

# Border Crossing to Purchase Alcoholic Beverages

Mark Stehr  
Department of Economics  
LeBow College of Business  
Drexel University  
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Address for correspondence: Rm. 504-E Matheson Hall, 32<sup>nd</sup> and Market Streets, Drexel University, Philadelphia, PA 19104-2875; email: [stehr@drexel.edu](mailto:stehr@drexel.edu); tel (215) 895-0554.

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## Abstract

Excise taxes and Sunday sales bans are important interventions in the market for alcoholic beverages. This paper uses time variation in prices, Sunday sales bans, and border populations to identify the effect of these policies on cross state purchases of beer and liquor. The analysis indicates that interstate price differences and Sunday sales bans can account for 0.9% and 1.1% of total sales of liquor respectively, but finds no statistically significant effects on sales of beer. Simulations based on the coefficient estimates indicate that border crossing would not undermine the ability of modest tax increases to raise revenue. Analogous simulations for the repeal of Sunday sales bans show that such repeals are likely to lead to fairly substantial increases in sales, but that the effect of such repeals is diminished if neighboring states also repeal their bans.

## 1. Introduction

State governments have enacted a variety of laws that intervene in the market for alcoholic beverages. Prominent among these laws have been those that influence the prices of alcoholic beverages or ban their sale. As of January 1<sup>st</sup>, 2003, all states levied excise taxes on beer and 32 states levied them on liquor. Those states that did not levy excises taxes on liquor required that it be sold through state stores where prices were controlled by markups on wholesale prices. As of the same date, eleven states had bans on Sunday sales of beer and twenty seven states plus the District of Columbia had such

bans in place for liquor<sup>1</sup>. These policies have been the focus of much recent legislative activity. Alaska and Tennessee increased their alcohol taxes in 2002; Idaho, Nebraska, Nevada, Utah, and Washington increased their taxes on alcoholic beverages in 2004; and at least twelve states considered bills to increase their taxes on alcoholic beverages in 2005 (Alcohol Policies Project, Center for Science in the Public Interest). At the same time, Oregon repealed its ban on Sunday sales of liquor in 2002; Delaware, New York, and Pennsylvania repealed or relaxed laws restricting Sunday sales of alcohol in 2003; and six other states passed similar legislation in 2004 with Washington set to follow suit in 2005. Because these interventions raise the full price of alcohol, some consumers may choose to circumvent them by traveling to jurisdictions where laws or enforcement are more lenient. Higher prices, for example, may cause some consumers to travel to other states where prices are lower and some consumers may shop in other states when faced with a Sunday sales ban at home. Such activity is of concern for several reasons. First, it undermines the ability of states to curb consumption. Second, it influences the amount of revenue states collect through taxation. Third, these policies impose extra time and transportation costs on consumers.

Cross border activity should lead to unexpected variation in sales across states. Table 1 presents average state per capita annual sales of beer and liquor for the years 1990-2004 from the Distilled Spirits Council of the United States (DISCUS). Sales of liquor in New Hampshire, Washington DC, Delaware, and Nevada are very high while sales in Utah and Pennsylvania are very low relative to other states. Dispersion in per capita beer sales is

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<sup>1</sup> Sunday sales bans were an outgrowth of Blue Laws enacted before the American Revolution to regulate behavior on the Christian Sabbath. They were revived toward the end of the nineteenth century as part of the temperance movement and again after the end of Prohibition when states regained control of laws governing the sale of alcohol. (Christian Science Monitor, December 5, 2003 edition)

not as great, but it is also evident. While the data is consistent with cross border traffic, it is also consistent with other hypotheses. The low level of sales in Utah, for example, may be due to the strong religious influences in that state, and the high sales in Nevada may be due to the strong tourism and gambling industries. Previous research has attempted to separate these effects, but the focus has been on border crossing in response to price differences. Baltagi and Griffin (1995) examine demand for liquor from 1959-1982 and find little evidence of border crossing effects. Beard, Gant, and Saba (1997) find that for the period 1989 to 1993, border crossing for lower prices was a statistically significant factor in explaining beer but not liquor sales. They estimate that in 1993 in the typical state, such activity accounted for less than 1% of total sales. No research that this author is aware of examines the impact of Sunday sales bans on cross border traffic, yet these bans may be as important as prices in explaining cross border movements because most price differences between states are relatively small, especially for beer. Of the lower 48 states where we expect that border crossing might occur, the lowest and highest average state prices for a six pack of Heineken beer in 2003 were \$6.79 and \$9.00 respectively, but the price difference between the states at the 25<sup>th</sup> and 75<sup>th</sup> percentiles of the distribution was just \$0.56.<sup>2</sup> The lowest and highest prices for a 750 ml bottle of J&B Scotch were \$17.25 and \$26.67, but the difference between prices at the 25<sup>th</sup> and 75<sup>th</sup> percentiles was \$2.30. These data suggest that price induced border crossing is likely to be restricted to certain states and that it is likely to exist mostly along the edges of these states. It is, for example, unlikely to be cost effective for a consumer to travel a great distance only to save \$0.56 per six pack of beer, even if he were to buy several cases.

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<sup>2</sup> Priced data based on state averages from the third quarter 2003 American Chamber of Commerce Research Association (ACCRA) survey. See the data section and Table 2 for a description of this data source.

The population that is close to the border is therefore likely to be more important than the total population when estimating border crossing effects. Even if price differences appear sufficient to motivate cross border traffic, they may be correlated with Sunday bans and other alcohol policies. In this case, these variables must be analyzed together in order to avoid the omitted variable bias that may emerge if they are considered in isolation. Indeed, in the tobacco literature, a number of researchers have found that omitting anti-smoking sentiment or smoking restrictions alters the estimated effect of cigarette taxes (DeCicca, Kenkel, Mathios, and Shin, 2004) and (Tauras, 1999).

This paper contains two key contributions. First, it estimates the effect of Sunday sales bans in addition to the effect of interstate price variation on the degree of state border crossing to purchase beer and liquor. Second, it uses the population of border counties rather than entire state populations to construct the measures of border crossing. I find that interstate price differences and Sunday sales bans can account for 0.9% and 1.1% of total sales of liquor respectively, but find no statistically significant effects for beer. The results for liquor suggest a price elasticity of border crossing for the average state of -0.35. Because state excise taxes on liquor are a small fraction of retail prices in most states, however, states with excise taxes would not be expected to lose tax revenues from a modest tax increase. The results also suggest that states that repeal their bans on the Sunday sales of liquor would experience significant sales and revenue increases assuming that their neighbors do not pursue the same policy. The rest of the paper is organized as follows: section two outlines the empirical specification, section three describes the data used in the analysis, section four presents the results, and section five concludes.

## 2. Empirical Specification

Sales of beer or liquor in a state are the sum of sales to members of that state plus sales to individuals who do not reside in that state, or exported sales. Exports may be identified by associating sales in a state with incentives for residents of neighboring states to cross into that state to purchase alcoholic beverages. Although I also construct a similar variable to measure imports, exports are likely to be easier to identify because large amounts of excess sales can occur in small states that export to large adjacent states. A dearth of sales due to high imports, on the other hand, must come entirely from own state residents choosing to shop out of state.

I propose two measures of exported sales: the first captures the incentive to export sales based on price differences, the second measures exports that are due to differences in Sunday sales laws. Population will clearly affect the degree of border crossing. Small states may experience large percentage increases in sales if they are exporting sales to a large adjacent state whereas the opposite holds true for large states that border small states. The distribution of population is also important. Those who live near the border are much more likely to cross it than those who live far from it. For this reason, I choose to rely on the population of border counties in an adjacent state rather than the population of the entire state. This approach has a clear advantage when population is unevenly distributed. Kansas, for example, had a ban on the Sunday sale of liquor through all of the 1990's and borders both Colorado and Missouri which have not had such bans in place. Much of the population of Kansas lives in and around Kansas City, located on the border with Missouri, while very few residents of Kansas live on the border with

Colorado. In this case, relying on the entire population of Kansas to construct the export variable for Colorado would lead to clear misspecification. Transportation is important as well. Three freeways and numerous smaller roads traverse the relatively short border between Massachusetts and New Hampshire, but the border between Mississippi and Arkansas follows the Mississippi River and is only crossed easily where there is a bridge.

With these factors in mind, I construct the following variable to measure sales that are exported due to price differences,

$$Price\ Export_{jt} = \sum_k \frac{countypops_{kt}}{statepop_{jt}} \left( price_{kt} - price_{jt} \right) \mathbb{1} \left( price_{kt} > price_{jt} \right), \quad (1)$$

where  $j$  indexes state,  $k$  indexes states that border state  $j$ , and  $t$  indexes year.

$Countypops_{kt}$  is the sum of the populations of the counties in state  $k$  that border state  $j$  and that have direct overland access to state  $j$  or access via a bridge. The last third of the expression sets the contribution of state  $k$  to zero when the price in state  $k$  is higher than the price in state  $j$  because in this case, there is no price incentive to export sales. State  $k$ 's contribution is also set to zero if price data for state  $k$  is missing.  $Price\ Export_{jt}$  is thus bounded from below at zero. Next, I construct a similar variable to measure exports that are due to Sunday sales restrictions in neighboring states,

$$Sunday\ Export_{jt} = \sum_k \frac{countypops_{kt}}{statepop_{jt}} \mathbb{1} \left( ban_{kt} > ban_{jt} \right), \quad (2)$$

where  $ban_{kt}$  equals one when a state prohibits Sunday sales and zero when it allows them. For those years in which a Sunday sales law changed, I code the variable as equal to the fraction of Sundays for which sales were banned. The National Institute of Health's APIS (Alcohol Policy Information System) provides additional data indicating states that have statewide laws banning Sunday sales of all alcoholic beverages, but allow local governments to override the state law.<sup>3</sup> For these states, I code the Sunday ban on beer to be 0.5. The contribution of state k to  $Sunday Export_{jt}$  is thus zero unless it has a ban that is more stringent than that of state j. Because both export variables are by construction nonnegative, the expected sign on their coefficients is positive. The variables measuring imports are similar in spirit to those measuring exports, but because own state residents are crossing the border to import alcoholic beverages, I sum over the populations of own state counties that lie on the borders with other states. The variable measuring imported sales due price differences is thus,

$$Price Import_{jt} = \sum_k \frac{countypops_{jt}}{statepop_{jt}} \left( price_{jt} - price_{kt} \right) \mathbb{I} \left( price_{jt} > price_{kt} \right), \quad (3)$$

where  $countypops_{jt}$  is the population of counties in state j that border state k and have direct access to state k. And, the variable measuring imports due to Sunday sales bans is,

$$Sunday Import_{jt} = \sum_k \frac{countypops_{jt}}{statepop_{jt}} \mathbb{I} \left( ban_{jt} > ban_{kt} \right). \quad (4)$$

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<sup>3</sup> States with a Sunday ban on beer also ban Sunday sales of liquor, but the opposite does not hold true. For this reason, the APIS data on partial bans may only be applied correctly to beer sales.

Because both import variables are constructed to be nonnegative, the expected sign on their coefficients is negative.

The model also contains other variables that should affect sales of beer and liquor. I include a quadratic of own beverage price as well as the price of the other alcoholic beverage to control for own and cross beverage price effects. Sunday sales bans are included to control for the effect of own state bans on own state sales independent of any border crossing effects. I include income because increased consumption of alcoholic beverages has been associated income.<sup>4</sup> Fraction black, Hispanic, Asian, and Native American, and the fraction of the population that falls within specific age categories are included to control for the possibility that drinking habits vary by race, ethnicity, and age.<sup>5</sup> I include the state unemployment rate because those without jobs may drink as a result of frustration or because they have more free time, or they may drink less because they lack a steady income. Unobserved determinants of drinking may also vary by state. Residents of Wisconsin, for example, may have a more positive attitude toward beer consumption than the residents of other states because many of their ancestors emigrated from countries such as Germany where beer is quite popular or because their state is home to Milwaukee, a city long associated with brewing beer. With this argument in mind, I estimate specifications that include state fixed effects and rely on within state variation over time for identification. I also include year dummies to capture the downward trend in per capita beer sales that has occurred from 1990 to 2004 and the U-shaped trend in liquor sales that has occurred over the same period. Other observable

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<sup>4</sup> Author's own calculations based on survey data from the Behavioral Risk Factor Surveillance System.

<sup>5</sup> See Table 2 for a complete description of age categories.

characteristics of states such as church membership, state control of liquor stores, bans on the sale of alcohol in grocery stores, and whether a state borders Canada or Mexico may also be important determinants of state sales of alcoholic beverages. Because data on church membership is only available for 1990 and the other variables are largely time invariant, their influence on drinking will be subsumed in the state fixed effects and they are excluded from the analysis. The final equation for estimation is thus,

$$sales_{jt} = \mathbf{a}_j + \Delta Prices_{jt} + \Phi Bans_{jt} + \mathbf{b}_1 priceimport_{jt} + \mathbf{b}_2 price export_{jt} + \mathbf{b}_3 sundayimport_{jt} + \mathbf{b}_4 sunday export_{jt} + \Gamma Z_{jt} + \mathbf{d}_t + e_{jt} \quad (5)$$

where  $sales_{jt}$  are in gallons of beer or liquor per capita per year,  $\mathbf{a}_j$  is a state fixed effect,  $Z_{jt}$  is the vector of time varying control variables,  $\mathbf{d}_t$  are year fixed effects, and  $e_{jt}$  is an error term.

### 3. Data

Summary statistics for the key variables used in the analysis are presented in Table 2. Price data for beer and liquor are taken from the 1990-2004 third quarter editions of the American Chamber of Commerce Researchers Association (ACCRA) cost of living indexes. ACCRA surveys roughly 300 cities per year that provide coverage for 43-48 states per year. I drop those state year observations with no data and for those state years that have multiple survey cities, I average prices across cities. Prices for each alcoholic beverage are not weighted averages across all brands, but instead reflect the price of a specified quantity of a particular branded product. The beer price for the 1990's, for

example, was for a six pack of Miller Lite or Budweiser. Although this price may be significantly higher or lower than beer prices as a whole, differences in this price should reflect differences in beer prices across states with reasonable accuracy because they are likely to be driven primarily by factors common across brands such as taxes, regulations, transportation costs, the level of competition, or income. Even if a shift in tastes toward a particular type of beer were to cause its market share and price to increase, interstate differences in this price would likely still be reflected in the survey price for Budweiser. In other words, it is unlikely that an increase in demand for another type of beer would increase its price in state A and not in an adjacent state B while at the same time the price of Budweiser remained unchanged in both states.

A different problem occurs when ACCRA changes the good whose price is surveyed. In 2000, for example, ACCRA switched the brand of beer included in the survey. Because there is no data on both goods for the same year, it is impossible to know the true relative prices of the goods. In these cases, I multiply all of the new prices by a factor such that the first year of the new good has the same price as the last year of the old good. Although not ideal, this normalization avoids a large spurious change in the price in the year that the good changes. It also preserves consistency in the magnitude of cross sectional price differences and in price differences over time with the exception of the two transition years.<sup>6</sup>

In the tobacco literature, many researchers have used cigarette taxes rather than cigarette prices to study the effect of price on consumption or other outcomes. This choice has been based on the belief that cigarette taxes are less endogenous than cigarette

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<sup>6</sup> The beer good was a Schlitz, Miller Lite, or Budweiser 6 pack from 1990 to 1999 and a 6 pack of Heineken from 2000 to 2004. The liquor good a J&B Scotch 0.75 liter bottle from 1990 to 2004.

prices and are measured with less error so that their use will lead to a better estimate of the effect of price than the price variable itself. Several reasons caution against following this path in the case of alcoholic beverages. First, the cross state association between prices and state excise taxes for liquor is weak and the correlation between beer prices and state excise taxes on beer is actually negative (Young and Bielinska-Kwapisz, 2002). Unlike the case of cigarettes, factors other than taxes play a large role in determining state price variation in alcoholic beverages. In Pennsylvania, for example, the excise tax on beer was 8 cents per gallon from 1990 to 2004, less than half the national average, but at the same time Pennsylvania had the highest beer prices in the lower 48 states for thirteen out of fifteen of those years, perhaps because state law required that beer sales occur through a limited number of state licensed beer distributors. Changes in beer taxes are, however, very good predictors of changes in beer prices and because the empirical model includes state fixed effects, this association would seem to be the relevant one. But because whether a bordering state contributes to an export or import variable is determined by comparing the difference in price between a given state and a bordering state, cross state differences remain important even with the fixed effects specification. Because higher beer prices are often associated with lower beer taxes, use of taxes would cause many of the states that should contribute to the border crossing variable to instead be assigned a weight of zero. A resulting export variable would then reflect variation in tax differences with bordering states that have lower prices, and a model with state fixed effects would be identified from time variation in tax differences with states with lower prices when we expect exports to occur to states that have higher prices. Finally, eighteen states do not have excise taxes on liquor. These states instead sell alcoholic

beverages through government controlled stores that earn money for the state. Such states have a range of markups over wholesale prices, but it is problematic to convert the markup to an equivalent excise tax because part of the markup covers the cost of store operations and because wholesale prices differ across states. With these considerations in mind, I choose to rely on price data.<sup>7</sup> Prices are adjusted to include sales taxes and deflated to 1982 cents using the consumer price index (CPI) from the Bureau of Labor Statistics.

Data on state sales of beer and liquor, Sunday sales laws for liquor, excise taxes, and sales taxes on alcoholic beverages are from the Distilled Spirits Council of the United States (DISCUS). Data on Sunday sales laws for beer are drawn from the Alcohol Policy Information System (APIS)<sup>8</sup>. State level data on unemployment rates; per capita income; fraction black, Hispanic, Asian, and Native American; the fraction of the population that falls within specific age categories, and county level population data are from the Bureau of Labor Statistics online files. Because county level population data were not available for the year 2004, I extrapolate based on population growth rates computed from 2000 to 2003.

#### 4. Results

Columns one and two of Table 3 present the results for beer. The coefficients on both import and export variables are statistically insignificant lending no support to the hypothesis that price differences or Sunday sales bans are important determinants of beer

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<sup>7</sup> Young and Bielinska-Kwapisz (2002) provide a detailed discussion of the relationship between excise taxes and prices for alcoholic beverages and argue against the use of taxes.

<sup>8</sup> APIS data extends from 2004 back to 1998. DISCUS reports that their lobbyists are unaware of any changes to Sunday sales laws dating back through at least 1990. I do not consider wine sales because there is no reliable source of data on Sunday sales bans for just wine.

sales. Columns three and four of Table 3 present the results for liquor. The coefficients on the variables measuring imports are both of the expected negative sign, but their statistical significance is marginal with the p-value on the coefficient of price imports equal to 0.07 and p-value for the coefficient on Sunday imports equal to 0.08. The coefficients measuring exports are also of the expected sign, but they are statistically significant at a higher level with p-values of less than 0.01 in each case. These results indicate that price differences and differences in Sunday sales bans are significant determinants of liquor sales. These coefficients represent marginal effects, but if we assume that they are constant over the range of the corresponding variables, they may be multiplied by the average of the variable for each state to arrive at the average per capita sales due exports in each state. The population weighted average of state exports may then be divided by average per capita national sales to arrive at the percent of total sales that are due to exports. According to these calculations, 0.9% of liquor sales are exports to other states as a result of price differences and 1.1% of sales are exports due to the existence of Sunday sales bans. If the calculations are instead based on the import variables and their coefficients, the corresponding percentages are 0.4% and 0.9%. These figures appear reasonable. In 2003, 42.2% of the US population lived in counties that border other states and 9.6% of the population lived in states with bans on Sunday sales of liquor *and* in counties that bordered states without such bans. If one seventh of shopping occurs each day of the week, then in the absence of a Sunday sales ban, we would expect that approximately  $(1/7)*0.096 = 1.37\%$  of total liquor sales would be to this second group of individuals. The presence of a ban, however, shifts some sales to other days, eliminates some sales, and according to the analysis, shifts  $1.1 / 1.37 = 80\%$

of them to other states. Although this is a large percentage, the purchase of liquor often involves a trip to a special store because liquor may not be sold in grocery stores in many states. For those who live close to a state offering Sunday sales, a trip over the border would not seem too inconvenient. The 80% figure also assumes that all cross border sales are to residents of border counties when in fact some sales may be to residents of other counties near the border. In addition, more than one seventh of sales may occur on Sunday because many people have more time to shop on the weekend.

Columns 1 and 2 of Table 4 present figures for each state.<sup>9</sup> Exports due to price differences range from zero in those states with the highest prices to above 5% of sales in several smaller states. Delaware leads all states with just over 12% of total sales due to exports. Sunday sales exports are by construction zero in those states that have Sunday bans and are below 1% of total sales for all but eight states that permit Sunday sales. New Jersey tops the list with 5.3% of total sales due to Sunday border traffic. Although this estimate also appears rather high, all three of New Jersey's neighbors had Sunday sales bans in effect until 2003 and contain large population centers immediately across their borders with New Jersey. Together, these populations easily exceed the entire population of New Jersey.

Although the total amount of border crossing may be of interest to policy makers, the effect of a policy change such as a tax or price increase or an end to a Sunday sales ban may be of greater relevance. I simulate the effect of a price increase by recalculating the price export variable with a 1% higher price for each state individually. I then use the coefficient of the price export variable to recalculate the quantity of exports for the given

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<sup>9</sup> The estimate is based on the average marginal effect for all states. Although correct on average, the estimate for a particular state may still be far from the truth. State specific estimates should therefore be interpreted with some caution.

state and each of its neighbors. The decrease in own state exports plus any increase in the exports of neighboring states then equals the change in sales for the given state. The percent change in sales can then be divided by the 1% change in price to arrive at a simulated price elasticity due to changes in border crossing. Column 3 of Table 4 presents the state specific elasticities. The average state has an elasticity of border crossing equal to -0.35, but substantial variation exists with the largest elasticity equal to -1.04. This elasticity must be combined with the price elasticity of consumption to determine the overall effect on state revenues of an increase in the price of liquor or the liquor tax. Using the coefficients on the price of liquor and its square I calculate an elasticity of consumption of 0.01 implying that all of the price response is due to border crossing. The low consumption elasticity may be due to attenuation bias arising from measurement error in the liquor price variable. If this is the case, it would be more appropriate to use an elasticity from the existing literature. Such elasticities vary widely, see Edwards (1994), but Baltagi and Goel (1990) report a sales elasticity of -0.74 using a quasi-experimental approach on US sales data from 1961 to 1982. Because this study does not separate consumption and border crossing effects, the reported elasticity presumably reflects both. If this elasticity is correct, then order crossing represents just under half of the total price response. Because state excise taxes are a small fraction of liquor prices, in no case would a state with an excise tax actually lose revenue from a moderate tax increase.<sup>10</sup> In the case where the price of liquor is determined by the state, total revenues might increase or decrease depending on the state. Because total costs would also decrease with the reduction in sales, additional information would be required

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<sup>10</sup>This calculation assumes a pass through rate from taxes to prices of one.

to determine the effect on state balance sheets, but only in the case of very large markups would a state actually lose revenue.<sup>11</sup>

The insignificance of the coefficient on *Sunday sales ban* is consistent with the hypothesis that all of the change in sales from repeal of bans is due to changes in cross border purchases.<sup>12</sup> Under this hypothesis, the effect on sales of an end to a Sunday ban can be simulated by first recalculating the Sunday export variable for a particular state under the assumption that no Sunday sales ban is in place. The change in the Sunday export variable multiplied by its coefficient then equals the change in exports due to the repeal of the ban. The sum of any new exports from the given state plus any decreases in the exports of surrounding states then equals the total change in sales for the given state. The results of these calculations performed for 2001 are listed in column 4 of Table 4. Because several states actually ended their Sunday sales bans in 2002 and 2003, it is possible to compare the results of the model with actual changes in sales for these instances. The model predicts that an end to the ban in Delaware would cause sales to increase by 28.2%, a very large amount. To determine the drop in sales associated with an end to the ban, I use state level monthly per capita sales data for the years 2002 to 2004 and create a dummy variable that equals zero for all observations except those months when Delaware had no Sunday sales ban in place. I include state, year, and month fixed effects and use the log of per capita monthly sales as the dependent variable.

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<sup>11</sup> If a state's "take home" revenues are 25% of total revenues, then a 1% increase in price corresponds to a 4% increase in "take home" revenues. Only if the elasticity were -4 would the 4% rise in take home revenues be matched by a 4% decrease in quantity.

<sup>12</sup> Because the standard error on *Sunday sales ban* is equal to 3% of average per capita liquor sales, the analysis only has the power to detect a drop in per capita sales in excess of 6% at the 95% confidence level. The analysis has less power to detect the direct effect of a Sunday sales ban than the cross border effect because the Sunday sales ban is identified only from time variation in bans which is restricted to the last two years of the sample whereas the border crossing variables are also identified from time variation in border populations.

The coefficient on  $DelBan_{jtm}$  can thus be interpreted as the percent change in sales associated with relaxation of the ban relative to the level of sales in the rest of the nation. Table 5 presents the results. The coefficient on  $DelBan_{jtm}$  implies that relative to other states, Delaware experienced a 13.2% increase in sales after relaxing its ban. Although this is far less than the predicted 28.2%, the model prediction assumes that other states do not respond by relaxing their own Sunday bans when in fact neighboring Pennsylvania began phasing out its Sunday sales ban a few months in advance of Delaware. If the simulation is re-run assuming that Pennsylvania ends its ban, then the predicted decrease in sales in Delaware is just 16.0%. Table 6 presents results when the scope of the variable of interest is expanded to include the repeal of bans in Oregon in 2002 and New York and Pennsylvania in 2003. The results indicate an increase in sales of 7.2% but with a 95% confidence interval extending from 0.6% to 13.9%. The predicted average for these four states while accounting for the fact that some of them border each other is 10.3%. Thus, the predictions of the model do not appear unreasonable.

## 5. Conclusion

This paper estimates the effect of both Sunday sales bans and price differences on state border crossing to purchase beer and liquor. The results indicate that these policies play a small but statistically significant role in explaining liquor sales, but not beer sales. The issue is of concern to states because taxes on alcoholic beverages are a source of revenue for state governments and because border crossing may undermine the ability of states to curb drinking through higher prices or sales bans. Fiscal crises in 2002 and 2003 led states to search for additional revenues and many responded by enacting cigarette tax

increases. Higher cigarette taxes, however, have been shown to cause cigarette smuggling and border crossing (Thursby and Thursby, 2000), (Yurekli and Zhang, 2000), and (Stehr, 2005). The analysis presented here suggests that for the average state, modest tax or price increases on alcoholic beverages would be unlikely to lead to significant amounts of these activities and that revenue leakage due to border crossing would be minimal. Because the period of analysis considered does not include any large state tax or price increases except for those in Alaska, where interstate border crossing is not an issue, the predictions of the model may not apply to such large increases. Certain states might face significant increases in imports or decreases in exports after a large tax increase, particularly if population centers are located near their borders. Although this paper finds that the entire price response for liquor is due to border crossing, this result probably arises from measurement error in prices rather than the lack of an effect of price on consumption. If we instead rely on other estimates in the literature which put the price elasticity of sales for liquor at around -0.8, then border crossing accounts for  $-0.35/-0.80 = 44\%$  of the price response, and higher prices are still expected to lower consumption.

Historically, Sunday sales bans have been justified on the grounds that they discourage drinking on the Christian Sabbath. The results presented here indicate that bans on liquor but not beer lead to border crossing and that ending them increases state liquor sales and therefore state revenues. Although not conclusive on this point, the evidence is consistent with a zero sum game in Sunday sales bans whereby the repeal of such bans shifts sales between states rather than increasing overall consumption. The fact that individuals cross borders to purchase liquor suggests that they are inconvenienced by these laws. The appropriate public policy must then balance the conflicting desires of

Sunday teetotalers with Sunday drinkers and also consider the effect of these laws on government revenues. Further research might seek to identify whether these laws have any benefits that might justify the extra cost and inconvenience they place on consumers.

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**Table 1****Per capita annual sales of beer and liquor by state**

<b>State</b>	<b>Beer</b>	<b>Liquor</b>
Alabama	20.78	1.05
Alaska	23.35	1.85
Arizona	26.29	1.39
Arkansas	19.55	1.08
California	19.62	1.28
Colorado	23.71	1.65
Connecticut	17.49	1.57
Delaware	24.84	2.03
D.C.	26.23	3.23
Florida	24.94	1.72
Georgia	21.27	1.39
Hawaii	23.54	1.13
Idaho	20.93	1.01
Illinois	23.00	1.34
Indiana	20.32	1.20
Iowa	23.67	0.96
Kansas	19.69	1.02
Kentucky	19.16	1.08
Louisiana	26.31	1.38
Maine	21.40	1.48
Maryland	19.04	1.52
Massachusetts	20.75	1.62
Michigan	21.35	1.36
Minnesota	22.20	1.67
Mississippi	24.23	1.19
Missouri	23.64	1.23
Montana	27.79	1.38
Nebraska	24.79	1.16
Nevada	33.45	2.86
New Hampshire	31.41	3.54
New Jersey	18.16	1.53
New Mexico	26.50	1.16
New York	17.56	1.20
North Carolina	20.86	1.07
North Dakota	27.24	1.61
Ohio	23.24	0.97
Oklahoma	19.61	0.99
Oregon	21.95	1.26
Pennsylvania	22.68	0.96
Rhode Island	21.74	1.39
South Carolina	25.09	1.42
South Dakota	24.75	1.39
Tennessee	21.39	1.04
Texas	26.92	0.97
Utah	12.67	0.71
Vermont	23.22	1.34
Virginia	21.39	1.02
Washington	20.26	1.29
West Virginia	21.82	0.78
Wisconsin	27.99	1.74
Wyoming	24.99	1.66
Mean	22.84	1.41
Standard Deviation	3.60	0.54

Data are from the Distilled Spirits Council of the United States and are averaged over the years 1990-2004. Figures are annual gallons per capita.

**Table 2****Summary Statistics for Key Variables**

<b>Variable</b>	<b>Number of Observations</b>	<b>Mean</b>	<b>Standard deviation</b>	<b>Minimum</b>	<b>Maximum</b>
Beer sales	765	22.84	3.74	12.19	39.63
Liquor sales	765	1.41	0.55	0.68	4.08
Beer price	701	5.07	0.42	3.92	7.19
Beer price squared	701	25.91	4.44	15.39	51.76
Liquor price	701	34.23	3.03	24.27	45.02
Liquor price squared	701	1181	209	589	2027
Wine price	701	10	1	6	15
Export beer price	701	17.72	46.61	0	422
Import beer price	765	30.87	75.11	0	715
Sunday ban beer	765	0.30	0.41	0	1
Export beer Sunday	765	0.14	0.26	0	1.28
Import beer Sunday	765	0.11	0.24	0	1.65
Export liquor price	701	112.2	243.0	0	2035
Import liquor price	701	188.5	387.0	0	2588
Sunday liquor ban	765	0.590	0.490	0	1
Export liquor Sunday	765	0.147	0.393	0	2.57
Import Liquor Sunday	765	0.127	0.266	0	1.65
Income in 1000s	765	20.32	3.34	12.82	30.99
Unemployment rate	765	5.24	1.45	2.30	11.30
Age15-19	765	7.18	0.73	4.65	10.42
Age20-29	765	14.21	1.51	11.12	21.37
Age 30-39	765	15.70	1.57	11.48	21.45
Age40-49	765	14.55	1.25	10.38	17.88
Age 50-59	765	10.31	1.45	6.75	14.93
Age 60-69	765	7.60	0.89	4.05	10.86
Age 70-79	765	5.72	0.91	1.73	8.78
Age 80 plus	765	3.19	0.71	0.57	4.88
Fraction Hispanic	765	0.070	0.084	0.004	0.430
Fraction Black	765	0.113	0.119	0.003	0.663
Fraction Native Amer.	765	0.019	0.031	0.001	0.181
Fraction Asian	765	0.035	0.089	0.004	0.671

Sales of beer and spirits are from the Distilled Spirits Council of the United States. Sales are expressed in gallons per capita per year. Price data for beer, wine, and liquor are from the American Chamber of Commerce Research Association (ACCRA) Cost of living index. All prices are in 1982 dollars. Import and export variables are defined in section 2. Data on income, unemployment, population, and population by age, ethnicity, and race are drawn from the census and Bureau of Labor Statistics online files, [www.bls.gov](http://www.bls.gov).

**Table 3****Regression Coefficients for Models of Beer and Liquor Sales**

	Dependent variable is per capita sales			
	Beer		Liquor	
	Coefficient	t-stat	Coefficient	t-stat
Beer price	0.969	0.83	0.03578	2.42
Beer price squared	-0.087	-0.79	-	-
Wine price	0.082	1.96	0.0102	2.02
Liquor price	-0.045	-2.23	0.0847	3.02
Liquor price squared	-	-	-0.00111	-2.85
Export due to price†	0.00191	1.19	0.00023	5.76
Import due to price†	-0.00126	-1.68	-0.00003	-1.82
Sunday sales ban	-0.983	-1.84	-0.023	-0.54
Export due to Sunday ban†	-0.71	-1.35	0.14	4.73
Import due to Sunday ban†	0.52	0.82	-0.09	-1.73
Income in 1000s	0.746	8.05	0.045	4.05
Unemployment rate	0.004	0.09	-0.006	-1.02
Age15-19	-0.528	-3.09	0.020	0.96
Age20-29	0.444	5.52	0.030	3.02
Age 30-39	0.186	1.33	-0.018	-1.08
Age40-49	0.927	8.22	0.050	3.66
Age 50-59	0.155	1.10	0.014	0.84
Age 60-69	1.022	5.81	-0.027	-1.28
Age 70-79	-0.388	-1.57	-0.052	-1.67
Age 80 plus	0.060	0.19	-0.107	-2.70
Percent Hispanic	-13.6	-2.69	-2.89	-4.78
Percent Black	51.9	9.64	3.00	4.66
Percent Native American	65.7	3.95	-0.04	-0.02
Percent Asian	-51.9	-4.31	-2.91	-2.00
Observations	701	-	701	-

†The variables in the beer regressions are functions of beer prices and beer bans while the variables in the liquor regressions are derived from the same functions applied to liquor prices and liquor bans. See section 2 for a complete description.

**Table 4****Total and Marginal Effects of Alcohol Policies by State**

State	Fraction of State Sales Due to Exported Sales		Simulated Marginal Effects of Policy Changes	
	Price Differences	Sunday Sales Bans	Elasticity Due to Border Crossing	Percent Change in Sales from Repealing Ban <sup>†</sup>
Alabama	0.000	0.000	-0.41	0.075
Alaska	0.000	0.000	0.00	-
Arizona	0.028	0.007	-0.51	-
Arkansas	0.011	0.000	-0.65	0.151
California	0.001	0.001	-0.10	-
Colorado	0.001	0.006	-0.09	-
Connecticut	0.017	0.000	-0.50	0.144
Delaware	0.114	0.000	-0.70	0.282
D.C.	0.004	0.000	-0.51	0.188
Florida	0.002	0.003	-0.02	-
Georgia	0.012	0.000	-0.17	0.036
Hawaii	0.000	0.000	0.00	-
Idaho	0.022	0.003	-0.60	0.178
Illinois	0.009	0.000	-0.22	0.040
Indiana	0.031	0.000	-0.25	0.251
Iowa	0.000	0.025	-0.31	-
Kansas	0.000	0.002	-0.27	0.076
Kentucky	0.013	0.002	-0.38	0.131
Louisiana	0.019	0.022	-0.11	-
Maine	.	0.000	.	-
Maryland	0.039	0.084	-0.45	-
Massachusetts	0.003	0.004	-0.41	0.113
Michigan	0.000	0.012	-0.05	-
Minnesota	0.004	0.000	-0.07	0.044
Mississippi	0.055	0.000	-0.47	0.130
Missouri	0.021	0.042	-0.27	-
Montana	0.001	0.000	-0.25	0.042
Nebraska	0.021	0.006	-0.24	-
Nevada	0.014	0.010	-0.59	-
New Hampshire	0.085	0.090	-0.47	-
New Jersey	0.026	0.053	-0.39	-
New Mexico	0.017	0.000	-0.38	0.121
New York	0.001	0.001	-0.30	0.091
North Carolina	0.009	0.000	-0.28	0.073
North Dakota	0.004	0.000	-0.20	0.038
Ohio	0.004	0.000	-0.25	0.052
Oklahoma	0.049	0.000	-0.27	0.083
Oregon	0.003	0.005	-0.22	0.063
Pennsylvania	0.005	0.002	-0.52	0.132
Rhode Island	0.068	0.008	-0.93	0.322
South Carolina	0.002	0.000	-0.30	0.107
South Dakota	0.021	0.015	-0.43	0.000
Tennessee	0.005	0.000	-0.61	0.059
Texas	0.000	0.000	-0.07	0.012
Utah	0.000	0.000	-0.32	0.061
Vermont	0.076	0.086	-0.58	-
Virginia	0.009	0.001	-0.43	0.108
Washington	0.005	0.000	-0.12	0.030
West Virginia	0.023	0.000	-1.04	0.308
Wisconsin	0.007	0.038	-0.10	-
Wyoming	0.030	0.042	-0.74	-

<sup>†</sup>Estimates assume that other states will not respond by repealing their own Sunday sales bans and are based on year 2001 data, the year before the first statewide repeal went into effect.

Estimates for Maine are missing because price data for Maine is missing for all years in the sample.

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**Table 5****Effect on sales of Sunday ban repeal in Delaware**

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	Coefficient	t-stat
Delaware Ban Repealed	0.132	2.18
State fixed effects	yes	-
Year fixed effects	yes	-
Month fixed effects	yes	-
Observations	1836	-

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Dependent variable is log of monthly per capita liquor sales. Sales data span the years 2002-2004 and were obtained from the Distilled Spirits Council of the United States (DISCUS).

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**Table 6****Effect on sales of Sunday ban repeal in Oregon,  
Pennsylvania, New York, and Delaware**

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	Coefficient	t-stat
Sunday ban repealed	0.072	2.15
State fixed effects	yes	-
Year fixed effects	yes	-
Month fixed effects	yes	-
Observations	1836	-

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See Table 5 for a description of the data.