	-0.7
45 to 54	55 to 64	16.4%	14.9%	-1.4

- This decline translates into 43,056 to 69,050 fewer deaths from smoking by 2038.

Conclusion

- Overall, I find that cigarette tax hikes:
  - Prevent long-term smoking initiation.
  - Cause adults who smoke to smoke fewer cigarettes in the near-term.
  - Lead to quitting over time.

- Although cigarette tax hikes have a limited impact on current smoking, they can have large impact on long-term smoking.

  - Cigarette tax hikes can still effectively decrease smoking despite the relatively inelastic response of smoking to taxes in the short-term.

  - Effects take roughly a decade to accumulate.

Conclusion

- Anti-smoking interventions should target older age groups in addition to teenagers/young people.
  - State cigarette excise taxes may be particularly valuable in this context, since tax hikes affect all ages.
  - Substantial morbidity and mortality benefits from quitting smoking even at older ages.
    - Adults who previously smoked but quit in their 60s experience large reductions in mortality after the age of 70 compared to individuals that continued to smoke (Nash, Liao, Harris, & Freedman, 2017).
    - People who quit smoking reduce the risks of heart attack within one year, stroke within two to five years, oral and throat cancers within five years, and lung cancer within ten years (CDC).

Thanks!

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Tobacco Policy Summary Statistics

	Mean	Std. Dev.	Min	Max
Annual Cigarette Tax, $1982-84	0.23	0.20	0	1.93
100% Smoke Free Laws	0.04	0.18	0	1
Synar FFY Compliance	0.22	0.37	0	0.99
Year		1950-2011		
Observations		3,162		

Notes: Summary statistics are annual and state-level.

Extensive Margin Analytic Sample Means and Years

	Aged 18 to 24	Aged 25 to 34	Aged 35 to 44	Aged 45 to 54	Aged 55 to 64
Panel A: BRFSS Analytic Samples					
Percent smoked 100 cigarettes in life	34.1	42.0	46.3	52.1	55.5
Percent current smoker	25.3	26.0	25.4	24.4	19.3
Age (years)	21.0	29.7	39.4	49.3	58.9
Percent female	48.5	49.8	50.5	50.9	52.1
Percent White	66.7	69.1	73.1	77.0	79.2
Percent Black	11.6	10.6	9.9	9.5	9.2
Percent Hispanic	16.1	14.9	11.9	9.2	7.6
Percent other	5.6	5.4	5.0	4.3	3.9
Percent with less than high school	14.5	10.1	9.7	10.7	12.8
Percent with high school graduation	37.4	29.5	29.0	30.0	31.5
Percent with some college	35.7	27.2	26.7	26.1	24.8
Percent with four year college or more	12.5	33.2	34.6	33.2	30.9
Observations	308,682	716,121	903,804	925,350	769,153
Birth Year	1960-1993	1950-1986	1940-1976	1933-1966	1933-1956
Year Age 17	1977-2010	1967-2003	1957-1993	1950-1983	1950-1973
Year Age 30			1970-2006	1963-1996	1963-1986
Year Age 40				1973-2006	1973-1996
Year Age 50					1983-2006
Interview Year	1984-2011	1984-2011	1984-2011	1984-2011	1988-2011
Panel B: Tobacco Policies Matched to BRFSS Analytic Samples					
Current cigarette tax	0.31	0.31	0.32	0.34	0.38
Age 17 cigarette tax	0.24	0.19	0.20	0.21	0.16
Age 30 cigarette tax			0.20	0.19	0.22
Age 40 cigarette tax				0.21	0.18
Age 50 cigarette tax					0.22
Current percent 100% smokefree laws	6.8	6.8	7.7	9.0	11.4
Current percent Synar FFY compliance	50.2	49.6	54.9	59.8	71.7
Current state GDP per capita	19744	19776	20048	20263	20853
Age 17 percent 100% smokefree laws	2.3				
Age 17 percent Synar FFY compliance	36.2				
Age 17 state GDP per capita	18605				

Intensive Margin Analytic Sample Means and Years

	Aged 18 to 24	Aged 25 to 34	Aged 35 to 44	Aged 45 to 54	Aged 55 to 64
Panel A: BRFSS Analytic Samples					
Average number of daily cigarettes (conditional on smoking)	13.8	16.4	18.7	20.0	18.9
Age (years)	21.1	29.7	39.3	49.0	58.1
Percent female	46.6	47.1	46.7	46.8	49.5
Percent White	79.4	78.3	79.2	80.5	81.9
Percent Black	6.6	9.4	10.3	10.4	10.0
Percent Hispanic	10.2	8.8	7.4	6.2	5.5
Percent other	3.7	3.4	3.1	2.9	2.7
Percent with less than high school	20.2	15.6	14.5	18.3	23.6
Percent with high school graduation	44.6	42.4	40.0	38.5	39.2
Percent with some college	28.8	27.4	28.6	26.2	22.3
Percent with four year college or more	6.5	14.7	16.9	17.0	14.9
Observations	38,780	86,603	94,564	63,771	27,400
Birth Year	1960-1983	1950-1976	1940-1966	1933-1956	1933-1946
Year Age 17	1977-2000	1967-1993	1957-1983	1950-1973	1950-1963
Year Age 30			1970-1996	1963-1986	1963-1976
Year Age 40				1973-1996	1973-1986
Year Age 50					1983-1996
Interview Year	1984-2001	1984-2001	1984-2001	1984-2001	1988-2001
Panel B: Tobacco Policies Matched to BRFSS Analytic Samples					
Current cigarette tax	0.20	0.20	0.2	0.20	0.22
Age 17 cigarette tax	0.18	0.19	0.23	0.16	0.12
Age 30 cigarette tax			0.17	0.22	0.23
Age 40 cigarette tax				0.17	0.21
Age 50 cigarette tax					0.17
Current percent any 100% smokefree laws	2.3	2.0	2.4	2.5	3.5
Current percent Synar FFY compliance	26.6	22.7	27.8	28.6	42.9
Current state GDP per capita	18248	18081	18263	18277	18921
Age 17 percent any 100% smokefree laws	0.3				
Age 17 percent Synar FFY compliance	6.9				
Age 17 state GDP per capita	16865				