Online Appendix for: Rees-Jones, Alex and Kyle Rozema. (2022) Price Isn't Everything: Behavioral Response around Changes in Sin Taxes. *National Tax Journal*

Assumption of cumulative effects. In our analyses, our measurements of news headlines, anti-smoking advertising, and political donations capture the cumulative amount leading up to the current month, thus assuming persistent effects of the non-price factors. We believe that the history of such activities affects current norms and sentiments regarding smoking, which justifies this cumulative treatment. For comparison, Appendix Table A3 reports the results for the current month non-price factors. We similarly find evidence that non-price factors predict consumption, although the quantitative reduction of estimated price effects is less when ignoring cumulative effects.

Role of functional form assumptions. The analyses in Table 2 assume a log-linear relationship between state taxes and cigarette consumption. Although this functional form assumption is common, it is possible that the estimates are influenced by specification error. To investigate the sensitivity of the estimates to functional form assumptions, we modify the regression framework to allow for a nonparametric relationship between taxes and cigarette consumption. In particular, we estimate the regressions in Columns 1 and 6 of Table 2 but replace the linear state tax variable with a cubic spline.[1] Appendix Figure A3 plots the estimated splines, which may be interpreted as estimated demand curves identified from within-event variation in taxes. The figure provides strong evidence that the curve estimated in the absence of controls is substantially steeper and spans a broader range of consumption levels than the curve with the controls. Overall, the figure indicates that controls for non-price factors substantially reduce estimated price responsivity in a manner that does not rely on the log-linear specification of our primary regressions.

[1] Because this spline can approximate a broad range of nonlinear relationships between taxes and consumption, we use the raw levels of cigarette consumption as our dependent variable (instead of its logarithmic transform).

Reweighting states based on number of tax changes. In our stacked event study design, states that have more tax changes correspondingly have more stacked events, and thus have more influence on the regression results. To explore the impact of this unequal influence on our regression estimates, we reproduce the results of Table 2 while inverse weighting all observations by the number of events in the state. Results are presented in Appendix Table A4. The differences between this table and Table 2 are extremely minor, leading us to conclude that our baseline approach is not unduly influenced by its inherent unequal assignment of influence.

Unique responsivity of pregnant smokers. The analyses thus far considered the smoking behavior of pregnant women. One concern that arises from this choice is that pregnant women might be especially responsive to non-price factors, rendering the results inapplicable to the broader population of smokers. A second concern is that the non-price factors could influence survey response bias, and pregnant women might be the group that responds the most to non-price factors by misreporting. To assess these concerns, we repeat the analyses in Table 2 using survey measurements of cigarette consumption available in the Behavioral Risk Factor Surveillance System (BRFSS). The BRFSS is a cross-sectional telephone survey overseen by the United States' Center for Disease Control, aimed to measure the health behaviors of the general populace of the United States.[2] Because the BRFSS discontinued its question on the number of cigarettes consumed in 2000, use of this dataset results in a substantially reduced number of usable tax-change events. Appendix Table A5 reports the results, which are broadly consistent with those reported above. In the log-linear regression with no non-price controls, the coefficient on State Tax is -0.381 (s.e.=0.070). With the inclusion of all non-price controls, this estimate is reduced to -0.136 (s.e.=0.055). As in Table 2, we find that the inclusion of non-price controls accounts for over half of the originally estimated price responsivity.

[2]We match our stacked-event study dataset to the BRFSS dataset constructed by Goldin and Homonoff (2013), who study the relationship between cigarette tax salience and regressivity. See their paper for a complete description of the dataset.

Potential for selection based on miscarriages. Beyond mere pregnancy, an additional form of selection influencing entry into our sample is the requirement of a live birth. Pregnancy terminating in miscarriage stops the would-be mother from entering our sample. In principle, because smoking is related to miscarriage, the nature of this selection could change in the windows before and after a tax change, and such a change can confound estimates. In practice, the effect sizes involved are sufficiently small that any such changes will have little quantitative effect. To illustrate, recall that 1) the average woman in our stacked event study smokes 1.72 cigarettes a day, 2) smoking decreased by 30 percent per dollar tax increase around the tax change, and 3) the average tax increase was \$0.25. The recent metaanalysis of Pineles et al. (2014) reports a 1 percent increase in the relative risk of miscarriage per cigarette smoked per day. Taking this all together, an average woman facing the average tax increase would decrease consumption by 0.13 cigarettes per day (30 percent response $\times$ \$0.25 average tax change $\times$ 1.72 average cigarettes a day). Based on the estimated 1 percent increase in the relative risk of miscarriage per cigarette per day, this decrease in consumption is expected to cause a 0.13 percent change in the relative risk in miscarriage. Thus, we expect selection arising from miscarriage to be quantitatively quite small.

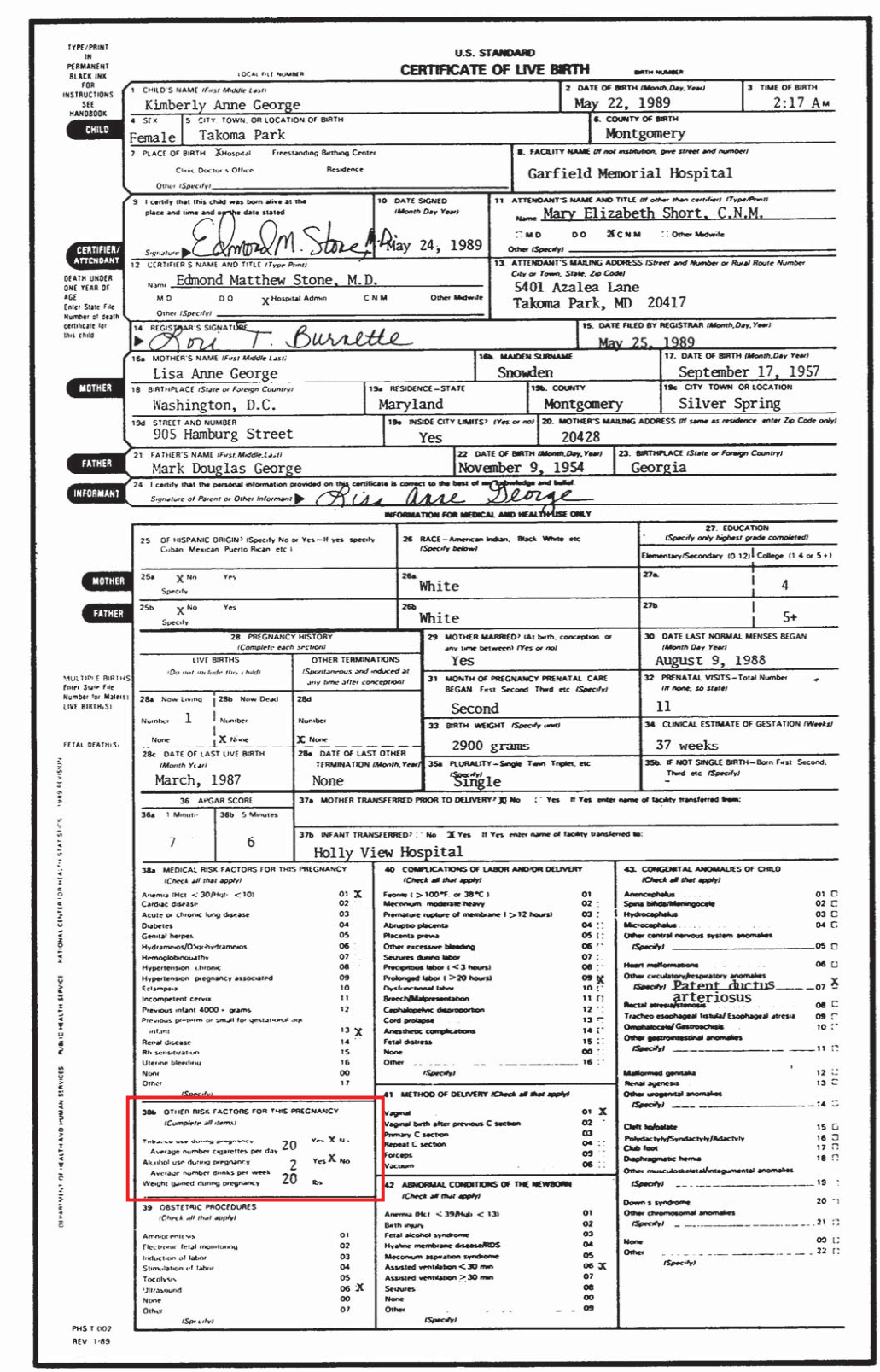
Role of different non-price factors in reducing responsivity estimates. How do different sets of our non-price factors individually contribute to our results? And in particular, are our results captured by including single non-price factors that have been used in prior research? While most of our measures are not commonly applied, is worth emphasizing that some research has estimated price responses after controlling for place-based legal restrictions in some way (see, e.g., Yurekli and Zhang 2000, Callison and Kaestner 2013, MacLean, Kessler, and Kenkel 2016, Nesson 2017).[3] If the large reduction in estimated responsivity were mainly driven by including controls for place-based legal restrictions, these prior estimates may be relatively unconfounded by the issues we discuss. Column 5 of Table 2 suggests that only part of the reduction in price effect is explained by place-based legal restrictions. We further assess the comparative importance of place-based legal restrictions

[3]Gruber and Koszegi (2001) do not control for place-based legal restrictions in the main analysis, but note that "controlling for the presence of various categories of clean air laws (using data described in Gruber [2000]) makes little difference to our results" (pg. 1274).

by re-running these regressions with different permutations of controls. Appendix Figure A4 reports the coefficients on cigarette taxes estimated from regressions with controls indicated on the x-axis. Controlling for the three other non-price factors reduce the price effect by nearly 50 percent relative to the baseline with only place-based legal restrictions controlled. Consistent with Table 2, the results of these analyses demonstrate that controls for news headlines and anti-smoking appropriations are responsible for the largest reductions in estimated price effects.

Appendix Figures and Tables

Figure A1: Example U.S. Standard Certificate of Live Birth



U.S. STANDARD
CERTIFICATE OF LIVE BIRTH

1 CHILD'S NAME: Kimberly Anne George
2 DATE OF BIRTH: May 22, 1989
3 TIME OF BIRTH: 2:17 AM
4 SEX: Female
5 CITY, TOWN, OR LOCATION OF BIRTH: Takoma Park
6 COUNTY OF BIRTH: Montgomery
7 PLACE OF BIRTH: X Hospital
8 FACILITY NAME: Garfield Memorial Hospital
9 I certify that this child was born alive at the place and time and on the date stated — Signature: Edmond M. Stone, M.D.
10 DATE SIGNED: May 24, 1989
11 ATTENDANT'S NAME AND TITLE: Mary Elizabeth Short, C.N.M.
12 CERTIFIER'S NAME AND TITLE: Edmond Matthew Stone, M.D.
13 ATTENDANT'S MAILING ADDRESS: 5401 Azalea Lane, Takoma Park, MD 20417
14 REGISTRAR'S SIGNATURE: Lori T. Burnette
15 DATE FILED BY REGISTRAR: May 25, 1989
16a MOTHER'S NAME: Lisa Anne George
16b MAIDEN SURNAME: Snowden
17 DATE OF BIRTH: September 17, 1957
18 BIRTHPLACE: Washington, D.C.
19a RESIDENCE – STATE: Maryland
19b COUNTY: Montgomery
19c CITY, TOWN OR LOCATION: Silver Spring
19d STREET AND NUMBER: 905 Hamburg Street
19e INSIDE CITY LIMITS?: Yes
20 MOTHER'S MAILING ADDRESS: 20428
21 FATHER'S NAME: Mark Douglas George
22 DATE OF BIRTH: November 9, 1954
23 BIRTHPLACE: Georgia
24 I certify that the personal information provided on this certificate is correct to the best of my knowledge and belief — Signature of Parent or Other Informant: Lisa Anne George

INFORMATION FOR MEDICAL AND HEALTH USE ONLY

25 OF HISPANIC ORIGIN? — MOTHER 25a: X No; FATHER 25b: X No
26 RACE – American Indian, Black, White, etc — MOTHER 26a: White; FATHER 26b: White
27 EDUCATION (Specify only highest grade completed) — MOTHER 27a: 4; FATHER 27b: 5+
28 PREGNANCY HISTORY — LIVE BIRTHS: 28a Now Living: Number 1; 28b Now Dead: None; OTHER TERMINATIONS: 28d Number: X None
28c DATE OF LAST LIVE BIRTH: March, 1987
28e DATE OF LAST OTHER TERMINATION: None
29 MOTHER MARRIED? (At birth, conception, or any time between): Yes
30 DATE LAST NORMAL MENSES BEGAN: August 9, 1988
31 MONTH OF PREGNANCY PRENATAL CARE BEGAN: Second
32 PRENATAL VISITS – Total Number: 11
33 BIRTH WEIGHT: 2900 grams
34 CLINICAL ESTIMATE OF GESTATION: 37 weeks
35a PLURALITY – Single, Twin, Triplet, etc: Single
35b IF NOT SINGLE BIRTH – Born First, Second, Third, etc:
36 APGAR SCORE: 36a 1 Minute: 7; 36b 5 Minutes: 6
37a MOTHER TRANSFERRED PRIOR TO DELIVERY? X No
37b INFANT TRANSFERRED? X Yes — If Yes, enter name of facility transferred to: Holly View Hospital

38a MEDICAL RISK FACTORS FOR THIS PREGNANCY (Check all that apply)
Anemia (Hct < 30/Hgb < 10) 01 X
Cardiac disease 02
Acute or chronic lung disease 03
Diabetes 04
Genital herpes 05
Hydramnios/Oligohydramnios 06
Hemoglobinopathy 07
Hypertension, chronic 08
Hypertension, pregnancy associated 09
Eclampsia 10
Incompetent cervix 11
Previous infant 4000 + grams 12
Previous preterm or small for gestational age infant 13 X
Renal disease 14
Rh sensitization 15
Uterine bleeding 16
None 00
Other 17

38b OTHER RISK FACTORS FOR THIS PREGNANCY (Complete all items)
Tobacco use during pregnancy: Yes X No
Average number cigarettes per day: 20
Alcohol use during pregnancy: Yes X No
Average number drinks per week: 2
Weight gained during pregnancy: 20 lbs

39 OBSTETRIC PROCEDURES (Check all that apply)
Amniocentesis 01
Electronic fetal monitoring 02
Induction of labor 03
Stimulation of labor 04
Tocolysis 05
Ultrasound 06 X
None 00
Other 07

40 COMPLICATIONS OF LABOR AND/OR DELIVERY (Check all that apply)
Febrile (>100°F. or 38°C.) 01
Meconium, moderate/heavy 02
Premature rupture of membrane (>12 hours) 03
Abruptio placenta 04
Placenta previa 05
Other excessive bleeding 06
Seizures during labor 07
Precipitous labor (<3 hours) 08
Prolonged labor (>20 hours) 09 X
Dysfunctional labor 10
Breech/Malpresentation 11
Cephalopelvic disproportion 12
Cord prolapse 13
Anesthetic complications 14
Fetal distress 15
None 00
Other 16

41 METHOD OF DELIVERY (Check all that apply)
Vaginal 01 X
Vaginal birth after previous C section 02
Primary C section 03
Repeat C section 04
Forceps 05
Vacuum 06

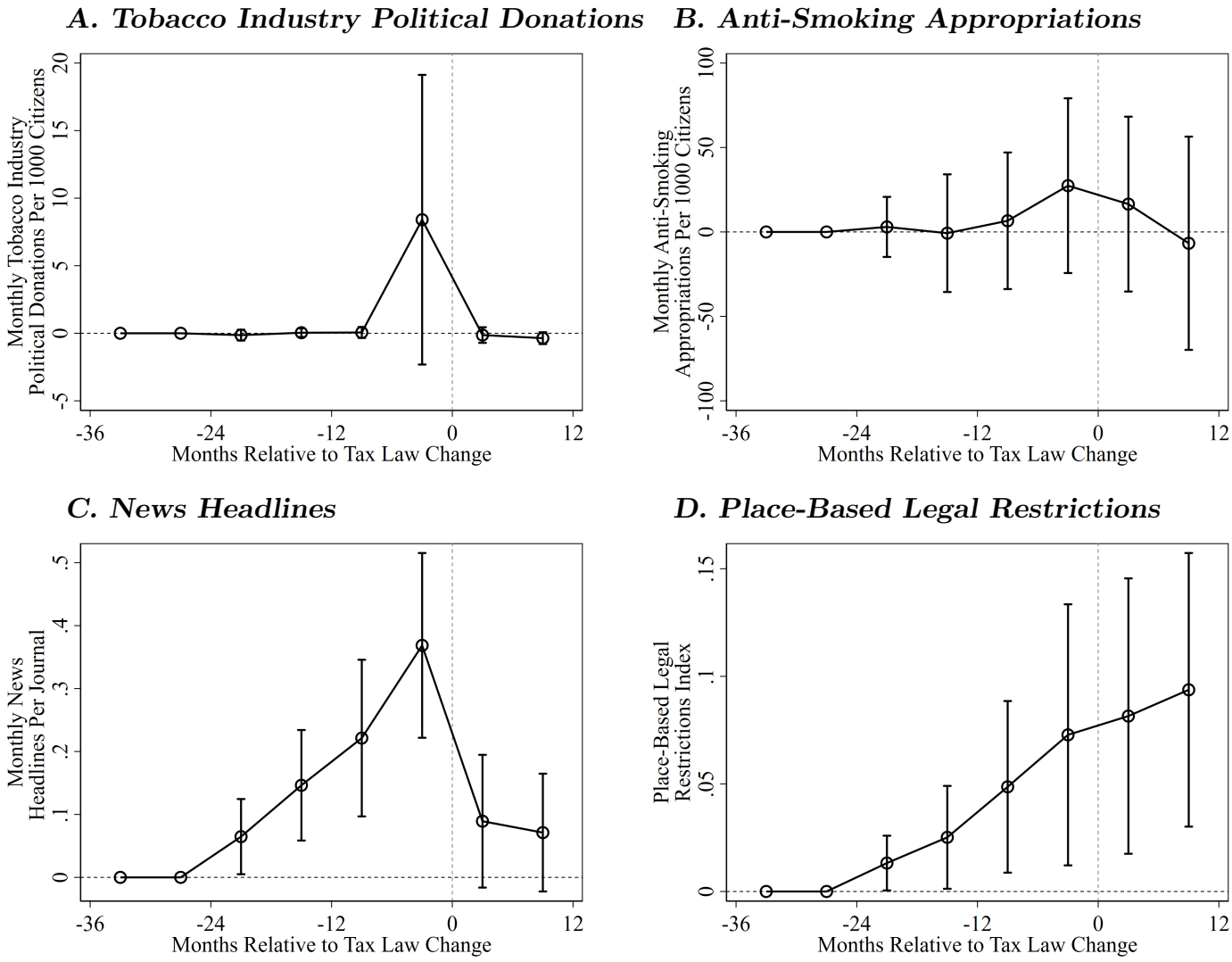
42 ABNORMAL CONDITIONS OF THE NEWBORN (Check all that apply)
Anemia (Hct < 39/Hgb < 13) 01
Birth injury 02
Fetal alcohol syndrome 03
Hyaline membrane disease/RDS 04
Meconium aspiration syndrome 05
Assisted ventilation < 30 min 06 X
Assisted ventilation > 30 min 07
Seizures 08
None 00
Other 09

43. CONGENITAL ANOMALIES OF CHILD (Check all that apply)
Anencephalus 01
Spina bifida/Meningocele 02
Hydrocephalus 03
Microcephalus 04
Other central nervous system anomalies (Specify) 05
Heart malformations 06
Other circulatory/respiratory anomalies (Specify) Patent ductus arteriosus 07 X
Rectal atresia/stenosis 08
Tracheo-esophageal fistula/Esophageal atresia 09
Omphalocele/Gastroschisis 10
Other gastrointestinal anomalies (Specify) 11
Malformed genitalia 12
Renal agenesis 13
Other urogenital anomalies (Specify) 14
Cleft lip/palate 15
Polydactyly/Syndactyly/Adactyly 16
Club foot 17
Diaphragmatic hernia 18
Other musculoskeletal/integumental anomalies (Specify) 19
Down's syndrome 20
Other chromosomal anomalies (Specify) 21
None 00
Other 22 (Specify)

DEPARTMENT OF HEALTH AND HUMAN SERVICES — PUBLIC HEALTH SERVICE — NATIONAL CENTER FOR HEALTH STATISTICS — 1989 REVISION
PHS T 002 REV 1/89

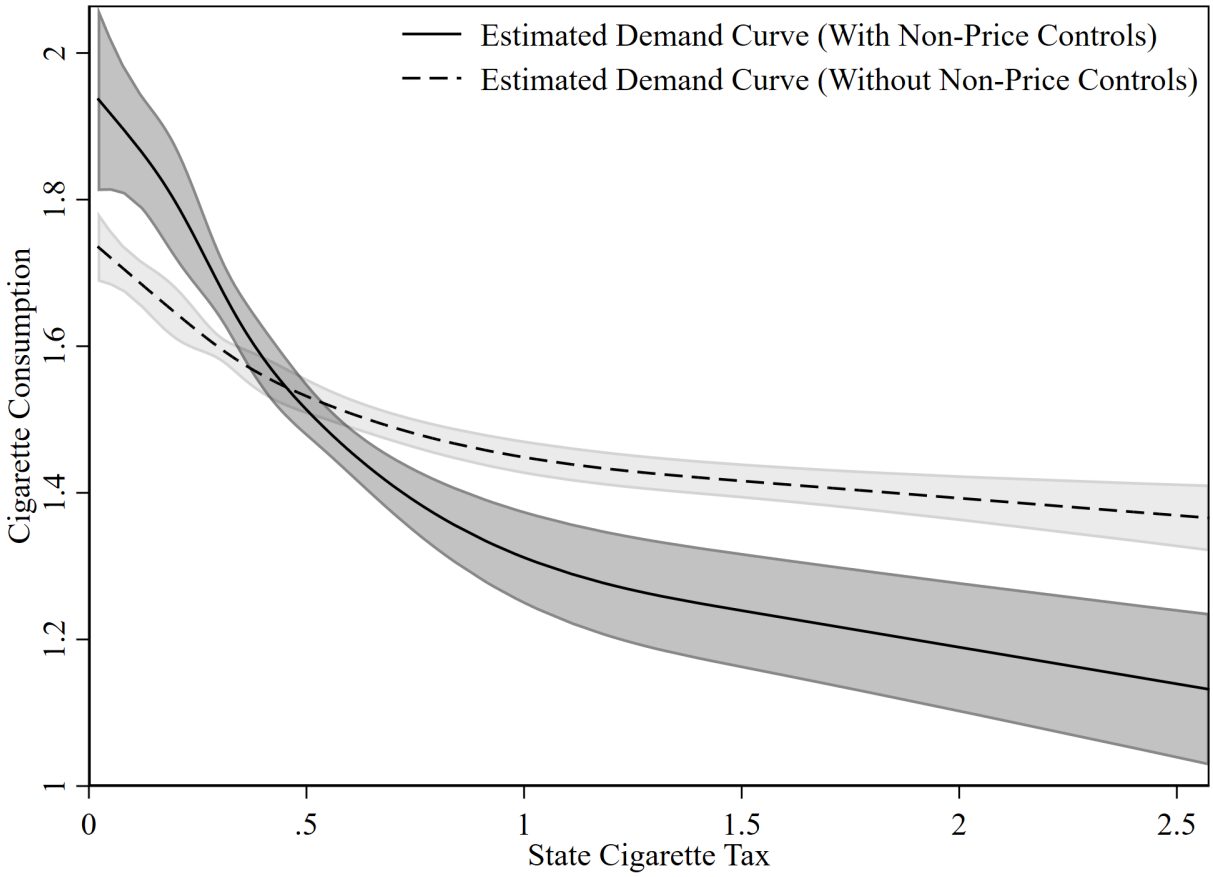
Notes: *Source*: National Center for Health Statistics (1987).

Figure A2: Time-Paths of Non-Price Factors With Non-Overlapping Events



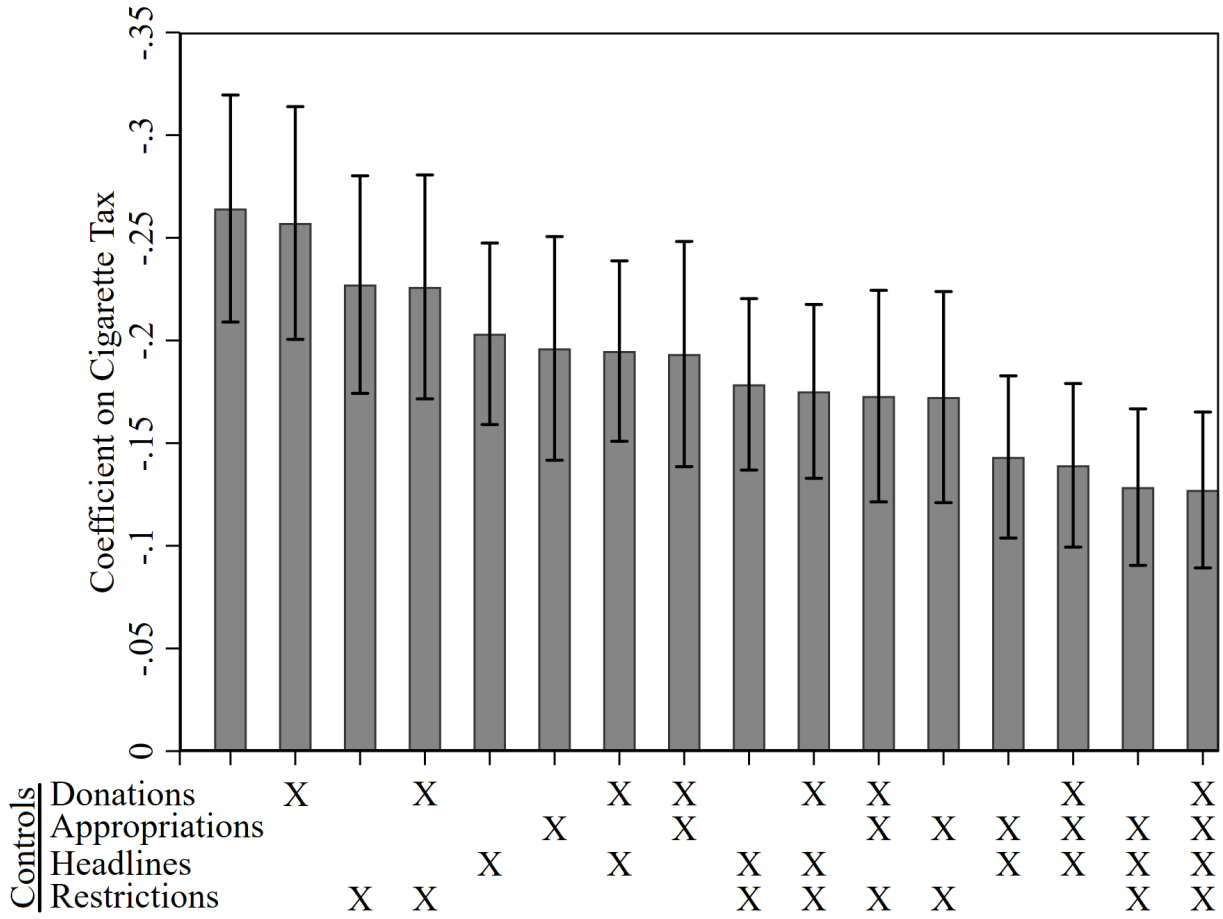
Notes: This figure reproduces the analysis of Figure 3 while excluding all tax-change events that have another tax change fall within their event window. Capped lines indicate 90-percent confidence intervals.

Figure A3: Cigarette Demand With and Without Non-Price Controls



Notes: This figure plots semiparametric estimates of the cigarette demand curve with or without non-price controls. We estimate Equation 2 while replacing the linear "statetax" term with a cubic spline. As in Table 2, estimates are identified from within-state variation with data restricted to a 3-year window surrounding a tax change. Estimates "with controls" linearly control for all non-price terms considered in Table 2. The shaded region reports 90 percent confidence intervals.

Figure A4: Specification Curve: Estimated Price Responsivity with Different Sets of Controls



Notes: This figure reports a specification curve of the responsivity of demand to the state tax level from estimating Equation 2. The bottom of the figure indicates the set of control variables included in the specification. The specifications are sorted on the estimated coefficient. Capped lines indicate 90-percent confidence intervals.

Table A1: Predictors of Cigarette Consumption in States without Tax Changes

	ln(Cigarettes)				
	(1)	(2)	(3)	(4)	(5)
Tobacco Industry Political Donations Per 1000 Citizens (Cumulative)	-3.095*** (0.139)				-1.543*** (0.090)
Anti-Smoking Appropriations Per 1000 Citizens (Cumulative)		-0.008*** (0.001)			-0.003*** (0.001)
News Headlines Per Journal (Cumulative)			-0.007*** (0.000)		-0.006*** (0.000)
Place-Based Legal Restrictions Index				-0.323*** (0.041)	-0.106*** (0.023)
State-Event Fixed Effects	Yes	Yes	Yes	Yes	Yes
N	114,067	114,067	114,067	114,067	114,067

Notes: This table reports the estimated coefficients from Equation 2. Unlike Table 2, which presents estimates derived from a sample of only treated states, these estimates are derived from a sample of only control states. Control states are those that have no tax change during the event window (which covers 36 months before and after the event) or in the six months immediately before or after the event window. The state tax variable is excluded because it is constant within these control states. Standard errors are in parentheses and are corrected using multi-dimensional clustering that allows for correlation within event, within state, and within year-month. * p<0.1, ** p<0.05, *** p<0.01.

Table A2: Within-Tax-Change-Event Predictors of Cigarette Consumption: News Headlines with and without the Word Tax

	ln(Cigarettes)			
	(1)	(2)	(3)	(4)
State Tax	-0.210***	-0.211***	-0.208***	-0.130***
	(0.027)	(0.027)	(0.026)	(0.023)
News Headlines Per Journal (Cumulative)				
Cigarette with Tax	-0.012***		-0.002	-0.001
	(0.002)		(0.003)	(0.003)
Cigarette without Tax		-0.007***	-0.006***	-0.007***
		(0.001)	(0.001)	(0.001)
Tobacco Industry Political Donations Per 1000 Citizens (Cumulative)				-0.027
				(0.054)
Anti-Smoking Appropriations Per 1000 Citizens (Cumulative)				-0.004***
				(0.001)
Place-Based Legal Restrictions Index				-0.083**
				(0.033)
State-Event Fixed Effects	Yes	Yes	Yes	Yes
N	9,642	9,642	9,642	9,642

Notes: This table reproduces the results of Table 2 but separates our measure of the number of headlines containing the word "cigarette" into two measures depending on whether the headline also contains the word "tax." Standard errors are in parentheses and are corrected using multi-dimensional clustering that allows for correlation within event, within state, and within year-month. * p<0.1, ** p<0.05, *** p<0.01.

Table A3: Non-Price Factors Measured Contemporaneously

	ln(Cigarettes)					
	(1)	(2)	(3)	(4)	(5)	(6)
State Tax	-0.264***	-0.264***	-0.253***	-0.259***	-0.227***	-0.217***
	(0.033)	(0.033)	(0.031)	(0.032)	(0.031)	(0.029)
Tobacco Industry Political Donations Per 1000 Citizens		-0.138*				-0.181**
		(0.072)				(0.074)
Anti-Smoking Appropriations Per 1000 Citizens			-0.147***			-0.139***
			(0.038)			(0.038)
News Headlines Per Journal				-0.003		-0.002
				(0.005)		(0.005)
Place-Based Legal Restrictions Index					-0.152***	-0.132***
					(0.031)	(0.031)
State-Event Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	9,642	9,642	9,642	9,642	9,642	9,642

Notes: This table reproduces the results of Table 2, replacing all cumulative non-price factor measures with their contemporaneous counterparts. Standard errors are in parentheses and are corrected using multi-dimensional clustering that allows for correlation within event, within state, and within year-month. * p<0.1, ** p<0.05, *** p<0.01.

Table A4: Within-Tax-Change-Event Predictors of Cigarette Consumption (Inverse Weighting for the Number of Events in the State)

	ln(Cigarettes)					
	(1)	(2)	(3)	(4)	(5)	(6)
State Tax	-0.260***	-0.258***	-0.182***	-0.200***	-0.221***	-0.126***
	(0.033)	(0.032)	(0.030)	(0.028)	(0.033)	(0.020)
Tobacco Industry Political Donations		-0.012				0.018
Per 1000 Citizens (Cumulative)		(0.091)				(0.078)
Anti-Smoking Appropriations			-0.006***			-0.004**
Per 1000 Citizens (Cumulative)			(0.002)			(0.002)
News Headlines				-0.004***		-0.004***
Per Journal (Cumulative)				(0.001)		(0.001)
Place-Based Legal					-0.146***	-0.076***
Restrictions Index					(0.030)	(0.028)
State-Event Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	9,642	9,642	9,642	9,642	9,642	9,642

Notes: This table reproduces the results of Table 2 while inverse-weighting all observations based on the number of tax-change events in the state. Standard errors are in parentheses and are corrected using multi-dimensional clustering that allows for correlation within event, within state, and within year-month. * p<0.1, ** p<0.05, *** p<0.01.

Table A5: Reproducing Table 2 Using BRFSS Data

	ln(Cigarettes)					
	(1)	(2)	(3)	(4)	(5)	(6)
State Tax	-0.381***	-0.330***	-0.360***	-0.189***	-0.373***	-0.136**
	(0.070)	(0.073)	(0.070)	(0.058)	(0.070)	(0.055)
Tobacco Industry Political Donations		-1.407***				-1.353***
Per 1000 Citizens (Cumulative)		(0.360)				(0.360)
Anti-Smoking Appropriations			-0.003**			-0.002***
Per 1000 Citizens (Cumulative)			(0.001)			(0.000)
News Headlines				-0.002***		-0.002***
Per Journal (Cumulative)				(0.000)		(0.000)
Place-Based Legal					-0.039	0.054
Restrictions Index					(0.059)	(0.045)
State-Event Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	4,980	4,980	4,980	4,980	4,980	4,980

Notes: This table reproduces the results of Table 2 using data from the Behavioral Risk Factor Surveillance System (BRFSS). Standard errors are in parentheses and are corrected using multi-dimensional clustering that allows for correlation within event, within state, and within year-month. * p<0.1, ** p<0.05, *** p<0.01.