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Spatial Economic Analysis of Liquor Privatization in Washington State

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ABSTRACT

Alcohol is both a dangerous drug and an economically significant good. State regulation of alcohol is motivated by an emphasis on public safety and efficient distribution of the product. The dual nature of alcohol policy in the post-Prohibition Era has been characterized by what can only be classified by anti-competitive regulations, including: policies that require distributors to charge the same "delivered" price to all retailers, regardless of actual delivery costs; policies that require alcohol distributors to charge uniform prices to all retailers; bans on volume discounts for beer and wine sales; franchise protection laws; policies granting wholesalers specific geographic territories; prohibitions on central warehousing of alcohol by retailers; policies that require distributors and producers to post their prices in advance and/or share those prices with rivals; and minimum mark-ups on sales from producers to wholesalers and from distributors to retailers, among others. Examination of state variation in regulation of alcohol markets is therefore an important area of applied microeconomic research.

The primary context for my analysis is liquor privatization in the State of Washington. On Nov. 8, 2011, Washington residents voted to end the state's nearly 80-year monopoly on the retail sale and distribution of liquor within the state. The first-order effect of the new private liquor market was higher prices —a mostly unanticipated outcome of new fees that were imposed as part of privatization on retailers and distributors.

The first chapter uses store-level data on liquor sales in Oregon to estimate the

effect of higher prices in Washington on the tendency for consumers to cross the border to buy cheaper liquor. I calculate the impact of ad-valorem taxes on tax avoidance using variation in Oregon stores' proximity to the Washington-Oregon (WA-OR) border. The empirical methodology benefits from 1) detailed location data on Oregon liquor stores and border crossings, 2) uniform pricing of liquor in Oregon, and 3) detailed sales for each of the 250 stores licensed to sell liquor in Oregon. I find that the stores closest to the WA-OR border experienced an additional 21 percent increase in sales relative to interior stores.

The second chapter examines the effect of liquor store entry on crime in the City of Seattle following liquor privatization. Previous research has linked the commission of violent crime and alcohol, although the causal relationship is ambiguous. I take advantage of precisely geocoded 911 police response data to measure the impact that store entry has on crime. Little evidence is found for an increase in the weekly number of calls for service for potentially "alcohol-related offenses," such as assaults, robbery, nuisance violations, social disorder more broadly defined, and driving while under the influence. Event study analysis and spatial analysis at the census block group level confirm the main results.

In the third chapter, I examine the outcome of Washington's public auction of the retail liquor rights associated with its former state-run stores. Privatization mandated that Washington auction off these rights ahead of privatization. Overall, I find winning bidders paid 40 percent more for the retail rights to stores closest to Oregon and Idaho border crossings. This outcome, as well as the fact that the State of Washington made $31 million from the public auction, suggests significant optimism on the part of entering firms. However, higher liquor prices from new fees have significantly reduced the value of owning a liquor store in Washington under privatization.

To my knowledge there exists no systematic study of the economic impact of

state regulation of alcohol. I believe there is scope for research which identifies the components which influence consumer and firm behavior in alcohol markets. Broadly speaking, such insights would be beneficial in evaluating public policies for a wide range of decision-making environments. From a social welfare perspective, the highly regulated alcohol industry in the U.S. has been shown to generate inefficiency, welfare loss, and higher consumer prices.

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Chapter 1

Driving to Drink: Tax Avoidance Along the WA-OR Border Following Liquor Privatization

1.1 Introduction

Liquor is an economically significant, easily transported and widely used commodity subject to differential tax rates (Beard et al., 1997). Variation in taxation may affect not only consumption activity, but shopping location decisions. Examining tax avoidance in the context of cross-border shopping for alcohol is therefore important for several reasons.[1] Consumers may take advantage of price differentials by transporting commodities across borders, and price differentials may be a factor in explaining variation in state-level demand for alcohol. On the other hand, border effects could reduce overall consumer welfare if resources wasted by avoidance exceed the benefit of consumption changes (Lovely, 1994).

Tax avoidance may also be important for policy analysis as governments have a significant interest in the regulation of alcohol. Governments are motivated to tax alcohol to raise revenue and to regulate its sale and supply. If raising the price of alcohol lowers per-capita consumption, the incidence of social and health problems associated with excessive consumption may also fall. Avoidance strategies could reduce the effectiveness of government regulation, in addition to diminishing the tax

[1] Cross-border shopping is defined as an activity in which consumers purchase goods across state or country borders because of lower taxes and transport them home for personal consumption.

base and reducing the revenue-generating potential of liquor tax increases. Avoidance strategies also impose real costs on the part of the consumer. Traveling across borders represents a time and resource investment, which may also be borne by society.

As taxes on alcohol change relatively infrequently, examining cross-border shopping following liquor privatization may help inform government policy. In the cross-border context, consumer response may also depend on the availability of avoidance opportunities. Consumers located near borders with significant differential tax rates may modify their purchasing behavior enough to alter equilibrium prices (Slemrod and Yitzhaki, 2002).

This paper uses detailed Oregon sales data to estimate the effect of liquor taxes on tax avoidance along the Washington-Oregon (WA-OR) border.[2] Average liquor prices in Washington rose 11 percent through higher effective excise tax rates.[3] This was an unexpected consequence of the new tax structure imposed as part of liquor privatization in Washington. Many expected that prices would be lower in a competitive market, but new fees on retailers and distributors combined to raise prices for consumers.

This paper examines the effect that higher prices have on the decision of Washington consumers to substitute to cheaper liquor in Oregon. The main empirical analysis focuses on Oregon liquor sales primarily because the Columbia River rigidly defines the majority of the WA-OR border, creating a natural choke point to interstate travel. I find that Oregon stores closest to 13 designated border crossings experienced an additional 21 percent increase in sales relative to interior stores, an effect which decreases monotonically in distance from the border.[4]

[2]Liquor or distilled spirits are alcoholic beverages that are first fermented and then distilled. Beer and wine are not included in this definition.

[3]See Figure 1.1 for the time series of average liquor prices in Washington in the year before and the year after the tax increase.

[4]The Columbia River defines the Washington-Oregon border for 309 miles. Where the river turns northward, the only other significant border crossing is the Oregon-Washington Highway outside Walla Walla, Wash.

My empirical strategy overcomes several challenges commonly faced in estimating the impact of price differentials on cross-border sales. First, my data set comprises sales for all stores licensed to sell liquor in Oregon, not just a sampling. Second, it relies on variation in taxes, which is more plausibly exogenous than variation in prices, to identify cross-border effects. While factors associated with tax changes are often correlated with other developments in the economy, my analysis benefits from an exogenous increase in ad valorem liquor taxes in Washington. Third, I benefit from the fact that the Columbia River spans much of the WA-OR border. By calculating the driving distances in miles between each Oregon store and designated crossing points, I am able to precisely estimate the impact of tax avoidance opportunities on liquor sales. Additionally, I observe the dissipation effects of tax differentials by distance to the border.

The findings contribute to a number of bodies of literature and build directly on micro work that examines tax avoidance and cross-border alcohol sales. This paper and its methodology are most closely associated with Asplund et al. (2007) and their examination of the sensitivity of Swedish liquor sales to foreign prices and distance to the border. Using variation in the relative prices from major tax changes and volatile exchange rates, they find that price elasticities decrease in distance to the border with Denmark. My analysis builds on this in several respects. In Asplund et al., the authors aggregate store-level data and use variation in per capita sales across 287 Swedish municipalities. I observe store-level sales and estimate the effect of an exogenous change in taxes by store proximity to the border. By calculating driving miles between stores and crossings, I can more accurately estimate cross-border shopping effects as well as test the hypothesis that stores located closest to the border experienced the largest sales increases. However, data limitations and the change in market structure preclude me from calculating true price elasticities; I observe only displacement of sales to Oregon.

Beard et al. (1997) rely on state-level variation in prices in major cities to estimate the extent to which tax differentials produced border crossing for alcohol in the U.S. from 1989 to 1993. The authors find evidence of cross-border sales for a representative beer product but not for the representative liquor product.[5] However, prices may be endogenous if they are set by retailers in the context of changing demand. Using variation in state excise taxes, Stehr (2007) finds that 20 percent to 40 percent of the elasticity for spirits stems from displacement of sales across state borders, rather than decreases in home-state consumption. My analysis extends this work in several respects. Instead of state-level averages, I observe sales at each location licensed to sell liquor in Oregon. I also capture dissipation patterns in the impact of tax differentials on store liquor sales. I find that sales increases are strongest for the first group of stores located near border crossings, and that this effect declines significantly for stores further out.

There is a large related literature on cross-border shopping in other contexts, including employment (Fox, 1986; Thompson and Rohlin, 2013), grocery store sales (Walsh and Jones, 1988; Tosun and Skidmore, 2007), Internet shopping (Goolsbee, 2000; Alm and Melnik, 2012), cigarettes (Lovenheim, 2008; Merriman, 2010; Goolsbee et al., 2010), state lotteries (Garrett and Marsh, 2002; Knight and Schiff, 2012), and gasoline sales (Chan et al., 2007; Doyle and Samphantharak, 2008). Overall, this literature finds that price elasticities for commodities vary with the distances consumers travel to markets with lower prices and the density of populations in areas along the border. In the case of online shopping, consumers in high sales tax areas are significantly more likely to buy online, and tax elasticities are higher in states with higher Internet penetration.

There is also a large related literature on cross-border gains and losses at the state level for alcohol (Beard et al., 1997), cigarette smuggling (Saba et al., 1995),

[5] The two products were a six-pack of Budweiser and a 750 ml bottle of J&B Scotch.

lotteries (Garrett and Marsh, 2002), and online shopping (Alm and Melnik, 2012). With the exception of Alm and Melnik, the evidence suggests non-trivial losses of state revenue to consumer avoidance and evasion behavior. Beard et al. find that the revenue losses or gains due to border crossing in alcohol sales is a modest problem for some states and a negligible problem for others.

The rest of the chapter is organized as follows. Section 2 presents institutional background of the retail alcohol market in Washington and examines the price differential with Oregon. A description of the Oregon sales data is presented in Section 3. The empirical strategy is presented in Section 4. The main empirical findings are covered in Section 5; in Section 5.1, I present several robustness checks. Section 6 concludes.

1.2 Institutional Background

On Nov. 8, 2011, Washington residents voted to end the state's nearly 80-year monopoly on the retail sale and distribution of liquor within the state. In this paper, I argue higher taxes as a part of Washington's privatization led to significant cross-border shopping in Oregon.

Before the initiative passed, Washington had been one of 19 "control" states in the U.S., all of which strictly regulate the sale and/or distribution of alcoholic beverages within their borders. The Washington State Liquor Control Board (WSLCB) had been the sole distributor and primary retailer of liquor in Washington since the end of Prohibition.[6] Distribution for the entire state was overseen by one entity, the Seattle Distribution Center. Consumer sales were met through a system of approximately 167 state-run liquor stores and 161 specially licensed "contract" stores, which were operated by independent contractors who earned a flat commission on all liquor sales.

[6] Formed in 1933 by the Steele Act.

1.2.1 Liquor pricing

Under Washington's publicly run system, uniform pricing had been imposed on all liquor sold by the state —prices for any given product were the same from store to store no matter the geographic location or variation in market demographics. The average price for a 750 ml bottle of liquor in the year prior to privatization was $16.36.[7] According to the WSLCB, the final price on a bottle of spirits under the public system consisted of the distiller's wholesale price to the board, federal taxes (excise taxes on all liquor, plus custom duty rates on imported liquor), average freight or transportation costs, the state's markup, and state sales taxes. Washington had imposed a markup of 51.9 percent on the wholesale liquor price, which covered operating costs of the state system. Any residual profit from the markup was shared by state and local governments. Consumers also paid a spirits sales tax (SST) of 20.5 percent on all liquor, as well as an excise tax of $3.7708 a liter (spirits liter tax, or SLT). The total excise tax rate on a gallon of alcohol in 2011 in Washington was $26.70, the highest total excise tax rate in the country. The national average was $7.02 a gallon. Oregon's total excise tax rate per gallon of spirits was $23.03 in 2011, just below Washington; Idaho, which also shares a border with Washington, was ranked 10th in 2011, with a total excise tax rate per gallon of spirits of $11.28.[8]

Washington liquor prices increased approximately 11 percent in the year following privatization. I find that the average price for a 750 ml bottle of liquor increased to $18.23.[9] Under the private system, consumers pay the same rates on the SST and SLT, but private distributors and retailers set their own markup. In addition to excise taxes and new markups, the state imposed new retailer and distributor licensing fees. I-1183 mandated that private distributors pay 10 percent of all gross

[7] June 2011 through May 2012. Figure 1.1 shows average monthly consumer liquor prices in Washington the year before and after privatization.

[8] From the research organization TaxFoundation.org.

[9] June 2012 through May 2013. Figure 1.1 shows average monthly consumer liquor prices in Washington the year before and after privatization.

spirit revenue to the state for the first two years of privatization, and 5 percent of revenue thereafter. Private retailers must pay 17 percent of all gross spirit revenue to the state.[10] I-1183 also mandated that if the new liquor distributor fees had brought in less than $150 million by March 2013, licensees would be required to pay the difference by May 31, 2013.

According to the liquor board, the state had expected a private sector markup of between 52 percent and 72 percent on spirits. The state also estimated I-1183 would result in 1,428 total retail liquor outlets.[11] Combined with the SST, the SLT, new markups, and the new licensing fees, average prices have substantially increased for consumers. Figure 1.1 shows monthly average per liter consumer liquor prices in Washington the year before and after privatization. The graph depicts a sharp increase in average prices after June 1, 2012. Overall, the figure shows higher average prices in each month after privatization, compared to the previous year's month under the state-run system.

In 2013, Washington's total excise tax rate rose to $35.22 a gallon, again the highest in the U.S. Oregon remained just behind Washington at $23.73 a gallon in 2013; Idaho was still ranked 10th with a total excise tax rate of $10.92 a gallon[12].

Oregon and Idaho are both alcohol "control" states. In Oregon, retail sales are overseen by the Oregon Liquor Control Commission (OLCC) and regulated through a system of 250 retail outlets. The state owns all distilled spirits in the state liquor stores, while independent contractors (the liquor store operators) are appointed by the commission and are responsible for the stores' daily operations. Liquor store operators and personnel are not considered state employees; operators are compensated via a commission on store sales.

Liquor prices in Oregon are set uniformly each month by the OLCC. From June

[10] Retailers and distributors must also pay an annual license renewal fee.
[11] In a separate analysis, I find 1,660 total liquor outlets as of June 17, 2013.
[12] From the research organization TaxFoundation.org.

2011 through May 2012, the average price for a 750 ml bottle of liquor in Oregon was $15.70. Oregon prices were already lower than Washington's before privatization, which suggests a certain level of tax avoidance in the pre-period. To the extent that Washington consumers took advantage of price differentials ahead of privatization, my findings in the post-period represent a lower bound on the amount of cross-border shopping. I observe only the increase in avoidance behavior from new ad valorem liquor taxes in Washington, not the total amount of avoidance from price differentials.

After privatization, there was no significant change in Oregon liquor prices. The average price for a 750 ml bottle of liquor in Oregon from June 2012 through May 2013 was $15.93. Figure 1.2 shows the average monthly prices in Oregon one year before and after the market structure change in Washington. While the figure does exhibit some seasonality, there is no significant change in Oregon price levels. Additional evidence is presented in Figure 1.3. This figure shows the average price charged for a 750 ml bottle of 80-proof liquor broken down by type in the year before and after privatization. The series in Figure 1.3 is relatively flat, which supports the hypothesis that prices in Oregon did not change appreciably during the timing of the intervention in Washington.

The average price differential between Oregon and Washington for a 750 ml bottle of liquor a year after privatization was 14.4 percent. I find that the closest liquor stores in Oregon are located 10 driving miles from the nearest border crossing. A 20-mile round-trip between the border and an Oregon liquor store would cost approximately $3.68 and take 27 minutes in driving time.[13] The average Washington consumer would have to buy at least two bottles of liquor in order to recoup the cost of the trip.

[13] Calculated with a fuel efficiency of 28 mpg and a gas price of $3.75 a gallon.

1.3 Data

I obtained monthly data on all consumer liquor sales in Oregon from January 2005 through August 2013. I construct a panel for all 250 licensed liquor stores in Oregon across 104 months, for a total of 26,000 observations in the pooled sample. Given the time series and cross-section components in the data, my analysis relies on changes in the magnitude of liquor prices in Washington following privatization. The analysis is simplified by the fact that neighboring states did not experience significant changes in tax rates on liquor or market structure during the period of analysis.

Estimation of the pooled data includes market and demographic characteristics from two sources. Market-level data from the 2011 Zip Code Business Patterns (ZCBP) and demographic characteristics from the 2011 American Community Survey at the Zip Code Tabulation Area (ZCTA) level supplement the data set. Data on the total number of firms, groceries, schools, churches, hospitals, and convenience stores were matched at the zip code level to each store. Demographic characteristics such as population density, median age, gender, race, and mean household income were matched at the ZCTA level to each store's zip code via crosswalks.

Geographic coordinates in longitude and latitude for each store were generated via hand-coding from addresses provided by the OLCC. I also obtain the geographical coordinates for the center points of 12 bridges that span the Columbia River and the population center of Walla Walla, Wash.[14] Driving distances in miles between each Oregon liquor store and each WA-OR border crossing are obtained via hand-coding.

1.4 Empirical Specification

This paper uses a panel comprised of Oregon sales data for 250 liquor stores across 104 months, for a total of 26,000 observations. I estimate the following equation

[14]The Columbia River spans the Washington-Oregon border for 309 miles. Travel between the two states requires crossing a bridge or the Oregon-Washington Highway outside Walla Walla, Wash.

using a difference-in-differences (D-in-D) approach with store-level and time fixed effects and standard errors clustered at the county level:

$$\ln S_{it} = \beta_0 + \beta_1 Post + \beta_2 Border\ store\ + \\ \beta_3(Post \times Border\ store) + \beta_4 \cdot X_{it} + \gamma C_i + \rho T_t + \epsilon_{it} \tag{1.1}$$

The dependent variable is the log of monthly consumer liquor sales in Oregon for store i at time t. *Post* is an indicator variable equal to 1 if the observation occurred after June 1, 2012, and zero otherwise.[15] *Border store* is an indicator variable equal to 1 if the store is located near the Washington border, and zero otherwise. I define border proximity in several ways. In the main analysis, crossing the border entails traversing one of 12 bridges spanning the Columbia River or the Oregon-Washington Highway near Walla Walla, Wash. First, I create a dummy variable equal to one if the Oregon store is one of the three closest stores to each border crossing, and zero otherwise. These stores are denoted *Proximity 1* stores, as consumers crossing the border to buy cheaper liquor would encounter these stores first. On average, *Proximity 1* stores are located 10 miles from any WA-OR border crossing, with the closest store 0.7 miles away and the farthest store 33.8 miles away. *Proximity 1* stores are on average 13.5 driving minutes from the nearest crossing. Theory suggests that if higher prices in Washington are motivating sales in Oregon, the effect should be more pronounced in stores closest to border crossing points. I also create a dummy variable equal to one if the Oregon liquor store is located in a county bordering Washington state, and zero otherwise. To separate out effects of the closest stores to the WA-OR border, I define *Proximity 2* stores as any store in a WA-OR border county that is not a *Proximity 1* store. Figure 1.4 maps border crossings in relation

[15] June 1, 2012, refers to the beginning of liquor privatization in Washington state. Higher prices followed the market change from the introduction of two new ad-valorem taxes.

to interior, *Proximity 1* and *Proximity 2* stores across Oregon.

C_i represents store-level fixed effects, in order to control for omitted variables that differ among stores but are constant over time. T_t are time fixed effects at the month level, in order to control for unobserved variables that vary across time. X_{it} represents demand and profit shifters at the zip code and ZCTA levels.[16] Then β_0 represents the baseline average of the dependent variable, β_1 is the overall change in time, and β_2 is the difference between border and interior stores in Oregon. Finally, β_3 is the coefficient of interest, the difference-in-differences estimator, and can be defined as the difference in average sales in border stores before and after June 1, 2012, minus the difference in average sales in interior stores before and after June 1, 2012.

I estimate the effect of Washington's privatization on Oregon liquor sales using fixed effects across time and stores. Standard errors are clustered at the county level. This approach is preferred if individual store or county fixed-effects are correlated with other exogenous variables. Also, a fixed-effects technique is more appropriate because the data includes all liquor stores in Oregon, not a sampling of stores across the state. Fixed-effect analysis supports inference when a sample exhausts the population, as fixed effects arise when the levels of an effect constitute the entire population of interest.

The nature of the panel data set indicate that spatial autocorrelation may be a concern. Ignoring spatial dependence may lead to inefficient estimates and biased statistical inference (LeSage and Pace, 2009). Therefore, my model accounts for spatial dependence between neighbors, spillover effects, and externalities generated between cross-sectional observations. Section 5.2 provides estimates of the effect of privatization on Oregon liquor sales robust to the presence of spatial autocorrelation.

[16] Such as the log of total population, log of total area, log of mean household income, log of the total male population 21 and over, log of the total population of African-Americans, log of the total number of firms, and the number of Oregon state stores in the same zip code.

The estimates do not differ significantly from the main results.

The D-in-D approach uses changes in the control group to estimate what would have been the change in the treatment group had that group not received the intervention in order to produce an estimate of the counterfactual. An assumption this approach uses is that the trajectories of the treatment and control groups would be the same in the absence of the treatment. Any difference between treatment and control groups observed in the post-period would then be an unbiased estimate of the intervention effect. Figures 1.5 and 2.7 suggest the common trends assumption is clearly met. Both figures indicate that liquor sales for *Proximity 1*, *Proximity 2*, and interior stores ran parallel until the timing of the intervention.

Figure 1.5 plots the time series of the log of average monthly consumer liquor sales in Oregon by border proximity. The top line plots the time series for the three closest stores to each of the 13 WA-OR border crossings, again denoted *Proximity 1* stores. The middle line plots the time series for all Oregon liquor stores in counties along the WA-OR border net of the three closest stores to border crossings, again denoted *Proximity 2* stores. The bottom line plots the time series for interior stores. A vertical red line corresponds to the data point May 2012, so that all post-treatment observations appear to the right of this line.

Overall, Figure 1.5 shows *Proximity 1*, *Proximity 2* and interior stores follow the same general trend until privatization in Washington. The figure also reveals that most of the increase in sales is being driven by those stores closest to the border. The main result is a significant jump in sales for *Proximity 1* stores, relative to interior and *Proximity 2* stores, in the post-period. For completeness, Table 1.1 provides summary statistics for border and interior stores in Oregon. The table indicates that border and interior stores are similar along most observable characteristics. Border stores in Oregon appear to have higher sales, on average, than interior stores in the pre-period, but this difference is not statistically significant.

Figure 2.7 uses methodology approximating an event study to analyze the aggregate effect of Washington's privatization on Oregon liquor sales. First, I obtain fitted values from separate regressions of monthly liquor sales on three different proximity measures: interior Oregon liquor stores; *Proximity 1* stores; and *Proximity 2* stores. The dependent variable in all specifications is the log of monthly consumer sales. Each specification is a standard linear regression with a dummy variable for each month in the time series —the excluded category corresponds to the May 2012 observation for ease of interpretation. Specifications include standard errors clustered at the county level.

Figure 2.7 plots the residuals of the fitted model. Following general practice in event study methodology, the plots in Figure 2.7 delivers sales value net of covariates and seasonal effects for *Proximity 1* stores that is compared to the counterfactual groups. A vertical red line again corresponds to May 2012, such that all observations to the right of this line are in the post-intervention period. The plots provide substantial evidence of cross-border shopping effects following privatization in Washington for those Oregon stores closest to the WA-OR border. From the figure, interior and *Proximity 2* liquor stores in Oregon followed roughly the same pattern before and after the change, while *Proximity 1* stores experienced a significant increase in sales. Consistent with my hypothesis, sales for *Proximity 1* stores jump much higher relative to other stores after June 1, 2012. Overall, Figure 2.7 provides compelling evidence for cross-border substitution effects due to differential tax rates, reinforcing evidence of significant border effects relative to the counterfactual groups.

The time series shows significant seasonality in liquor sales and a positive time trend. Therefore, the main empirical analysis includes and time and store-level fixed effects to correct for any small but significant differences between border and interior stores (Heckman and Hotz, 1989). Separately, D-in-D estimations with many time periods have been criticized for focusing on serially correlated outcomes while

ignoring the possibility of inconsistent standard errors (Bertrand et al., 2004). Conventional D-in-D standard errors have been found to severely understate the standard deviation of the estimators, thereby overstating the significance of interventions. Bertrand, Duflo, and Mullainathan (2004) propose several econometric corrections that I employ here. Block bootstrapping techniques, which take into account the auto-correlation of the data, have been found to give consistent errors provided the number of entities is large enough. I modify my model to include block-bootstrapping techniques with standard errors clustered at the county level.

Fundamentally, any alternative explanation of the paper's main results must be based on the idea that the increase in Oregon liquor sales in border stores following privatization is driven by some other unobserved factor. The D-in-D specification is only valid under the assumption that changes in liquor sales over time would have been similar in border and interior stores in the absence of Washington's privatization. One solution I employ is a more highly refined definition of the treatment and control groups. I use driving distances to border crossings to identify which stores are most likely to be affected by higher prices from privatization. The analysis is aided by the fact that there are few crossing points between Washington and Oregon, ensuring a more accurate estimate of the treatment effect. I also use the precise timing of the treatment to identify the impact of cross-state tax differentials on liquor sales in Oregon.

1.5 Results

In this section, I provide evidence supporting my main hypothesis that cross-state tax differentials increased liquor sales in Oregon, particularly for stores closest to WA-OR border crossings. Table 1.2 is the fixed-effects analysis of cross-border shopping that corresponds to the results shown in Figure 2.7.

The dependent variable in all specifications is the log of gross monthly consumer

liquor sales. Specifications without time fixed effects include dummies for the calendar month. All specifications employ block-bootstrapped standard errors clustered at the county level. Column 1 presents results obtained from the pooled OLS, or population-averaged, model. Covariates include the *Post* indicator for whether the observation occurred after June 1, 2012, indicator variables for whether the store is a *Proximity 1* or *Proximity 2* store, and the primary coefficients of interest, *Post* $\times$ *Proximity 1 store* and *Post* $\times$ *Proximity 2 store*. Column 2 adds zip code- and ZCTA-level market and demographic characteristics to the simple pooled OLS model in Column 1.

In Column 1, I find that the main coefficient of interest, *Post* $\times$ *Proximity 1 store*, is large, positive and significant at the 1 percent level. *Proximity 1* stores experienced an additional 32.39 percent increase in sales relative to interior stores. The coefficient on *Post* $\times$ *Proximity 2 store* is small and positive, but not statistically significant at conventional levels.

In Column 2, the coefficient on *Post* $\times$ *Proximity 1 store* falls with the inclusion of market and demographic characteristics, from 32.39 percent to 27.74 percent. The coefficient on *Post* $\times$ *Proximity 2 store* is still small and positive, but is now significant at the 1 percent level. I find that *Proximity 2* stores experienced an additional 6.04 percent increase in sales due to cross-border shopping effects, relative to interior stores.

Column 3 fits a linear regression that replicates a fixed effects model by absorbing one categorical factor. Dummy variables for each store are included in the model, which is estimated without time fixed effects. The coefficients of interest change moderately with the inclusion of store fixed effects. I find that *Proximity 1* stores experienced an additional 20.78 percent increase in sales, while *Proximity 2* stores experienced an additional 6.99 percent increase in sales, relative to interior stores. Both coefficients are significant at the 1 percent level. The inclusion of time fixed

effects in Column 4 has little impact on the coefficients of interest. I find that *Proximity 1* stores experienced an additional 20.69 percent increase in sales, and that *Proximity 2* stores experienced an additional 7.21 percent increase in sales, relative to interior stores. Both coefficients of interest are significant at the 1 percent level.

Overall, the results indicate that *Proximity 1* stores experienced an additional increase in sales of nearly 21 percent relative to interior stores. While *Proximity 2* stores also experienced an additional increase in sales relative to interior stores, cross-border shopping effects appear to be driven primarily by *Proximity 1* stores. These results are consistent with both theory and previous work on cross-border sales. The presence of significant cross-border shopping effects for liquor are consistent with results from Asplund et al. (2007) and Stehr (2007), but differ from Beard et al. (1997), as they found a border effect for beer but not for liquor. The results are also consistent with previous empirical work on cross-border shopping in other contexts; Lovenheim (2008) finds that price elasticities for cigarettes vary with the distances consumers travel to markets with lower prices. Table 1.2 supports the key prediction that Oregon border stores gained significantly from Washington consumers taking advantage of cross-state tax differentials.

1.5.1 Robustness Checks

I employ several robustness checks on the impact of tax differentials on cross-border liquor sales. Table 1.3 examines dissipation patterns and further tests the hypothesis that stores located closest to the WA-OR border experienced the largest sales increase. In addition to a dummy variable which takes a value of one if the Oregon liquor store is located within a county that borders Washington and zero otherwise, I include a variable that corresponds to the log of the minimum driving distance (in miles) to the nearest crossing. I also create dummy variables corresponding to three

different distance bands from border crossings. The closest band takes a value of one if the Oregon liquor store is fewer than 10 miles from the nearest crossing, and zero otherwise; the second band takes a value of one if the Oregon liquor store is between 10 and 14 miles from the nearest crossing, and zero otherwise; the last band takes a value of one if the store is between 15 and 34 miles of the nearest border crossing, and zero otherwise.

The dependent variable in all specifications is the log of monthly consumer sales, and each specification uses fixed effects at the time and store levels with block-bootstrapped standard errors clustered at the county level. The coefficients of interest represent the interaction between the geospatial or distance measure and the *Post* indicator variable for whether the observation occurred after June 1, 2012.

The geospatial measure in Column 1 is whether an Oregon liquor store is located within a border county. The point estimate is nearly 12 percent, and significant at the 1 percent level. Column 1 can be interpreted as the average effect of the tax differential between Washington and Oregon on border stores. However, as Table 1.2 indicates, the increase in sales is concentrated among those stores closest to WA-OR border crossings.

The distance measure in Column 2 is the log of the minimum driving distance (in miles) to the nearest border crossing. The coefficient is negative, as expected, as theory predicts that increased distance from a border crossing will be associated with lower sales. Column 2 indicates that for each additional 1 percent increase in minimum driving distance to the nearest border crossing, consumer sales decrease by 0.0543 percent.

The rest of the results support the main hypothesis. The coefficient of interest for stores between 15 to 34 miles of the nearest border crossing is insignificant and indistinguishable from zero at 0.0087. Column 4 shows a marginally significant increase in sales for stores between 10 and 14 miles of the nearest crossing, but the

point estimate remains quite small at 0.0371. Column 5 shows that the increase in sales is being driven by stores closest to the WA-OR border. Stores fewer than 10 miles from the nearest crossing experienced an additional 18.98 percent increase in sales, relative to interior stores. The coefficient approximates the effect found among *Proximity 1* stores in Table 1.2, and is significant at the 5 percent level.

Column 6 tests the effect of cross-state tax differentials for all the exclusive distance bands. The specification includes a variable = 1 if the store in between 15 and 34 miles from any border crossing, a variable = 1 if the store is between 10 and 14 miles of any border crossing, and a dummy variable = 1 if the store is fewer than 10 miles from any crossing. As expected, the majority of the sales increase is being driven by stores within 10 miles of any border crossing. I find that the closest stores experienced an additional sales increase of 20.47 percent, a result significant at the 5 percent level. While the coefficients for whether a store is between 10 and 14 miles and between 15 and 34 miles of the nearest crossing are also positive and significant, the effects are much smaller and decline in distance from the nearest stores.

Last, Table 1.4 estimates the effects of privatization on a second outcome variable called *dispenser* sales. According to the Oregon Liquor Control Commission, dispenser sales denote licensees sales, or sales to restaurants and bars. In Oregon, licensees are required to purchase liquor from an OLCC agent (state liquor store), and they receive a discount of 5 percent off the retail price of their purchases. The monthly dispenser sales data provided the OLCC are tallied at full retail price, and are kept separate from consumer sales for compensation purposes.

My findings indicate that higher prices in Washington are driving consumers to seek cheaper liquor in Oregon for consumption at home. However, it may be less likely that consumers are also taking advantage of lower prices in Oregon for consumption in bars and restaurants. Examining the effect of privatization on dispenser sales serves as a useful counterfactual and helps to rule out demand shocks for alcohol

that may be correlated with the law change.

I find the main coefficient of interest, *Post* × *Proximity 1 store*, indistinguishable from zero across all specifications. This result is consistent with the prediction that bars and restaurants in Oregon stores along the WA-OR border did not experience significant cross-border shopping effects. The findings also make demand shocks for liquor in border counties an unlikely explanation for my main results.

As an additional robustness check on the main results, I estimate the effect of Washington's privatization on Oregon liquor stores while correcting for possible spatial correlation in the data. Theory predicts the nature of panel data may mask patterns of mutual dependence between stores. If present, spatial correlation would tend to overstate the amount of information in the data, producing biased and inconsistent estimates.

Table 1.5 shows the effect of border proximity under the assumption of spatial dependence. The dependent variable in all specifications is the log of monthly consumer sales, and each model includes calendar month dummies and standard errors clustered at the county level. In Columns 1 and 3, I obtain heteroskedasticity and autocorrelation (HAC) consistent standard errors up to spatial lags 8 and 16, respectively. Columns 2 and 4 use the robust standard errors proposed by Driscoll and Kraay (1998) for consumer sales up to spatial lags 8 and 16, respectively.

Table 1.5 indicates that the paper's main results are robust to the presence of spatial dependence in the cross-section. Overall, I find that Oregon liquor stores closest to the 13 WA-OR border crossings experienced an additional 21 percent increase in sales relative to interior stores.

1.6 Conclusion and Policy Implications

Commodity tax avoidance along the WA-OR border also significantly reduces state revenue. Aggregating the dollar value of the sales increases in Oregon after privatiza-

tion provides a useful approximation of the loss to government coffers. The caveat is that the estimated amount is only an approximation, not a dollar-to-dollar transfer. In Section 2, I find that consumers taking advantage of tax differentials would have to buy at least two bottles of liquor in order to make border crossing worthwhile. Consumers may purchase more liquor than they would have in the absence of tax differentials.

My analysis finds that avoidance in Oregon translates into a monthly loss of $1.5 million in liquor sales for Washington state. Annually, this translates into $18.2 million in lost liquor sales, or 2.3 percent of all after-tax liquor sales in Washington. Of the estimated monthly loss, however, the state would forgo approximately $211,911 in spirit sales taxes (SST) and $268,867 in spirit iter taxes (SLT). If tax avoidance was not possible, Washington could collect an additional 17 percent off the top of the $1.5 million, or $257,460. Therefore, the total estimated tax revenue lost to avoidance is $738,238 a month.

The evidence presented in the main analysis is consistent with previous work on the prevalence of cross-border sales of alcohol. The implication is that border crossing is a significant determinant of state-level demand for alcohol. My estimates suggest that state tax policies designed to raise revenue and lower excessive consumption are less effective when consumers are able to take advantage of lower tax environments across state borders. From a policy standpoint, cross-border shopping can significantly affect state tax revenues, and there may be incentives for home states to unilaterally lower tax rates to deter avoidance. In the case of Washington, a more aggressive approach could also be taken, such as stopping and searching cars at border crossings.

This paper explores the effect that higher liquor prices has on consumer behavior. Using store-level data on liquor sales in Oregon from January 2005 to August 2013, I estimate the effect of cross-state tax differentials on consumer demand. Unlike

previous studies, I use variation in tax rates instead of variation in price levels to identify the impact of policy changes in nearby Washington on Oregon liquor sales. I obtain the driving distances between each Oregon store and the WA-OR border. Therefore, I am able to employ a quasi-experimental approach in estimating the effect of cross-state tax differentials on Oregon liquor sales by proximity to Washington. I find that the closest Oregon liquor stores to the WA-OR border experienced an additional 21 percent increase in sales relative to interior stores.

My findings suggest that the consequences for tax revenues and lost sales are non-trivial. More work is needed to evaluate state-level alcohol taxation as a policy instrument to limit excessive consumption and increase revenue in the presence of cross-state tax differentials and avoidance opportunities.

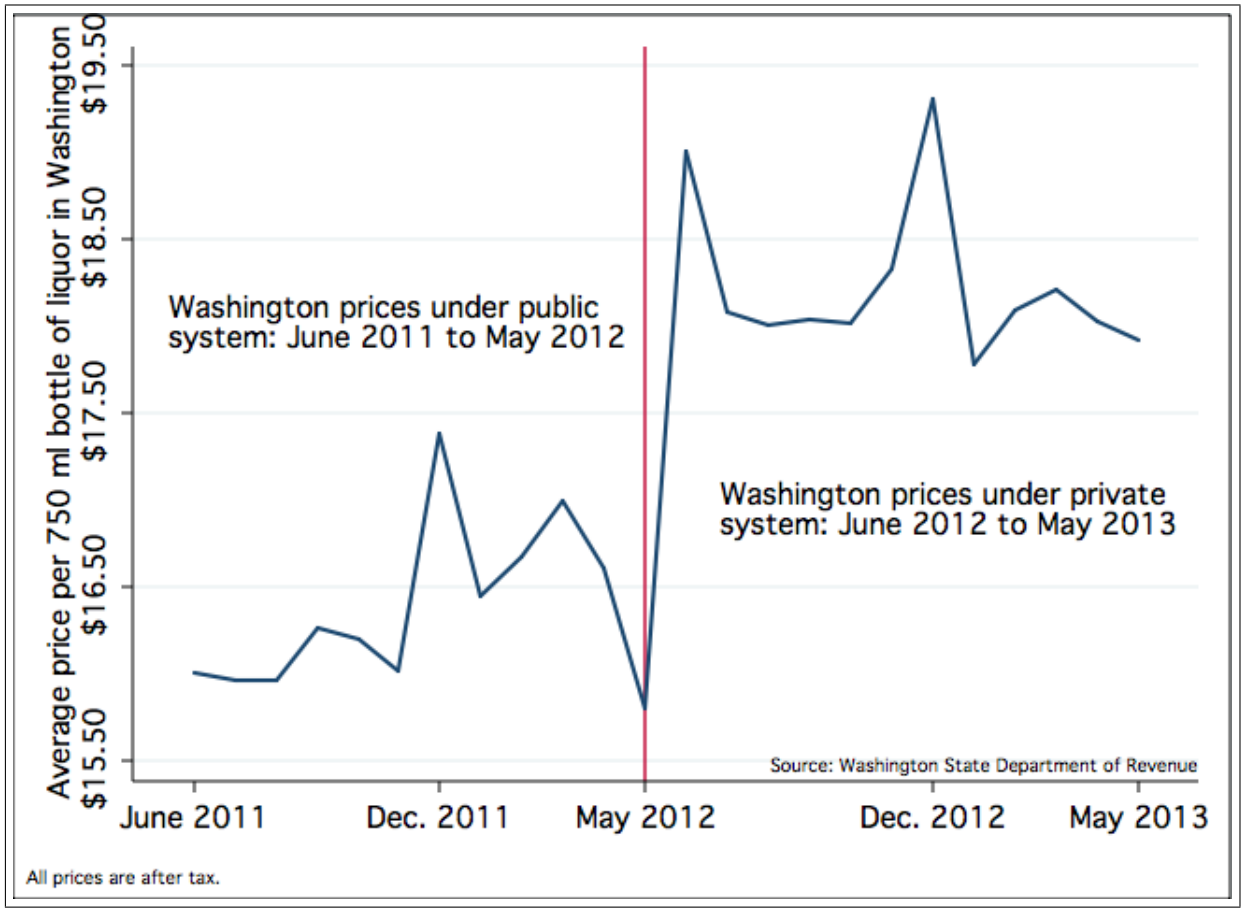


Figure 1.1: Washington State: Average Liquor Prices By Market Structure

Figure 1.2: Oregon State: Average Liquor Prices

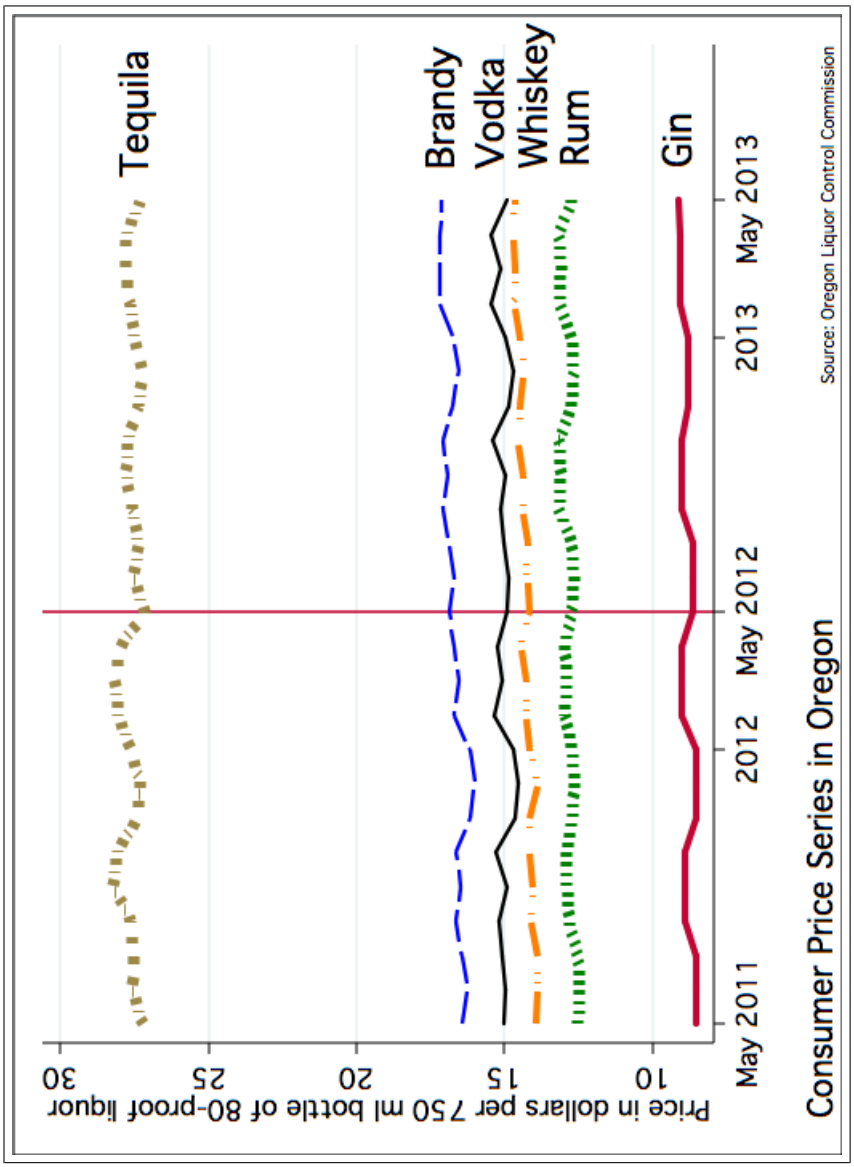


Figure 1.3: Oregon State: Consumer Price Series By Liquor Type

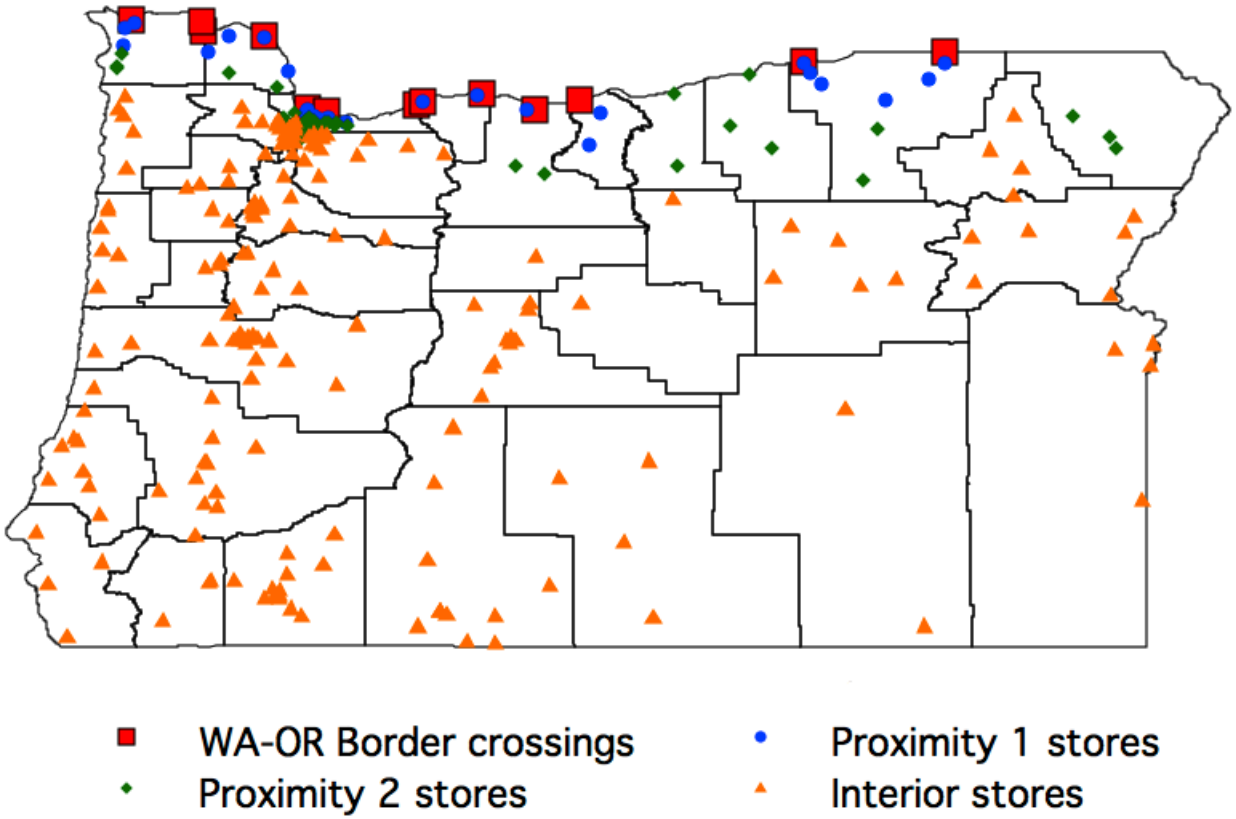


Figure 1.4: Oregon Liquor Store Locations by Border Proximity

Proximity 1 stores in Oregon defined as the three closest stores to the 13 designated WA-OR border crossings. *Proximity 2* stores defined as any store in a county bordering Washington that is not a *Proximity 1* store. Interior stores are all other stores.

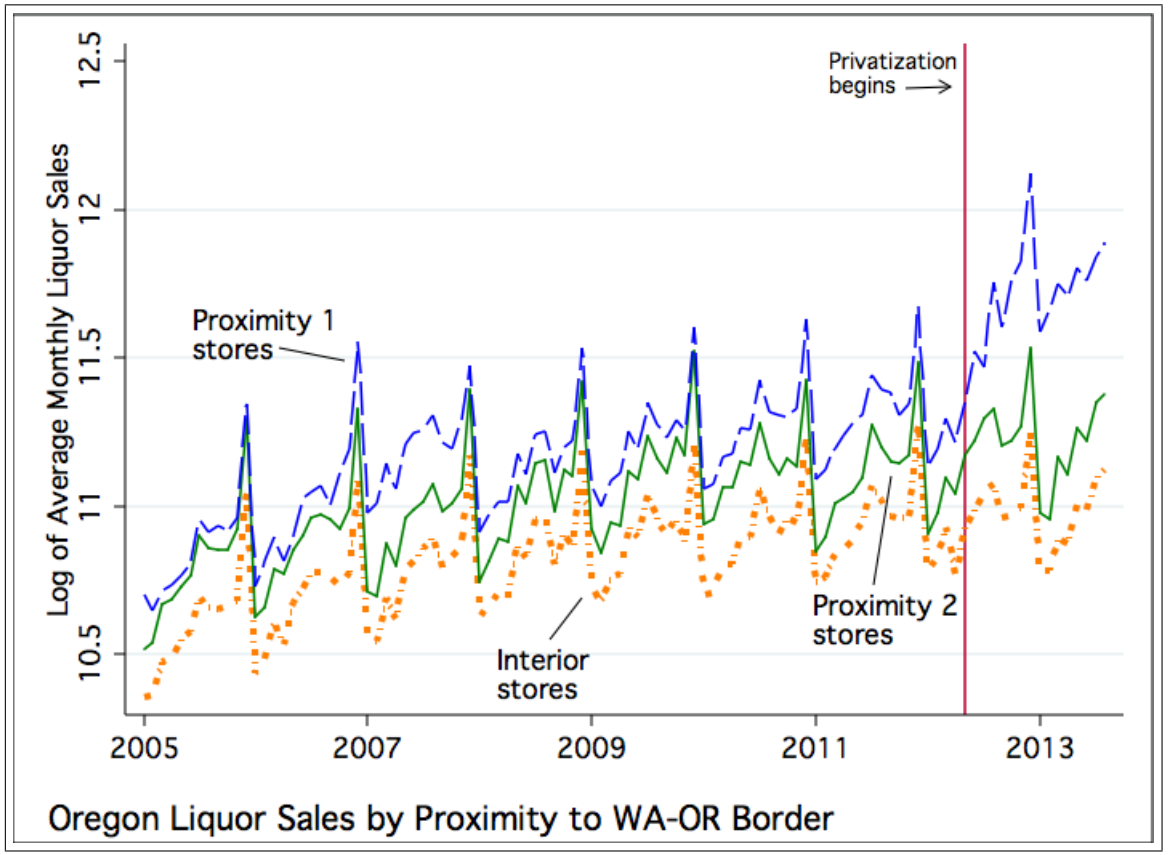


Figure 1.5: Time Series: Oregon Liquor Sales by Border Proximity

Proximity 1 stores in Oregon defined as the three closest stores to the 13 designated WA-OR border crossings. *Proximity 2* stores defined as any store in a county bordering Washington that is not a *Proximity 1* store. Interior stores are all other stores. Privatization in Washington began June 1, 2012, and was accompanied by higher liquor prices from new taxes.

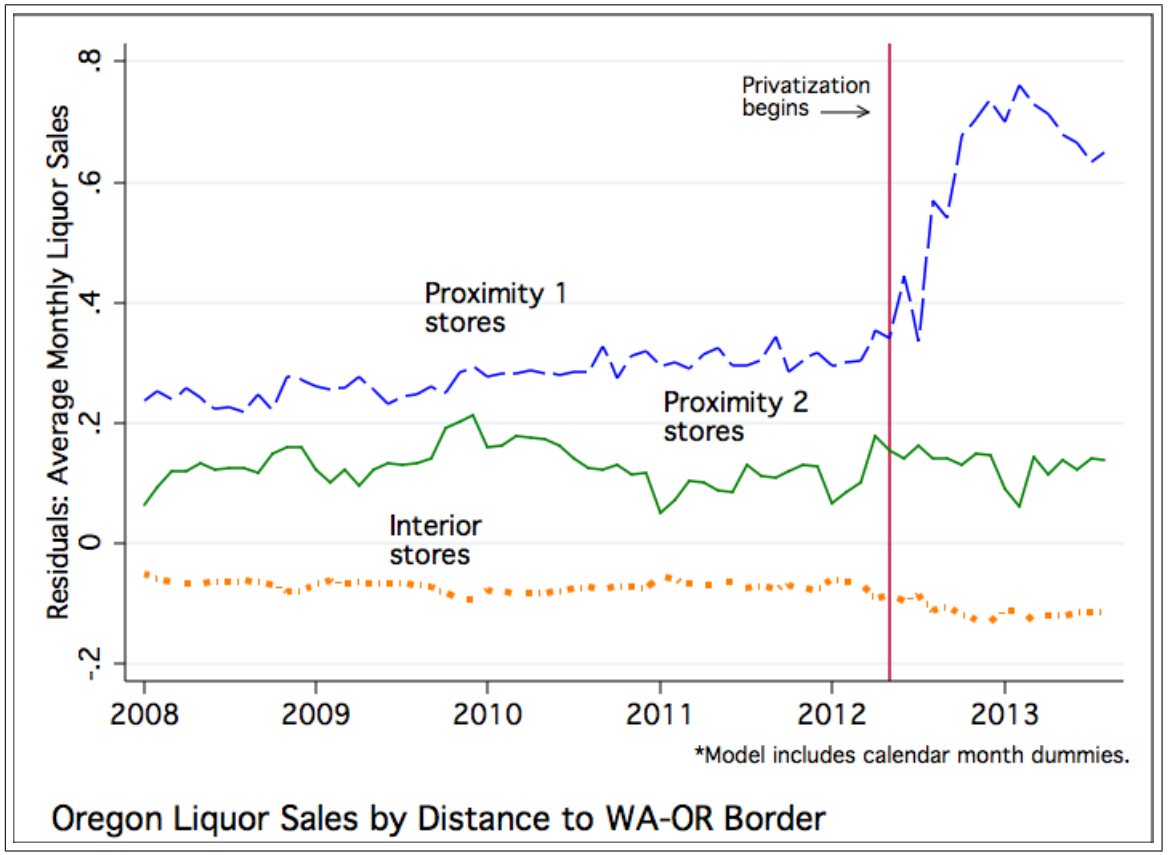


Figure 1.6: Effect of Washington's Liquor Privatization on Oregon Liquor Sales

Proximity 1 stores in Oregon defined as the three closest stores to the 13 designated WA-OR border crossings. *Proximity 2* stores defined as any store in a county bordering Washington that is not a *Proximity 1* store. Interior stores are all other stores. Privatization in Washington began June 1, 2012, and was accompanied by higher liquor prices from new taxes.

Table 1.1: Descriptive Statistics: Oregon Liquor Stores

	(1) Interior stores	(2) Border stores	(3) t-stat	(4) Interior N	(5) Border N
Average gross monthly consumer sales (in dollars)	94688.6	113501.3	-1.546	180	70
Annual payroll of employees in store zip (in dollars)	250562.6	358571.1	-1.938	180	70
Total number of firms in store zip	522.5	537.2	-0.188	180	70
Mean household income in store ZCTA	60129.3	65318.5	-1.874	180	70
Number of Oregon liquor stores in store zip code	1.289	1.314	-0.355	180	70
Total population in store ZCTA	17643.3	16952.8	0.295	180	70
Total male population in store ZCTA	8697.1	8405.6	0.253	180	70
Total population over 21 in store ZCTA	12849.9	12740.7	0.0646	180	70
Number of groceries in Oregon store zip	3.267	3.371	-0.250	180	70
Number of supercenters in Oregon store zip	0.800	0.486	2.296*	180	70
Number of conveniences in Oregon store zip	3.728	4.200	-0.734	180	70
Number of gas conveniences in Oregon store zip	2.867	2.800	0.163	180	70
Land area of ZCTA of Oregon store (in thousand square meters)	475799.1	362794.5	0.819	180	70
Total African-American population in store ZCTA	185.4	734.6	-5.533***	180	70

Average monthly consumer liquor sales calculated in the pre-treatment period only, from January 2005 through May 2012. An Oregon border store is located in a county that borders Washington state only. *ZCTA* refers to the U.S. Census Zip Code Tabulation Area. The ZCTA designation was matched to each store's zip code via crosswalks. A supercenter or big-box store is a physically large retail establishment, usually part of a chain. *** p<0.01, ** p<0.05, * p<0.1

Table 1.2: Effect of Washington Liquor Privatization on Oregon Consumer Sales

	(1) Log of monthly consumer sales	(2) Log of monthly consumer sales	(3) Log of monthly consumer sales	(4) Log of monthly consumer sales
Post × Oregon liquor store is a *Proximity 1* store	0.3239***	0.2774***	0.2078***	0.2069***
	(0.0621)	(0.0360)	(0.0451)	(0.0490)
Post × Oregon liquor store is a *Proximity 2* store	0.0525	0.0604***	0.0699***	0.0721***
	(0.0365)	(0.0218)	(0.0270)	(0.0242)
Post = 1 if after June 1, 2012	0.1553***	0.1569***	0.1752***	
	(0.0181)	(0.0107)	(0.0136)	
Oregon liquor store is a *Proximity 1* store	0.8239***	-0.0471		
	(0.0308)	(0.0292)		
Oregon liquor store is a *Proximity 2* store	0.1108***	-0.1718***		
	(0.0188)	(0.0239)		
No. state stores in same zip code		-0.5387***		
		(0.0125)		
Log of total population (ZCTA)		-0.0230		
		(0.0427)		
Log of 2010 Census land area (square meters)		-0.0546***		
		(0.0045)		
Log of total number of firms in zip code		0.2793***		
		(0.0117)		
Log of total annual payroll (in thousands) in zip code		0.0362***		
		(0.0065)		
Log of mean household income		-0.0639***		
		(0.0176)		
Log of total male population age 21 and over		0.4340***		
		(0.0469)		
Log of total African-American population (ZCTA)		0.0351***		
		(0.0050)		
Constant	9.0870***	8.0290***	11.2452***	11.0078***
	(0.0588)	(0.1924)	(0.2436)	(0.2341)
Store Fixed Effects?	No	No	Yes	Yes
Time Fixed Effects?	No	No	No	Yes
Calendar Month Dummies?	Yes	Yes	Yes	No
Number of stores (panel ID)			250	250
Observations	25,299	25,299	25,299	25,299
R-squared	0.5833	0.8865	0.9741	0.9803

Observations at the store-month level. *Proximity 1* store is a dummy variable = 1 if the Oregon liquor store is one of the three closest stores to each of the 13 designated WA-OR border crossings. *Proximity 2* store is a dummy variable = 1 if the Oregon liquor is located in a WA-OR border county but is not a *Proximity 1* store. Dependent variable in all specifications is the log of monthly consumer sales. June 1, 2012, refers to the date privatization began in Washington state. *ZCTA* refers to a store's designated U.S. Census Zip Code Tabulation Area. Bootstrap methods with standard errors clustered at the county level employed in all specifications and given in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 1.3: Effect of Washington Liquor Privatization on Oregon Consumer Sales

	(1) Log of monthly consumer sales	(2) Log of monthly consumer sales	(3) Log of monthly consumer sales	(4) Log of monthly consumer sales	(5) Log of monthly consumer sales	(6) Log of monthly consumer sales
Post x Oregon store in a WA-OR border county	0.1192***					
	(0.0254)					
Post x Log of mininum distance to any border crossing		-0.0543***				
		(0.0119)				
Post × Store between 34 and 15 miles from nearest crossing			0.0087			0.0455**
			(0.0209)			(0.0201)
Post × Store between 10 and 14 miles from nearest crossing				0.0371*		0.0720***
				(0.0212)		(0.0233)
Post × Store fewer than 10 miles from nearest crossing					0.1898**	0.2047**
					(0.0822)	(0.0846)
Constant	10.9804***	10.9802***	11.0080***	11.0080***	11.0078***	11.0077***
	(0.2312)	(0.2262)	(0.2060)	(0.1986)	(0.2037)	(0.2057)
Store Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes
Number of stores (panel ID)	250	250	250	250	250	250
Observations	25,299	25,299	25,299	25,299	25,299	25,299
R-squared	0.9802	0.9804	0.9801	0.9801	0.9803	0.9803

Observations at the store-month level. *Border county* is a dummy variable = 1 if the Oregon liquor store is located in a county that borders Washington state. Dependent variable in all specifications is the log of monthly consumer liquor sales. Bootstrap methods with standard errors clustered at the county level employed in all specifications and given in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 1.4: Robustness Checks: Effect of Privatization on Oregon Dispenser Sales

	(1) Log of monthly dispenser sales	(2) Log of monthly dispenser sales	(3) Log of monthly dispenser sales	(4) Log of monthly dispenser
Post × Oregon liquor store is a *Proximity 1* store	0.0783	0.0557	0.0236	0.0230
	(0.0839)	(0.0383)	(0.0510)	(0.0487)
Post × Oregon liquor store is a *Proximity 2* store	0.1669***	0.1623***	0.1294	0.1296
	(0.0520)	(0.0436)	(0.1621)	(0.1485)
Post = 1 if after June 1, 2012	-0.0033	-0.0115	0.0053	0.0059
	(0.0296)	(0.0212)	(0.0287)	(0.0374)
Oregon liquor store is a *Proximity 1* store	-0.3903***	-0.9865***		
	(0.1102)	(0.0951)		
Oregon liquor store is a *Proximity 2* store	-0.8168***	-0.8968***		
	(0.1025)	(0.0942)		
No. state stores in same zip code		-0.4581***		
		(0.0167)		
Log of total population (ZCTA)		-1.4536***		
		(0.0716)		
Log of 2010 Census land area (square meters)		-0.0405***		
		(0.0073)		
Log of total number of firms in zip code		-0.0322***		
		(0.0122)		
Log of mean household income		-0.3862***		
		(0.0370)		
Log of total male population age 21 and over		1.5428***		
		(0.0813)		
Log of total pop. of African-Americans (ZCTA)		0.0629***		
		(0.0116)		
Constant	7.6543***	11.8200***	9.5956***	9.5375***
	(0.0566)	(0.4170)	(0.2793)	(0.3025)
Store Fixed Effects?	No	No	Yes	Yes
Time Fixed Effects?	No	No	No	Yes
Calendar Month Dummies?	Yes	Yes	Yes	No
Number of stores (panel ID)			250	250
Observations	23,303	23,303	23,303	23,303
R-squared	0.4475	0.7196	0.9325	0.9338

Dependent variable in all specifications is the log of monthly *dispenser* liquor sales. Dispenser sales are liquor sales to bars and restaurants. In Oregon, licensees are required to purchase liquor from an OLCC agent. Observations at the store-month level. *Proximity 1* store is a dummy variable = 1 if the Oregon liquor store is one of the three closest stores to each of the 13 designated WA-OR border crossings. *Proximity 2* store is a dummy variable = 1 if the Oregon liquor is located in a WA-OR border county but is not a *Proximity 1* store. June 1, 2012, refers to the date privatization began in Washington state. *ZCTA* refers to a store's designated U.S. Census Zip Code Tabulation Area. Bootstrap methods with standard errors clustered at the county level employed in all specifications and given in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 1.5: Robustness Checks for Spatial Dependence

	(1) Log of monthly consumer sales	(2) Log of monthly consumer sales	(3) Log of monthly consumer sales	(4) Log of monthly consumer sales
Post × Oregon liquor store is a *Proximity 1* store	0.2411***	0.2078***	0.2411**	0.2078***
	(0.0869)	(0.0241)	(0.1039)	(0.0261)
Post × Oregon liquor store is a *Proximity 2* store	0.0638	0.0699***	0.0638	0.0699***
	(0.0537)	(0.0083)	(0.0638)	(0.0101)
Post = 1 if after June 1, 2012	0.1622***	0.1752***	0.1622***	0.1752***
	(0.0266)	(0.0363)	(0.0319)	(0.0457)
Oregon liquor store is a *Proximity 1* store	-0.0307		-0.0307	
	(0.0755)		(0.1014)	
Oregon liquor store is a *Proximity 2* store	-0.1573***		-0.1573**	
	(0.0587)		(0.0789)	
No. state stores in same zip code	-0.4737***		-0.4737***	
	(0.0316)		(0.0424)	
Log of total population (ZCTA)	-0.0043		-0.0043	
	(0.1288)		(0.1721)	
Log of 2010 Census land area (square meters)	-0.0220*		-0.0220	
	(0.0122)		(0.0163)	
Log of total number of firms in zip code	0.3425***		0.3425***	
	(0.0336)		(0.0449)	
Log of total annual payroll (in thousands) in zip code	-0.0128		-0.0128	
	(0.0194)		(0.0261)	
Log of mean household income	-0.0510		-0.0510	
	(0.0435)		(0.0581)	
Log of total male population age 21 and over	0.3570**		0.3570*	
	(0.1445)		(0.1931)	
Log of total pop. of African-Americans (ZCTA)	0.0585***		0.0585***	
	(0.0145)		(0.0194)	
Constant	7.3956***	10.9207***	7.3956***	10.9207***
	(0.5354)	(0.0410)	(0.7158)	(0.0484)
Spatial Lag?	8	8	16	16
Calendar Month Dummies?	Yes	Yes	Yes	Yes
Store Fixed Effects?	No	No	No	No
Time Fixed Effects?	No	No	No	No
Observations	23,003	25,299	23,003	25,299
Number of groups		250		250

Observations at the store-month level. *Proximity 1* store is a dummy variable = 1 if the Oregon liquor store is one of the three closest stores to each of the 13 designated WA-OR border crossings. *Proximity 2* store is a dummy variable = 1 if the Oregon liquor is located in a WA-OR border county but is not a *Proximity 1* store. Dependent variable in all specifications is the log of monthly consumer sales. June 1, 2012, refers to the date privatization began in Washington state. *ZCTA* refers to a store's designated U.S. Census Zip Code Tabulation Area. Each model includes calendar month and dummies for the county in which each store is located. In Columns 1 and 3, I obtain heteroskedasticity and autocorrelation (HAC) consistent standard errors up to spatial lags 8 and 16, respectively. Columns 2 and 4 use the robust standard errors proposed by Driscoll and Kraay (1998) for consumer sales up to spatial lags 8 and 16, respectively. *** p<0.01, ** p<0.05, * p<0.1

Chapter 2

Alcohol Availability and Crime: Evidence from Liquor Privatization in Washington State

2.1 Introduction

Alcohol has long been associated with violent crime. Nearly 40 percent of all violent victimizations involve the use of alcohol; the same proportion of offenders report they were using alcohol at the time of the offense; and about four in 10 fatal motor vehicle accidents reportedly involve alcohol (Greenfeld, 1998).[1] Alcohol consumption is widely believed to precipitate violence, but empirical evidence on alcohol availability and the likelihood of violent crime is sparse, as few studies are able to adequately resolve the ambiguous causal relationship between alcohol use and crime (Gyimah-Brempong, 2001; Britt et al., 2005).

This paper uses geospatial analysis and detailed 911 incident response data to estimate the impact of liquor store entry on crime in the City of Seattle. In 2012, Washington state privatized the retail sale and distribution of all liquor within its borders. Prior to the market structure change, consumers across the state had purchased their liquor through a system of 167 state-run stores and 161 "contract" stores that sold liquor for the state on consignment. The empirical strategy exploits not only an exogenous increase in alcohol outlet density following privatization, but also

[1] Based on victim reports, offender alcohol use was a factor in 37 percent of rapes and sexual assaults, 15 percent of robberies, 27 percent of aggravated assaults and 25 percent of simple assaults (Greenfeld, 1998).

variation in the timing of store entry. The analysis focuses on Seattle to take advantage of precisely geocoded police response to 911 calls for service over a three-year period.

In the nearly two years following privatization, Washington state has approved 130 new retail liquor licenses in Seattle.[2] Twenty-two stores had been operating in the city under the public system, therefore privatization has resulted in a nearly 600 percent increase in liquor outlet density. Examining the impact of store entry on crime is therefore important for several reasons. An increase in liquor outlet density decreases the effective price of alcohol by reducing transportation costs for consumers. To the extent that alcohol and crime are correlated, more cheaply acquired alcohol may also increase the incidence of alcohol-related crimes such as armed robbery, assault, social disorder and nuisances, and driving while under the influence (DUI).

I use two primary strategies to estimate the effect of store entry on crime. First, I construct a panel of all 911 calls for service at the census block group level from January 2011 through March 2014. I then employ standard difference-in-differences (D-in-D) to compare the change in weekly calls for service for those block groups that *strictly* received a new liquor store, and those that did not.[3]

One fundamental concern is that treatment and control block groups may be significantly different from each other along observable characteristics. Overwhelmingly, I find that new liquor stores are locating in poorer, less residential areas with a larger share of African-American residents.[4] To take advantage of the spatial nature of the outcome data, as well as the local nature of crime, I employ a second strategy that uses the staggered timing of entry by liquor stores. Using the geographic location of new liquor outlets as the primary center of analysis, I exploit variation in the

[2] Ten of those firms have since had their licenses terminated, but no information for the termination was given in the data provided by the Washington State Liquor Control Board (WSLCB).

[3] *Strict* entry defines a block group that received a new liquor store but did not have a state-operated store within its boundaries under the public system.

[4] See Table 2.2 for summary statistics.

timing of entry to estimate the impact of increased alcohol outlet density on weekly calls for service in concentric rings around new stores.[5]

The empirical findings point to several important conclusions. At the block group level, I find positive but insignificant increases in the number of assault calls, nuisance violations, and social disorder calls after store entry.[6] I also find that the number of calls for service for DUI violations is negatively but insignificantly correlated with store entry. While ambiguous in the context of privatization, a negative coefficient on DUI violations may suggest a reduction in costs associated with the search for liquor. In the store-level analysis, I find positive but insignificant increases in the weekly number of 911 calls for armed robbery, violent assaults, and nuisance violations in areas immediately surrounding stores after entry. The coefficients remain insignificant, but attenuate markedly in rings farther away from stores' geographic coordinates. While suggestive of dissipation patterns in crime around store entrants, the results indicate that new liquor stores in Seattle are not significant crime attractors for the neighborhoods in which they locate.

The paper's findings contribute to a number of bodies of literature. I build directly on micro work that explores the strong positive relationship among alcohol availability, outlet density and crime. Carpenter (2007) uses of variation in state adoption of zero-tolerance drunk-driving laws to estimate the effect of alcohol use on crime. He finds that zero-tolerance laws significantly increased the fraction of adult male DUI arrests attributable to 18- to 20-year-olds, and reduced the fraction of arrests for public drunkenness, vandalism and disorderly conduct attributable to 18- to 20-year-olds. A previous paper finds that zero-tolerance laws reduced the 18-to-20-year-old arrest ratio for vandalism by about 4.5 percent relative to the pre-reform mean (Carpenter, 2005). Conlin et al. (2005) evaluate the effect of alcohol access on drug-related crime and mortality using variation in county access laws

[5] See Figure 2.1 for a map of entry and exit into the Seattle market.
[6] See Table 2.1 for a definition of each offense by type.

in Texas between 1978 and 1996. After controlling for both county and year fixed effects, they find that local alcohol access decreases crime and mortality associated with illicit drugs. Other work has examined the relationship between increases in weekly outlet business hours and the reported incidence of violent crimes, aggravated assaults and non-gun violence (Schofield and Denson, 2013).

My analysis builds on this work in several respects. Carpenter uses statewide data on crime index rates; Conlin et al. use county-level arrest records. However, more aggregated data may not adequately control for all environmental variables that influence neighborhood crime. Following Gyimah-Brempong (2001), state-level data may also mask variation in alcohol outlet density among urban and rural areas. Liquor stores may serve as crime attractors if potential offenders and victims converge in large numbers (Willits et al., 2011; Pridemore and Grubesic, 2012; Gyimah-Brempong, 2001). This paper takes advantage of geocoded event data to geographically link crime to outlet density in Seattle. A highly disaggregated approach may be a better predictor of violent crime at both the block group and store levels. The use of block group data from one city may also reduce confounding between alcohol availability and crime found in much of this literature (Gyimah-Brempong, 2001).

Gyimah-Brempong (2001) uses census tract data and the FBI index crime rate to calculate the elasticity of crime with respect to alcohol availability in the City of Detroit. He finds that reducing alcohol availability may decrease crime rates and improve social welfare. By calculating the distance between each new liquor store and each call for service, I more accurately identify the impact of entry on neighborhood crime. The staggered timing of entry following liquor privatization also provides a more exogenous source of variation in alcohol availability.

There is also a related literature on location and proximity as exogenous determinants of outcomes. Adams and Cotti (2008) exploit geographic variation in local and state smoke-free bar laws in the U.S. to identify the impact of bans on fatal

alcohol-related accidents. Overall, they find that the increased miles driven by drivers wishing to smoke and drink offsets any reduction in driving from smokers choosing to stay home following the ban, resulting in a net increase in alcohol-related accidents. Kreft and Epling (2007) analyze the impact of border crossings to Canada following Michigan raising its minimum legal drinking age to meet the national drinking age of 21. Using a "differences-in-differences-in-differences" approach, they find Michigan's law change did not significantly increase underage deaths in border-crossing counties. Linden and Rockoff (2006) use the location of sex offenders to exploit variation in the threat of crime within small, homogenous groupings of homes. In Roman et al. (2008), the authors use spatial analysis and address-level data to investigate the relationship between alcohol availability, alcohol establishment type, distribution policies, and violence and disorder at the block group level in the District of Columbia. They find evidence that increased alcohol outlet density is associated with higher levels of violence and social disorder. While Roman et al. helps to inform much of the analysis in this work, their paper is subject to a significant amount of endogeneity. Liquor privatization in Washington state led to a nearly seven-fold increase in outlet density in Seattle, and provides a novel context in which to estimate the effect of alcohol availability on crime. To my knowledge, this is the first paper to exploit both inter-temporal and cross-sectional variation in the presence of new off-premise liquor outlets to estimate the effect of increased store density on crime.

This paper is also related to literature on firm entry in regulated markets. In their examination of Pennsylvania's liquor market, Seim and Waldfogel (2013) show how the limited size of the state store network might restrict access to alcohol and reduce overall consumption in Pennsylvania. Other work analyzes the deteriminants of firm entry in location space (Seim, 2006; Gowrisankaran and Krainer, 2011; Chan et al., 2007). While this paper does examine the impact of store entry on crime, I do not focus on the determinants of firm entry. Future work could help distinguish between

public and private market priorities in locating liquor outlets across Washington, as well as investigate the impact of privatization on social welfare and estimated firm profits.

The rest of the paper is organized as follows. Section 2 provides background information for Washington's retail liquor market. In Section 3, I describe the data used in the study. In Section 4, I describe the empirical methodology and present the model used for formal statistical analysis. The main empirical findings are presented in Section 5. Section 6 concludes.

2.2 Background

Private retail liquor sales began June 1, 2012, in Washington state, following voter approval of Initiative 1183 (I-1183) in November 2011. The Washington State Liquor Control Board (WSLCB) began accepting applications for off-premise spirits licenses as of Feb. 8, 2012.

According to the WSLCB, adjudication on the application process takes on average between 60 to 90 days. While the privatization initiative did not limit the total number of liquor licenses that would be issued by the state, applications are subject to neighborhood review and comment. Applicants are subject to a background investigtation, and local authorities, churches, and schools can object to license applications.

Three new retail liquor licenses were created under the initiative. The *spirits retail license* allows the sale of spirits: to consumers for off-premises consumption; to permit holders; for resale to retailers licensed to sell spirits for on-premise locations; for consumption; and for the export of spirits. The *spirits distributor license* governs the sale of spirits from suppliers to distributors and retailers, and the export of spirits by distributors. Last, a *spirits certificate of approval* governs out-of-state spirits suppliers.

Under the public system, consumer liquor sales were met through the operation of 167 specially licensed state stores and 161 "contract" stores —which were operated by independent contractors who earned a commission on all liquor sales. The retail rights to the 167 state stores were auctioned off prior to privatization, while contract store owners were given a choice to continue operating under the new system.[7]

Using data provided by the WSLCB, I identify 22 state stores that were operating under the public system in the City of Seattle as of May 31, 2012. As of March 2014, 16 of the former state stores were still operating, while 6 former state stores never applied for a new license. As of March 2014, I find that the state has approved 130 new liquor licenses under privatization, although 10 of those firms have had their licenses terminated since approval.[8] Overall, this represents a significant increase in the availability of liquor in the City of Seattle.

Privatization in Washington state was accompanied by several competing effects. First, firm entry into the liquor market increased both the availability of liquor and decreased the distance consumers would have to travel to purchase alcohol. Campbell et al. (2009) find that increases in alcohol outlet density increase access to alcoholic beverages not only by decreasing travel costs to outlets, but by increasing exposure to alcohol marketing, which may change social norms around drinking and increase excessive alcohol consumption and its related social harms. However, demand for alcohol may be reduced by a corresponding increase in price. LoPiccalo (2014) finds that new fees imposed as a part of Washington's privatization increased liquor prices on average 11 percent. As a result, consumers located along the Washington-Oregon border substituted to cheaper liquor in Oregon state. Sustained tax avoidance is likely not an option for Seattle consumers, and higher prices may lead either to an overall reduction in demand or the purchase of cheaper brands, though direct evidence is lacking.

[7] See Chapter 3 for a comprehensive review of the outcome of the public auction.
[8] No further information on the reason for termination was given in the data.

An empirical challenge to the standard analysis is the market structure created by the initiative. I-1183 specifically required that all new retail liquor outlets have a minimum footprint of 10,000 square feet in a fully enclosed space. The 10,000-square-foot requirement represents a significant barrier to entry for all but the largest firms. Trade names for stores licensed to sell distilled spirits in Seattle and across Washington indicate entry is dominated by large chain stores, with many Costcos, Safeways, Bevmos, and QFCs, among others.

The overwhelming presence of large firms in Seattle's retail liquor market indicates heterogeneous treatment effects, and endogeneity may create severe problems for identification of population averages (Imbens and Angrist, 1994). My empirical methodology would then identify the local average treatment effect for firms that are induced by privatization to enter the market, but heterogeneous entry would restrict the extrapolation of causal effects to other contexts.

2.3 Data

My analysis relies on data on Seattle liquor store locations, the location and characteristics of Seattle's 482 census block groups, and geocoded data on police response to 911 calls for service within the city.

Geographic coordinates in longitude and latitude for each new private and all former state liquor stores were generated via hand-coding from addresses provided by the WSLCB. Because there is no strict enforcement regarding the opening of liquor stores following license approval, there may be a short lag between the approval date and actual entry date. However, a phone survey of approximately 30 percent of still operating stores reveals little to no lag time between approval and entry. This may be indicative of the fact that each potential store location must first be vetted by local officials, as well as the minimum footprint requirement favoring entry by large chains and/or established businesses. Figure 2.1 maps store locations by type in the Seattle

area. Figures 2.2 and 2.3 show store approval and entry following privatization.

The 911 incident response data was provided by Seattle's Open Data project via their Web site. The data set is all police responses to 911 calls within the city, showing all officers dispatched, and includes a detailed log that is geocoded and time-stamped. According to the Open Data project, the events are added to the Web site only after the incident is considered safe to close out. The delay is meant to help to protect the security of the scene, the safety of officers and the public, as well as ongoing investigations, according to the project. While the data does span to January 2010, errors in the data collection process during this time period necessitated truncating the observations to those from January 2011 through March 2014.[9] Table 2.1 shows the means of each offense type of interest in this paper. Figure 2.4 shows the distribution of calls for service by type throughout the day. Overall, the crime data exhibit significant seasonality, both in the timing of calls during the day, as well as throughout the year.

One empirical challenge is that the Seattle Police Department may have responded to the general perceived phenomenon of crime attraction around liquor stores by increasing patrols or altering policing strategies. This would confound measurement of the direct effect of alcohol outlet density, as endogenous police response may reduce crime as a consequence of 911 calls. While this remains a general concern, the data does not indicate police are increasing call response rates in anticipation of privatization. Nor has there been any reported change in policing strategies in the Seattle area ahead of or during privatization. Figure 2.5 plots average weekly calls for service for treatment and control block groups, and Figure 2.6 plots average

[9]The data made available here has been modified for use from its original source, which is the City of Seattle. Neither the City of Seattle nor the Office of the Chief Technology Officer (OCTO) makes any claims as to the completeness, timeliness, accuracy or content of any data contained in this application; makes any representation of any kind, including, but not limited to, warranty of the accuracy or fitness for a particular use; nor are any such warranties to be implied or inferred with respect to the information or data furnished herein. The data is subject to change as modifications and updates are complete. It is understood that the information contained in the Web feed is being used at one's own risk.

weekly calls in the area immediately surrounding new liquor stores, one year before and one year after privatization. Both figures indicate police did not increase 911 response rates ahead of privatization.

For the census block group analysis, I construct a panel for each of the 482 block groups across 167 weeks, for a total of 80,494 observations in the pooled sample. There are 409 control block groups and 73 treatment blocks groups in the sample. Table 2.2 shows the descriptive statistics for treated and control block groups along demographic and offense type characteristics. Overall, treated and control groups are significantly different along most observable characteristics. Table 2.2 shows that overwhelmingly, liquor stores are entering into areas with greater population density, poorer residents, fewer residential areas and more minorities. One solution is to test whether the changes over time in the treatment group are the same as those in the control group in the pre-privatization period. If the time trends of both groups are similar in the pre-privatization period, then they would have likely been the same in the post-privatization had it not been for the market structure change. The first panel in Figure 2.5 plots the raw time series for average weekly calls for service across all offense types for treatment and control block groups one year before and one year after privatization; the second panel plots the raw time series for all potentially alcohol-related offenses. While this figure does not correct for variation in the timing of store entry into block groups, it is still useful in comparing trends between treated and control block groups in the pre-privatization period. Figure 2.5 suggests the common trends assumption is met. Weekly calls for service treated and control block groups ran parallel until the timing of the intervention (given by the red vertical line).

For the store-level analysis, I construct a panel for the 120 new and still operating liquor stores in Seattle across 167 weeks, for a total of 20,040 observations in the pooled sample. However, three of these liquor stores are located in areas that also

had a former state store, leaving 19,539 observations in the pooled sample. Figure 2.6 shows the raw times series for all calls for service a year before and a year after privatization within two different distance rings around liquor store entrants. Given the time series and cross-section components in the data, my analysis relies on variation in the timing of store entry in Seattle following privatization.

Demographic and neighborhood characteristcs from the 2010 U.S. Census, such as population density, median age, gender, race, poverty rates, income and home-ownership status, supplement the data.

2.4 Empirical Methodology

Two models are used to estimate the effect of store entry on crime in Seattle. I use panel data comprised of weekly 911 calls for service at both the census block group and liquor store location levels.

I first consider store entry into census block groups which did not have a former state store operating within their boundaries under the public system. Second, I discuss the empirical challenges of endogenous entry into census block groups and use an alternative method of analysis, which exploits variation in the timing of liquor store entry in geographic space.

In the basic model, I employ the standard difference-in-differences estimation with block group-level and time fixed effects, and standard errors clustered at the census tract level. Here, a block group is considered treated if it received a liquor store after privatization, and did not have a state store operating at any time under the public system. Exclusion of block groups with former state stores is meant to differentiate the impact of additional liquor store (intensive margin) from the effect of new firm entry (extensive margin). Treatment is designated in all cases as *strict* entry and is given by:

$$\ln V_{it} = \beta_0 + \beta_1 Post + \beta_2 Strict\ Entry\ + \\ \beta_3(Post \times Strict\ Entry) + \beta_4 \cdot X_{it} + \gamma C_i + \rho T_t + \epsilon_{it} \tag{2.1}$$

The dependent variable, V, represents the weekly number of 911 calls for service by offense type in block group i at time t. Calls for service are examined in aggregate —all calls in a week —and also by offense types more closely associated with alcohol, such as robberies, assaults, nuisance calls, social disorder broadly defined and driving while under the influence. *Post* is an indicator variable equal to one if the observation occurred in the week after the block group received a new liquor store, and zero otherwise. Because not all liquor stores entered the market at the same time, the standard model does take advantage of some variation in the timing of entry into block groups. *Strict Entry* is an indicator variable equal to one if the block group is classified as a treated unit, and zero otherwise. C_i represent block group-level fixed effects, in order to control for omitted variables that differ among entities but are constant over time. T_t are time fixed effects at the weekly level, in order to control for unobserved variables that vary across time. Where applicable, X_{it} represents demographic characteristics at the census block group level. Then β_0 represents the baseline average of the dependent variable, β_1 is the overall change in time, and β_2 is the difference between block groups that received a liquor store and those that did not. Finally, β_3 is the coefficient of interest, the difference-in-differences estimator, and can be defined as the difference in weekly 911 calls for service in treated and control block groups before and after liquor store entry.

The above approach is straightforward but estimates may be subject to bias. The standard definition of a treated unit identifies a block group that received at least one new liquor store after privatization but did not have a liquor store under the public system. However, if an increase in alcohol availability is associated with

an increase in crime, the effect may spill over to adjacent block groups. Or, any potential increase in crime may be confined to areas immediately surrounding the liquor store. There may also be spillover effects if liquor stores are located near more than one block group.

In the second model, I use the Haversine formula to construct concentric rings around the geographic coordinates in longitude and latitude of each new liquor store. I construct four concentric rings around each store with a radius of 0.25 km. The first ring is 0.0 km to 0.25 km; the second ring is 0.26 km to 0.50 km; the third ring is 0.51 km to 0.75 km; and the fourth ring is 0.76 km to 1.0 km. If liquor stores serve as crime attractors, then the effect should be concentrated more immediately in the area where liquor in newly available.

The second model avoids the problem of the counterfactual completely by centering the analysis at the liquor store entrant level. I rely on variation in the timing of entry across liquor stores to identify the impact of an increase in alcohol availability on crime. One benefit of this approach is that it more narrowly focuses on the presumption that liquor stores act as crime attractors. Another benefit is that this approach allows for a partial test of the identifying assumption that absent liquor privatization, calls for service would have followed similar trends across all City of Seattle census block groups. If the timing of liquor store entry is unrelated to underlying trends and crime in block groups, the difference-in-differences estimator should completely capture the change in 911 service calls for areas that received a liquor store earlier, compared to areas that received a liquor store later.

This approach itself yields several empirical challenges. The first relates to the timing of entry itself. Retail sales under privatization began June, 1, 2012. However, the Washington State Liquor Control Board (WSLCB) began accepting applications as early as Feb. 8, 2012. Many entrants into the Seattle market both applied for and received off-premise distilled spirits licenses in the months preceding the privatization

date, although they could not begin sales until June 1, 2012. This result may limit the amount of variation to be exploited in the data.[10]

As a robustness check, I use analysis approximating an event study of store entry into local markets on crime attraction. I create a series of dummy variables indicating time relative to store entry to estimate the dynamic effects of the increase in alcohol availability. The standard D-in-D approach uses changes in the control group to estimate what would have been the change in the treatment group had that group not received the intervention in order to produce an estimate of the counterfactual. However, following Mora and Reggio (2012), D-in-D often involves assumptions other than parallel trends which may influence the estimate of the treatment effect. The event study sidesteps this issue by using a general additive model with fully flexible dynamics, capturing the change in 911 service calls for locations that received a liquor store earlier, compared to those locations that got a liquor store later:

$$y_{it} = \alpha + \theta_i + \gamma_i + \sum_{k}^{K} \lambda_k \delta_{k,it} + \epsilon_{it} \tag{2.2}$$

where α is a constant, θ_i is a census block group fixed effect, γ_i is a week fixed effect, $\delta_{k,it}$ is an indicator variable equal to one if store location i is k weeks relative to its liquor store entry week in week t and 0 otherwise. ϵ_{it} is an error term.

The time-since-entry dummy variables ($\delta_{k,it}$) span 52 weeks before entry to 52 weeks after entry. The pattern of λ_k's describes the change in the trend in the left-hand-side variables associated with liquor store entry (Mora and Reggio, 2012). For example, $\lambda_1 - \lambda_0$ is the expected change in the dependent variable associated with moving from week zero to week one (the first week of liquor store entry).

This approach allows for a partial test of the identifying assumption that absent

[10] See Figure 2.2 and 2.3 for a distribution of approval and entry dates.

liquor privatization in Washington state, 911 service calls would have followed similar trends across each location that eventually received a new liquor store. If the timing of liquor store entry is unrelated to underlying trends and crime in surrounding areas, there should be no trend in the λ_k's for $k \leq 0$.

Figure 2.7 shows the results of the event study analysis. Coefficients are plotted for all weekly calls by type within 0.25 km of new liquor stores, relative to entry date. The plots reveal no significant discontinuities in calls for service at the timing of entry. Overall, the event study analysis supports the main findings that liquor stores in Seattle are not serving as crime attractors.

2.5 Results

Table 2.3 is the fixed-effects analysis of store entry on calls for service at the block group level. In Column 1, the dependent variable corresponds to all weekly calls for service within the block group from January 2011 to March 2014. The dependent variables in Columns 2 through 6 correspond to the potentially alcohol-related offenses of robbery, assault, nuisance violations, social disorder, and DUI violations, respectively. In Column 7, the dependent variable corresponds to weekly calls for service for all offenses minus the ones included in Columns 2 through 6. All specifications employ block group and time fixed effects, with robust standard errors clustered at the census tract level.

The primary coefficient of interest is *Post* $\times$ *Block group strictly received a new store*. I find positive but insignificant effects for store entry on all calls for service, assaults, nuisance violations, social disorder broadly defined, and other offenses (Column 7). Overall, the results indicate that treated block groups did not experience a significant increase in crime. Liquor store entry does not appear to be significantly correlated with an increase in calls for service for the types of offenses commonly associated with alcohol use.

I also find negative but insignificant effects of store entry on robbery calls and calls for service for driving while under the influence. Prior literature on the impact of alcohol availability on crime also finds a negative impact of off-premise outlets on DUI offenses. Fundamentally, any increase in alcohol outlet density reduces transportation costs to purchasing liquor.

However, there may be endogeneity of entry into block groups may confound the ability to draw any causal inference from these results. Failure to account for endogeneity of liquor store entry may result in an underestimate of crime elasticities with respect to alcohol availability (Gyimah-Brempong, 2001).

Table 2.4 is the fixed-effects analysis at the store-level. I use variation in the timing of entry to estimate the change in weekly calls for service in four concentric rings around the geographic location of new liquor stores. All specifications include store-level and time fixed effects, as well as robust standard errors clustered at the census tract level.

The dependent variable in Column 1 corresponds to all weekly calls for service within the specified ring from January 2011 to March 2014. The dependent variables in Columns 2 through 6 correspond to the weekly number of robbery calls, assault calls, nuisance calls, social disorder calls and calls for DUI violations, respectively, within each specified ring diameter. In Column 7, the dependent variable corresponds to weekly calls for service for all offenses minus the ones included in Columns 2 through 6. The primary coefficient of interest across all distance measures is *Post = 1 if after entry.*

In the liquor store analysis, I find positive, but insignificant effects for the potentially alcohol-related offenses of robbery, assaults, and DUI violations. The results seem to suggest that new liquor stores in Seattle are not serving as crime attractor. While the coefficient on all weekly calls for service in Column 1 is positive and significant at the 1 percent level, it appears the increase is not being driven by offenses

more commonly associated with alcohol use. Consistent with the positive and significant coefficient in Column 7, it appears the increase in all 911 calls within 0.25 km of the geographic location of new liquor stores is being drive by all other offense categories. Notably, the coefficient on all weekly calls for service remains positive in the second ring around the liquor store, but is no longer significant. And if the outlying concentric circles of 0.26 to 0.50 km and 0.51 km to 0.75 km, the coefficient magnitude attenuates significantly, and even turns negative in the farthest ring at 0.76 km to 1.0 km.

The coefficients for robbery calls, assaults and DUI violations are positive, though indistinguishable from zero in the first ring around liquor store locations. The coefficients turn negative in rings farther out, but remain indistinguishable from zero. These results are consistent with the findings in the previous model that liquor stores do not appear to crime attractors for the neighborhoods in which they locate. Nuisance and social disorder calls are negative and and indistinguishable from zero in the first ring around liquor store locations, but turn positive in rings farther out.

Again, these results suggest that store entry is not significantly correlated with an increase in calls for service. The results are also consistent with the event study analysis that found no increase in the number of calls after store entry.

2.5.1 Robustness Checks

I employ several robustness checks on the impact of liquor store entry on 911 calls for service. I use the 22 former state stores in Seattle as the center of analysis and construct four concentric rings around the geographic location of each of the former state stores. The first ring is all calls within 0.25 km; the second ring is 0.26 km to 0.50 km; the third ring is 0.51 km to 0.75 km; and the fourth ring is 0.76 km to 1.0 km. I then take advantage of variation in the timing of re-licensing under privatization to estimate the impact of entry on incident response. The results should function as

a placebo test of the impact of entry on calls for service.

Table 2.5 is the fixed-effects analysis of the impact of re-licensing under privatization. The dependent variable in Column 1 corresponds to all weekly calls for service within the specified ring from January 2011 to March 2014. The dependent variables in Columns 2 through 6 correspond to the weekly number of robbery calls, assault calls, nuisance calls, social disorder calls and calls for DUI violations, respectively, within each specified ring diameter. In Column 7, the dependent variable corresponds to weekly calls for service for all offenses minus the ones included in Columns 2 through 6.

The primary coefficient of interest is *Post = 1 if after re-licensing.* I find positive but insignificant effects for store entry on all calls for service, robbery, assaults, nuisance calls, social disorder calls, and other all offenses in the area immediately surrounding former state stores after re-licensing. The coefficients remain indistinguishable from zero across all distance rings, although some coefficients turn negative in rings farther out, they remain indistinguishable from zero. Overall, the results indicate no significant effect of re-licensing on calls for service, and lend support to previous findings that liquor stores in Seattle are significant attractors of crime.

2.6 Conclusion and Policy Implications

This paper explores the impact of increased in alcohol outlet density on crime in the City of Seattle. Theory predicts that neighborhoods with high densities of alcohol outlets are associated with higher rates of assault, social disorder and other violence. Privatization in Washington state created a substantial increase in outlet density. In Seattle, the number of stores licensed to sell liquor increased nearly 600 percent in the two years following privatization. I use the exogenous increase in outlet density, as well as a detailed data set on police response to 911 calls for service, to empirically test the theory on crime attraction.

However, Washington's privatization initiative was accompanied by higher prices —both for on- and off-premise liquor sales. Higher prices accompanied by greater availability may have an ambiguous effect on crime. Further, the institutional environment created by Washington's transition to private retail sales may be less conducive for crime attraction. Washington required that new liquor stores must have a minimum footprint of 10,000-square-feet in a fully enclosed space. The minimum footprint requirement appears to have served as a significant barrier to entry.

I find no significant increases in weekly calls for service in census block groups which received new liquor stores, nor do I find significant increases in calls for service in areas immediately surrounding liquor store entrants. Further study may be needed to adequately assess the effect of increased outlet density on crime and violence in Seattle.

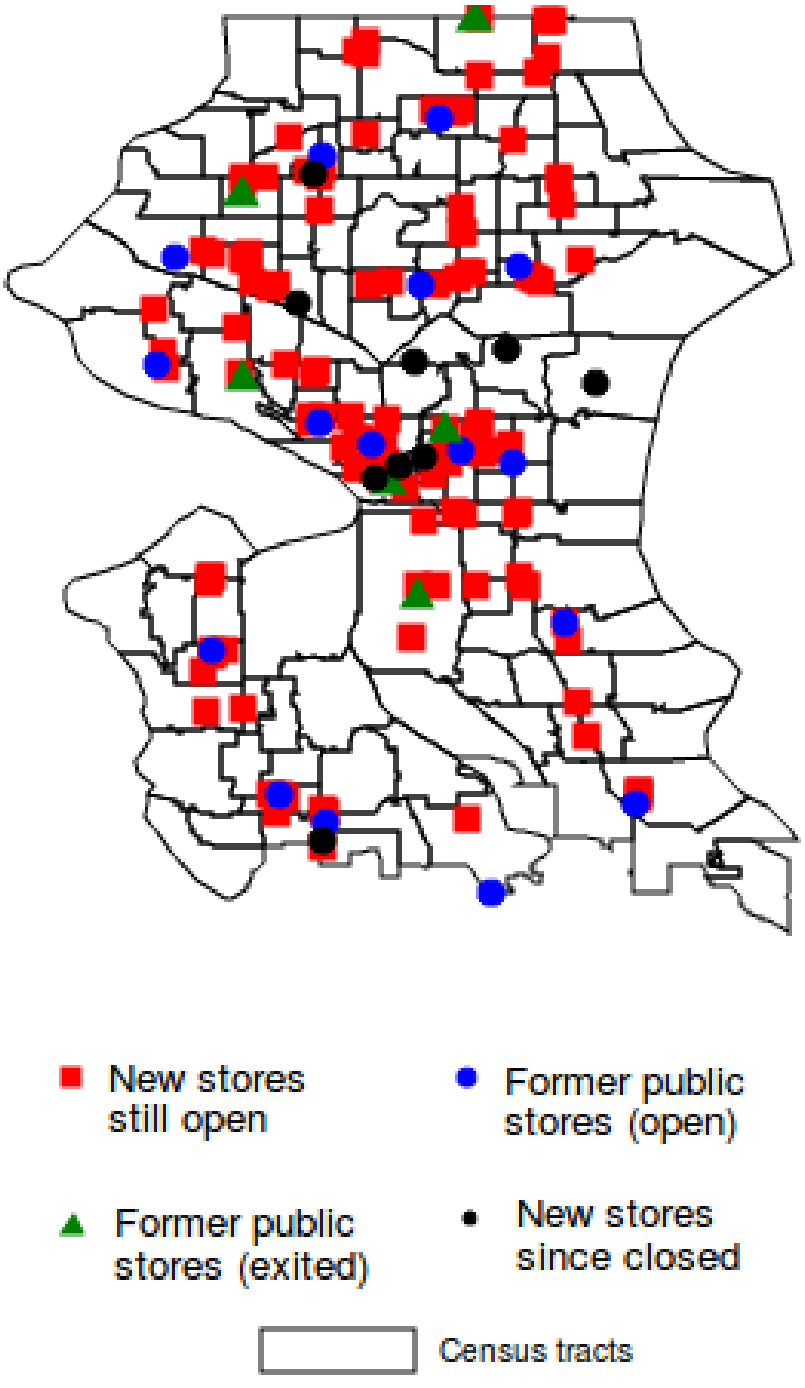


Figure 2.1: City of Seattle: Store Entry

Figure 2.2: Timing of Store Entry by Calendar Week

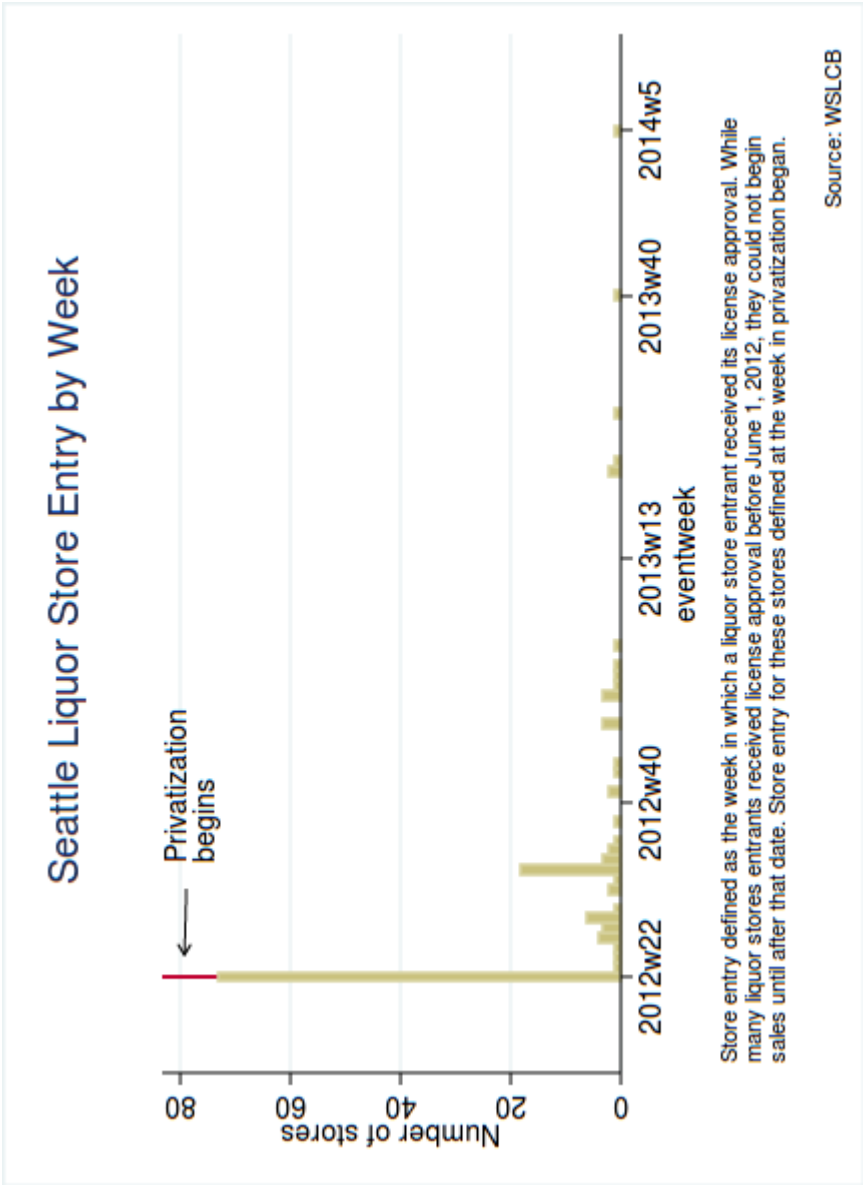


Figure 2.3: Timing of Store Entry by Calendar Week

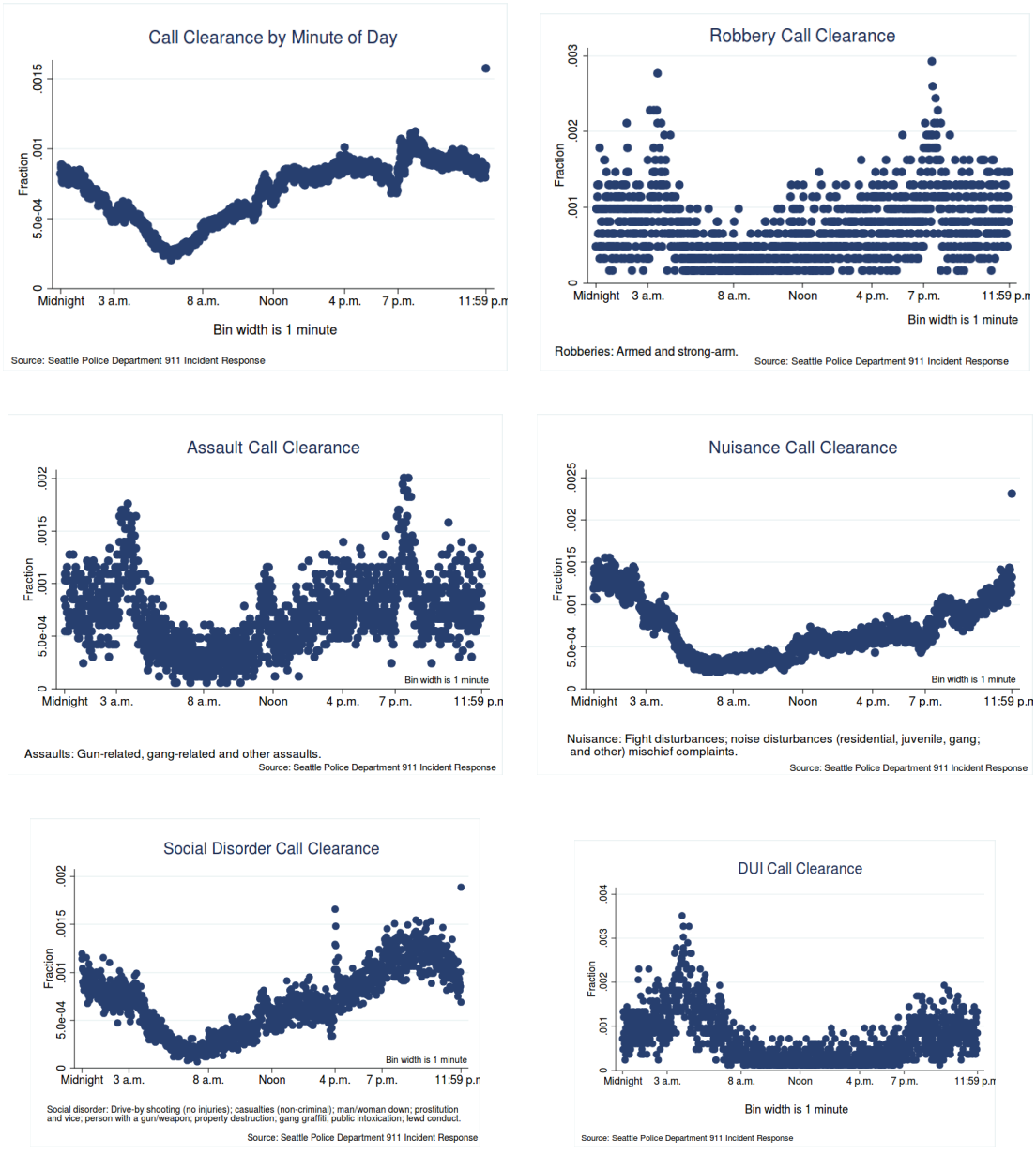
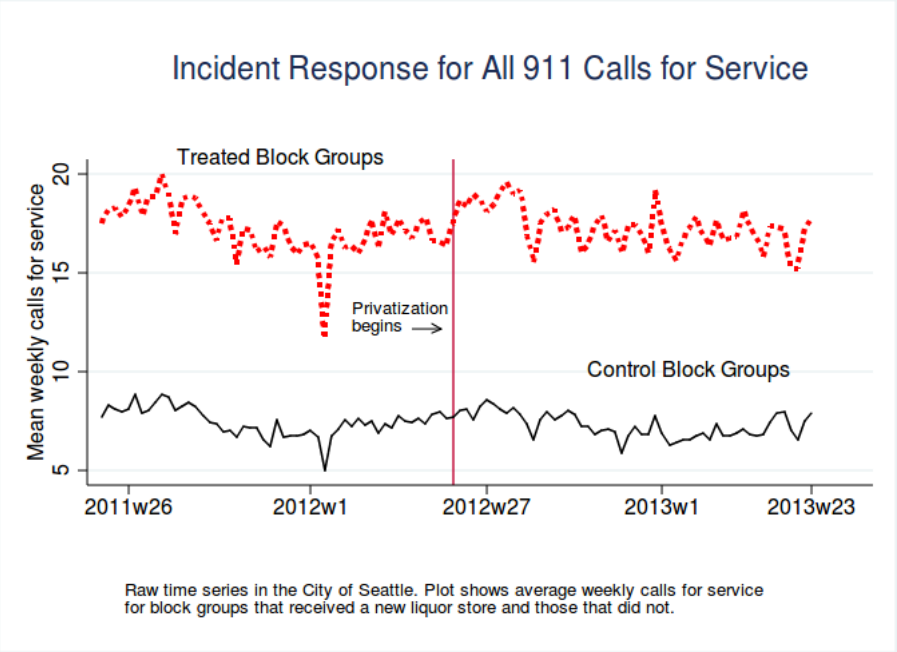


Figure 2.4: Clearance of 911 Calls for Service by Minute of Day



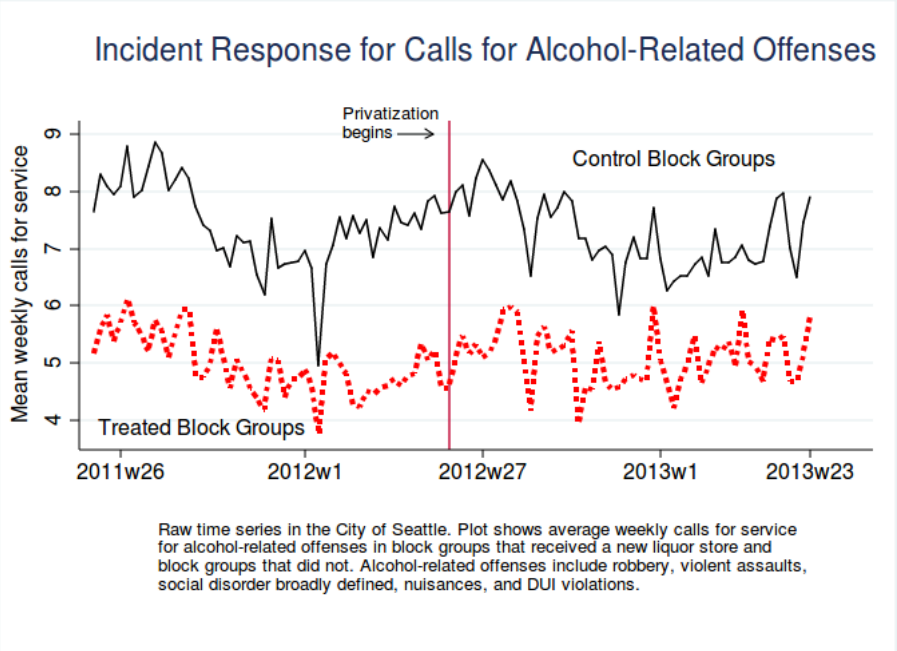
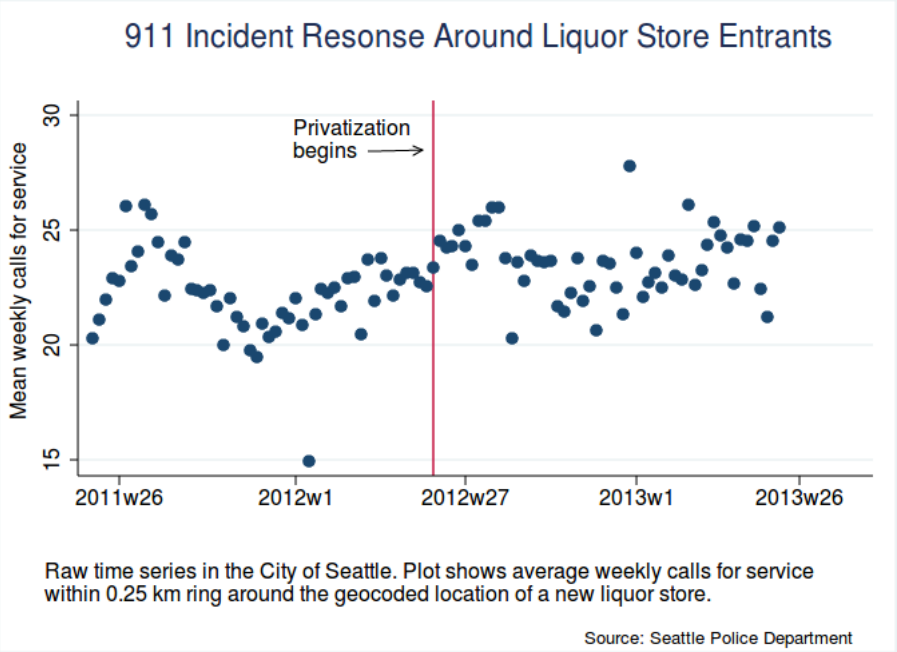


Figure 2.5: Raw Time Series: Treatment vs. Control Block Groups



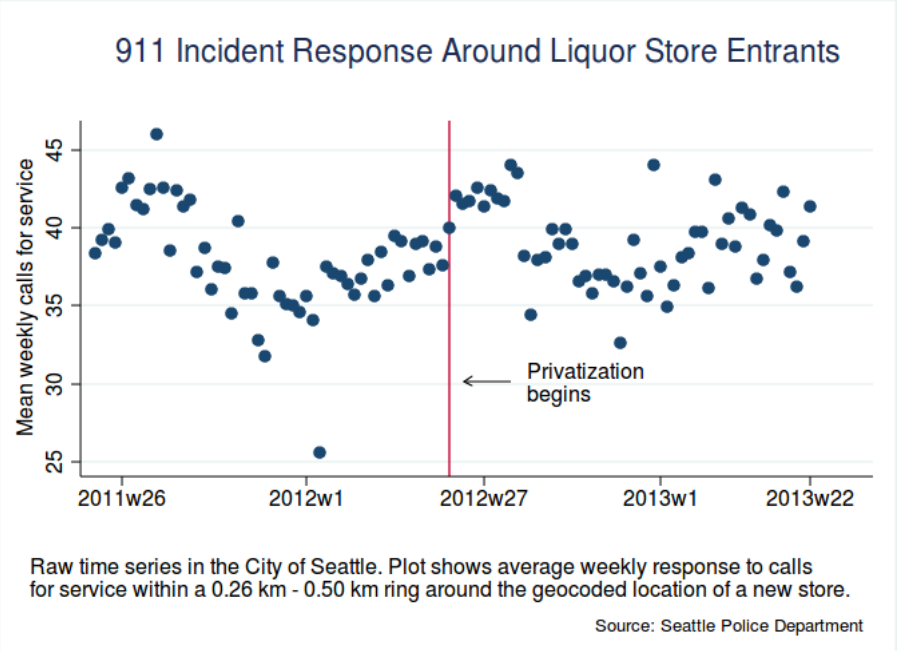


Figure 2.6: Raw Time Series: Liquor Store Rings

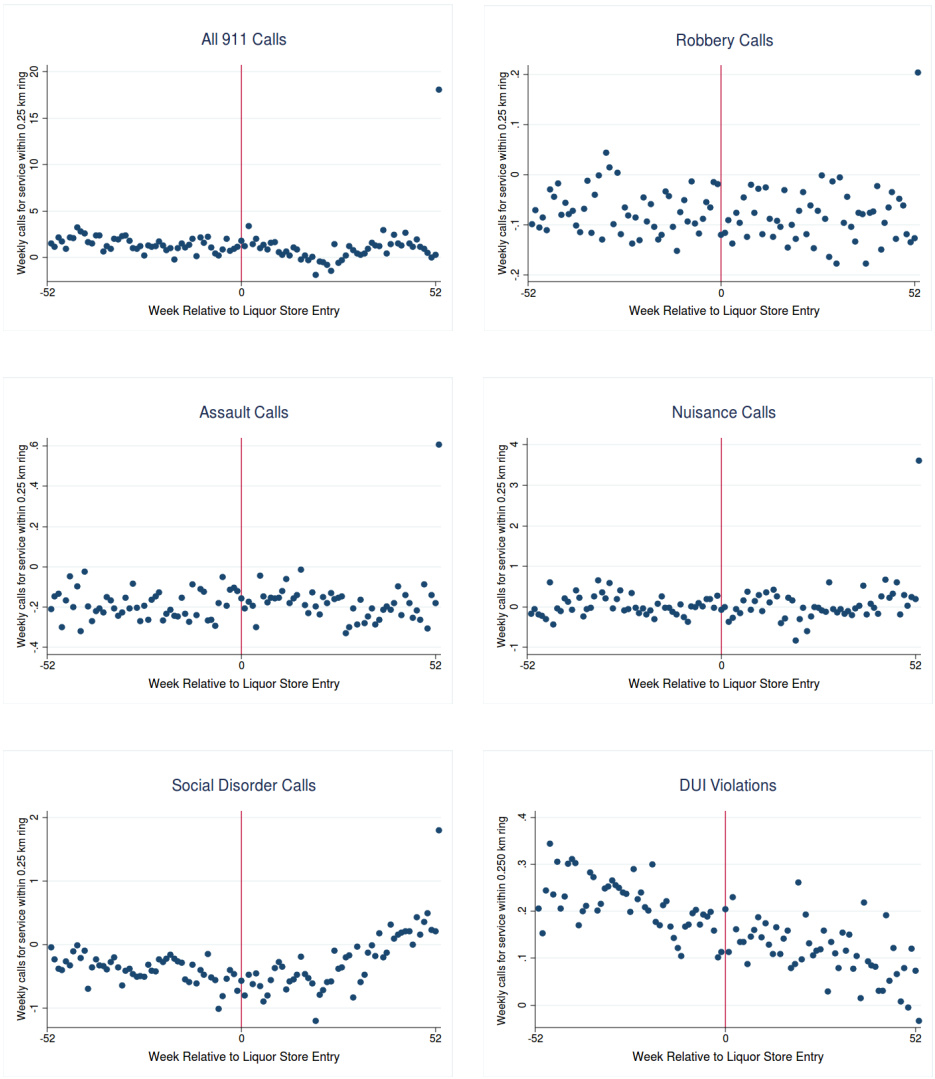


Figure 2.7: Coefficient Plots: Event Study of Store Entry on 911 Incident Response

Table 2.1: Descriptive Statistics: 911 Incident Response for Calls of Interest

	(1) Mean	(2) Std. Dev.	(3) Min	(4) Max
Robbery calls	0.0063	0.0793	0	1
Armed robbery	0.0022	0.0470	0	1
Strong-arm robbery	0.0041	0.0641	0	1
Assaults	0.0169	0.1288	0	1
Assaults, firearm related	0.0005	0.0220	0	1
Assaults, gang related	0.0001	0.0097	0	1
Assaults, other	0.0163	0.1266	0	1
Social disorder	0.0760	0.2650	0	1
Drive-by shooting, no injuries	0.0004	0.0202	0	1
Man/woman down, sick persons, injured, DOA	0.0065	0.0804	0	1
Prostitution	0.0029	0.0542	0	1
Vice, other	0.0002	0.0131	0	1
"Stay out of area of prostitution"	0.0000	0.0048	0	1
Person with a gun	0.0015	0.0381	0	1
Person with a weapon (not gun)	0.0009	0.0298	0	1
Property destruction	0.0157	0.1242	0	1
Gang graffiti	0.0023	0.0475	0	1
Lewd conduct	0.0020	0.04472	0	1
Intoxicated person	0.0436	0.2043	0	1
Nuisances	0.1546	0.3615	0	1
Fight disturbance	0.0058	0.0761	0	1
Noise disturbance	0.0290	0.1677	0	1
Disturbance, other	0.0900	0.2862	0	1
Noise disturbance, residential	0.0059	0.0763	0	1
Noise disturbance, gang-related	0.0003	0.0166	0	1
Mischief, nuisance complaints	0.0236	0.1518	0	1
Driving while under influence (DUI)	0.0087	0.0930	0	1
All other coded offenses	0.7375	0.4400	0	1
N =859,819				

Mean calls for service in the City of Seattle by potentially alcohol-related offense type as a proportion of total calls for service from January 2011 through March 2014. Source: Seattle Police Department 911 Incident Response.

Table 2.2: Descriptive Statistics: Seattle Block Groups

	Control	Treatment	t
Number of acres (land)	115.6	88.52	15.50***
Total population	1262.4	1318.7	-11.97***
Black or African-American alone	99.05	116.2	-8.204***
Female population	631.5	660.8	-11.93***
Median age (both sexes)	37.67	36.78	9.008***
Total households	575.4	681.7	-35.45***
Housing units that are renter occupied	282.6	442.2	-47.25***
Male population 25 years and over	446.5	477.0	-13.52***
Population 25 years and over	898.6	948.2	-12.46***
Median household income (2010 dollars)	71323.8	53189.9	38.83***
Number of households with public assistance income	13.80	24.95	-35.62***
Total own children under 18 years	178.8	158.1	11.81***
Median value (dollars) of owner-occupied housing units	483139.3	417284.3	26.55***
In other families - Female householder, no husband present	32.16	39.96	-10.58***
Population in labor force	777.6	841.5	-16.80***
Average weekly calls for service	7.358	17.15	-34.91***
Calls for armed robbery and strong-arm robbery	0.0391	0.120	-20.09***
Violent assault calls (firearms, gang, and other)	0.120	0.335	-23.82***
Calls for services for social disorder more broadly defined	0.596	1.522	-18.46***
Fights, noise and other disturbances, nuisances	1.087	2.773	-33.41***
Driving while under the influence (DUI)	0.0565	0.120	-14.45***
Number of Block Groups	409	73	

Average weekly calls for service calculated before June 1, 2012. Treatment refers to whether a U.S. Census block group received a liquor store after privatization and that did not have a state store operating at any time under the public system. Demographic data from U.S. Census Bureau. Police response data courtesy of Seattle Open Data and the Seattle Police Department.

Table 2.3: Block Group Analysis: Effect of Store Entry on 911 Incident Response

	(1) All 911 calls	(2) Robbery calls	(3) Assault calls	(4) Nuisance violations	(5) Social disorder	(6) DUI violations	(7) All other offenses
Post × Block group *strictly* received a new liquor store	2.8081	-0.0027	0.0314	0.2870	0.8458	-0.0116	1.6582
	(2.7209)	(0.0225)	(0.0609)	(0.4955)	(0.8648)	(0.0177)	(1.4325)
Block Group Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Block Groups	482	482	482	482	482	482	482
Mean of Dep. Var.	8.61	0.052	0.151	1.37	0.71	0.08	6.25
	(0.067)	(0.001)	(0.0001)	0.002	(0.013)	(0.001)	(0.043)
Observations	80,494	80,494	80,494	80,494	80,494	80,494	80,494
R-squared	0.9434	0.2807	0.5494	0.8385	0.8555	0.2048	0.9195

Observations at the block group-week level. *Strict* entry define a block group in which a new liquor store entered and which did not have a liquor store operating under the public system. Dependent variables are the weekly number of 911 calls for service by type for each block group in the City of Seattle from January 2011 to March 2014. *Robbery* includes both armed robbery and strong arm robbery. *Assaults* includes assaults with a deadly weapon, gang assaults, and all other assaults. *Nuisance violations* includes all fight and noise-related disturbances, as well all nuisance (mischief) complaints. *Social disorder* includes drive-by shootings, man/woman down, prostitution and vice, person with a gun, person with a weapon, property destruction, gang graffiti, lewd conduct and public intoxication. *All other offenses* are all 911 calls less those for robbery, assault, nuisances, social disorder, and DUI violations. Block groups are second-smallest geographic area for which the U.S. Census collects and tabulates decennial census data. They are formed by streets, roads, railroads, streams and other bodies of water, other visible physical and cultural features, and the legal boundaries shown on Census Bureau maps. Standard clustered at the census tract level given in parentheses. *** p<0.01, ** p<0.05, * p<0.10

Table 2.4: Store Analysis: Effect of Entry on 911 Incident Response

	(1) All 911 calls	(2) Robbery calls	(3) Assault calls	(4) Nuisance violations	(5) Social disorder	(6) DUI violations	(7) All other offenses
Post = 1 if after entry (Ring 1)	2.2152***	0.0104	0.0136	-0.1008	-0.0266	0.0200	0.7149*
	(0.4963)	(0.0164)	(0.0175)	(0.0998)	(0.1659)	(0.0137)	(0.4234)
R-squared	0.9498	0.3387	0.5697	0.8730	0.8320	0.1429	0.9350
Mean of Dep. Var.	22.50	0.18	0.45	3.98	2.27	0.17	15.45
	(0.254)	(0.004)	(0.008)	(0.051)	(0.041)	(0.003)	(0.162)
Post = 1 if after entry (Ring 2)	1.0023	-0.0331	-0.0181	-0.0792	0.2097	-0.0049	0.9280*
	(0.7042)	(0.0209)	(0.0265)	(0.1695)	(0.1591)	(0.0151)	(0.5503)
R-squared	0.9643	0.4222	0.6851	0.9075	0.8687	0.2503	0.9529
Mean of Dep. Var.	37.89	0.26	0.75	6.47	3.82	0.27	26.31
	(0.400)	(0.004)	(0.012)	(0.077)	(0.061)	(0.004)	(0.261)
Post = 1 if after entry (Ring 3)	0.1485	0.0094	-0.0509	0.0162	0.1524	-0.0177	0.0389
	(0.7936)	(0.0225)	(0.0360)	(0.2173)	(0.2012)	(0.0276)	(0.5920)
R-squared	0.9628	0.4262	0.6998	0.9084	0.8938	0.2950	0.9507
Mean of Dep. Var.	50.95	0.34	1.05	9.05	5.14	0.37	35.01
	(0.480)	(0.005)	(0.015)	(0.095)	(0.075)	(0.005)	(0.305)
Post = 1 if after entry (Ring 4)	-0.4605	-0.0082	-0.0376	0.1195	0.0450	-0.0198	-0.5594
	(0.9550)	(0.0285)	(0.0531)	(0.2208)	(0.1958)	(0.0223)	(0.8907)
R-squared	0.9686	0.4261	0.7437	0.9199	0.9078	0.2900	0.9552
Mean of Dep. Var.	62.62	0.41	1.29	10.65	6.56	0.474	43.24
	(0.553)	(0.006)	(0.017)	(0.106)	(0.089)	(0.006)	(0.353)
Store-level Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,539	19,539	19,539	19,539	19,539	19,539	19,539
Number of Liquor Stores	117	117	117	117	117	117	117

Observations at the store location-week level. Dependent variables are the weekly number of 911 service calls by type around each liquor store entrant in the City of Seattle from January 2011 to March 2014. Ring 1 = 0.0 km to 0.25 km around each store's geographic coordinates; Ring 2 = 0.26 km to 0.50 km; Ring 3 = 0.51 km to 0.75 km; and Ring 4 = 0.76 km to 1.0 km around each store's geographic coordinates. *Robbery* includes both armed robbery and strong arm robbery. *Assaults* includes assaults with a deadly weapon, gang assaults, and all other assaults. *Nuisance violations* includes all fight and noise-related disturbances, as well all nuisance (mischief) complaints. *Social disorder* includes drive-by shootings, man/woman down, prostitution and vice, person with a gun, person with a weapon, property destruction, gang graffiti, lewd conduct and public intoxication. *All other offenses* are all 911 calls less those for robbery, assault, nuisances, social disorder, and DUI violations. Standard errors clustered at the census tract level and given in parentheses. *** p<0.01, ** p<0.05, * p<0.10

Table 2.5: Placebo Test: Effect of State Store Re-Licensing on 911 Incident Response

	(1) All 911 calls	(2) Robbery calls	(3) Assault calls	(4) Nuisance violations	(5) Social disorder	(6) DUI violations	(7) All other offenses
Post = 1 if after re-licensing (Ring 1)	0.8493	0.0061	0.0331	0.2692	1.1741	0.0261	1.0440
	(0.8778)	(0.0259)	(0.0507)	(0.5261)	(0.8002)	(0.0319)	(1.0268)
R-squared	0.8581	0.1514	0.3196	0.6635	0.6355	0.1590	0.8566
Mean of Dep. Var.	26.58	0.12	0.29	2.63	1.85	0.14	11.53
	(0.300)	(0.006)	(0.011)	(0.060)	(0.060)	(0.006)	(0.204)
Post = 1 if after re-licensing (Ring 2)	-3.1099	0.0179	-0.1454	-0.7759	-0.3333	-0.0152	-1.8580
	(3.2175)	(0.0539)	(0.1557)	(0.9595)	(0.6450)	(0.0503)	(1.6161
R-squared	0.9645	0.4393	0.6472	0.9002	0.8605	0.2894	0.9536
Mean of Dep. Var.	33.88	0.261	0.62	5.67	3.29	0.23	23.81
	(0.886)	(0.012)	(0.023)	(0.165)	(0.122)	(0.009)	(0.588)
Post = 1 if after re-licensing (Ring 3)	-3.9992	-0.1280	-0.0039	-1.6852	-1.1569	-0.0159	-1.0094
	(4.1289)	(0.1053)	(0.1203)	(1.1291)	(1.9325)	(0.0538)	(2.6916)
R-squared	0.9614	0.4449	0.7628	0.9172	0.8896	0.2846	0.9500
Mean of Dep. Var.	52.28	0.34	1.15	9.77	5.64	0.33	35.04
	(1.235)	(0.013)	(0.039)	(0.256)	(0.191)	(0.011)	(0.767)
Post = 1 if after re-licensing (Ring 4)	1.7215	-0.0519	-0.0859	0.0553	0.5211	0.0424	1.2405
	(1.9027)	(0.0650)	(0.1164)	(1.0211)	(1.3550)	(0.0626)	(1.6280)
R-squared	0.9774	0.4812	0.7401	0.9342	0.9182	0.2750	0.9658
Mean of Dep. Var.	60.63	0.369	1.20	10.33	7.06	0.400	41.26
	(1.376)	(0.014)	(0.037)	(0.257)	(0.248)	(0.012)	(0.869)
Store-level Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,340	3,340	3,340	3,340	3,340	3,340	3,340
Number of Liquor Stores	22	22	22	22	22	22	22

Observations at the store location-week level. Dependent variables are the weekly number of 911 service calls by type around each former state store in the City of Seattle from January 2011 to March 2014. Ring 1 = 0.0 km to 0.25 km around each store's geographic coordinates; Ring 2 = 0.26 km to 0.50 km; Ring 3 = 0.51 km to 0.75 km; and Ring 4 = 0.76 km to 1.0 km around each store's geographic coordinates. *Robbery* includes both armed robbery and strong arm robbery. *Assaults* includes assaults with a deadly weapon, gang assaults, and all other assaults. *Nuisance violations* includes all fight and noise-related disturbances, as well all nuisance (mischief) complaints. *Social disorder* includes drive-by shootings, man/woman down, prostitution and vice, person with a gun, person with a weapon, property destruction, gang graffiti, lewd conduct and public intoxication. *All other offenses* are all 911 calls less those for robbery, assault, nuisances, social disorder, and DUI violations. Standard errors clustered at the census tract level and given in parentheses. *** p<0.01, ** p<0.05, * p<0.10

Chapter 3

Expectations of Profit in a Public Auction of Liquor Rights

3.1 Introduction

The retail sale of liquor has long been the province of state control. The 21st Amendment, ratified by Congress in 1933, both signalled an end to Prohibition and granted states sweeping power in the regulation of all beer, wine, and spirits sold and distributed within their borders.

Much of this regulation has been justified by social welfare and public health concerns commonly associated with alcohol consumption. Many states opted for "monopoly" control over the sale of alcohol. In Washington, the state regulated the importation, manufacture, distribution and sale of all liquor to consumers for nearly 80 years. In 2011, voters approved an initiative privatizing the retail sale and distribution of all spirits starting June 1, 2012.

This paper examines expectations of profit to owning a liquor store in Washington under privatization. The main contribution is the analysis of a unique data set on the outcome of a public auction of retail liquor rights ahead of the market transition. Retail sales across the state had previously been met through a system of specially licensed "state" and "contract" stores, which sold liquor on consignment.[1] All of Washington's state-run liquor stores were auctioned off prior to privatization. I infer expectations of profit using bidders' willingness to pay.

[1] Figure 3.1 maps state and contract store locations by type.

Many residents expected that liquor prices would be lower in a competitive market. Much of the rationale behind the economics of privatization suggests that increased competition will generate efficiencies that are passed on to consumers (Vickers and Yarrow, 1991) (Greenfeld, 2012). Analysis of bidding behavior shows that winners expected to gain consumers from Oregon and Idaho crossing into Washington in search of lower prices. Oregon and Idaho are both monopoly control states, which typically have higher average liquor prices than "open" states. I find that winners were willing to pay an average of $183,000 for the retail rights associated with former state liquor stores, despite knowledge of free entry into the market after June 1, 2012. I also find a significant premium for stores located closest to Oregon and Idaho border cross-points.

Privatization in Washington state provides a singular opportunity to evaluate the disposal of public goods via auction. Much of the empirical work on public auctions has focused primarily on assets such as electromagnetic spectrum licenses, or natural resources such as oil, gas, and timber. This author knows of no prior empirical study of the sale of retail liquor rights through public auction. However, there exists prior precedent for the public sale of liquor assets. In Canada, Alberta province sold off its stores when it privatized retail liquor sales in 1993-'94.

While the auction design in covered in greater detail in the next section, it is important to highlight here the difference between the Canadian sale and Washington's approach. Unlike Alberta province, Washington did not own the physical location of its 167 state-run stores, the buildings were leased from private businesses. Bidders in the Washington auction competed not for the physical store or inventory, but solely for the right to sell liquor at the location of the former state store. Winning an auction did not guarantee exclusivity in the corresponding market area, nor did the state plan to restrict the total number of licenses issued. Winning an auction granted two things: 1) the exclusive right to sell liquor at the location (address) of

the former state store, and; 2) a special exemption to a new rule that all liquor stores in Washington have a minimum footprint of 10,000 square feet in a fully enclosed structure.[2] All state-run stores were smaller than 10,000 square feet, so bids may not only reflect expected profitability of operating a liquor store, but the value of this exemption. If commercial lots at or above 10,000 square feet were prohibitively expensive or unavailable in high-density urban areas, then the value of the exemption could be quite high.

The findings contribute to the wider literature on disposal of goods via auction. According to the Washington State Liquor Control Board (WSLCB), the auction attracted 551 individual bidders who generated 14,627 bids across all store auctions. Kagel and Levin (1986) find that auctions with large numbers of bidders produce more aggressive bidding than with small numbers, resulting in negative profits and the winner's curse. Assuming bidders are rational, a winning bid is an unbiased estimate of the net present value of extra-marginal profits from purchasing retail rights vs. free entry. According to theory, the bidder with the most optimistic value of the good wins the auction, but tends to overpay relative to the item's intrinsic value. A winner's curse can arise in common value auctions from uncertainty and judgmental failures that affect market outcomes (Capen et al., 1971) (Kagel and Levin, 1986). In a common values auction, the item to be sold has a intrinsic value to all bidders, but this intrinsic value is unknown. In this paper, I assume the exact value of retail rights associated with any given liquor store is uncertain, but that bidders know enough about the store and the surrounding area to base their bids on their own proprietary estimates of the value of the store.[3]

Capen et al. (1971) document earnings by oil companies from Gulf of Mexico oil leases bought at auction. The authors suggest that companies' low returns were

[2] Contract stores were also exempt from the minimum footprint requirement.

[3] I do not observe all bids in each store's auction, only the high bids for each bidder in each auction. Therefore, much of standard analysis on strategic bidding behavior, collusion, and bidder statements about their objectives may not be directly testable.

due to the failure to correct for adverse selection in the bidding process. However, Hendricks and Porter (1988) conclude that bidding patterns on oil leases were consistent with rational behavior in the presence of asymmetric information. Neighbor firms were better informed about the value of a lease than non-neighbor firms, and neighbor firms were better able to coordinate bidding decisions.

The winner's curse has also been explored in the corporate takeover market (Roll, 1986) (Varaiya, 1988), the baseball labor market (Cassing and Douglas, 1980), and the market for initial public offerings of common stock (Koh and Walter, 1989), with mixed results. In the baseball labor market, Cassing and Douglas (1980) find that the majority of free agents signed in the 1970s were overpaid by about 20 percent, relative to estimates of the revenue impact of their performance.

The retail rights won in the Washington auction could be resold, and the possibility of resale might attract bidders who have no use value for retail liquor rights but participate in order to resell those rights (Pagnozzi, 2010). Other work posits that bidders may allow speculators to win in order to keep the auction price low (Wolfram, 1998) (Ausubel and Cramton, 1998). Another empirical irregularity of the Washington approach was that bidders were allowed to compete simultaneously across all store auctions. Bidders may have tried to group purchases. In prior work on multiunit auctions, such as sales of FCC spectrum rights, bidder competition for multiple licenses may result in lower prices (Wolfram, 1998) (Ausubel and Cramton, 1998). A multi-unit auction is one in which multiple identical or distinct objects are allocated to bidders.

The rest of the paper is organized as follows. Section 2 presents describes the public auction of retail liquor rights. In Section 3, I describe the data used in the study. In Section 4, I briefly describe the empirical approach. The main empirical findings are presented in Section 5. Section 6 concludes.

3.2 Public Auction

Privatization required the sale, by public auction, of the retail rights associated with Washington's state-run liquor stores. Under the public system, retail sales were overseen by a combination of 167 state-run and 161 contract stores. Contract stores were not subject to the privatization initiative's auction requirement, as contract stores were operated independently by owners who earned a commission on the sale of spirits. However, contract stores were still required to apply to the WSLCB for a new retail license to continue selling liquor at their current location under privatization.[4]Figure 3.1 maps state and contract store locations across Washington.

From March 8, 2012, to April 20, 2012, the state conducted simultaneous online, first-price English auctions (open, ascending order) for rights to each of the state's 167 stores. The auction was run by the auction Web site Public Surplus and hosted by the Washington State Department of Enterprise Services.

The state did not own the physical locations associated with each retail liquor store, instead leasing the space from property landlords. Therefore, each bidder competed for the exclusive right to apply for a new retail liquor license at the location of the former state store in its current footprint. More specifically, the winning bidder would be granted the right to establish a liquor retail business at the site of the original state liquor store without challenge by local jurisdiction, a right that could be sold or transferred at any time (WSLCB). Additionally, auction winners would be exempt from a new requirement that all liquor stores in the competitive market have a minimum footprint of 10,000 square feet in a separate, fully enclosed structure. All

[4]There were two types of contract stores under the public system. Level 1 stores were characterized by small retail markets. Stores would pay a monthly base rate and a commission based on monthly net sales. Level 2 stores were characterized by larger, urban market areas. Level 2 stores would pay a flat percentage of monthly net sales. Both types of stores would receive liquor inventory at no cost from the liquor control board, as well as any equipment found necessary to conduct sales, such as computers, modems, printer/scanner/copier, deposit slips, and paper bags, among other items.

stores up for auction occupied a footprint smaller than the new required minimum, so winning an auction guaranteed a very limited exemption. Former contract stores were also exempt from the minimum footprint requirement, but this right could not be transferred or sold.

Registered bidders were required to make a deposit of $1,000 (the de facto minimum bid in each auction) before making an official bid. Bidders could bid on one or multiple stores. A separate auction for all store locations at a single bid was held concurrently with the individual store auctions. The state held the individual and all-store auctions simultaneously in order to maximize potential revenue —it would compare the winning bid in the all-store auction with the combined winning bids for the individual store auctions, taking the higher of the two. The state brought in $30.75 million in the combined individual store auctions; the highest all-store bid was $4.6 million. Proceeds from the individual store auctions went into the state's revolving fund.

Following standard practice, the winning bidder was defined as the highest bidder at the time the auction closed. The end of the online auction was scheduled for 4 p.m. (PDT) on Friday, April 20, 2012. Following standard protocol in online auctions, a bid placed during the final five minutes of each auction automatically extended that auction another five minutes. Nearly 80 percent of individual store auctions were extended in this manner, pushing back the end of all auctions nearly two and a half hours to 6:25 p.m. (PDT), April 20, 2012. A store's final price was the winner's final bid, plus a 6 percent "buyer's premium" payable to the state, and any applicable fixture or inventory removal costs. According to the board, if a winning bidder was able to negotiate rental rights with the property landlord before the board terminated its lease, the bidder would also receive the right to certain fixtures within the store. Store inventory was not included in the auctions. Winning bidders were allowed to buy the store's remaining inventory as of May 31, 2012, only after first negotiating

a lease with the property landlord, applying for and receiving a new spirits license, and notifying the liquor control board by May 15, 2012. The price for all inventory at each location was calculated as the original cost minus a blanket discount of $7.97 per case.

Once the auction concluded, winning bidders were not required to apply for a liquor license, nor were they required to operate a liquor-licensed business at the former state store's location. The auction merely granted transferable operating rights at the location of the former state store. If winning bidders wanted to operate a retail liquor store, they were required to first secure a new lease with the property landlord. If winning bidders were unable to negotiate a lease, they were allowed to resell or transfer their right, or request an alternative location within a one-mile radius of the state store's existing location, according to the WSLCB. If winning bidders decided to relocate within a one-mile radius, the new location would then be subject to local jurisdictional comment.

The online auction for the state's 167 stores lasted approximately 43 days and ended April 20, 2012. Winning bidders were informed they would lose their initial deposit of $1,000 if they did not pay their final bid (or bids if they purchased more than one store) by May 15, 2012. Overall, 18 stores had winning bidders who did pay their bids to the liquor control board. Subsequently, the state held a second, live auction at the state's liquor control distribution center in Seattle on May 24, 2012, for these remaining 18 stores. Participants were required to post a $10,000 deposit, which would again be forfeited if they won an auction but failed to pay the final price. Overall, 6 stores had winning bidders who did not pay their final bids in the May 24 reauction. Subsequently, the state held a third, live auction at the Seattle distribution center on June 28, 2012, for these remaining 6 stores. Participants were required to post another deposit, which would again be forfeited if they won but failed to pay their final bid. All winners in this final auction paid their winning bids

to the liquor control board. See Table 3.3 for a distribution of winning bids across all auctions.

3.3 Data

I combine information from several different data sets in the analysis of expectations to profits from owning a liquor store under privatization. For stores in the public auction, characteristics such as location, square footage, number of employees, net profits, gross sales, dollar value of inventory, number of liters sold, cost of employee salaries, dollar value of taxes paid, and the dollar value of utilities paid, were made available to both potential bidders and the general public through an electronic data book compiled by the liquor control board.[5]Auction-level characteristics on the identity of winning bidders, their winning bids, total number of bids, total number of bidders, number of retracted bids and auction length, were generated using information obtained from the Web site Public Surplus, which hosted the online auctions.

Information on which stores were sold in the live May and June reauctions was generated from data provided by the liquor control board. Identities of the winning bidders in both live reauctions, as well as the final prices paid to the board, were provided by the WSLCB upon request.

Market data at the zip code level and demographic characteristics at the ZCTA level supplement the data set. Data on the total number of firms, supermarkets, "supercenters", schools, churches, hospitals, and convenience stores were matched at the zip code level to each store.[6] Demographic characteristics such as population density, median age, gender, race, and mean household income were matched at the U.S. Census Zip Code Tabulation Area (ZCTA) level to each store's zip code via crosswalks.

[5]Figures 3.4 and 3.5 illustrate what information bidders saw on the auction Web site.
[6]A supercenter or big-box store is a physically large retail establishment, usually part of a chain.

Following Seim (2006), data on the total number of firms in each zip code serves as a proxy for general business density, as well as for the extent to which zoning laws enforce the residential nature of the market area. Data on schools, hospitals and religious organizations serve as a proxy for community preferences regarding the sale of alcohol. These variables provide a general overview of the competitive market in each location that might influence bidder expectations of profits.

In order to identify competition effects from nearby stores in the bidding process, a count of the number of state liquor stores in a six-mile radius was generated via hand-coding using store addresses provided by the liquor control board. I also account for significant differences between stores in high-density urban areas such as Seattle, and stores in more rural locations along the state border. I stratify corresponding market areas into five population density quintiles. I then create an indicator variable for each quintile, such that if a store is located in a ZCTA with a population density in the first quintile, the corresponding dummy variable takes a value of one, and zero otherwise.

I identify a border premium to winning bid by first obtaining the geographic coordinates in longitude and latitude for each state store via hand-coding and addresses provided by the WSLCB. I calculate the driving distances in miles between each Washington store and 13 Washington-Oregon (WA-OR) border crossings. The Columbia River defines the WA-OR border for 309 miles, suppressing interstate travel to 12 bridges and one interstate highway outside Walla Walla, Wash. I also obtain the driving distances between Washington stores and two Washington-Idaho (WA-ID) crossings at Post Falls and Moscow in Idaho. If bidding behavior is being driven by expectations of profit from cross-state traffic, then the effect should be strongest for stores closest to the 15 border crossings. Figure 3.2 is a map of all border crossings by proximity to state and contract stores in Washington.

Table 3.1 presents descriptive statistics for the 167 state stores and their corre-

sponding auction outcomes. There is considerable variation across state stores in the amount of winning bids. Figure 3.3 shows the frequency distribution of winning bids across all auctions. Washington state brought in $30.75 million from the auction overall; the mean winning bid was $183,186.10. Bidders paid as much as $750,100 for retail rights to a store in Tacoma and as little as $49,600 for the retail rights to a store in Spokane. Store auctions attracted an average of 87 bids from 17 individual bidders.

The average footprint per state store was just short of 5,193 square feet, although one store occupied a footprint as large as 9,500 square feet. However, Table 3.2 indicates that store square footage is not significantly correlated with auction outcomes. Each store employed on average 5-6 workers and earned average net profits of $336,000 from fiscal year 2009 to fiscal year 2011.[7] I find that 92 people purchased a single store only, while the remaining 75 stores (or 44 percent) were part of a group of at least two purchased by the same bidder. In separate analysis, I find that winning bidders did not try to group stores in the same area.

About 15 percent of state stores are located in counties bordering Oregon and Idaho. My results suggest that bidders placed a premium on these stores, likely echoing expectations of future cross-border shopping from Oregon and Idaho. In separate analysis, I find higher liquor prices in Washington after privatization drove consumer traffic to liquor stores in Oregon, significantly reducing the value of owning a liquor store in Washington, particularly for firms located near the borders.

The amount bidders were willing to pay is suggestive of significant expectations of profits to operating a liquor store under privatization. Bidders could have waited until June 1, 2012, to apply to the WSLCB for a retail license for only $166. As mentioned previously, winning an auction did not guarantee exclusivity in the surrounding market area, nor did the liquor control board plan to restrict the total

[7]Washington's fiscal year runs from July 1 through June 30 of the following year, and is named for the calendar year in which it ends (e.g., July 1, 2012, through June 30, 2013, is state fiscal 2013.

number of private licenses it would issue across the state. Auctions did not include store inventory, and winning an auction did not guarantee the right to fixtures within the store. While winning bidders were exempt from the 10,000-square-foot requirement, it is unclear if winners' final bids reflected the true value of this exemption. A bid in this context can be interpreted as the value placed on owning retail liquor rights in the newly competitive market.

If expectations of profit are driving bidding behavior, we should expect factors correlated with higher demand —such as population density —to have significant explanatory power in the bidding process. Conditional on past profits, I find that bidders paid $29,329 more for stores in high population density areas relative to low density areas, a difference that is significant at the 5 percent level.[8] While not included in the main results, I find that after controlling for other store and market demographic characteristics, median population density is no longer significantly correlated with auction outcomes. In the main analysis, I use population density quintiles to better capture a store's demand profile.

3.4 Empirical Approach

This paper uses geospatial analysis and data on a public auction of retail liquor rights to estimate expectations of profit to own a liquor store in Washington under privatization. I fit a simple linear model with standard errors clustered at the county level:

$$\ln W_i = \beta_0 + \beta_1 \cdot \textit{Border store} \ + \beta_2 \cdot X_i + \beta_3 \cdot C_i + \beta_4 \cdot V_i + \epsilon_i \tag{3.1}$$

[8] A high population density area is defined as an area with a population density above the median; a low population density has a population density below the median.

The dependent variable is the log of the winning bid in store i's auction. *Border store* is an indicator variable equal to 1 if the store is located near the WA-OR or WA-ID border, and zero otherwise. I define border proximity in several ways. In the main analysis, crossing the border entails traversing one of 12 bridges spanning the Columbia River or the Oregon-Washington Highway near Walla Walla, Wash., as well two Washington-Idaho (WA-ID) crossings at Post Falls and Moscow. First, I create a dummy variable equal to one if the Washington store is one of the two closest stores to each border crossing, and zero otherwise. These stores are denoted *Proximity 1* stores, as consumers crossing into Washington to buy cheaper liquor would encounter these stores first. Theory suggests that if bidders expected lower prices under privatization, stores closest to border crossings would attract a premium. I also create a dummy variable equal to one if the Washington liquor store is located in a county bordering Oregon or Idaho, and zero otherwise. To separate out effects of the closest stores to the WA-OR and WA-ID borders, I define *Proximity 2* stores as any store in a border county that is not a *Proximity 1* store. Figure 3.2 maps border crossings in relation to interior, *Proximity 1* and *Proximity 2* stores across Washington.

X_i represents demand and profit shifters at the zip code and ZCTA levels for store i; C_i represents store-level characteristics; and V_i represents auction-level characteristics for store i.[9] Then β_0 represents the baseline average of the dependent variable, and β_1 is the coefficient of interest, capturing the premium to winning retail rights to a store near state borders. If bidding behavior is being driven by expectations of profit from cross-state traffic, then the effect should be strongest for *Proximity 1* stores.

[9]Such as the log of total population, log of total area, log of mean household income, log of the total male population 21 and over, log of the total population of African-Americans, log of the total number of firms, and the number of state stores in the same zip code, store square footage, average net profits, number of employees, and number of bidders in an auction.

3.5 Results

Turning to Table 3.2 and the main outcomes of the public auction, I present evidence indicating which store- and market-level characteristics drove bidding behavior. The dependent variable in Table 3.2 is the log of winning bids by store auction. Each specification includes standard errors clustered at the county level.

Column 1 includes only the log of net profits in fiscal year 2011 and the number of individual bidders. Controlling for the number of bidders in an auction, I find that past profits have significant explanatory power in bidding behavior. Column 1 indicates that for each additional 1 percent increase in net profits, the winning bid increases by 0.347 percent, a result significant at the 1 percent level. The R-squared suggests that over a third of the variation in winning bids can be explained by the regression of store net profits and the number of bids in an auction. The large, positive and significant coefficient on the log of net profits is consistent with the interpretation of winning bids as expectations of profits.

Column 2 adds only those store-level characteristics made available to potential bidders in the liquor board's online data book, as well as a count of the number of state stores within a six-mile radius. Variables significantly correlated with higher winning bids are the number of individual bidders, the number of retracted bids and the log of net profits in fiscal year 2011. The coefficient on the log of net profits increases from 0.374 to 0.4132. While the coefficient on the number of state liquor stores within a six-mile radius is not significant, it is positive, contrary to expectations. This might suggest excess demand in the market area, but more evidence is needed.

Column 2 also adds population density quintiles, the log of the total number of firms by store zip code, and an indicator variable for whether the store is located in a county bordering Oregon or Idaho. For population density, the omitted variable

corresponds to the most densely populated quintile. The coefficients for quintiles 1 through 4 are negative, consistent with expectations, but none are significant at conventional levels. The signs on the point estimates for population quintiles suggest that bidders paid less for stores in less densely populated areas relative to the highest density area. The log of the total number of firms in a store's zip code, a measurement of overall business density, is positive and significant at the 5 percent level. This suggests that bidders paid more for stores in more commercially developed areas.

Column 2 also indicates that bidders paid 15.50 percent more for stores in border counties. An alternative explanation to a premium is that the border variable is capturing some shared characteristic among these stores that is unrelated to border proximity. If bidders expected to be unable to negotiate a new lease or find a large commercial space within a mile of the former state store, more rural areas (such as those found in border counties) might be more attractive.

To answer this question, Column 3 includes the proximity variables discussed in previous sections. If bidding behavior is being driven by expectations of profit from cross-state traffic, then the effect should be strongest for *Proximity 1* stores. Column 3 supports the hypothesis of a border premium. The coefficient on *Proximity 1* stores is 34.47 percent, and significant at the 1 percent level. The coefficient on *Proximity 2* stores is small, positive but not significant at any conventional level. Therefore, the premium seems to be driven solely by those stores closest to the 15 border crossings. Overall, the results support the existence of a border premium.

The specification in the final column of Table 3.2 includes other market and demographic characteristics. The coefficient on *Proximity 1* stores increases to 40.24 percent, and is still significant at the 1 percent level. The coefficient on *Proximity 2* stores remains positive but insignificant at conventional levels.

The coefficient on the total number of firms in a store's zip code increases to 13.63 percent, and is significant at the 5 percent level. I find that the number of convenience

stores in a store's zip code is positive and significant at the 5 percent level. It is not clear why the number of convenience stores should be positively correlated with winning bid amounts, although it is possible that the term is capturing a measure of business density. I also find the coefficient on the number of supercenters in a store's zip code is negative and significant at the 5 percent level. This result is consistent with the fact that large warehouse stores such as Washington-based Costco Wholesale Corp. would be able to directly compete by selling discount liquor under privatization. Characteristics which proxy for community preferences, such as the number of religious organizations in a store's zip code, are negatively correlated with winning bid amounts and significant at conventional levels. However, the number of schools in a store's zip code is positive but not significant at conventional levels.

Because auctions are often used when sellers do not have a good estimate of either the true value of an item, or buyers' true value of an item, there may be other factors driving bidding behavior that I am not able to directly capture. Retail liquor licenses under privatization are subject to comment and review by local jurisdictions. According to the liquor board, a new liquor license is typically processed within 60 to 90 days, depending on the findings from a background check, location review and local comment. Therefore, winning bid amounts could encapsulate the intrinsic value of bypassing jurisdictional review and general legislative ease of opening a liquor store. In parts of the state with high commercial occupancy rates and/or leasing rates, such as downtown Seattle, the true value of the rights won by auction could be quite high.

3.6 Conclusion and Policy Implications

Winning bidders had unrealistic ex-ante beliefs about the expected profitability of retail liquor rights under privatization. Bidders were unable to predict the increase in higher average prices, and as such the value of owning a liquor store after June 1,

2012, is an upward-biased estimate of the true ex-post value.

For Washington liquor stores located near the Oregon border, the difference between expected and realized values could be quite large. Even if bidders were able to incorporate some amount of uncertainty into their bidding strategy, it is highly unlikely that they would be able to predict price differentials high enough to induce cross-border shopping effects approaching 21 percent. The large magnitude of commodity tax avoidance along the WA-OR border suggests that the impact on Washington firms is non-trivial. Table 3.2 shows that winning bidders paid more significantly more for the retail rights to stores located near Oregon and Idaho border crossings, suggesting that firms expected an inflow of consumers expecting lower prices under privatization. In separate analysis, I find that average liquor prices increased by 11 percent under privatization for a number or reasons but most directly from the imposition of new ad valorem taxes.

Cross-state tax differentials led to increased sales for Oregon liquor stores along the WA-OR border. The magnitude by which Washington residents cross the border to buy cheaper liquor in Oregon can be directly interpreted as lost revenue for Washington firms. Cross-border shopping effects greatly reduce the value of operating a liquor store in Washington, especially for stores along the border. Taking the dollar value of the increase in liquor sales for Oregon stores, and the dollar value of sales in the pre-period for Washington's *Proximity 1* stores along the WA-OR border, I find that cross-border shopping effects in Oregon translate into a per-store, per-month sales loss of 12.5 percent for Washington firms. While this estimate is only applicable to Washington liquor stores operating in the pre-period, and is dependent on per-store sales in the pre-period, it provides a general estimate of the magnitude of the revenue loss to cross-border sales.

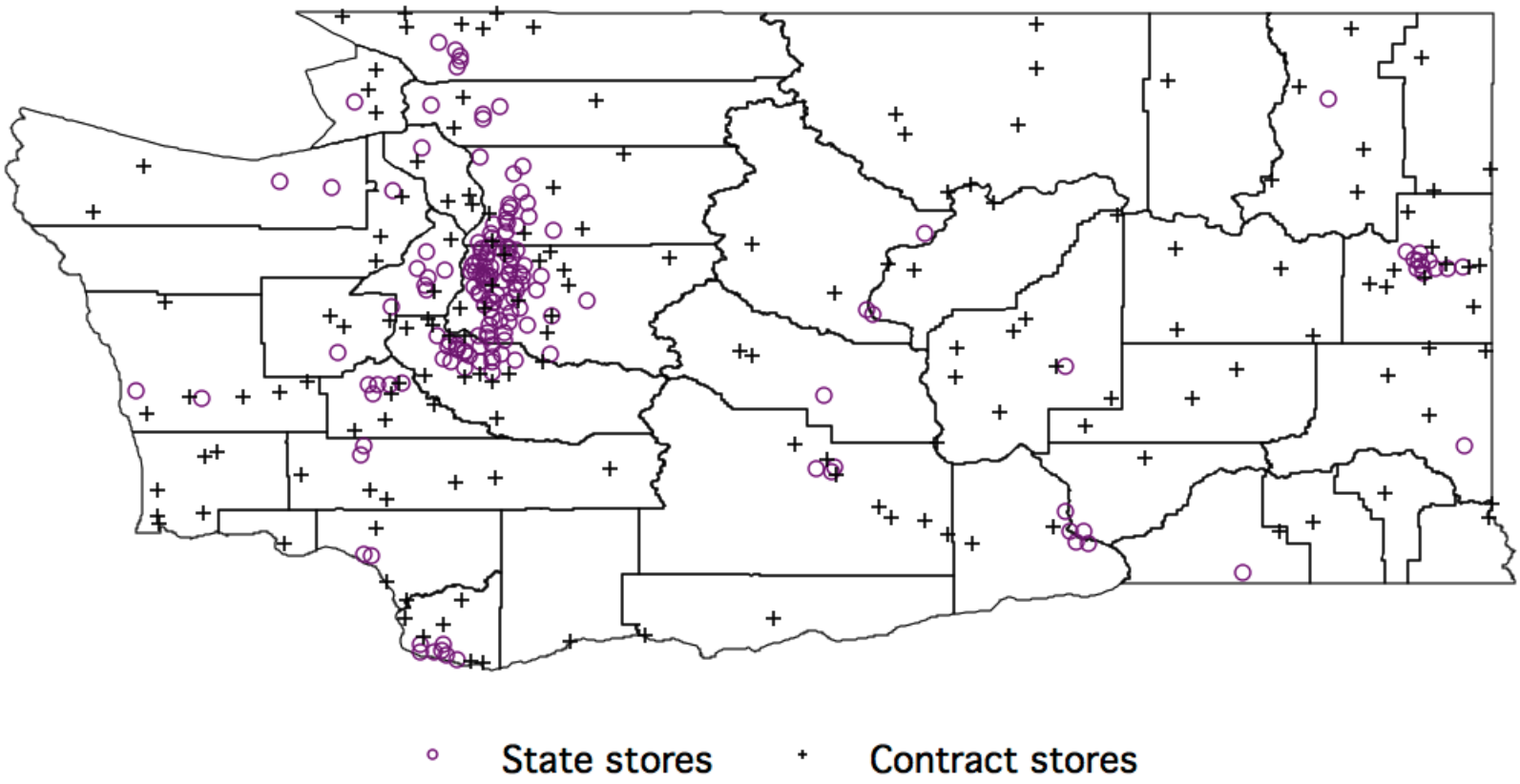


Figure 3.1: Washington State Liquor Stores

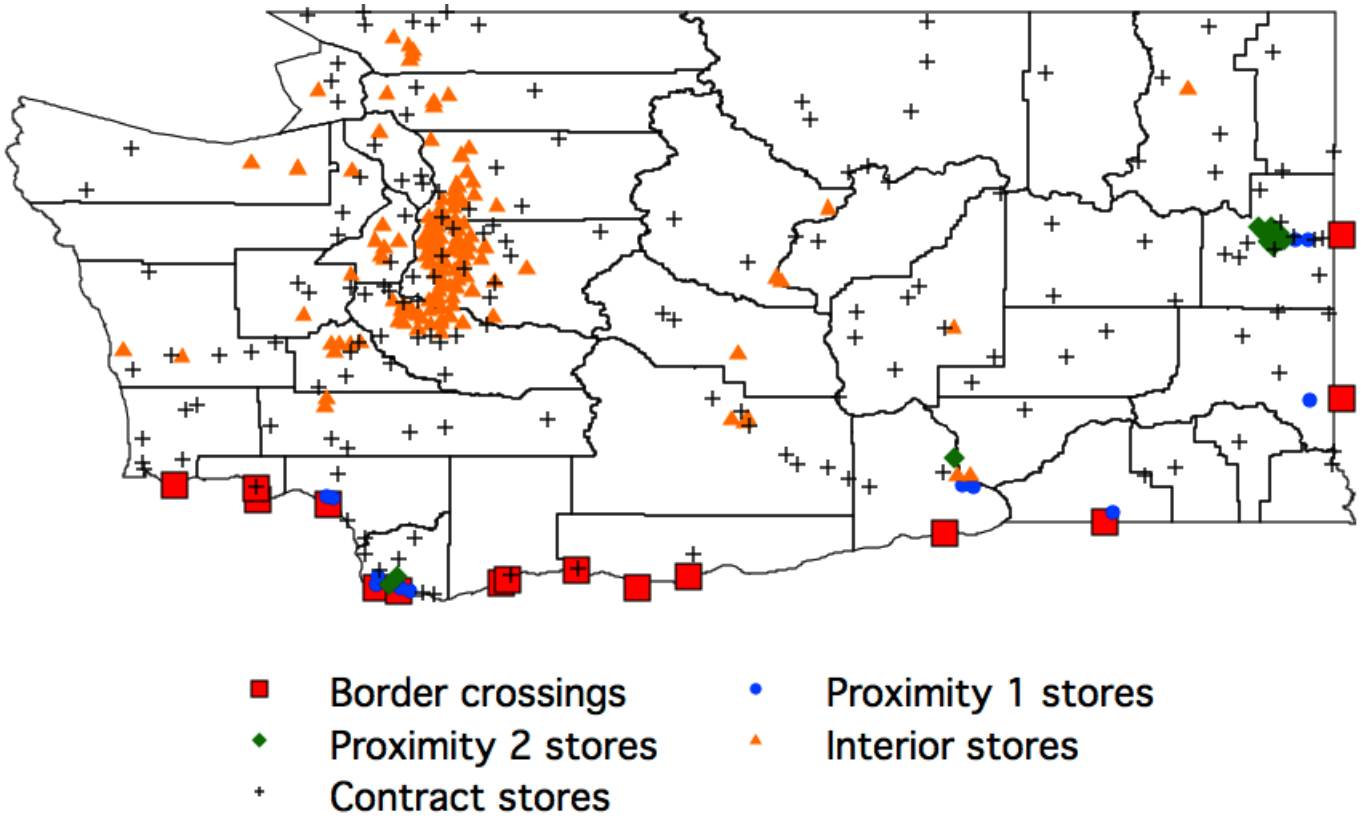


Figure 3.2: Washington State and Contract Store Locations

Proximity 1 stores in Washington defined as the two closest stores to 13 WA-OR and two WA-ID border crossings. *Proximity 2* stores defined as any store in a border county that is not a *Proximity 1* store. Interior stores are all other stores.

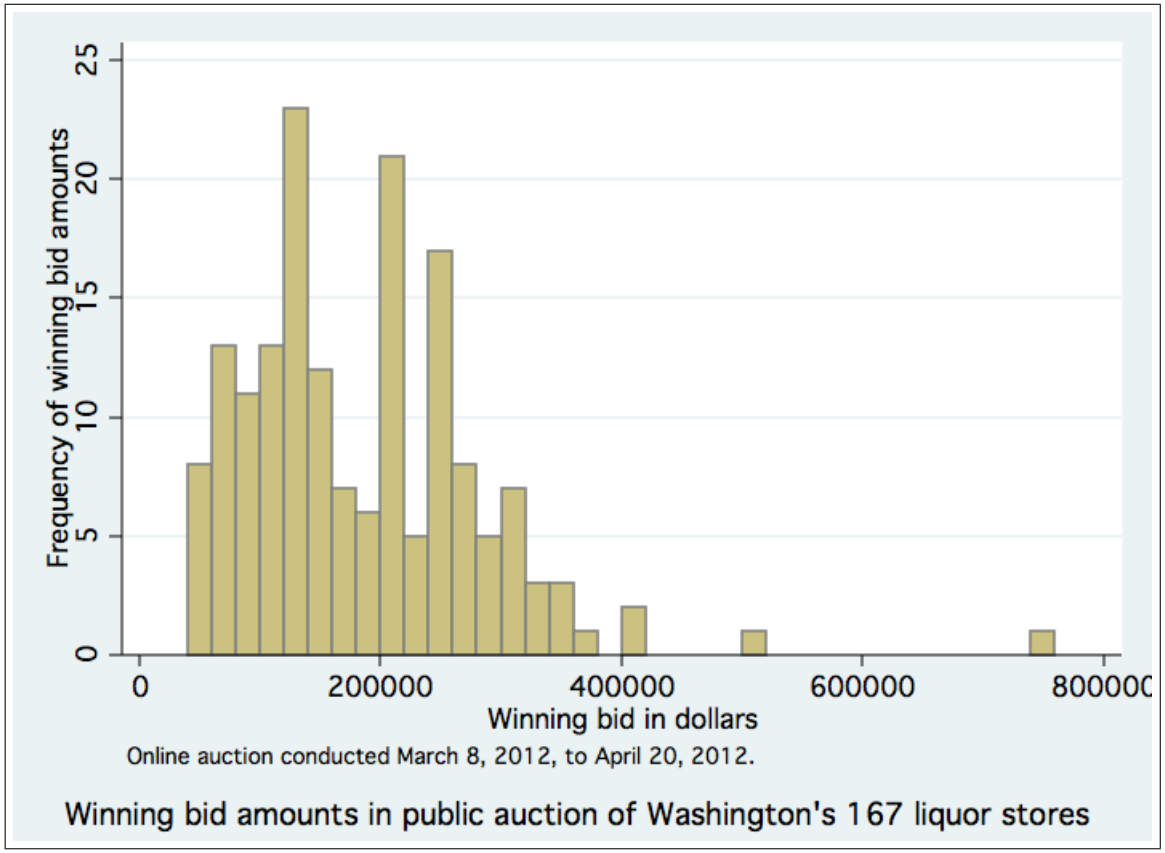


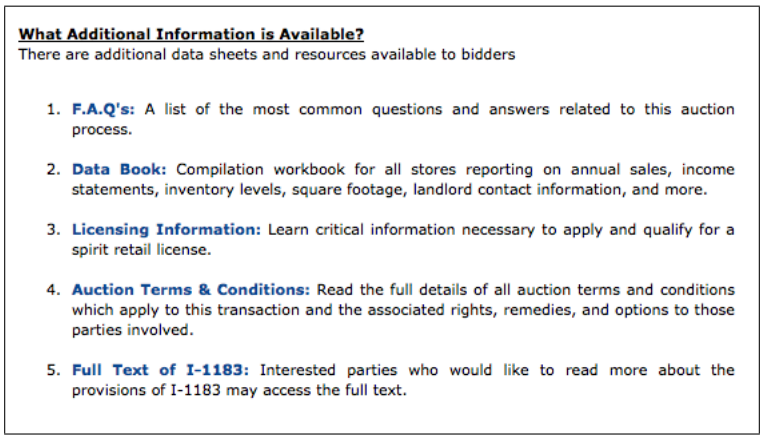
Figure 3.3: Distribution of Winning Bids in Liquor Store Auction

Privatization required Washington state to auction off the retail rights associated with its 167 state stores. An online auction was held from March 8, 2012, to April 20, 2012, and brought $30.75 million in revenue for the state.

Quick Stats

Store #	:	193
Store Established	:	2007
Approx. Cost Base of Current Inventory	:	$168,250
Fiscal Year 2011 Gross Sales	:	$3,211,454
Approx. Square Footage	:	5,664
Typical Staffing Level	:	4-8 Employees
Typical Hours of Operation	:	Mon - Thu 10:00 a.m. to 9:00 p.m. Fri - Sat 10:00 a.m. to 10:00 p.m Sunday - Closed

Figure 3.4: State Auction: Store Info Example



What Additional Information is Available?

There are additional data sheets and resources available to bidders

1. **F.A.Q's:** A list of the most common questions and answers related to this auction process.
2. **Data Book:** Compilation workbook for all stores reporting on annual sales, income statements, inventory levels, square footage, landlord contact information, and more.
3. **Licensing Information:** Learn critical information necessary to apply and qualify for a spirit retail license.
4. **Auction Terms & Conditions:** Read the full details of all auction terms and conditions which apply to this transaction and the associated rights, remedies, and options to those parties involved.
5. **Full Text of I-1183:** Interested parties who would like to read more about the provisions of I-1183 may access the full text.

Figure 3.5: Washington Store Auction: Example of Information Available to Bidders

Table 3.1: Summary Statistics: State Stores and Characteristics of Their Auctions

	Mean	Std. Dev.	Min	Max
Winning bid (in dollars)	183,186.10	96,897.93	49,600	750,100
Winning bid for stores in high population density areas (in dollars)	198,653.90	110,563.3	49,600	750,100
Winning bid for stores in low population density areas (in dollars)	167,532	78,364.44	51,200	401,100
Number of bids	87.59	31.72	29	203
Number of individual bidders	17.15	5.359	7	34
State store located in any border county	0.15	0.36	0	1
State store located in Oregon border county	0.08	0.27	0	1
State store located in Idaho border county	0.07	0.2	0	1
Store sold at May 24, 2012, reauction	0.11	0.31	0	1
Store sold at June 28, 2012, reauction	0.04	0.19	0	1
Number of retracted bids	1.22	1.08	0	5
Auction extended?	0.80	0.40	0	1
Store square footage	5193.27	1002.19	2888	9500
Number of employees	5.51	1.49	2	13
Number of supermarkets in zip code	6.99	3.70	0	21
Number of supercenters in zip code	0.78	0.89	0	3
Number of convenience stores in zip code	2.86	2.16	0	10
Number of gas conveniences in zip code	7.99	5.09	0	22
Number of state liquor stores within 10km	6.509	5.089	0	21
Number of state liquor stores in same zip code	1.329	0.51	1	3
Multiple store win	0.45	0.50	0	1
Average net profits, FY2009 - FY2011 (in dollars)	336,162.50	227,493.50	-110,715.40	1,175,181
Dollar value of inventory (Jan. 2012)	168,889.30	105,223.90	70,359.7	932,535
Taxes paid (in dollars), FYTD 2012	612,231.50	264,297.80	79,371.25	2,169,115
Dollar cost of employee salaries, FYTD 2012	84,098.96	21,365.08	34,256.21	198,851.30
Dollar cost of utilities, FYTD 2012 (electric, gas, garbage)	4329.208	1510.36	267.70	10033.73
Observations	167			

Washington's fiscal year runs from July 1 through June 30 of the following year, and is named for the calendar year in which it ends (e.g., July 1, 2012, through June 30, 2013, is state fiscal year 2013). Fiscal Year-to-Date 2012 (FYTD 2012) covers July 2011 to December 2011. Online auction of all state-run liquor stores was held from March 8, 2012, to April 20, 2012. A high population density area is defined as an area with a population density above the median. A low population density area has a population density below the median. A supercenter or big-box store is a physically large retail establishment, usually part of a chain.

Table 3.2: OLS Regression Estimates on Winning Bids

	(1) Log of winning bid	(2) Log of winning bid	(3) Log of winning bid	(4) Log of winning bid
Number of individual bidders	0.0409***	0.0405***	0.0393***	0.0424***
	(0.0050)	(0.0065)	(0.0061)	(0.0067)
Log of net profits, FY2011	0.3474***	0.3327***	0.3345***	0.3518***
	(0.0574)	(0.0603)	(0.0591)	(0.0564)
Log of total number of total firms in store zip		0.0961**	0.0813*	0.1363**
		(0.0454)	(0.0405)	(0.0647)
Number of retracted bids		0.0338	0.0369	0.0355
		(0.0410)	(0.0403)	(0.0317)
Number of state stores w/in 10km radius		0.0061	0.0101	0.0062
		(0.0065)	(0.0065)	(0.0082)
Log of store square footage		-0.0196	-0.0659	-0.0131
		(0.1530)	(0.1333)	(0.1600)
Log of dollar value of inventory, January 2012		-0.0587	-0.0545	-0.0474
		(0.0763)	(0.0741)	(0.0828)
Population density in logs, quintile 1		-0.0400	-0.0398	0.1257
		(0.2036)	(0.2052)	(0.2026)
Population density in logs, quintile 2		-0.1192	-0.0969	-0.0239
		(0.1988)	(0.1964)	(0.2312)
Population density in logs, quintile 3		-0.2048	-0.2071	-0.1612
		(0.2160)	(0.2233)	(0.2702)
Population density in logs, quintile 4		-0.1927	-0.2062	-0.1511
		(0.2005)	(0.2159)	(0.2479)
Washington store is a *Proximity 1* store			0.3447***	0.4024***
			(0.0956)	(0.1088)
Washington store is a *Proximity 2* store			0.0464	0.0994
			(0.0874)	(0.1094)
Number of supercenters in store zip code				-0.0728**
				(0.0313)
Number of convenience stores in zip code				0.0318**
				(0.0137)
Number of gas conveniences in store zip code				-0.0009
				(0.0114)
Number of religious organizations in store zip code				-0.0109*
				(0.0054)
Number of elementary/secondary schools in store zip code				0.0171
				(0.0157)
Log of mean household income				-0.0642
				(0.0944)
Median age (years)				-0.0115
				(0.0082)
Percent of total African-American population				0.0019
				(0.0038)
Males per 100 females, all ages				-0.0071*
				(0.0035)
Number of colleges in store zip code				-0.0124
				(0.0384)
Number of hospitals in store zip code				-0.0251
				(0.0761)
State store located in any U.S. border county		0.1550**		
		(0.0719)		
Constant	6.8623***	7.2972***	7.7004***	8.3240***
	(0.7540)	(1.5288)	(1.4334)	(2.2669)
Observations	167	167	167	167
R-squared	0.3662	0.4240	0.4400	0.4829

Washington's fiscal year runs from July 1 through June 30 of the following year, and is named for the calendar year in which it ends (e.g., July 1, 2012, through June 30, 2013, is state fiscal year 2013). Online auction of all state-run liquor stores held from March 8, 2012, to April 20, 2012. A border county store is in a county that borders either Oregon or Idaho, but not Canada. A *Proximity 1* store is defined as one of the two closest state liquor stores to 13 WA-OR and 2 WA-ID border crossings. *A Proximity 2* store is defined as any store in a border county that is not a *Proximity 1* store. A supercenter or big-box store is a physically large retail establishment, usually part of a chain. Standard errors clustered at the county level in parentheses. *** p<0.01, ** p<0.05, * p<0.10

Table 3.3: Winning Bids: State Store Reauctions

	Mean	Std. Dev.	Min	Max	Obs.
Original Online Auction					
Winning bids (inclusive)	262477.8	137852.6	65200	750100	18
Winning bids	271541.7	165089.8	65200	750100	12
Winning bids	244350.2	63714.92	136000	305100	6
First Live Reauction					
Winning bids, May 24, 2012, reauction (inclusive)	309444.4	96404.31	165000	550000	18
Winning bids, May 24, 2012, reauction	305416.7	112663.2	165000	550000	12
Winning bids, May 24, 2012, reauction	317500	59644.78	245000	405000	6
Second Live Reauction					
Winning bids, June 28, 2012, reauction	100000	44384.68	70000	180000	6

A total of 167 state stores were originally sold via an online auction that ended April 20, 2012. The winners in 18 of those auctions did not pay their final bid, sacrificing a $1,000 deposit. On May 24, 2012, the state held a live auction for those 18 stores, with a $10,000 deposit. Of the new 18 store winners, 6 did not pay their bid, sacrificing their deposit. On June 28, 2012, the state held another live auction, deposit unknown, for those 6 stores, which all sold.

Bibliography

Scott Adams and Chad Cotti. Drunk driving after the passage of smoking bans in bars. *Journal of Public Economics*, 92(5â6):1288 – 1305, 2008. 36

James Alm and Mikhail I. Melnik. Does online cross-border shopping affect state use tax liabilities? Tulane Economics Working Paper Series 1206, Tulane University, 2012. 4, 5

Marcus Asplund, Richard Friberg, and Frederik Wilander. Demand and distance: Evidence on cross-border shopping. *Journal of Public Economics*, 91(1–2):141–157, 2007. 3, 16

Lawrence M. Ausubel and Peter C. Cramton. Demand reduction and inefficiency in multi-unit auctions. Mimeo, Department of Economics, University of Maryland, 1998. 67

T. Randolph Beard, Paula A. Grant, and Richard P. Saba. Border-crossing sales, tax avoidance, and state tax policies. *Southern Economic Journal*, 64:293–306, 1997. 1, 3, 4, 5, 16

Marianne Bertrand, Esther Duflo, and Sendhil Mullainathan. How much should we trust difference-in-differences estimates? *The Quarterly Journal of Economics*, 119:249–275, 2004. 14

Barry Blecherman and Colin F. Camerer. Is there a winner's curse in the market for

baseball players? evidence from the field. Social science working paper no. 966, California Institute of Technology, 1996.

Heather R. Britt, Bradley P. Carlin, Traci L. Toomey, and Alexander C. Wagenaar. Neighborhood level spatial analysis of the relationship between alcohol outlet density and criminal violence. *Environmental and Ecological Statistics*, 12(4):411–426, 2005. ISSN 1352-8505. 33

Carla Alexia Campbell, Robert A. Hahn, Randy Elder, Robert Brewer, Sajal Chattopadhyay, Jonathan Fielding, Timothy S. Naimi, Traci Toomey, Briana Lawrence, Jennifer Cook Middleton, and Task Force on Community Preventative Services. The effectiveness of limiting alcohol outlet density as a means of reducing excessive alcohol consumption and alcohol-related harms. *American Journal of Preventative Medicine*, 37(6):411–426, 2009. ISSN 556-569. 39

E. C. Capen, R. V. Clapp, and W. M. Campbell. Competitive bidding in high-risk situations. *Journal of Petroleum Technology*, 23:641–653, 1971. 66

Christopher Carpenter. Heavy alcohol use and crime: Evidence from underage drunkâdriving laws. *Journal of Law and Economics*, 50(3):pp. 539–557, 2007. 35, 36

Christopher S. Carpenter. Heavy alcohol use and the commission of nuisance crime: Evidence from underage drunk driving laws. *The American Economic Review*, 95 (2):pp. 267–272, 2005. 35

James Cassing and Richard W. Douglas. Implications of the auction mechanism in baseball's free agent draft. *Southern Economic Journal*, 46:110–121, 1980. 67

Tat Y. Chan, V. Padmanabhan, and P. B. Seetharaman. An econometric model of location and pricing in the gasoline market. *Journal of Marketing Research*, 44(4): 622–635, 2007. 4, 37

Michael Conlin, Stacy Dickert-Conlin, and John Pepper. The effect of alcohol prohibition on illicit-drug-related crimes. *Journal of Law and Economics*, 48(1):215–34, April 2005. 35, 36

Joseph J. Jr. Doyle and Krislert Samphantharak. $2.00 gas!: Studying the effects of a gas tax moratorium. *Journal of Public Economics*, 92:869–884, 2008. 4

William F. Fox. Tax structure and the location of economic activity along state borders. *National Tax Journal*, 39(4):387–401, 1986. 4

Thomas A. Garrett and Thomas L. Marsh. The revenue impacts of cross-border lottery shopping in the presence of spatial autocorrelation. *Regional Science and Urban Economics*, 32:501–519, 2002. 4, 5

Austan Goolsbee. In a world without borders: The impact of taxes on internet commerce. *Quarterly Journal of Economics*, 115:561–576, 2000. 4

Austan Goolsbee, Michael F. Lovenheim, and Joel Slemrod. Playing with fire: Cigarettes, taxes, and competition from the internet. *American Economic Journal: Economic Policy*, 2(1):131–154, 2010. 4

Gautan Gowrisankaran and John Krainer. Entry and pricing in a differentiated products industry: evidence from the atm market. *The RAND Journal of Economics*, 42(1):1–22, 2011. 37

Lawrence A. Greenfeld. Alcohol and crime: An analysis of national data on the prevalence of alcohol involvement in crime. Research report, U.S. Department of Justice, Office of Justice Programs, 1998. 33

Lawrence A. Greenfeld. Impaired judgement: The economic and social consequences of liquor privatization in western canada. Research report, Parkland Institute, Canadian Centre for Policy Alternatives, October 2012. 65

Kwabena Gyimah-Brempong. Alcohol availability and crime: Evidence from census tract data. *Southern Economic Journal*, 68(1):pp. 2–21, 2001. 33, 36, 48

James J. Heckman and Joseph Hotz. Choosing among alternative nonexperimental methods for estimating the impact of social programs: The case of manpower training. *Journal of the American Statistical Association*, 84:862–874, 1989. 13

Kenneth Hendricks and Robert H. Porter. An empirical study of an auction with asymmetric information. *The American Economic Review*, 78:865–883, 1988. 67

Guido W. Imbens and Joshua D. Angrist. Identification and estimation of local average treatment effects. *Econometrica*, 62(2):pp. 467–475, 1994. 40

John H. Kagel and Dan Levin. The winner's curse and public information in common value auctions. *The American Economic Review*, 76(5):894–920, 1986. 66

Brian Knight and Nathan Schiff. Spatial competition and cross-border shopping: Evidence from state lotteries. *American Economic Journal: Economic Policy*, 4: 199–229, 2012. 4

Francis Koh and Terry Walter. A direct test of rock's model of the pricing of unseasoned issues. *Journal of Financial Economics*, 23:251–272, 1989. 67

Steven F. Kreft and Nancy M. Epling. Do border crossings contribute to underage motor-vehicle fatalities? an analysis of michigan border crossings. *The Canadian Journal of Economics*, 40(3):765–781, 2007. 37

James LeSage and Robert Kelley Pace. *Introduction to Spatial Econometrics*. CRC Press/Taylor and Francis Group, London 2009. 11

Leigh L. Linden and Jonah E. Rockoff. There goes the neighborhood? estimates of the impact of crime risk on property values from megan's laws. Working Paper 12253, National Bureau of Economic Research, May 2006. 37

Katherine C. LoPiccalo. Driving to drink: Tax avoidance along the border following liquor privatization. Working paper, University of California, Santa Cruz, June 2014. 39

Mary E. Lovely. Crossing the border: Does commodity tax evasion reduce welfare and can enforcement improve it? *The Canadian Journal of Economics*, 27(1): 157–174, 1994. 1

Michael F. Lovenheim. How far to the border?: The extent and impact of cross-border casual cigarette smuggling. *National Tax Journal*, 58:281–302, 2008. 4, 16

David Merriman. The micro-geography of tax avoidance: Evidence from littered cigarette packs in chicago. *American Economic Journal: Economic Policy*, 2(2): 61–84, 2010. 4

Ricardo Mora and Iliana Reggio. Treatment effect identification using alternative parallel assumptions. Economics Working Papers we1233, Universidad Carlos III, Departamento de EconomÃa, December 2012. 46

Marco Pagnozzi. Are speculators unwelcome in multi-object auctions? *American Economic Journal: Microeconomics*, 2(2):97–131, 2010. 67

William Alex Pridemore and Tony H. Grubesic. Community organization moderates the effect of alcohol outlet density on violence. *The British Journal of Sociology*, 63(4):pp. 680–703, 2012. 36

Richard Roll. The hubris hypothesis of corporate takeovers. *Journal of Business*, 59: 197–216, 1986. 67

Caterina G. Roman, Shannon E. Reid, Avinash S. Bhat, and Bogdan Tereshchenko. Alcohol outlets as attractors of violence and disorder: A closer look at the neigh-

borhood environment. Research report, Urban Institute, Justice Policy Center, 2008. 37

Richard R. Saba, T. Randolph Beard, Robert B. Ekelund Jr., and Rand W. Ressler. The demand for cigarette smuggling. *Economic Inquiry*, 33:189–202, 1995. 4

Timothy P. Schofield and Thomas F. Denson. Alcohol outlet business hours and violent crime in new york state. *Alcohol and Alcoholism*, 2013. 36

Katja Seim. An empirical model of firm entry with endogenous product-type choices. *The RAND Journal of Economics*, 37(3):619–640, 2006. 37, 72

Katja Seim and Joel Waldfogel. Public monopoly and economic efficiency: Evidence from the pennsylvania liquor control board's entry decisions. *American Economic Review*, 103:831–862, 2013. 37

Joel Slemrod and Shlomo Yitzhaki. Tax avoidance, evasion, and administration. *Handbook of Public Economics*, 3(1):1423–1470, 2002. 2

Mark Stehr. The effect of sunday sales bans and excise taxes on drinking and cross-border shopping for alcoholic beverages. *National Tax Association*, 60(1):85–105, 2007. 4, 16

Jeffrey P. Thompson and Shawn M. Rohlin. The effect of state and local sales taxes on employment at state borders. Working paper, Federal Reserve Board, Division of Research and Statistics and Monetary Affairs, 2013. 4

Mehmet S. Tosun and Mark L. Skidmore. Cross-border shopping and the sales tax: An examination of food purchases in west virginia. *The B.E. Journal of Economic Analysis and Policy*, 7(1):1–20, 2007. 4

Nikhil P. Varaiya. The 'winner's curse' hypothesis and corporate takeovers. *Managerial and Decision Economics*, 9:209–219, 1988. 67

John Vickers and George Yarrow. Economic perspectives on privatization. *The Journal of Economic Perspectives*, 5(2):pp. 111–132, 1991. 65

Michael J. Walsh and Jonathan D. Jones. More evidence on the 'border tax' effect: The case of west virginia, 1979-84. *National Tax Journal*, 41(2):261–265, 1988. 4

Dale Willits, Lisa Broidy, Ashley Gonzales, and Kristine Denman. Place and neighborhood crime: Examining the relationship between schools, churches, and alcohol related establishments and crim. Research report, Justice Research and Statistics Association,, March 2011. 36

Catherine D. Wolfram. Strategic bidding in a multiunit auction: an empirical analysis of bids to supply electricity in england and wales. *RAND Journal of Economics*, 29(4):703–725, 1998. 67