Still Not Seen:

Unintended Consequences of Public Policy

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DISSERTATION

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SUMMARY

State and local policies affect how individuals choose to purchase goods and services. Even though such policies may not explicitly mention prices, they often effectively change the real price to the consumer. Disparity in relative prices arises from contrasting policies. The empirical evidence presented supports the notion that regions bordering municipality lines, whether they be state or local jurisdictions, allow for increased substitution when policy is different across such jurisdictions. When researchers neglect to control for transient populations, comparison of the treatment and control groups does not accurately describe reality. Chapter one is a brief introduction to the major topics discussed. After controlling for border regions in all US counties from 1997-2012, the second chapter shows the impact of smoking bans on employment in the hospitality sector is clearly identified as positive, but that a negative effect is possible in certain areas when nearby regions retain smoke-friendly policies. The third chapter illustrates how the increased travel that some residents willingly undertake in border regions in order to patronize establishments that fit their smoking preferences results in a greater risk of alcohol-related traffic fatalities. Together, the second and third chapters suggest the negative outcomes resulting from a comprehensive smoking ban can be eradicated when these policies are consistent over heavily populated geographic areas. The fourth chapter investigates methamphetamine lab activity at the county level from 2004-2012. It corroborates the claim that areas adopting a pseudoephedrine control policy earlier in time see subsequent lower methamphetamine pro-

duction earlier than states that adopted such controls later after controlling for border crossing behavior. The final chapter concludes all findings and suggests future research.

CHAPTER 1

INTRODUCTION

Long ago, Frederic Bastiat (1848) wrote about what is seen and what is not seen. The immediate effects of public policy are often very visible, but there are consequences that require deeper investigation to observe. Henry Hazlitt (1996) called economics the "study of secondary effects". The writings here are an attempt to quantify some of these effects. Each of the three following chapters examines how public policies have unexpectedly changed our world.

The first goal of the work presented is to show the effects of legislation that were unanticipated at the time a policy was implemented. Subsequent effects can be beneficial, detrimental, or both. The relevant conclusion is that solid economic thinking could have, and more importantly, should have, anticipated their existence. Policy-makers can be myopic, so it is the economist's job to shed light on the remote, whether it be distant in time or scope.

The second function of the analysis is to show inconsistencies in the research methods currently used to conduct such studies. Political boundaries are not as rigid as advocates of natural experiments presume them to be. Great care must be taken to anticipate and correct for potential biases precisely because such environments were not designed by researchers. It is our responsibility to be diligent and to avoid common errors.

Policy changes do not occur inside a vacuum. Treatment and control groups in natural experiments have the incentive to seek out viable alternatives to their respective assignments. Laws are only as strong as the loopholes most available to circumvent them. Of all the disci-

plines, economics should be most concerned with correcting such mistakes as incentives are a primary focus of our field.

Contrasting policies often create divergent changes in real prices on opposite sides of a border. Relative, not absolute prices, are what most heavily influence decision-making processes. Disparity in relative prices often arises from incongruous laws; dissimilar policies in close proximity of one another are the chief concern of this research.

Cowen and Tabarrok (2009) stress that the "best institutions align individual self-interest with the social interest". Research that ignores substantial misalignment of these two interests leads to a distortion of findings. Such misinformation sets the table for poor decision-making by both the policy-makers and the electorate.

The third and final purpose is to tell some interesting stories with an insightful twist. Economic communication is about encouraging policymakers, students, fellow economists, and the general public to think through logical sequences of events and to subsequently develop the necessary empathy to understand how people will react in diverse situations. When dissemination of economic research occurs through compelling narrative, the message resonates strongly with the audience.

CHAPTER 2

WALL OF SMOKE:

SMOKING BANS, BORDERS, AND PATRON BEHAVIOR

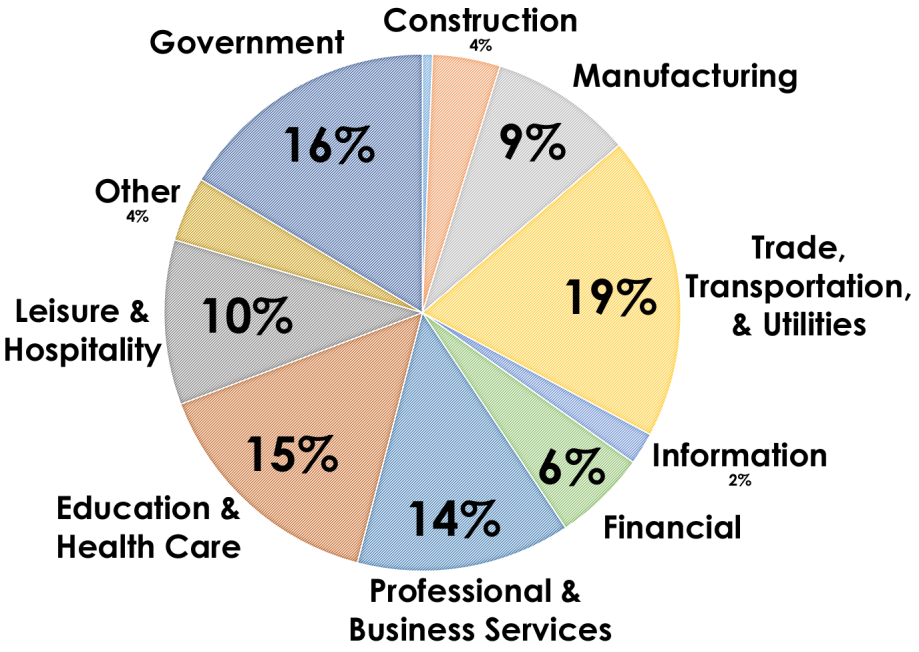
2.1 Introduction

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.

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

Figure 1: 2012 Employment by Sector



percentage of their income directly through gratuities. While the variable being measured is employment, the relevant changes that occur happen in consumer spending.

2.1.1 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.

2.1.2 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 I.

2.1.3 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 I 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

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

TABLE I: 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)

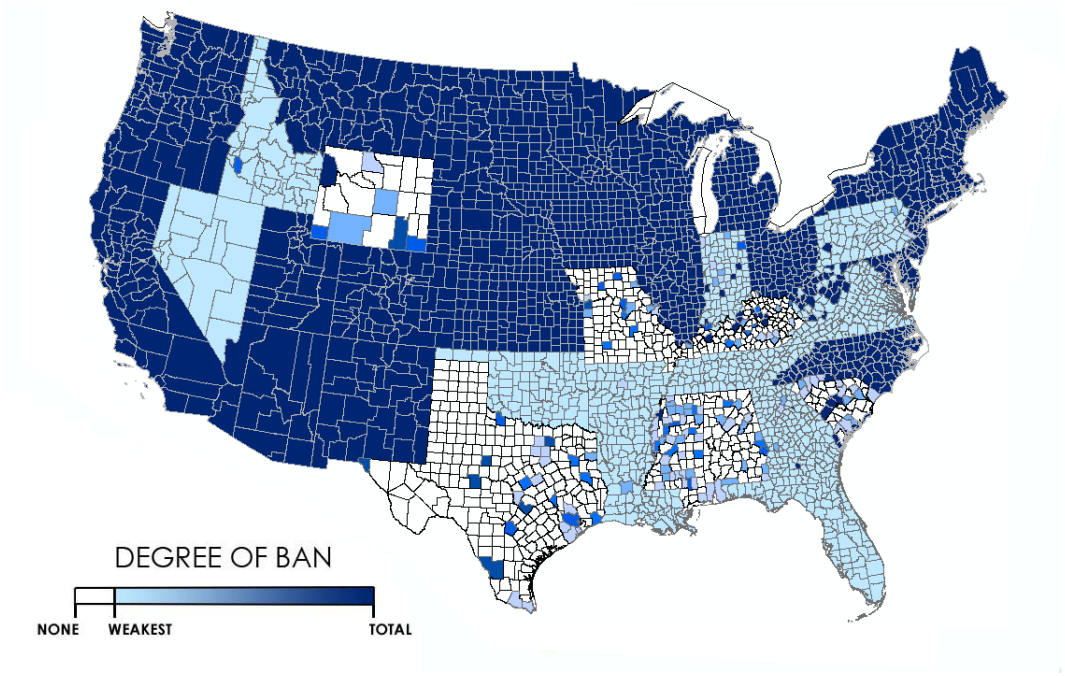
standard deviations are in parenthesis

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.

2.2 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. Currently, more areas live under some ban than under no ban at all (see Figure 2).

Figure 2: Smoking Bans Implemented 1997-2012



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 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.

2.2.2 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[1] 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.

2.2.3 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

[1] Illinois General Assembly House Bill HB1965

privileges or exemptions.[1] 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 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.

2.3 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

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

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; Alamar and Glantz (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.

2.4 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.

2.5 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.

2.5.1 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.

2.5.2 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.

2.5.3 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[1]. Time spent consuming one of the goods cannot be spent consuming the other.[2]

   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.

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[1] 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.

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

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[1] 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

[1]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.

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 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.

2.5.4 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.

2.5.5 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.

2.6 Contamination Distorts Results and Causes Bias

When researchers neglect to control for transient populations, comparison of the treatment[1] and control[2] 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.

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

[2]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.

2.6.1 Initial Contaminated, Uncontaminated, and Overall Results

When only contaminated counties[1] are included in a simple regression (see Table II), 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.

2.6.2 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.[2] 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

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

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

TABLE II: 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*** (2.70)	35.78*** (1.85)	34.57*** (1.55)
difference when any smoking ban is implemented	2.22*** (0.56)	1.64*** (0.32)	1.89*** (0.27)
difference when smoking ban is fully comprehensive	-1.02 (0.64)	1.11** (0.44)	1.30*** (0.24)
adjusted R^2	0.9980	0.9657	0.9960

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

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[1]. 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 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.

2.7 Data and Sources

The data cover a sixteen year time period from 1997-2012[2]. 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

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

[2]For more detailed information please consult Appendix B: Data Sources and Descriptions.

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*[1]. 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.

2.8 Empirical Strategy and Results

2.8.1 Estimated Regression Equation

The estimated regression equation is listed below:

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

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.

[1]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

2.8.2 Interpretation of Results

Remember that the results listed in Table II 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 III) 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

TABLE III: 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

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 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%[1] growth in jobs. If the ban is a total smoking ban, jobs will grow by an additional 3.6%[2] on average. For every thousand smokers in an area near a ban county that do not live under a ban, 88[3] jobs will be lost, but this is countered by the influx of nonsmokers from the same county. This movement creates about 14[4] 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.

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[1]This is calculated by dividing 2.15 by 34.03.

[2]This is calculated by dividing 1.21 by 34.03.

[3]To obtain per capita values multiply by 1/(smoking prevalence rate).

[4]To obtain per capita values multiply by 1/(1 – smoking prevalence rate)

2.8.3 Simulation

2.8.3.1 Simulation of Hypothetical Counties

Table IV 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 V 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.

Table VI 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.

2.8.3.2 Simulation of an Actual County

Table VII shows the estimated change in jobs for Fayette County, Kentucky and the six counties it borders. Fayette enacted a total ban in late 2003 and none of the surrounding counties enacted any type of ban for the next two years. The model predicts 9% growth for

TABLE IV: 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 V: 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 VI: 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%

jobs in Fayette county for the next two years. The actual growth was 2%. This discrepancy could be due to the lack of time and county fixed effects used in simulation. The predicted and actual changes in employment can be seen at the bottom of Table VII.

2.9 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

TABLE VII: Simulation of Border Effects for Fayette County, Kentucky 2003-2005

	Fayette	**Scott**	**Woodford**	**Jessamine**	**Madison**	**Clark**	**Bourbon**
2003 population	271441	36534	23610	41335	75204	33825	19442
2004 population	274581	37810	23775	42068	76966	34245	19576
2005 population	278313	39318	24030	43147	79122	34653	19703
area (square miles)	284	282	189	172	437	252	290
population density	957	130	125	240	172	134	67
shared border with Fayette County	-	13.37	8.00	17.76	12.62	18.23	17.96
estimated population along shared border	-	1733	1000	4265	2170	2443	1205
smoking prevalence	27%	27%	27%	27%	27%	27%	27%
estimated smokers along own border	-	468	270	1152	586	660	325
estimated nonsmokers along own border	-	1265	730	3113	1584	1783	880
estimated smokers over ban border	-	3454	2067	4589	3261	4710	4641
predicted jobs 03	9341	1286	809	1431	2618	1165	666
change due to ban	923	-	-	-	-	-	-
change from pop 03-04	107	43	6	25	60	14	5
change from pop 04-05	127	51	9	37	73	14	4
jobs from smokers crossing in	-	191	115	254	181	261	257
jobs from nonsmokers crossing in	131	-	-	-	-	-	-
jobs from smokers not crossing in	-306	-	-	-	-	-	-
predicted change 03-04	854	235	120	279	241	275	262
percent change	9%	18%	15%	20%	9%	24%	39%
predicted change 04-05	874	243	123	291	254	275	261
percent change	9%	16%	13%	17%	9%	19%	28%
actual change 03-04	226	111	N/A	86	-100	-107	N/A
percent change	2%	9%	N/A	8%	-4%	-10%	N/A
actual change 04-05	214	230	N/A	6	216	44	N/A
percent change	2%	18%	N/A	1%	8%	5%	N/A

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.

CHAPTER 3

DRIVEN TO DRINK: SUBSTANCE BANS, BORDERS, AND DRUNK DRIVING

3.1 Introduction

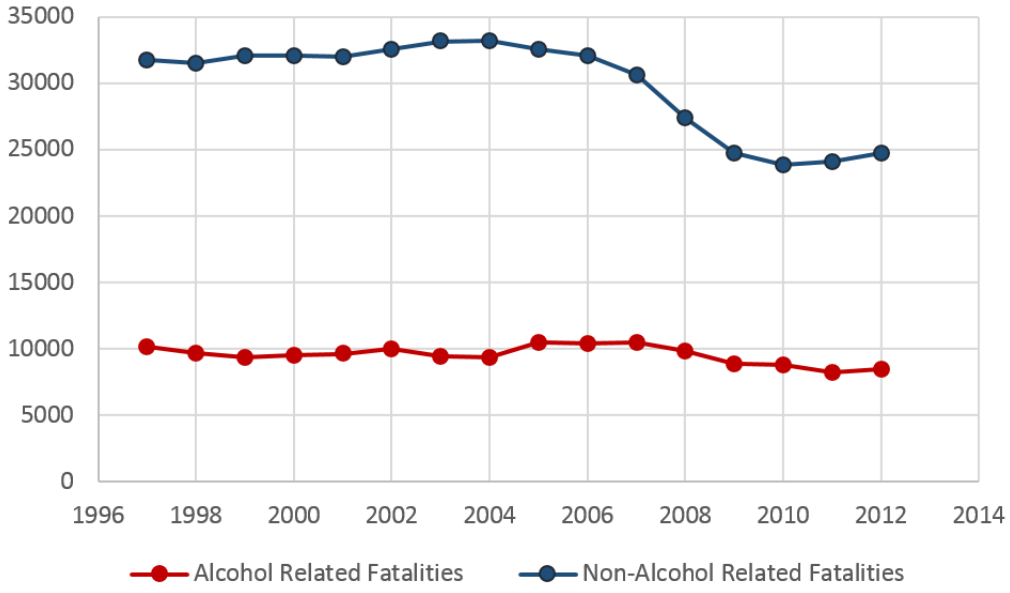
Policies are only as strong as the lowest cost path to avoiding them. Municipality borders often present this route. Local laws, taxes, and regulations are especially vulnerable to avoidance because of their relatively short reach and how comparatively easy it is to travel to the next town or county over.

Fatalities on the roads have diminished great in the past decade (See Figure 3). While deaths that occurred where alcohol was not a factor in the accident have seen a steep drop, the decline in alcohol related fatalities has not been nearly as sharp. The research presented here suggests the lack of corresponding decline may be due to unforeseen effects of policies that encourage certain portions of the population to increase the distance they drive when consuming alcoholic beverages in bars and restaurants.

3.2 Inconsistent Policy Incentivizes Driving Further to Drink

People will choose to drive further in order to better satisfy their personal preferences when choices are not available locally. Two key policies are investigated that create incentives to travel. One deals with regulation of smoking, a long-time complement of drinking. The other deals with local prohibition of alcohol itself.

Figure 3: United States Traffic Fatalities 1997-2012



3.2.1 People Will Drive in Order to Meet Their Smoking Preferences

Some people who like to smoke indoors when they drink will travel further to be able to do so. Similarly, some smoke averse people will travel to clean air establishments. When policy lines are drawn locally, there is reason to believe that driving by both groups to and from drinking establishments will increase. Any drunk driving that does occur on the trip home will most likely be concentrated in the home jurisdiction. This is because travelers do not have to venture very far into the adjacent municipality in order to take advantage of the policy they prefer, they simply have to get out of their own territory with the policy they dislike. There is a slight but important distinction of the effects anticipated caused by the traveling populations investigated in the previous chapter. In that work, employment was affected in the jurisdictions

entered by these groups. Their travel increased the workers in establishments outside of their own counties. In this model, it is not the destination that is important, but the journey. While they travel to establishments peripheral to their home locale, a large majority of the expedition occurs in the originating region.

3.2.2 Dry County Residents Will Drive to Drink

Figure 4: County Alcohol Policy 1997-2012

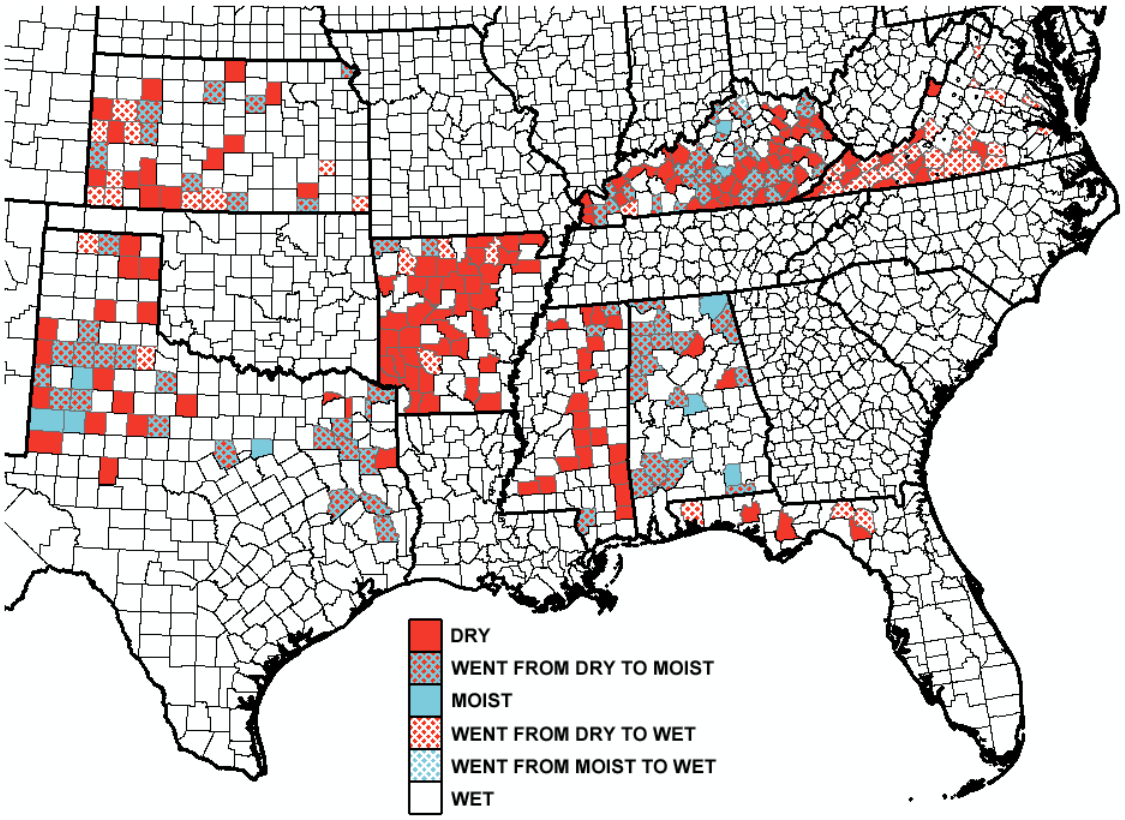
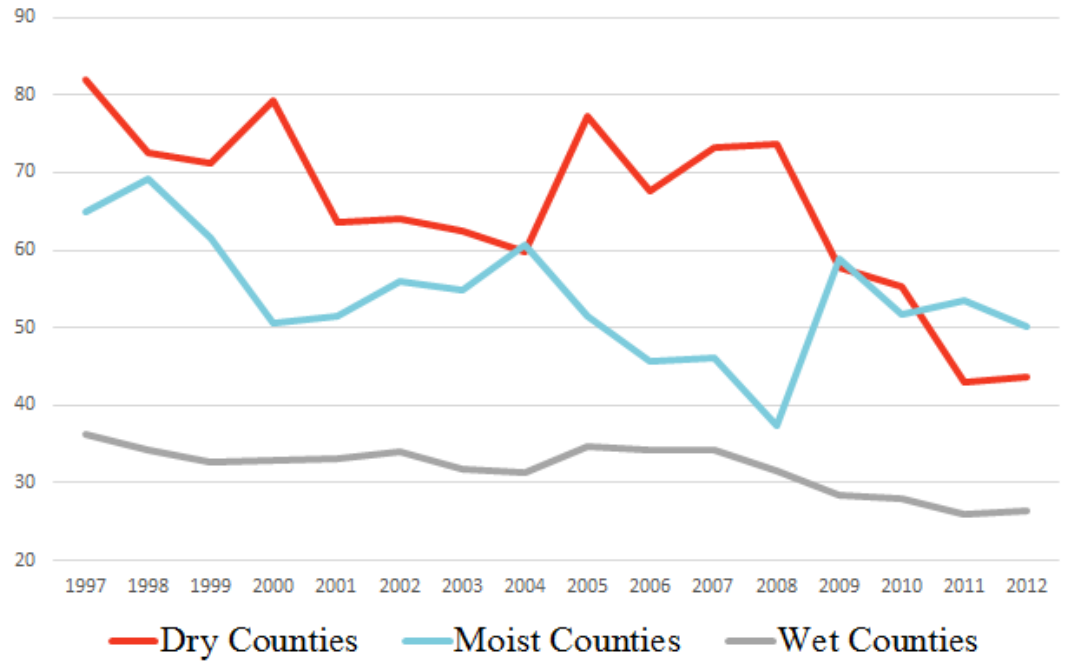


Figure 4 shows changes in alcohol policy at the county level from 1997-2012. All of the counties not shown on the map were wet for the entire duration. People who live in dry counties that choose to frequent drinking establishments will have to leave their county. If we believe that people do in fact vote with their feet, then it is very plausible that those who choose not to drink will also decide to live in these areas. If, however, people make decisions where to live based on other criteria such as proximity to workplaces, quality of schools, or safety of neighborhoods, then some drinkers may end up living in dry counties. This creates a scenario where people drive to a bar or restaurant outside of the county they live in. Most likely they will not have to go very far into the next county over to avoid the local regulations. As in the smoking example above, after the drinks are consumed the ride home takes place mainly in the county in which they live. If these individuals have been over-served, the place they are most likely to do harm in the dry county itself.

3.3 Previous Studies on Traffic Fatalities

The Transportation Research Board, TRB (2011), suggests key reasons that the total number of fatalaties have decreased include the condition of the overall economy, increased vehicle safety measures, demographics, improved road conditions, and safety policies. If changes in smoking laws cause people to cross county lines to go to bars and restaurants where smoking is permitted, the streets and highways may become more dangerous. Adams and Cotti (2008) found that smokers will drive further to continue indoor smoking and that such behavior may lead to an increase in drunk driving accidents. Kopits and Cropper (2005) find that key economic factors such as employment and per capita income along with the rate of motorization

Figure 5: Alcohol Related Fatalities per Million Residents



(vehicles per capita) all have positive effects on traffic fatalities. Dee (1999) finds that the movement of the minimum legal drinking age to twenty-one had a significant negative impact on alcohol related traffic fatalities while increases in beer taxes had an insignificant effect statistically and in magnitude. Ponicki et al. (2007) find a similar effect as Dee (1999) for minimum drinking ages yet a larger effect of beer taxes in reducing fatalities linked to alcohol.

3.4 Data and Sources

The metrics of automobile fatalities are not perfect. Two measures used as dependent variables in this work will be alcohol related traffic fatalities and non-alcohol related traffic

fatalities. These data are reported to the National Highway Traffic Safety Administration (NHTSA). They do not perfectly represent deaths caused by drunk drivers and deaths caused by sober drivers[1]. In fact, the non-alcohol related fatalities include those for which alcohol use was not reported in addition to the fatalities where it was reported explicitly that there was not any alcohol use involved in the crash. This creates possible measurement error which will be discussed in more detail below.

In the sixteen year time period examined, there were 152,733 reported alcohol related traffic fatalities. This represents about thirty-two deaths each year for every million people in the county. Economic and demographic controls will be used in the model presented below. Vehicle safety and alcohol taxes are assumed to be captured by the time fixed effects. Road conditions and local safety policies are the most difficult to control for at the county level. A good measure for doing so has not been constructed in this work.

Vehicle miles traveled (VMT) and the number of automobiles have been estimated at the county level for the entire country based on state reporting of values and a sample of slightly less than half of all counties reporting. Population data come from the U.S. Census bureau. Employment and unemployment numbers come from the Bureau of Labor Statistics. The smoking ban data come from the Robert Wood Johnson Foundation. Dry and moist county data were collected from state records in the eight states that have such counties.

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[1]The NHTSA states that "a motor vehicle crash is considered to be alcohol-related if at least one driver or non-occupant (such as a pedestrian or pedalcyclist) involved in the crash is determined to have had a blood alcohol concentration (BAC) of .01 gram per deciliter (g/dL) or higher. Thus, any fatality that occurs in an alcohol-related crash is considered an alcohol-related fatality. The term 'alcohol-related' does not indicate that a crash or fatality was caused by the presence of alcohol."

3.5 Empirical Strategy and Results

3.5.1 Estimated Regression Equation

The estimated regression equation is listed below:

$$ARTF = \beta_0 + \beta_1 P_{tc} + \beta_2 T_{tc} + \beta_3 A_{tc} + \beta_4 SO_{tc} + \beta_5 NSO_{tc} + \beta_6 AU_{tc} + \beta_7 MVT_{tc}$$

$$+\beta_8 E_{tc} + \beta_9 U_{tc} + \beta_{10} M_{tc} + \beta_{11} U_{tc} + u_t + v_c + \varepsilon_{tc}$$

$ARTF$	=	alcohol related traffic fatalities
P	=	population
T	=	total ban dummy weighted by population
A	=	any ban dummy weighted by population
SO	=	smokers leaving a ban county
NSO	=	nonsmokers leaving a non-ban county
AU	=	vehicles in the county
VMT	=	vehicle miles traveled in the county
E	=	employment
U	=	unemployment
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. 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.

TABLE VIII: Effects on Accidents

	total	**unreported and non-alcohol related**	**alcohol related**
	8.1	**8.2**	**8.3**
accidents per million residents	-0.21 (9.19)	-8.09 (7.7)	7.88** (3.98)
difference when a weak smoking ban is implemented	-5.96*** (1.45)	-8.95*** (1.44)	2.99*** (0.901)
difference when a total smoking ban is implemented	-16.00*** (1.38)	-15.4*** (1.32)	-0.60 (0.61)
adjusted R^2	0.9664	0.9571	0.8846
observations	50267	50267	50267

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

TABLE IX: Effects on Fatalities

	total	**unreported and non-alcohol related**	**alcohol related**
	9.1	**9.2**	**9.3**
fatalities per million residents	-9.62 (10.50)	-15.5* (8.94)	5.90 (4.52)
difference when a weak smoking ban is implemented	-6.87*** (1.61)	-10.1*** (1.59)	3.23*** (1.01)
difference when a total smoking ban is implemented	-17.7*** (1.61)	-17.00*** (1.47)	-0.65 (0.72)
adjusted R^2	0.9621	0.9507	0.8772
observations	50267	50267	50267

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

TABLE X: Effects on Unreported and Non-Alcohol Related Accidents

	10.1	**10.2**	**10.3**
non-alcohol related accidents per million residents	-7.12 (7.78)	-51.6*** (13.20)	-1.85 (15.4)
difference when a weak smoking ban is implemented	-9.36*** (1.48)	-7.51*** (1.38)	-6.59*** (1.20)
difference when a total smoking ban is implemented	-16.00*** (1.48)	-14.5*** (1.38)	-11.1*** (1.19)
difference in a moist county	- -	-5.1 (10.5)	-2.57 (10.6)
difference in a dry county	- -	7.67 (8.23)	12.6 (8.26)
NON-POPULATION VARIABLES			
per million vehicles owned	- -	75.8*** (9.11)	29.6*** (10.5)
per billion vehicle miles traveled	- -	3.54*** (1.22)	-0.07 (1.03)
per million unemployed workers	- -	- -	-383*** (45.4)
per million employed workers	- -	- -	62.5*** (24.0)
COUNTIES WITHOUT A BAN			
additional accidents for every million non-smokers living near a ban county	-29.70*** (8.56)	-28.00*** (8.63)	-15.5* (8.29)
COUNTIES WITH A BAN			
additional accidents for every million smokers living near a ban-free county	-6.65 (101.3)	-8.96 (104.4)	-76.90 (150.9)
adjusted R^2	0.9572	0.9608	0.9653
observations	50267	47126	47044

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

TABLE XI: Effects on Unreported and Non-Alcohol Related Traffic Fatalities

	11.1	**11.2**	**11.3**
non-alcohol related fatalities per million residents	-14.1 (9.03)	-60.8*** (15.5)	-2.0 (17.5)
difference when a weak smoking ban is implemented	-10.70*** (1.64)	-8.62*** (1.54)	-7.62*** (1.34)
difference when a total smoking ban is implemented	-17.90*** (1.64)	-16.20*** (1.54)	-12.3*** (1.36)
difference in a moist county	- -	-12.00 (12.2)	-9.22 (12.4)
difference in a dry county	- -	7.00 (8.89)	12.4 (9.0)
NON-POPULATION VARIABLES			
per million vehicles owned	- -	83.90*** (9.89)	32.00*** (11.3)
per billion vehicle miles traveled	- -	3.52** (1.40)	-0.517 (1.20)
per million unemployed workers	- -	- -	-437*** (50.4)
per million employed workers	- -	- -	63.1** (27.1)
COUNTIES WITHOUT A BAN			
additional fatalities for every million non-smokers living near a ban county	-38.9*** (9.76)	-36.5*** (9.74)	-22.6** (9.41)
COUNTIES WITH A BAN			
additional fatalities for every million smokers living near a ban-free county	9.75 (104.2)	9.2 (107.8)	-67.6 (158.8)
adjusted R^2	0.9508	0.9547	0.9595
observations	50267	47126	47044

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

TABLE XII: Effects on Alcohol Related Accidents

	12.1	**12.2**	**12.3**
alcohol related accidents per million residents	8.8**	-32.6***	-45.3***
	(3.79)	(5.52)	(7.6)
difference when a weak smoking ban is implemented	2.85***	2.3**	2.68***
	(0.87)	(0.94)	(0.96)
difference when a total smoking ban is implemented	-1.01	-1.19**	-0.79
	(0.48)	(0.57)	(0.66)
difference in a moist county	-	-11.4	-10.7
	-	(7.33)	(7.3)
difference in a dry county	-	-11.0	-9.8*
	-	(5.41)	(5.36)
NON-POPULATION VARIABLES			
per million vehicles owned	-	4.6	-3.34
	-	(4.05)	(4.03)
per billion vehicle miles traveled	-	6.65***	6.03***
	-	(0.55)	(0.54)
per million unemployed workers	-	-	-12.6
	-	-	(19.7)
per million employed workers	-	-	59.4***
	-	-	(12'3)
COUNTIES WITHOUT A BAN			
additional accidents for every million non-smokers living near a ban county	7.32**	6.43*	10.5**
	(3.52)	(3.81)	(4.29)
COUNTIES WITH A BAN			
additional accidents for every million smokers living near a ban-free county	158.8	170.2	163.6
	(109.6)	(111.3)	(100.6)
adjusted R^2	0.8852	0.8963	0.8982
observations	50267	47126	47044

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

TABLE XIII: Effects on Alcohol Related Traffic Fatalities

	13.1	**13.2**	**13.3**
alcohol related fatalities per million residents	7.11*	-39.7***	-53.4***
	(4.25)	(6.21)	(8.74)
difference when a weak smoking ban is implemented	3.03***	2.42**	2.83***
	(0.958)	(1.03)	(1.06)
difference when a total smoking ban is implemented	-1.19**	-1.36*	-0.91
	(0.53)	(0.63)	(0.73)
difference in a moist county	-	-11.1	-10.3
	-	(8.92)	(8.89)
difference in a dry county	-	-11.6*	-10.3*
	-	(5.97)	(5.93)
NON-POPULATION VARIABLES			
per million vehicles owned	-	5.72	-3.1
	-	(4.89)	(4.95)
per billion vehicle miles traveled	-	7.48***	6.79***
	-	(0.6104)	(0.59)
per million unemployed workers	-	-	-15.0
	-	-	(23.2)
per million employed workers	-	-	65.0***
	-	-	(14.1)
COUNTIES WITHOUT A BAN			
additional fatalities for every million non-smokers living near a ban county	7.25*	6.33	10.8**
	(3.9)	(4.19)	(4.77)
COUNTIES WITH A BAN			
additional fatalities for every million smokers living near a ban-free county	197.8	209.9	202.4
	(136.3)	(138.8)	(126.7)
adjusted R^2	0.8779	0.889	0.8909
observations	50267	47126	47044

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

3.5.2 Interpretation of Results

Smoking bans are shown to have a negative effect on non-alcohol related traffic accidents and fatalities. More about this result will be discussed below. The key finding is that a weak smoking ban increases the rate of alcohol related traffic fatalities by almost three per million residents while the effect of a total ban is negligible and statistically insignificant. This makes sense because of all of the additional self sorting done by smokers and nonsmokers. Each is willing to drive a little farther in a county that has both smoke-free and smoke-friendly establishments. That extra driving means a great deal of more potential harm on the way home. A total ban does not present the same incentives.

The results suggest that nonsmokers willing to drive out of their own county without a ban to frequent smoke-free areas nearby raise the number of fatalities by about eleven for every million of them (nonsmokers not total population). To put it another way, there was an additional alcohol related death for every 90,000 smokers incentivized to travel. While the weak ban and travel by nonsmoker estimates were statistically significant, the estimate of smoker travel was not[1]. The effect was nearly twenty times the size of the nonsmoker estimate, however. It suggests that on average, for every million smokers incentivized to cross borders to smoke indoors, there were two hundred more alcohol related fatalities. This is an additional death for about every five thousand smokers living on the wrong side of a border.

The presence of a small but statistically significant negative effect on non-alcohol related traffic accidents and fatalities in the areas with smoking bans may be capturing an overall avoid-

[1]This estimate was just barely not significant at the 90% level, with a p-value of 0.89

ance of risky behavior by those that live in such areas. It is also possible that municipalities that ban smoking are also more likely to enact other measures aimed at public safety. The smoking ban variables may be picking up the aforementioned lack of controls for road improvements and changes in safety policy. As more controls were added in the the regressions pertaining to non-alcohol related accidents and fatalities, the size of this negative effect decreased by nearly thirty percent. Other controls are most likely necessary. Other measures that may be correlated with smoking bans that could be causing this significance are telecommuting, youth licensing rate[1], participation in social networking sites, and changes in safety measures for professional drivers.

The estimates for the effect of being a moist or dry counties were the opposite of what was expected. They were negative and not very statistically significant. Some controls added to the regressions interacted poorly with each other due to sever multicollinearity. As can be seen in Table XIV, unemployment, employment, the number of automobiles, and vehicle miles traveled were more than a 0.90 correlation coefficient. They were all left in the final regressions as the coefficients estimated were not of primary concern.

3.5.3 Simulation

3.5.3.1 Simulation of a Hypothetical County

Table XV shows two hypothetical counties in which County K imposes a ban while County J does not. The national average in 2012 was 27 alcohol related traffic fatalities per million

[1]According to Schoettle and Sivak (2013), young drivers have been obtaining their licenses at a decreasing rate in recent years.

TABLE XIV: Correlations Between Control Variables

	unemployment	employment	automobiles	vmt
unemployment	1			
employment	0.9107	1		
number of automobiles	0.9097	0.9853	1	
vehicle miles traveled	0.9117	0.983	0.979	1

people. The estimates shown represent a 7.5% increase above the average for the ban county and a 3.7% increase for the non-ban county.

3.5.3.2 Simulation of an Actual County

Table XVI shows estimates for changes in alcohol related traffic fatalities for Fayette County and the counties that surround it. For Fayette County, the prediction is an average of four higher deaths per year which did not occur. The estimates are much smaller for the other counties, but each of them saw an increase in fatalities in at least one of the two years in question, if not both.

3.6 Conclusion

The results are not terribly shocking. When incentives exist for people to drive further to drink there are a greater number of alcohol related traffic fatalities. Smokers respond to these incentives more strongly on average, but with less consistency than nonsmokers. There are plenty of other relevant policy variables that may be examined in the future with this model. Differences in alcohol taxes may entice people to travel further to bars and restaurants for lower prices. Public transportation availability may affect where and when people choose to drive

TABLE XV: Hypothetical Additional Alcohol Related Traffic Fatalities

	No Ban	**Ban**
	County J	**County K**
population	300000	500000
area (square miles)	200	500
population density	1500	1000
estimated population along 25 mile shared border	37500	25000
smoking prevalence	25%	20%
estimated smoking population along border	9375	5000
estimated nonsmoking population along border	28125	20000
additional ARTF from smokers travelling to another county	-	1.012
additional ARTF from nonsmokers travelling to another county	0.30375	-

TABLE XVI: Estimated Change in ARTF for Fayette County Area

	Fayette	**Scott**	**Woodford**	**Jessamine**	**Madison**	**Clark**	**Bourbon**
shared border with Fayette County	87.94	13.37	8.00	17.76	12.62	18.23	17.96
estimated population along shared border	-	1733	1000	4265	2170	2443	1205
smoking prevalence	27%	27%	27%	27%	27%	27%	27%
estimated smokers along own border	22722	468	270	1152	586	660	325
estimated nonsmokers along own border	-	1265	730	3113	1584	1783	880
estimated smokers over ban border	-	3454	2067	4589	3261	4710	4641
predicted additional ARTF from smokers traveling	4.6	-	-	-	-	-	-
predicted additional ARTF from nonsmokers traveling	-	0.014	0.008	0.034	0.017	0.019	0.010
change in ARTF 03-04	-2	1	2	0	4	-1	1
change in ARTF 04-05	4	1	0	1	2	2	1

when drinking. Hours of operation for bars (including the ability to sell drinks on Sunday) when they vary may also encourage people to engage in more risky behavior. Policy makers need to consider these effects before they pass legislation that may entice their drinking electorate to literally go the extra mile.

CHAPTER 4

DOMESTIC METH PRODUCTION: PHARMACIES, PSEUDOEPHEDRINE, AND METH LABS

4.1 Introduction

Methamphetamine is a powerful and dangerous drug. It is a white powder or crystal that is eaten, snorted, injected or smoked. According to the National Institute on Drug Abuse, NIDA (2011), the prolonged use of the drug can lead to a number of severe problems including anxiety, confusion, paranoia, delusions, hallucinations and violent behavior.

Unlike many other popular drugs, methamphetamine is made through a series of chemical reactions instead of processing or refining plants or other organic matter. In addition, many of the chemicals needed to produce the drug are completely legal and have been widely accessible until recently. In the last couple decades production of the drug has become popular in places where the mainstream drug market does not reach. Rural areas and less densely populated parts of western states have been hit the hardest.

Some of the precursors used to make methamphetamine are common household items. These include, but are not limited to lithium camera batteries, matches, tincture of iodine, hydrogen peroxide, charcoal lighter fluid, gasoline and kerosene, paint thinner, rubbing alcohol, mineral spirits, sulfuric acid in battery acid, and sodium hydroxide from lye-based drain cleaners according to the U.S. Department of Justice, USDOJ (2011). One key ingredient in domestic synthesis is a substance called pseudoephedrine. It is mainly available to the general consumer

in over-the-counter cold medicines and diet pills. This is where federal, state, and local governments have attempted to control the supply of a integral ingredient for one of the country's most dangerous drugs.

Over the last decade many states have placed tougher controls on the purchase of pseudoephedrine. It has been placed behind-the-counter, people must show identification to purchase it, limits have been placed on the amount that can be purchased, and logs have been kept on who is doing the purchasing. This paper takes advantage of this natural experiment to test the effectiveness of the primary goal of the policy in question: reduction of the domestic production of methamphetamine.

The major contribution of this paper is that it investigates the effects of a policy that has not undergone much scrutiny yet. In addition, while most of the previous literature is concerned with the changes that occur in drug use after a new policy is administered, the interest of this paper is chiefly with the production of the drug.

4.2 Legislative History of Methamphetamine Precursors

As the threat of potentially dangerous chemically created drugs became a bigger fear in the United States, the federal government began controlling substances that were not necessarily drugs themselves, but that could be used in the production of drugs. The flagship bill of its kind, the Chemical Diversion and Trafficking Act (CDTA) of 1988 significantly curbed activities involving several different chemicals. In attempts to stay ahead of drug chemists, the Domestic Chemical Diversion Act (DCDA) of 1993 put safeguards in place to hamper ephedrine

transactions even if the good containing ephedrine was completely legal under Food and Drug Administration guidelines.

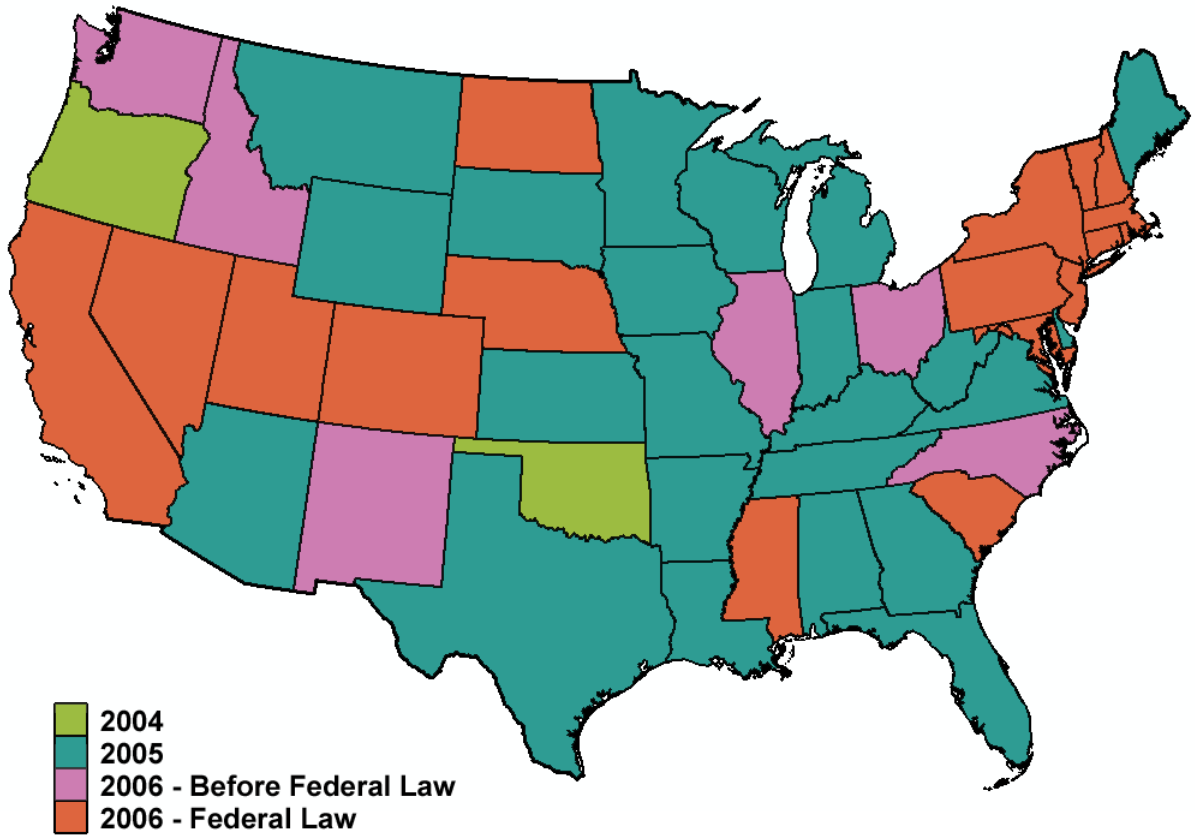
The Comprehensive Methamphetamine Control Act (CMCA) of 1996 extended these restrictions and some additional ones to pseudoephedrine, phenylpropanolamine, iodine and hydrochloric gas. It also increased punishment guidelines for violations involving controlled chemicals and substances. Most of these controls dealt with bulk amounts and with movement within the country involving suppliers and distributors.

The Methamphetamine Anti-Proliferation Act (MAPA) of 2000 introduced some new restrictions and extended all existing conditions to import and export activities. Many states and local governments were having trouble dealing with the externalities of methamphetamine production due to its chemical aspect. This included chemical fires, toxic dump sites, and the presence of poisonous chemicals. This bill set aside federal funds to help with the cleanup of hazardous materials associated with meth labs. In addition, it proposed to raise some of these funds by increasing penalties for a variety of activities associated with trafficking methamphetamine.

After the federal legislation made it difficult to obtain key chemicals in bulk, methamphetamine cooks had to find other methods to substitute for their previous recipes. There are many different ways to cook; a simple web search will yield over three hundred recipes for methamphetamine. Pseudoephedrine can be found as the main active ingredient in plenty of over the counter cold remedies and diet pills. With some work and some basic chemistry skills, the active ingredient can be isolated. Cooks figured out these methods and production of methamphetamine continued to thrive. In response to this, states started to take some action

of their own. Two states passed restrictions in 2004, twenty-four followed suit in 2005, and seven more did so in 2006 before the federal government passed their own law (see Figure 6).

Figure 6: Pseudoephedrine Restrictions 2004-2006



These state laws mainly consisted of three different policies. The first simply involved placing goods with the active ingredient of pseudoephedrine behind-the-counter of pharmacies. The second limited the purchase of the good to either 6 milligrams per month[1], 7.6 milligrams per month[2], or 9 milligrams per month[3]. The final step created a written or electronic log requiring identification and a signature which would monitor the sale of these chemicals to ensure that individuals were operating within the rules.

In the latest federal legislation, the Combat Methamphetamine Epidemic Act (CME) of 2005 , extended to all states the behind-the-counter policy, the 9 milligram per month limit, the log-keeping system, and a new 3.6 mg daily limit to all states. It did not require any state to lessen its restrictions if they were harsher than the federal mandate. The sales restriction portion of this law went into effect on April 8th, 2006, while the portion which required a log of sales to be kept did so on September 30th, 2006. Since then, two states have moved to even harsher restrictions. Oregon began requiring a doctor's prescription for any substance containing pseudoephedrine in 2006; Mississippi adopted the same policy in 2010.

4.3 Previous Studies of Methamphetamine Controls

Dave (2006) finds that there is both a statistically and economically significant decrease in mentions of heroin and cocaine in emergency room visits in response to changes in current and future prices of these drugs. Likewise, Cunningham and Liu (2003) show that state regulations in California, Arizona, and Nevada in the 1990s targeting methamphetamine precursors reduced

[1]This occurred in nine states.

[2]This occurred in three states.

[3]This occurred in twenty-one states.

hospital admissions related to the drug substantially. Dobkin and Nicosia (2009) examine the federal efforts in 1995 to control pseduoephedrine. They discover a temporary price increase and purity decrease of the drug because of the controls, but find that price and purity return to the pre-controlled levels after a year and a half. Barr (2005) show that burns associated with methamphetamine production decrease in Iowa after pseudoephedrine restrictions are put into place. Cunningham and Rafert (2008) show that increased methamphetamine use causes an increase in foster care admissions. The main focus of their conclusion, however, is that when additional funding is given to law enforcement to combat methamphetamine, family services will tend to need greater funding as well.

4.4 Assumptions and Reaction to Policy

The additional controls of precursors to methamphetamine production are essentially a non-monetary price change. When these substances become harder to acquire, they decrease the production of methamphetamine at each price level. This forces upward pressure on prices and makes substitution toward other substances more attractive. This is expected to increase the supply in these regions of other hard drugs such as cocaine. In addition, methamphetamine users may substitute toward more available substances such as alcohol.

Lab operators may react in a number of different ways.

1. **Lab operators can shut down.** If the new controls put a high enough strain on the production process, labs may simply stop producing.

2. **Labs can move to a less restrictive location.** If a nearby municipality does not have restrictions on methamphetamine purchases, it might be worthwhile for the lab owner to move production to that area.

3. **Labs can get pseudoephedrine from a less restrictive location.** If a nearby municipality does not have restrictions on methamphetamine purchases, producers may simply travel to these regions.

4. **Labs can get pseudoephedrine in other manners.** Even when the law went national, methamphetamine production still continued. Labs have smuggled pseudoephedrine in from Mexico and Canada. They have also set up networks of *smurfing*, which is where many people buy the maximum amount allowed and pool their purchases.

TABLE XVII: Top Five Counties on the Methamphetamine Lab Registry 2004 - 2012

County	State	Labs
Tulsa County	OK	610
Jefferson County	MO	471
Summit County	OH	323
Kalamazoo County	MI	316
Saint Charles County	MO	309

4.5 Data and Sources

This paper estimates the effect of pseudoephedrine control policy at the state level on measures related to methamphetamine, a drug made from pseudoephedrine. Due to the fact that all of the models in this paper use cross-sectional data by state or county, all of the regressions used in this paper use county and time fixed-effects. The data have been available in yearly increments. Below describes in greater detail the data collected and used in the paper.

1. Legislation Data

   State legislation data were compiled by reading state laws and tabulating when the legislation went into effect and what type of limitations where put on the purchase of pseudoephedrine.

2. County Methamphetamine Clandestine Lab Register

   These data contain the addresses and discovery dates of all clandestine methamphetamine labs for each state from 2004 to 2012. During this period, 20,516 labs were discovered across the country.

4.6 Empirical Strategy and Results

4.6.1 Estimated Regression Equation

The estimated regression equation is listed below:

$$L = \beta_0 + \beta_1 P_{tc} + \beta_2 C_{tc} + \beta_3 S_{tc} + \beta_4 SI_{tc} + \beta_5 SO_{tc} + \beta_6 CI_{tc} + \beta_7 CO_{tc} + u_t + v_c + \varepsilon_{tc}$$

L	=	methamphetamine lab incidents
P	=	population
C	=	pseudoephedrine buying controls weighted by population
S	=	pseudoephedrine prescription controls weighted by population
SI	=	dummy when a state has restrictions and borders a state that does not weighted by population
SO	=	dummy when a state has no restrictions and borders a state that does weighted by population
CI	=	dummy when a county is in a state that has restrictions and borders a county in a state that does not weighted by population
CO	=	dummy when a county is in a state that has no restrictions and borders a county in a state that does weighted by population

TABLE XVIII: County Methamphetamine Labs Added to Registry

	18.1	**18.2**
when any pseudoephedrine buying restrictions are in place	0.06 (0.31)	0.04 (0.31)
when a prescription is required to obtain pseudoephedrine	0.13 (0.61)	0.11 (0.61)
when the county is moist	- -	1.59 (1.16)
when the county is dry	- -	0.91 (1.27)
adjusted R^2	0.2613	0.2614
observations	28278	28278

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

TABLE XIX: County Methamphetamine Labs Added to Registry (with Controls)

	19.1	**19.2**	**19.3**
when any pseudoephedrine buying restrictions are in place	-3.67*** (0.96)	-3.68*** (0.96)	-3.52*** (0.97)
when a prescription is required to obtain pseudoephedrine	-1.41 (0.94)	-1.42 (0.94)	-1.17 (0.95)
when a state has restrictions and borders a state that has no restrictions	5.48*** (0.96)	5.47*** (0.96)	5.13*** (0.99)
when a state has no restictions and borders a state that has restrictions	2.31*** (0.43)	2.29*** (0.44)	2.08*** (0.45)
when a county has restrictions and borders a county that has no restrictions	- -	- -	1.54** (0.66)
when a county has no restictions and borders a county that has restrictions	- -	- -	2.05*** (0.73)
when the county is dry	- -	1.35 (1.16)	1.34 (1.16)
when the county is moist	- -	0.81 (1.27)	0.81 (1.28)
adjusted R^2	0.2641	0.2641	0.2648
observations	28278	28278	28278

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

4.6.2 Interpretation of Results

The coefficients for all of the variables on the right hand side are expected to have a positive value with the exception of C and S. 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.

Regressions run without controls for border crossing behavior are displayed in Table XVIII. The results suggest that putting pseudoephedrine behind the counter and limiting sales have no real effect on the number of methamphetamine labs in the county added to the national registry. Controls for avoidance are then added in Table XIX. The controlled results support the hypothesis that domestic producers do cut down on methamphetamine production when purchasing controls on pseudoephedrine are put in place.

Purchasing restrictions reduce the number of labs recorded by about 3.5 per hundred thousand residents. Prescription requirements for pseudoephedrine reduce this by an additional lab per hundred thousand.[1] A state with restrictions that borders a state without restrictions can expect about five more labs per hundred thousand residents. This is intended to be a measure of the labs where operators or their agents travel across state lines to obtain pseudoephedrine in uncontrolled areas. In a state with no restrictions that borders a state with restrictions there are about two additional labs per hundred thousand residents. This is intended to be a measure of labs that move operations to locales with fewer controls.

[1]This is not statistically significant. A reasonable explanation for why this control may not be very effective is the fact that avoiding the prescription law simply requires another trip over the border. Avoidance is easily possible in the only two states that have enacted such a policy, Oregon and Mississippi.

The same concepts were then measured in the border counties of such states. When a county with controls borders a county without controls,[1] it is estimated to have an additional 1.5 labs reported per hundred thousand. When a county has no restictions and borders a county that has restrictions, an two more labs per hundred thousand residents is expected.

Finally, on average dry counties have about 1.3 more labs per hundred thousand than their wet counterparts, while moist counties have 0.8 more. These results are not statistically significant, but do corroborate the suggestion that alcohol controls may increase the incentive to produce methamphetamine.

4.6.3 Simulation

Figure 7 shows the dates when seven states all bording Illinois implemented their pseudoephedrine controls. Illinois was the last to do so. Table XX shows the estimated and actual changes in the number of labs from 2005 to 2006 based on the border populations in these regions and the amount of time in which a different policy existed. All of the expected changes had the same predicted sign of the number of actual incidents with the exception of Illinois. The increase that occurred in contradiction to the predicted decrease may represent the presence of a different outlet for pseudoephedrine that arose in Illinois.

The magnitudes of the predictions for the rest of the states were all greater in magnitude than the actual change in incidents with the exception of Missouri. The key problem with this analysis is that some of the states around Illinois also have borders with other states that went

[1]This must be in another state because all pseudoephedrine control laws were enacted at the state level.

through policy changes in the time period mentions. In other words the predicted changes are actually predicted changes due to Illinois implementing their policy in early 2006.

Figure 7: Pseudoephedrine Restrictions Dates for Six States

TABLE XX: Simulation of Change in Labs Added to Registry

	Illinois	Indiana	Iowa	Kentucky	Missouri	Wisconsin
2005 population	12674452	6253120	2949450	4182293	5806639	5541443
2006 population	12718011	6301700	2964391	4219374	5861572	5571680
shared miles with Illinois	-	295.5	200.5	122.4	331.6	144.4
2005 border county population (not IL)	-	759213	450722	106761	2173121	515086
2005 Illinois border county population	-	6226103	287241	45296	803702	1401967
2005-2006 predicted lab incident changes	-812	-180	-104	-124	-168	-178
2005-2006 actual change lab incidents	+15	-51	-32	-67	-216	-9

4.7 Conclusion

The results are consistent with the assumptions that when local laws are passed to combat methamphetamine production, the production will continue as long as there are relatively easy ways to circumvent policy. While this work is unique in its measurement of production of methamphetamine, no measure of consumption of the drug has been included. Further analysis should be extended to look at the effects of border crossing policy on measures related to consumption. If use of the drug has not diminished, then pseudoephedrine controls may simply be taking American methamphetamine production jobs and moving them across international borders.

CHAPTER 5

CONCLUSION

The previous chapters have shown that people are willing to travel to better suit their needs. This is an important lesson for policy makers. Regulation does not occur in a vacuum.

The first subject we explored was the effect that smoking bans had on the food and bar industry. The intention of the legislation was to protect workers and patrons from the dangers of second-hand smoke. What we found was that if these policies are enacted without consideration for neighboring policies, they may be detrimental to the employment for the very people they are meant to protect.

On a much more grave note, the added travel that drinking patrons are willing to take most likely creates a hazard to many people's lives. Alcohol related traffic fatalities are shown to be more likely when smoking bans are inconsistent over geographical areas. Even worse, when bans are applied to only certain types of businesses, people do not need to cross borders and create a greater risk for everyone in their home county.

The last section of this work investigated the effects that a pseudoephedrine ban had on the prevalence of methamphetamine labs. Once again, we learned that regulation is not worth much if neighbors do not also have similar controls. Not only did the number of drug labs increase on one side of the inconsistent border, it occurred on both.

It is difficult to make laws that people will actually abide to. Incentives arise for circumvention. As economists, we should be aware of these incentives. We should also do our best to stop poor legislation before it begins.

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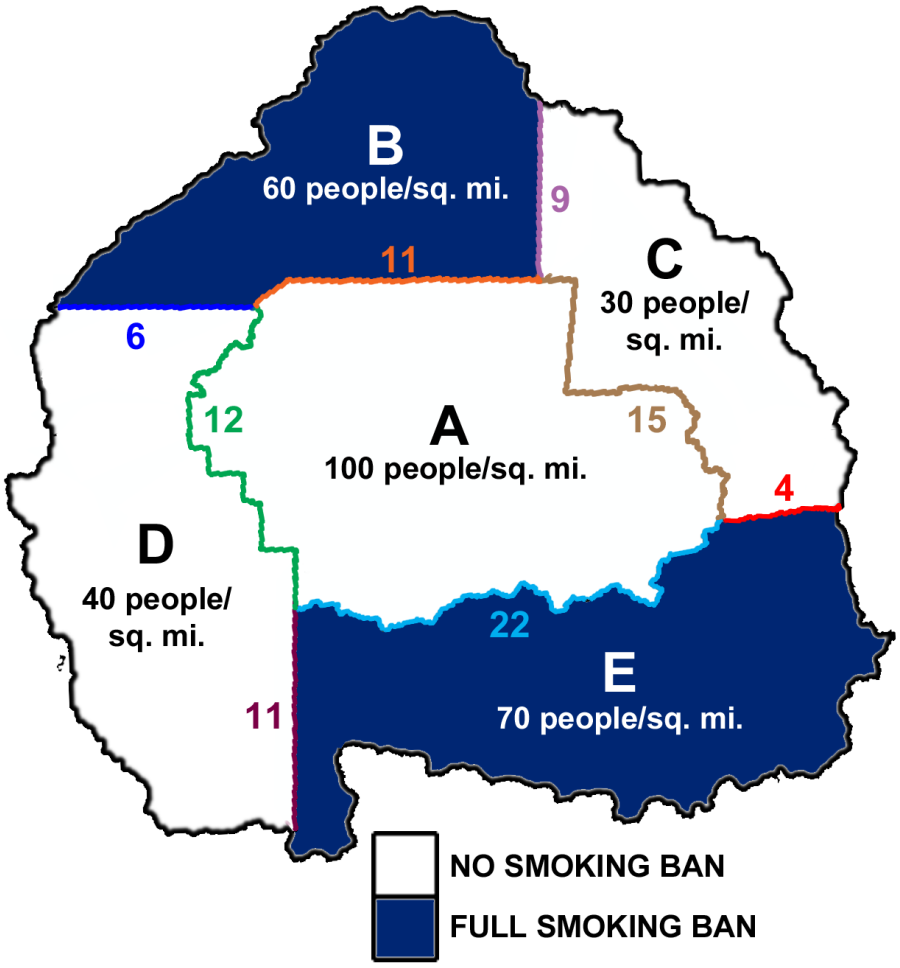
APPENDICES

Appendix A

ADDITIONAL MATHEMATICS

A.1 Creating the Mobile Population Estimates

Figure 8: Five Hypothetical Counties on an Island



Appendix A (Continued)

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 8).[1] Note that the border lengths 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:

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

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.[2] The population density (PD) matrix is therefore:

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

[1] 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 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.

[2] Note the subscript for time.

Appendix A (Continued)

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.[1] Values in the matrix for any given year can have positive, zero, or negative values.[2] Policy variables 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[3]:

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

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

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[1] 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.

[2] 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.

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

Appendix A (Continued)

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

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 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 XXI shows values of these three variables for the island example when a smoking prevalence of 20% is assumed. The *smokers in* for counties A, B, an D are calculated by totaling their respective columns from TP_y and multiplying by 0.20.[1] To calculate the *non-smokers in*

[1]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.

Appendix A (Continued)

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 XXI: 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

A.2 Estimating Vehicle Miles Traveled

For all years investigated, Vehicle Miles Traveled (VMT) data were available for all states. Only twenty-three states provided this data at the county level. I ran a regression for each state in which the county's share of VMT was determined by the county's share of both population and land area. None of these regressions had an R^2 value of less than 0.95. These regressions were then used to estimate the share of VMT in all years for all counties of a given state. This estimated share was then multiplied by the state level values for each year and county. The resulting values have been referred to as the *in-sample estimated VMTs*. Because of the simple

Appendix A (Continued)

regressions involved and the fact that all three shares measured have to add to one in any given year, the total VMT for the state was preserved.

The *out-of-sample estimated VMTs* used a regression of the same form as shown above of all the county level data available. The only difference was that the constant was suppressed in order to preserve state VMT totals. Thes values were then used to estimate values for the states that did not report any county level values. Hawaii and Alaska were not estimated.

Appendix B

SELECTED DATA SOURCES

B.1 Geographical Data

SHARED COUNTY BORDERS:

The county file comes from the National Atlas:

http://www.nationalatlas.gov/atlasftp.html#countypURL

Listed under boundaries, the file is located at:

http://dds.cr.usgs.gov/pub/data/nationalatlas/countyp010_nt00795.tar.gz

The file is a three dimensional rendering of a spherical earth. It was projected to a plane using ArcGIS 10.1 geographical information system software and the North American Equidistant Conic Miles Projected Coordinate System. Then through the use of polygon neighbors, the length of the shared borders of all U.S. counties were tabulated.

COUNTY LAND AREA IN SQUARE MILES:

The data file comes from the U.S. Census and is located at:

http://quickfacts.census.gov/qfd/download_data.html

The actual dataset is contained in the file:

http://quickfacts.census.gov/qfd/download/DataSet.txt

The headers for the dataset are contained in the file:

http://quickfacts.census.gov/qfd/download/DataDict.txt

The key for the Federal Information Processing Standard (FIPS) code for each state and county is contained in the file:

http://quickfacts.census.gov/qfd/download/FIPS_CountyName.txt

Appendix B (Continued)

B.2 Employment Data

STATEWIDE DATA:

Data come from the Bureau of Labor Statistics and report back to 1990. Some data are reported on a monthly basis. Most data are available annually. The link is below:

http://www.bls.gov/data/#employment

Under the Monthly header, find Employment, Hours, and Earnings - State and Metro Area: Choose One Screen Data Search to see available data and retrieve codes.

COUNTY DATA:

Data come from the Bureau of Labor Statistics and report back to 2001. Some data are reported on a monthly basis. Most data are available annually. Follow the link above, look under the Quarterly header, find State and County Employment and Wages: choose One Screen Data Search to see available data and retrieve codes.

USING GENERATED CODES TO RETRIEVE SERIES DATA:

The following link allows users to input series codes to retrieve data:

http://data.bls.gov/cgi-bin/srgate

B.3 Population Data

COUNTY DATA:

Population data come from the U.S. Census Bureau.
From 1990–2000 the data can be found here:

http://www.census.gov/popest/data/intercensal/st-co/index.html

From 2000–2010 the data can be found here:

http://www.census.gov/popest/data/intercensal/county/county2010.html

The most recent data can be found here:

http://www.census.gov/popest/data/index.html

Appendix C

DATA CODEBOOK

Name	Description
alacc	alcohol related traffic accidents
alfat	alcohol related traffic fatalities
anyban	dummy variable for any smoking ban
areasqmi	county area in square miles
autoest	estimated number of automobiles
banstatebno	dummy variable for a state which has placed pseudoephedrine behind-the-counter that borders a state that has not
btcd	dummy variable for behind-the-counter restrictions of pseudoephedrine
dry	dummy variable for a dry county
dryp	dummy variable for a dry county weighted by population
emp	employment
fips	federal information processing standard county code
moist	dummy variable for a moist county
moistp	dummy variable for a moist county weighted by population
nobstatebban	dummy variable for a state which has not placed pseudoephedrine behind-the-counter that borders a state that has
pop	population
popdens	population density (people per square mile)
popk	population in thousands
panyban	dummy variable for any smoking ban weighted by population
ptotban	dummy variable for a fully comprehensive smoking ban weighted by population
pweakban	dummy variable for a smoking ban less than fully comprehensive weighted by population
scripd	dummy variable for presription requirement for pseudoephedrine
snpopouta	smoking population that will no longer cross a border because the neighboring county has enacted a smoking ban
spopout	smoking population that can cross a nearby border to avoid a smoking ban
state	two letter state abbreviation
stprev	state smoking prevalence
tnaacctot	non-alcohol related traffic accidents
tnafat	non-alcohol related traffic fatalities
totban	dummy variable for a fully comprehensive smoking ban
une	unemployment
vmtest	estimated number of annual vehicle miles traveled in millions
weakban	dummy variable for a smoking ban less than fully comprehensive

Appendix D

PROGRAMMING CODE

```
***Load Data for Chapters 2 and 3

use "C:\data\Chapters2&3.dta", clear

** Bar and Restaurant Employment (Contaminated and Clean)

areg hemp1 pop ptotban panyban _I*  if  popin+popout >0, absorb(fips) robust
areg hemp1 pop ptotban panyban _I*  if  popin+popout==0, absorb(fips) robust
areg hemp1 pop ptotban panyban _I*  , absorb(fips) robust

** Bar and Restaurant Employment With Transient Populations

areg hemp1 pop ptotban panyban spopina spopnotina nspopina _I*, absorb(fips) robust
areg hemp1 pop ptotban panyban spopina spopnotina nspopina dryp moistp _I*, absorb(fips) robust

** All Accidents

areg acctot pop ptotban pweakban _I*, absorb(fips) robust
areg tnaacctot pop ptotban pweakban _I*, absorb(fips) robust
areg alacctot pop ptotban pweakban _I*, absorb(fips) robust

* With Dry and Moist

areg acctot pop ptotban pweakban moistp dryp _I*, absorb(fips) robust
areg tnaacctot pop ptotban pweakban moistp dryp _I*, absorb(fips) robust
areg alacctot pop ptotban pweakban moistp dryp _I*, absorb(fips) robust

** All Fatalities

areg totfat pop ptotban pweakban _I*, absorb(fips) robust
areg tnafat pop ptotban pweakban _I*, absorb(fips) robust
areg alfat pop ptotban pweakban _I*, absorb(fips) robust
```

Appendix D (Continued)

```
* With Dry and Moist

areg totfat pop ptotban pweakban moistp dryp _I*, absorb(fips) robust
areg tnafat pop ptotban pweakban moistp dryp _I*, absorb(fips) robust
areg alfat pop ptotban pweakban moistp dryp _I*, absorb(fips) robust


** Non-Alcohol Related Traffic Accidents

areg tnaacctot spopout nspopouta ptotban pweakban pop _I*, absorb(fips) robust
areg tnaacctot autoest vmtest spopout nspopouta ptotban pweakban moistp dryp pop _I*, absorb(fips
areg tnaacctot une emp autoest vmtest spopout nspopouta ptotban pweakban moistp dryp pop _I*, abs

** Non-Alcohol Related Traffic Fatalities

areg tnafat spopout nspopouta ptotban pweakban pop _I*, absorb(fips) robust
areg tnafat autoest vmtest spopout nspopouta ptotban pweakban moistp dryp pop _I*, absorb(fips) r
areg tnafat une emp autoest vmtest spopout nspopouta ptotban pweakban moistp dryp pop _I*, absorb

** Alcohol Related Traffic Accidents

areg alacc spopout nspopouta ptotban pweakban pop _I*, absorb(fips) robust
areg alacc autoest vmtest spopout nspopouta ptotban pweakban moistp dryp pop _I*, absorb(fips) ro
areg alacc une emp autoest vmtest spopout nspopouta ptotban pweakban moistp dryp pop _I*, absorb(

** Alcohol Related Traffic Fatalities

areg alfat spopout nspopouta ptotban pweakban pop _I*, absorb(fips) robust
areg alfat autoest vmtest spopout nspopouta ptotban pweakban moistp dryp pop _I*, absorb(fips) ro
areg alfat une emp autoest vmtest spopout nspopouta ptotban pweakban moistp dryp pop _I*, absorb(

*** Clear All Data

clear

*** Load State Data for Chapter 4

use "C:\data\Chapter4-2.dta"
```

Appendix D (Continued)

```
*** Per capita Regressions (County Fixed Effects)
areg labipc btcd scripd _I*, absorb(fips) robust
areg labipc btcd scripd dry moist _I*, absorb(fips) robust
areg labipc btcd banstatebno nobstatebban scripd _I*, absorb(fips) robust
areg labipc btcd banstatebno nobstatebban scripd dry moist _I*, absorb(fips) robust
areg labipc btcd banstatebno nobstatebban scripd cnpbp cpbnp dry moist _I*, absorb(fips) robust
```

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EDUCATION

2009–2014 University of Illinois at Chicago

Doctor of Philosophy

Department: Economics
Fields: Health Economics, Public Economics, & Econometrics
Dissertation: *Still Unseen: Unintended Consequences of Public Policy*
· Wall of Smoke: Smoking Bans, Borders, and Hospitality Employment
· Driven to Drink: Borders, Public Policy, and Drunk Driving
· Meth Production: Pharmacies, Pseudoephedrine, and Meth Labs
Committee: F. Chaloupka (Chair), D. McCloskey, R. Peck, J. Persky, M. Wenz

2006–2008 George Mason University

Master of Arts

Department: Economics
Fields: Public Choice & Law and Economics

2003–2006 Northeastern Illinois University

Bachelor of Arts

Major: Economics
Minor: Political Science

WORKING PAPERS

Free Ride: Public Transportation Policy, Senior Citizens, and Traffic Fatalities
Measures the effect on related traffic fatalities of a three year policy in the State of Illinois that gave senior citizens free access to all public transportation.

Seniority and Subsidies: Incumbency and Federal Spending at the State Level
Estimates the effect that seniority has on the composition of private and public subsidies secured by members of Congress for their constituents.

The Vector Voting Model: Incorporating Issue Weight into the Median Voter Theorem
This model allows for voters to weigh issues, provides the basis for Monte Carlo simulation of mock elections, and explains some situations in which elections produce inefficient results.

Line Change: Incentives and Collusive Behavior in the National Hockey League
Presents evidence of implicit collusion in professional hockey following a series of rule changes that occurred in the last decade.

Winners and Losers: How the Big Four Sports Championships Affect Local Economies
Measures the effect that making the playoffs, reaching the championship, and winning a season title in football, baseball, basketball, or hockey have on local economies.

TEACHING EXPERIENCE (43 SECTIONS OF 14 COURSES)

2013–Present — Visiting Clinical Instructor

Loyola University Chicago

· Econ 395 – Independent Study in Behavioral Economics, 2014 (2)
· Econ 203 – Principles of Microeconomics, 2014 (2)
· Econ 303 – Intermediate Microeconomics, 2014 (2)
· Econ 329 – Health Economics, 2014
· Econ 202 – Principles of Macroeconomics, 2013
Reference: Marc HAYFORD · (312) 915 6073 · mhayfor@luc.edu

2010–2014 — Visiting Lecturer

University of Illinois at Chicago

· Econ 215 – Health Economics, 2014
· Econ 346 – Introduction to Econometrics, 2011–2013 (4)
· Econ 333 – International Economics, 2013
· Econ 120 – Principles of Microeconomics, 2013
· Econ 390 – Behavioral Economics, 2012
· Econ 345 – Mathematical Economics, 2011
· Econ 121 – Principles of Macroeconomics, 2011
· Econ 218 – Intermediate Microeconomics, 2010
Reference: Evelyn LEHRER · (312) 413 2363 · elehrer@uic.edu

2011–2013 — Adjunct Professor

Northeastern Illinois University

· Econ 310 – Business and Economics Statistics II, 2013
· Econ 401 – Fundamentals of Business Economics, 2012
· Econ 360 – Behavioral Economics, 2012
· Econ 303 – Intermediate Macroeconomics, 2012
· Econ 215 – Principles of Macroeconomics, 2012–2013 (2)
· Econ 332 – Industrial Organization, 2012
· Econ 217 – Principles of Microeconomics, 2011
· Econ 306 – Labor Economics, 2011
Reference: Michael WENZ · (773) 442 5597 · m-wenz@neiu.edu

2010 — Adjunct Professor

DeVry University Chicago, IL

· Econ 312 – Principles of Economics (50% online), 2010 (2)
Reference: Carolyn BAIR · (773) 697 2208 · cbair@devry.edu

2009–2010 — Adjunct Professor

ITT Technical Institute Orland Park, IL

· EG 273 – Principles of Microeconomics, 2009–2010 (2)
· EG 452 – Principles of Macroeconomics, 2009
· GE 184 – Introduction to Problem Solving, 2009–2010 (9)
Reference: Gayla AUDIA · (708) 326 3215 · gaudia@itt-tech.edu

2008 — Adjunct Professor

George Mason University

· Econ 345 – Introduction to Econometrics, 2008
Reference: Mary JACKSON · (703) 993 1135 · mjacksoq@gmu.edu

NON-ACADEMIC WORK EXPERIENCE

2010–2011 **Quantitative Analyst**

Kottke Associates
Chicago, IL

Provided statistical support for day traders at the Chicago Mercantile Exchange. Used time series, cointegration, and other models to facilitate daily trades.
Reference: James KENSIK · (773) 930 9210 · kensik11@gmail.com

2006–2007 **Data Analyst**

Trinity-Consorta Hospital Group
Schaumburg, IL

Developed quarterly reports for hospital purchases and contract compliance for eighteen hospitals. Contract project performed via telecommute.
Reference: Deb CAMPBELL · (773) 209 6142 · debcalcampbell@sbcglobal.net

2004–2006 **Information Manager / Pricing Specialist**

D & L Produce
Elk Grove, IL

Managed daily database issues for produce distribution. Priced thousands of items on a near daily basis.
Reference: Matteo LOBUE · (630) 514 1075 · mattlobue@gmail.com

2002–2004 **Development Assistant**

Subway, Inc
Chicago, IL

Liaison between franchise sales, construction, and leasing. Facilitated the opening of new stores and managed sales data and quarterly reports.
Reference: Mary Ann CIMARUSTI · (773) 380 3040

1999–2002 **Data Analyst**

Philip Morris USA
Schaumburg, IL

Provided support for Senior Account Managers. Data reporting including quarterly performance, projected sales, and promotion effectiveness.
Reference: Eric VON SLAGLE

OTHER INFORMATION

Awards & Grants

2012 · NEIU Arts and Sciences Research Grant
2011 · The Oscar Miller Award for Teaching Excellence
2010 · The APEE Young Scholar Award

Certifications

2013 · UIC Graduate Certificate in the Teaching of Economics
2012 · Collaborative Institutional Training Initiative (CITI) Human Subjects Biomedical Research Certification Course (Central DuPage Hospital)

Paid Referee Work

2013 · Cartwright, Edward. *Behavioral Economics, Second Edition*. Routledge Publishers, London.
2013 · *Introduction to Econometrics*. Online course. Saylor Foundation, Washington, D.C.

Research Interests

Public Economics · Health Economics · Econometrics
Behavioral Economics · Regional Economics · Law and Economics
Public Choice · Labor Economics · Sports Economics

Other Interests

Songwriting · Steel Tip Darts · Cycling · Culinary Arts · Trivia