Cigarette Consumption and Tax Salience

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Abstract

This paper studies how cigarette consumption responds over time to changes in tax rates. Using a panel of state data, I estimate that the cumulative effect of an excise tax rise on consumption is larger than the cumulative effect of an increase in sales tax, in line with a theory of tax salience. In addition, I find that consumption falls in advance of an excise tax hike, whereas it only falls in the year after a sales tax increase. The pattern of consumption response to sales taxes is also consistent with consumer learning over time.

1 Introduction

The consumption response to changes in tax rates is an important parameter for evaluating the efficiency of various taxes. However, there has been a growing body of evidence that such responses are complicated and can be highly context-dependent. Most notably, a seminal paper by Chetty, Looney, and Kroft (2009), henceforth CLK, showed that consumers tend to under-react to taxes that are less salient. Later papers on this topic have shown that the degree of under-reaction varies by the size of the tax, and is heterogeneous across consumers (Taubinsky and Rees-Jones, 2018, and Goldin and Homonoff, 2013).

This paper investigates the consumption response of cigarettes to changes in tax rates. Taxes are one of the primary means of smoking regulation, and as of November 2014, account for more than 40% of the retail price of cigarettes in the United States (Orzechowski and Walker, 2014). There are two main types of taxes levied on cigarettes – excise taxes and sales taxes – where the former is typically included in the posted price of cigarettes and the latter is not. In a world where consumers are perfectly attentive to all types of taxes, the demand elasticities with respect to the excise and sales tax-inclusive prices will be equal to the price elasticity of demand. On the other hand, if sales taxes are less salient to consumers, we

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would expect a greater consumption response to a change in excise tax relative to a change in sales tax.

I compare how cigarette consumption reacts to changes in excise and sales taxes using a panel of state data from 1970 to 2003. Following CLK's analysis for the beer market, I start by studying the contemporaneous consumption response to tax changes. I find that the cigarette consumption per capita falls by around -0.5 percent in response to a 1 percent increase in the excise-tax-inclusive cigarette price in the same year, but stays roughly constant in response to the same increase in the sales-tax-inclusive price. These results are qualitatively similar to CLK's findings for the beer market, and is consistent with the sales tax being less salient to consumers. Moreover, the elasticity estimate with respect to the excise-tax-inclusive price is similar to previous estimates of the price elasticity of demand of around -0.45 (Chaloupka and Warner, 2000). This is in line with the excise tax being fully salient to consumers, as one might expect given that it is included in the posted price.

However, these basic findings miss richer dynamics in the consumption response of cigarettes to tax changes. In particular, I find that while consumption falls contemporaneously as an increase in the excise tax rate, consumption falls in the year *after* an increase the sales tax rate. The timing of tax pass-throughs is important in explaining these consumption dynamics. The finding that consumption responds to an increase in the sales tax with a lag is consistent with consumers learning about the tax change over time. Comparing the cumulative effect three years after an excise and sales tax increase, I am able to reject the null hypothesis that the long-run elasticities for the excise and sales taxes are equal at the 5 percent significance level. On the other hand, I can also reject that there is no consumption response to changes in the sales tax, which is in contrast to the results based on immediate responses.

This paper is most closely related to two papers in the literature on tax salience. The basic empirical strategy of comparing consumption responses to excise and sales taxes is motivated by CLK's analysis of the beer market. Similar to CLK, I find that consumers under-react to changes in sales taxes relative to changes in excise taxes. However, while CLK lacked data on state-specific beer prices, the availability of cigarette prices allows me to study the role that the timing of tax pass-through plays in the dynamics of consumption responses. I also find suggestive evidence that consumers learn about changes in sales taxes and adjust to them over time, whereas CLK find no such pattern of learning in the beer market.

My paper is also related to Goldin and Homonoff (2013), who explore heterogeneity in tax salience with an application to the cigarette market. However, while their paper focuses on how tax salience differs by consumer income and its implications for optimal tax policy, my paper focuses on the dynamic aspects of the consumption response and tax salience. My results on learning over time also have implications for the empirical analysis in Goldin and

Homonoff, who focus on the contemporaneous consumption response to tax changes.

The rest of this paper is organized as follows. Section 2 describes my data sources, and provides some summary statistics for my dataset. Section 3 outlines my empirical approach, first under the assumptions that excise taxes are passed through in full to consumers and no dynamics, then relaxing these assumptions. Section 4 presents and discusses my empirical results. Section 5 concludes.

2 Data and Descriptive Statistics

2.1 Data Sources and Variable Definitions

I obtain state-level data on consumption of tax-paid cigarettes per capita, prices, and excise and sales taxes from the Tax Burden on Tobacco (Orzechowski and Walker, 2014). All variables in dollar units are converted to real terms in year 2000 dollars using CPI from the FRED database maintained by the St. Louis Federal Reserve Bank.

I convert the excise tax (which is a specific tax) to percentage units by dividing the real value of the tax by the average cost of a pack of cigarettes in the US in 2000. I use the national average cost of cigarettes in 2000 for this calculation since the price in each state is endogenous to its tax rate. However, this may lead to measurement error in the excise tax rate to the extent that prices are not constant across states and over time. I will revisit this issue when exploring the robustness of my results.

In state-years where sales taxes do not apply to cigarettes, I define the sales tax to be zero. I follow CLK and drop Hawaii and West Virginia from the analysis. I do so because sales taxes are included in prices in Hawaii, West Virginia's tax revenues are poorly correlated with its sales tax rates, and there are frequent changes to West Virginia's sales tax base.

While the sales and excise tax data in the Tax Burden on Tobacco are based on taxes as of November of each year, the data on consumption per capita is based on the period between July of the previous year and June of the present year. To account for the discrepancy in time windows covered by these variables, I adjust the consumption per capita variable by linear interpolation. Specifically, I define the adjusted value of this variable as the sum of two-thirds the original value in year t and one-third the original value in year $t+1$.[1]

The various regressions specifications control for unobserved aggregate shocks via year fixed effects, as well as population, economic conditions, smoking regulations, and regional trends. I follow CLK in my definition of state-level population, income, and unemployment data. State unemployment data is unavailable for several states in the first few years of my sample, so my estimation sample is slightly smaller in regressions that control for unemployment rate. Data on smoking bans was collected by the American Nonsmokers' Right

[1] The correlation between the original quantity variable and the adjusted quantity variable is 0.997.

Foundation. I define two variables for smoking bans following Adda and Cornaglia (2010), namely bans in workplaces, and bans in bars and restaurants. Further details about the construction of my dataset can be found in Section A of the Appendix.

2.2 Descriptive Statistics

Table 1 shows some summary statistics for the panel of state data from 1970 to 2003. We observe that changes in the state excise taxes (in nominal terms) are relatively frequent, occurring in more than 10 percent of state-years in my sample. There are also 5 changes in the nominal federal excise tax during the sample period. State sales taxes tend to make up a much smaller fraction of the cost of a pack of cigarettes than state excise taxes, and changes in state sales taxes are also less frequent.

Table 1: Summary Statistics

Excise Taxes	
State Excise Tax in Year 2000 Dollars ($/pack)	0.343
	(0.195)
State Excise Tax (percent)	14.5
	(8.2)
Number of Changes to State Excise Tax	222
Federal Excise Tax in Year 2000 Dollars ($/pack)	0.261
	(0.054)
Federal Excise Tax (percent)	11.0
	(2.3)
Number of Changes to Federal Excise Tax	5
Sales Taxes	
State Sales Tax (percent)	3.5
	(2.4)
Number of Changes	132
After-Tax Price (per pack) in Year 2000 Dollars	2.04
	(0.72)
Consumption Per Capita (packs per year)	113.0
	(33.8)
Number of State-Years	1,666

Notes: The number of changes to the excise taxes in this Table refers to legislative changes, i.e. changes to the nominal value of the specific tax. Standard deviations are shown in parentheses.

Figure 1 shows trends in average taxes, prices, and average consumption over the sample period. The average excise tax rate fell between 1970 and 1980 largely due to inflation, but has been drifting upwards since 1980. There is a clear upward trend in the average sales tax rate during the sample period, with the fastest increase occurring in the 1980s. Both average pre-tax and after-tax prices of cigarettes (in real terms) have generally been increasing from the 1980s onwards. Average consumption per capita shows the opposite pattern, increasing before 1980 and falling steadily thereafter.

Figure 1: Trends in Cigarette Taxation, Prices, and Consumption

Notes: Panel (a) shows average federal, state, and total excise tax rates separately over the sample period from 1970 to 2003. The excise tax rate is defined as the real value of the excise tax (which is a specific tax) in year 2000 dollars, divided by the national pre-tax cost of a pack of cigarettes in 2000 from the Tax Burden on Tobacco. Panel (b) shows average sales tax rates in the US over the sample period. Panel (c) shows average real pre-tax and after-tax prices over time. Panel (d) shows average cigarette consumption per capita (packs per year) over the sample period. All averages in these figures are unweighted averages over the 49 states included in my sample.

3 Empirical Approach

My empirical test of tax salience relies on the difference between how excise and sales taxes are administered for cigarettes. Since excise taxes are collected upstream of the retailer, they are typically included in the posted price of cigarettes. This is in contrast to sales taxes, which are only added at the register. If consumers are not fully attentive to taxes, they might under-react to sales taxes relative to excise taxes. To test this hypothesis, I use state-level panel data from 1970 to 2003, which includes consumption per capita, prices, excise and sales taxes, and a number of control variables.

3.1 No Consumer Learning

In this subsection, I assume that consumers respond to perceived tax changes immediately (i.e. there is no learning over time). In this setting, a consumer in state i in year t makes purchase decisions based on her perceived price:

$$\tilde{q}_{it} = (1+\tau_{it}^S)^\theta (1+\tau_{it}^E) p_{it},$$

where p_{it} is the pre-tax price, and θ is a tax salience parameter. However, the price that the consumer actually pays is:

$$q_{it} = (1+\tau_{it}^S)(1+\tau_{it}^E) p_{it}.$$

The cases where $\theta = 0$ or $\theta = 1$ represent the extremes where the consumer either pays no attention to the sales tax at all, or where she fully takes it into account.

I assume a log-log specification for cigarette demand:

$$\begin{aligned} log(x_{it}) &= a_i + \beta log(\tilde{q}_{it}) + e_{it}, \\ &= a_i + \beta log(p_{it}) + \beta log(1+\tau_{it}^E) + \theta\beta log(1+\tau_{it}^S) + e_{it}, \end{aligned}$$

where x_{it} denotes cigarette consumption per capita. I consider a first-difference specification, which removes the unobserved time invariant state effects a_i. Specifically, letting $\beta^E = \beta$, $\beta^S = \theta\beta$, and X_{it} denote a set of controls, I estimate variants of the following equation:

$$\Delta log(x_{it}) = \alpha + \beta^E \Delta log(1+\tau_{it}^E) + \beta^S \Delta log(1+\tau_{it}^S) + X_{it}'\gamma + \epsilon_{it}. \tag{1}$$

I choose not to include pre-tax prices in this equation to avoid simultaneity bias (due to unobserved demand shocks being correlated with prices). If pre-tax prices are constant across states, they will be absorbed by the year fixed effects in the controls.[2] The identifying assumption is that conditional on the controls X_{it}, changes to state excise and sales taxes are uncorrelated with state-specific shocks to cigarette consumption. Standard errors in all regressions are clustered at the state level.

[2] Keeler et al. (1996) find evidence of price discrimination across states by cigarette producers. However, they also find that the effects are not large relative to the final retail price.

3.2 Allowing for Consumer Learning

Estimates of the short-run effects from the empirical test above may not correspond to the long run impact if consumers learn over time. Hence, I enrich the working model to allow consumers to learn about tax changes over time (which can be thought of as a dynamic form of tax salience).

I incorporate consumer learning by modeling perceived prices as:

$$\hat{q}_{it} = \left[\prod_{k=0}^{L}(1+\tau^{E}_{i,t-k})^{\nu_k}\right]\left[\prod_{l=0}^{L}(1+\tau^{S}_{i,t+l})^{\lambda_l}\right]p_{it},$$

where the λ_l's are restricted to sum to 1 (due to the presence of a "scale" parameter θ for tax salience). This nests the case with no consumer learning, which corresponds to $\lambda_0 = 1$ and $\nu_0 = 1$, with λ_l and ν_k equal to zero for $l, k \neq 0$. Assuming the log-log demand specification as before, the demand equation is given by:

$$log(x_{it}) = a_i + \beta\sum_{k=0}^{L}\nu_k log(1+\tau^{E}_{i,t-k}) + \theta\beta\sum_{l=0}^{L}\lambda_l log(1+\tau^{S}_{i,t-l}) + e_{it}.$$

For my implementation, I use first-difference specifications, and include the same number of leads and lags for the different taxes for consistency.[3]Consumption responding to tax changes with a lag would serve as evidence of consumer learning Hence, I regress the change in log consumption on lags of the tax variables:

$$\begin{aligned}\Delta log(x_{it}) = & \sum_{j=0}^{L}\beta^{E}_{j}\Delta log(1+\tau^{E}_{i,t-j}) \\ & + \sum_{j=0}^{L}\beta^{S}_{j}\Delta log(1+\tau^{S}_{i,t-j}) + \sum_{j=0}^{J}X'_{i,t-j}\phi_j + u_{it}. \qquad (2)\end{aligned}$$

The preceding discussion abstracts from a complication in the empirical analysis that has to do with the coarseness of my data. Specifically, the fact that only annual (rather than quarterly or monthly) data is available makes it tricky to test hypotheses about consumer learning, since a fall in consumption the year after a tax hike could be due either to consumer learning, or to the tax increase occurring late in the year.[4] I will address this issue in greater

[3]Moreover, the extra estimated coefficients also serve as a useful robustness check of my analysis. For example, if there is no price response in the periods before a change in sales tax, there should not be any consumption response in those periods either, according to my model.

[4]For example, consider the simple case where all taxes are passed through in full at exactly the same time as the tax change legally comes into effect. In addition, suppose our data in each year t is based on tax rates as of November 1 and consumption is based on the year leading up to this date. In this case, if a tax increase in year t leads to a fall in consumption in year $t+1$, without knowing the exact date of the tax

detail when discussing the results.

4 Results

4.1 Results Assuming Full and Immediate Tax Pass-Through and No Consumer Learning

Table 2 shows regression results from specifications based on equation 1. All estimates include year fixed effects (which control for unobserved aggregate shocks), as well as log changes in population. Subsequent mentions of controls should be understood as abbreviations for log changes in these variables unless otherwise noted.

Table 2: Regression Results Assuming Full and Immediate Tax Pass-Through and No Consumer Learning

	(1)	(2)	(3)	(4)	(5)	(6)
Specification:	OLS (1st diff.)	OLS (1st diff.)	OLS (1st diff.)	OLS (1st diff.)	IV (1st diff.)	OLS (3rd diff.)
Dependent Variable:	$\Delta log(x_{it})$	$\Delta log(x_{it})$	$\Delta log(x_{it})$	$\Delta log(x_{it})$	$\Delta log(x_{it})$	$\Delta log(x_{it})$
$\Delta log(1 + \tau^E_{i,t})$	-0.532	-0.509	-0.515	-0.492		-0.101
	(0.064)	(0.068)	(0.066)	(0.067)		(0.067)
$\Delta log(q_{i,t})$					-0.481	
					(0.068)	
$\Delta log(1 + \tau^S_{i,t})$	-0.171	-0.156	-0.157	-0.144	-0.143	0.097
	(0.139)	(0.140)	(0.140)	(0.140)	(0.140)	(0.147)
Population Control	x	x	x	x	x	x
Economic Controls		x	x	x	x	x
Smoking Ban Controls			x	x	x	x
Region Fixed Effects				x	x	x
Year Fixed Effects	x	x	x	x	x	x
F-test for Equality of Coefficients	0.008	0.012	0.011	0.015	0.017	0.228
Number of Obs.	1,617	1,491	1,491	1,491	1,491	1,393

Notes: Columns 1 through 4 of this table show regression estimates of equation 1. The IV strategy for column 5 is described in the main text. The regression for column 6 is the same as the one for column 4, except with third-differences instead of first-differences for all variables. The F-test for equality of coefficients tests the null hypothesis that the coefficient on the excise tax variable is equal to the coefficient on the sales tax variable. All regressions include year fixed effects. The population control is the change in log population. Controls for economic conditions include changes in log unemployment and log income. Smoking ban controls include the changes in dummy variables for a smoking ban in workplaces, and a smoking ban in bars/restaurants. There are four regions, so the region fixed effects include three dummy variables (with the remaining region being the omitted category). The excise tax rate is defined as the real value of the specific excise tax in year 2000 dollars, divided by the average national cost of a pack of cigarettes in 2000 in the US. The unit of observation is a state-year. Standard errors clustered by state are reported in parentheses.

Column 1 of Table 2 shows estimates controlling only for population. The elasticity with respect to the excise-tax-inclusive price is -0.532 (0.064), in line with estimates of

change, it is unclear whether this fall is due to consumers learning about the tax hike over time, or whether the tax change occurred sometime close to but before November 1 in year t so that most of the consumption response will occur after year t even in the absence of consumer learning.

the price elasticity of demand from the prior literature of around -0.45 (Chaloupka and Warner, 2000). This is consistent with excise taxes being fully salient to consumers, which is unsurprising given that they are included in the posted price. On the other hand, the elasticity with respect to the sales-tax-inclusive price is much smaller in magnitude, at around -0.171 (0.139). This estimate is not statistically significantly different from zero, and is statistically different from the elasticity with respect to the excise-tax-inclusive price at the 5 percent significance level. In other words, we can reject the null hypothesis that the salience parameter θ is equal to one (i.e. that sales taxes are fully salient to consumers), and we fail to reject that θ is equal to zero (i.e. that consumers pay no attention to sales taxes).

Even assuming no dynamics, there are several threats to the identification assumption that changes in state taxes are orthogonal to state-specific shocks to cigarette consumption. A negative local economic shock might lead to lower cigarette consumption (if cigarettes are a normal good), and may also prompt state governments to change tax rates (either lowering them to compensate for lost tax revenues, or raising them to stimulate the local economy). To address this concern, column 2 of Table 2 adds controls for state unemployment and income. Another worry is that changing attitudes towards or tastes for smoking are correlated with excise taxes. For example, a state government concerned about an increase in smoking rates may raise cigarette excise taxes in response to this public health threat; alternatively, increasingly negative public sentiment towards smoking may prompt officials to increase excise taxes as a more politically convenient way of raising revenue. Column 3 of Table 2 includes controls for smoking bans in workplaces and bars/restaurants to mitigate this threat. Column 4 adds region fixed effects to account for the possibility that changing social norms may be correlated with changes in excise taxes. The inclusion of these controls yield estimates of the elasticities with respect to excise- or sales-tax-inclusive prices that are slightly smaller than those in column 1 (in magnitude), although these differences are economically and statistically insignificant. In each case, we can still reject equality of the coefficients on excise and sales taxes, and the sales tax coefficient remains statistically insignificantly different from zero at the 5 percent level.

There are two sources of variation in excise tax rates. The first is due to state legislative changes in the specific taxes, and the second is the result of inflation eroding the real value of a given specific tax. Following CLK, I pursue an instrumental variables (IV) strategy to test whether these two sources of variation yield similar results. Specifically, I consider the nominal excise tax $s_{it}^{nominal}$ divided by the sample average nominal pre-tax price $\bar{p}^{nominal}$, and use $\Delta log\left(1+\frac{s_{it}^{nominal}}{\bar{p}^{nominal}}\right)$ as an instrument for $\Delta log(1+\tau_{it}^{E})$. Column 5 of Table 2 shows that the resulting estimate (which is based on the variation in excise tax rates due to policy changes and not due to inflation) is very similar to those in previous specifications.

As mentioned in Section 2, changes in the real pre-tax price of cigarettes over time may lead to measurement error in the excise tax rate (which is defined based on the average pre-tax cost of cigarettes in 2000). Moreover, measurement error in highly persistent regressors tends to be exacerbated by taking first differences. Nonetheless, any attenuation bias in the excise tax coefficient should strengthen the result that consumers are inattentive to sales taxes. This is because attenuation bias implies that the true excise tax coefficient is larger in magnitude, and thus the true difference with the sales tax coefficient should be larger as well. As a gauge of the influence of attenuation bias, column 6 of Table 2 estimates a version of equation 1 (with the full set of controls) based on third differences.[5] This third-difference specification in fact results in a coefficient on excise tax rate that is smaller (in magnitude), which is the opposite of what we might expect if mismeasurement error is the main source of bias. The excise tax rate coefficient is still larger than the sales tax rate coefficient, although their difference is no longer statistically significant (p-value of 0.228) since the estimates are less precise.

The results in this subsection are in general agreement qualitatively with those in CLK – consumers seem less than fully attentive (if they pay any attention at all) to changes in sales tax rates. However, these results are predicated on the assumption that there is no learning by consumers. The next subsection shows that these assumptions are too simplistic.

4.2 Results Allowing for Consumer Learning

As mentioned in Section 3, regressions based on equation 1 in the previous subsection may be misleading, or if there is consumer learning over time. To gain insight into the extent and dynamics of tax pass-through and consumption response, I regress changes in log consumption on three lags of one plus the excise and sales tax rates, as in equation 2. The endogeneity concerns discussed in the previous subsection still apply, so I include the same set of controls as in Table 2 as well as three lags of these control variables.

Regression estimates of consumption responses are shown in Table 3, and the coefficients and 95 percent confidence intervals (CIs) are plotted in Figure 2 for easy reference. The cumulative consumption responses to changes in excise and sales tax rates[6] (and their 95 percent CIs, based on standard errors computed via the delta method) are shown in Figure 2.[7]

[5] Griliches and Hausman (1986) show that taking longer differences reduces the attenuation bias under certain assumptions about the data-generating process (e.g. if the excise tax variable followed an AR(1) process).

[6] The estimated cumulative effects on cigarette consumption per capita k periods after a change in the excise or sales tax are computed respectively as $\hat{\beta}^E_{0:k} = \sum_{j=0}^{k} \hat{\beta}^E_j$ and $\hat{\beta}^S_{0:k} = \sum_{j=0}^{k} \hat{\beta}^S_j$.

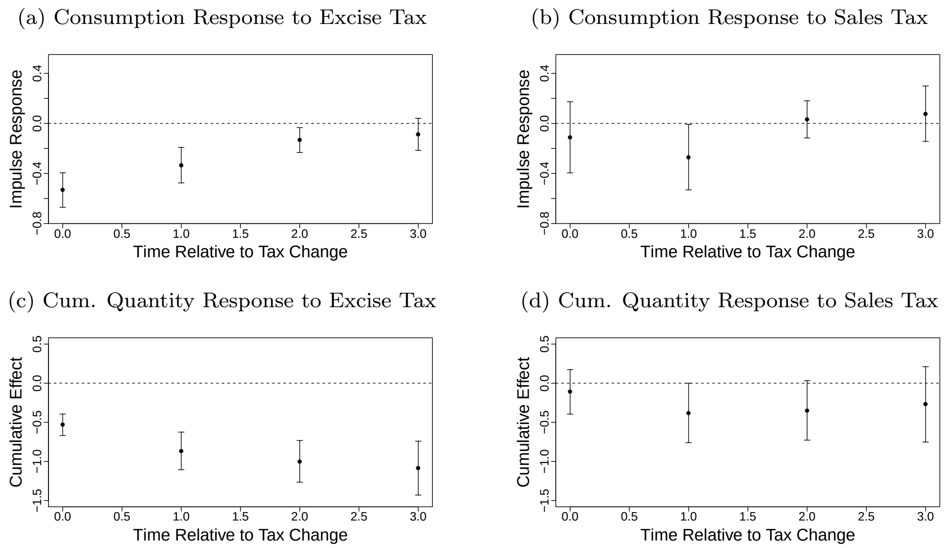
[7] Coefficients from various consumption regressions with different sets of controls are plotted in Appendix Figures A.1 and A.2. Cumulative effects from these regressions are also plotted in Appendix Figures A.3 and A.4. These figures show that the consumption responses to changes in excise and sales taxes when different sets of controls are included in the regression are very similar, which eases concerns about endogeneity.

Table 3: Regression Results Allowing for Differences in Tax Pass-Through and Consumer Learning

	(1)	(2)	(3)	(4)
Dependent Variable:	$\Delta log(x_{it})$	$\Delta log(x_{it})$	$\Delta log(x_{it})$	$\Delta log(x_{it})$
Excise Taxes				
$\Delta log(1+\tau^{E}_{i,t})$	-0.553	-0.544	-0.547	-0.532
	(0.066)	(0.068)	(0.068)	(0.070)
$\Delta log(1+\tau^{E}_{i,t-1})$	-0.372	-0.368	-0.351	-0.334
	(0.072)	(0.073)	(0.072)	(0.072)
$\Delta log(1+\tau^{E}_{i,t-2})$	-0.165	-0.160	-0.148	-0.133
	(0.050)	(0.051)	(0.050)	(0.051)
$\Delta log(1+\tau^{E}_{i,t-3})$	-0.131	-0.115	-0.104	-0.087
	(0.071)	(0.075)	(0.066)	(0.065)
Sales Taxes				
$\Delta log(1+\tau^{S}_{i,t})$	-0.182	-0.131	-0.126	-0.111
	(0.130)	(0.144)	(0.145)	(0.145)
$\Delta log(1+\tau^{S}_{i,t-1})$	-0.341	-0.283	-0.282	-0.269
	(0.115)	(0.131)	(0.132)	(0.133)
$\Delta log(1+\tau^{S}_{i,t-2})$	-0.018	0.020	0.021	0.033
	(0.080)	(0.074)	(0.075)	(0.076)
$\Delta log(1+\tau^{S}_{i,t-3})$	0.066	0.068	0.064	0.077
	(0.119)	(0.110)	(0.110)	(0.113)
Population Control	x	x	x	x
Economic Controls		x	x	x
Smoking Ban Controls			x	x
Region Fixed Effects				x
Year Fixed Effects	x	x	x	x
Number of Obs.	1,323	1,197	1,197	1,197
Cumulative Effects				
Excise Tax	-1.22	-1.19	-1.15	-1.08
	(0.18)	(0.18)	(0.17)	(0.18)
Sales Tax	-0.47	-0.33	-0.32	-0.27
	(0.23)	(0.23)	(0.23)	(0.25)
p-value for equality	.01	.004	.005	.005

Notes: Columns 1 through 4 show regression estimates of equation 2. All regressions include year fixed effects. The population control is the change in log population. Controls for economic conditions include changes in log unemployment and log income. Smoking ban controls include the changes in dummy variables for a smoking ban in workplaces, and a smoking ban in bars/restaurants. There are four regions, so the region fixed effects include three dummy variables (with the remaining region being the omitted category). The excise tax rate is defined as the real value of the specific excise tax in year 2000 dollars, divided by the average national cost of a pack of cigarettes in 2000 in the US. Three lags of the control variables are also included in all specifications. The unit of observation is a state-year. Standard errors clustered by state are reported in parentheses.

Figure 2: Consumption Responses to Increase in Taxes



Notes: Panels (a) and (b) show coefficients and 95 percent CIs on the changes in log of one plus the excise and sales tax rates and their lags respectively from the regression in column 4 of Table 3, while panel (c) and (d) show the corresponding cumulative effects and 95 percent CIs. Standard errors are clustered by state.

The results show that consumption falls in the period of an excise tax rate increase, yet there is a statistically significant fall in consumption only in the year after a sales tax change. If we assume that the pass-throughs of both excise and sales taxes are one (which is the general consensus in the literature), then the test of whether the long-run tax salience parameter θ is equal to one is equivalent to the test of whether the cumulative effects of an excise tax increase and a sales tax increase are the same. The results show that the cumulative effect on cigarette consumption several periods after a tax change is larger in the case of excise taxes than sales taxes, and the null hypothesis that $\theta = 1$ can be rejected at conventional signifinance levels. Although the cumulative effect of sales taxes is not statistically significantly different from zero (since the error bars become wider as we add coefficients), the consistent pattern of a consumption drop the year after the sales tax passes provides suggestive evidence of consumer learning about sales taxes.

The results on consumer learning here contrasts with CLK's finding that beer consumption does not respond to changes in the sales tax even after a few years. Several differences between cigarette and beer consumption may contribute to this apparent conflict. On the one hand, smokers may purchase cigarettes more frequently than beer drinkers buy beer, and cigarettes typically take up a larger share of income than beer does. Both of these explanations may explain why tax changes for cigarettes are more salient. On the other hand, consumer demand for cigarettes is probably less elastic due to the addictive nature of cigarettes, which may lower the tax salience of cigarettes.

The model in Gabaix (2014) provides a framework to think about these conflicting forces. Attention to the price of good i, given in Proposition 3 of Gabaix is $m_i^* = A_\alpha \left(\left(\frac{\sigma_{p_i}}{p_i^d} \right)^2 \frac{\psi_i \lambda^d p_i^d c_i^d}{\kappa} \right)$, where ψ_i and $p_i^d c_i^d$ are price elasticity and expenditure share of income respectively. As a back of the envelope calculation, we abstract from differences in purchase frequency, and assume that the price elasticities of demand for cigarettes and beer are -0.45 and -0.9 respectively, and the prices of a cheap pack of cigarettes and a can of beer are \$5 and \$1 respectively. Also, assume that income for smokers and beer drinkers are equal and similarly for the coefficient of variation σ_{p_i}/p_i^d. Then, the formula suggests that consumers should be about 5/2 times as attentive to price changes for cigarettes as for beer.

4.3 Other Explanations for the Response to Tax Changes

Tax salience is not the only candidate explanation for differential responses to excise and sales taxes. As mentioned in CLK (2013), a change in sales tax affects not only the price of the good in question, but also a whole range of other goods. To illustrate, consider the extreme case where all goods (that the consumer considers buying) are subject to the sales tax. In that case, an increase in the sales tax is equivalent to a negative income shock, whereas an increase in the excise tax corresponds to an increase in the price of a single good. Now, recall from basic consumer theory that the Marshallian price elasticity of demand ϵ^p is equal to the Hicksian demand elasticity ϵ_c^p minus the income elasticity ϵ^I:

$$\epsilon^p = \epsilon_c^p - \epsilon^I.$$

Since the Hicksian elasticity is negative, we obtain $\epsilon^p < -\epsilon^I$, and under the reasonable assumption that the Marshallian elasticity is negative and cigarettes are a normal good, we get $|\epsilon^p| > \epsilon^I$. Hence, even in the absence of inattention to sales taxes, one might expect a greater consumption response to excise relative to sales taxes. However, the reasoning above fails to explain why consumers will react to a negative income shock with a lag, but instead react to a price shock immediately.

A separate possibility for the difference in response to excise and sales taxes is that excise tax changes tend to be much larger than sales tax changes. In partiular, this explanation emphasizes that it is not whether or not the tax is included in the posted price that matters, but rather that there is some nonlinearity in the consumption response to taxes (e.g. consumers ignore small tax changes, but react disproportionately to large changes). To test this hypothesis, I estimate the regression equation:

$$\begin{aligned}
\Delta log(x_{it}) = & \sum_{j=0}^{L} \beta_j^E \Delta log(1+\tau_{i,t-j}^E) + \sum_{j=0}^{L} \beta_j^S \Delta log(1+\tau_{i,t-j}^S) + \sum_{j=0}^{L} \kappa_{t-j}^E \cdot D_{i,t-j}^E + \sum_{j=0}^{L} \kappa_{t-j}^S \cdot D_{i,t-j}^S \\
& + \sum_{j=0}^{L} \gamma_j^E \Delta log(1+\tau_{i,t-j}^E) \cdot D_{i,t-j}^E + \sum_{j=0}^{L} \gamma_j^S \Delta log(1+\tau_{i,t-j}^S) \cdot D_{i,t-j}^S \\
& + \sum_{j=-J}^{J} X'_{i,t-j}\phi_j + u_{it}, \qquad (3)
\end{aligned}$$

where $D_{i,t}^E$ and $D_{i,t}^S$ are dummies respectively for whether there was a change in excise or sales tax exceeding 5 percent respectively. The results are shown in Table 4, and the number of lags L is set to either 0 or 3, as in columns 1 and 2 respectively. While the coefficients on the interaction terms in column 1 and the sum of the corresponding coefficients in column 2 are not statistically different from zero, the sign suggests that consumers do indeed respond disproportionately to large tax changes.

Table 4: Regression Results Allowing for Heterogeneous Responses to Small and Large Tax Changes

	(1)	(2)
Interactions with Excise Taxes		
$\Delta log(1+\tau^{E}_{i,t}) \times D^{E}_{i,t}$	-0.229	-0.327
	(0.139)	(0.156)
$\Delta log(1+\tau^{E}_{i,t-1}) \times D^{E}_{i,t-1}$		0.088
		(0.187)
$\Delta log(1+\tau^{E}_{i,t-2}) \times D^{E}_{i,t-2}$		0.158
		(0.174)
$\Delta log(1+\tau^{E}_{i,t-3}) \times D^{E}_{i,t-3}$		-0.110
		(0.162)
Interactions with Sales Taxes		
$\Delta log(1+\tau^{S}_{i,t}) \times D^{S}_{i,t}$	-2.164	-2.678
	(1.044)	(1.002)
$\Delta log(1+\tau^{S}_{i,t-1}) \times D^{S}_{i,t-1}$		1.149
		(1.695)
$\Delta log(1+\tau^{S}_{i,t-2}) \times D^{S}_{i,t-2}$		-1.173
		(0.961)
$\Delta log(1+\tau^{S}_{i,t-3}) \times D^{S}_{i,t-3}$		1.666
		(0.441)
Number of Obs.	1,442	1,344
Cumulative Effects		
Interactions with Excise Taxes	-	-0.191
	-	(0.407)
Interactions with Sales Taxes	-	-1.038
	-	(1.375)

Notes: Columns 1 and 2 show regression estimates of equation 4 with $L = 0$ and $L = 3$ respectively. All regressions include year fixed effects, population control, controls for economic conditions, controls for smoking bans, and region fixed effects, as in column 4 of Table 3. The excise tax rate is defined as the real value of the specific excise tax in year 2000 dollars, divided by the average national cost of a pack of cigarettes in 2000 in the US. Three lags of the control variables are also included in all specifications. The unit of observation is a state-year. Standard errors clustered by state are reported in parentheses.

4.4 Heterogeneity in Tax Salience

4.4.1 Heterogeneity by Smuggling Rates

Consumption responses to tax hikes may differ across states depending on the extent of cigarette smuggling. If consumers in states with high smuggling rates respond to increases in taxes by substituting to smuggled cigarettes, we would expect demand elasticities for tax-paid cigarettes to be greater in magnitude in such states. In line with this reasoning, Gruber, Sen, and Stabile (2003) find using Canadian provincial data, that excluding provinces with higher smuggling rates leads to smaller estimates of the demand elasticity. On the other hand, if a large fraction of consumers in states with high smuggling rates are already consuming smuggled cigarettes, consumption of tax-paid cigarettes may in fact be less responsive in such states. According to Gabaix (2014), attention to price changes is greater for products with more inelastic demand, so we might expect similar patterns for tax salience.

To test for heterogeneity in consumption responses by smuggling rates, I use data from LaFaive, Fleenor, and Nesbit (2008) on smuggling import and export rates by state (given as negative and positive values of the smuggling rate variable). It seems likely that both states with high import or export smuggling rates will be more sensitive in the short run to changes in prices, so I focus on the absolute value of the smuggling rate. Specifically, I estimate the following regression equation:

$$\begin{aligned}\Delta log(x_{it}) = &\sum_{j=0}^{L}\beta_j^E \Delta log(1+\tau_{i,t-j}^E) + \sum_{j=0}^{L}\beta_j^S \Delta log(1+\tau_{i,t-j}^S) + \kappa \cdot W_i \\ &+ \sum_{j=0}^{L}\gamma_j^E \cdot \Delta log(1+\tau_{i,t-j}^E)\cdot W_i + \sum_{j=0}^{L}\gamma_j^S \Delta log(1+\tau_{i,t-j}^S)\cdot W_i \\ &+ \sum_{j=-J}^{J} X'_{i,t-j}\phi_j + u_{it}, \end{aligned} \tag{4}$$

where W_i is the absolute smuggling rate.

We observe that the sum of the coefficients from the interaction between the smuggling and excise tax variables is close to zero, whereas the sum of coefficients from the interaction between smuggling and sales tax variables tends to be negative, in both these specifications. Although the negative interaction is not statistically significant, this provides suggestive evidence that the consumption response to sales taxes are greater in states where smuggling is more common.

4.4.2 Heterogeneity by Sales Taxes

Another source of heterogeneity is in the salience of sales taxes, which may differ across states for a number of reasons. Moreover, heterogeneity in the consumption response may take different forms – the cumulative fall in consumption may be larger or smaller, or consumer learning may occur faster or slower.

If consumers incur a cognitive cost when computing sales-tax-inclusive prices, a model of rational inattention may predict greater salience in states with higher sales taxes. Indeed, Rees-Jones and Taubinsky (2018) produce experimental evidence that consumers who face higher sales taxes tend to pay more attention to them. To test whether the consumption response of cigarettes to sales taxes follows a similar pattern, I estimate equation 4 where W_i is the baseline sales tax rate. The results, shown in columns 3 and 4 of Table 5, do not indicate strong evidence that consumers response to baseline sales tax changes, but this may also due to the very limited variation in baseline sales taxes – although the coefficient is of the correct sign, it is statistically indistinguishable from zero.

Another explanation for consumers' neglect of sales taxes is forgetfulness on their part.

In such a model, consumers who are frequently reminded about sales taxes are more likely to take them into account when making purchase decisions. As a proxy for frequency of reminders about sales taxes, I consider variation in frequency of sales tax changes across states. Consumers in states that often change their sales taxes are likely to encounter more media reports on sales taxes, and thus respond quicker or more to changes in sales taxes. To assess the plausibility of this argument, I estimate equation 4 where W_i is the number of sales tax changes in state i during the sample period. Columns 5 and 6 of Table 5 shows the results. Again, although the coefficient on the interaction variable (for sales taxes) is of the correct sign, the estimate is statistically insignificant.

Table 5: Regression Results Allowing for Heterogeneity in Tax Salience

	(1)	(2)	(3)	(4)	(5)	(6)
Interaction Variable (W_i)	*Absolute Smuggling Rate*	*Absolute Smuggling Rate*	*Baseline Sales Tax*	*Baseline Sales Tax*	*Number of Sales Tax Changes*	*Number of Sales Tax Changes*
Interactions with Excise Taxes						
$\Delta log(1+\tau^E_{i,t}) \times W_i$	0.000	0.001	-4.160	-4.460	-0.017	-0.009
	(0.005)	(0.005)	(1.773)	(1.895)	(0.021)	(0.024)
$\Delta log(1+\tau^E_{i,t-1}) \times W_i$		-0.008		-5.935		-0.016
		(0.006)		(1.821)		(0.017)
$\Delta log(1+\tau^E_{i,t-2}) \times W_i$		0.007		1.068		0.017
		(0.005)		(1.962)		(0.019)
$\Delta log(1+\tau^E_{i,t-3}) \times W_i$		0.001		0.137		0.004
		(0.007)		(2.183)		(0.023)
Interactions with Sales Taxes						
$\Delta log(1+\tau^S_{i,t}) \times W_i$	-0.049	-0.045	-5.712	-4.042	-0.065	-0.082
	(0.036)	(0.037)	(6.394)	(6.571)	(0.102)	(0.109)
$\Delta log(1+\tau^S_{i,t-1}) \times W_i$		-0.004		-2.176		0.037
		(0.045)		(9.819)		(0.105)
$\Delta log(1+\tau^S_{i,t-2}) \times W_i$		0.001		3.514		0.006
		(0.020)		(3.779)		(0.065)
$\Delta log(1+\tau^S_{i,t-3}) \times W_i$		-0.065		-4.777		-0.017
		(0.028)		(6.425)		(0.097)
Number of Obs.	1,352	1,260	1,442	1,344	1,442	1,344
Cumulative Effects						
Interactions with Excise Taxes	-	0.002	-	-9.189	-	-0.004
	-	(0.014)	-	(4.100)	-	(0.057)
Interactions with Sales Taxes	-	-0.113	-	-7.482	-	-0.056
	-	(0.075)	-	(16.132)	-	(0.174)

Notes: Columns 1 through 6 show regression estimates of equation 4. All regressions include year fixed effects, population control, controls for economic conditions, controls for smoking bans, and region fixed effects, as in column 4 of Table 3. The excise tax rate is defined as the real value of the specific excise tax in year 2000 dollars, divided by the average national cost of a pack of cigarettes in 2000 in the US. Three lags of the control variables are also included in all specifications. The unit of observation is a state-year. Standard errors clustered by state are reported in parentheses.

5 Conclusion

In this paper, I explore the issue of tax salience in the context of the cigarette market. Consistent with the prior literature, I find that consumers tend to under-react to sales taxes relative to excise taxes. However, I find that consumers do respond to sales taxes albeit with a lag, which may be consistent with consumer learning. Nonetheless, the cumulative fall in consumption several years after an increase in the sales tax is still smaller than the cumulative fall after an increase in the excise tax.

This suggests that a potential future direction of research to develop cleaner empirical tests of consumer learning outside the lab, and to determine the conditions under which such learning occurs.

Appendix

A Details on Construction of the Dataset

Cigarette prices in the Tax Burden on Tobacco are not defined the same way for the entire sample period. To the best of my knowledge, prices up to 1989 include sales taxes whereas prices after that do not. Hence, I define the after-tax and pre-tax price variables for my dataset appropriately to avoid this inconsistency. The source also gives average prices from 1990 onwards that either include or exclude generics. I chose to use average prices that include generics.

Combined excise taxes from the Tax Burden on Tobacco are not always consistent with state-level excise taxes from the same source. Specifically, subtracting the latter from the former does not always yield the federal excise tax in the corresponding year (and even results in negative values in some cases). Since the exact definition of combined state and federal taxes from the source is not clear, I chose to use the state-level excise taxes from this source (which are well-defined) and manually code federal excise taxes for the sample period.

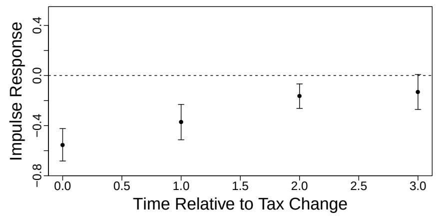
Two other papers on tax salience – CLK (2009), and Goldin and Homonoff (2013) – have used sales tax data from the World Tax Database (University of Michigan). However, I opted to use sales tax data from the Tax Burden on Tobacco instead since it is collected at the same date as the excise tax in November of each year (in contrast, the sales tax data from the World Tax Database seems to be collected much earlier in the year). Given the importance of timing issues discussed throughout the paper, I prioritized consistency in the date of collection for excise and sales tax data.

The average national cost of cigarettes in 2000, which is used to define the ad valorem excise tax rate, is the market-share-weighted average pre-tax price given in the Tax Burden on Tobacco. It is not clear whether we would prefer this measure or an unweighted average price (which excludes the two states that I drop from my analysis), given that the regressions presented in the paper are unweighted. In any case, the exact choice of the average cost of cigarettes used to define the excise tax rate makes little difference to the analysis.

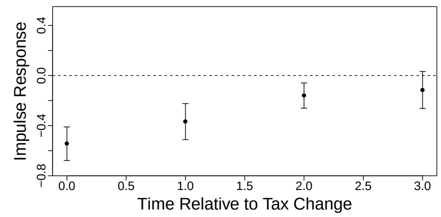
Data on smoking bans in workplaces and bars/restaurants are obtained from the replication files of Adda and Cornaglia (2013).

Figure A.1: Consumption Response to Increase in Excise Taxes

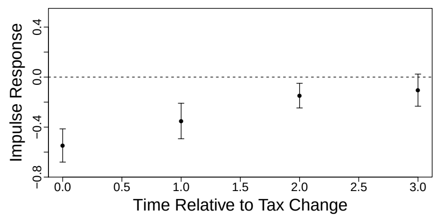
(a) Controls: Population



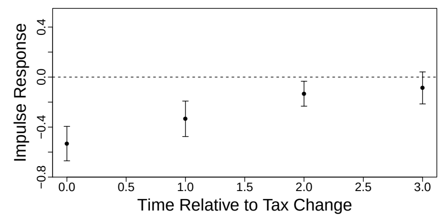
(b) Controls: Population, Economic



(c) Controls: Pop., Econ., Bans



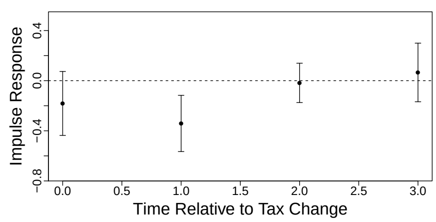
(d) Controls: Pop., Econ., Bans, Regional Trends



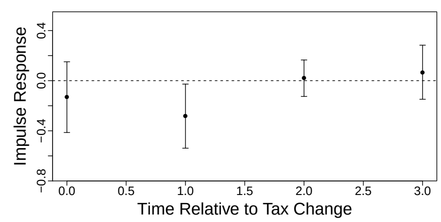
Notes: Panels (a) through (d) show coefficients and 95 percent CIs on the leads and lags of the change in log of one plus the excise tax rate, from the regressions in columns 1 through 4 of Table 3 respectively. Standard errors are clustered by state.

Figure A.2: Consumption Response to Increase in Sales Taxes

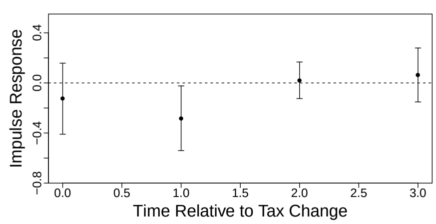
(a) Controls: Population



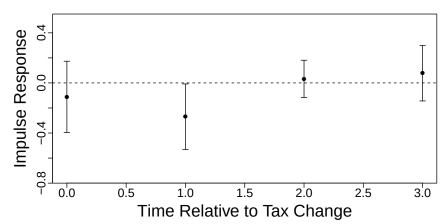
(b) Controls: Population, Economic



(c) Controls: Pop., Econ., Bans



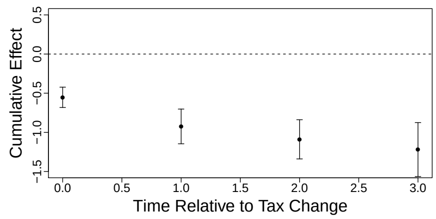
(d) Controls: Pop., Econ., Bans, Regional Trends



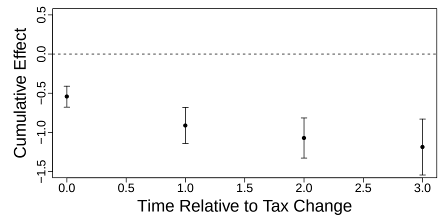
Notes: Panels (a) through (d) show coefficients and 95 percent CIs on the leads and lags of the change in log of one plus the sales tax rate, from the regressions in columns 1 through 4 of Table 3 respectively. Standard errors are clustered by state.

Figure A.3: Cumulative Consumption Response to Increase in Excise Taxes

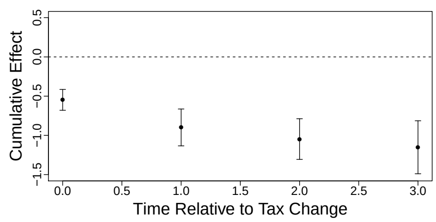
(a) Controls: Population



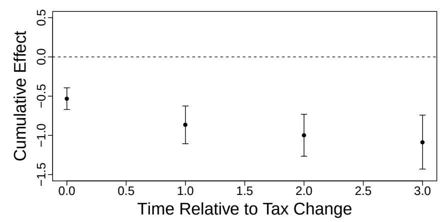
(b) Controls: Population, Economic



(c) Controls: Pop., Econ., Bans



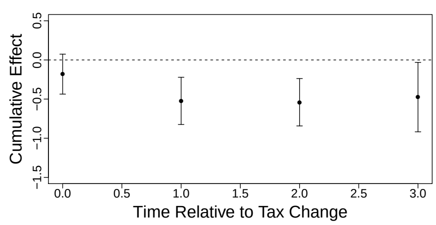
(d) Controls: Pop., Econ., Bans, Regional Trends



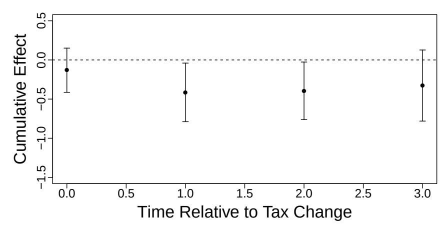
Notes: Panels (a) through (d) show the cumulative effects and 95 percent CIs based on coefficients from the regressions in columns 1 through 4 of Table 3 respectively. Standard errors are clustered by state.

Figure A.4: Cumulative Consumption Response to Increase in Sales Taxes

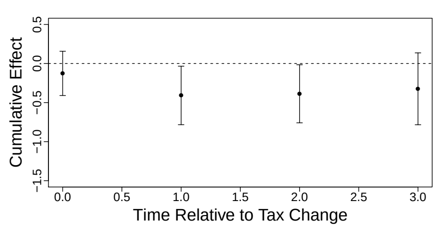
(a) Controls: Population



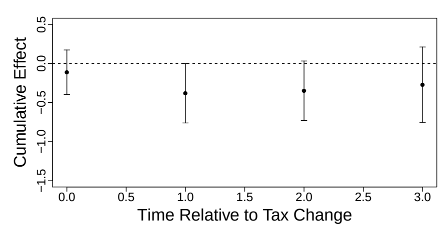
(b) Controls: Population, Economic



(c) Controls: Pop., Econ., Bans



(d) Controls: Pop., Econ., Bans, Regional Trends



Notes: Panels (a) through (d) show the cumulative effects and 95 percent CIs based on coefficients from the regressions in columns 1 through 4 of Table 3 respectively. Standard errors are clustered by state.

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