The Effect of State-level Smoking Bans on Cigarette Consumption

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1. Introduction

The smoking of tobacco is as ingrained in America's society as is the idea of freedom itself. And yet, over 16 million adults in the United States currently have a disease caused by smoking, with 480,000 of those diseases causing death annually.[1] In other words, smoking is one of the most prominent cause of preventable death. Governments over the past decades have sought to control and mitigate the negative effects of smoking. In this thesis, I study specifically the effect of state-level anti-smoking legislation on cigarette consumption.

According to the Centers for Disease Control and Prevention (CDC), as of 2015, 15.1% of the adult population, or 36.5 million people, were regular smokers (Jamal, et al., 2016). In addition to this figure, over 3,200 adolescents and young adults smoke their first cigarette every day, with 2,100 of the same demographic transitioning to become regular smokers daily. Despite this, there are long time trends of public discomfort with smoking and increasing acknowledgment of its harmful side effects.

Public frustration with smoking came to a culmination in 1999 with a complete public advertising ban on tobacco products (while in 1971 such advertising was banned on television and radio).[2] Over the years, thousands of pages of medical research have shown conclusively that smoking tobacco is, in fact, a harmful, if not deadly, activity. As a result, government programs, both in the United States and across the world have been enacted to tax tobacco products, provide cessation services, and limit the visibility of tobacco-related companies. Most absolutely, state governments have sought control over smoking by instituting public bans. The other main tool that governments have is the ability to levy taxes. Consequently, building upon previous research, I

[1] "Smoking and Tobacco Use: Fast Facts," Centers for Disease Control and Prevention, accessed 1 December 2017, https://www.cdc.gov/tobacco/data_statistics/fact_sheets/fast_facts/index.htm.

[2] Jane McGrew, "History of Tobacco Regulation," Schaffer Library of Drug Policy, accessed 7 December 2017, http://www.druglibrary.org/Schaffer/LIBRARY/studies/nc/nc2b.htm.

obtained data on all state-level public smoking bans and aggregate cigarette consumption and employed a difference-in-differences approach to find the effect of bans in different years between states that ban and one that do not. The paper finds that while bans are effective in some circumstances, what is most relevant is the interaction between tobacco taxes and public smoking bans. As will be seen, bans are most effective at low-to-medium tax rates and at a decreasing pace as tax rates rise.

2. Literature Review

Fundamental to any discussion of smoking is the underlying theory behind why one would choose to smoke. Most compelling (and simplest to adapt to this approach) is the work done by Gary Becker and Kevin Murphy. In their 1988 paper, "A Theory of Rational Addiction", the authors propose a model of addictive consumption- whether that be of tobacco or alcohol or heroin, etc.- to be a utility maximizing behavior (Becker and Murphy, 1988). More specifically, they posit that a consumer's current decision to smoke now is influenced by the knowledge of all discounted future costs, whether health, monetary, or something else. Furthermore, this decision is made under perfect information, such that the smoker is fully aware of what he/she is giving up by smoking, but that the benefits accumulated in the past along with the learned 'consumption capital' to determine future benefit are greater than all future discounted costs for the addict. The problem with this model is that some empirical tests have found normal, non-addictive goods to be addictive under this model, such as milk (since the benefits will outweigh the future discounted costs when deciding to drink a glass of milk for most people). The authors used simple time-series aggregate data and concluded that the autocorrelation present in many such datasets means further analysis must be done to demonstrate rational addition (Auld and Grootendorst, 2004). Especially relevant

to this thesis, however, other empirical work has corroborated Becker's and Murphy's theory. For instance, Gruber and Koszegi showed that in the intervening time between when states pass legislation for cigarette tax increases and when they are enacted, smokers tend to dampen their demand, indicating that current utility is in some part derived by future considerations (2001). This finding is especially helpful to my approach, since it shows that state-level changes in cigarette policies do affect individuals' decision to smoke and thus overall cigarette consumption. Expanding the question to state-level bans is a logical next step for both empirical and policy purposes.

Other research shows that smoking poses a serious cost to the economy and to businesses, a fact that should serve as an impetus for state-level legislation that regulates smoking in workplaces. Besides most obviously adding to overall health care costs, smoking significantly affects productivity and thus economic output.

Considering that smoking leads to 20% of adult deaths, Xu, Bishop, Kennedy, Simpson, and Pechacek found that the direct health care costs from smoking to the United States total $170 annually (2014). These expenditures deal only with costs such as hospital stays associated with emphysema or chemotherapy treatments for lung cancer. The United States Department of Health and Human Services sought to add to this figure a cost of $156 billion, which represents lost productivity overall due to premature smoking-induced death and secondhand smoke exposure. Meanwhile, Goodchild, Nargis, and d'Espaignet sought to estimate related figures for the global health landscape that included both developing and rich countries among their 152-country sample. In their 2017 paper, they found that in 2012 the direct health care costs from smoking were globally $422 billion annually, comprising 5.7% of total global health care expenditures (Goodchild, et al., 2017). Additionally, they found that the 'loss to productivity', or indirect costs, from smoking

totaled $1012 billion (Goodchild, et al., 2017). Importantly, their method for estimation differed from the study by Xu, et al. in that the latter devised their own estimates of health care costs at all attributable to cigarettes based on two domestic health surveys whereas the former used the conventional Cost of Illness formula which uses a more strict and standardized approach to defining direct costs. To estimate indirect (productivity) costs, the authors employed the Human Capital Method (HCM), which sequentially finds the smoking-attributable years lost to disability, the labor years lost due to disability (using countries' employment-population ratios), the value of lost productivity due to disability (using countries' GDP per working adult), and then discounting that figure with an appropriate rate and estimate of labor productivity growth. While the cost to developing countries was high, they found the 'tobacco epidemic' to be most significant in the mostly rich regions of North America and Europe. The study employed methods now common to researchers seeking to study the economic costs of smoking. A similar study in Germany found that for every current or former smoker, the productivity cost was € 379 in 1999 (Wegner, Gutsch, Hessel, and Wasem, 2004). This study also employed the HCM. In doing so, though, these studies rely on hypothetical generalities based on macro country data that may not represent the true value of work being lost from smoking-related disease and death. Nevertheless, their findings heavily support the idea that there are serious costs to smoking to the economy at large, much greater than what is easily or simply measured, and that as a result governments have an incentive to limit the productive and health care damage done from smoking. These facts will also serve as a justification for including similar variables as covariates when estimating the consumption of cigarettes.

The earliest regulation of smoking was not related to health or productivity concerns at all but was to help prevent fires and other hazards from the byproducts of cigarettes (Eriksen and Chaloupka, 2007). Early in the 1970s, though, public health authorities began to draw attention to

the negative effects of secondhand smoke, a decidedly more constitutional question than the economic and cultural costs that have been discussed up until now. Since then, as will be discussed in the *Data* discussion, a significant amount of legislation has been passed on the state level, in addition to even more on the local level. As a precursor to the findings that study the effectiveness of anti-smoking laws, it is important to show that these laws have minimal adverse economic effects, meaning they do not simply transfer the costs of smoking between parties. An early paper studying such effects looked at local smoke-free ordinances regulating restaurants in different California and Colorado communities enacted between 1985 and 1992. Using restaurant revenue as a share of total revenue before and after implementation, they found there to be no negative economic impact from the ordinances (Glantz and Smith, 1997). Other studies have expanded the question to state-level laws and have examined their effect on employment-related numbers and on the number of licensed restaurants and bars. An analysis of Massachusetts's 2004 ban found that there was no significant negative impact on employment in the primary venues where the law was applicable, restaurants and bars (Connolly et al. 2005). New York City's 1995 restaurant ordinance was analyzed for its effect on restaurant openings and closings. The authors found that the number of restaurant openings was no different than in surrounding areas or in the rest of the state (Hyland et al., 1999). Clearly, there is not an obviously significant adverse economic effect from anti-smoking laws. Whether the laws are effective is a more difficult question, and one this thesis seeks to partially answer.

The Surgeon General's *The Health Consequences of Involuntary Exposure to Tobacco Smoke,* published in 2006, provides a good framework for understanding anti-smoking legislation and its effects despite its primary focus on the health-related aspects of smoking. It finds that in 2002, while nearly 80% of white-collar workers reported smoke-free workplaces, only 60% of

service workers, less than 55% of blue collar workers, and under 50% of farm workers report the same numbers, almost identical figures to 1999 after a decade of strong growth (US Department of Health and Human Services, 2006). Despite this, there is evidence that anti-smoking bans and restrictions do, in fact, decrease exposure to environmental tobacco smoke (ETS). A New York City study found that New York's 2003 statewide ban on all enclosed workplace smoking resulted in a decrease of 85% in the levels of cotinine, a marker of tobacco smoke exposure, among nonsmoking employees of restaurants and bars (New York City Department of Finance, 2004). Many other studies have found similar results, that regulation is statistically significant in decreasing the amount of ETS that people are exposed to. In fact, in another report the Surgeon General has concluded that "smoking bans are the most effective method for reducing ETS exposure" (US Department of Health and Human Services, 2000). Elsewhere, Fichtenberg and Glantz found California's tobacco control program (not a ban) decreased disease mortality and saved 58,900 lives over the course of eight years after the law's implementation (Fichtenberg and Glantz, 2000), while Sargent et al. concluded that a Helena, Montana law that was in effect for six months significantly decreased the number of monthly heart attack admissions to hospitals (Sargent et al., 2004). Still, whether these laws affect consumption and not simply workplace ETS and its health outcomes is a different question.

Other papers seek to answer this very question. Glasgow and colleagues studied self-reported survey data of 8,271 smoking workers to find that those employees whose workplaces completely prohibited smoking were 25% more likely to attempt to quit and were also 25% more likely to be successful at quitting compared with workers whose workplaces did not have smoking bans (Glasgow et al., 1997). When coupled with increases in taxes, it has been shown in isolated cases that comprehensive statewide smoking bans caused adult smoking rates to decrease by 11%

over the course of the year following the implementation (State of Delaware, 2004). Furthermore, Levy et al. were able to show that state anti-smoking laws (not necessarily all bans) that were effected between 1993 and 2003 led to a reduction by 9% of adult smoking prevalence over the same period (Levy et al., 2005). Remarkably, it has been found that anti-smoking laws do affect attitudes and norms toward smoking, a key fact that can enable an exogenous interpretation of such laws (Tang et al., 2003, Gilpin et al., 2004). The bulk of the research shows that laws do have a role to serve in decreasing the amount of tobacco that is smoked. Hence, the data and analysis will focus more specifically on whether state-level bans have something to say in such conversations.

3. Data and Variables

I collected data on state-specific anti-smoking legislation across time as the primary dependent variable, specifically legislation that enacts complete public bans. All smoking data were obtained from consulting firm Orzechowski and Walker and their 2014 report, *The Tax Burden on Tobacco,* and verified with state tax administrators and the Treasury Department's Alcohol and Tobacco Tax and Trade Bureau. By 'ban', I refer to the outlawing of smoking in the specific targeted locale when it becomes effective (not when it is signed into law). While smoking has been regulated on a state level for some time, the banning of public smoking on a wide scale is a relatively recent phenomenon. For instance, while Minnesota first regulated smoking on the state level in 1975, it was not until 2007 that they instituted a complete ban.[3] More generally, by 2003 every state had some sort of restriction on smoking, along with many localities that strengthened restrictions further. The issue, then, is not that smoking was not regulated until the

[3] 2008 Minnesota Statutes §144.414.

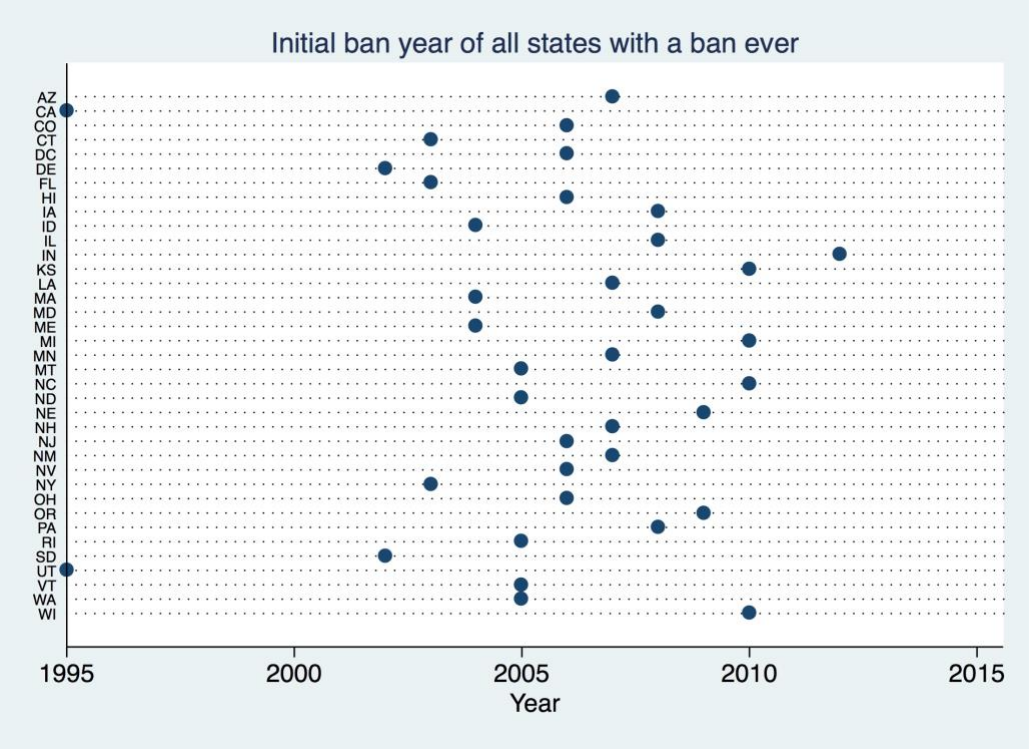
1990s and 2000s, but that the regulation of smoking during that period represents the final 'nail in the coffin' of governments' control over the matter in that the regulation was complete and total, not partial and riddled with exemptions.

Given the relatively consistent language of state-level legislation, I categorized state bans under the types of locales that they regulated: *restaurants, bars,* and *non-hospitality workplaces*. This is modeled roughly after the system put forth in the 1989 Surgeon General's Report which classified laws under four categories: nominal, which indicates a restriction on one to three, often minor, public places; basic, which includes four or more public places, but not restaurants or worksite; moderate, which covers restaurants but not worksites; and extensive, which regulates private worksites. For purposes of this thesis, laws are categorized slightly differently (US Department of Health and Human Services, 1989). A state that has a ban for each of the three venues has a 'full' ban, and those states that ban smoking in all three venues in the same year have a 'shock' ban. With help in identifying legislation from the American Nonsmokers' Rights Foundation, each state's legislation was reviewed and then classified accordingly. All laws' years are from when they are effective. Below, **Figure 1** shows a timeline of the first year of any ban for each of the states that ever have had a ban (for more, see **Figures 9 and 10** in the appendix).

The first laws in the set are in California and in Utah, both effecting legislation in 1995. Over the next 20 years, 95 more laws were added to reach an aggregate total of 97 total bans in restaurants, bars, or non-hospitality workplaces across all states as of 2014. Some states sequentially regulate each category, while others choose all three locales as the primary targets in a single piece of legislation. More importantly, states implement laws at different times and to differing degrees (depending on the locale), allowing for a difference-in-differences approach that

will be discussed in the next section. **Table 4** in the appendix shows a detailed list of each state's bans by year and locale.

Figure 1: Timeline of initial bans



The dependent variable measures the amount of smoking on an aggregate level. This way, it will be easier to interpret an individual state's policy effect on the total number of cigarettes consumed if there is indeed found to be an effect. The per-capita annual consumption of cigarettes is calculated by taking a state's annual tax receipts derived from cigarettes divided by the annual tax and then divided by the state's annual population as estimated by the Census Bureau. Using aggregate data has several advantages in a study like this. First, survey data relies on self-reporting, and it is conceivable that a stigma associated with smoking could affect respondents' answers about their smoking habits. Cigarettes cannot be obtained and smoked without paying a tax. Second, tax receipts provide a fuller picture of a state's consumption landscape without having to

infer from a sample. Since the focus of the paper is on an aggregate effect, it makes sense to use overall tax receipts even considering the possibility that residents at the border can distort true consumption by traveling cross-border to a cheaper or less regulated regime. Lastly, it enables better state-by-state comparisons, as there can be no selection or response bias that might be inconsistent across geographies. Included in the data is each state's tax rate (in dollars per pack by year).

Separately, several state-level demographic and economic variables are included in the models as covariates. They include the average Supplemental Nutrition Assistance Program (SNAP), personal income, Gross Domestic Product (GDP) and GDP per capita, poverty rate, Labor Force Participation Rate (LFPR), civilian employment rate, and unemployment rate. These data were obtained from the Food and Nutrition Service of the United States Department of Agriculture, the Bureau of Economic Analysis, the United States Census Bureau, and the Bureau of Labor Statistics. As a note, all dollar amounts, including those involved in the backward-solved consumption variable, are in real terms using the 2014 Consumer Price Index as the base year. **Table 1** shows some summary statistics of the data.

The various aggregate economic indicators being used as covariates are strongly related to smoking. **Table 6** in the appendix shows that the covariates vary significantly, and negatively, with the smoking rate. This is in line with a reasonable prediction that these variables tend to shift the backdrop against which people smoke cigarettes. This is not to imply causality with any of these statewide economic indicators. The simple analysis serves merely to identify certain variables as appropriate covariates.

Most pertinent to this study, however, is the fact that states' cigarette consumption and tax rates vary significantly over years, indicating a strong time trend as seen in **Figures 2 and 3.**

Table 1: Summary statistics of selected variables

Variable	n	Mean	S.D.	Min	25th	Median	75th	Max
Never-ban states:								
Packs per capita/yr.	490	96.6	29.6	28.7	75.1	97.6	115.6	197.6
Tax rate ($/pack)	490	0.41	0.38	0.03	0.19	0.31	0.48	2.21
GDP per capita (th.)	490	42.6	14.9	23.6	33.5	39.5	46.4	140.0
Poverty rate (%)	490	15.5	4.0	7.1	12.6	15.5	17.8	27.2
LFPR (%)	490	65	5	51	62	64	68	74
Ever-ban states:								
Packs per capita/yr.	1295	82.0	36.1	15.4	52.3	79.3	107.3	271.1
Tax rate ($/pack)	1295	0.84	0.73	0.03	0.36	0.55	1.01	4.58
GDP per capita (th.)	1295	47.4	19.0	25.9	37.7	44.3	51.4	190.0
Poverty rate (%)	1295	12.3	3.5	2.9	9.9	11.8	14.2	26.4
LFPR (%)	1295	67	3	56	65	67	70	75

Figure 2: Taxes by year

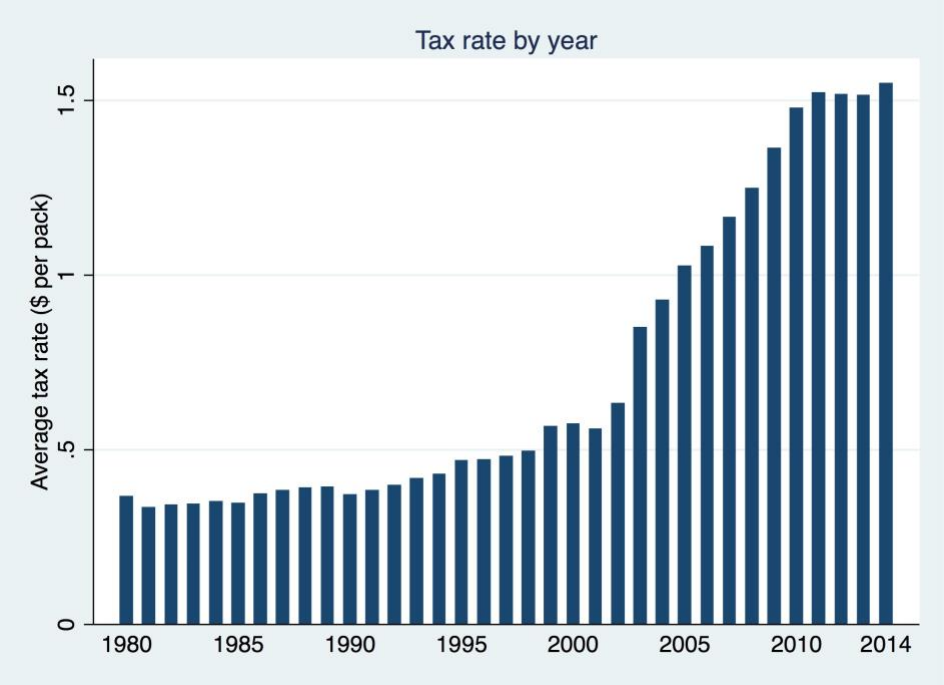
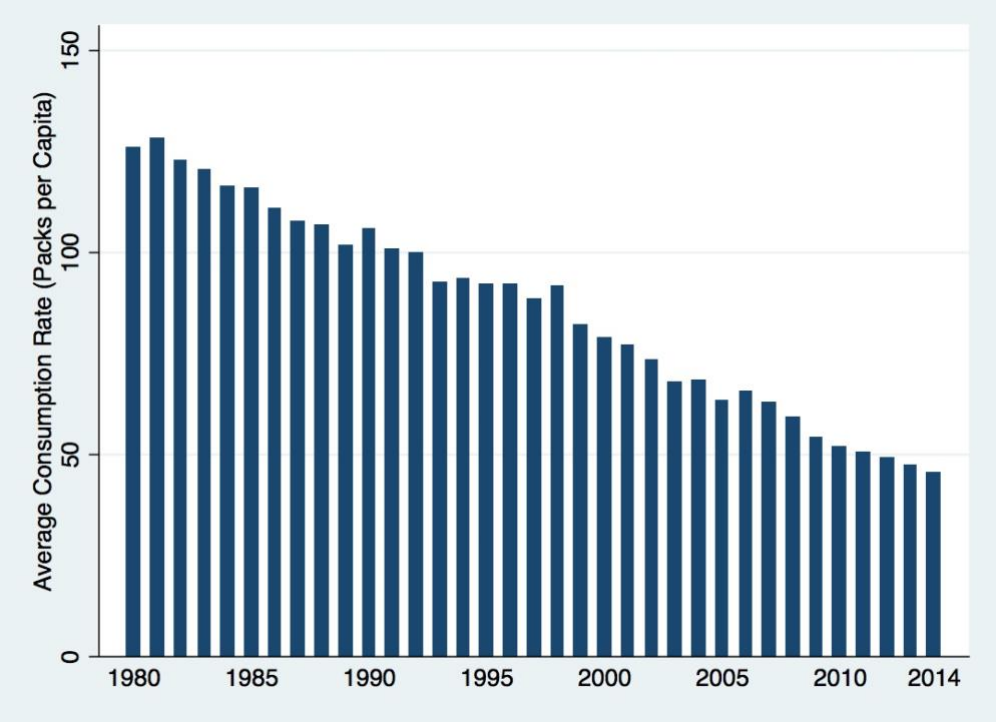


Figure 3: Cigarette consumption by year



Cigarette consumption also varies over tax rate. The correlation coefficient between the tax rate and the average consumption of cigarette packs per capita is -.64, indicating a substantive negative correlation. However, given that this number does not account for time trends, it is possible that the true relationship is less strong. Furthermore, the same correlation coefficient for observations that have at least one ban is -.44, while it is -.58 for those that have no ban. This might indicate several things, but it points to the possibility that state-level bans have some effect on consumption habits. More specifically, it might be that a ban's interaction with a state's given tax rate matters quite a bit.

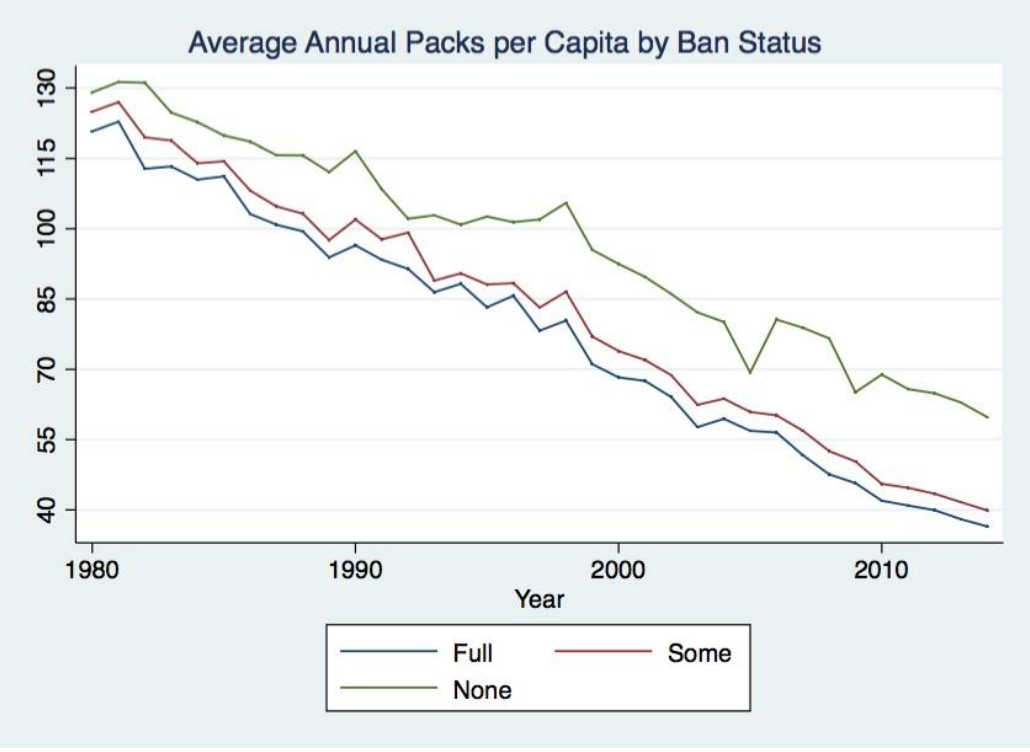
Given this variation between states and bans combined with strong trends of consumption over both taxes and time, a helpful natural experiment can be constructed from the data. I adopt a difference-in-differences strategy that examines states with and without bans, before and after the

bans take place. The underlying assumption is that smoking in states without bans had a common trend before the bans were implemented, conditional on tax rates and other covariates. Importantly, a state's tax rate interacts with the presence of a ban to ultimately shift consumption habits. This will be explored in the next section.

4. Models and Results

I start my analysis by showing trends in the average consumption per year by ban status. There is a clear difference emerges between states with different levels of ban. **Figure 4** shows the different trend lines for states that never pass a ban, states that pass at least one ban, and states that pass three bans (the maximum for this study) over the course of the 34 years.

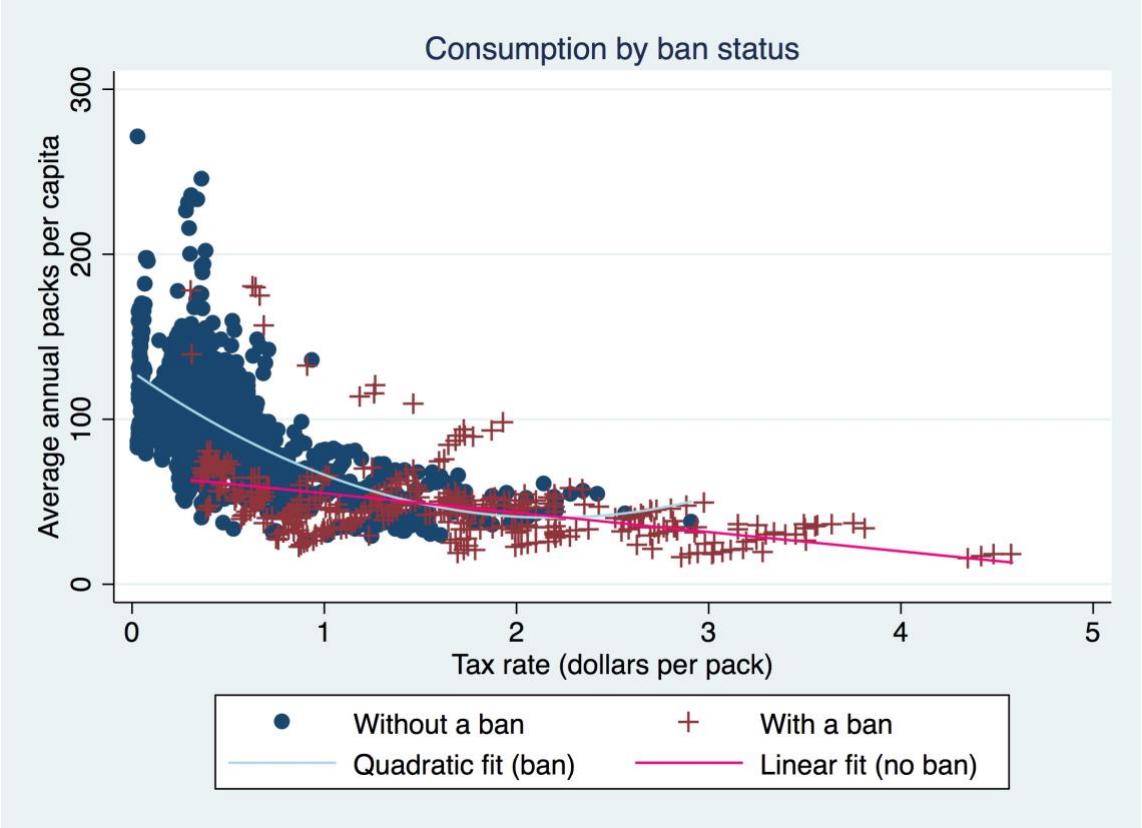
Figure 4: Time trend in consumption over ban type



As can be seen from the chart and from **Table 7** in the appendix, it to matter less how many bans are passed (or which locales were targeted in legislation), and more whether a ban was passed at all. While there are certainly reasons to believe certain locale bans ought to be more effective than others, and those will be helpful in testing for robustness, it seems reasonable that the presence of *any* law could serve as a type of signal from a state government that causes a shift in consumption habits.

Even more striking than consumption over time, however, is the relationship between cigarette consumption and tax rate when separated by ban status. Below is a scatter plot of average annual packs per capita with overlaid polynomial fits:

Figure 5: Consumption vs. tax rate by ban status



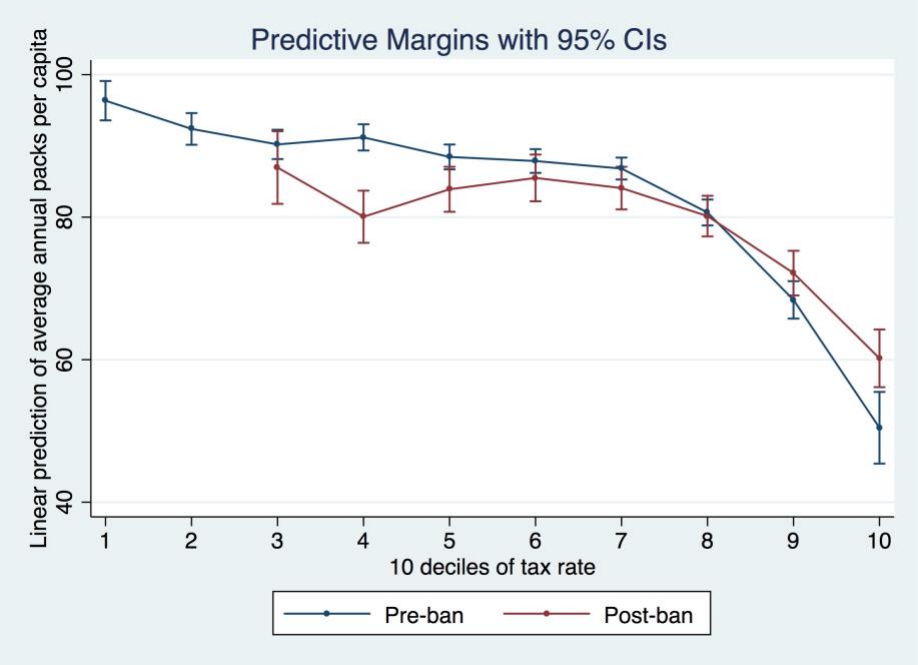
Since this population includes the entire population of states, there are fewer data points in high tax environments, mostly because those states with high taxes tend to have implemented those high taxes in later years along with bans (meaning both that states without bans tend to not tax as highly and that states with bans tend to tax highly after bans have been passed). Still, the above **Figure 5** plots all data points, and so it could be that the presence of a ban is really an endogenous signal of a particular state, meaning the clear differences in consumption that are seen are the result of different smoking 'cultures' by state and not directly caused by bans. It *does* show, though, evidence that bans are effective only at relatively low tax rates. This fact will be used shortly in the main model specification.

First, though, I isolated the data points for states ever have at least one ban from the rest of the data to test the ban dummy on a population where the only interpretation of its coefficient is pre- and post-ban. To do that, I ran the following simple specification on the covariates ($\boldsymbol{X}$), tax rate, the presence of a ban, and the interaction between tax rate and ban:

$$(1)\ Packs_{st} = \alpha \boldsymbol{X_{st}} + \beta TaxRate_{st} + \rho Ban + \phi TaxRate * Ban + \delta_s + \delta_t + \varepsilon_{st}$$

where δ_s and δ_t are state and year fixed effects. The sample of ever-ban states was split between before and after using the Ban dummy. The resulting plots are shown below:

Figure 6: Predicted consumption per tax decile



The graph plots the predicted packs per capita according to (1) at each decile of tax rate, separated by pre- and post-ban status. Note that at low tax rates there appears to be a small negative effect of having a ban, as would be predicted from **Figure 5.** However, this effect seems to quickly disappear as the tax rate increases. Furthermore, deciles one and two are omitted in the post-ban case since there is no data for state's having such low taxes with a ban also in place. Most importantly, the graph shows that among states that ever ban smoking, the bans seem to matter only at low tax rates. Still, it does not account entirely for the trend that appears obvious in the earlier scatter plot.

A large reason for this is that (1) is not a full difference-in-differences approach since it fails to include states that never pass a ban (the first difference). While it is important to see such a trend among states that ever ban smoking, it is crucial that such a trend exists in the larger population to make any causal argument. And while **Table 8** shows the results for a linear interaction between a ban (whose effect turns out to be negative) and tax rate on consumption, a

different specification should be used to capture the true effect of a ban. Given the apparent curve in the scatter plot and the desire to measure cigarette consumption in terms of a percentage change (since states have radically different levels of smoking), it makes sense to perform a logarithmic transformation on consumption. Accordingly, using data from all states instead of only those that ever have a ban, the following model regresses the log of consumption on a vector of covariates, $\boldsymbol{X}$, time, the tax rate and a ban dummy along with their interaction, with state fixed effects,

$$(2)\ \ln(Packs_{st}) = \alpha \boldsymbol{X}_{st} + \beta' t + \gamma_s + \delta Ban_{st} + \rho Ban_{st} * Tax_{st} + \phi Tax_{st} + \varepsilon_{st}$$

Since this regresses over the entire dataset, it will be easier to measure what the true effect of a ban is on consumption rates. **Table 2** shows the results, excluding the coefficients for the covariates. Since there is already an observed trend in the effectiveness of bans at lower tax rates, we can infer what might be the effect of a ban at various rates using the regression results. This is where the difference-in-differences model becomes useful. **Table 3** selects various rates (roughly up to the 90th percentile) and determines the predicted effect of the ban on consumption at different tax rates for both the with- and without-ban cases. Note that the resultant percentages estimate the *marginal* effect of the tax and the ban on cigarette consumption, so it should be no surprise that the values become more negative as rate rises. The resulting difference-in-difference is the effect of a ban at that tax rate.

Table 2: Output of ban-tax rate interaction model (2)

VARIABLES	ln(Packs per capita)
Year	-0.0196***
	(0.000608)
Tax rate	-0.351***
	(0.0146)
Any law dummy	-0.0939***
	(0.0212)
Ban*Tax rate	0.0992***
	(0.0152)
Constant	43.68***
	(1.202)
Observations	1,785
R-squared	0.915
State FE	Yes

Table 3: Approximate effect of ban at selected tax rates

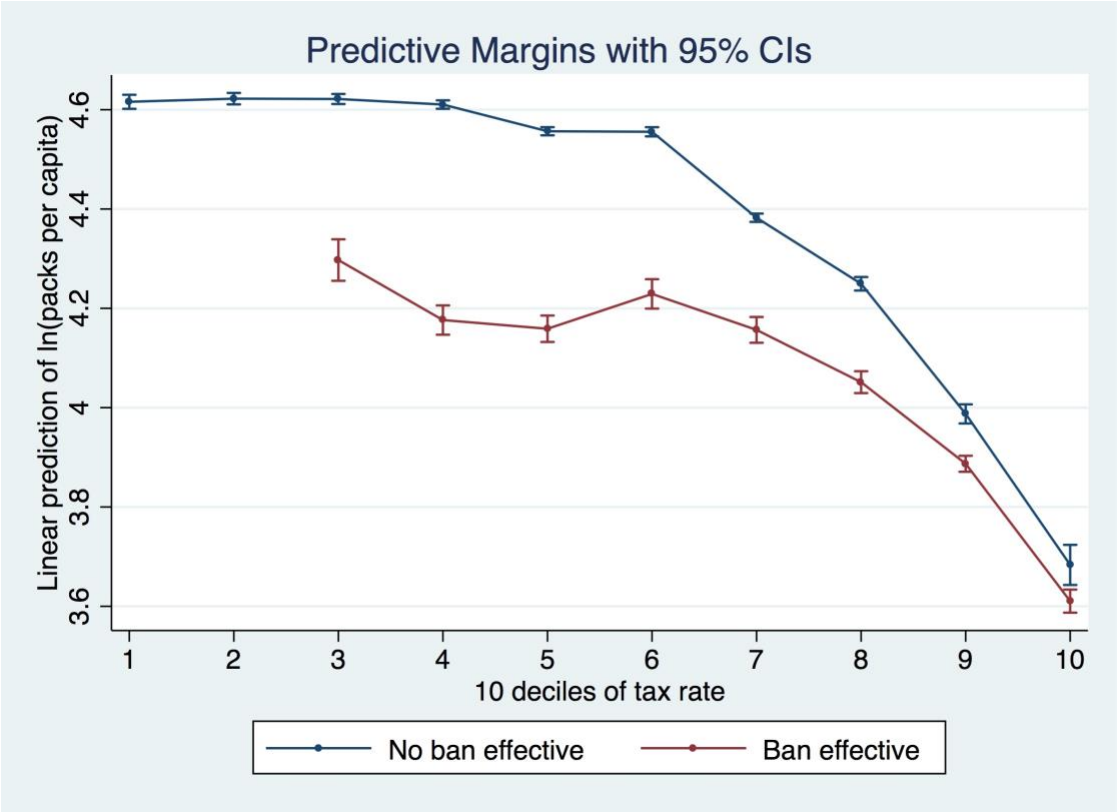
Rate ($ per pack):	0	.50	1	1.50	2
Some ban	-9.4%	-24.5	-39.5	-54.6	-69.6
No ban	0%	-17.5	-35.0	-52.5	-70.0
Difference-in-Difference	-9.4%	-7.0	-4.5	-2.1	0.04

This further supports the hypothesis that bans matter at low tax rates, albeit at a more modest effect than was previously seen. Still, **Figure 7** plots the estimated level of the log of consumption at each rate decile by ban status (the log values in this case factor in all variables in the regression, not merely the marginal effect of tax and ban like in **Table 3**). According to the model, the effect changes significantly depending on tax rate. But this variation is helpful in determining when bans are effective and when they are not.

Once again, the outliers in the post-ban case at low tax rates serve to distort the lower tax rate estimations, since there is no data for the first two deciles when a ban is in place. Still, it shows that as tax rates approach a relatively high level, bans start to become less effective. This result

confirms the hypothesis that there is an interaction between bans and tax rates and that the effectiveness of bans is ultimately a function of tax rate (among other things).

Figure 7: Estimate of ln(packs per capita) at each tax decile by ban



Finally, to establish robustness, the same analysis was applied to each locale of ban to confirm the predicted effect of bans as being more negative with lower tax rates. Below, **Table 4** shows the results. As can be seen from the chart (see appendix **Table 7**), which simply regresses consumption on covariates, time, and ban dummies, restaurant and bar bans seem to be particularly significant.

Table 4:

VARIABLES	(1) ln(packs p.c.) Restaurants	(2) ln(packs p.c.) Bars	(3) ln(packs p.c.) Non-hosp. workplaces
year	-0.0197***	-0.0201***	-0.0209***
	(0.000604)	(0.000585)	(0.000591)
Law dummy	-0.103***	-0.0981***	0.00575
	(0.0227)	(0.0272)	(0.0251)
Law dummy*Tax	0.0856***	0.0799***	0.0252*
	(0.0144)	(0.0154)	(0.0146)
Tax rate	-0.329***	-0.321***	-0.294***
	(0.0130)	(0.0126)	(0.0117)
Constant	43.89***	44.51***	46.04***
	(1.191)	(1.156)	(1.172)
Observations	1,785	1,785	1,785
R-squared	0.915	0.915	0.914
State FE	Yes	Yes	Yes

In this case, non-hospitality workplace bans are not significant. This could be for several reasons. It is likely, though, that since many workplaces explicitly prohibit smoking on the premises of worksites (apart from laws either state or local), most people who have historically smoked at work already cannot do so when a workplace ban becomes effective. In other words, the marginal smoker will require a relatively high additional tax or ban to further alter smoking behavior due to workplace restrictions. For most workers, a non-hospitality workplace ban does not meet this threshold. To better see these differences between locales, see **Figures 11-13** in the appendix.

5. Conclusion

It appears that state-level bans do have a role to play in the curbing of public smoking. The findings show that the bans are most effective in locales with low tax rates, consistent with the fact

that individuals decrease their consumption as more barriers to smoking are introduced. While this could be for a variety of reasons correlated with variables I did not include in my analysis, theory would predict that a ban, which functions like an 'infinite-level' tax, should matter more when less of a tax is already present. In other words, when a state is already highly taxed, an additional 'infinite-level' tax on smoking in particular locales is less likely to be effective. A similar result is found when testing the significance of bans by locale. Just like high taxes already impose a high cost on smoking, many already existing workplace bans place a higher cost to smoking at worksites and offices than do restaurant and bar bans that are less likely to be already regulated since such establishments have incentives to attract customers whether they smoke or not. It makes sense, then, that restaurant and bar bans would be more effective than those targeting non-hospitality workplaces.

There are, of course, limitations in taking these conclusions as definitive. Most significantly, there are serious limitations in interpreting too much from an aggregate study that fails to account for variables that almost certainly affect individuals' decisions to smoke. Among these concerns is the fact that tax receipts might not be a good proxy for the smoking rate. Furthermore, there is a possibility that the two main independent variables, tax rates and laws, are endogenous to states. While I spent time attempting to identify an appropriate instrumental variable that would only indirectly affect cigarette consumption through the direct effect on the enactment of bans, I did not find such a variable. Even so, the overall results intuitively make sense. State governments have several tools at their disposal to regulate smoking, many of which involve increasing the cost of smoking. Since bans do just that, they function much like a tax. At low tax rates, this additional cost of a ban is significant, but as tax rates rise there are fewer and fewer marginal smokers left for a government to dissuade from smoking with conventional tools.

Appendix

Figure 9: Level of Statewide Smoking Regulation in 2004

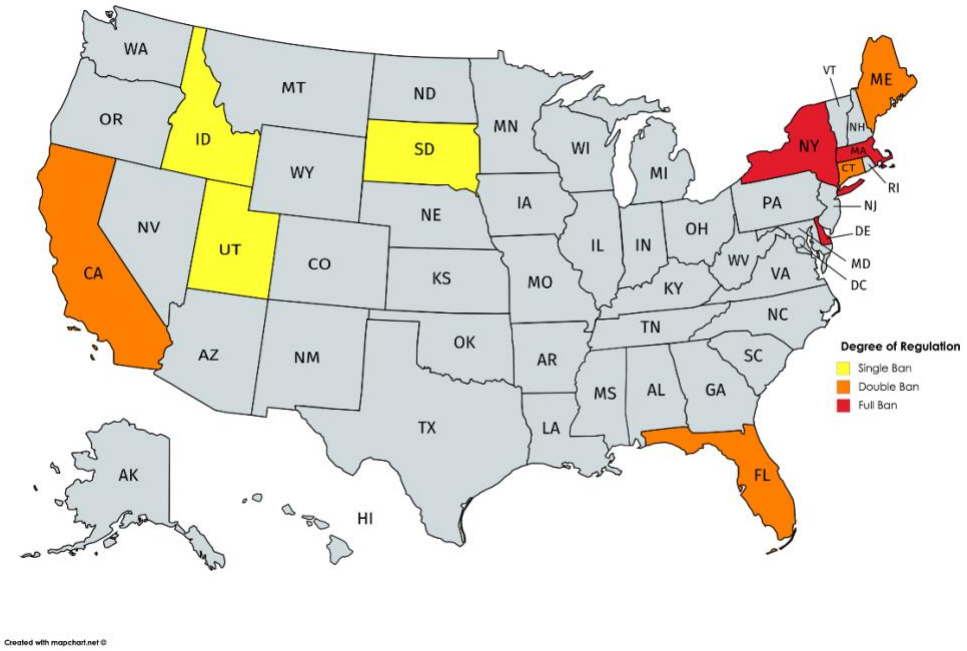
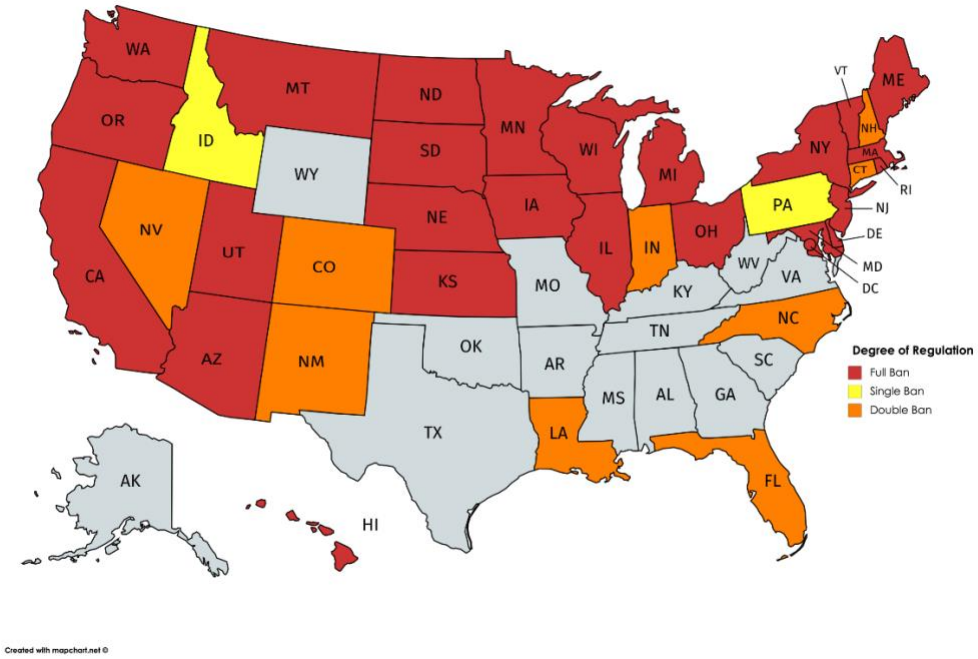
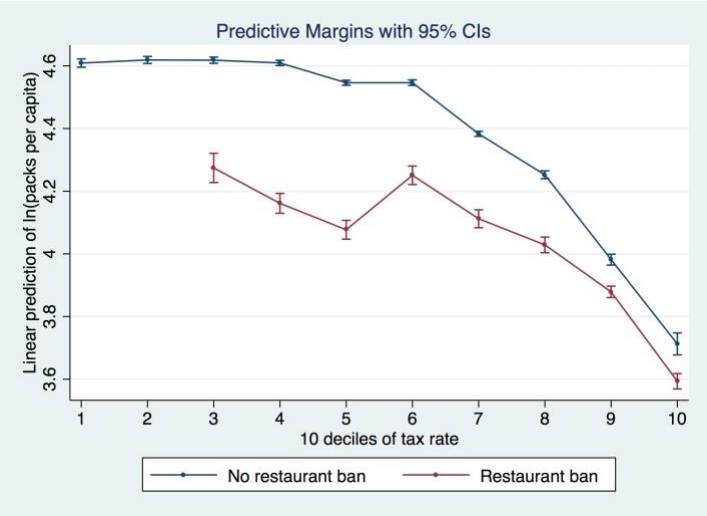
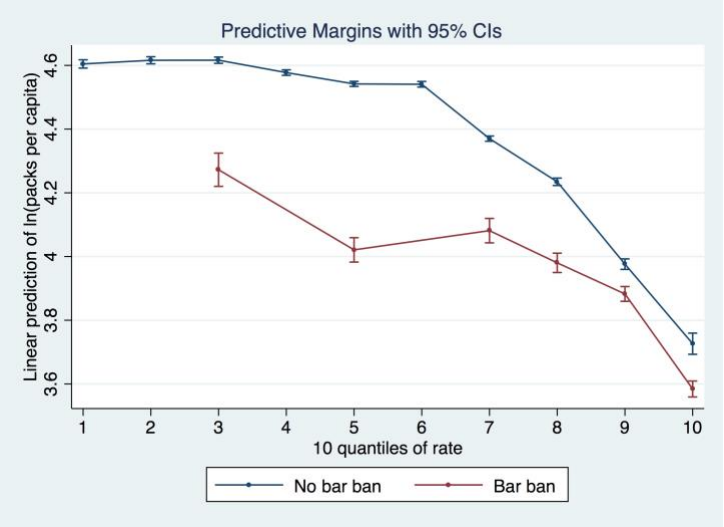


Figure 10: Level of Statewide Smoking Regulation in 2014



Figures 11-13: Log of consumption with tax interaction at each tax decile





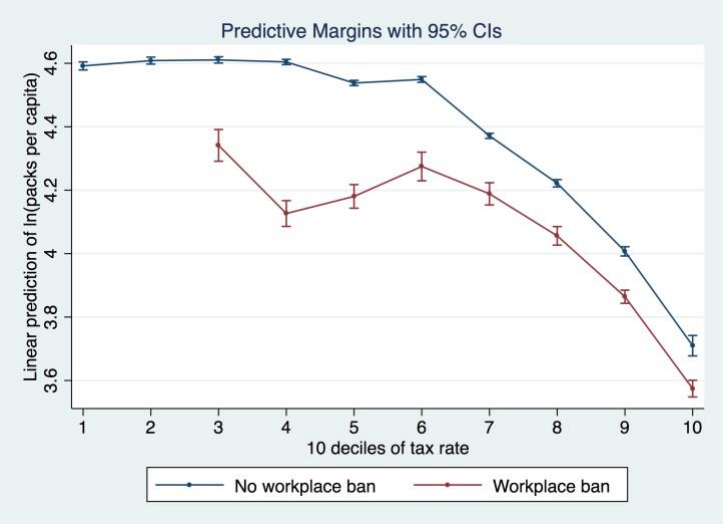


Table 5: Statewide Effective Smoking Ban by Year

STATE	SHOCK BAN	YEAR	FULL BAN	YEAR	NON-HOSPITALITY	YEAR	RESTAURANT	YEAR	BAR	YEAR
ALABAMA	0		0		0		0		0	
ALASKA	0		0		0		0		0	
ARIZONA	1	2007	1	2007	1	2007	1	2007	1	2007
ARKANSAS	0		0		0		0		0	
CALIFORNIA	0		1	2016	1	2016	1	1995	1	1998
COLORADO	0		0		0		1	2006	1	2006
CONNECTICUT	0		0		0		1	2003	1	2004
DELAWARE	1	2002	1	2002	1	2002	1	2002	1	2002
D.C.	0		1	2007	1	2006	1	2007	1	2007
FLORIDA	0		0		1	2003	1	2003	0	
GEORGIA	0		0		0		0		0	
HAWAII	1	2006	1	2006	1	2006	1	2006	1	2006
IDAHO	0		0		0		1	2004	0	
ILLINOIS	1	2008	1	2008	1	2008	1	2008	1	2008
INDIANA	0		0		1	2012	1	2012	0	
IOWA	1	2008	1	2008	1	2008	1	2008	1	2008
KANSAS	1	2010	1	2010	1	2010	1	2010	1	2010
KENTUCKY	0		0		0		0		0	
LOUISIANA	0		0		1	2007	1	2007		0
MAINE	0		1	2009	1	2009	1	2004	1	2004
MARYLAND	1	2008	1	2008	1	2008	1	2008	1	2008
MASSACHUSETTS	1	2004	1	2004	1	2004	1	2004	1	2004
MICHIGAN	1	2010	1	2010	1	2010	1	2010	1	2010
MINNESOTA	1	2007	1	2007	1	2007	1	2007	1	2007
MISSISSIPPI	0		0		0		0		0	
MISSOURI	0		0		0		0		0	
MONTANA	0		1	2009	1	2005	1	2005	1	2009
NEBRASKA	1	2009	1	2009	1	2009	1	2009	1	2009
NEVADA	0		0		1	2006	1	2006	0	
NEW HAMPSHIRE	0		0		0		1	2007	1	2007
NEW JERSEY	1	2006	1	2006	1	2006	1	2006	1	2006
NEW MEXICO	0		0		0		1	2007	1	2007
NEW YORK	1	2003	1	2003	1	2003	1	2003	1	2003

NORTH CAROLINA	0		0		0		1	2010	1	2010
NORTH DAKOTA	0		1	2012	1	2005	1	2012	1	2012
OHIO	1	2006	1	2006	1	2006	1	2006	1	2006
OKLAHOMA	0		0		0		0		0	
OREGON	1	2009	1	2009	1	2009	1	2009	1	2009
PENNSYLVANIA	0		0		1	2008	0		0	
RHODE ISLAND	1	2005	1	2005	1	2005	1	2005	1	2005
SOUTH CAROLINA	0		0		0		0		0	
SOUTH DAKOTA	0		1	2010	1	2002	1	2010	1	2010
TENNESSEE	0		0		0		0		0	
TEXAS	0		0		0		0		0	
UTAH	0		1	2009	1	2006	1	1995	1	2009
VERMONT	0		1	2009	1	2009	1	2005	1	2005
VIRGINIA	0		0		0		0		0	
WASHINGTON	1	2005	1	2005	1	2005	1	2005	1	2005
WEST VIRGINIA	0		0		0		0		0	
WISCONSIN	1	2010	1	2010	1	2010	1	2010	1	2010
WYOMING	0		0		0		0		0	

Table 6: OLS estimate for covariates

	(1)
VARIABLES	Packs per capita
GDP per capita	-162.9***
	(36.36)
LFPR	-92.95***
	(21.07)
Poverty Rate	-1.086***
	(0.206)
Constant	206.4***
	(15.62)
Observations	1,785
R-squared	0.520
Year FE	Yes

Table 7: Cigarette consumption on covariates with ban dummies

$$Packs_{st} = \alpha GDP_{st} + \beta LFPR_{st} + \gamma PovRate_{st} + \delta Year + \rho Ban + \varepsilon_{st}$$

VARIABLES	(1) Packs per capita	(2) Packs per capita	(3) Packs per capita	(4) Packs per capita	(5) Packs per capita
GDP per capita	-146.7***	-139.9***	-155.6***	-159.6***	-143.2***
	(35.41)	(35.87)	(35.98)	(35.77)	(35.38)
LFPR	-93.63***	-91.85***	-84.63***	-90.54***	-86.89***
	(19.65)	(19.79)	(19.87)	(19.92)	(19.56)
Poverty rate	-1.097***	-1.093***	-1.022***	-1.104***	-1.083***
	(0.195)	(0.196)	(0.197)	(0.198)	(0.194)
Year	-2.092***	-2.184***	-2.250***	-2.264***	-2.044***
	(0.0704)	(0.0684)	(0.0692)	(0.0658)	(0.0725)
Restaurant dummy	-14.89***				
	(1.867)				
Bar dummy		-12.63***			
		(2.019)			
Non-hospitality workplace dummy			-7.882***		
			(2.036)		
Shock dummy				-10.70***	
				(2.285)	
Any law dummy					-14.98***
					(1.792)
Constant	4,349***	4,530***	4,657***	4,691***	4,249***
	(142.5)	(138.6)	(140.4)	(133.7)	(146.7)
Observations	1,785	1,785	1,785	1,785	1,785
R-squared	0.531	0.525	0.519	0.520	0.533

Table 8: Simple linear interaction of tax rate and ban

$$Packs_{st} = \alpha COV_{st} + \beta Year + \gamma_i State_i + \delta Ban_{st} + \rho Ban_{st} * Tax_{st} + \phi Tax_{st} + \varepsilon_{st}$$

VARIABLES	(1) Packs per capita	(2) Packs per capita	(3) Packs per capita	(4) Packs per capita	(5) Packs per capita
Year	-1.924***	-2.012***	-1.954***	-1.951***	-2.006***
	(0.0546)	(0.0515)	(0.0543)	(0.0525)	(0.0528)
Tax	-22.05***	-15.70***	-19.48***	-18.85***	-16.93***
	(1.309)	(0.986)	(1.165)	(1.130)	(1.049)
Any law dummy	-5.950***				
	(1.900)				
Any*Tax	11.43***				
	(1.365)				
Shock dummy		2.015			
		(2.976)			
Shock*Tax		4.801***			
		(1.490)			
Restaurant dummy			-4.763**		
			(2.041)		
Restaurant*Tax			9.364***		
			(1.295)		
Bar dummy				-4.388*	
				(2.442)	
Bar*Tax				8.751***	
				(1.387)	
Non-hospitality workplace dummy					0.921
					(2.247)
Workplace*Tax					6.073***
					(1.302)
Constant	3,952***	4,115***	4,002***	3,997***	4,107***
	(107.8)	(102.3)	(107.0)	(103.8)	(104.7)
Observations	1,785	1,785	1,785	1,785	1,785
R-squared	0.884	0.881	0.883	0.882	0.882
State FE	Yes	Yes	Yes	Yes	Yes

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