Tax incidence for menthol cigarettes by race: Evidence from Nielsen Homescan data

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Disclosure and Disclaimer

Outline

Motivation

- Black (African American) smokers have the highest percentage of menthol cigarette use

    – 77% of Black smokers use menthol products; only 25% of white smokers do

- Menthol creates a cooling and anesthetic effect that masks the harshness of smoke (FDA 2013)

    – Menthol smokers inhale more deeply, hold the smoke in their lungs longer, and show a higher level of nicotine addiction (Clark et al. 1996; U.S. FDA 2013, 2022; Watson et al. 2017) → mixed and inconclusive findings

- Blacks have the highest mortality rate for lung cancer and other smoking-related diseases although they have similar smoking rates as whites (American Cancer Society 2022; Kitts 2019)

Motivation

- Racial disparities in menthol cigarette use are part of the reasons for the <u>recent proposal to ban menthol cigarettes</u> in the United States

  - Opponents argue that banning menthol cigarettes may lead to increased cigarette smuggling, reduced tax revenues, and aggressive policing in Black communities

    - Potential for decreasing youth smoking initiation is less compelling, given recent shifts in smoking patterns (the smoking rate is only around 1% for both Black and non-Black youth groups)

- A more conventional method: increasing cigarette taxes

  - If Black menthol smokers are price-sensitive at all (i.e., not perfectly inelastic), increasing taxes would effectively reduce menthol cigarette use among Blacks

  - The effectiveness of taxes to reduce Black menthol smoking depends on the extent to which taxes are passed through to prices paid by Black menthol smokers

What we do

- This study empirically examines whether the incidence of cigarette taxes on menthol products varies with race of smokers

- We use Nielsen Homescan data to estimate the rate at which cigarette excise taxes are shifted to consumer prices across race and products

  – Data contain consumer prices at the Universal Product Code (UPC) level paid by 30,802 households across 48 continental states and the District of Columbia.

  – Data provide the identity (race and income) and location of consumers, and the type of products purchased

Findings

- Taxes are shifted at significantly lower rates to Black buyers of menthol cigarettes than any other
    - $1 increase in state cigarette excise taxes leads to a $1 increase in menthol cigarette prices for white buyers (i.e., full shifting) but only a $0.68 increase for Black buyers
    - A potential explanation: Black menthol smokers may be more responsive to cigarette prices than others
        - Tobacco industry has long targeted Blacks for the sale of menthol cigarettes: free samples, discount offers, and sponsoring special events
- Racial difference in pass-through rates for menthol products is more significant in areas with a large Black population
- Black smokers receive significantly more price discounts for menthol products than white menthol buyers

Literature

- DeCicca et al. (2013) use the Current Population Survey and find that the rates of tax shifting are not statistically different between menthol and nonmenthol smokers
  - We show that the average rate of tax shifting by product masks substantial differences by race
- Kim and Lee (2021) use store-level scanner data and find that the rates of tax shifting for both menthol and non-menthol products are smaller in cities with a larger Black population
  - Their use of city-level demographics is limited (ignoring within-city segregation by race)
- Harding et al. (2012) use Nielsen Homescan data (as in our study) and find that cigarette taxes are less than fully shifted to consumer prices owing to cross-state tax avoidance
  - They do not consider the differences in tax shifting by race or product

Why tax incidence for menthol smokers differs by race

- A general principle of tax shifting: Taxes are shifted away from economic agents most able to change their behavior in response to taxation
  - Observed tax pass-through is an equilibrium of both demand- and supply-side behaviors
- (Demand side) Taxes will be shifted away from consumers with more price-elastic demand
  - Evidence on the price elasticity of demand among Black menthol smokers is limited and indirect (Farrelley et al. 2001; Chaloupka and Pacula 1999; Gruber and Zinman 2000; Cheng et al. 2022)
- (Supply side) If Black smokers are more price sensitive, manufacturers/retailers can increase profits by targeting price promotions to Black menthol smokers and shifting taxes to the prices paid by other smokers
  - Price promotions are generally more common in Black communities

Data

- Nielsen Homescan panel data from January 2008 to December 2014

    – 1.6 million transactions made by 30,802 households across 48 states and the DC

    – Using in-home scanner, households scan the barcode of the products purchased from retail outlets

        • supercenters, grocery stores, drug stores, club stores, tobacco shops, convenience stores, and gas stations

- Scanner records product at the UPC level

    – A UPC distinguishes each product by detailed attributes such as brand, packaging, and flavor (e.g., Marlboro menthol 100s soft pack)

    – 4,596 UPCs (324 brands)

- Households enter the price and quantity of each purchase

    – Each week, households send the data to Nielsen by connecting the scanner to a computer

- Demographics: Household size, income, age, number and age of children, education, employment, and race

- Observation unit: monthly average price paid by a household for each UPC

Data

Table 1. Summary Statistics

	Mean	S.D.
Panel A: Cigarette prices, taxes, and products		
Consumer price per pack (dollars)	4.631	1.762
Excise tax (dollars)	1.215	0.822
Menthol products	0.350	0.477
Carton	0.332	0.471
Generic brands	0.362	0.481
Number of observations	595,246	
Number of households	30,802	

Notes. Observations are at the household–UPC–month level. Homescan data are weighted by projection factors (sampling weights). Summary statistics for demographics are omitted (link to Panel B).

Data

Table 2. Purchasing Patterns of Mentholated Cigarettes by Race

	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
	Share of menthol purchase (%)				Indicator of menthol smoker			
Whites	30.1	43.5	0	100	0.303	0.460	0	1
Blacks	73.6	42.1	0	100	0.741	0.438	0	1
Others	36.8	46.0	0	100	0.368	0.482	0	1

Notes. The share of menthol purchase is calculated as the ratio of menthol purchases in packs to the total number of cigarette packs purchased by each household within a year. A menthol smoker is defined as a household whose share of menthol purchase is at least 50% of the total cigarette purchases.

Pause and Q&A

Empirical model

- Empirical model

$$P_{ijst} = \beta_0 + \beta_1 \tau_{st} + \phi \cdot X_j + \delta_i + \mu_s + \lambda_t + \varepsilon_{ijst}$$

P_{ijst} : price per pack for UPC i paid by household j in state s in month t

τ_{st} : state cigarette excise tax per pack in state s

X_j : vector of household demographic characteristics

$\delta_i, \mu_s, \lambda_t$: the set of UPC, state, and time (year and month) fixed effects

- $\beta_1 = 1$ implies full shifting of taxes to consumer prices
- State cigarette excise taxes increased at least once in 23 states in the period 2008–2014
    - The average tax increase is $0.96 per pack Table A1 Cigarette consumer prices and taxes by State (20...

Identification strategy

- UPC fixed effects allow us to abstract from the possibility that consumers alter product choices when excise taxes increase

  – Consumers may upgrade the quality of cigarettes when excise taxes increase

  – In the short term, consumers may downgrade to offset the effect of tax increases

- State fixed effects : states have time-invariant unobservable characteristics correlated with both tax levels and the increase in cigarette prices (e.g., strong anti-smoking sentiment)

- Within-UPC difference-in-difference model (Harding et al. 2012)

  – β_1 is identified by comparing the within-UPC change in prices among 23 states that changed their taxes during the 2008–2014 period relative to states that did not, holding household characteristics constant

  – Key identifying assumption: price trends in both treated states and control states would be the same absent the tax increase, conditional on the fixed effects and other set of controls Figure A1. Cigarette Prices Before and After Excise Tax C...

Baseline results

Table 3. Effects of Cigarette Taxes on Consumer Prices by Race

	1 All households	2 Whites	3 Blacks	4 Non-Black minorities
Excise tax (dollars)	0.885***	0.907***	0.750***	0.863***
	(0.0215)	(0.0255)	(0.0747)	(0.0431)
Number of observations	595,246	493,867	54,759	46,620
Number of households	30,802	25,156	2,955	3,147
R-squared	0.631	0.634	0.675	0.711
State FE, Time FE, UPC FE	Yes	Yes	Yes	Yes
$\beta_1 = 1$ (p-value)	0.000	0.001	0.002	0.003

Notes. Consumer prices and excise taxes are in dollars per pack. Results are weighted by sampling weights (projection factors). Cluster-robust standard errors are reported in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. $\beta_1 = 1$ (p-value): p-value for rejecting the null hypothesis that the pass-through rate is not different from 1. ([link to the full version](#))

- The average rate of tax shifting by race masks substantial differences across products (i.e., menthol and non-menthol)

Main results

Table 4. Effects of Cigarette Taxes on Consumer Prices by Race and Product

Panel A. Menthol products

	1	2	3	4	
	All households	Whites	Blacks	Non-Black minorities	$\beta_{1,\text{Black}} - \beta_{1,\text{White}}$
Excise tax (dollars)	0.911*** (0.0265)	0.988*** (0.0432)	0.675*** (0.0843)	0.865*** (0.0572)	-0.313*** (0.1102)
R-squared	0.664	0.674	0.679	0.755	
State FE, Time FE, UPC FE	Yes	Yes	Yes	Yes	
$\beta_1 = 1$ (p-value)	0.002	0.790	0.000	0.023	

Panel B. Non-menthol products

	All households	Whites	Blacks	Non-black minorities	$\beta_{1,\text{Black}} - \beta_{1,\text{White}}$
Excise tax (dollars)	0.858*** (0.0250)	0.869*** (0.0284)	0.990*** (0.0580)	0.856*** (0.0612)	0.121* (0.0613)
R-squared	0.609	0.616	0.675	0.679	
State FE, Time FE, UPC FE	Yes	Yes	Yes	Yes	
$\beta_1 = 1$ (p-value)	0.000	0.000	0.858	0.023	

Notes. Consumer prices and excise taxes are in dollars per pack. Only the coefficients on excise tax are reported from the full equation. Cluster-robust standard errors are reported in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. $\beta_{1,\text{Black}} = \beta_{1,\text{White}}$: statistical significance of the difference in pass-through rates between white and Black smokers

Interpretations

- The rate at which excise taxes are shifted to menthol cigarette prices: 0.68 for Black buyers vs. 0.99 for white buyers (full shifting)

  – Evaluated at the sample mean, tax burden for Black buyers is lower than white buyers by about 8% of menthol cigarette price per pack

  – The lower rate of shifting for Black menthol smokers would reduce the regressiveness of cigarette taxes because Blacks have relatively lower income as well as the highest percentage of menthol cigarette use

- Increasing cigarette taxes would effectively reduce menthol smoking among Blacks, given that the pass-through rate for Black menthol smokers is substantially above zero

Interpretations

- Potential explanations for heterogeneity in pass-through rates across race and products

  - Black menthol smokers may have more price-elastic demand than other smokers

  - On the supply side, this may indicate that cigarette manufacturers offer more price discounts to Black menthol smokers than other smokers

Additional results

Table A2. Effects of Cigarette Taxes on Menthol Cigarette Prices by the share of Black population

Dep. Var.: Consumer price of menthol cigarettes (dollars)	1 All households	2 Whites	3 Blacks	4 Non-Black minorities
Panel A. Top 10 percent of counties with the highest share of Blacks				
Excise tax (dollars)	0.822*** (0.0554)	1.189*** (0.110)	0.474*** (0.0661)	0.904*** (0.0527)
Panel B. Top 25 percent of counties with the highest share of Blacks				
Excise tax (dollars)	0.865*** (0.0618)	1.024*** (0.0499)	0.485*** (0.0782)	0.811*** (0.113)
Panel C. Top 50 percent of counties with the highest share of Blacks				
Excise tax (dollars)	0.937*** (0.0312)	1. 052*** (0.0475)	0.666*** (0.0899)	0.830*** (0.0523)

Notes. Consumer prices and excise taxes are in dollars per pack. Only the coefficients on excise tax are reported from the full equation. Cluster-robust standard errors are reported in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

- Compared to the average results in Table 4 (Panel A), the difference in pass-through rates between Black and whites menthol smokers is larger in counties with a large Black share of population

Additional results

Table 5. Price Discounts by Race and Product

Panel A. Price discounts per pack (dollar)

	Whites		Blacks	
	Mean	S.D.	Mean	S.D.
All products	0.169	0.376	0.203	0.406
Menthol	0.128	0.327	0.191	0.395
Non-menthol	0.152	0.354	0.147	0.349

Panel B. Relationship between price discounts per pack and racial demographics

Dependent variable: Price discounts per pack (dollar)	All products	Menthol	Non-menthol
Blacks	0.0356*** (0.000102)	0.0656*** (0.000116)	-0.000407*** (0.000145)
Constant	0.194*** (0.000180)	0.141*** (0.000229)	0.172*** (0.000202)
R-squared	0.016	0.020	0.012

Notes. Price discounts per pack is the quantity-weighted average of price discounts computed for each household and year. Price discount is calculated as the difference between the regular price and the actual price paid, where the regular price is defined for each UPC–month combination as the maximum price paid by households located in the same zip code over the month.

Interpretations

- Black menthol smokers <u>receive more discounts</u> than white menthol smokers

  – Results do not include other types of promotions such as multi-pack deals

  – This may underestimate the price promotions available for Black menthol smokers

Robustness check: Alternative explanations

Table 6. Robustness Checks: Alternative Explanations

Panel A. Tax shifting and search for volume discounts

	Menthol, Pack		Menthol, Carton	
	Whites	Blacks	Whites	Blacks
Excise tax (dollars)	1.053***	0.741***	0.725***	0.393***
	(0.0528)	(0.0901)	(0.0993)	(0.143)
R-squared	0.639	0.658	0.790	0.793
State FE, Time FE, UPC FE	Yes	Yes	Yes	Yes
$\beta_1 = 1$ (p-value)	0.316	0.006	0.008	0.000
$\beta_{1,Black} - \beta_{1,White}$	-0.313***		-0.332***	
	(0.1166)		(0.0818)	

Notes. Only the coefficients on excise tax are reported from the full equation. Results are weighted by sampling weights (projection factors). Cluster-robust standard errors are reported in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Robustness check: Alternative explanations

Panel B. Tax shifting and search for quality

	Menthol, Premium		Menthol, Generic	
	Whites	Blacks	Whites	Blacks
Excise tax (dollars)	1.078***	0.730***	0.786***	0.275*
	(0.0650)	(0.0868)	(0.0792)	(0.138)
R-squared	0.635	0.636	0.637	0.680
State FE, Time FE, UPC FE	Yes	Yes	Yes	Yes
$\beta_1 = 1$ (p-value)	0.236	0.003	0.009	0.000
$\beta_{1,Black} - \beta_{1,White}$	-0.348***		-0.511***	
	(0.1269)		(0.1674)	

Notes. Only the coefficients on excise tax are reported from the full equation. Results are weighted by sampling weights (projection factors). Cluster-robust standard errors are reported in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Robustness check: Alternative explanations

Panel C. Tax shifting and border effects

	Menthol			Non-menthol		
	All	Whites	Blacks	All	Whites	Blacks
Excise tax (dollars)	1.118***	1.148***	0.830***	1.034***	1.044***	1.228***
	(0.112)	(0.103)	(0.115)	(0.0722)	(0.0724)	(0.185)
Tax difference	-0.472***	-0.317*	-0.308	-0.488***	-0.592***	-0.428
	(0.0986)	(0.188)	(0.305)	(0.141)	(0.147)	(0.407)
Distance (log)	-0.0105	0.0139	-0.00685	0.00397	-0.00116	0.0911
	(0.0248)	(0.0302)	(0.0416)	(0.0175)	(0.0170)	(0.0663)
Tax difference×Distance (log)	0.0500	0.0239	0.0274	0.0643	0.0922**	0.0478
	(0.0431)	(0.0698)	(0.0839)	(0.0394)	(0.0374)	(0.0817)
Constant	3.594***	3.325***	4.154***	3.404***	3.374***	3.081***
	(0.152)	(0.201)	(0.223)	(0.127)	(0.108)	(0.362)
Number of observations	203,823	148,300	38,778	391,423	345,567	15,981
Number of households	15,382	11,659	2,352	22,643	19,417	1, 742
R-squared	0.666	0.675	0.680	0.610	0.618	0.676
State FE, Time FE, UPC FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes. Only the coefficients on tax, tax difference, distance to the nearest lower-tax state (in logs), and the interaction term are reported from the full equation. Results are weighted by sampling weights. Cluster-robust standard errors are reported in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$ (Model)

Conclusion and Implication

- Racial patterns of tax incidence for menthol cigarettes have important policy implications

  - Black smokers have the highest percentage of menthol cigarette use and have been the main target of various marketing strategies for menthol products

- Using Nielsen Homescan data, we find that cigarette taxes are shifted at significantly lower rates to Black menthol smokers

  - Rate of shifting is 1.00 for white menthol smokers but 0.68 for Black menthol smokers

  - Potential explanation: Black menthol smokers are more responsive to cigarette prices

    - We find that (1) the racial difference in tax pass-through is more significant in areas with more Black residents and (2) Black smokers receive significantly more price discounts for menthol products

- Our findings suggest that a tax increase will effectively reduce menthol smoking among Blacks, given that the pass-through rate for Black menthol smokers is substantially above zero

  - Whether tax increases also reduce racial disparities in menthol smoking would depend on the relative price elasticities of demand between Black and white menthol smokers

Thank you

Comments and Q&A

Table A1 Cigarette consumer prices and taxes by State (2008-2014)

State	Mean per-pack prices paid	Mean taxes in dollars	Tax change in dollars	State	Mean per-pack prices paid	Mean taxes in dollars	Tax change in dollars
Alabama	3.865	0.425	-	North Carolina	3.826	0.426	0.10
Arkansas	4.145	1.057	0.56	North Dakota	3.652	0.440	-
Arizona	5.180	2.000	-	Nebraska	3.932	0.640	-
California	4.603	0.870	-	New Hampshire	5.091	1.628	0.70
Colorado	4.293	0.840	-	New Jersey	6.379	2.673	0.125
Connecticut	6.689	2.950	1.40	New Mexico	4.832	1.392	0.75
District of Columbia	5.984	2.436	1.90	Nevada	4.155	0.800	-
Delaware	4.543	1.498	0.45	New York	6.585	3.704	2.85
Florida	4.309	1.125	1.00	Ohio	4.530	1.250	-
Georgia	3.798	0.370	-	Oklahoma	3.942	1.030	-
Iowa	4.480	1.360	-	Oregon	4.601	1.199	0.13
Idaho	3.930	0.570	-	Pennsylvania	4.903	1.535	0.25
Illinois	4.883	1.337	1.00	Rhode Island	5.566	3.296	1.04
Indiana	4.415	0.995	-	South Carolina	3.634	0.391	0.50
Kansas	4.082	0.790	-	South Dakota	4.711	1.530	-
Kentucky	3.678	0.546	0.30	Tennessee	3.786	0.620	-
Louisiana	3.891	0.360	-	Texas	4.640	1.410	-
Massachusetts	6.258	2.641	2.00	Utah	4.626	1.341	1.005
Maryland	5.327	2.000	-	Virginia	3.841	0.300	-
Maine	5.468	2.000	-	Vermont	6.111	2.371	0.96
Michigan	5.321	2.000	-	Washington	5.811	2.692	1.00
Minnesota	5.079	1.906	1.857	Wisconsin	5.350	2.341	0.75
Missouri	3.364	0.170	-	West Virginia	3.642	0.550	-
Mississippi	3.673	0.579	0.50	Wyoming	3.942	0.600	-
Montana	5.385	1.700	-				

Table 1 Panel B

Panel B: Demographic variables

|		
White	0.773	0.419
Black	0.104	0.305
Hispanic	0.085	0.278
Asian	0.010	0.101
Other	0.028	0.165
One household (HH) member	0.238	0.426
Two HH members	0.357	0.479
Three HH members	0.187	0.390
Four HH members	0.113	0.317
Five HH members	0.062	0.240
Six+ HH members	0.043	0.203
HH Income < $30,000	0.416	0.493
HH Income $30,000-$70,000	0.375	0.484
HH Income > $70,000	0.209	0.406
Head age < 35	0.106	0.307
Head age 35–49	0.313	0.464
Head age 50–64	0.438	0.496
Head age 65+	0.143	0.350
Education: Less than high school	0.106	0.307
Education: High school	0.407	0.491
Education: Some college	0.329	0.470
Education: BA and above	0.158	0.365
Kids under 18	0.207	0.405
Male head employed < 30 hours	0.034	0.181
Male head employed 30–34 hours	0.024	0.154
Male head employed 35+ hours	0.354	0.478
Male head unemployed	0.267	0.442
Female head employed < 30 hours	0.079	0.270
Female head employed 30–34 hours	0.037	0.189
Female head employed 35+ hours	0.250	0.433
Female head unemployed	0.389	0.487
Number of observations	595,246	
Number of households	30,802	

Table 3 full version

Table 3. Effects of Cigarette Taxes on Consumer Prices by Race

	1 All households	2 Whites	3 Blacks	4 Non-Black minorities
Excise tax (dollars)	0.885***	0.907***	0.750***	0.863***
	(0.0215)	(0.0255)	(0.0747)	(0.0431)
Two HH members	0.0204	0.0261	0.00658	-0.0168
	(0.0200)	(0.0211)	(0.0543)	(0.0354)
Three HH members	-0.0368	-0.0462	-0.0679	0.0354
	(0.0278)	(0.0332)	(0.0656)	(0.0655)
Four HH members	-0.00963	0.00656	-0.101	0.0199
	(0.0222)	(0.0265)	(0.0677)	(0.0662)
Five HH members	-0.0272	0.0148	-0.219*	-0.0424
	(0.0443)	(0.0351)	(0.117)	(0.0992)
Six+ HH members	-0.0415	-0.0260	-0.0134	-0.0801
	(0.0362)	(0.0464)	(0.108)	(0.0619)
HH Income $30,000-$70,000	0.00464	0.0144	-0.0374	0.0116
	(0.0144)	(0.0155)	(0.0497)	(0.0480)
HH Income > $70,000	0.0579***	0.0757***	0.0325	0.0311
	(0.0207)	(0.0237)	(0.0506)	(0.0999)
Age 35-49	-0.0373	-0.0773**	0.0299	0.0914
	(0.0344)	(0.0352)	(0.0620)	(0.0588)
Age 50-64	-0.0138	-0.0561	0.113**	0.0861
	(0.0440)	(0.0482)	(0.0524)	(0.0548)
Age 65+	-0.0104	-0.0608	0.0374	0.212**
	(0.0439)	(0.0443)	(0.0599)	(0.0844)
Education − High school	0.0296	0.0465*	0.0506	-0.0839*
	(0.0227)	(0.0234)	(0.0609)	(0.0479)
Education − Some college	0.00364	0.0169	0.0249	-0.0799
	(0.0277)	(0.0262)	(0.0729)	(0.0499)
Education − BA+	0.0455**	0.0579**	0.0459	-0.0588
	(0.0215)	(0.0277)	(0.0878)	(0.0867)
Black	-0.00976			
	(0.0373)			
Hispanic	0.0584			
	(0.0648)			
Asian	-0.00102			
	(0.0575)			
Other	0.0893			
	(0.0565)			
Kids under 18	-0.0164	-0.00799	0.0169	-0.0784*
	(0.0181)	(0.0203)	(0.0540)	(0.0423)
Male head employed 30-34 hours	-0.0341	-0.0426	0.00583	-0.115
	(0.0506)	(0.0448)	(0.111)	(0.133)
Male head employed 35+ hours	-0.00983	-0.00779	0.0846*	-0.0855
	(0.0174)	(0.0131)	(0.0470)	(0.0605)
Male head unemployed	-0.0365	-0.0101	-0.116*	-0.166***
	(0.0228)	(0.0187)	(0.0633)	(0.0553)
Female head employed 30-34 hours	-0.0442	-0.0265	-0.131*	-0.150
	(0.0462)	(0.0300)	(0.0719)	(0.224)
Female head employed 35+ hours	-0.0174	-0.0173	-0.0148	-0.0326
	(0.0234)	(0.0200)	(0.0726)	(0.0609)
Female head unemployed	-0.000852	0.0127	-0.0714	-0.0664
	(0.0183)	(0.0180)	(0.0718)	(0.0680)
Constant	3.563***	3.463***	4.028***	3.891***
	(0.0514)	(0.0553)	(0.156)	(0.121)
R-squared	0.631	0.634	0.675	0.711

Figure A1. Cigarette Prices Before and After Excise Tax Changes
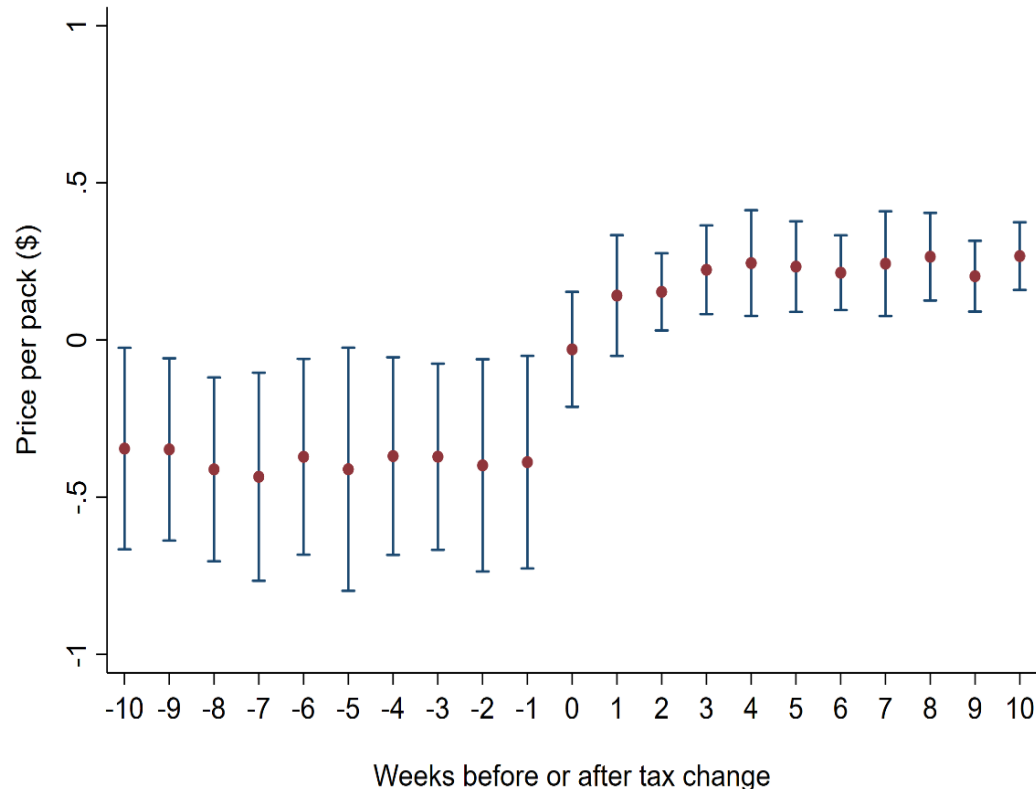
Notes. Each dot shows the coefficient estimate of the weekly dummy variable before or after a tax change. The excise tax is increased in week zero. The coefficient estimates represent prices relative to prices paid in states that did not change taxes in the period 2008–2014. The vertical lines indicate the 95 percent confidence intervals for the estimates. The regression includes the UPC, state, and time (year and month) fixed effects, and the standard errors are clustered at the state level.

Empirical model: Border effect

- Empirical model for examining the border effect (Harding et al. 2012):

$$P_{ijst} = \beta_0 + \beta_1 \tau_{st} + \beta_2\left(\tau_{st}^h - \tau_{st}^b\right) + \beta_3 \ln(D_{jst}) + \beta_4\left(\tau_{st}^h - \tau_{st}^b\right)\ln(D_{jst})$$

$$+ \phi \cdot X_j + \delta_i + \mu_s + \lambda_t + \varepsilon_{ijst}$$

$\tau_{st}^h - \tau_{st}^b$: tax difference between home state (τ_{st}^h) and nearest lower-tax state (τ_{st}^b)

D_{jst} : distance between the household and the border to the nearest lower-tax state

- $\beta_2 < 0$ implies that cross-border purchasing lowers the rate of tax shifting

- $\beta_4 > 0$ indicates that a larger distance from the lower-tax border reduces the opportunity for cross-state tax avoidance