Where There's a Smoking Ban, There's Still Fire

Michael T. Owyang and E. Katarina Vermann

Since 2001, the pervasiveness of 100-percent smoke-free bans has increased dramatically—from 32 local laws in 2001 to 308 by the end of 2009. The authors use individual-level data from the Behavioral Risk Factor Surveillance System survey to examine the effect of these bans in workplaces, bars, and restaurants on changes in smoking initiation, continuation, and cessation. They find that, relative to increases in cigarette taxes, smoking bans do not appear to be correlated with changes in smokers' behavior. (JEL I18)

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As information about the health consequences of smoking emerged in the 1960s, governments at all levels began regulating cigarettes through higher taxes, advertising restrictions, and warning labels. The most recent smoking regulation trend is the rise in 100-percent smoke-free bans in public and private spaces such as bars and restaurants. These bans are primarily a public health measure intended to decrease nonsmokers' exposure to second-hand smoke. Since the early 2000s, these bans have spread at a dramatic rate—from 32 local laws in 2001 to 308 by the end of 2009. At this rate, the Centers for Disease Control and Prevention (CDC, 2011) estimates that smoke-free indoor air laws will cover the entire United States by 2020.

Despite the rapid spread of smoking bans, there has been little explicit discussion on their intended effects on smokers. Do bans encourage smoking cessation? Do they discourage smoking initiation among nonsmokers? Do they change public sentiment on smoking? Do they raise the opportunity cost of smoking? Preliminary data suggest that the impact of smoking bans on smokers may be limited. Figure 1 illustrates that, although the number of smoking bans has increased dramatically, smokers' habits have remained fairly constant. Over time, the data show a dramatic rise in the presence of smoking bans, a minor rise in smokers who have quit successfully, and almost no change in smokers attempting to quit. This information raises the question of whether these bans change smokers' habits.

The lack of behavioral change contrasts with the findings from previous economic studies on the effects of other forms of smoking legislation. Although 100-percent smoke-free bar and

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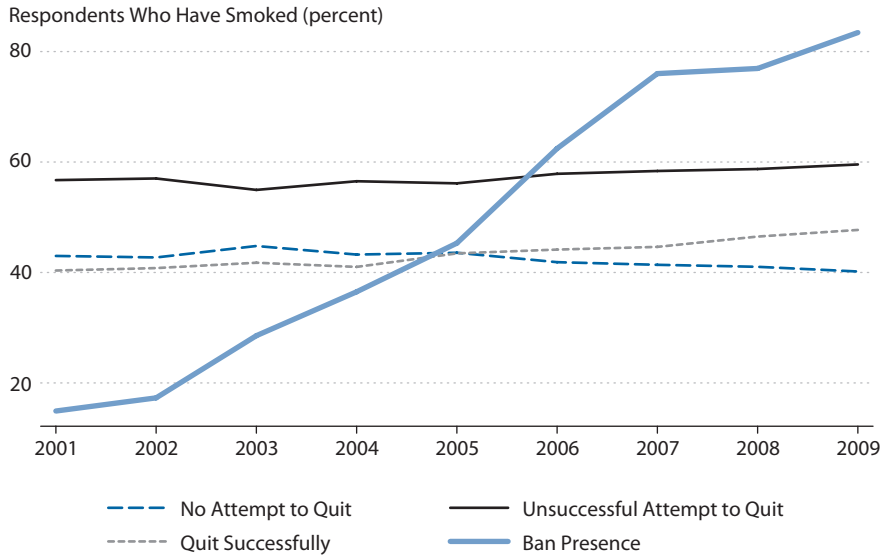
Figure 1

Trends in Smoking Cessation and Smoking Ban Presence



SOURCE: Behavioral Risk Factor Surveillance System survey and Americans for Nonsmokers' Rights.

restaurant bans are fairly new, economists have studied how less stringent bans in public places and workplaces have influenced smoking initiation and prevalence. The early literature—which controls for bans in examinations of tax policy and youth smoking—estimates how bans affect cigarette demand using indexes that take into account (i) ban stringency (e.g., Sung and Keeler, 1994, and Wasserman et al., 1991), (ii) the probability of encountering a ban (Yurekli and Zhang, 2000), or (iii) a combination of these two factors (Chaloupka, 1992). These analyses indicate that bans have robust, significant, and negative effects on smoking.

The assumptions surrounding the construction of these indexes, however, could have skewed results in one of two ways. Studies that weight their indexes based on the stringency of policies assume the same marginal effects for all types of bans. They also assume compliance with and complete enforcement of the restrictions (DeCicca, Kenkel, and Mathios, 2008a, and Ross and Chaloupka, 2004). On the other hand, studies with indexes that are weighted by the likelihood of encountering each specific type of ban assume that individuals respond to all bans in the same way. Yet, it has been shown that individuals who face comprehensive bans—those that cover indoor and outdoor areas—are less likely to use tobacco, but those who face indoor-only bans do not exhibit significant changes in their tobacco consumption (Knudsen, Boyd, and Studts, 2010, and Ross and Chaloupka, 2004).

Another branch of the literature on smoking bans focuses on the introduction of bans in the workplace. With the exception of Chaloupka and Saffer (1992), these studies estimate larger changes in smoking demand than studies that use indexes (e.g., Brownson, Hopkins, and Wakefield, 2002; Farrelly, Evans, and Sfekas, 1999; Irvine and Nguyen, 2011). Nonetheless, many

studies on the effects of workplace bans do not control for the presence of other bans in public places or for other aspects of tobacco control (e.g., Irvine and Ngyuen, 2011, and Farelly et al., 1999). In excluding tax rates and other venue-specific restrictions, these studies may falsely attribute the effects of other policies to workplace bans, overestimating the effect of such bans on smoking.

Finally, studies that examine the effects of smoke-free bans in bars and restaurants typically focus on the economic impact of these bans. For summaries of two different perspectives on the issue, see Scollo and Lal (2008) and Pakko (2006, 2008). Although studies of smoke-free bans find questionable evidence on the economic impact of bans largely because of limited data, they do not examine whether smoking bans stop people from smoking.

In examining the effects of 100-percent smoke-free bans in workplaces, bars, and restaurants, this paper addresses the limitations of the previous literature in three ways. First, all of the bans examined here have the same level of stringency. Second, we explicitly control for bans in workplaces, restaurants, and bars. These methods allow us to overcome the limitations of the assumed ban homogeneity in the ban index literature. Finally, we take into account other aspects of tobacco control policy, such as taxes and state-level funding. Thus, we assess the role smoking restrictions play within the myriad of tobacco control policies and determine whether they do influence smokers to change their behavior.

EMPIRICAL STRATEGY

We consider the effect of anti-smoking policies on three aspects of individual smoking behavior: *initiation*, *continuation*, and *cessation*. "Initiation" is equal to 1 if an individual responds positively when asked whether he or she has smoked at least 100 cigarettes (5 packs) in his or her lifetime; otherwise, it is equal to zero. Among the subsample of people who have initiated smoking, "continuation" equals 1 when a respondent responds positively when asked if he or she is a current smoker; otherwise, it is equal to zero. From the subsample of current smokers, "cessation" equals 1 if a current smoker has positively responded when asked whether he or she has attempted to quit smoking in the past year; otherwise, it is equal to zero.

The objective of anti-smoking policies is to raise the cost of smoking, either by increasing the nominal price through taxes levied on cigarettes or increasing the real price through smoking restrictions. When the government imposes a smoking ban, the real price of smoking increases. Rather than deciding how much to smoke based solely on the cost per pack, a smoker determines his or her optimal level of cigarette consumption by considering the opportunity cost of smoking in the presence of a ban (Irvine and Nguyen, 2011). The increased opportunity cost can reflect either the need to travel away from areas with bans to smoke or the cost of sanctions imposed for smoking within an area with a ban. Perceived social norms about smoking may also influence how an individual smoker internalizes the implicit costs of smoking in an area with a ban (Hamilton, Biener, and Brennan, 2008). Hence, large-scale changes in the public's perception of smoking—one of the goals of a smoking ban—would influence an individual's decision to smoke (Singleton, 2008; DeCicca et al., 2008b; Kim and Shanahan, 2003).

We are interested in evaluating the correlation between the presence of a smoking ban and the prevalence of each smoking behavior. In the presence of a smoking ban, one would expect initiation to decrease over time. This decrease would indicate that bans would make smoking

even less appealing, thus making the costs of smoking today outweigh the benefits. Continuation shows us whether areas with bans have more former smokers. Over time, this variable could indicate whether bans encourage current smokers to quit. Cessation shows us whether a ban is correlated with a higher proportion of individuals attempting to quit, indicating that the ban has increased the real cost of smoking. Cessation also shows us whether a ban is a good commitment device for quitting, as the individuals in the survey who have attempted to quit have not succeeded in quitting.

The treatment variables consist of a set of 100-percent smoking ban dummy variables defined for various geographic-establishment combinations. We assume a ban can affect workplaces, restaurants, or bars. We also assume a ban can be at the municipality, county, or state level. Obviously, a ban with a narrower geographic scope (i.e., a municipality) is subsumed by a ban with a wider geographic scope (i.e., a county). The wider the ban, the costlier it presumably is for the affected smoker. Thus, we also control for the ease with which an individual can avoid a ban by calculating the percentage of a population within a county or metropolitan area facing a ban.

Aside from the policy considerations, some local conditions and individual-level characteristics may affect smoking behavior. For example, we include local cigarette and beer prices; the latter are included because smoking and drinking are often thought of as complements (DiFranza and Guerrera, 1990; Bask and Melkersson, 2004; Picone, Sloan, and Trogdon, 2004). At the individual level, we include respondent age, gender, education, income, employment status, marital status, parental status, and alcohol consumption (see Dedobbeleer et al., 2004; Dodgen, 2005; Cheng and Kenkel, 2010). These characteristics are argued to serve as proxies for the individual's degree of tobacco addiction, which cannot be measured directly (Irvine and Nguyen, 2011, and Harris and Chan, 1999). Table 1 provides summary statistics for each of the variables.

We model the smoking behavior j for individual i as a function of a vector of individual-level factors, $\boldsymbol{Z}_i$, and a vector of policies, $\boldsymbol{P}_i$, that the individual faces. In $\boldsymbol{P}_i$, we consider smoking bans, the chance an individual will encounter a ban, taxes (through cigarette price per pack data, which include taxes), and state tobacco control funding. Let $S_{ij} \in \{0,1\}$ be an indicator variable that reflects whether individual i responded positively to the survey question about smoking behavior $j \in \{initiation, continuation, cessation\}$. Because the smoking behaviors are binary, we model the probability that an individual undertakes a particular smoking behavior with a binomial probit:

$$\Pr\left[S_{ij} = 1\right] = \Phi\left(\beta_z Z_i + \beta_p P_i\right),$$

where $\boldsymbol{\Phi}(\cdot)$ is the standard normal cumulative density function and the βs are coefficients.[1]

The main coefficients of interest from these estimates are those for the ban dummy variables, the probability of encountering a ban, and the cigarette price per pack. We expect these coefficients to be negative for estimations of smoking initiation and continuation but positive for estimations of cessation. Generally, the results of a probit can be used to estimate marginal effects at the means of the other covariates. However, when the probability of encountering a ban is a right-hand-side variable, the computation of the marginal effect is not straightforward. The ban encounter probability is not independent of the ban- and individual-level variables: It can change

because of changes in population, the introduction of new municipality-level bans, and individual choices (e.g., whether an individual chooses to go to a bar).

We estimate the marginal effects two ways: First, we compute the marginal effect of instituting a particular type of ban when there was no previous ban. In other words, we find the effect of switching one (and only one) of the policy variables from 0 to 1, holding all continuous variables (e.g., cigarette price) constant at the mean and all dummy variables (e.g., ban indicators, individual characteristics) constant at zero. We compute these values for the regressions with binary ban dummies but not the ban encounter probability. In a separate regression that includes only the ban encounter probability but not the ban dummy variables, we estimate the marginal effect of a 1 percent increase in the probability of encountering a ban. In each case, we compute the marginal effect at the mean for the remaining continuous variables (e.g., cigarette price) and at zero for the remaining dummy variables (e.g., individual characteristics).

Our model also attempts to account for potential endogeneity among the tobacco policy variables—bans, taxes, and state tobacco control funding. The relationship between tobacco control policy and cigarette consumption may not be completely causal: One major issue in the literature on smoking is that the possibility of tobacco control policies reflecting public sentiment toward smoking is largely unaddressed. Indeed, Hamilton, Biener, and Brennan (2008) find that local tobacco control regulations are correlated with individual perceptions of descriptive and injunctive norms, supporting the notion of a social multiplier effect (Cutler and Glaeser, 2010). It follows, then, that a high level of public distaste for smoking may increase the perceived need for and adoption of tobacco control policies (Hersch, Del Rossi, and Viscusi, 2004). Consequently, regulations may increase the public demand for further anti-smoking regulation. In fact, evidence suggests that states adopting 100-percent smoke-free bans are likely to have lower smoking rates and more tobacco control policies (Dunham and Marlow, 2000, and Boyes and Marlow, 1996). Hence, a smoking ban may follow rather than dictate changes in smoking behaviors and norms. Despite this evidence, Chaloupka (1992) and Wasserman et al. (1991) argue that when individual-level data are used to estimate cigarette demand, endogeneity is not a problem because the presence of clean indoor air laws is more closely related to average state-level cigarette consumption. In other words, they argue that a single individual's decision to smoke will not factor into legislators' decisions to enact more stringent tobacco control policies, but the decisions of a group of individuals will.

In light of these arguments, we tackle endogeneity issues in two ways: First, following Chaloupka (1992) and Picone, Sloan, and Trogdon, (2004), we use 1-quarter-lagged ban variables and 1-year-lagged state funding variables. However, we do not lag the cigarette price variable or the ban probability in the interaction term because we assume that individuals respond to these factors immediately. Second, following Farrelly et al. (2001), we control for time- and state-specific fixed effects. By controlling for cultural/regional and temporal variation in smoking attitudes, we take into account the differences in state smoking rates, which arguably influence legislators' decisions to enact bans in the first place.

DATA

To estimate the causal effects of clean indoor air laws in workplaces, bars, and restaurants on smoking behavior, one would ideally have panel data on individuals, their smoking habits,

their level of addiction, the factors that influence their smoking decisions, and how often they encounter smoking bans. Unfortunately, only cross-sectional data on individual smoking consumption exist, so an individual's response to smoking bans cannot be observed over time. In an attempt to circumvent this problem, this paper uses repeated cross-sectional data from the CDC's Behavioral Risk Factor Surveillance System survey (BRFSS).[2]

In addition to being conditioned on individual-level factors, we assume smoking behavior is driven by aggregate policy-level factors, such as the tax per pack of cigarettes, an anti-smoking "culture" inferred from tobacco control policies, and the presence of bans themselves.[3] Since the BRFSS data lack information on smoking policies within a municipality, county, or state, we merge the BRFSS data with 100-percent smoke-free workplace, bar, and restaurant ban enactment data, the annual average state-level price per pack of cigarettes (including taxes), and each state's average annual tobacco control spending per capita.[4] Also, because the BRFSS data are at the county level and the smoking ban data are available at the municipality level, we use municipality, county, and core based statistical area (CBSA) populations to calculate the probability of encountering a 100-percent smoke-free ban.[5]

Overall, 42 percent of respondents have smoked, 24 percent are current smokers, and 18 percent are former smokers (see Table 1). Of the current smokers (56 percent of those who have ever smoked), 57 percent have attempted to quit within the past year. Across counties that have enacted smoking bans, there are very few differences in demographic characteristics. The same applies to smoking behaviors: There is at most a 7 percent difference in smoking behaviors and demographic characteristics across individuals living in areas with and without bans.

As shown in Table 2, 46 percent of all individuals in the sample live in a county with a smoking ban; state-level smoking bans in restaurants are the most commonly encountered type of ban (32 percent of the sample); and county-level workplace, bar, and restaurant bans are the least common (1 percent, 0 percent, and 1 percent of the sample, respectively).[6] Although only 46 percent of the sample lives in a county with a smoking ban, 53 percent of the survey respondents live in a metropolitan area with a ban.[7] All respondents are most likely to encounter bans in restaurants and least likely to encounter bans in bars. For more information on the samples and data, see the data appendix and/or contact the authors.

Table 2 and Figure 2 indicate that over time, the presence of all three types of bans at the municipality, county, and state levels has increased dramatically. These increases were largely driven by the spread of state-level smoking bans rather than municipality- or county-level bans. For example, in 2001, 3 percent of BRFSS survey respondents encountered a state-level bar ban; but in 2009, 53 percent of respondents encountered such a ban. In contrast, in 2001, 4 percent of respondents encountered a municipality-level smoking ban in bars and 0 percent encountered one in their county. By 2009, those numbers rose to 9 percent and 1 percent, respectively. Figure 2 indicates that though the presence of these bans has spread, they have largely been clustered in the West and Northeast. As such, the bans are likely correlated with cultural and political factors.

RESULTS

Tables 3 through 5 present the estimated coefficients of smoking bans and tobacco policy on smoking initiation (Table 3), continuation (Table 4), and cessation (Table 5). In these tables,

Table 1

Summary Statistics of Select Variables

Variable	All	No Ban	Ban	Variable	All	No Ban	Ban
Has smoked	42	44	40	Female	60	60	61
	(49)	(50)	(49)		(49)	(49)	(49)
Current smoker	24	26	21	White	74	76	72
	(42)	(44)	(41)		(44)	(43)	(45)
Former smoker	18	18	19	Single	38	39	36
	(39)	(38)	(39)		(48)	(49)	(48)
Quit attempt	14	15	12	Parent	62	61	63
	(34)	(36)	(33)		(48)	(49)	(48)
Smoker*	56	60	53	Drinker	59	58	61
	(50)	(49)	(50)		(49)	(49)	(49)
Former smoker*	44	40	47	Employed	77	77	77
	(50)	(49)	(50)		(42)	(42)	(42)
Quit attempt**	57	56	59	Income <$25,000	15	16	14
	(49)	(50)	(49)		(36)	(37)	(34)
Age <25	18	17	19	Income <$50,000	20	23	18
	(38)	(37)	(39)		(40)	(42)	(38)
Age <30	12	13	11	Income <$75,000	36	38	34
	(32)	(35)	(31)		(48)	(48)	(47)
Age <35	13	14	13	Income >$75,000	29	23	34
	(34)	(34)	(33)		(45)	(42)	(47)
Age <40	17	17	16	Cigarette price + tax	4.42	4.31	4.51
	(38)	(37)	(37)	($, per pack)	(0.68)	(0.58)	(0.75)
Age <45	19	19	20	State funding ($, per capita)	2.74	2.81	2.68
	(39)	(39)	(40)		(2.73)	(2.64)	(2.80)
Age <50	21	20	21	Beer price ($, per 6-pack)	8.12	8.53	7.67
	(41)	(40)	(41)		(1.10)	(0.93)	(1.10)
HS non-graduate	07	07	07	Indoor workplace	38.26	38.09	39.32
	(26)	(26)	(25)		(4.82)	(4.60)	(4.78)
HS graduate	26	29	24	Restaurant	2.81	2.78	2.83
	(44)	(45)	(43)		(0.58)	(0.66)	(0.61)
Some college	28	30	27	Bar	0.67	0.73	0.62
	(45)	(46)	(45)		(0.51)	(0.58)	(0.42)
College graduate	38	34	41	Urban	93	91	95
	(49)	(47)	(49)		(25)	(29)	(22)

NOTE: All demographic variables are dummy variables. Standard deviations are listed in parentheses. Values are percents unless otherwise noted. The total number of observations is 965,359; of these 507,540 are within areas with bans. *Sample of respondents who have smoked; **sample of respondents who are current smokers.

Table 2

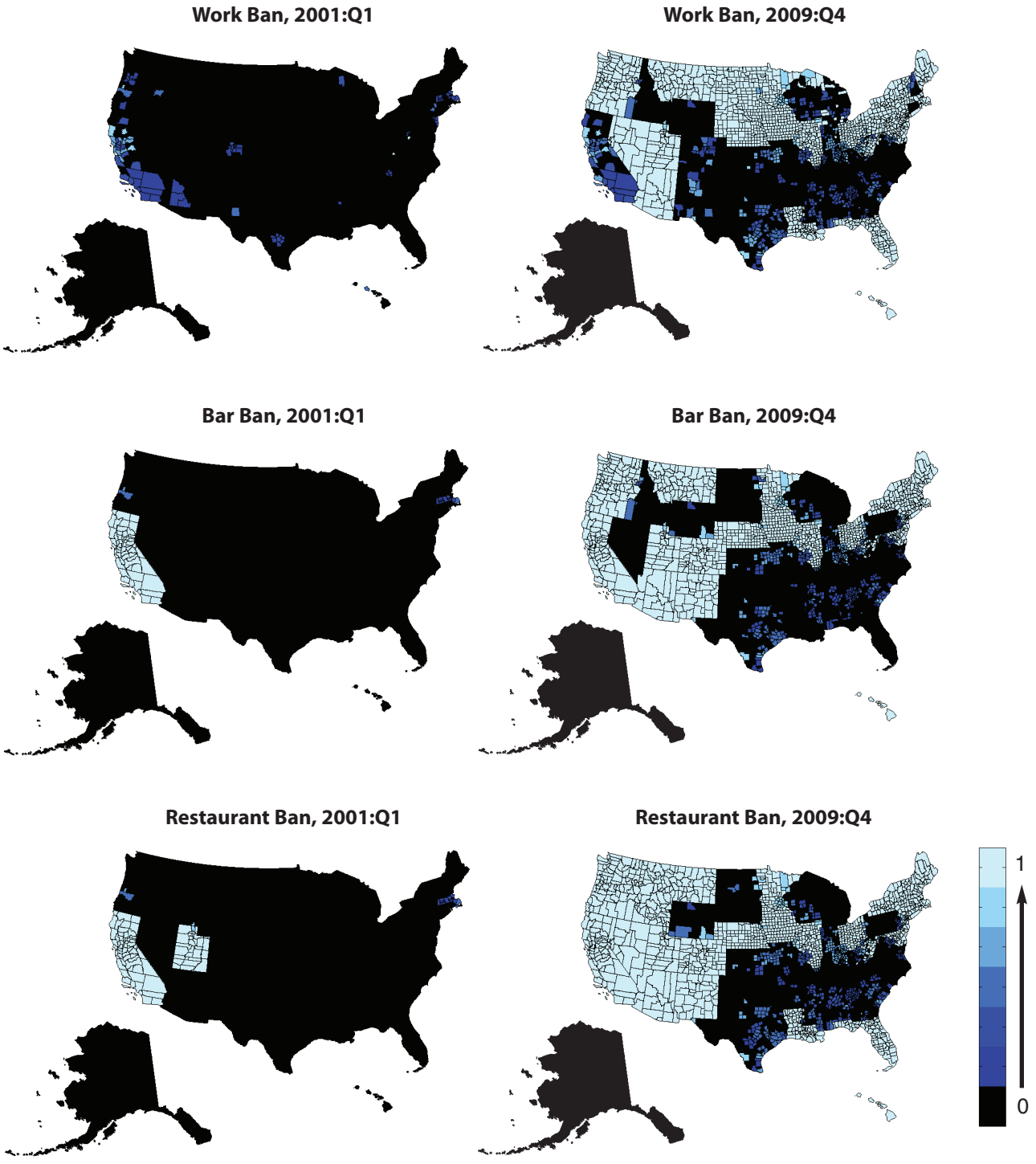
Ban Statistics

Type of ban	All	2001	2009
Municipality workplace ban	12	8	17
	(33)	(27)	(38)
County workplace ban	1	0	2
	(10)	(2)	(13)
State workplace ban	24	0	47
	(42)	(0)	(50)
Any workplace ban in CBSA	44	14	72
	(50)	(32)	(45)
Workplace ban probability	29	1	57
	(44)	(7)	(47)
Municipal bar ban	7	4	9
	(25)	(19)	(29)
County bar ban	0	0	1
	(6)	(0)	(11)
State bar ban	24	3	53
	(43)	(16)	(50)
Any bar ban in CBSA	36	7	69
	(48)	(27)	(46)
Bar ban probability	27	3	57
	(42)	(16)	(46)
Municipality restaurant ban	8	4	12
	(28)	(20)	(32)
County restaurant ban	1	0	1
	(09)	(01)	(11)
State restaurant ban	32	5	60
	(47)	(22)	(49)
Any restaurant ban in CBSA	45	11	79
	(50)	(31)	(41)
Restaurant ban probability	36	6	66
	(45)	(22)	(43)
Any ban in county	46	12	78
	(50)	(32)	(41)
Any ban in CBSA	53	15	83
	(50)	(36)	(37)
Observations	965,359	76,483	119,260

NOTE: All variables except probabilities are dummy variables. Standard deviations are listed in parentheses. Values are percents. Ban dummy variables refer to bans in counties. Ban probabilities use the probability of encountering a ban in a CBSA for urban residents and in a county for rural residents.

Figure 2

Smoking Ban Probabilities (2001:Q1–2009:Q4)



each column represents different specifications: Column 1 contains the results for the baseline regression, in which we explicitly control for each type of municipal-, county-, and state-level ban and the chance of encountering each of these bans. The remaining columns present results for various robustness checks. Column 2 contains the results for the probability of encountering a ban only. Column 3 controls for state-level bans and the probability of encountering any type of ban in an attempt to control the multicollinearity within the regression. Column 4 controls only for the type of ban encountered. Column 5 includes establishment shares (i.e., bars as a percentage of total establishments in a county) in the probability of encountering a ban.[8] Table 6 shows the estimated marginal effects for the specifications in columns 2 and 4 for each of the dependent variables. Because the results for the individual-level covariate, $\boldsymbol{Z}_i$, are robust to changing the specification of the ban variables, we present probit coefficients from the baseline regression in Table 7 and marginal effects from the fourth specification (i.e., column 4 in Tables 3 through 5) in Table 8.

Despite some statistically significant coefficients on the ban dummy variables, we find that the correlations between smoking bans and the smoking behaviors examined are not quantitatively significant. In other words, the bans do not generally correlate with fewer people starting to smoke or continuing to smoke. They also do not generally correlate with more people attempting to quit smoking. In the following section, we discuss each of the examined smoking behaviors separately.

Effects on Smoking Behaviors

Smoking Initiation. Table 3 contains the results for the probit regression with smoking initiation (whether a respondent has smoked 100 cigarettes in his or her lifetime) as the left-hand-side variable and various specifications of the vector of policy-level variables. The results in column 1 indicate that the presence of any indoor workplace, municipality bar, municipality restaurant, or state restaurant ban is not statistically significantly correlated with the number of respondents who have smoked in their lifetime. These results imply that the adoption of these types of smoking bans is independent of the smoking rates in a particular region and that individuals are no less likely to start smoking in areas where indoor workplace and restaurant smoking bans exist.

The presence of a county- or state-level bar ban, as well as the probability of encountering a smoking ban in a bar, is statistically significant from zero, suggesting that smoking initiation is negatively correlated with the presence of county- and state-level bar bans and, for those who drink, the presence of any bar ban. These coefficients are not only statistically significant, but also larger in magnitude than those of the other policy variables, though they are relatively small compared with those of the demographic variables. Further, only a small number of respondents encounter a county-level ban, making the correlations between initiation and county-level bar and restaurant bans possibly spurious. The marginal effects of these coefficients show that county-level and state-level bar bans are associated, respectively, with a 2.5 percent and a 1.9 percent decrease in the probability that an individual has smoked. The introduction of any smoking ban in bars is associated with up to a 1.3 percent decrease in smoking initiation among individuals who drink.

Table 3

Initiation Probit Results

	Baseline	Robustness checks			
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Municipality workplace ban	0.000	—	—	0.001	0.003
	(0.025)	—	—	(0.204)	(0.500)
County workplace ban	–0.001	—	—	0.000	0.005
	(0.040)	—	—	(0.014)	(0.276)
State workplace ban	0.003	—	0.004	0.007	0.013
	(0.398)	—	(0.417)	(0.883)	(1.265)
Probability of encountering workplace ban	0.003	0.004	0.002	—	—
	(0.386)	(0.641)	(0.354)	—	—
Probability of encountering workplace ban × Indoor workplace %	—	—	—	—	0.000
	—	—	—	—	(1.008)
Municipality bar ban	–0.003	—	—	–0.008	–0.009
	(0.282)	—	—	(0.634)	(0.742)
County bar ban	–0.064*	—	—	–0.066*	–0.068*
	(1.980)	—	—	(2.066)	(2.102)
State bar ban	–0.039**	—	–0.037**	–0.050**	–0.053**
	(3.832)	—	(3.604)	(5.230)	(5.160)
Probability of encountering bar ban	–0.024**	–0.033**	–0.026**	—	—
	(3.651)	(5.541)	(4.003)	—	—
Probability of encountering bar ban × Bar %	—	—	—	—	0.007
	—	—	—	—	(0.747)
Municipality restaurant ban	–0.015	—	—	–0.018	–0.018
	(1.305)	—	—	(1.617)	(1.595)
County restaurant ban	0.063**	—	—	0.055*	0.055*
	(2.677)	—	—	(2.460)	(2.312)
State restaurant ban	0.023	—	0.027*	0.012	0.011
	(1.724)	—	(2.119)	(1.189)	(0.893)
Probability of encountering restaurant ban	–0.011	–0.008	–0.013	—	—
	(1.101)	(1.331)	(1.461)	—	—
Probability of encountering restaurant ban × Restaurant %	—	—	—	—	0.000
	—	—	—	—	(0.124)
Cigarette price + tax (per pack)	0.017	0.008	0.015	0.016	0.016
	(0.746)	(0.351)	(0.665)	(0.698)	(0.692)
State tobacco control funding	0.004	0.004	0.004	0.005	0.005
	(1.351)	(1.332)	(1.259)	(1.516)	(1.468)
Beer price (per 6-pack)	–0.019	–0.019	–0.014	–0.017	–0.016
	(0.426)	(0.428)	(0.311)	(0.365)	(0.361)
% Correctly predicted	65.26	65.26	65.27	65.25	65.26

NOTE: The absolute values of *z*-statistics are listed in parentheses. * and ** indicate significance at the 5 percent and 1 percent levels, respectively; 965,359 observations.

Table 4

Continuation Probit Results

	Baseline	Robustness checks			
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Municipality workplace ban	–0.001	—	—	–0.006	0.005
	(0.075)	—	—	(0.594)	(0.461)
County workplace ban	–0.049	—	—	–0.066*	–0.038
	(1.715)	—	—	(2.324)	(1.306)
State workplace ban	0.003	—	0.005	–0.02	0.014
	(0.191)	—	(0.390)	(1.698)	(0.884)
Probability of encountering workplace ban	–0.037**	–0.036**	–0.038**	—	—
	(3.560)	(4.075)	(3.768)	—	—
Probability of encountering workplace ban × Indoor workplace %	—	—	—	—	–0.001**
	—	—	—	—	(3.768)
Municipality bar ban	–0.003	—	—	–0.016	–0.025
	(0.147)	—	—	(0.836)	(1.331)
County bar ban	–0.005	—	—	–0.029	–0.053
	(0.110)	—	—	(0.594)	(1.083)
State bar ban	0.008	—	0.012	–0.031*	–0.056**
	(0.524)	—	(0.737)	(2.059)	(3.447)
Probability of encountering bar ban	–0.072**	–0.067**	–0.071**	—	—
	(7.111)	(7.159)	(7.067)	—	—
Probability of encountering bar ban × Bar %	—	—	—	—	0.054
	—	—	—	—	(3.886)**
Municipality restaurant ban	–0.046*	—	—	–0.037*	–0.029
	(2.468)	—	—	(2.049)	(1.599)
County restaurant ban	–0.012	—	—	0.012	0.034
	(0.344)	—	—	(0.373)	(0.971)
State restaurant ban	–0.011	—	0.017	0.016	0.037
	(0.539)	—	(0.856)	(0.965)	(1.884)
Probability of encountering restaurant ban	0.032*	0.025*	0.006	—	—
	(2.132)	(2.506)	(0.418)	—	—
Probability of encountering restaurant ban × Restaurant %	—	—	—	—	–0.009
	—	—	—	—	(1.849)
Cigarette price + tax (per pack)	–0.168**	–0.164**	–0.166**	–0.169**	–0.169**
	(4.770)	(4.691)	(4.745)	(4.814)	(4.803)
State tobacco control funding	0.005	0.003	0.004	0.006	0.005
	(1.026)	(0.513)	(0.719)	(1.216)	(0.948)
Beer price (per 6-pack)	0.071	0.09	0.074	0.074	0.076
	(1.019)	(1.289)	(1.060)	(1.066)	(1.084)
% Correctly predicted	65.083	65.098	65.079	65.081	65.076

NOTE: The absolute values of *z*-statistics are listed in parentheses. * and ** indicate significance at the 5 percent and 1 percent levels, respectively; 404,861 observations.

Table 5

Cessation Probit Results

	Baseline	Robustness checks			
Variable	(1)	(2)	(3)	(4)	(5)
Municipality workplace ban	0.004	—	—	0.006	0.007
	(0.293)	—	—	(0.412)	(0.468)
County workplace ban	–0.048	—	—	–0.043	–0.042
	(1.318)	—	—	(1.208)	(1.120)
State workplace ban	–0.001	—	0.000	0.006	0.007
	(0.034)	—	(0.006)	(0.372)	(0.307)
Probability of encountering workplace ban	0.011	0.009	0.008	—	—
	(0.795)	(0.753)	(0.649)	—	—
Probability of encountering workplace ban × Indoor workplace %	—	—	—	—	0.000
	—	—	—	—	(0.262)
Municipality bar ban	0.046	—	—	0.049*	0.046
	(1.852)	—	—	(1.973)	(1.819)
County bar ban	0.032	—	—	0.038	0.028
	(0.528)	—	—	(0.622)	(0.461)
State bar ban	–0.026	—	–0.030	–0.018	–0.028
	(1.241)	—	(1.436)	(0.917)	(1.288)
Probability of encountering bar ban	0.015	0.010	0.018	—	—
	(1.091)	(0.787)	(1.313)	—	—
Probability of encountering bar ban × Bar %	—	—	—	—	0.021
	—	—	—	—	(1.148)
Municipality restaurant ban	–0.024	—	—	–0.026	–0.023
	(0.976)	—	—	(1.117)	(0.960)
County restaurant ban	0.015	—	—	0.008	0.018
	(0.337)	—	—	(0.185)	(0.408)
State restaurant ban	0.013	—	0.007	0.004	0.016
	(0.463)	—	(0.273)	(0.201)	(0.610)
Probability of encountering restaurant ban	–0.010	–0.011	–0.003	—	—
	(0.490)	(0.874)	(0.184)	—	—
Probability of encountering restaurant ban × Restaurant %	—	—	—	—	–0.005
	—	—	—	—	(0.734)
Cigarette price + tax (per pack)	0.153**	0.151**	0.158**	0.153**	0.151**
	(3.328)	(3.312)	(3.441)	(3.328)	(3.297)
State tobacco control funding	–0.019**	–0.018**	–0.018**	–0.019**	–0.019**
	(2.902)	(2.772)	(2.841)	(2.919)	(2.909)
Beer price (per 6-pack)	–0.177	–0.197*	–0.186*	–0.178	–0.176
	(1.943)	(2.166)	(2.043)	(1.949)	(1.926)
% Correctly predicted	58.99	58.96	58.97	58.98	58.98

NOTE: The absolute values of *z*-statistics are listed in parentheses. * and ** indicate significance at the 5 percent and 1 percent levels, respectively.

Table 6

Marginal Effects of Bans on Smoking Behavior

Variable	Initiation*		Continuation†		Cessation‡	
Municipality workplace ban	0.1	—	–0.2	—	0.2	—
County workplace ban	0.0	—	–2.6	—	–1.7	—
State workplace ban	0.3	—	–0.8	—	0.2	—
Probability of encountering a workplace ban	—	0.1	—	–1.4	—	0.3
Municipality bar ban	–0.3	—	–0.6	—	1.9	—
County bar ban	–2.5	—	–1.1	—	1.5	—
State bar ban	–1.9	—	–1.2	—	–0.7	—
Probability of encountering a bar ban	—	–1.3	—	–2.6	—	0.4
Municipality restaurant ban	–0.7	—	–1.5	—	–1.0	—
County restaurant ban	2.2	—	0.5	—	0.3	—
State restaurant ban	0.5	—	0.6	—	0.2	—
Probability of encountering a restaurant ban	—	–0.3	—	1.0	—	–0.4
Cigarette price + tax (per pack)	0.6	0.3	–6.6	–6.4	6.0	5.9
State tobacco control funding	0.2	0.2	0.2	0.1	–0.7	–0.7
Beer price (per 6-pack)	–0.6	–0.8	2.9	3.5	–7.0	–7.7

NOTE: Marginal effects are denoted in percent and were estimated at the mean of the continuous variables and at 0 for all other dummy variables using the specifications in columns 2 and 4 in Tables 3 through 5. (*The left-column values correspond to column 4 probit results and the right-column values correspond to column 2 probit results in Table 3. †The left-column values correspond to column 4 probit and the right-column values correspond to column 2 probit results in Table 4. ‡The left-column values correspond to column 4 probit and the right-column values correspond to column 2 probit results in Table 5.) Marginal effects for continuous variables represent the change in the probability associated with an infinitesimal change in the variable evaluated at the mean of the other variables; marginal effects for dummy variables report the change in the probability associated with a discrete change in the variable.

One interpretation of the results is that, in the absence of exposure to smoking in bars, individuals are more likely to begin smoking. Alternatively, government officials may be more likely to pass smoking bans in bars if there are lower smoking rates among their constituents (see Pakko, 2006, for an explanation). Given the relative magnitudes of these marginal effects and coefficients, the latter seems plausible for the state-level ban. Regardless, the marginal effects of instituting a smoking ban on smoking behavior are small compared with the effects of other individual-level characteristics associated with smoking initiation (see Table 8).

Smoking Continuation. Table 4 presents the results for smoking continuation. The correlation between continuation and smoking ban dummy variables is generally not statistically significant. In fact, only the municipality-level restaurant smoking bans are statistically significant, suggesting that restaurant bans at the local level are either more likely to encourage successful quitting or are more likely to be passed because the area already has a high number of nonsmokers. The effect of bans on smoking behavior, though, is still small compared with the effect of cigarette prices and other demographic variables. For the mean individual in the sample, the effects of instituting a ban are small (approximately a 1.5 percent decrease in the likelihood of being a current smoker) compared with increases in cigarette prices (between a 6.4 and a 6.6 percent decrease).

Table 7

Probit Results for Controls

Variable	Initiation	Continuation	Cessation
Female	–0.071**	0.026**	0.057**
	(25.133)	(6.004)	(10.101)
Age ≥ 25 & < 30	–0.513**	0.373**	0.349**
	(99.320)	(45.662)	(35.285)
Age <35	–0.233**	0.267**	0.218**
	(47.700)	(35.916)	(22.333)
Age <40	–0.223**	0.219**	0.136**
	(48.259)	(31.025)	(14.344)
Age <45	–0.190**	0.197**	0.045**
	(42.889)	(29.353)	(5.027)
Age <50	–0.093**	0.115**	(0.002)
	(21.687)	(18.377)	(–0.224)
Single	0.103**	0.277**	–0.039**
	(32.181)	(58.111)	(6.442)
Parent	–0.042**	–0.101**	0.091**
	(13.999)	(22.202)	(15.618)
High school graduate	–0.237**	–0.197**	(0.017)
	(40.759)	(24.612)	(–1.92)
Some college	–0.419**	–0.366**	0.127**
	(71.189)	(44.763)	(13.796)
College graduate	–0.878	–0.706**	0.134**
	(144.280)**	(80.935)	(12.625)
Income < $50,000	–0.095**	–0.119**	–0.028**
	(20.397)	(17.342)	(3.504)
Income < $75,000	–0.236**	–0.297**	–0.052**
	(50.586)	(42.947)	(6.296)
Income ≥ $75,000	–0.388**	–0.499**	–0.057**
	(73.002)	(61.618)	(5.455)
Employed	–0.057**	–0.025**	–0.071**
	(14.583)	(4.131)	(9.603)
Drinker	0.363**	0.183**	–0.025**
	(108.682)	(35.374)	(3.79)
Survey year	–0.009**	–0.004**	0.009**
	(8.558)	(2.640)	(4.311)
Constant	18.125**	8.979**	–17.088**
	(8.694)	(2.796)	(4.167)
F-statistic: Race	18035.900**	808.510**	1201.907**
F-Statistic: State	3020.399**	1592.463**	232.856**

NOTE: The absolute values of *z*-statistics are listed in parentheses. * and ** indicate significance at the 5 percent and 1 percent levels, respectively.

Table 8

Marginal Effects of Controls on Smoking Behavior

Variable	Initiation	Continuation	Cessation
Female	–2.8	1.0	2.2
Age ≥ 25 & < 30	–18.6	14.0	13.2
Age <35	–8.8	10.2	8.4
Age<40	–8.5	8.5	5.3
Age<45	–7.3	7.6	1.8
Age<50	–3.6	4.5	0.1
Single	4.0	10.8	–1.5
Parent	–1.6	–4.0	3.6
High school graduate	–9.1	–7.8	0.7
Some college	–15.8	–14.4	5.0
College graduate	–32.3	–27.6	5.2
Income < $50,000	–3.7	–4.7	–1.1
Income < $75,000	–9.1	–11.7	–2.0
Income ≥ $75,000	–14.7	–19.7	–2.2
Employed	–2.2	–1.4	–2.7
Drinker	13.7	6.5	–0.8
Survey year	–0.4	–0.2	0.3

NOTE: Marginal effects are denoted in percent and were estimated at the mean of the continuous variables and at 0 for all other dummy variables using the specifications in columns 2 and 4 in Tables 3 through 5. Marginal effects for continuous variables represent the change in the probability associated with an infinitesimal change in the variable evaluated at the mean of the other variables; marginal effects for dummy variables report the change in the probability associated with a discrete change in the variable.

Although the coefficients on the smoking ban dummy variables are statistically insignificant, those for the probabilities of encountering a bar ban are significant at the 5-percent or 1-percent level. Increasing the probability of encountering a bar ban has the largest effect of any ban, but it is still small compared with the effect of increasing cigarette prices. The potential effects associated with an increase in the probability of encountering a ban in the workplace (1.4 percent decrease) are also small. Unfortunately, these effects may be biased: The positive and significant coefficient on the probability of encountering a restaurant ban indicates there are more smokers in areas with restaurant bans. Despite this potential bias, price controls have larger and generally more statistically significant correlations with changes in smoking behavior than non-price controls.

Smoking Cessation. The final behavior examined—whether a current smoker has attempted to quit in the past year—indicates whether bans encourage people to stop smoking. Living in an area with any type of smoking ban is not correlated with an increased likelihood of cessation. Thus, enacting smoking prohibitions in indoor workplaces, bars, and restaurants does not appear to increase the likelihood that a current smoker will attempt to quit.

In contrast, a 1 percent increase in the price of a pack of cigarettes is associated with approximately a 6 percent increase in the likelihood that a current smoker has attempted to quit in the

past year. It is also worth noting that cessation is the only dependent variable for which state tobacco control funding is negative and statistically significant. It is possible either that states with fewer people attempting to quit smoking spend more on tobacco control or that policymakers are more likely to use more aggressive legislation (i.e., taxes and introduction of cessation programs rather than bans) to encourage smokers to quit.

Robustness of Findings

The remaining columns of Tables 3 through 5 check the robustness of our findings. These specifications exclude (some of) the ban dummy variables (columns 2 and 3), exclude the chance of encountering a ban (column 4), and scale the chance of encountering a smoking ban by the establishment shares for that particular type of ban (column 5). Regardless of specification, the results are largely consistent with those of the baseline regression for each dependent variable. Certain ban dummy variables do change statistical significance when the probabilities of encountering a ban are excluded (column 4).[9] This change suggests that some bans do have a statistically significant, albeit economically small, effect on some smoking behavior.

Factoring establishment shares into the probability of encountering a ban dramatically changes the magnitudes of the estimated coefficients on these probabilities. For example, the coefficient on the probability of encountering a workplace ban in column 5 of Table 4 is much closer to zero when controlling for the share of indoor workplaces. In other cases, scaling the probability of encountering a smoking ban by establishment share negates its statistical insignificance. To illustrate, the correlation between encountering a restaurant ban and smoking continuation (Table 4, column 5) has a different sign, but becomes statistically insignificant.

Controlling for establishments in the probability of encountering a smoking ban in a bar changes the sign of statistically significant coefficients. The change in sign indicates that areas with more bars are more likely to have higher smoking rates. This finding implies alcohol and cigarette consumption are complements. It follows, then, that areas with more bars may be less likely to enact smoking bans in bars because of the economic consequences for the bar industry. In fact, the counties and metropolitan areas in our data with the highest number of bars are those without bar bans. Since smoking restrictions in bars may be enacted in areas where they are naturally less likely to be encountered, their efficacy may be limited because they are easily avoidable.

CONCLUSION

We find that 100-percent smoke-free bans in indoor workplaces, bars, and restaurants are not typically correlated with smoking behavior: The effects of bans on the smoking behavior of individuals most likely to encounter bans are generally small or statistically insignificant. Because the data do not track the same individuals over time, we cannot observe changes in smoking activity. Thus, we do not test whether these effects are causal and cannot conclude that enacting a smoking ban has no effect on smoking behavior.

Several factors may explain the lack of an observed correlation between bans and smoking behavior even if bans do work. First, bans may change smoking behavior slowly, with effects seen only years after their enactment and possibly after the end of our data sample. Second,

bans may be endogenous—more prevalent in areas with initially higher smoking rates—and only equalize smoking rates across areas. However, a smoker is no more likely to have tried to quit in areas with smoking bans than in areas without smoking bans, providing some evidence against this form of endogeneity.

It is also possible that the results do indicate that bans are ineffective in changing smoking behavior. Smokers may have simply changed *where* they smoke instead of changing *how much* they smoke. For example, they may not consider smoking outside a bar or restaurant as an inconvenience. They may also spend less time at bars and restaurants and more time at home where they can smoke freely (Adda and Cornaglia, 2010). They may even be more willing to travel farther to areas without bans to go to bars and restaurants (Adams and Cotti, 2008). Thus, enacting a smoking ban may not increase the opportunity cost of smoking enough to significantly deter smokers from smoking.

Nonetheless, the results of this paper imply that increasing cigarette taxes may be more effective in changing smoking behavior than implementing a ban. In the majority of the estimates, the magnitude of an increase in cigarette prices is larger and of greater statistical significance than any of the magnitudes for an individual ban or the aggregate effect of all three types of bans. Hence, increasing taxes appears to be more effective in reducing the number of smokers. This finding is especially true in analyses of current smokers and their attempts to quit smoking: In all models of smoking cessation attempts, the ban variables are neither statistically nor economically significant, but the price variables are.

Although the correlations between bans and being a current smoker tend to be small relative to changes in price controls, smoking bans may still have health benefits by limiting individuals' exposure to secondhand smoke. In fact, previous studies find that smoking bans do not have significant effects on the smoker but do decrease the amount of secondhand smoke in workplaces, bars, and restaurants (Carpenter, 2009, and Carpenter, Postolek, and Warman, 2011) and the number of smoking-related hospital admissions (Juster et al., 2007).

A final consideration must be the economic effect of the bans on businesses. Pakko (2006) argues that these effects vary depending on an establishment's clientele and marketing, especially in the entertainment and hospitality sectors. If imposing a ban has little correlation with or little effect on smoker behavior, it is important to consider the outcomes for all affected parties—smokers, nonsmokers, and business owners who are forced to comply with such regulations. Only after quantifying these factors can we determine whether smoking bans increase social welfare.

NOTES

1 One feature of the probit is that it is robust to the presence of time-invariant variables (Gallet, Hoover, and Lee, 2006). This proves useful here as a number of our regressors vary across space but not across time.

2 Centers for Disease Control and Prevention (CDC). *Behavioral Risk Factor Surveillance System Survey Data*. Atlanta, Georgia: U.S. Department of Health and Human Services, 2001-09.

3 See Siegel and Biener, 2000; Liu and Tan, 2009; Marlow, 2007.

4 Ban data are from Americans Nonsmoker's Rights Foundation. Chronological Table of U.S. Population Protected by 100-percent Smoke-Free State or Local Laws (data file), 2010; www.no-smoke.org/pdf/EffectivePopulationList.pdf. Cigarette price data are from (i) Orzechowski, William and Walker, Robert. *The Tax Burden on Tobacco: Historical*

Compilation. Volume 44. Arlington, VA; (ii) Council for Community and Economic Research. *ACCRA Cost of Living Index*. Arlington, VA: Council for Community and Economic Research, 2010. State tobacco control funding data are from (i) ImpacTeen State Level Tobacco Control Policy and Prevalence Database. Tobacco Control Policy and Prevalence Data: 1991-2008, http://www.impacteen.org/tobaccodata.htm; (ii) CDC. State Tobacco Activities Tracking and Evaluation (STATE) System, http://apps.nccd.cdc.gov/statesystem/DetailedReport/DetailedReports.aspx; and (iii) Council for Community and Economic Research. *ACCRA Cost of Living Index*. Arlington, VA: Council for Community and Economic Research, 2010.

[5] Data are from (i) U.S. Census Bureau. Population Estimates—All States, All Geography, 2009, www.census.gov/popest/data/cities/totals/2009/files/SUB-EST2009_ALL.csv; (ii) U.S. Census Bureau. Annual Estimates of the Population of Combined Statistical Areas: April 1, 2000 to July 1, 2009, www.census.gov/popest/data/metro/totals/2009/tables/CBSA-EST2009-02.csv; (iii) U.S. Census Bureau. Metropolitan and Micropolitan Statistical Areas and Components, December 2009, With Codes, 2009, www.census.gov/population/metro/files/lists/2009/List1.txt; and (iv) Missouri Census Data Center, http://mcdc.missouri.edu/.

[6] Of the total sample, 5 percent lives in a municipality or county without a smoking ban that is located in a CBSA with other municipalities or counties that do have smoking bans.

[7] Of urban respondents, 87 percent live in a CBSA with a ban.

[8] Establishment numbers are from the U.S. Census Bureau, County Business Patterns, 2001-2009, www.census.gov/econ/cbp/download/index.htm.

[9] Additional robustness checks examining various ban dummy variable and ban probability lags were estimated. The results of these estimates were consistent with those reported in this paper.

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DATA APPENDIX

Individual-Level Data

The BRFSS, conducted by the CDC, provides all of the individual-level data on smoking and demographics for the sample of 965,359 individuals 18 to 50 years of age who were interviewed between January 2, 2001, and December 31, 2009. The appropriate variables were taken and coded as dummy variables.

Ban Data

We merged the BRFSS data by interview date and county code with the 100-percent smoke-free workplace, bar, and restaurant ban enactment data from the Americans for Nonsmokers' Rights (ANR). The ANR data were presented as simply the date on which a ban in a location (municipality, county, or state) went into effect. We manually geocoded county- and state-level bans, while we conducted a number of string-to-string merges with Census data to geocode the municipality-level bans. When a less stringent ban was passed after a more stringent ban (e.g., a municipality codified the more stringent ban in its own ordinance), we used the more stringent ban date. Our construction of the smoking ban variables did not take into account bans that had been passed and then repealed, as they were not included in the ANR data.

Ban Probability Data

We calculated the ban probabilities for urban residents by determining the portion of a CBSA population living in an area with a ban using annual place, county subdivision, county, state, and CBSA population data from the Census. We calculated ban probabilities for rural residents by determining the proportion of a county's population living in an area with a ban using annual place, county subdivision, and county population data from the Census. These probabilities were calculated for each of the three types of bans. In other words, the probabilities for a

workplace ban, bar ban, and restaurant ban may not be the same for an individual respondent. Instead, they reflect the probability of encountering each ban on its own. We then multiplied the workplace ban probabilities by an indicator (0, 1) for whether an individual is employed and multiplied the bar ban probabilities by an indicator (0,1) for whether an individual drinks.

Cigarette Price and State Tobacco Control Funding Data

The cigarette price and state tobacco control variables are annual, state-level variables. These nominal variables were adjusted using annual consumer price index data and again using quarterly values of the average ACCRA Cost of Living Index composite index for each state, as the number participating urban areas in each state in each quarter varied. In the end, these price variables control for temporal and geographic changes in the cost of living. They were matched to BRFSS respondents based on state Federal Information Processing Standard (FIPS) codes.

Establishment Data

The establishment data in the robustness checks are from the Census Bureau's County Business Patterns. Specifically, we used the total number of restaurants and bars in each county. To determine the total number of indoor workplace establishments, we took the sum of establishments in information services, finance, professional services, management, administrative services, healthcare, and manufacturing in each county. We divided the total number of indoor workplaces, restaurants, and bars by the total number of establishments within a county to obtain the establishment percentages.

Close

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