The Impact of Tobacco-Free School Laws on Student and Staff Smoking Behavior

Rachana Bhatt
Board of Regents of the University System of Georgia
Rachana.Bhatt@usg.edu

Peter Hinrichs
Federal Reserve Bank of Cleveland
peter.hinrichs@clev.frb.org *

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Abstract: A number of U.S. states have enacted bans on tobacco use by students, staff, and visitors anywhere on the grounds of public elementary and secondary schools statewide. These laws are intended to reduce tobacco use, reduce exposure to secondhand smoke, reinforce anti-tobacco curricula taught in schools, and prevent children from viewing their teachers and fellow students using tobacco products. We examine the impact that the laws have on the smoking behavior of students, teachers, and other school staff by estimating difference-in-differences models that exploit the time variation in adoption of the laws across states. We generally find that these laws do not impact smoking behavior, although we do find some evidence suggesting a possible effect on non-teaching school staff.

Keywords: smoking, tobacco, smoke-free laws
JEL Classification: I10, I20

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1 Introduction

Reducing tobacco use is a leading goal of public health officials in the United States. Medical research has linked tobacco use to numerous adverse health consequences, including heart disease, hypertension, lung and pancreatic cancer, and low birth weight. In addition to the large medical costs of treating tobacco-related diseases, there may be a substantial loss of economic output due to tobacco-related morbidity and mortality among workers. Research has also found negative impacts of nicotine on brain development, which is particularly important for young populations (U.S. Department of Health and Human Services, 2014).

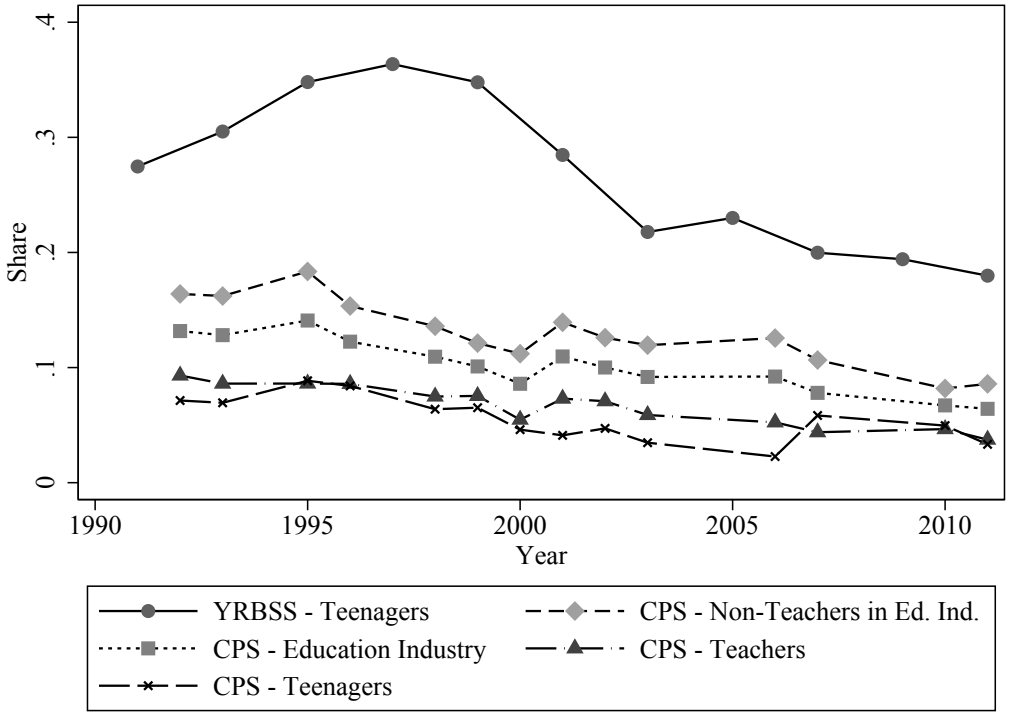
In an attempt to reduce tobacco use and exposure to secondhand smoke, numerous state and local authorities, along with individual businesses and workplaces, have implemented restrictions on smoking and other tobacco use. Examples include bans on smoking in bars, restaurants, non-hospitality workplaces, and schools.

One type of smoking ban that has not been a large focus of research up to this point is statewide bans that apply to elementary and secondary school campuses. In 1994, the federal government banned smoking inside of school buildings in all states by enacting the Pro-Children Act of 1994. However, this law does not cover outdoor areas. Some states have thus enacted tobacco bans that impose the additional restriction that individuals are not allowed to smoke outside of a school building on school premises either. By our count, 24 states, as well as the District of Columbia, enacted a law at some point between 1993 and 2011 that banned smoking on the premises of public schools.

Given their educational role and the amount of time spent there during the day, schools can be a particularly important venue for encouraging and developing healthy habits for both students and staff members. In addition to the general relationship between education and health, which is summarized by Cutler and Lleras-Muney (2008) and Cutler and Lleras-Muney (2014), there has been a growing research interest in particular school policies that may impact health.[1] School smoking bans work much like the bans in bars, restaurants, and other workplaces by limiting opportunities to smoke and observe others smoking, and it is possible that these bans could impact smoking behavior. Figure 1 illustrates smoking rates among teenagers and school staff over the time period that smoking bans were enacted, and it shows a substantial decline over this time period, particularly for young smokers. School smoking bans may be one factor that may potentially have contributed to the decline. Moreover, by some measures, youth smoking rates are still quite high. For example, in the 2011 Youth Risk Behavioral Surveillance System (YRBSS), 18.0% of teenagers

[1] Some examples include the School Breakfast Program and the National School Lunch Program (Frisvold, 2015; Hinrichs, 2010; Schanzenbach, 2009), school-based health centers (Lovenheim, Reback, and Wedenoja, 2016), and body mass index (BMI) "report cards" (Almond, Lee, and Schwartz, 2016).

Figure 1: Share Having Smoked in Past 30 Days



had smoked in the past 30 days.[2] This suggests that there is further room for smoking rates to fall and that policies that limit opportunities to smoke during the day may be effective in doing so. In addition, because most adults who smoke regularly began smoking before the age of 18 (U.S. Department of Health and Human Services, 2014, Table 13.2), a smoking ban that applies to youth can potentially affect tobacco usage into adulthood. For these reasons, an analysis examining the effects of school smoking laws may provide educational administrators and public health officials with useful information to craft policies that are effective at reducing smoking.

This research examines the impact of statewide school anti-tobacco laws on the smoking behavior of students and school staff. In doing this, we draw on data from the Youth Risk Behavioral Surveillance System (YRBSS) and the Tobacco Use Supplements to the Current Population Survey (TUS-CPS), our own coding of school anti-tobacco laws based on our reading of state legislative documents, and state-level covariates from government statistical agencies and from organizations that monitor tobacco policy. We identify the effects of the tobacco bans by utilizing their differential timing across states. We estimate a series of difference-in-differences models that include controls for individual and state-level characteristics that might be correlated with both smoking behavior

[2]The rate in the CPS is substantially lower, an issue we return to in Section 3.3.

and the implementation of school anti-tobacco laws. We generally find that these laws do not impact smoking behavior, although we do find some evidence suggesting a possible effect on non-teaching school staff.

Research examining the impact of these smoking bans has found mixed effects on smoking behavior.[3] Early work by Evans, Farrelly, and Montgomery (1999) exploiting cross-sectional variation in workplace smoking policies finds that workplace smoking restrictions in the United States are associated with less smoking. Most of the more recent work on smoking bans takes the form of difference-in-differences analyses that exploit both cross-sectional and time variation in smoking policies. For example, Anger, Kvasnicka, and Siedler (2011) find similar results to Evans, Farrelly, and Montgomery (1999) for hospitality smoking bans in Germany for people with a high propensity to go to bars and restaurants. Additionally, Carton et al. (2016) find that comprehensive statewide smoking bans in the United States reduce the prevalence of smoking, and Pfeifer, Reutter, and Strohmaier (2017) find that German school smoking bans reduce smoking along both the extensive and intensive margins. In contrast, Jones et al. (2015) find little impact of English and Scottish smoking bans on smoking prevalence and intensity, and Cotti, Nesson, and Tefft (2016) find little impact of U.S. bar smoking bans on cigarette purchases. Furthermore, Bitler, Carpenter, and Zavodny (2010) find that venue-specific smoking bans have little impact on the smoking behavior of the venues' employees.[4]

Evidence regarding whether smoking bans are effective in reducing secondhand smoke and alleviating other negative externalities is likewise mixed. On the one hand, Carpenter (2009) finds that local workplace smoking ordinances in Ontario reduced exposure to secondhand smoke for blue-collar workers; Carpenter, Postolek, and Warman (2011) find that public-place smoking bans in Canada reduced exposure to secondhand smoke in bars and restaurants; and Nguyen (2013) finds that smoke-free car laws in Canada led to less exposure to secondhand smoke inside cars for youth; and Wildman and Hollingsworth (2013) and Kuehnle and Wunder (2017) find that smoking bans improve self-reported health for nonsmokers in Great Britain and Germany, respectively. On the other hand, Adda and Cornaglia (2010) find that U.S. bar and restaurant smoking bans displace smoking toward private homes and other locations, which results in an increase in exposure to secondhand smoke for nonsmokers. And on the issue of outcomes for newborn children, Bharadwaj,

[3] In addition to studying smoking bans, economists have studied other issues related to smoking and the tobacco industry. These issues include price and income elasticities of demand, risk perceptions, the impacts of advertising, the effects of settlements between tobacco companies and U.S. states, the industrial organization of the tobacco industry, and issues related to addiction. See Chaloupka and Warner (2000) for a thorough review of earlier research related to smoking and the tobacco industry, and see DeCicca and Kenkel (2015) for a recent discussion of cigarette demand elasticities.

[4] An exception is that bar smoking bans reduce smoking by bartenders, but Bitler, Carpenter, and Zavodny (2011) find that this is a result of nonsmokers replacing smokers in the bartender workforce rather than a causal effect on the smoking behavior of individual bartenders.

Johnsen, and Loken (2014) find that Norway's bar and restaurant smoking ban improved birth outcomes for children of female bar and restaurant workers, and McGeary et al. (2017) find that comprehensive smoking bans improved birth outcomes in the United States. In contrast, Markowitz et al. (2013) find little impact of smoking bans in the United States.[5]

Research on the direct effects of smoking bans on health outcomes, which may be informative about smoking behavior as well as exposure to secondhand smoke, is also mixed. On the one hand, Adams, Cotti, and Fuhrmann (2013) find that smoking bans in the United States led to fewer fatal heart attacks, and Kvasnicka, Siedler, and Ziebarth (2018) find that smoking bans in Germany led to fewer hospital admissions related to cardiovascular diseases and asthma. On the other hand, Shetty et al. (2011) find little impact of U.S. smoking bans on mortality or hospital admissions for smoking-related conditions.[6]

The existing research most similar to our study is Bitler, Carpenter, and Zavodny (2010).[7] Although they focus primarily on bartenders, the authors also estimate the effects of school smoking bans on the smoking behavior of school workers and find little effect. Our findings are consistent, but there are several differences between our paper and theirs. First, we study impacts on students in addition to school employees. Second, we take a deeper look at the education industry, whereas Bitler, Carpenter, and Zavodny (2010) take a broad look at a variety of industries but focus primarily on bartenders. Third, we are able to use additional years of data that have been released since the Bitler, Carpenter, and Zavodny (2010) study, which is important because the effects may have changed over time. Fourth, we use a different source for our coding of smoking bans. Bitler, Carpenter, and Zavodny (2010) use ImpacTeen data, which measure school smoking policies in a state with an integer between 0 and 5 that depends on when and where smoking is allowed.[8] In our research, we draw directly from state statutes and other primary documents to create a binary indicator of whether a statewide school smoking ban is in place.[9]

The remainder of the paper is organized as follows. In Section 2, we provide background infor-

[5] Also see Lakdawala and Simon (2017) for a review of research on the impacts of smoking bans on birth outcomes.

[6] An additional line of research estimates the effects of smoking bans on happiness for smokers and non-smokers in order to test models of rational addiction or behavioral models of smoking. For example, see Odermatt and Stutzer (2015).

[7] Earlier work estimating the effects of school smoking policies as part of a broader study, albeit generally relying only on cross-sectional variation in the treatment variables, includes Chaloupka and Grossman (1996), Chaloupka and Wechsler (1997), and Wakefield et al. (2000).

[8] For example, "restrict smoking to designated areas" is coded as 1, "ban at all times when children are present (buildings and grounds)" is coded as 4, and "ban at all times (building and grounds)" is coded as 5. Bitler, Carpenter, and Zavodny (2010) enter this into their regressions as a continuous variable.

[9] There are also some differences in what we and the ImpacTeen data classify as a smoking ban. For example, several states have laws that do not directly ban smoking on school premises but do require schools to enact policies that ban smoking on school premises. The ImpacTeen data do not consider these cases to be a ban, even for the ImpacTeen variable measuring smoking restrictions at public schools. In contrast, we do code these cases as having a smoking ban in place.

mation on tobacco bans at schools. Section 3 describes the data, and Section 4 details our estimation strategy. In Section 5 we present the main regression results. Section 6 discusses compliance with statewide school smoking bans, and Section 7 concludes.

2 Background Information

The Pro-Children Act of 1994 prohibits smoking in all educational facilities that receive federal funding from the Department of Education, the Department of Agriculture (the administrator of the National School Lunch Program and the School Breakfast Program), or the Department of Health and Human Services. As a consequence, indoor smoking became illegal in primary and secondary schools throughout the United States on December 26, 1994. However, the Pro-Children Act does not restrict tobacco use outside of a school building on school grounds. For instance, schools might still tolerate smoking by school staff, visitors, and students who have reached the minimum state smoking age in parking lots and other outdoor areas. This smoking might occur during school hours, immediately before or after school, at school events such as football games, or at times when community members are using school facilities and school grounds.

Over the past several decades a number of states have passed school anti-tobacco laws that are stricter than the 1994 federal law. Most of these are "24/7 Tobacco-Free School" laws that prohibit students, staff, and visitors from using any tobacco product anywhere on a school's premises at any time for any reason. The typical state tobacco-free school law bans the use of all tobacco products on the grounds of public schools, but there is some variation. For example, some state laws also cover private schools, explicitly mention only smoking and remain silent about other forms of tobacco use (such as chewing tobacco), or regulate possession in addition to use of tobacco products. The typical penalty for violation listed in the state statutes is a small fine, although there is some variation. For example, New York's law specifically mentions the possibility of school employees being dismissed or suspended without pay for violating the law. Finally, some states have anti-tobacco laws that are less strict than 24/7 Tobacco-Free School laws in that they only apply to certain people (e.g., students), during certain times of the day (e.g., during school hours), or in certain areas (e.g., within 25 feet of a school building). In our main analysis we focus on the 24/7 laws, but we also provide results that consider the effects of these less stringent bans.

Tobacco-free school laws have several rationales. First, by making it more difficult to smoke during certain hours of the day, they may directly reduce smoking by students and staff. As we will show later, close to 10% of students in our YRBSS sample report having smoked at school in the past month. To the extent that students, faculty, and other school staff smoke during their arrival to school, departure from school, or breaks throughout the day, school anti-smoking laws

may have non-negligible impacts on tobacco consumption. Second, the laws may reduce exposure to secondhand smoke. According to survey data from the 2013 National Youth Tobacco Survey (NYTS), close to 31% of students in grades 9-12 reported that they breathed tobacco smoke on school grounds in the past week.[10] A school smoking ban should, in theory, eliminate this. Third, the bans may "teach by example," thereby reinforcing any anti-tobacco messages that are part of a school's curriculum. Fourth, the tobacco bans may make it less likely that students (as well as staff and visitors) will see others smoking and using other tobacco products, which can have an impact on smoking behavior if peer effects or role model effects play a role in the decision to use tobacco.[11] Data from the 1993 Teenage Attitudes and Practices Survey (TAPS), a survey conducted toward the beginning of the time period we study, indicate that 62% of respondents aged 15-18 reported seeing at least a few of their teachers smoke. Moreover, nearly 54% of the students in grades 9-12 surveyed in the 2013 National Youth Tobacco Survey admit that at least one of their closest friends uses tobacco products, suggesting that exposure to tobacco users is quite extensive.

3 Data

3.1 Tobacco-Free School Laws

Our coding of the timing of tobacco-free school laws is based on Lexis-Nexis searches of state legislative documents and, in some instances, direct contact with state public health administrators.[12] Figure 2 shows the number of states that have 24/7 tobacco bans in effect for each year between 1990 and 2011. By our count, four states adopted school smoking bans even before the 1994 Pro-Children Act, while twenty states and the District of Columbia have done so since.

As discussed earlier, there are several states that have adopted school anti-tobacco laws that allow for some exceptions. For instance, some states have tobacco bans that apply only to pupils, some states prohibit smoking during school hours but not at other times of the day, and some states prohibit smoking within some specified distance of school buildings but leave open the possibility that smoking may occur beyond this distance. In our main regression specification we consider a state to have a school smoking ban if it prohibits smoking by anyone on all school grounds at any time other than for educational purposes.[13] We then examine how robust the results are to alternative definitions of school smoking bans.

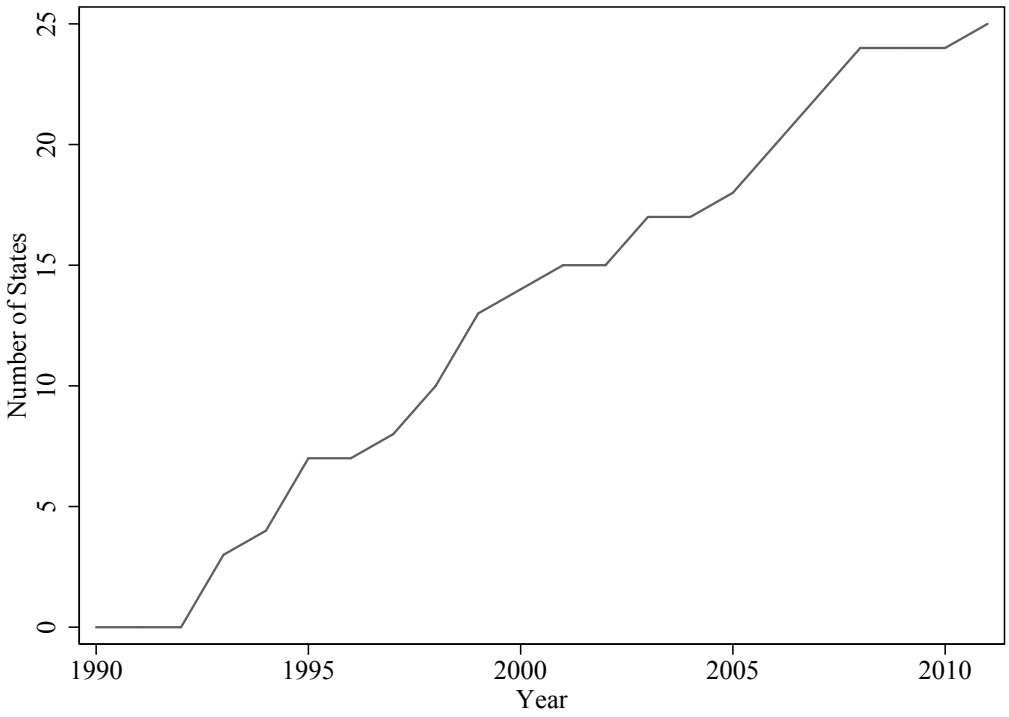
[10] We use sample weights throughout the paper when reporting descriptive statistics.

[11] Hsieh and van Kippersluis (2018) thoroughly review research on peer effects in smoking and conclude, "Our reading of the literature is that peer effects in smoking seem well-established irrespective of the used methodology." Also see recent work on peer effects by Card and Giuliano (2013).

[12] Other documents, such as various editions of the American Lung Association's *State Legislated Actions on Tobacco Issues*, helped guide our search.

[13] Only a small number of states allow exceptions for educational purposes.

Figure 2: Adoption of 24/7 Tobacco-Free Laws by State



3.2 Youth Risk Behavioral Surveillance System (YRBSS)

We use data from the Youth Risk Behavioral Surveillance System (YRBSS) to examine impacts on youth smoking. YRBSS is a cross-sectional survey that has been conducted every odd year, beginning in 1991, by the Centers for Disease Control and Prevention. YRBSS surveys high school students from schools throughout the United States regarding their tobacco, alcohol, and drug use. We also have access to information on demographic characteristics and state of residence.[14] We pool data from the national YRBSS for 1991-2011 for our analysis. YRBSS includes students in grades 9-12, and we limit the sample to those who are at least 14 years old.[15]

Students are asked various questions about their smoking behavior, including whether or not they had ever tried a cigarette; the number of days out of the past 30 days that they smoked a cigarette; and, beginning in 1993, the number of days out of the past 30 days that they smoked a cigarette on school property.[16] We use the responses to these questions to construct several variables that measure smoking behavior. The variables we focus on are indicators for (1) whether the respondent has ever smoked, (2) whether the respondent has smoked on at least one day of the past 30 days, (3) whether the respondent has smoked on three or more days out of the past 30 days, (4) whether the respondent has smoked at school on at least one day of the past 30 days, and (5) whether the respondent has smoked at school on three or more days in the past 30 days. In additional analyses, we also consider the effect of anti-tobacco laws on other parts of the distribution of days smoked and days smoked at school (e.g., smoking on 20 or more days out of the past 30).

Table 1 displays summary statistics for the YRBSS data. Close to 61% of respondents report having tried a cigarette, and nearly 27% have smoked within the past 30 days. Moreover, as mentioned earlier, about 10% have smoked at school within the past 30 days.

The YRBSS data do not include information on which month of the year each student is surveyed, although we do know that the survey is generally conducted in the spring. Our main coding of the treatment variable in the YRBSS regressions considers a smoking ban to exist in a given state and year if a statewide smoking ban is in effect on the first day of the year.[17] This categorization will be subject to misclassification, however, for students that are surveyed in the year their state passed a ban but at a time of the year after the ban went into effect. For instance, if a ban went into effect

[14] State of residence was obtained from the restricted-use version of the YRBSS, which is available from the Centers for Disease Control and Prevention upon request.

[15] There are a small number of students in the YRBSS data whose age is listed as 12 or 13. We drop these children, who comprise less than 0.5% of the YRBSS sample, from our analysis because their enrollment in grades 9-12 at such young ages suggests they are somewhat anomalous. Alternatively, these responses might indicate incorrect reporting. We also drop the small number of students whose age is missing.

[16] Answers to the questions about the number of days the respondent smoked in the past month are reported in the following categories: 0, 1-2, 3-5, 6-9, 10-19, 20-29, 30.

[17] We do not observe any cases in the data of a state implementing and later reversing a smoking ban.

Table 1: Descriptive Statistics for YRBSS

Variable	Mean (SD)
Individual-Level Smoking Outcomes	
Has Ever Smoked	0.61
Smoked in Past 30 Days	0.27
Smoked 3+ Days of Past 30 Days	0.20
Smoked at School in Past 30 Days	0.10
Smoked 3+ Days at School in Past 30 Days	0.06
State-Level School Smoking Bans	
School Smoking Ban	0.21
School Smoking Ban, Distance Exemptions Treated as Ban	0.25
School Smoking Bans, Staff/Visitor Exemptions Treated as Ban	0.49
School Smoking Ban, Hours Exemptions Treated as Ban	0.27
Individual-Level Covariates	
Age 14	0.11
Age 15	0.24
Age 16	0.26
Age 17	0.25
Age 18+	0.14
Female	0.49
Male	0.51
Gender Missing	0.00
White	0.63
Black	0.14
Hispanic	0.13
Asian	0.04
Native American	0.01
Other Race/Multiracial	0.05
Race Missing	0.01
State-Level Covariates	
Non-Hospitality Smoking Ban	0.14
Restaurant Smoking Ban	0.22
Bar Smoking Ban	0.18
Cigarette Tax (2013 $/Pack)	0.84
	(0.69)
State Median HH Income (2013 $1000s)	53.72
	(6.70)
Unemployment Rate	6.19
	(2.08)
N	158,841

Notes: The table presents means calculated using sample weights. Weighted standard deviations for non-binary variables are shown in parentheses.

in March 1995, our classification would not treat students being interviewed in April 1995 as being exposed to a ban that year. We examine the sensitivity of our results to this issue by considering an alternative classification of bans that includes cases in which the ban went into effect in the first six months of the year. This alternative definition, however, will classify some students as being exposed to a smoking ban slightly before the ban actually went into effect.[18]

3.3 Tobacco Use Supplements to the Current Population Survey (TUS-CPS)

We use the Tobacco Use Supplements to the Current Population Survey (TUS-CPS) to examine how school smoking bans affect teens as well as school staff. The Current Population Survey (CPS) is a monthly survey of households that collects information on demographic and economic characteristics of individuals from throughout the United States. The CPS is often supplemented with an additional survey that consists of a variety of questions on a common theme. One such supplement is the supplement on tobacco use. This supplement has been given often, but on an irregular basis, between 1992 and 2011.[19] This supplement consists of questions on smoking behavior and other tobacco use that are asked of individuals aged 15 and above and, beginning in 2007, only to those aged 18 and above. We pool data across all the different waves of the TUS-CPS, although we exclude the January and May 2000 TUS-CPS due to the limited range of questions on the survey in that year. We use the state identifiers in the CPS to link individuals to tobacco policies in place in the relevant state. Individuals who are part of the TUS-CPS are also asked the core CPS demographic and employment questions, which makes it possible to study the smoking behavior of individuals from specific occupations or industries.

Information about tobacco use is gathered through a series of questions in the TUS-CPS. Individuals are first asked whether or not they have smoked at least 100 cigarettes in their lifetime. If the answer is no, no further questions on smoking are asked. If the answer is yes, individuals are asked whether they currently smoke every day, some days, or not at all. Those who smoke every day are asked further questions such as how many cigarettes they smoke per day, and those who

[18] In addition, our event study estimates may be useful here. For example, suppose that the laws result in just a "level shift." In other words, suppose that they have an immediate impact on an outcome and that this impact does not change based on how long the law has been in effect. In this situation, we might actually expect to see an effect, albeit a muted one, in year -1 with our main coding of the smoking variable because some (but not all) students actually are subject to a smoking ban in year -1 due to misclassification. In our alternative coding of the smoking variable, we might expected a muted effect in year 0, followed by a larger effect in year 1, because not all of the individuals coding as being subject to a ban in year 0 truly are subject to a ban in year 0. It is also worth noting that some of the bans occur in even-numbered years, and in these cases we can be more confident of our coding because the YRBSS data are from only odd-numbered years.

[19] Specifically, the tobacco supplement was included in the CPS in September 1992, January 1993, May 1993, September 1995, January 1996, May 1996, September 1998, January 1999, May 1999, January 2000, May 2000, June 2001, November 2001, February 2002, February 2003, June 2003, November 2003, May 2006, August 2006, January 2007, May 2010, August 2010, and January 2011.

report smoking some days are asked the number of days out of the past 30 days that they smoked and how many cigarettes they typically smoke on the days that they do smoke. However, in the case of proxy response, in which one household member answers on behalf of another, questions on cigarettes smoked per day and the number of days out of 30 the individual smoked are not asked.

We again use individuals' responses to construct a series of binary indicators detailing smoking behavior. The variables we focus on are indicators for (1) whether the respondent has smoked at least 100 cigarettes in his/her lifetime, (2) whether the respondent has smoked on at least one of the past 30 days, (3) whether the respondent has smoked on at least three of the past 30 days, and (4) whether the respondent smokes at least one pack of cigarettes (20 cigarettes) per day.[20] In further analysis, we consider other parts of the distribution of days smoked and cigarettes smoked per day. It is worth mentioning that our measure of cigarettes smoked per day does not condition on being a smoker. Thus, the variable takes on a value of zero for a sizable share of respondents.

In order to identify which individuals are high school students and which are employed by elementary and secondary schools, we use information collected in the CPS on age, school enrollment, and industry of employment. We classify an individual as a high school student if he/she is (a) 15 years old or (b) 16-18 years old and reports being enrolled in high school.[21] However, we exclude the small number of individuals who meet one of these criteria but are coded in a separate CPS question as having educational attainment beyond high school. We classify an individual as working in the education industry if the individual is aged 22-65 and reports "elementary and secondary schools" as the primary industry of employment. Additionally, we use information on primary occupation for those in the education industry to allow for differential effects between teachers and other school staff.[22]

Table 2 presents descriptive statistics for the CPS sample. Youth smoking rates in the CPS are much lower than those in the YRBSS and other sources, a disparity that may be attributable to differences in question wording or to differences in interview procedure. For instance, because of the 100 cigarette threshold in the TUS-CPS, we may be classifying some youth who have smoked as non-smokers simply because they have not yet smoked 100 cigarettes in their lifetime. Another possibility is that proxy respondents may report incorrectly or youth may not report truthfully in the TUS-CPS if they are questioned in the presence of a parent. Whatever the reason, it should be noted that the TUS-CPS data have been used for youth in earlier work, such as Harris and López-Valcárcel (2008), despite this caveat. However, caution should be exercised when interpreting the results for youth smoking from the CPS.

[20] We code the other variables as a zero if the answer to the question about having smoked 100 cigarettes is "no."

[21] The school enrollment questions are only asked of those who are between the age of 16 and 24.

[22] Some examples in the data of occupations in the education industry other than teaching are administrators, counselors, secretaries, cooks, janitors, and bus drivers.

Table 2: Descriptive Statistics for CPS

Variable	Youth Mean (SD)	Education Industry Mean (SD)	Teachers Mean (SD)	Non-Teach. in Ed. Ind. Mean (SD)
Individual-Level Smoking Outcomes				
Smoked 100 Cigarettes in Lifetime	0.08	0.28	0.23	0.32
Smoked in Past 30 Days	0.05	0.10	0.07	0.13
Smoked 3+ Days of Past 30 Days	0.05	0.10	0.06	0.13
Smokes at Least Pack/Day	0.01	0.03	0.02	0.04
State-Level School Smoking Bans				
School Smoking Ban	0.17	0.21	0.21	0.21
School Smoking Ban, Distance Exemptions Treated as Ban	0.21	0.25	0.25	0.25
School Smoking Bans, Staff/Visitor Exemptions Treated as Ban	0.50	0.52	0.52	0.53
School Smoking Ban, Hours Exemptions Treated as Ban	0.27	0.30	0.30	0.31
Individual-Level Covariates				
Age 15	0.30	0.00	0.00	0.00
Age 16	0.29	0.00	0.00	0.00
Age 17	0.26	0.00	0.00	0.00
Age 18	0.14	0.00	0.00	0.00
Female	0.48	0.76	0.73	0.78
Family Income < 20K	0.18	0.07	0.03	0.10
Family Income 20-35K	0.18	0.13	0.10	0.16
Family Income 35-50K	0.15	0.16	0.15	0.16
Family Income 50-75K	0.18	0.25	0.28	0.23
Family Income 75K+	0.22	0.32	0.39	0.27
Family Income Missing	0.09	0.07	0.06	0.07
Less than High School Graduate	1.00	0.03	0.00	0.06
High School Graduate	0.00	0.31	0.00	0.53
College Graduate	0.00	0.66	1.00	0.41
White	0.65	0.78	0.84	0.73
Black	0.16	0.11	0.09	0.13
Hispanic	0.14	0.08	0.05	0.10
Asian	0.04	0.02	0.02	0.02
Native American	0.01	0.01	0.00	0.01
Other Race/Multiracial	0.01	0.00	0.00	0.00
State-Level Covariates				
Non-Hospitality Smoking Ban	0.05	0.13	0.13	0.13
Restaurant Smoking Ban	0.15	0.23	0.23	0.23
Bar Smoking Ban	0.12	0.20	0.19	0.20
Cigarette Tax (2013 $/Pack)	0.72	0.87	0.87	0.87
	(0.52)	(0.72)	(0.73)	(0.72)
State Median HH Income (2013 $1000s)	54.94	54.83	54.81	54.91
	(7.47)	(7.48)	(7.50)	(7.43)
Unemployment Rate	5.53	6.01	6.01	6.01
	(1.48)	(2.01)	(2.00)	(2.02)
N	79,025	65,280	28,833	34,665

Notes: The table presents means calculated using sample weights. Weighted standard deviations for non-binary variables are shown in parentheses.

Furthermore, 16.7% of the TUS-CPS youth sample is exposed to a school smoking ban, whereas 20.5%-20.7% of the other samples is. This disparity is attributable to the fact that the TUS-CPS youth sample disproportionately appears earlier in the sample period due to the minimum age for the TUS-CPS questionnaire changing to 18 in 2007. As an additional note about the data, the percentage of the sample exposed to a ban is higher when exceptions are allowed under the definition of the ban. This is especially true when we include bans that restrict smoking for pupils but not staff or visitors.

We use information on age, gender, family income, educational attainment, and race/ethnicity as control variables. The race question and Hispanic ethnicity question are separate questions in the CPS, which we combine to create a set of mutually exclusive race/ethnicity categories that include Hispanics as well as different categories for non-Hispanic members of the different racial groups.[23]

For the TUS-CPS regressions, we base our coding of the smoking ban variable on whether there was a ban in place in the relevant state on the first day of the month of the survey. Thus, this is defined somewhat differently than in the YRBSS regressions due to the nature of the two data sets.

3.4 State-Level Control Variables

We merge additional information on state tobacco policies and other state-level data to both the YRBSS and TUS-CPS data for use as control variables in our regressions. Our set of tobacco control policies allows us to control for other policies that may be related to both smoking behavior and school smoking bans. This includes three variables collected from the American Nonsmokers' Rights Foundation (2015) that indicate whether there are statewide smoking bans that apply to restaurants, bars, and non-hospitality workplaces, respectively. We also use information on state cigarette taxes from Orzechowski and Walker (2014), which we convert to 2013 dollars per pack using the CPI-U for the relevant month for the CPS data and first month of the relevant year for the YRBSS data.[24] As with the school smoking bans variable, we code all of these variables based on policies in place on the first day of the year for the YRBSS regressions and the first day of the month for the CPS regressions. Finally, we use state median annual household income (in 2013 dollars) from the U.S. Census Bureau and the state unemployment rate from the Bureau of Labor Statistics as a way of controlling for state-level economic conditions.

The bottom parts of Tables 1 and 2 show the mean values for these variables in each of our

[23]There are a small number of people that have missing data on the Hispanic question in the CPS in 1992 and 1993. We treat these cases as being non-Hispanic and belonging to whichever race they are a part of.

[24]We use data on cigarette taxes rather than data on prices. Adda and Cornaglia (2006, 2013) and Gruber and Frakes (2006) argue that taxes are a more exogenous measure of costs for customers than prices are. Furthermore, Harding, Leibtag, and Lovenheim (2012) find that a large share, but not all, of cigarette taxes are passed on to consumers.

samples, as well as the standard deviations for non-binary variables. Even when we confine attention our baseline definition of 24/7 smoking bans that apply to everyone, the share of each sample exposed to a statewide school smoking ban is comparable to the share of the sample exposed to a statewide restaurant smoking ban, which is higher than the share exposed to a statewide bar smoking ban, which is in turn higher than the share exposed to a statewide non-hospitality workplace smoking ban.

4 Empirical Framework

We examine the effects of the school smoking bans by estimating difference-in-differences models. These models exploit variation in the timing of adoption of the bans by states across time. Specifically, we estimate models of the following form:

$$Y_{ist} = \alpha_0 Ban_{st} + \alpha_1 X_{ist} + \alpha_2 Z_{st} + \delta_t + \theta_s + \gamma_s t + \epsilon_{ist}. \quad (1)$$

Here Y_{ist} denotes a smoking outcome for individual i living in state s and observed in survey year t. Ban_{st} is our treatment variable of interest.[25] X_{ist} is a vector of individual-level controls, and Z_{st} is a vector of state-level controls. The model includes full sets of year dummies, state dummies, and state-specific linear time trends, and the error term is ϵ_{ist}. We estimate these linear probability models by ordinary least squares. Finally, the standard errors allow for clustering at the state level.

Loosely, our estimates of α_0 are obtained by studying breaks from trends when smoking bans go into effect. The identifying assumption for difference-in-differences models that include covariates and state-specific linear time trends is that treated and control units would follow a common trend in the absence of the treatment, after conditioning on the covariates and time trends. The inclusion of covariates and state-specific time trends makes it more plausible that we are estimating the causal effects of statewide school smoking bans. However, sources of bias may remain. The identifying assumption would be violated if there are omitted factors that are correlated with school smoking bans and are causing breaks in trends of smoking behavior.

Although the identifying assumption is not directly verifiable, we provide several pieces of evidence suggesting its plausibility. First, we will later show results of regressions that replace the "ban" indicator with a set of dummies for the number of years before and the number of years after a ban goes into effect. If there is evidence of differential pre-existing trends across states with and without bans prior to when they were actually enacted, this casts doubt on whether any measured

[25] With the TUS-CPS regressions, we actually code certain variables by month. However, we suppress month subscripts from the displayed equation.

effect of the bans (after they were put into place) is actually causal. Second, in Table 3 we show the results from regressing the treatment dummy on all the covariates in our three main samples, including the year effects and the state-specific time trends, in order to study which characteristics are associated with school smoking bans. If the treatment variable were truly randomly assigned, we would generally expect to see coefficients that are close to 0 and are statistically insignificant except for type I errors. In the non-experimental setting here we would not necessarily expect to see estimates that are close to 0 and statistically insignificant, but for variables for which this is not true it points to the potential importance of controlling for those variables. The different columns include different variables on the right-hand side due to the availability of different variables in the different data sets, and thus we should not expect the results to be identical across columns due to the slightly different models estimated in the three columns. Indeed the coefficient estimates differ slightly across columns. But as the results show, the variables in the regression generally appear to be unrelated to school tobacco bans.

Table 3: Correlates of Smoking Bans

Variable	YRBSS Youth	CPS Youth	CPS Education Industry
Age 15	−0.0011		
	(0.0019)		
Age 16	−0.0001	0.0011	
	(0.0019)	(0.0011)	
Age 17	−0.0004	0.0006	
	(0.0022)	(0.0012)	
Age 18+	0.0022		
	(0.0028)		
Age 18		−0.0001	
		(0.0018)	
Female	0.0013	0.0009	0.0023**
	(0.0013)	(0.0011)	(0.0011)
Gender Missing	0.0047		
	(0.0063)		
Family Income 20-35K		−0.0016	−0.0031
		(0.0022)	(0.0034)
Family Income 35-50K		−0.0015	−0.0009
		(0.0028)	(0.0026)
Family Income 50-75K		0.0002	−0.0022

		(0.0022)	(0.0038)
Family Income 75K+		−0.0015	−0.0020
		(0.0020)	(0.0036)
Family Income Missing		−0.0034	−0.0048
		(0.0029)	(0.0050)
High School Graduate			0.0021
			(0.0049)
College Graduate			0.0030
			(0.0043)
Black	0.0008	−0.0006	−0.0023
	(0.0056)	(0.0024)	(0.0023)
Hispanic	0.0202	−0.0002	0.0004
	(0.0141)	(0.0024)	(0.0029)
Asian	−0.0058	0.0030	0.0109*
	(0.0059)	(0.0050)	(0.0055)
Native American	−0.0006	−0.0021	−0.0072
	(0.0075)	(0.0048)	(0.0079)
Other Race/Multiracial	0.0000	−0.0149	0.0147
	(0.0052)	(0.0153)	(0.0088)
Race Missing	−0.0070		
	(0.0063)		
Non-Hospitality Smoking Ban	−0.0262	0.1754	0.1693
	(0.2409)	(0.1553)	(0.1383)
Restaurant Smoking Ban	0.1625	0.2916	0.3301*
	(0.2883)	(0.2227)	(0.1704)
Bar Smoking Ban	−0.1003	−0.2033	−0.3136*
	(0.2746)	(0.2499)	(0.1835)
Cigarette Tax (2013 $/Pack)	0.0062	−0.0044	0.0095
	(0.0586)	(0.0508)	(0.0407)
State Median HH Income (2013 $1000s)	0.0084	−0.0033	−0.0012
	(0.0090)	(0.0070)	(0.0065)
Unemployment Rate	−0.0033	−0.0004	−0.0019
	(0.0156)	(0.0228)	(0.0182)
N	158,841	79,025	65,280

Notes: Standard errors that allow for clustering at the state level are shown in parentheses. A single asterisk denotes statistical significance at the 10% level, a double asterisk denotes statistical significance at the 5% level, and a triple asterisk denotes statistical significance at the 1% level. All models include full sets of year dummies, state dummies, and state-specific linear time trends. The regression reported in the column contains a full set of age dummies.

5 Results

5.1 YRBSS Results

Table 4 shows results for the frequency of youth smoking using data from YRBSS. All regressions include a full set of year dummies, a full set of state dummies, a full set of state-specific linear time trends, and individual- and state-level controls. We find no significant effect of the tobacco bans for the outcomes we consider in Table 4. In fact, most of the point estimates are positive. The estimates are also generally small in magnitude, especially the estimates related to smoking at school. This suggests that the tobacco bans are of limited economic significance for these outcomes. For example, Table 1 suggests that approximately 9.7% of the sample has smoked at school in the past 30 days, and the results in Table 4 suggest that youth subject to a school smoking ban are a statistically insignificant 0.148 percentage points more likely to smoke at school than those who are not subject to such a ban. The minimal impact we find in Table 4 is also supported by Figures 3 and 4, which show the point estimates and confidence intervals associated with the bans when we replace the dependent variable with other parts of the distribution of days smoked and days smoked at school.

In contrast to the school tobacco ban variable, though, many of the covariates in Table 4 are statistically significant and practically meaningful. For example, older students are more likely to smoke than younger students. Females are over 3 1/2 percentage points less likely to have smoked in the past 30 days than males. Black students and Asian students are less likely to smoke than the omitted category of white students, whereas Native Americans are more likely to smoke than white students. The results for Hispanics depend on the outcome considered but generally suggest that Hispanics smoke less than whites. The state-level control variables are generally insignificant, although in some specifications household income and the unemployment rate have a statistically significant relationship with smoking.

Figure 5 shows results from regressions that replace the "ban" indicator with a set of indicators for the number of years before or after a tobacco ban is in effect. For states that do not have a tobacco ban, all these variables take on the value of 0. These specifications allow for the effects of

Table 4: Effects of School Smoking Bans on Youth Smoking in YRBSS Data

Variable	Has Ever Smoked	Smoked 1+ Days of Past 30 Days	Smoked 3+ Days of Past 30 Days	Smoked at School in Past 30 Days	Smoked 3+ Days at School in Past 30 Days
School Smoking Ban	0.0133	0.0148	0.0187	0.0015	−0.0028
	(0.0116)	(0.0165)	(0.0117)	(0.0095)	(0.0059)
Age 15	0.0721***	0.0391***	0.0320***	0.0144***	0.0093***
	(0.0040)	(0.0031)	(0.0037)	(0.0031)	(0.0026)
Age 16	0.1190***	0.0743***	0.0656***	0.0246***	0.0202***
	(0.0054)	(0.0035)	(0.0038)	(0.0038)	(0.0033)
Age 17	0.1545***	0.0982***	0.0926***	0.0312***	0.0287***
	(0.0052)	(0.0041)	(0.0040)	(0.0046)	(0.0043)
Age 18+	0.1774***	0.1269***	0.1181***	0.0395***	0.0338***
	(0.0062)	(0.0051)	(0.0067)	(0.0066)	(0.0054)
Female	−0.0347***	−0.0356***	−0.0347***	−0.0285***	−0.0240***
	(0.0094)	(0.0100)	(0.0081)	(0.0027)	(0.0023)
Gender Missing	0.0344	0.0786***	0.0652**	0.0378**	0.0271
	(0.0286)	(0.0269)	(0.0261)	(0.0179)	(0.0194)
Black	−0.0513***	−0.1837***	−0.1686***	−0.0700***	−0.0522***
	(0.0137)	(0.0096)	(0.0097)	(0.0048)	(0.0038)
Hispanic	0.0426***	−0.0496***	−0.0643***	−0.0212***	−0.0222***
	(0.0126)	(0.0089)	(0.0066)	(0.0028)	(0.0028)
Asian	−0.1134***	−0.1146***	−0.0969***	−0.0313***	−0.0219***
	(0.0095)	(0.0066)	(0.0071)	(0.0051)	(0.0038)
Native American	0.1259***	0.0647***	0.0320***	0.0392***	0.0242***
	(0.0204)	(0.0204)	(0.0116)	(0.0091)	(0.0087)
Other Race/Multiracial	0.0197**	−0.0387***	−0.0368***	−0.0009	−0.0019
	(0.0092)	(0.0120)	(0.0117)	(0.0064)	(0.0049)
Race Missing	−0.0016	−0.0595***	−0.0565***	−0.0090	−0.0005
	(0.0145)	(0.0097)	(0.0085)	(0.0085)	(0.0071)
Non-Hospitality Smoking Ban	0.0266	−0.0001	−0.0031	−0.0014	0.0019
	(0.0202)	(0.0247)	(0.0246)	(0.0181)	(0.0131)
Restaurant Smoking Ban	−0.0111	0.0036	−0.0017	−0.0125	−0.0132
	(0.0273)	(0.0363)	(0.0285)	(0.0175)	(0.0117)
Bar Smoking Ban	−0.0215	−0.0254	−0.0256	0.0011	0.0044
	(0.0236)	(0.0320)	(0.0222)	(0.0082)	(0.0062)
Cigarette Tax (2013 $/Pack)	0.0012	−0.0017	−0.0035	0.0017	0.0002
	(0.0174)	(0.0119)	(0.0097)	(0.0042)	(0.0033)
State Median HH Income (2013 $1000s)	0.0018	0.0014	0.0011	0.0019**	0.0018**
	(0.0016)	(0.0011)	(0.0010)	(0.0009)	(0.0008)
Unemployment Rate	0.0025	0.0067	0.0065	0.0049*	0.0038*
	(0.0068)	(0.0046)	(0.0040)	(0.0029)	(0.0020)
N	152,703	151,544	151,544	142,446	142,446

Notes: Standard errors that allow for clustering at the state level are shown in parentheses. A single asterisk denotes statistical significance at the 10% level, a double asterisk denotes statistical significance at the 5% level, and a triple asterisk denotes statistical significance at the 1% level. All models include full sets of year dummies, state dummies, and state-specific linear time trends.

Figure 3: Effect on Days Smoked in Past 30 in YRBSS

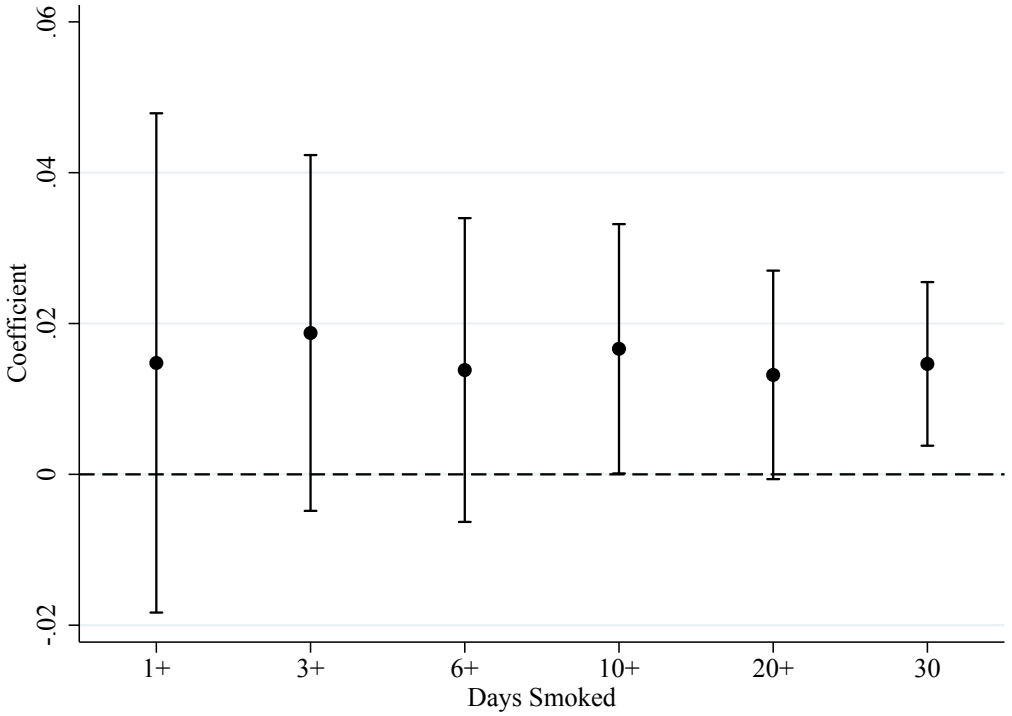


Figure 4: Effect on Days Smoked at School in Past 30 in YRBSS

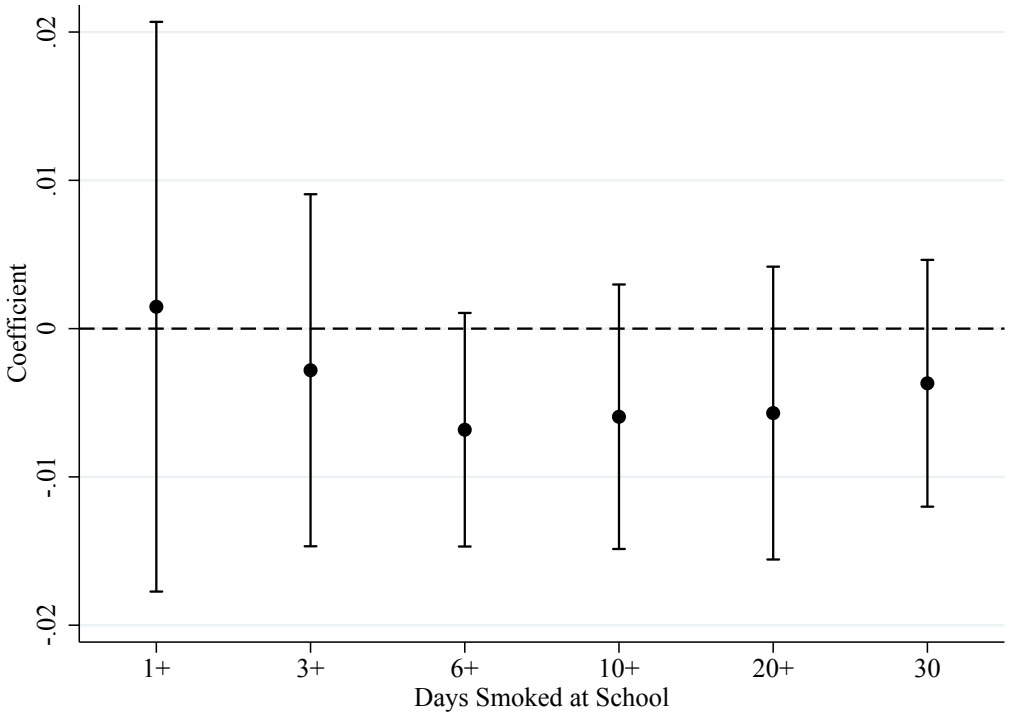


Table 5: Effects of School Smoking Bans Using Alternative Definitions of Smoking Bans

Outcome Variable	Includes Bans Implemented January-June	Distance Exemptions Treated as Ban	Staff/Visitor Exemptions Treated as Ban	Hours Exemptions Treated as Ban
Smoked in Past 30 Days	0.0139	0.0189	0.0035	0.0018
	(0.0166)	(0.0149)	(0.0184)	(0.0160)
Smoked at School in Past 30 Days	0.0035	0.0124	−0.0088	−0.0052
	(0.0096)	(0.0110)	(0.0122)	(0.0119)

Notes: Standard errors that allow for clustering at the state level are shown in parentheses. A single asterisk denotes statistical significance at the 10% level, a double asterisk denotes statistical significance at the 5% level, and a triple asterisk denotes statistical significance at the 1% level. All models include the full set of covariates from Table 4.

tobacco bans to vary based on how long they have been in place, with nine or more years before the ban as the excluded category. We may not necessarily expect an effect to show up right away because, for example, it may take time to change smoking behavior. Additionally, the variables that measure the number of years before a ban goes into effect provide an indirect test of the identifying assumption. If there is a visible pre-existing trend, it casts doubt on this assumption. However, the estimates are generally statistically insignificant and close to zero in magnitude. The results here suggest that there is not an important trend in smoking behavior before bans are implemented and also that the effects do not change much over time.

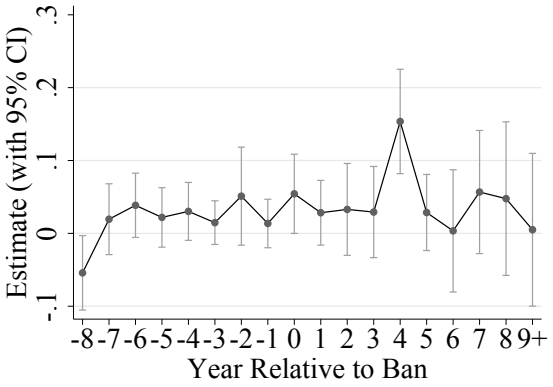
Table 5 uses four alternative definitions of the tobacco ban variable. The top row of the table considers the outcome of having smoked within the past 30 days, while the bottom row considers the outcome of having smoked at school within the past 30 days. In the first column we display the results when we adjust for the timing of the ban by considering a smoking ban to exist in a given state and year if the ban is implemented in the first six months of the given year, rather than if it just in effect on the first day of the year.[26] In these specifications, we also adjust the definition of bar, restaurant, and non-hospitality workplace smoking bans in a similar manner. As with the results from the main coding of the treatment variable, the coefficient estimates are small and are statistically insignificant at conventional levels.

The remaining columns of Table 5 show results from considering broader definitions of tobacco bans. Our main coding of this variable considers a school tobacco ban to be in effect only if everyone is prohibited from smoking on all school grounds at any time. However, some states have laws that generally ban tobacco use on school premises but allow for exceptions for tobacco use that occurs beyond a certain distance from school buildings, for tobacco use by adults, and for tobacco use outside of school hours. When we include each of these situations as part of our definition of a

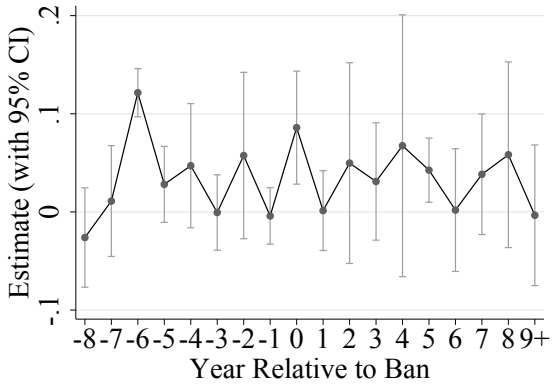
[26] In practice, all of the total school smoking bans that went into effect in the first half of the year but after January 1 went into effect at some point in May.

Figure 5: Dynamic Effects in YRBSS for Youth

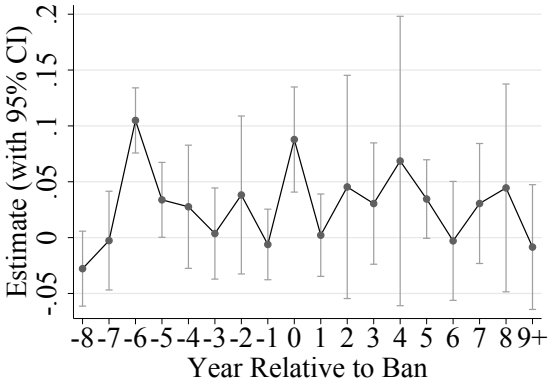
(a) Has Ever Smoked



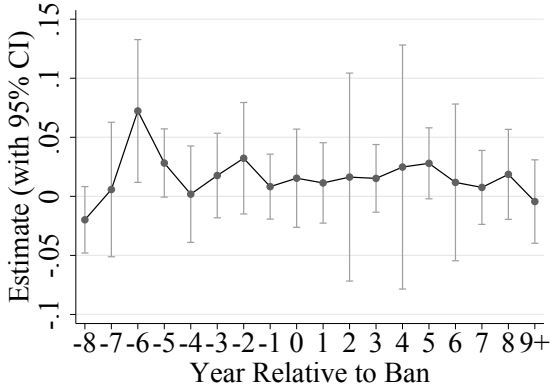
(b) Smoked in Past 30 Days



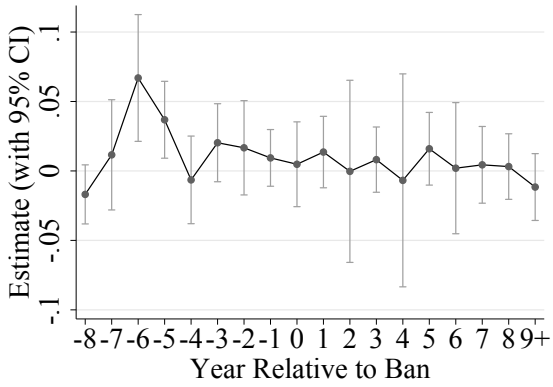
(c) Smoked 3+ Days of Past 30 Days



(d) Smoked at School in Past 30 Days



(e) Smoked 3+ Days at School in Past 30



tobacco ban in Table 5, the results remain largely as before.

5.2 TUS-CPS Results

The TUS-CPS results begin in Table 6, which shows results for youth. Even though there may be reason to be skeptical of the responses to the smoking questions for youth in the TUS-CPS, the results are consistent with the YRBSS results in showing small and statistically insignificant effects of the smoking bans for youths. Moreover, as in the YRBSS, older students are more likely to smoke than younger students in the TUS-CPS, females are less likely to smoke than males, and black and Asian students are less likely to smoke than white students. Native Americans are more likely to smoke than white students for most of the measures of smoking, although the results are not always statistically significant at conventional levels. Hispanics are less likely to smoke than white students are. Unlike the YRBSS, the CPS includes information on family income. Although there is a fair amount of missing data on family income, including measures of family income in the smoking regressions shows that students from higher-income families are less likely to smoke than those from lower-income families.

Unlike the YRBSS, the TUS-CPS covers adults in addition to youth, and it includes information on occupation and industry. This allows for an analysis of the effects of school smoking bans on the smoking behavior of teachers and others in the education industry. These results begin in Table 7, which considers all adults in the education industry together. As with the results from the youth regressions, the results from the adult regressions suggest little impact of the school smoking bans. Moreover, as with the youth regressions, many of the control variables are associated with smoking behavior. As with youth, females are less likely to smoke than males; blacks, Asians, and Hispanics are less likely to smoke than whites; Native Americans are more likely to smoke than whites on most measures of smoking; and those from higher-income families are less likely to smoke than those from lower-income families.[27] As we did with the YRBSS, we show results for other parts of the distribution of the outcomes we consider as well as results that allow for dynamic effects of school smoking bans. These results are shown in Figures 6, 7, and 8. As with the earlier results from YRBSS, the results are generally statistically insignificant and close to zero.

There are several reasons to suspect that school smoking bans may affect teachers and non-teachers differently. As shown in Table 2, teachers and non-teachers in the education industry have quite different baseline smoking rates, with the latter exhibiting higher values. Furthermore, those

[27] Our results for the effect of income are similar to most previous research but are somewhat in contrast to Kenkel, Schmeiser, and Urban (2014), who find that smoking is a normal good. Our small effects for the tax variable are somewhat in contrast to earlier work and to some recent work such as Goolsbee, Lovenheim, and Slemrod (2010) and Lovenheim (2008), but the results are consistent with Callison and Kaestner (2014) and Hansen, Sabia, and Rees (2017) in finding very low tax elasticities using recent data.

Table 6: CPS Results for High School Students Aged 15-18

Variable	Smoked 100 Cigarettes in Lifetime	Smoked 1+ Days of Past 30 Days	Smoked 3+ Days of Past 30 Days	Smokes at Least Pack/Day
School Smoking Ban	0.0000	−0.0049	−0.0051	−0.0007
	(0.0062)	(0.0060)	(0.0058)	(0.0018)
Age 16	0.0257***	0.0201***	0.0201***	0.0026***
	(0.0021)	(0.0018)	(0.0017)	(0.0007)
Age 17	0.0546***	0.0414***	0.0415***	0.0058***
	(0.0031)	(0.0028)	(0.0029)	(0.0010)
Age 18	0.0981***	0.0789***	0.0784***	0.0157***
	(0.0066)	(0.0061)	(0.0061)	(0.0021)
Female	−0.0133***	−0.0101***	−0.0100***	−0.0033***
	(0.0021)	(0.0017)	(0.0017)	(0.0007)
Family Income 20-35K	−0.0275***	−0.0244***	−0.0241***	−0.0053***
	(0.0050)	(0.0046)	(0.0045)	(0.0017)
Family Income 35-50K	−0.0448***	−0.0376***	−0.0371***	−0.0080***
	(0.0064)	(0.0057)	(0.0056)	(0.0017)
Family Income 50-75K	−0.0629***	−0.0542***	−0.0537***	−0.0103***
	(0.0059)	(0.0052)	(0.0052)	(0.0019)
Family Income 75K+	−0.0767***	−0.0630***	−0.0627***	−0.0124***
	(0.0064)	(0.0053)	(0.0053)	(0.0020)
Family Income Missing	−0.0547***	−0.0449***	−0.0447***	−0.0050**
	(0.0071)	(0.0053)	(0.0054)	(0.0019)
Black	−0.0885***	−0.0664***	−0.0663***	−0.0132***
	(0.0033)	(0.0024)	(0.0024)	(0.0012)
Hispanic	−0.0655***	−0.0517***	−0.0513***	−0.0107***
	(0.0059)	(0.0042)	(0.0040)	(0.0009)
Asian	−0.0639***	−0.0474***	−0.0468***	−0.0088***
	(0.0043)	(0.0040)	(0.0039)	(0.0008)
Native American	0.0442*	0.0334*	0.0293	−0.0052
	(0.0233)	(0.0187)	(0.0185)	(0.0035)
Other Race/Multiracial	0.0078	0.0018	0.0007	0.0006
	(0.0130)	(0.0104)	(0.0099)	(0.0031)
Non-Hospitality Smoking Ban	−0.0051	0.0036	0.0042	−0.0016
	(0.0102)	(0.0086)	(0.0083)	(0.0022)
Restaurant Smoking Ban	−0.0068	−0.0018	−0.0027	0.0001
	(0.0135)	(0.0134)	(0.0130)	(0.0029)
Bar Smoking Ban	−0.0008	−0.0121	−0.0112	0.0008
	(0.0137)	(0.0139)	(0.0137)	(0.0031)
Cigarette Tax (2013 $/Pack)	0.0014	0.0039	0.0029	0.0002
	(0.0042)	(0.0039)	(0.0039)	(0.0011)
State Median HH Income (2013 $1000s)	0.0004	0.0002	0.0001	0.0000
	(0.0005)	(0.0005)	(0.0005)	(0.0002)
Unemployment Rate	0.0021	0.0008	0.0007	−0.0001
	(0.0023)	(0.0019)	(0.0019)	(0.0005)
N	78,609	77,916	77,916	76,641

Notes: Standard errors that allow for clustering at the state level are shown in parentheses. A single asterisk denotes statistical significance at the 10% level, a double asterisk denotes statistical significance at the 5% level, and a triple asterisk denotes statistical significance at the 1% level. All models include full sets of year dummies, state dummies, and state-specific linear time trends, as well as a full set of age dummies.

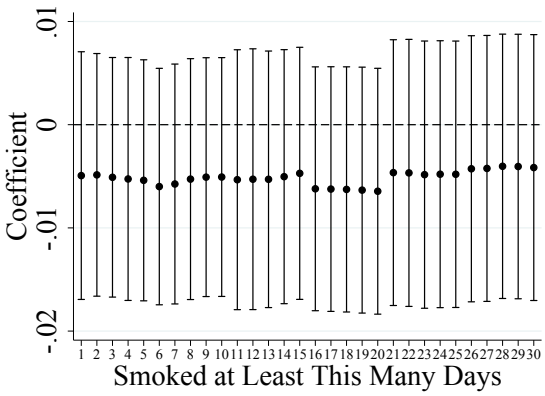
Table 7: CPS Results for Persons Aged 22-65 in Education Industry

Variable	Smoked 100 Cigarettes in Lifetime	Smoked 1+ Days of Past 30 Days	Smoked 3+ Days of Past 30 Days	Smokes at Least Pack/Day
School Smoking Ban	−0.0071	0.0003	−0.0001	−0.0039
	(0.0092)	(0.0087)	(0.0089)	(0.0049)
Female	−0.0628***	−0.0186***	−0.0187***	−0.0132***
	(0.0056)	(0.0031)	(0.0032)	(0.0014)
Family Income 20-35K	−0.0187**	−0.0330***	−0.0331***	−0.0147***
	(0.0080)	(0.0064)	(0.0065)	(0.0039)
Family Income 35-50K	−0.0411***	−0.0659***	−0.0666***	−0.0266***
	(0.0081)	(0.0060)	(0.0059)	(0.0039)
Family Income 50-75K	−0.0555***	−0.0854***	−0.0847***	−0.0314***
	(0.0087)	(0.0058)	(0.0056)	(0.0035)
Family Income 75K+	−0.0651***	−0.1031***	−0.1020***	−0.0419***
	(0.0080)	(0.0054)	(0.0053)	(0.0040)
Family Income Missing	−0.1059***	−0.0953***	−0.0932***	−0.0367***
	(0.0104)	(0.0076)	(0.0075)	(0.0045)
High School Graduate	−0.0759***	−0.0809***	−0.0817***	−0.0436***
	(0.0143)	(0.0137)	(0.0142)	(0.0099)
College Graduate	−0.1960***	−0.1646***	−0.1655***	−0.0812***
	(0.0167)	(0.0160)	(0.0167)	(0.0111)
Black	−0.0801***	−0.0150*	−0.0153*	−0.0279***
	(0.0136)	(0.0082)	(0.0083)	(0.0037)
Hispanic	−0.1118***	−0.0528***	−0.0531***	−0.0400***
	(0.0143)	(0.0076)	(0.0077)	(0.0041)
Asian	−0.1201***	−0.0359***	−0.0353***	−0.0189***
	(0.0174)	(0.0079)	(0.0083)	(0.0042)
Native American	0.1132*	0.1007**	0.0972**	−0.0007
	(0.0672)	(0.0407)	(0.0415)	(0.0114)
Other Race/Multiracial	0.0222	0.0453***	0.0472***	0.0070
	(0.0247)	(0.0156)	(0.0157)	(0.0071)
Non-Hospitality Smoking Ban	−0.0294**	−0.0192**	−0.0172**	0.0039
	(0.0123)	(0.0076)	(0.0078)	(0.0033)
Restaurant Smoking Ban	0.0056	0.0088	0.0080	−0.0160***
	(0.0169)	(0.0085)	(0.0084)	(0.0032)
Bar Smoking Ban	0.0211	0.0063	0.0056	0.0187***
	(0.0158)	(0.0084)	(0.0088)	(0.0037)
Cigarette Tax (2013 $/Pack)	−0.0227***	−0.0035	−0.0026	0.0024
	(0.0071)	(0.0039)	(0.0041)	(0.0019)
State Median HH Income (2013 $1000s)	0.0035***	0.0013**	0.0014**	0.0008**
	(0.0008)	(0.0005)	(0.0005)	(0.0003)
Unemployment Rate	0.0095***	0.0034**	0.0033**	0.0013
	(0.0023)	(0.0016)	(0.0016)	(0.0009)
N	65,125	64,713	64,713	63,880

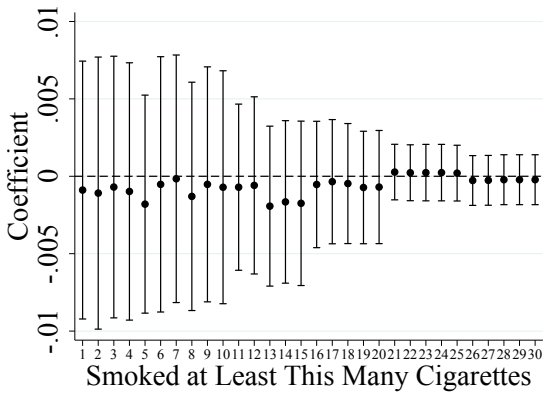
Notes: Standard errors that allow for clustering at the state level are shown in parentheses. A single asterisk denotes statistical significance at the 10% level, a double asterisk denotes statistical significance at the 5% level, and a triple asterisk denotes statistical significance at the 1% level. All models include full sets of year dummies, state dummies, and state-specific linear time trends, as well as a full set of age dummies.

Figure 6: Effects on Distributions in CPS

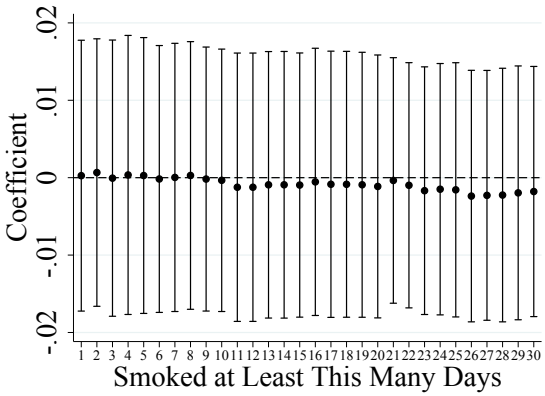
(a) Days Smoked in Past 30 - CPS Youth



(b) Cigarettes Smoked Per Day - CPS Youth



(c) Days Smoked in Past 30 - CPS Adults



(d) Cigarettes Smoked Per Day - CPS Adults

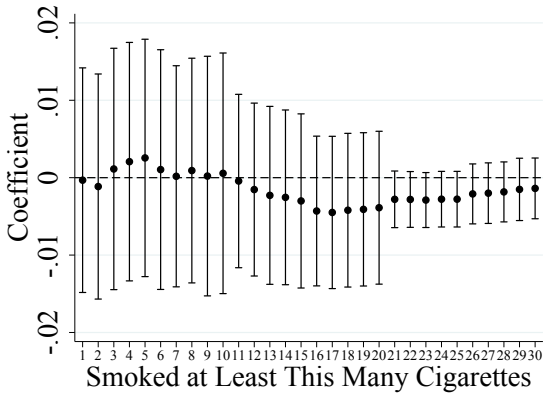
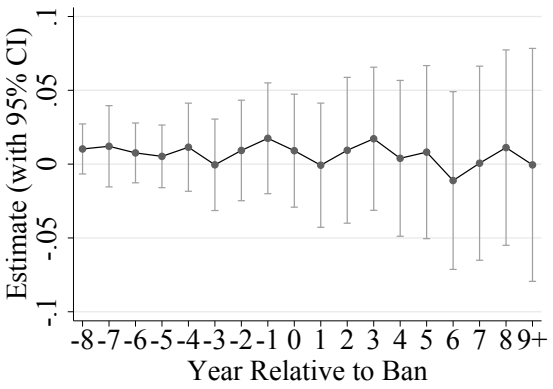
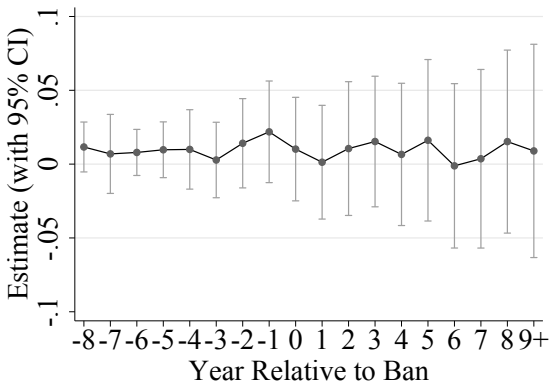


Figure 7: Dynamic Effects in CPS for Youth

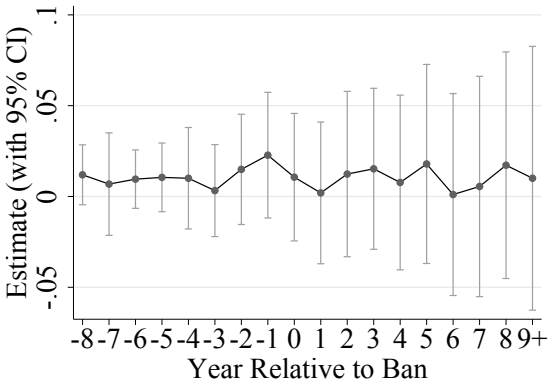
(a) Smoked 100 Cigarettes in Lifetime



(b) Smoked in Past 30 Days



(c) Smoked 3+ Days of Past 30 Days



(d) Smoked at Least Pack/Day

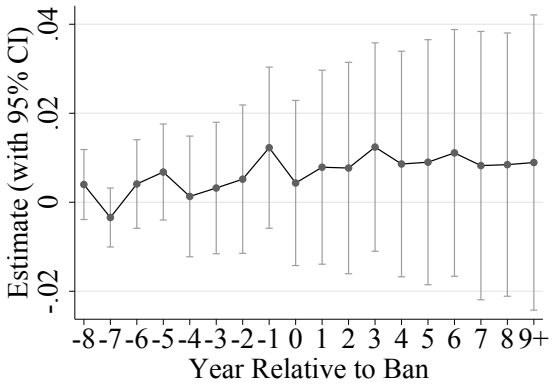
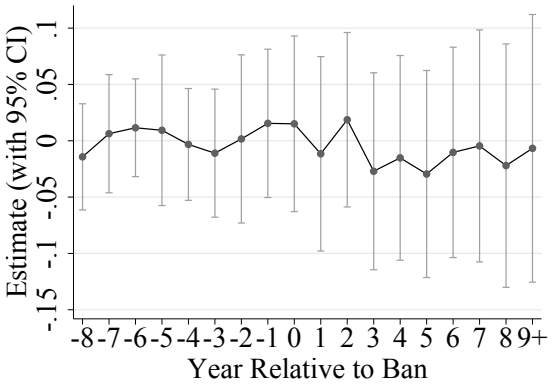
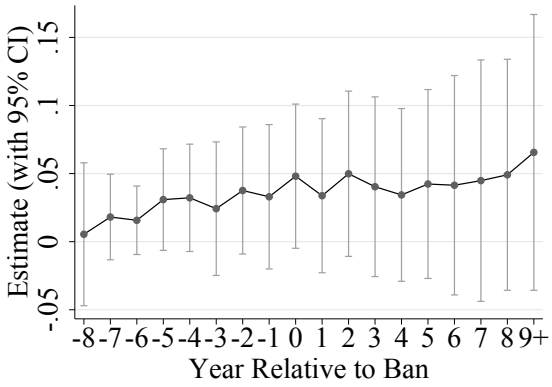


Figure 8: Dynamic Effects in CPS for Adults

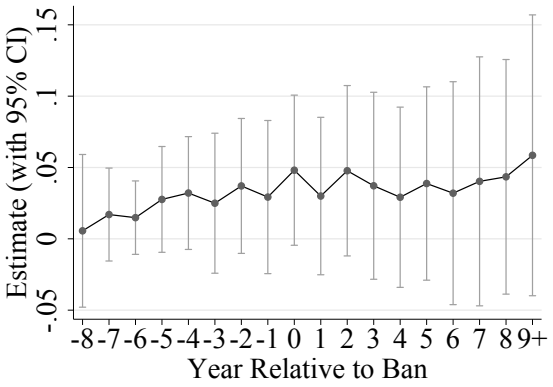
(a) Smoked 100 Cigarettes in Lifetime



(b) Smoked in Past 30 Days



(c) Smoked 3+ Days of Past 30 Days



(d) Smoked at Least Pack/Day

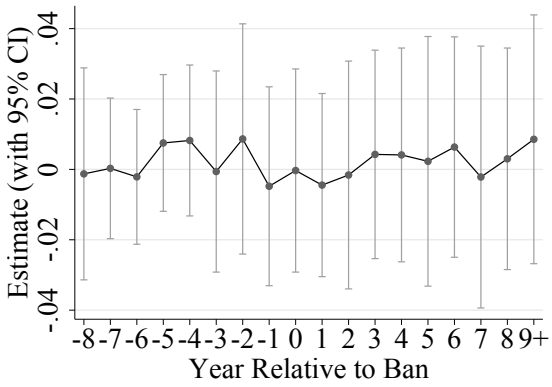


Table 8: CPS Results for Teachers vs. Non-Teachers in Education Industry

Sample	Smoked 100 Cigarettes in Lifetime	Smoked 1+ Days of Past 30 Days	Smoked 3+ Days of Past 30 Days	Smokes at Least Pack/Day
Teachers Aged 22-65				
Coefficient	−0.0043	0.0002	0.0003	−0.0040
(Standard Error)	(0.0143)	(0.0077)	(0.0075)	(0.0059)
Sample Size	28,771	28,627	28,627	28,431
Non-Teachers in Education Industry Aged 22-65				
Coefficient	−0.0143	−0.0024	−0.0029	−0.0067
(Standard Error)	(0.0111)	(0.0133)	(0.0135)	(0.0081)
Sample Size	34,578	34,327	34,327	33,722

Notes: Standard errors that allow for clustering at the state level are shown in parentheses. A single asterisk denotes statistical significance at the 10% level, a double asterisk denotes statistical significance at the 5% level, and a triple asterisk denotes statistical significance at the 1% level. All models include the full set of covariates from Table 7.

in certain non-teaching occupations that do not require supervising students for a large portion of the day may have more opportunities to smoke. In addition, the opportunity cost of taking a smoking break may depend on job requirements and work schedules. For teachers, taking a smoking break may come at the expense of time spent grading or preparing lesson plans, which may require working later into the day in order to complete work. Employees that have more rigid working hours may have less of a time cost to taking breaks throughout the day. Table 8 explores this potential heterogeneity. The top part of the table shows results for teachers, while the bottom part shows results for non-teachers in the education industry.[28] Perhaps surprisingly, the overall results do not differ dramatically for the two groups.

Table 9 shows results of alternative specifications that consider broader definitions of tobacco bans. The top part of the table codes as bans situations in which smoking is not allowed within a specified distance of school buildings, the middle part of the table includes cases in which a smoking ban applies only to students, and the bottom part of the table uses an alternative definition of the smoking ban variable that also includes cases where smoking is not allowed during certain hours. A possible negative effect of the tobacco bans on smoking by non-teachers in the education industry is apparent in the middle and bottom part of the table. These results are suggestive, but they are not robust across alternative codings of the tobacco ban variable. Additionally, comparing the magnitudes across the various columns in the bottom row of Table 9 suggests that, if this effect is real, it may be a composition effect rather than a causal effect on the smoking behavior of

[28]Table 8 excludes individuals who are coded in the CPS as being teachers but have educational attainment less than the college level. However, these individuals are included in Table 7, which does not stratify by occupation.

particular individuals. The effect on having smoked 100 cigarettes in a lifetime is nearly as large as the effects on the other smoking outcomes. Unless we believe, for example, that smoking bans have an immediate negative effect on smoking initiation, this points to a potential change in the smoker vs. non-smoker composition of the school workforce. However, regardless of whether it is a composition effect or a causal effect on particular individuals, the effect on students may be the same in that they may be exposed to less smoking by school staff.

Insofar as results are statistically significant in Table 9 with the alternative codings of the bans whereas they are not statistically significant in the earlier tables, it appears to be mostly as a result of coefficient estimates that are larger in magnitude rather than standard errors that are smaller. These larger coefficients could be coming about for two reasons. One is that there may be heterogeneous treatment effects across states. Essentially, a different set of states is coded as being treated with the different definitions of the bans, and perhaps smoking bans are differentially effective in different states. A second possibility is that the different treatments may actually have different treatment effects. Even if there were homogeneous treatment effects across states, the fact that the different regressions are including slightly different situations to be included in the treatment may have an effect on the results. To the extent that the effects are real, the former possibility seems more likely because we are finding larger effects for a less stringent policy.[29] In other words, it is likely due to heterogeneity across states that happen to implement different policies rather than heterogeneous effects of the policies themselves.

Finally, even if there is in fact a difference between the effect on teachers and non-teachers, it is difficult to determine with the available data to what extent this difference is driven by low baseline smoking rates for teachers compared to non-teachers and to what extent it is driven by teachers having fewer opportunities for smoking breaks during the day.

6 Compliance with Statewide School Smoking Bans

Why do we find such little evidence that statewide school smoking bans reduce smoking? One possibility is that smoking may be displaced across time or space. It should be noted that, even if this type of displacement occurs, one possible silver lining is that students might be less exposed to secondhand smoke. Unfortunately, the available data do not allow us to say very much about this possibility. A second possibility, though, is that there is not full compliance with the laws. Various data sources do allow us to gain some insight on this issue.

The results in Table 4, which suggest that the rate of smoking at school does not fall to zero

[29] Furthermore, in Panel B of the table we now find effects on school staff despite the fact that we now include in the list of ban states some states in which the ban does not even apply to these staff.

Table 9: CPS Results Using Alternative Definitions of Smoking Bans

Subgroup	Smoked 100 Cigarettes in Lifetime	Smoked 1+ Days of Past 30 Days	Smoked 3+ Days of Past 30 Days	Smokes at Least Pack/Day
A. Distance Exemptions Treated as Ban				
High School Students Aged 15-18	−0.0014	−0.0051	−0.0053	0.0009
	(0.0055)	(0.0052)	(0.0050)	(0.0017)
Persons Aged 22-65 in Education Industry	−0.0044	0.0023	0.0020	−0.0052
	(0.0080)	(0.0079)	(0.0081)	(0.0047)
Teachers Aged 22-65	−0.0064	−0.0008	−0.0008	−0.0054
	(0.0132)	(0.0073)	(0.0071)	(0.0055)
Non-Teachers in Education Industry Aged 22-65	−0.0090	0.0017	0.0014	−0.0088
	(0.0104)	(0.0134)	(0.0136)	(0.0082)
B. Staff/Visitor Exemptions Treated as Ban				
High School Students Aged 15-18	0.0053	0.0018	0.0019	0.0031
	(0.0052)	(0.0053)	(0.0052)	(0.0021)
Persons Aged 22-65 in Education Industry	−0.0066	−0.0089	−0.0098	−0.0110**
	(0.0095)	(0.0097)	(0.0097)	(0.0045)
Teachers Aged 22-65	0.0059	0.0046	0.0033	−0.0039
	(0.0146)	(0.0108)	(0.0108)	(0.0061)
Non-Teachers in Education Industry Aged 22-65	−0.0214*	−0.0246*	−0.0251*	−0.0203***
	(0.0119)	(0.0133)	(0.0131)	(0.0066)
C. Hours Exemptions Treated as Ban				
High School Students Aged 15-18	0.0078	0.0040	0.0042	0.0013
	(0.0052)	(0.0051)	(0.0051)	(0.0018)
Persons Aged 22-65 in Education Industry	−0.0045	−0.0120	−0.0132	−0.0113***
	(0.0085)	(0.0083)	(0.0083)	(0.0039)
Teachers Aged 22-65	0.0082	−0.0013	−0.0027	−0.0066
	(0.0129)	(0.0075)	(0.0077)	(0.0049)
Non-Teachers in Education Industry Aged 22-65	−0.0201*	−0.0264**	−0.0273**	−0.0189***
	(0.0109)	(0.0115)	(0.0114)	(0.0063)

Notes: Standard errors that allow for clustering at the state level are shown in parentheses. A single asterisk denotes statistical significance at the 10% level, a double asterisk denotes statistical significance at the 5% level, and a triple asterisk denotes statistical significance at the 1% level. All models include the full set of covariates from Table 7.

Table 10: Results from SHPPS on School Smoking Policies at Secondary Schools

	1994	2000			2006		
	Overall	Overall	Ban States	Non-Ban States	Overall	Ban States	Non-Ban States
Violations from Students	68.6%	57.6%	54.7%	58.2%	45.6%	46.4%	45.2%
Students Not Allowed to Smoke on School Grounds...							
...During School Hours	98.9%						
...During Non-School Hours	96.5%						
...During Any School Activity		96.5%	95.8%	96.7%	97.4%	97.7%	97.3%
Faculty Not Allowed to Smoke on School Grounds...							
...During School Hours	71.4%						
...During Non-School Hours	61.9%						
...During Any School Activity		77.0%	83.3%	75.6%	87.4%	93.9%	84.3%

when a statewide school smoking ban is implemented, provide initial evidence in support of the hypothesis that the laws are not always followed. Further evidence comes from other surveys. In the 1989 Teenage Attitudes and Practices Survey, less than 10% of respondents aged 15-18 who say that their school has a rule prohibiting students from smoking on school property report that all students who smoke obey, whereas only about 36% report that most or all obey. Furthermore, 37% of students in grades 9-12 in the 2013 National Youth Tobacco Survey report knowing that someone has smoked a tobacco product on school property in the past 30 days when they were not supposed to.

Another piece of evidence regarding noncompliance comes from the School Health Policies and Practices Study (SHPPS). This study surveys schools regarding various policies related to health and nutrition every six years, from 1994 to 2006. In the latter two waves, we know which state the school is in, and hence, whether a tobacco ban is in place. We utilitize responses to questions about whether there are restrictions on smoking on school grounds for students and faculty at school, along with the extent to which students have violated these rules. The top row of Table 10 illustrates the percentage of schools which reported that one or more students violated non-smoking policies at schools. The results suggest that many schools experienced violations of their tobacco policies by students, although this has apparently happened less often in recent years.[30]

The SHPPS data also allow us to examine the extent to which schools themselves implement

[30] All SHPPS results we show are for secondary schools. The 2000 and 2006 SHPPS ask slightly different questions than the 1994 SHPPS. The question on violations in the 1994 SHPPS survey asks whether there have been any student violations of the tobacco policy during the past 12 months, whereas the question in the 2000 and 2006 SHPPS asks how many times students were caught smoking cigarettes in the 1998-99 and 2004-05 school years, respectively.

smoking bans. Two important pieces of evidence can be gleaned from this: First, we can assess the extent to which schools comply with their state anti-tobacco laws. Second, we can gauge the extent to which schools in states without a ban implement restrictions at the local level. The middle and lower sections of Table 10 display the results.

In 1994, only four states had statewide 24/7 school tobacco bans, yet 98.9% of schools did not allow students to smoke during school hours, and 96.5% of schools did not allow students to smoke at school during non-school hours. 71.4% of schools did not allow faculty to smoke during school hours, while 61.9% did not allow them to smoke during non-school hours. This suggests that schools themselves may have stricter anti-tobacco laws than their states require. Even more telling are the results from 2000 and 2006, where we can separate schools into states with bans and without bans. The vast majority of schools had a policy against students smoking, and the incidence of such policies was quite similar between ban states and non-ban states. Most schools also had a policy against teachers smoking, although in this case there is a gap between ban states and non-ban states. This disparity is 83.3% for ban states vs. 75.6% for non-ban states in 2000, and 93.9% for ban states vs. 84.3% for non-ban states in 2006.

The less than 100% rates for schools in states with bans suggest that perhaps not every school actually enforces smoking bans. But with that said, the almost 10 percentage point difference in school-level faculty smoking restrictions in 2006 across states with and without bans suggests that the state level bans likely influence local level practicies. Table 10 also indicates that schools in states without statewide bans can have restrictions on smoking in place, and the rate at which this occurs is non-trivial. This brings up an important point: part of the treatment effect of school smoking bans involves how schools respond to them. We are estimating the effects of statewide smoking bans but are not able to estimate the effect of a school having or not having a smoking ban.[31] The latter question may be of interest to schools deciding whether to implement a smoking ban, but the former question would be important for state policymakers deciding whether to enact a smoking ban. In this case the response of schools to whatever policy is enacted is something that should be taken into account when the state is deciding which policy to enact.

The general picture that emerges from analyzing these auxiliary data sources is that the vast majority of schools have some policy in place to prohibit smoking by students, a large and growing number have such a policy in place for faculty and staff, and the rules for students do not always deter smoking. In addition to this non-compliance by students, there may be non-compliance by schools that are supposed to prohibit smoking on school grounds. There also appears to be a

[31] In studying state smoking policies, we are consistent with earlier research on tobacco control, such as Bitler, Carpenter, and Zavodny (2010), who also focus on state policy even though individual municipalities may have their own policies.

large amount of "non-compliance" by schools in the other direction, in that most schools have their own policy against smoking on school grounds even if they are not compelled to do so by state law. However, it is possible that the additional statewide laws can reduce smoking even at schools that already have their own anti-smoking policies if, for example, the state laws come along with additional enforcement.

One final caveat is that we are not able to estimate the impact of the federal 1994 Pro-Children Act, which banned smoking inside of schools nationwide. One possibility is that we do not find much effect of statewide smoking bans on school grounds because the Pro-Children Act had a large effect.

7 Conclusion

Our examination of statewide school smoking bans finds little effect of these laws. In certain specifications there is some slight evidence to suggest that they may reduce smoking for non-teaching school staff, but this result is not robust across different codings of the smoking ban variable. The results are thus generally in line with those of Bitler, Carpenter, and Zavodny (2010) in finding little impact of school smoking bans, despite the differences in methodology between the two papers. The results are somewhat in contrast to the earlier results of Evans, Farrelly, and Montgomery (1999), although one reason for the difference could be that we focus on statewide smoking bans whereas they focus on policies in place at particular employers. If statewide smoking bans are in part a substitute for smoking bans implemented by particular schools or school districts, this could reconcile the results of our work with Evans, Farrelly, and Montgomery (1999). Another reason for the difference could be our focus on schools but the study of a broader group of employers in Evans, Farrelly, and Montgomery (1999).

The fact that we find little effect of these laws even on youth smoking at school suggests they may simply displace smoking across time or space, or else that there is not full compliance with smoking bans. We have provided some evidence in favor of the latter but are unable to say much about the former. Whatever the case, other policies may be more effective at reducing smoking for youth and for adults. The null result in this paper suggests that perhaps resources devoted to statewide school smoking bans can be more effectively employed in other ways.

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