Wall of Smoke:
Smoking Bans, Borders, and Patron Behavior

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Abstract

In the days before indoor smoking bans, individual bars and restaurants were resistant to prohibit smoking for three main reasons: they were unable to predict consumer reactions, they were reluctant to go against the status quo, and they were hesitant to act first among their peers. However, the decision to go smoke-free was made for many in the service industry when various states and counties passed control legislation. This natural experiment allows for the testing of hypotheses about the implications restrictions have on the bar and restaurant industry. This paper examines the effect smoking bans have on bar and restaurant patronage ultimately observed through employment, which is directly derived from the business of smokers and non-smokers. Because people can avoid policies by crossing borders, choosing an appropriate control group presents trade-offs. Researchers may either use geographically close localities (which may be contaminated by spillover effects) or distant regions (which may not be as characteristically similar to the treatment area in question). This paper presents a novel approach by using both sets of controls while also accounting for spillover into adjacent areas, thereby avoiding the trade-off decision all together. Although created to account for the spillover effect of smoking bans, this model is relevant to an endless number of future evaluations of geographically inconsistent policies. This paper focuses on how including additional measures of contamination in the analysis yields results that strongly support a net financial benefit for bars and restaurants under smoking bans while also explaining how previous studies (which have neglected these spillover effects) may have found a range of insignificant and contradictory results.

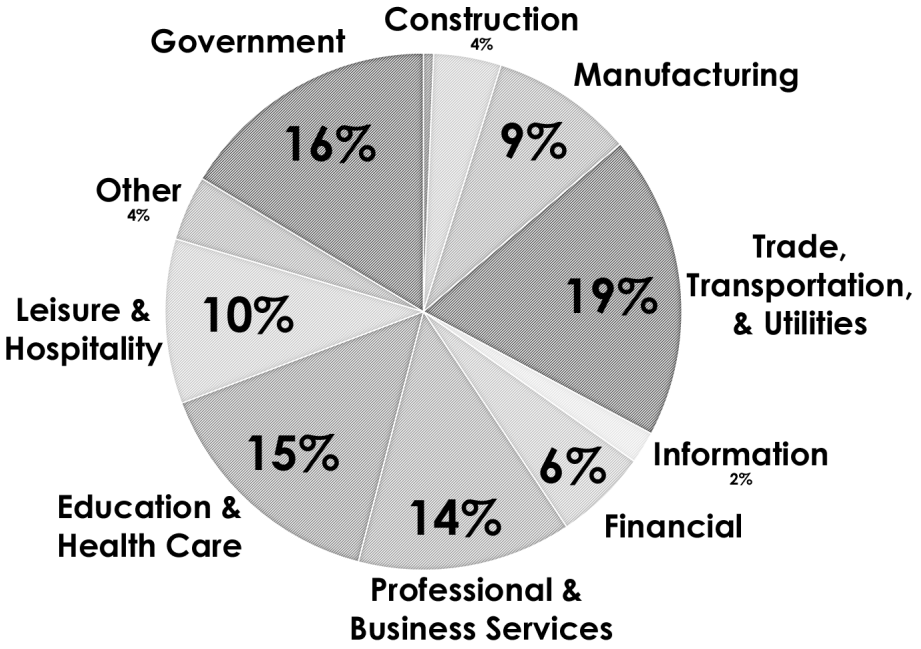
Keywords: local government regulations, smoking bans, employment

1. Introduction

Almost as long as there have been regulations on the trade, uses, or prices of goods, there have been individuals that have sought to circumvent such restrictions. Smuggling, tax dodging, and black markets have existed for centuries. Avoidance behaviors today are not limited to such explicit lawlessness, yet are similar in spirit.

When policies are enacted, they not only affect the behavior of their constituents, but those in neighboring areas where policy differs. In order to estimate the effects of regulations that people can avoid (or take advantage of) with travel their movement across policy boundaries must be taken into account. This research examines the impact of state and local smoking bans on employment in the bar and restaurant industry while taking into account the flow of populations across borders where policy differs.

Figure 1: 2012 Employment by Sector



The demand for workers in bars and restaurants is assumed to be directly derived from the demand for food and drink services. As consumers spend more, jobs increase and vice versa. The workforce in this sector is extremely fluid. Most jobs are low skilled and workers can enter and leave the market

quite easily. Employers often do not have to pay the full minimum wage as many states allow for a tip credit because customers give bartenders and servers a high percentage of their income directly through gratuities. While the variable being measured is employment, the relevant changes that occur happen in consumer spending.

1.1. Importance of the Subject Matter

Why be concerned about smoking policies and their effect on this industry? First, the sector is large. Recent estimates by the Bureau of Labor Statistics show that one in ten employees in the non-farm sector work in leisure and hospitality services (see Figure 1). Second, these policies are widespread and differ drastically across the United States. The nature and timing of such laws create a natural experiment that allows for the testing several hypotheses related to smokers' and nonsmokers' reactions to changes in regulations. Third, policy is inconsistent across municipalities creating incentives for consumers to cross borders to avoid or take advantage of different regulations. The results presented can help inform policy makers about the possible consequences of different options. Finally, economic theory about the direction of the effect of smoking bans is ambiguous. If a smoking ban draws more nonsmokers than the number of smokers it drives away then the net effect will be positive. If the opposite occurs, the net effect will be negative. This research attempts to settle the argument by using an original model, new methods, and more data.

1.2. Novel Model, Method, and Scope

This paper adds to the smoking ban literature in three areas. First, a clearer, simpler description of the actions and motivations of business owners, smokers, and nonsmokers in the face of a specific set of policy changes is presented. The behaviors are explained using fundamentals of economic theory coupled with insights from behavioral economics.

Second, this research employs novel empirical testing of hypotheses related to consumer behavior (and subsequently bar and restaurant employment) by estimating movement of consumers over geographical areas. This helps to eliminate some of the contamination of results caused by transient customers. Policies implemented in one jurisdiction often have an impact in neighboring area. In addition, all smoking bans are not treated as equal. Classifying bans by the availability of substitutes to consumers makes the measurement of individuals' reactions in similar regions more consistent.

Both of these approaches allow the estimates of subsequent outcomes to more accurately depict the behavior of groups following a smoking policy change.

Finally, this work investigates the effects of smoking bans on a much larger scope than previous research. Many earlier studies have researched smoking bans in a concentrated locality. The analysis examines the impact of bans on county employment across the entire nation over a sixteen year period.[1] Mean values of several key variables for different subsets of the data are displayed in Table 1.

1.3. Findings and Implications

The results suggest that the effect of a comprehensive smoking ban (one which prohibits smoking in all bars and restaurants) is beneficial to the bar and restaurant industry as a whole once border crossing behavior is controlled for. Weaker bans (those which only prohibit smoking in selected bars and restaurants) are also shown to be beneficial to the same establishments. Smoking bans do drive away some smoking customers, but bans drive away many more smokers when smoke-friendly alternatives are available in nearby regions.

Smoking bans *could* be detrimental to employment in a particular area if a relatively large percentage of the population is smokers and significant portion of the population lives close to bordering smoke-friendly regions. Enacting a smoking ban will be the most beneficial to an area already surrounded by smoke-free territory because smokers do not have close smoke-friendly substitutes for local smoke-free establishments.

Table 1 shows some characteristics of the entire sample used and four important subsamples. The contaminated counties along with those that have a ban are larger than average in population, service industry employment, and square mileage. Those with a ban tend to be smaller in size and have fewer residents and bar and restaurant employees than the mean. The clean counties–those that do not suffer from any contamination–have very similar characteristics on average as the entire sample of all counties.

[1] As with any large dataset, observations were not reported for all counties in all time periods.

Table 1: Mean Values of Relevant County Variables

	all counties	**contaminated**	**clean**	**ban**	**no ban**
	1.1	**1.2**	**1.3**	**1.4**	**1.5**
observations	42531	4267	38264	11435	31096
population	108114	136788	104917	205883	72162
	(326976)	(319206)	(327680)	(537085)	(188022)
bar and restaurant employment	3252	4225	3143	6332	2119
	(10211)	(10311)	(10194)	(16443)	(6197)
square mileage	1107	1530	1060	1142	1094
	(3022)	(2855)	(3037)	(1763)	(3369)
smoking prevalence	0.212	0.207	0.212	0.195	0.218
	(.033)	(.0387)	(.0318)	(.0336)	(.0299)

standard deviations are in parenthesis

2. Smoking Legislation Spreads Like Wildfire

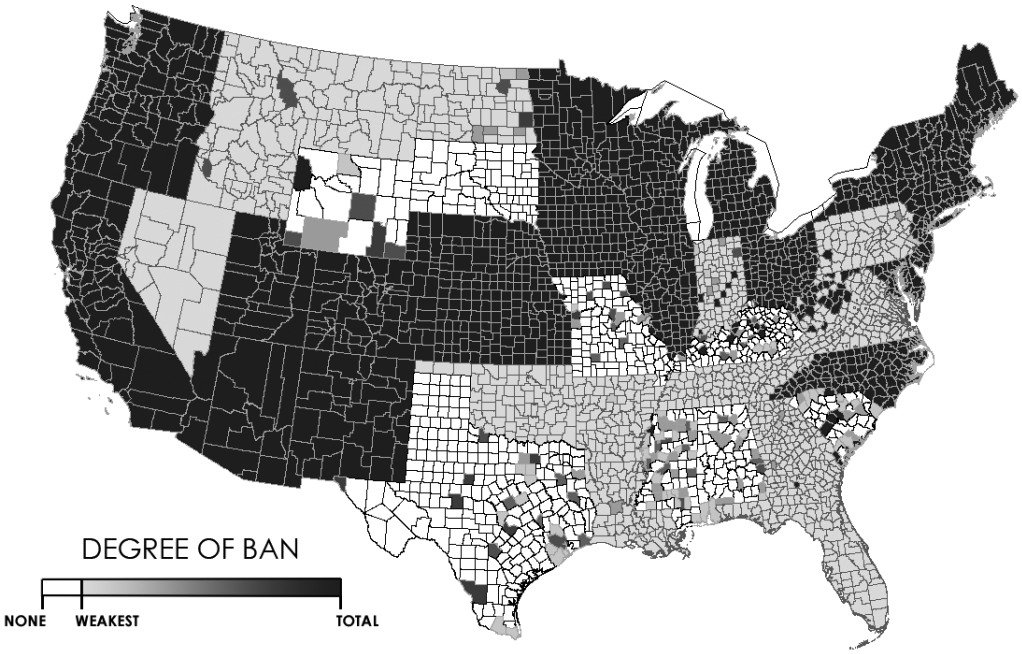
As early as 1990, fully comprehensive smoking bans for bars and restaurants began appearing on the books in towns and cities across America. The first of these bans at the county level occurred in 1993. Since then, counties in almost every state of the union have followed suit. In 1998, California became the first to enact a statewide smoking ban. As of 2012, more areas live under some ban than under no ban at all (see Figure 2).

2.1. Complacency, Fear, and Uncertainty Prevent Policy Change

Why has smoking ban legislation been necessary if it has a positive effect for restaurants? Most areas should have had a large number of establishments go smoke-free on their own and allow their smoking and nonsmoking customers to self sort. Three primary reasons that may have prevented individual establishments from prohibiting indoor smoking are:

1. **Status Quo Bias**
   Individuals, including business owners, are reluctant to stray from the norm. Allowing indoor smoking has been the norm in this country for most of its existence. Fighting tradition that spans hundreds of years is

Figure 2: Smoking Bans Implemented 1997-2012



no easy task. This bias is believed to be so powerful that Ginsburg et al. (2013) suggest that the best remedy is to enact temporary smoking bans everywhere and let everyone decide for themselves again once the status quo has been altered for a significant amount of time.

2. **Fear to Act First in a Non-cooperative Game**
   Choosing whether to be smoke-free or smoke-friendly has implications directly impacted by what neighbors decide to do. Smokers will travel to places they can smoke. Going smoke-free will have an immediate and possibly permanent visible effect of fewer smoking customers. It will take time for nonsmokers to learn of the change and increase their patronage. Business owners may not be willing to trade guaranteed short-term losses for uncertain long term gains.
3. **Representative Bias**
   In a smoke-filled room, the presence of smokers will be highly noticeable, while the presence of nonsmokers will be less conspicuous. This

will lead proprietors considering prohibition to overestimate the loss associated with smokers and underestimate the gains from the nonsmokers. In fact, many of the gains from nonsmokers are practically unpredictable by business owners and managers because they will be generated by customers that will fail to exist until a smoke-free policy is put into place.

2.2. Policy Can Remedy (or Cause) a Coordination Problem

If bars and restaurants all would be better off under a smoking ban, but each does not want to be the first to do so, legislation can correct for this. Whether this is morally just from an individual liberty standpoint is beyond the scope of this paper. The concern here is whether policy coordination can make all involved better off (as judged by themselves). Lawmakers cannot control the policy outside of their jurisdictions. Establishments near borders without similar prohibitions have the most to lose (or gain).

Constituents in smoke-free areas have felt the loss in patronage due to their cross-border smoke-friendly counterparts. In 2011, a bill[2] passed the Illinois State House of Representatives that would reinstate smoking in casinos if the nearest bordering state also allowed smoking in their gaming industry. If a nearby state passed legislature to prohibit smoking in their gambling facilities then the Illinois casinos near that state would revert to smoke-free. The bill did not pass the Illinois State Senate, but its mere existence confirms the coordination problem between neighboring competitors and supports the notion that smokers may be more willing to travel than nonsmokers.

2.3. Bars and Restaurants After a Ban

Once a ban has been put in place, compliance becomes the path of least resistance for service industry establishments. Some establishments can attempt to circumvent the law by providing segregated smoking areas that replicate conditions before the ban. Establishments can buy outdoor heating systems, build structures with faux roofs , or find loopholes for special privileges or exemptions.[3] Bars and restaurants can also ignore the ban outright and risk being charged penalties for doing so. To compensate, some establishments may charge a rental fee for an ashtray in order to pay fines

[2]Illinois General Assembly House Bill HB1965

[3]For example, some firms can buy licenses to become a private club or a cigar bar.

that accrue. Finally, some bars and restaurants exist outside the reach of authorities where officials cannot effectively monitor compliance with the law.

While all of these service industry reactions occur, they will not be modeled in this paper. Because the above actions minutely affect overall employment and consistently elude the available data, they needlessly complicate the research model. If such behaviors do have any significant impact on the hospitality industry, the effects would diminish the border-crossing trends the model predicts and make it harder to find evidence of spillover effects.

3. The Verdict is Not In

Previous studies report the full spectrum of possible findings. According to the International Agency for Research on Cancer (IARC (2009)), only two out of nineteen peer-reviewed studies found a negative economic impact due to a hospitality industry smoking ban. Adams and Cotti (2007) found that smoking bans reduce employment in bars. They also found that these same bans affect restaurant employment in a neutral or positive manner. Phelps (2006) found that 100% smoking bans affect bar employment negatively and restaurant employment positively. Adda et al. (2011) find a decline in pub patronage and sales in Scotland after authorities banned smoking. They use pubs across the English border as the control group, but fail to separate the possible increased patronage of Scots in English pubs from the control. Cultural differences and stricter drunk driving laws may hinder the ability to compare their findings with results obtained from studies conducted in the United States.

Eriksen and Chaloupka (2007) created criteria for a reliable study of the effect of smoking bans on the hospitality industry. They then evaluated scores of papers on the subject and concluded that the literature lacks solid evidence of smoking bans negatively impacting the hospitality industry. Hughes et al. (1999) find that full smoking bans insignificantly affected hospitality employment in New York City and possibly increased employment in the food service industry. Two papers Alamar and Glantz (2004, 2007) presented evidence of increased sales by restaurants and bars in areas with a full smoking ban. The authors observed the effect indirectly. They concluded that both types of establishments in the smoke-free jurisdictions, when put up for sale, sold for significantly more–both statistically and economically–than their counterparts in areas without any variety of smoking ban.

4. Bars and Restaurants Employ Based on Demand

This paper makes two simple assumptions about the service industry labor market. The first is that the labor supply curve is flat, indicating that bars and restaurants can hire as many employees as they want at the market wage. Labor moves freely in and out of the restaurant and bar industry and the pay is often minimum wage (and in states that allow for tip credits the hourly wage is far below the minimum wage). The second assumption is that demand for labor is directly derived from consumers' demand for hospitality services. In other words, the amount of people an establishment hires is determined by the demand customers have for their service. Customer demand is assumed to be the most powerful determinant of labor demand and the one that managers most often consult when making hiring and firing decisions.

These combined assumptions explain the mechanism that managers use to deal with a negative shift in consumer demand. Their response is often to cut the hours of the least senior employees instead of firing anyone. The employees that are the least committed to the job or most sensitive to reductions in take-home pay leave the establishment to pursue other service industry work or to join another sector completely. When total demand in the area sees a negative shock, more of these marginal employees will leave the industry. In the wake of a positive shift in consumer demand, it is assumed that managers temporarily increase the hours of the most senior employees. If the demand shock is believed to be permanent, managers make a deliberate decision to increase staff. Regional service industry employment is a reasonable proxy for changes in regional consumer demand.

5. Smokers and Nonsmokers React Differently

Smokers and nonsmokers regard the act of smoking indoors in different ways. Smokers are expected to patronize the newly smoke-free establishments less while nonsmokers are expected to frequent more. The actions of the two groups move in opposite directions, which makes it extremely unlikely that smoking bans consistently affect different regions or jurisdictions the same way. By looking at the behavior of these populations and linking them to individual incentives, a better understanding of the net result in any particular region emerges. Border populations of smokers where policy differs act much differently because of the single additional substitute available to

them: nearby establishments on the other side of the border that continue to permit smoking. In the same manner, populations of nonsmokers in non-ban areas adjacent to smoke-free jurisdictions have the available substitute of a smoke-free establishment.

Support for the anticipated behavior comes from Biener and Siegel (1997). They find that before a ban is put into place, a greater percentage of smokers intend to decrease their patronage of the service industry and a greater fraction of nonsmokers plan to increase their patronage. How smokers and nonsmokers carry out these changes matters.

The rational addiction model presented in Becker and Murphy (1988) suggests that behavior may change in anticipation of new policies. For this analysis, it is assumed that expectations of future policy changes have no effect on current behavior. Patronage remains the same until the law goes into effect. Habits persist until the smoke has literally cleared the room.

5.1. Two Classification of Bans

Assembling a useful set of policy treatment variables requires the classification of different types of bans that exist as well as a compilation of details surrounding enactment. Bans are classified as either total or weak. A total ban requires prohibition of smoking in all types of establishments. It represents the most common and the most comprehensive category of ban. Borders represent a full frontier of incentive changes; smokers' only option (if available) for substitution within the hospitality industry requires a trip over the border. Comprehensive smoking policy changes weaken in strength if neighboring municipalities or states fail to adopt the same policy. A weak ban prohibits smoking in some restaurants and/or bars. In this case, smokers may choose to substitute towards local smoke-friendly establishments in order to perpetuate their habits. The strict categorization of such bans are a result of the limited places left for patrons to smoke publicly indoors.

5.2. Smoking and Patronage are Complements for Smokers

To smokers, cigarettes consumed in a service establishment complements the purchase of food and beverages: smoking makes these activities more pleasurable. The relationship that results between smoking and drinking or eating is one characteristic of complementary goods. When the price of smoking is low, we expect smokers to consume more food and drink.

A smoking ban represents a government mandated price change of indoor smoking at hospitality establishments. This change occurs in real, not monetary terms. Smoking after a ban requires greater costs in effort and time than it did before the implementation of a ban. Smokers' demand for service industry goods shifts inward because of the price increase of a complement, smoking. Carmody et al. (1985) find that smokers consume more alcohol than nonsmokers. If individual smokers purchase a larger portion of beverages than average changes in their behavior will have greater impact on the industry. Gallet and Eastman (2007) find that restaurant and bar smoking bans decrease the demand for beer and liquor while increasing the demand for wine. Picone et al. (2004) use survey data to conclude that smoking bans reduce female patrons' demand for alcohol but do not significantly affect male patrons' demand.

5.3. Reaction of Smokers

A ban entices smokers to change their behavior. The following four options represent smokers' behavior after a smoking ban is put into place:

1. **Smokers can do nothing.** The simplest new behavior is the old behavior. Smoke-free environments become the new default setting. Compliance with the law while still frequenting the same establishments is the path of least resistance. Thaler and Sunstein (2009) tell us that default settings can be strong motivators for behavior. Anything else requires action. Before the ban, many smokers may not have experienced a nonsmoking establishment. They may end up preferring a smoke-free atmosphere after exposure to it. People often do not know what they like until they try all of the options. In many jurisdictions, the smoke-free option never occurred before the ban.
   Smokers must head outside if they wish to continue smoking after a ban. This may lead to less patronage or simply less hourly consumption of food and drink as smoking and consumption of these purchases have become substitutes with respect to the time necessary to consume them[4]. Time spent consuming one of the goods cannot be spent consuming the other.[5]

[4]A more intuitive way of thinking about this is that cigarette breaks and socialization over food and drink are two separate commodities that a smoker must produce with a set amount of a key resource, time.

[5]This occurs unless open alcohol containers are allowed in outdoor smoking areas.

On the other hand, there could be no real effect on smokers' consumption. The absence of an effect exists for two reasons. First, smokers may utilize outdoor seating areas where their patterns do not have to change. Second, they may increase their drinking or eating pace in order to rush outside to smoke. This increased pace may offset any consumption loss that occurs from leaving the establishment.

2. **Smokers can quit or reduce smoking.** Albers et al. (2007) found that local restaurant smoking bans did not lead to a decrease in prevalence, but did increase the chances of smokers attempting to quit. Because comprehensive bans greatly exceed the coverage of restrictions that only apply to restaurants or bars that serve food, smokers may view the total ban as an incentive to quit or cut down on smoking. Thaler and Sunstein (2009) suggest this may happen because of the reduction in what they call a hot environment. Hot environments cause people to consume more of a good[6] than they would in cold environments. It is easy to believe that a smoke filled room creates a greater temptation for one to light up a cigarette than a clean-air room does. When a total ban occurs, smokers no longer have the option of visiting a hot public environment within their own area.
3. **Smokers can avoid the hospitality industry.** When bans commence, smokers can opt to no longer patronize bars and restaurants as often, or at all. They can stay home or partake in social activities at private residences instead. They simply substitute away from the service industry. The strength and frequency of substitution depends heavily on the social structure of the local community and how individuals fit into that structure.
4. **Smokers can travel to smoke-friendly establishments.** In the eyes of smokers, something that had little or no cost experienced a near infinite price increase in relative terms. Those who live near areas which do not have a ban may be willing to cross borders in order to continue their habits. It is this behavior that is of primary concern in the measurement of spillover effects in the upcoming sections.

In the case of a weak ban, all of these effects contribute to the net effect

[6]This behavior usually occurs in the case of what Thaler and Sunstein (2009) call a sinful good (such as smoking, drinking alcohol, or eating poorly): benefits occur immediately and costs are realized later.

of the treatment variable. For a total ban, however, any potential travel requires patrons to cross borders. Such an effect will be estimated separately through channels explained in more detail below.

5.4. Smoking is a Bad for Nonsmokers

Nonsmokers act in an opposite manner. Second-hand smoke decreases the marginal benefit of nonsmokers' hospitality consumption. The resulting relationship suggests that for nonsmokers, smoke-filled rooms are a bad, while patronage remains a good. When the price of smoking is low, more smoke is present and we expect nonsmokers to consume less food and drink.

As stated before, a smoking ban increases the real price of smoking indoors. Nonsmokers face an outward shift of their segment of market demand for food and drink at all price levels. More specifically, while smokers substitute away from patronizing clean air establishments while nonsmokers substitute towards them.

5.5. Reaction of Nonsmokers

A smoking ban creates new opportunities for patrons. The following options represent options for nonsmokers behavior after a ban goes into place:

1. **Nonsmokers can do nothing.** The easiest thing for nonsmokers to do is not make any changes. They can continue to frequent the same places at the same rate.
2. **Nonsmokers can frequent smoke-free bars and restaurants more often.** The most immediate effect will be for current patrons to increase the duration of their outings. When smoking was allowed, a portion of these patrons stayed until the marginal benefit of the social activity was equal to the marginal cost of dealing with the smoke. In the absence of smoke, each visit can potentially last longer.
   Patronage by nonsmokers increases in the long run. People tend to continue the habits they already have. Adjustment takes time. Once enough time has passed, we can observe the full effect of substitution toward this new lower priced good.
3. **Nonsmokers can travel to smoke-free locales.** In the case of a weak ban, nonsmokers might drive past the closest smoky watering hole to visit an establishment affected by the ban. When no ban exists at home, but a total ban takes place in a nearby locality, nonsmokers may travel even farther to take advantage of clean air facilities.

4. **Nonsmokers can follow smokers away from smoke-free establishments.** If social affiliations persist strongly, there is an opportunity to lose nonsmoking customers because of a smoking ban. As Mark Twain (1980) said, "[people] go to heaven for [the] climate, hell for [the] company." If nonsmokers and smokers socialize together and new habits develop outside of smoke-free establishments, the nonsmokers can choose to remain with their social group instead of continuing to patronize the regular bar and restaurant establishments.

All smoker and nonsmoker behaviors above will be represented in the treatment variables. The overall expected effect of a ban on the nonsmoking population's patronage of the hospitality industry is positive.

6. Contamination Distorts Results and Causes Bias

When researchers neglect to control for transient populations, comparison of the treatment[7] and control[8] groups become disrupted in two important ways: first, treatment areas that experience an exodus of their own residents across county or state borders report downwardly biased results in terms of employment; and second, the patronage in some control areas is upwardly biased in the same measure because of the positive impact of the very same exodus. For example, when smokers can travel to patronize an establishment in a neighboring area it makes the effect of a ban look worse for service industry employment than it actually is. Such behavior by smokers can also add to employment in the hospitality industry in the neighboring non-ban area, which is part of the control group against which the ban area is measured. The omitted variable bias within the treatment variable is negative, weighted by the potential transient group of smokers, and doubled in magnitude through the channels mentioned above.

Furthermore, when nonsmokers can travel from smoke-friendly areas to smoke-free zones, the ban may appear to be more beneficial to employment than it actually is. In this case, the omitted variable bias is positive, weighted by the potential transient group of nonsmokers, and also doubled in magnitude.

[7]The treatment groups are the areas that enact different smoking bans.

[8]The control group represents areas with no smoking ban.

The relative sizes and behaviors of such groups determines the magnitude and direction of the bias when estimating treatment effects. Including a relevant proxy variable for movement of both groups across borders more accurately measures the true effect of smoking bans.

6.1. Initial Contaminated, Uncontaminated, and Overall Results

When only contaminated counties[9] are included in a simple regression (see Table 2), the treatment variable for a total ban returns a coefficient that is negative yet statistically insignificant. When the uncontaminated controls and treatments are also included, the sign of the coefficient becomes positive and also statistically significant. Contamination from cross-border travel distorts the results heavily. A sample without enough uncontaminated observations may yield a result that is inconsistent with reality. As these results show, simply adding enough observations that do not suffer from such contamination can remedy the bias it causes. To further correct for this bias, movement across borders must be controlled for.

6.2. Traveling Consumers Must Be Accounted For

Policy has less influence over residents when some of them live near the border with states that have more lenient policies. Tiebout (1956) was right: people indeed can vote with their feet. Holmes (1998) finds major changes in manufacturing activity near state borders when the policy in question is a right-to-work law.[10] In Holmes's work the decision-makers were owners of firms. Moving or starting a business is a much larger task than deciding which establishments to frequent. Stehr (2005) examines the effectiveness of cigarette taxes near state borders. The effects of discrepancies of alcohol taxes and policies at the state border have been investigated by Goel (1990), Baltagi and Griffin (1995), Beard et al. (1997), and Stehr (2007).

The border variable constructed here is similar to the one Stehr (2007) used to focus on the discrepancies between the policies of neighboring states. Three key variables had to be constructed[11]. When areas that have full smoking bans border areas that do not have such bans, the estimated smoking population that lives in the ban area within one mile of a non-ban area

[9] Those which incentivize travel by smokers and nonsmokers.

[10] These laws diminish union power in the labor force and are attractive to firms.

[11] For a full summary of the construction of these variables, please consult the mathematical appendix.

Table 2: Effects on Bar and Restaurant Employment in Two Samples

sample	contaminated counties	uncontaminated counties	all counties
observations	4267	38264	42531
counties	947	3096	3098
	2.1	**2.2**	**2.3**
restaurant and bar jobs per thousand residents	38.33***	35.78***	34.57***
	(2.70)	(1.85)	(1.55)
difference when any smoking ban is implemented	2.22***	1.64***	1.89***
	(0.56)	(0.32)	(0.27)
difference when smoking ban is fully comprehensive	-1.02	1.11**	1.30***
	(0.64)	(0.44)	(0.24)
adjusted R^2	0.9980	0.9657	0.9960

*significant at 90% level **significant at 95% level ***significant at 99% level

is totaled and labeled "smoking population entering ban-free area". This variable is attached to the nearby county without the ban. On the other side of the border the nonsmokers that live within the county without a ban within a mile of the county with a ban are totaled and labeled "nonsmoking population entering ban area". This variable is attached to the ban county. Finally, the smokers that live in the non-ban county within one mile of the border with the ban county are summed and lableled "smoking population not entering ban area". This variable is attached to the ban county. A fourth variable representing the nonsmokers that no longer enter the ban-free county is left out to avoid double counting as its effect is already included in both the contaminated and non-contaminated treatment variables.

7. Data and Sources

The data cover a sixteen year time period from 1997-2012[12]. Every county in the United States is represented. Population and population density data come from the United States Census Bureau. All population measurements are in thousands of people. County employment for all sectors investigated was obtained from the Bureau of Labor Statistics. Geographical information was provided by the National Atlas. The shared border length information for all counties in the country was extracted using detailed maps from the National Atlas and ArcGIS software. Specifically, a very helpful tool called *polygon neighbors*[13]. Smoking ban information was provided by the Robert Wood Johnson Foundation. Adult smoking prevelence data come from the Tobacco Use Supplement to the Current Population Survey (TUS-CPS) for years 1992-2007 and from the Behavioral Risk Factor Surveillance System (BRFSS) for the years 2011-2012.

8. Empirical Strategy and Results

8.1. Estimated Regression Equation

The estimated regression equation is listed below:

$$E = \beta_0 + \beta_1 P_{tc} + \beta_2 T_{tc} + \beta_3 A_{tc} + \beta_4 S_{tc} + \beta_5 NS_{tc} + \beta_6 SN_{tc} + D_{tc} + M_{tc} + u_t + v_c + \varepsilon_{tc}$$

[12]For more detailed information please consult the Appendix: Creating the Mobile Population Estimates.

[13]For more information on how the shared border data was used to create variables consult Appendix B: Additional Mathematics

E	=	bar and restaurant employment
P	=	population
T	=	total ban dummy weighted by population
A	=	any ban dummy weighted by population
S	=	smokers entering a non-ban county
NS	=	nonsmokers entering a ban county
SN	=	smokers no longer entering a ban county
D	=	dry county dummy weighted by population
M	=	moist county dummy weighted by population

The coefficients for all of the variables on the right hand side are expected to have a positive value with the exception of SN. The subscripts t and c represent time (year) and county respectively. Fixed effects are included for both time and county. Robust standard errors are reported because using them is equivalent to clustering the standard errors by county-year.

8.2. Interpretation of Results

Remember that the results listed in Table 2 suggest the effect of a total ban on bar and restaurant employment appears to be negative and not statistically significant when only the contaminated counties are included in the sample. The control variables all have the expected signs, large magnitudes, and are statistically significant. When we also include in the counties in which no ban exists (the uncontaminated control group) the effect of a total ban becomes positive and both economically and statistically significant.

Finally, when all counties are included (see Table 3) the effect of both a total ban and any ban are large in magnitude, positive, and statistically significant. The interpretation of the spillover variables is important to clarify. The smoking population entering the ban free area truly does mean smoking population so it is important to interpret the magnitude correctly. If 5000 people live within a mile of the border and 20% are smokers, the number recorded is 1000 smokers. Likewise for the nonsmokers. The effect from the smoking population looks smaller, and it is per capita, but keep in mind that nonsmokers are about 80% of the population in most places. Another reason magnitudes may seem large is the fact that the population estimates are based on those living withing one mile of the border. This was done for simplicity, but it may be the case that five or ten miles may be more

Table 3: Effects on Bar and Restaurant Employment with Spillover Effects

	3.1	**3.2**
restaurant and bar jobs per thousand residents	34.03***	34.02***
	(2.15)	(1.57)
difference when any smoking ban is implemented	2.15***	2.15***
	(0.30)	(0.30)
difference when smoking ban is fully comprehensive	1.21***	1.21***
	(0.39)	(0.39)
difference in a moist county	-	3.26***
	-	(0.58)
difference in a dry county	-	1.11***
	-	(0.47)
COUNTIES WITHOUT A BAN		
additional jobs for every thousand smokers nearby in a ban county	55.59***	55.43***
	(6.53)	(6.53)
COUNTIES WITH A BAN		
additional jobs for every thousand smokers nearby in a ban-free county	-88.32***	-88.53***
	(21.32)	(21.32)
additional jobs for every thousand non-smokers nearby in a ban-free county	13.97***	14.01***
	(5.01)	(5.01)
adjusted R^2	0.9958	0.9958
observations	42531	42531

*significant at 90% level **significant at 95% level ***significant at 99% level

realistic of actual willingness to travel. Including larger populations would drive down the magnitude of these variables.

To put all of this in simpler terms, any smoking ban will result in an average of a 6.3%[14] growth in jobs. If the ban is a total smoking ban, jobs will grow by an additional 3.6%[15] on average. For every thousand smokers in an area near a ban county that do not live under a ban, 88[16] jobs will be lost, but this is countered by the influx of nonsmokers from the same county. This movement creates about 14[17] jobs for every thousand nonsmokers. The county without the ban will see an inflow of smokers and for every thousand of them, nearly 56 jobs will be created.

Finally, the per capita employment rates in the moist and dry counties are shown to be higher than their wet county counterparts. This goes against what was expected by including them in the analysis. Possible explanations for this are that these counties are generally poorer and may have higher levels of low skilled fast food workers. These areas also do not have any age restrictions on employees as serving alcohol does not bar younger segments of the population from working. Firms in these counties may be substituting a larger number of young people with fewer hours for a smaller quantity of full time workers.

8.3. Simulation of Hypothetical Counties

Table 4 shows a hypothetical example where County Z enacts a full smoking ban and County W does not. Because of the relative population densities and smoking prevalences used, if a regression were run without controlling for transient populations, it would show that the smoking ban has a negative effect on employment in the bar and restaurant industry. This negative effect exists only because nearby County W does not have a smoking ban.

Table 5 shows a second hypothetical example where County Y enacts a full smoking ban. The outcomes in the percentage increase in jobs in both counties is exactly the same. A regression that did not control for spillover effects between these counties would show no effect whatsoever because of a smoking ban, when in fact the gain for both counties would not exist without the ban in County Y.

[14]This is calculated by dividing 2.15 by 34.03.
[15]This is calculated by dividing 1.21 by 34.03.
[16]To obtain per capita values multiply by 1/(smoking prevalence rate).
[17]To obtain per capita values multiply by 1/(1 – smoking prevalence rate)

Table 6 rounds out the three possible outcomes by illustrating a case where a positive effect of a smoking ban in County R will be observed compared to the neighboring County Q, which does not have a ban. The effect of the ban would be understated, however, because the positive effect observed in County Q would be picked up by the time fixed effects instead of correctly attributed to the spillover caused by smokers from County R.

9. Conclusion

Economists should always be aware of the available substitutes for those who wish to circumvent public policy. When transportation costs are relatively low and benefits differ across geography, people are often willing to travel to better satisfy their preferences. Because jurisdictions have boundaries and these boundary areas have residents, laws that are not universal across regions can change patterns in consumption. Only when these considerations are included in models can we get a clearer view of the true effects of such policies.

The work here concludes that comprehensive smoking bans have a net positive effect on the service industry. Once the transient effects of smokers are controlled for, the increase in patronage a state with a comprehensive ban experiences from the nonsmoking population greatly outweighs the decrease resulting from smokers' behavior. The detriments that can occur are not because of the enactment of smoking bans, but because of differences in policy among neighboring regions. Areas that impose full smoking bans can potentially lose employment to their neighbors that do not adhere to the same policies.

What does this mean for policy makers? Cooperation and coordination are important for adjacent jurisdictions. Policies that are timed together and cover a large region minimize the possible negative effects outlined in this work. Finally, some policy makers may be hesitant to adopt the same policies as their neighbors because they perceive the negative consequences of their neighbors' full smoking bans along their common borders. These concerns can be eased. Late adopters of comprehensive bans will experience few or none of these negative consequences because they add to or complete the consistency of policy in their region.

Table 4: Two County Simulation with Negative Ban Effect

	No Ban County W	**Ban County Z**
population	100000	30000
area (square miles)	250	200
population density	400	150
estimated population along 25 mile shared border	10000	3750
smoking prevalence	25%	20%
estimated smoking population along border	2500	750
estimated nonsmoking population along border	7500	3000
jobs before smoking ban	3402	1021
change in jobs from ban	-	101
jobs gained from smokers crossing the border in	42	-
jobs gained from nonsmokers crossing the border in	-	105
jobs lost from smokers not crossing the border in	-	-221
net change	42	-15
percent change	1.23%	-1.51%

Table 5: Two County Simulation with Zero Ban Effect

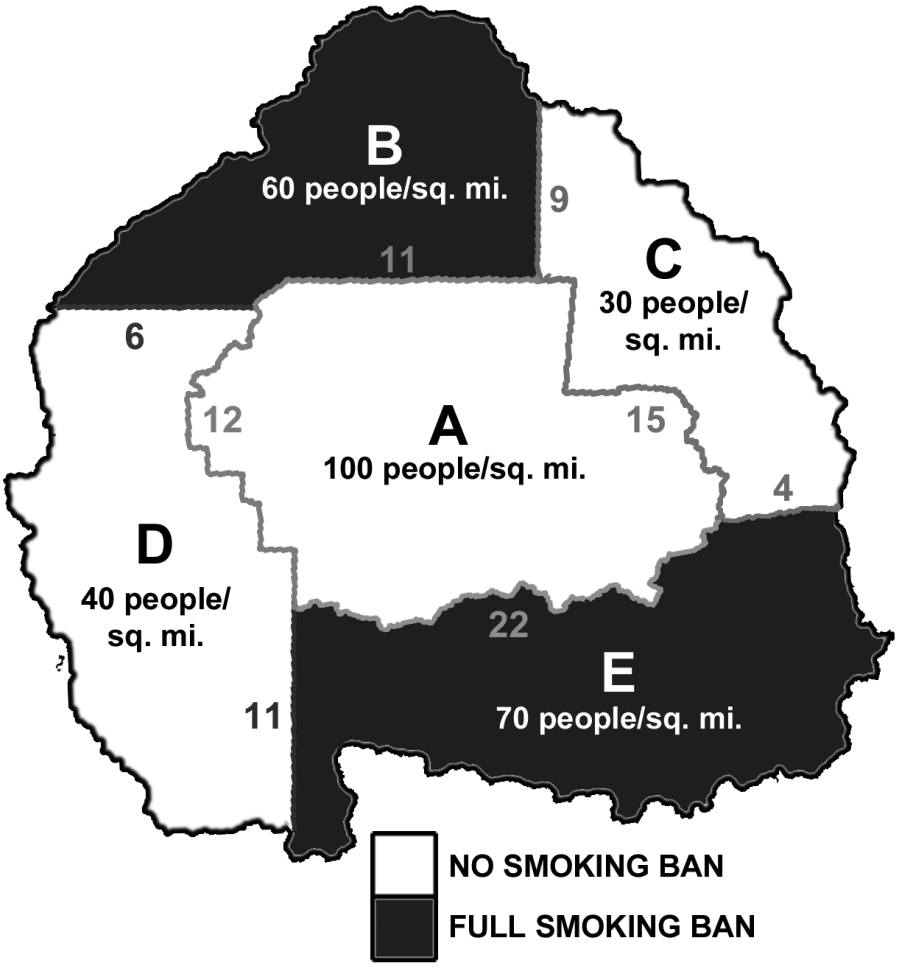
	No Ban County X	**Ban County Y**
population	50000	100000
area (square miles)	250	200
population density	200	500
estimated population along 25 mile shared border	5000	12500
smoking prevalence	25%	20%
estimated smoking population along border	1250	2500
estimated nonsmoking population along border	3750	10000
jobs before smoking ban	1701	3402
change in jobs from ban	-	336
jobs gained from smokers crossing the border in	139	-
jobs gained from nonsmokers crossing the border in	-	53
jobs lost from smokers not crossing the border in	-	-111
net change	139	278
percent change	8.17%	8.17%

Table 6: Two County Simulation with Positive Ban Effect

	No Ban County Q	**Ban County R**
population	85000	120000
area (square miles)	200	400
population density	425	300
estimated population along 25 mile shared border	10625	7500
smoking prevalence	25%	20%
estimated smoking population along border	2656	1500
estimated nonsmoking population along border	7969	6000
jobs before smoking ban	2892	4082
change in jobs from ban	-	403
jobs gained from smokers crossing the border in	83	-
jobs gained from nonsmokers crossing the border in	-	112
jobs lost from smokers not crossing the border in	-	-235
net change	83	280
percent change	2.88%	6.85%

Appendix A. Creating the Mobile Population Estimates

Figure A.3: Five Hypothetical Counties on an Island



The mobile population estimates used in Chapters 2 and 3 are detailed here. The first step is to create a matrix of all shared borders between counties. For the sake of example we will consider a hypothetical island consisting of five counties (see Figure A.3).[18] Note that the border lengths

[18] An island is used because it limits the number of borders in which people can cross. In the actual analysis all of the matrices constructed are of dimension 3143 × 3143, where

are indicated on the map. These values do not change over the time period of the study so the single matrix is used in repeated time periods. The resulting matrix of shared borders (SB) is:

$$SB = \begin{array}{c} \\ A \\ B \\ C \\ D \\ E \end{array} \begin{array}{c} \begin{array}{ccccc} A & B & C & D & E \end{array} \\ \left[\begin{array}{ccccc} 0 & 11 & 15 & 12 & 22 \\ 11 & 0 & 9 & 6 & 0 \\ 15 & 9 & 0 & 0 & 4 \\ 12 & 6 & 0 & 0 & 11 \\ 22 & 0 & 4 & 11 & 0 \end{array}\right] \end{array}$$

The next piece of information needed is the population density of each county. This should be converted to a diagonal matrix. The population density changes yearly, so this variable must be reconstructed yearly.[19] The population density (PD) matrix is therefore:

$$PD_y = \begin{array}{c} \\ A \\ B \\ C \\ D \\ E \end{array} \begin{array}{c} \begin{array}{ccccc} A & B & C & D & E \end{array} \\ \left[\begin{array}{ccccc} 100 & 0 & 0 & 0 & 0 \\ 0 & 60 & 0 & 0 & 0 \\ 0 & 0 & 30 & 0 & 0 \\ 0 & 0 & 0 & 40 & 0 \\ 0 & 0 & 0 & 0 & 70 \end{array}\right] \end{array}$$

The next piece of information that has to be compiled is a difference in policy matrix. This is based on the value of the total smoking ban dummy variable assigned to each county in each time period.[20] Values in the matrix for any given year can have positive, zero, or negative values.[21] Policy vari-

each county in the country is compared with every other county. Most of the values in the matrix are equal to zero, but this size is necessary to achieve the desired result.

[19]Note the subscript for time.

[20]For clarity, these values are listed in the column (above) and the row (to the left) headers of the counties in the matrix below. The value of any element in the matrix is equal to the value of the policy dummy variable for the county in the column less the value of the policy dummy for the county in the row. All diagonal elements of this matrix will be equal to zero.

[21]A negative one means the county in the row has a smoking ban while the county in the column does not, a zero means that both counties have the same policy, whether that be a smoking ban or no ban, and a positive one means the county in the row does not have smoking ban while the county in the column does. Elements can take values anywhere between the extremes because of the possibility of policy only existing for a portion of the year in question.

ables change over time, so this matrix must be regenerated for each year in the sample. The example matrix for difference in policy (DP) is:

$$DP_y = \begin{array}{cc} & \begin{array}{ccccc} 0 & 1 & 0 & 0 & 1 \\ A & B & C & D & E \end{array} \\ \begin{array}{cc} 0 & A \\ 1 & B \\ 0 & C \\ 0 & D \\ 1 & E \end{array} & \left[\begin{array}{ccccc} 0 & -1 & 0 & 0 & -1 \\ 1 & 0 & 1 & 1 & 0 \\ 0 & -1 & 0 & 0 & -1 \\ 0 & -1 & 0 & 0 & -1 \\ 1 & 0 & 1 & 1 & 0 \end{array}\right] \end{array}$$

Using these three matrices, we can construct an new matrix which estimates four different populations living on the border of counties which do not have consistent policies. This matrix of possible transient populations (TP_y) is created as follows[22]:

$$TP_y = \ PD_y \ SB \ \circ \ DP_y$$

The TP matrix for the island counties example is listed below:

$$TP_y = \begin{array}{cc} & \begin{array}{ccccc} A & B & C & D & E \end{array} \\ \begin{array}{c} A \\ B \\ C \\ D \\ E \end{array} & \left[\begin{array}{ccccc} 0 & -1100 & 0 & 0 & -2200 \\ 660 & 0 & 540 & 360 & 0 \\ 0 & -270 & 0 & 0 & -120 \\ 0 & -240 & 0 & 0 & -440 \\ 1540 & 0 & 280 & 770 & 0 \end{array}\right] \end{array}$$

The sum of the positive numbers in a row is a measure of a population in a county with a ban along the border with a county without a ban. Multiplying this measure by smoking prevalence gives an estimate of smokers incentivized to leave their home county and is measured for the home county. The sum of the absolute value of all negative numbers in column is a similar measure for the counties without a smoking ban along a border with a county that has enacted a ban. Multiplying this by one minus smoking prevalence give an estimates of nonsmokers given the opportunity to leave their home county to frequent smoke-free places. This is measured as an influx of nonsmokers for the ban county. Finally, the same population (the absolute value

[22]Where $\circ$ represents element-wise multiplication.

of all negative numbers in a column) multiplied by smoking prevalence represents the nearby smokers in the ban-free county that no longer patronize establishments in the ban county.

Table A.7 shows values of these three variables for the island example when a smoking prevalence of 20% is assumed. The *smokers in* for counties A, C, an D are calculated by totaling their respective columns from TP_y and multiplying by 0.20.[23] To calculate the *non-smokers in* variable, sum the columns for B and E, multiply by 0.80, and take the absolute value. Finally, to calculate *smokers not in*, take the sum of the rows for B and E and multiply by 0.20.

Table A.7: Transient Smokers and Nonsmokers on the Island

	smokers in	nonsmokers in	smokers not in
COUNTIES WITHOUT A BAN			
County A	440	0	0
County C	164	0	0
County D	226	0	0
COUNTIES WITH A BAN			
County B	0	1288	312
County E	0	2208	518

[23]When changes take place in the middle of a year it is possible for columns and rows to have a combination of positive and negative numbers. In this case, columns and rows cannot simply be summed and their absolute values taken. To eliminate all negative numbers from a matrix, add its absolute value and divide by two. To eliminate all positive numbers from a matrix, subtract its absolute value and divide by two.

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