What is the Marginal Effect of Entry? Evidence from a Natural Experiment in Liquor Licensure*

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October 11, 2017

Abstract

We leverage a natural experiment in liquor licensure requirements to estimate the causal effect of entry on prices and sales volumes. When Washington state privatized liquor sales in 2012, it required retailer premises exceed 10,000 square feet in order to sell spirits. We exploit this discontinuity to overcome the endogeneity of entry to local demand conditions and firm unobservables. We find a 27 percentage point jump in entry at the licensure threshold and an 60% decline in entry for independent stores neighboring marginally-eligible potential entrants. While entry does not affect prices for individual products, we find that an additional entrant boosts liquor consumption by 30% and product variety by 20%. However, these effects are limited to duopoly and triopoly markets, indicating the size-based entry restriction is a blunt instrument for reducing liquor externalities across the state.

1 Introduction

This paper examines the competitive effects of firm entry by leveraging a natural experiment induced by Washington State's 2012 deregulation of liquor sales. The interplay between entry and competition is central to policy-makers and correspondingly, has received considerable attention among Industrial Organization economists. A lengthy theoretical literature investigates how the number of competitors in a market affects equilibrium prices and quantities (dating back to Bertrand and Cournot), but also differentiation

*This research was partially funded by the Center for the Study of Industrial Organization at Northwestern University, the George and Obie B. Schultz Dissertation Grant, and the Lynde and Harry Bradley Foundation. Matias Escudero and Mathew Li provided excellent research assistance. The authors would like to thank Alberto Cavallo and Kathleen Hagerty for their help in procuring access to data, as well as the Washington State Liquor and Cannabis Board and the Kilts Center for Marketing at the University of Chicago Booth School of Business. We thank seminar participants at the Chicago IO Fest, the CSIO-IDEI conference, the IIOC, Indiana University, the University of Pennsylvania, Yale University, and the WCAI-Santiago conference. Special thanks to Glenn Ellison, Natalia Fabra, Lorenzo Magnolfi, Robert Porter, Mar Reguant, Mathias Reinhold, Nancy Rose, and Paulo Somaini. The usual disclaimer applies.

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in other characteristics, such as location and quality (beginning with Hotelling [1929] and Salop [1979]). Empirical research on this topic has recognized the dependence of entry decisions on unobservable (to the econometrician) market and firm characteristics, and a rich literature that employs structural econometric methods has emerged to deal with this issue (Bresnahan and Reiss [1991], Berry [1992], Jia Barwick [2008], Ciliberto and Tamer [2009], Magnolfi and Roncoroni [2017] among others). In contrast to this literature, we exploit a natural experiment to identify reduced-form causal effects of entry. Coupled with detailed data about the market outcomes most relevant to consumer welfare, such as prices and quantities, this strategy delivers a clearer interpretation of the identification assumptions of the model and permits examination of a wider array of mechanisms than would be tractable in a structural model.

Our RD approach utilizes a licensure threshold in Washington's newly private liquor market. Through May 2012, the Washington State Liquor Control Board (WSLCB)[1] held a monopoly on spirit sales, overseeing approximately 360 outlets across the state. Only these state stores could sell alcoholic beverages above 24% ABV.[2] This regulation, introduced in the wake of Prohibition, was similar to those of fourteen other "Alcohol Beverage Control" (ABC) states.[3] In November 2011, Washington became the first, and so far sole, ABC state to privatize sales. In the transition to the new regime, state stores were sold at auction or closed, and private retailers were allowed to enter the market so long as their premises exceeded 10,000ft^2. Our identification argument is that existing stores just above the size threshold were otherwise similar to stores just below, except in their license eligibility. We find a 27 percentage point jump in licensure at the threshold for all stores, and an 86 percentage point effect for chain stores. Any differences in the behavior of rival firms in the markets where these stores compete can therefore be attributed to this additional entry.

A first finding is that retailer entry decisions are interdependent, but only for independent (non-chain) stores facing nearby rivals. Independent grocers 0.3 miles or less from a marginally license-eligible (just above the threshold) competitor are 60% less less likely to sell spirits than those a similar distance to a marginally ineligible firm (just below). This effect disappears for neighbors further than half a mile away. In contrast, chain stores are overwhelmingly likely to sell liquor, regardless of their rivals' eligibility. While IO economists often define markets at the city-level, our results indicate that competition is much more local for goods like liquor. Mistakenly aggregating markets is particular problematic for policy-makers, as it tends to understate industry concentration.

A second result is that entry is market-expanding, but only in markets with relatively few other competitors. Entry has no effect in markets with an above-median number of license-eligible firms; in these markets,

[1] Now Washington State Liquor and Cannabis Board.

[2] As per the guidelines on the Washington State Department of Revenue website: `http://dor.wa.gov/Content/GetAFormOrPublication/PublicationBySubject/TaxTopics/SpiritsSales/`.

[3] Alabama, Idaho, Maine, Maryland, Mississippi, Montana, New Hampshire, North Carolina, Ohio, Oregon, Pennsylvania, Utah, Vermont, and Virginia.

an entrant constitutes a sixth liquor outlet on average. In contrast, entry leads to higher liquor consumption in duopoly and triopoly markets. In these markets, households purchase 30% more liquor (by volume) when there is an additional liquor outlet in their home zip code. The square footage policy therefore appears successful in reducing alcohol consumption, an explicit regulatory goal of this entry restriction. But the size threshold is a blunt instrument, effective only in areas with fewer competitors, which tend to be poorer and less populated.

Finally, we use UPC level prices and quantities from Nielsen's Consumer Panel dataset to analyze the effects of entry on the set of product offerings. We find that in concentrated markets entry has no effect on prices of particular products, but rather affects the set of products being offered. In particular, firm entry leads to an overall expansion of the product space, as well as increases in proof and average quality. This set of results ties our paper to the empirical product variety literature (Berry and Waldfogel [2001], McManus [2007], Sweeting [2010, 2013], Fan [2013], Eizenberg [2014], Wollmann), providing additional evidence for how competition shifts product offerings in multi-product retail markets. Considering the the sensitivity of theoretical predictions of entry effects in competitive second degree price discrimination markets to assumptions regarding unknown quantities such as the correlation between vertical and horizontal unobserved product preferences (Stole [2007]), the fact that we can recover the effects of entry on product variety from the reduced form is encouraging. Our results are most similar to the theoretical predictions of Champsaur and Rochet [1989], as in their model entry leads to an expansion of product variety, and to Fabra and Montero [2017], who extend Champsaur and Rochet [1989] by adding search frictions and find the potential for some overlap of product lines between competing duopolists.

We also build on a body of work investigating the motives and efficiency of state-level liquor regulations across the United States. This work includes Seim and Waldfogel [2013], who focus on entry explicitly; they find that the state-run monopoly in Pennsylvania operates relatively few stores compared to a profit-maximizing monopolist or a total welfare-maximizing state planner. Miravete et al. [2014], Conlon and Rao [2015a] and Conlon and Rao [2015b] all compare different state price and tax systems. In contrast to these papers, our chief comparison is across privatized markets, rather than between private and state-monopoly systems. In that sense, our work is most similar to Milyo and Waldfogel [1999], who study how advertising affects price competition in liquor markets. We see this work as providing evidence from a program evaluation perspective of the effectiveness of one commonly used regulation, licensure restrictions, in shifting liquor consumption. Finally, this paper contributes also to a nascent literature exploiting Washington's deregulation: Seo [2016] analyzes how privatization increases the willingness to pay for liquor by increasing convenience, while Chamberlain [2014] analyzes the effects of increased liquor availability on crime.

The rest of the paper proceeds as follows: section 2 introduces our data sources, section 3 describes our empirical strategy and results, and section 4 concludes.

2 Data

2.1 Data on Beer, Wine and Liquor Licensure

Our data on beer, wine and liquor licensure comes from the Washington State Liquor Control Board's (WSLCB) list of off-premise licensees from January 2013, six months after liberalization. These retailers can sell beer, wine and/or liquor for consumption outside of their store. For each alcohol license, this list contains the trade name, license number, store address and phone number, and dates for the following events: commence of business operations, liquor license application submission, license issue, license expiration, and (potential) license termination. We therefore observe all liquor licensees through January 2013, including former licensees that already ceased operating.

Our analysis focuses on the set of beer and wine retailers that began operating before 2012. These licensees compose the set of firms for whom we have a natural experiment on entry into spirits markets, as these firms plausibly did not set square footage in response to the licensure threshold in Referendum I-1193. Our identification argument, presented fully in section 3, argues that stores sized just above the 10,000ft^2 threshold are comparable to those just below. We therefore interpret any discontinuities in outcomes across this threshold as causal effects (for example, of license-eligibility on entry). In contrast, after 2011, the licensure threshold induces a discontinuity in the payoff to square footage for new beer and wine establishments. A new wine retailer who chooses 9,999ft^2 is different from another who enters at $10,000$ft^2, because the former found it profitable to enter at a format that commits it to never sell liquor (barring costly expansion). From this difference in revealed preference, we might suspect other differences between those retailers sized just above compared to those sized just below 10,000ft^2. Essentially, we have no purchase on a control group for any establishments built explicitly after the licensure threshold is introduced, even when they are near the threshold.

Our focus on existing beer and wine resellers captures the lion's share of entrants into Washington's nascent spirit market. 4,978 out of 5,569 alcohol retailers in January 2013 were selling alcohol prior to 2012 (as private retailers selling beer or wine or as state liquor stores). Of these, 1,075 are licensed to sell liquor by 2013. While 570 new alcohol retailers enter during 2012, a mere 57 sell spirits. That is, only 5.3% of spirits retailers fall outside of our potential entry sample. Table 1 presents summary statistics for licensees over time. The highly complementary nature of beer, wine and liquor sales, and the low levels of realized entry by stores that were not selling any alcohol prior to 2012 makes us confident that the set of stores that we consider captures the majority of potential entrants.

Summary Statistics for Beer, Wine and Liquor Licensure		
Alcohol-licensed retailers, prior to 2012	4,978	
Liquor-licensed	1,075	21.60%
Beer and wine licensed	4,977	99.98%
Chain stores	2,098	42.15%
Entrants in 2013	570	
Liquor-licensed	57	10.00%
Beer and wine licensed	558	97.89%
Chain stores	130	22.81%
Chain stores licensed prior to 2012	2,098	
Beer and wine licensed	2,098	100.00%
Liquor-licensed	924	44.04%

Table 1: Summary Statistics for WSLCB Stores

An important characteristic of liquor retailers is their chain identity. Most chains are either fully spirits licensed or completely out of the spirits market, as Figure 1 shows. Chains are identified in our sample if there are at least 2 outlets with the same store name in different locations. The smallest chain has 2 locations, the median chain has 12 locations, and the largest chain (7-Eleven) has 242 stores. Figure A.1 in Appendix A reports chain names and sizes (in number of stores) for all chains with 5 or more stores. Overall, there are 2,098 chain stores in the sample, and 44% of them obtain a liquor license. Chains that are always out of the liquor market, such as gas stations and convenience stores, typically feature formats that are quite small. In contrast, large format retailers, like Costco and Safeway, are always in. Variation in licensure is highest for chains of small grocery stores, like Trader Joe's. In section 3, we document that chain stores are close to perfect compliers, as the probability they sell liquor jumps from nearly 0 to 1 at the licensure threshold. In what follows, we will use the term "independent" stores to refer to non-chain stores.

2.2 Data on Square Footage

We obtain data on store square footage using Google Map Developers' Area Calculator.[4] This application overlays a tool for calculating square footage on top of Google Maps' satellite images. Figure C.1 in Appendix C presents an example of how we use the application to calculate area for a particular store. We find this tool delivers a more accurate square footage match to the WSLCB dataset than CoreLogic (a dataset based on records from county assessors' offices) or TDLinx (a proprietary dataset maintained by Nielsen). To obtain data for all 4,978 stores in our sample, in May of 2017 we hired Amazon Mechanical Turk (MTurk) workers to measure each stores' square footage. Absent MTurk, gathering the square footage data would have been prohibitively expensive in terms of time. We present details of our procedure in Appendix C in the hopes it will be useful to other research requiring extensive data-gathering tasks.

To ensure data quality, we hire multiple workers to calculate square footage for each store and use the

[4]https://www.mapdevelopers.com/area_finder.php

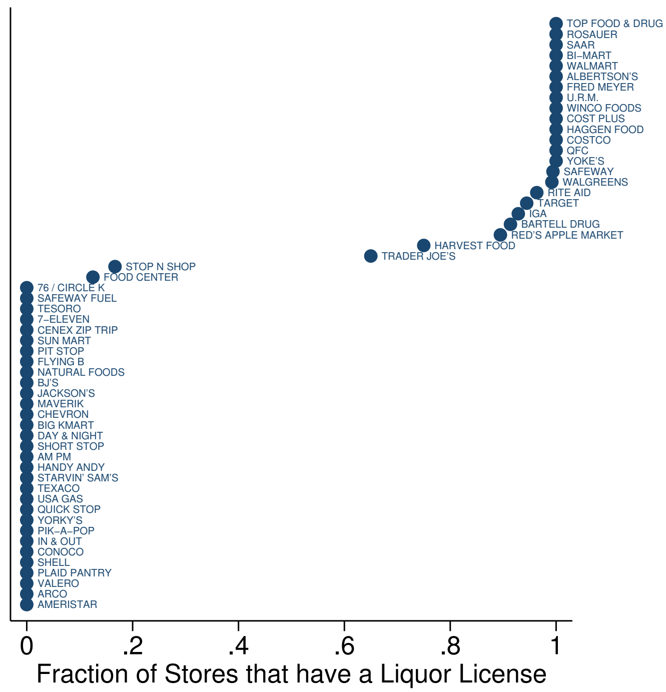
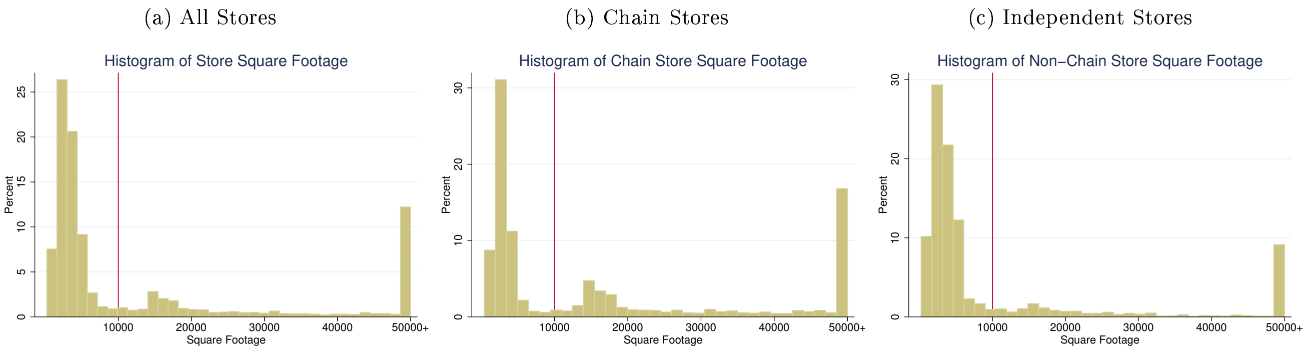


Figure 1: Chain Licensure

average across their reports. After collecting data from MTurk, we also double-checked each store with square footage recorded as 5,000-15,000ft^2, to ensure accurate responses around the licensure threshold. Despite these checks, some measurement error remains: 36 out of the 3,292 stores we code to be below 10,000ft^2 are licensed to sell liquor. Based on our conversations with the WSLCB, we are confident that these stores are in reality larger than 10,000ft^2: the law is upheld. We choose not to drop these stores or to re-code their square footage, as that would induce a correlation between measurement error and the outcome. So long as this measurement error is classical, then it should not bias the regression discontinuity design. If anything, in its presence our chief concern becomes whether we have power to identify a discontinuity in entry at the licensure threshold.

Our MTurk dataset is missing information for 6% of our sample (303 firms). In most cases, these constitute stores that have closed in the intervening years between 2012 and 2017, so that it is impossible in 2017 to accurately determine their previous location using Google Maps. The probability we obtain square footage is therefore a function of survival to 2017. Indeed, we find that match rates are not balanced across store observables that co-vary with survival: the match rate for former state liquor stores is 88%, while the match rate excluding these stores is 95%; the match rate for chain stores is 99%, while the match rate for non-chains is 93%. This instance of measurement error is not likely to be classical; if selling spirits is profitable, then survival should discontinuously increase at the licensure threshold. In that case, our discontinuity estimates

Figure 2: Histogram of Store Sizes



are conservative, as we are missing more stores below the threshold (that do not sell liquor) than stores above it. However, the low incidence of missing stores allays our concerns that measurement error is a major concern.

Figure 2a presents a histogram of retailer size in our final dataset. The distribution is heavily skewed towards small formats, consistent with the large number of gas stations and convenience stores that sell beer and wine. 73% of our sample consists of stores below 10,000ft^2, which are not license-eligible. Figures 2b and 2c present the distribution for chain and non-chain stores, respectively. Chain stores are larger, but the majority of stores (54.6%) are still below the licensure threshold.

2.3 Data on Liquor Prices and Quantities

Our data on liquor sales comes from the 2010-2015 Nielsen Consumer Panel Dataset hosted by the Kilts Center. The data comprises all transactions for a revolving panel of households in the United States, including 2,700 households in Washington State. Our goal is to measure whether liquor sales vary with local market characteristics, so it is important that this data includes prices and quantities of liquor purchases at the product level (by UPC), but also panelist zip codes.

Our identification strategy, discussed in depth in section 3, compares outcomes in markets with stores below and above the liquor licensure size threshold. Our analysis therefore focuses on panelists who reside in zip codes with at least one store sized near the threshold, i.e. those between 5,000-15,000ft^2. This includes some 302 zip codes and 2,211 households. 523 of these households purchase hard liquor at least once during the panel. Table 2 displays summary statistics for the relevant set of panelists, including the liquor selling configuration in their home zip code. As an example, only 15% live in a zip code that had a WSLCB store under the state monopoly, but these panelists average nearly 3 liquor-selling stores within their zip once sales are deregulated. Consistent with national alcohol consumption trends, liquor purchasing is highly skewed. The median liquor-buying household buys 1.6 liters annually, while the 90th percentile buys 17 liters. Nielsen groups products into modules, but we restrict attention to the set of these that correspond to the WSLCB definition of liquor. See Appendix B for details on sample construction.

Panelist Summary Statistics					
		Mean	SD	Min	Max
WSLCB Stores before 06/2012		0.13	0.33	0	1
Number of Beer & Wine Licensees	Operating in 2011	20.88	11.29	1	51
	Selling Liquor in 2012	2.95	3.24	0	11
	5k - 15k ft^2	2.63	1.82	1	11
	10k - 15k ft^2	0.93	1.08	0	7
Monthly Liquor	Purchase Probability	0.08	0.27	0	1
	Total Expenditures ($)	7.07	49.50	0	1430.98

Notes: Sample is 2,211 panelists who reside in a Washington State zip code with at least one store sized 5,000-15,000 ft^2 in 2010-2015.

Table 2: Panelist Summary Statistics

Nielsen selects households to resemble the demographics of the overall United States population, each census-region, and several major markets (including Seattle). These demographics include race, household size, income, and head-of-household age. Table 3 includes a side-by-side display of Washington panelists and state residents. The two groups have a similar proportion of Whites, but panelists tend to be more educated (a higher fraction have earned a bachelors or beyond). The income distribution for panelists is also more flat, as a lower proportion of panelists earn less than \$25,000 or more than \$100,000. Our analysis therefore speaks more to the median household, rather than to the richest or poorest Washington denizens.

While Nielsen reveals panelists' home zip codes, the identities of the retailers where they shop are obscured to preserve anonymity. We learn only the three-digit zip codes of retail outlets, and these are sometimes imputed from the panelists' home zip codes. Our principal analysis therefore analyzes how the market configuration in panelists' home zip codes affects their purchasing behavior.

Demographics of Panelists vs State Population		
Demographic	Consumer Panel	State
% White	85.1	82.5
% Income		
< 25k	17.5	20.3
> 100k	14.2	24.4
% Education		
< HS	4.1	10.6
HS	20.5	24.0
BA +	42.4	29.5
Notes: Data on Washington State population comes from the 2010 census. Education is for male heads of household from the Consumer Panel.		

Table 3: Demographics of Panelists versus Population for Washington State

3 Results

3.1 License Eligibility and Entry

3.1.1 Empirical Strategy

In this section, we describe our estimation strategy built on the discontinuity of license eligibility in store size at 10,000ft^2. We first establish that the discontinuity in eligibility generates a discontinuity of entry. That is, we show that stores just above 10,000ft^2 are more likely to obtain a liquor license than stores just below. If stores slightly larger than 10,000ft^2 do not find it profitable to sell liquor, then there would be no discontinuity and the threshold would not give us purchase to study the effects of entry. Establishments might not enter for a myriad reasons: deterrence by larger firms, low bargaining power in upstream markets and correspondingly high acquisition costs of liquor, a higher opportunity cost of space, among others. If this the licensure threshold is not binding, we would not expect it to affect market outcomes.

Our basic model for estimating the effect of eligibility on entry is:

$$\begin{aligned} 1\left[\text{Has Liquor License}_s\right] &= \alpha_0 + \alpha_1 \cdot 1\left[SqFt_s \geq 10,000\right]_s + \alpha_2 \cdot SqFt_s \\ &\quad + \alpha_3 \cdot 1\left[SqFt_s \geq 10,000\right]_s \cdot SqFt_s + \epsilon_s \end{aligned} \tag{1}$$

where $1\left[\text{Has Liquor License}_s\right]$ is a liquor licensure indicator variable for store s and $SqFt_s$ is the square footage of store s's. We are mainly interested in the coefficient on $1\left[SqFt_s \geq 10,000\right]_s$, an indicator variable for square footage greater than 10,000ft^2, which captures any change in likelihood of licensure at that threshold. The exclusion restriction that permits a causal interpretation of the discontinuity estimates is

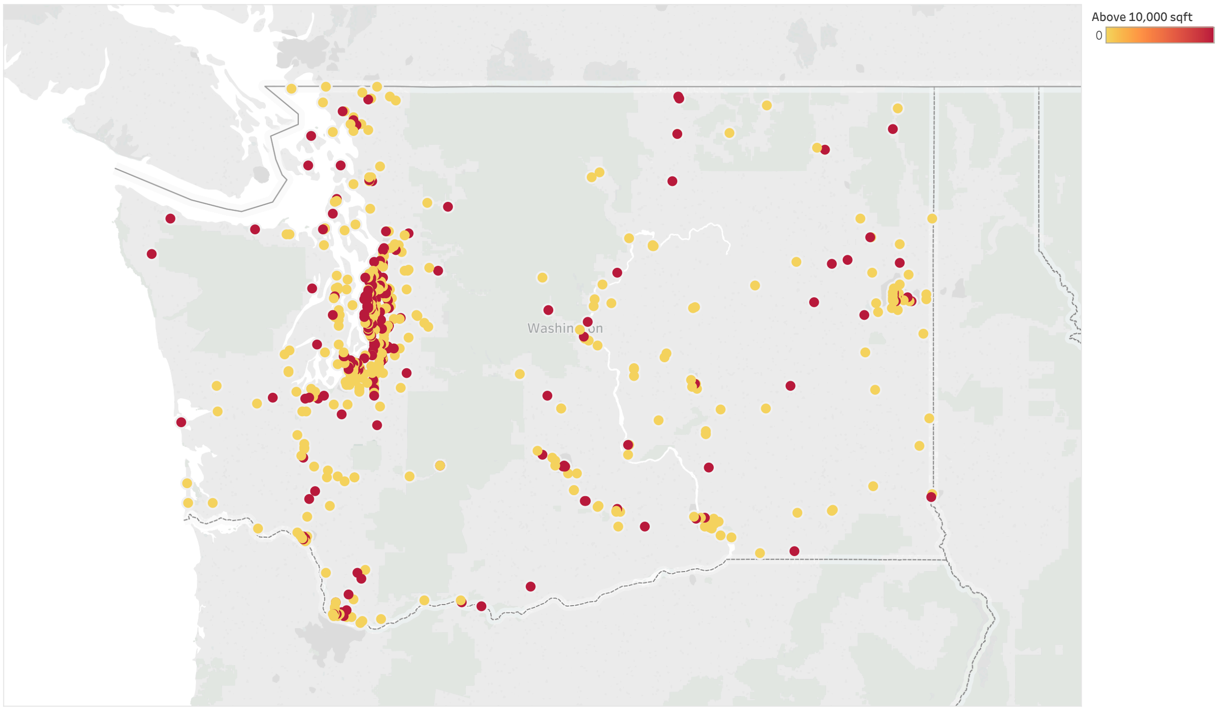


Figure 3: Map of Beer/Wine Licensed Retailers Sized 5,000 - 15,000ft^2

that stores with square footage close to 10,000ft^2, but on different sides of the cutoff, are otherwise identical in expectation. We focus on stores alcohol retailers established before Referendum I-1193 introduced the 10,000ft^2 threshold rule, precisely because for these stores near the 10,000 ft^2 cutoff, being above or below this threshold should be as good as random.

One concern is that establishments might game the licensure threshold, for example by building an annex. This behavior would create a selection problem, as only stores that enjoy profits from liquor sales would undertake an expansion. To test for manipulation of square footage, we examine whether there is bunching above the threshold. Table 6 presents the results of a McCrary test (McCrary [2008]), which tests manipulation of the running variable around the threshold. For all specifications, we can reject the hypothesis that there is a discontinuity in the density of store square footage at the 10,000ft^2 licensure cutoff at the 5% level.

3.1.2 Covariate Balance

We also analyze whether store characteristics are balanced around the licensure threshold. If stores just below 10,000ft^2 differed from stores just above on dimensions correlated with liquor demand, then these stores would serve as a poor control group. We therefore estimate (1) using store covariates from the WSLCB as outcome variables to look for discrepancies, and present results in table 4. As an example, the first row reports the discontinuity at 10,000ft^2 in the probability that we can geolocate a store using the address provided by the WSLCB. We find no significant difference at conventional levels for geolocating, for store latitude and longitude (conditional on geocoding), license type prior to privatization (e.g. beer or wine), and the license issue date. We do find a significant discontinuity at the cutoff in the probability that a store belongs to a chain: those above 10,000ft^2 are 40 percentage points more likely to be chain stores. We therefore condition on chain status in one of our main specifications. The last four rows table 4 display results on the network of rival stores, a test for similarity of market configuration prior to privatization. We measure market configuration in several ways. First, we identify each store's five nearest competitors, and count the number sized 5,000-15,000ft^2 (the bandwidth of interest) There is no statistically significant difference in this quantity across the discontinuity. Second, we count the number of rivals within 0.5 miles of the store in the bandwidth. Here we find a significant difference at the cutoff for chain stores. However, stores above the cutoff have more rivals, which should reduce entry. That is, if there is a systematic difference in the number of competitors, our estimate of the causal effect of licensure eligibility on liquor licensure is likely to be biased downward. Since the estimate for chain stores is already close to 1, this does not appear a significant issue. As a robustness check, we compare the number of rivals within 0.5 miles of the store that have square footage below 5,000ft^2 and above 15,000ft^2 (the final two rows of table 4). This comparison aims to study whether there are other systematic differences in rival configuration across the licensure threshold. We cannot reject the null hypothesis that configurations are the same across the threshold, further relieving our concerns.

We have shown that the distribution of stores around the threshold is smooth, suggesting that retailers do not target the 10,000ft^2 requirement. It is possible, however, that small stores undergo large-scale expansions in response to I-1193, which put them far above the threshold. If renovation has large fixed costs and small marginal costs of square footage, then large expansions might be more profitable than small ones. Ideally, we would estimate an intent-to-treat effect using square footage measurements before liberalization, sidestepping this issue. Since our primary square footage data is from 2017, we instead leverage an auxiliary dataset, CoreLogic, to explore retailer renovation in Washington state.

We use CoreLogic to test whether retailers just below 10,000ft^2 are more likely to renovate between 2012-2015 than those just above. CoreLogic pools County Assessor tax records for each parcel of land registered in the United States as of May 2015. It contains square footage, year of construction, and year of initial assessment with current configuration. We determine a store has undergone a renovation if this initial assessment year is later than the year of construction.[5] We restrict attention to stores likely to sell beer or wine using Property Indicator Codes, Land Use Codes, and Building Codes, three variables

[5]Unfortunately, we cannot accurately match CoreLogic and WSLCB records, precluding use of CoreLogic size measures in a regression on licensure (our main specification). We attempted a match based on trade names, addresses, latitude and longitude, but had little success.

Covariate Balance of Store Characteristics Around the Licensure Threshold			
	(1)	(2)	(3)
	All Stores	Independent Stores	Chains
Is Geolocated	-0.050	-0.005	-0.008
	(0.088)	(0.103)	(0.150)
Latitude	0.228	0.517*	0.259
	(0.178)	(0.273)	(0.507)
Longitude	0.343	0.437	0.485
	(0.705)	(0.909)	(0.601)
Has Beer/Wine Specialty Shop License	0.031	0.024	-0.007
	(0.038)	(0.036)	(0.007)
Has Beer/Wine Grocery Store License	-0.117	-0.243	-0.003
	(0.093)	(0.162)	(0.004)
Has Wine Retailer/Reseller License	0.098	0.061	0.170
	(0.071)	(0.052)	(0.117)
Is a Chain Store	0.392*		
	(0.211)		
Earliest Alcohol Licensure Date (Days)	313.7	224.6	1,351.6
	(561.7)	(638.8)	(1674.5)
Among 5 Closest Competitors, Number Sized 5,000-15,000ft^2	-0.159	-0.245	0.244
	(0.224)	(0.288)	(0.218)
Number of Rivals within 0.5 Miles Sized 5,000-15,000ft^2	0.985*	-0.211	2.458**
	(0.580)	(0.455)	(1.114)
Number of Rivals within 0.5 Miles above 15,000ft^2	-0.048	-0.083	-1.728
	(0.856)	(0.418)	(1.322)
Number of Rivals within 0.5 Miles below 5,000ft^2	1.278	-0.792	5.381
	(1.385)	(0.996)	(3.275)

Notes: This table presents results of a local polynomial regression-discontinuity design model with robust bias-corrected confidence intervals and an optimal bandwidth, estimated in Stata via the "rdrobust" command using techniques in Calonico, Cattaneo and Titiunik (2014), Calonico, Cattaneo and Farrell (2016) and Calonico, Cattaneo, Farrell and Titiunik (2016). The dependent variable is different store characteristics. Column 1 reports the discontinuity estimate for each variable for all stores in our sample. Column 2 considers only stores in cities where there is more than one alcohol-selling outlet. Column 3 considers only non-chain stores, while column 4 only considers chain stores and Column 5 considers only chain stores for chains with 10 stores or more. Robust, bias-corrected standard errors in parentheses. Coefficients are significant at the * 10%, ** 5% and *** 1% levels.

Table 4: Covariate Balance Across Licensure Threshold

created by CoreLogic to describe the economic activity on a given parcel. Our final sample contains 18,224 commercial parcels in the state of Washington built prior to 2012, excluding those with economic activity inconsistent with retail alcohol sales. For example, we exclude commercial parcels marked as "Hotel/Motel" or "Hospital." See Appendix B for sample construction details, and table B.2, subsample "All Potential Alcohol Retail Records", for summary statistics. While roughly 37% of these parcels have been renovated at least once, only 0.04% have been renovated after 2011. It therefore seems unlikely that selective renovation of stores below 10,000ft^2 is important in this setting.

For completeness, we run a battery of other tests using the CoreLogic data. Panel B of table B.2 reports estimates for discontinuities in other variables. We do not find a significant change in year built, year renovated (conditional on renovation), or renovation after 2011. We repeat this exercise for smaller CoreLogic subsamples for which we assign a high probability of carrying alcohol, where the incentive to renovate is strongest. Again, the overall probability of renovating post-2012 is tiny, and we cannot detect a discontinuity at the licensure threshold. The final row of this table reports the estimate from a McCrary test for bunching (in the number of stores) at 10,000ft^2. Again, we find no evidence of this behavior. Overall, the information from this auxiliary dataset leaves us confident that selective renovation of stores below the licensure threshold does not come into play in the Washington context and our regression discontinuity

Covariate Balance of Store Characteristics Around the Licensure Threshold – Corelogic Sample			
	(1)	(2)	(3)
Panel A: Descriptive Statistics			
	All Potential Alcohol Retail Records	Selected Land Use Codes	Selected Building Codes
Number of Records	18,224	1,193	1,423
Square Footage, 10th Percentile	960	1,641	1,650
Square Footage, 50th Percentile	3,749	4,151	3,438
Square Footage, 90th Percentile	19,664	46,821	51,300
Year Built, 10th Percentile	1923	1929	1945
Year Built, 50th Percentile	1974	1974	1980
Year Built, 90th Percentile	2003	2000	2001
Percentage Ever Renovated	37.04%	57.67%	49.05%
Year Renovated, 10th Percentile	1964	1964	1970
Year Renovated, 50th Percentile	1982	1985	1988
Year Renovated, 90th Percentile	1997	2000	2000
Percentage Renovated Post 2012	0.04%	0.08%	0.00%
% Renovated Post 2012, If Ever Renovated	0.10%	0.15%	0.00%
Panel B: Discontinuity at Licensure Cutoff			
	All Potential Alcohol Retail Records	Selected Land Use Codes	Selected Building Codes
Year Built	-0.559	-35.309**	-13.309
	(3.119)	(16.441)	(13.602)
Ever Renovated	0.096**	0.307	-0.204
	(0.046)	(0.221)	(0.218)
Year Renovated, If Ever Renovated	1.073	-5.280	-2.794
	(1.918)	(7.923)	(6.809)
Renovated Post 2012	-0.001	0.010	-
	(0.001)	(0.010)	-
Renovated Post 2012, If Ever Renovated	0.000	-	-
	(0.000)	-	
McCrary Test P-Value	0.30	0.48	0.26

Notes: This table presents results of a local polynomial regression-discontinuity design model with robust bias-corrected confidence intervals and an optimal bandwidth, estimated in Stata via the "rdrobust" command using techniques in Calonico, Cattaneo and Titiunik (2014), Calonico, Cattaneo and Farrell (2016) and Calonico, Cattaneo, Farrell and Titiunik (2016). The relevant sample is the set of Corelogic property tax records of potential alcohol retailers, as defined in Appendix XX. Column 2 further restricts the sample to selected Corelogic "Land Use Codes" that are associated with retail sale of food (supermarket/food store/wholesale). Column 3 further restricts the sample to selected Corelogic "Building Codes" that are associated with retail sale of food (market/supermarket/food stand/convenience market, convenience store). For each sample, the dependent variable is different store record characteristics. More details regarding variable definitions and sample construction are in Appendix XX. Robust, bias-corrected standard errors in parentheses.
Coefficients are significant at the * 10%, ** 5% and *** 1% levels.

Table 5: Corelogic Covariate Balance

design consistently covers the causal effect of license eligibility on licensure.

3.1.3 Results on Entry Probabilities

We present estimates of the licensure discontinuity at 10,000ft^2 in table 6, results of a local linear regression discontinuity design model with robust, bias-corrected standard errors and an optimal bandwidth as in Calonico et al. [2014].[6] There is a 27 percentage point jump in the probability of licensure at 10,000ft^2 (column 1). This estimate corresponds to figure 4a, a plot of the predicted licensure probabilities for stores in the bandwidth.[7] The regulation binds for roughly 30% of stores near the threshold, but we learn that selling liquor is not sufficiently profitable so as to warrant entry by all eligible firms. The probability of licensure above the threshold is approximately 40%, significantly below one. This leaves room for strategic

[6] Estimated in Stata using the "rdrobust" command (Calonico et al. [2017]).

[7] We note that the likelihood of licensure is approximately 10 percentage point for stores just below, indicating that some measurement error in square footage remains (as these retailers must, in fact, be larger than 10,000ft^2).

RD Estimates of the Effect of Licensure on Entry				
	(1)	(2)	(3)	(4)
	All Stores	Independent Stores	Chain Stores	Large Chains (10+ Stores)
Licensure Discontinuity	0.26**	-0.03	0.86***	0.88***
	(0.112)	(0.133)	(0.153)	(0.160)
Observations	4605	2599	2006	1870
McCrary Test P-Value	0.379	0.545	0.981	0.984

Notes: This table presents results of a local polynomial regression-discontinuity design model with robust bias-corrected confidence intervals and an optimal bandwidth, estimated in Stata via the "rdrobust" command using techniques in Calonico, Cattaneo and Titiunik (2014), Calonico, Cattaneo and Farrell (2016) and Calonico, Cattaneo, Farrell and Titiunik (2016). Licensure Discontinuity denotes the estimated change in licensure probability at the 10,000 square foot cutoff. Column 1 reports this estimated quantity for all stores in our sample. Column 2 considers only stores in cities where there is more than one alcohol-selling outlet. Column 3 considers only non-chain stores, while column 4 only considers chain stores and Column 5 considers only chain stores for chains with 10 stores or more. The row labelled "McCrary Test p-value" presents the p-value of a McCrary test of the density of the running value around the 10,000 square foot cutoff. Robust, bias-corrected standard errors in parentheses. Coefficients are significant at the * 10%, ** 5% and *** 1% levels.

Table 6: Regression Discontinuity Estimates of the Effect of License eligibility on Entry

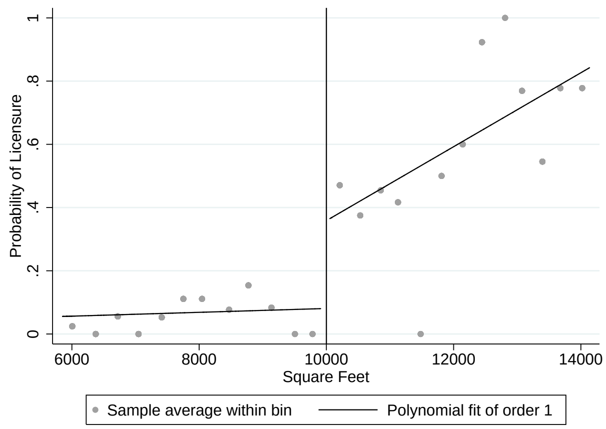
considerations, as competitors may engage in entry deterrence, an issue we consider below. It also suggests that heterogeneity in market and store characteristics might interact with entry decisions and the role of the licensure threshold.

We split the sample by chain affiliation and report results in columns 3 and 4 of table 6. We expect the behavior of chain and independent stores to be different, as a portion of the fixed costs of spirits sales are likely to be sunk for chain stores. As an example, a chain with large stores that must already negotiate with suppliers and establish a distribution network faces different costs in selling spirits at smaller retail locations. Indeed, column 4 shows that the discontinuity for chain stores is 86 percentage points, statistically indistinguishable from perfect compliance. That is, for chain stores the licensure threshold forecloses stores who almost surely would otherwise enter. Figure 4b is the predicted licensure probability plot for chain stores. Column 5 further restricts the sample to chains with 10 or more stores in Washington, with no significant change in the estimated licensure discontinuity. Figure A.2 in the Appendix presents the predicted licensure probability plot for this subsample.

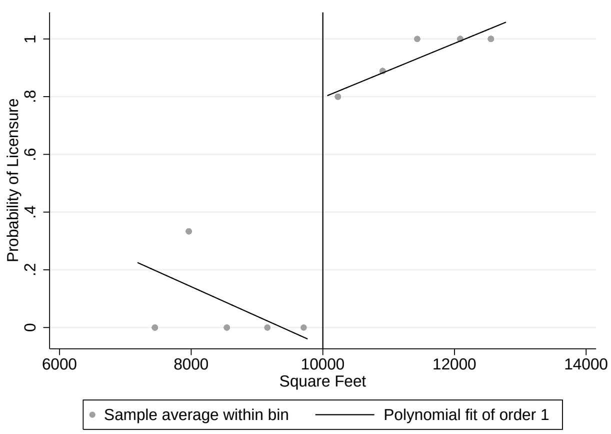
The results in column 3 indicate that the opposite story holds for non-chains: there is no discontinuity in licensure at the threshold. It does not appear that measurement error muddies the waters for independent stores. As shown in Figure 4c, the licensure probability hovers around 10% on both sides of the cutoff. Therefore, we conclude that the licensure threshold does not exclude independent stores from spirits sales.

Figure 4: Probability of Spirits Licensure by Store Size

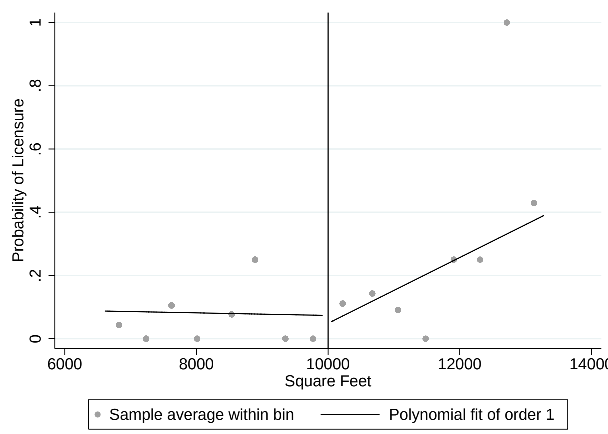
(a) Full Sample



(b) Chains



(c) Independent Stores



3.2 Neighbor License Eligibility and Entry

3.2.1 Empirical Strategy

In this section, we test whether stores respond to the license eligibility of their neighbors. That is, do marginally license-eligible stores crowd out rival entry? Examining rival entry can teach us about the degree of competition in these markets, and is important to understanding how the licensure restriction affects consumers. At the extreme, each store above the threshold might drive out a larger potential entrant, so that the total number of spirits retailers does not change. Consumers would therefore experience a smaller gain from convenience compared to a scenario where the marginally eligible entrant has no effect on rival entry. Even in this extreme crowd-out case, however, market outcomes might shift because the composition of liquor sellers - the types of retailers - changes.

We therefore estimate regressions of entry decisions on neighbor configurations. Of course, firms select locations in response to (potentially unobservable) market conditions, so we cannot simply compare stores with more/fewer competitors to establish causal effects. Instead, we condition on the number of competitors sized 5,000-15,000ft^2, and compare firms with a different number above versus below the threshold. To illustrate, we compare the entry decision of a 20,000ft^2 grocer with a rival sitting at 9,999ft^2 to one with a rival sitting at 10,000ft^2. Our goal is to determine whether, and to what extent, a store that faces an additional potential competitor is less likely to enter.

A challenge in this exercise is determining the relevant set of rivals for each store s. We consider only those stores themselves eligible to enter, and construct two sets of potential rivals: those stores within a certain distance d of store s, and store s's n-nearest neighbors. More specifically, the distance-based regressions estimate models of the following form:

$$\begin{aligned} 1\left[\text{Has Liquor License}\right]_s \quad = \quad & \alpha_0 + \alpha_1 \cdot 1\left[Is\,Chain\right]_s + \alpha_2 \cdot N_s^{d,10-15} \\ & + \alpha_3 \cdot 1\left[Is\,Chain\right]_s \cdot N_s^{d,10-15} + \textstyle\sum_k \lambda_k^d \cdot 1\left[N_s^{d,5-15} = k\right] + \epsilon_s \end{aligned} \tag{2}$$

where $1\left[Is\,Chain\right]_s$ is an indicator variable for whether store s belongs to a chain, $N_s^{d,10-15}$ is the number of stores within d miles of store s sized 10,000-15,000ft^2, and $N_s^{d,5-15}$ is the number of stores within d miles of store s sized 5,000-15,000ft^2, so that λ_k^d is a fixed effect for stores that have k competitors within d miles sized 5,000-15,000ft^2. We are interested in the coefficient α_2, which captures the effect eligibility on rival entry. The causal interpretation is rooted in an identification assumption that conditional on the number of rivals with 5,000-15,000ft^2, the number between 10,000-15,000ft^2 is orthogonal to any unobserved market and firm-level profit shifters. The own-entry regressions presented above suggests that chain and independent stores behave differently, so we allow for the effect on rival entry to be different for chains (α_3). Note that we only consider stores with at least one competitor in the bandwidth ($N_s^{d,5-15} \geq 1$), since we do not have a plausibly exogenous profit-shifter for firms without competitors near the licensure threshold. Across all specifications, standard errors are clustered at the zip code level.

It is important to note that we need not assume that store s competes only with stores sized 10,000-15,000ft^2. Our argument is simply that the effect of all other factors, including larger competitors, is orthogonal to the number of stores above the cutoff, once you control for the total number of stores in the bandwidth. This allows us to estimate the causal effect of an additional license-eligible competitor on store entry decisions without having to fully specify the relevant set of competitors for each store.

One challenge with estimating (2) is choosing a distance radius d appropriate to the entire state. As an example, within Seattle, firms may compete only with other firms within walking distance, compared to Snohomish, where rival five or ten miles apart might compete intensely. We therefore estimate a second version of the rival entry regressions that does not rely on a driving distance radius. Instead, we create a metric based on the license eligibility of the n-nearest neighbors to store s. That is, for every store we calculate the distance to all other stores, and then focus on the n-nearest neighbors, analyzing entry decisions based on their license eligibility. We adapt (2) as follows:

$$\begin{aligned} 1\left[\text{Has Liquor License}\right]_s \quad = \quad & \alpha_0 + \alpha_1 \cdot 1\left[Is\,Chain\right]_s + \alpha_2 \cdot N_s^{n,10-15} \\ & +\alpha_3 \cdot 1\left[Is\,Chain\right]_s \cdot N_s^{n,10-15} + \textstyle\sum_k \lambda_k^n \cdot 1\left[N_s^{n,5-15} = k\right] + \epsilon_s \end{aligned} \tag{3}$$

where $N_s^{n,10-15}$ is the number of store s's n-nearest neighbors sized 10,000-15,000ft^2. For example, if $n = 2$ and store s's two nearest neighbors nearest neighbors are 23,000ft^2 and 12,000ft^2 , then $N_s^{n,10-15} = N_s^{n,5-15} = 1$. As before, we include fixed effects λ_k^n for the number of store s's n-nearest neighbors in the bandwidth. As in (2), standard errors are clustered at the zip code level, and the sample includes stores with have at least one n-nearest neighbor in the bandwidth ($N_s^{n,5-15} \geq 1$). Results from this specification are consistent with the results of the distance based specification, so they will be presented in Appendix A.

3.2.2 Covariate Balance

In these specifications we rely on an exclusion restriction regarding retailers neighboring marginally license-eligible rivals. While we cannot test the exclusion restriction directly, we check whether stores with a rival just-above versus just-below 10,000ft^2 are similar on observables. That is, we estimate equations 2 and 3 with different store s observables as the outcome variable. We report these estimate in tables 7 and A.1 for the distance- and the n-nearest neighbor based specification, respectively.

Focusing on Table 7, each row presents results for different store observables (square footage, latitude, longitude, beer and/or wine license types, and earliest alcohol licensure date), while each column focuses on different distance bandwidths, from 0.1 miles to 1 mile. For example, the first two rows show that there is no statistically significant correlation between the number of license-eligible competitors in the bandwidth (our profit-shifter) and own-store size, conditional on the number of competitors in the bandwidth. This result holds for all distance thresholds we tested (0.1-1 miles), and for both chain and independent stores. We find no consistent pattern in geographic location, although some specifications show a weak correlation between latitude and our regressor of interest. As one degree of latitude is around 69 miles, and one degree of longitude at Seattle's latitude is around 47 miles,[8] a coefficient of 0.1 implies that stores located 6.9 miles further North (latitude) and 4.7 miles further West (longitude) are more likely to have an additional competitor sized 10,000-15,000ft^2. Since this effect is economically small, it seems unlikely to threaten the validity of the exclusion restriction. Finally, we find no difference in beer/wine license types or earliest alcohol licensure date across stores with more license-eligible competitors. While there are a few significant coefficients in specifications with narrow bandwidths, these disappear as the sample size increases.[9]We also check covariate balance for the n-nearest neighbor metric, and present results in Table A.1. Taken together, the regression results in this section lend support to the licensure threshold strategy for identifying rival entry.

3.2.3 Results

We present estimates of neighbor license-eligibility on own entry decisions in Table 8, which correspond to equation 2. As in Table 7, each column corresponds to a different radius around the store, so that column 1 includes only stores with at least one neighbor within 0.1 miles sized 5,000-15,000ft^2. Rows 1 and 2 (3 and 4) include results for independent (chain) stores. We split the sample because we have already determined that entry decisions are very different for chains, which have a baseline entry probability of 90+%, compared to 35% for independent stores. Our results indicate that neighbor eligibility only impacts independent stores: an additional license-eligible competitor reduces the entry probability by 20 percentage points if the store is within 0.2 and 0.3 miles. The effect falls to around 10 percentage points for 0.5 and 0.6 miles, and is indistinguishable from 0 for larger distances. These magnitudes are large (a 20 percentage point drop corresponds to a two-third reduction in the likelihood of spirits licensure), but competition appears fairly localized. In contrast, chain stores do not seem to respond to their neighbors: the estimated effect of an

[8]The length of a degree of longitude in miles ranges from 69.71 miles at the Equator to 0 at the poles, the length of a degree in miles greatly varies with latitude. The same is also true for a degree of latitude, as the earth is not a perfect sphere, but its range is much smaller: 68.71 miles at the Equator and 69.40 miles at the poles.

[9]With one exception: chain stores with an additional competitor in the bandwidth and above the threshold are roughly 5 percentage points more likely to have a wine retailer/reseller license. This difference is significant at the 5% level in regressions using a 0.9 and 1 mile distance bandwidth, and the mangitude is consistent across all bandwidths. However, we do not except this imbalance to alter our results for chain stores, as chains almost always enter.

Covariate Balance Across License-Eligible Stores with Differing Numbers of License-Eligible Neighbors within Distance Bandwidths

Square Footage Bandwidth = 5000 square feet

Distance to Store (miles):		0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Own Square Footage	Independents	-5,252	-1,300	-122	-1,182	276	-436,683	-443,202	-357,557	-283,483	-244,256
		(5,576.)	(6,381.)	(4,723.)	(4,942.)	(3,859.)	(437,150.)	(445,305.)	(360,986.)	(287,782.)	(248,056.)
	Chains	-7,637	-6,127	-2,183	-2,578	-4,061	19,933	-58	-2,889	-13,485	-11,552
		(9,427.)	(5,431.)	(4,852.)	(4,471.)	(3,953.)	(26,488.)	(11,863.)	(14,170.)	(17,833.)	(15,214.)
Latitude	Independents	0.040	-0.005	0.144	0.158	0.176	0.165*	0.123	0.124	0.140*	0.134*
		(0.374)	(0.209)	(0.184)	(0.159)	(0.124)	(0.100)	(0.112)	(0.090)	(0.083)	(0.073)
	Chains	0.121	0.042	0.009	0.051	0.109	0.103	0.090	0.095	0.087	0.090
		(0.174)	(0.103)	(0.098)	(0.094)	(0.092)	(0.083)	(0.088)	(0.076)	(0.074)	(0.070)
Longitude	Independents	0.102	-0.226	-0.403*	-0.139	-0.176	-0.175	-0.137	-0.141	-0.191	-0.147
		(0.705)	(0.268)	(0.244)	(0.179)	(0.191)	(0.154)	(0.168)	(0.145)	(0.145)	(0.134)
	Chains	-0.196	-0.440	-0.482*	-0.318	-0.265	-0.174	-0.162	-0.168	-0.165	-0.124
		(0.316)	(0.267)	(0.247)	(0.210)	(0.186)	(0.175)	(0.162)	(0.136)	(0.134)	(0.125)
Has Beer/Wine Specialty Shop License	Independents	-0.172*	-0.067	-0.030	-0.001	0.023	0.017	0.029	0.009	0.013	0.021
		(0.093)	(0.068)	(0.041)	(0.041)	(0.041)	(0.030)	(0.031)	(0.025)	(0.021)	(0.019)
	Chains	-0.036	-0.012	-0.007	-0.007	0.001	0.005	0.001	0.002	0.004	0.007
		(0.027)	(0.011)	(0.007)	(0.009)	(0.007)	(0.007)	(0.009)	(0.011)	(0.009)	(0.007)
Has Beer / Wine Grocery Store License	Independents	0.093	0.063	0.008	-0.055	-0.075	-0.044	-0.036	-0.017	-0.019	-0.039*
		(0.133)	(0.073)	(0.051)	(0.048)	(0.046)	(0.040)	(0.039)	(0.033)	(0.025)	(0.022)
	Chains	0.033	0.023	0.019*	0.012	0.013	0.012	0.015	0.015	0.012	0.003
		(0.025)	(0.017)	(0.010)	(0.010)	(0.009)	(0.011)	(0.010)	(0.010)	(0.009)	(0.008)
Has Wine Retailer / Reseller License	Independents	-0.004	-0.033	-0.042	-0.018	-0.011	-0.006	-0.028	0.003	0.007	0.010
		(0.015)	(0.036)	(0.040)	(0.035)	(0.024)	(0.022)	(0.023)	(0.026)	(0.024)	(0.021)
	Chains	0.228**	0.112*	0.068	0.047	0.042	0.042	0.045	0.036	0.051**	0.046**
		(0.116)	(0.064)	(0.056)	(0.047)	(0.041)	(0.036)	(0.032)	(0.027)	(0.025)	(0.023)
Earliest Alcohol Licensure Date (Days)	Independents	698.249	716.540	529.116	315.896	254.604	169.671	161.341	106.371	82.939	-1.094
		(667.058)	(469.021)	(370.493)	(266.883)	(206.978)	(169.695)	(196.760)	(142.867)	(143.140)	(116.151)
	Chains	-908.163**	-196.686	-173.062	-79.772	48.915	68.902	46.443	16.308	-0.648	0.132
		(437.124)	(288.080)	(222.623)	(203.541)	(178.283)	(152.351)	(142.364)	(118.236)	(110.771)	(101.145)
N		96	208	295	369	433	516	572	628	690	737

Notes: This table presents results of a linear regression of different store characteristics on a constant and the interaction between a chain store dummy and the number of neighbors who are within the relevant distance and who are above the 10,000 square foot licensure threshold, but below 15,000 square feet. All specifications include a fixed effect for the total number of stores between 5,000 and 15,000 square feet and who are also within the relevant distance. The sample is restricted to stores who are not former state liquor stores, are eligible to sell liquor, and have at least one neighbor within the relevant distance. Robust standard errors with clustering at the zip code level in parentheses. Coefficients are significant at the * 10%, ** 5% and *** 1% levels.

Table 7: Covariate Balance Across License-Eligible Stores with Differing Numbers of License-Eligible Neighbors within Distance Bandwidths

	Effect of the License Eligibility of Nearby Stores on Own Entry Decisions Bandwidth = 5000 square feet										
	Distance to Store (miles):	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Independents	# of Marginally License Eligible Neighbors	0.017	-0.200*	-0.208**	-0.165***	-0.111*	-0.093**	-0.039	-0.052	-0.017	-0.036
		(0.160)	(0.106)	(0.091)	(0.058)	(0.059)	(0.042)	(0.045)	(0.039)	(0.036)	(0.031)
	Baseline Entry Probability	0.125	0.308***	0.371***	0.344***	0.352***	0.348***	0.318***	0.322***	0.318***	0.330***
		(0.086)	(0.082)	(0.071)	(0.056)	(0.058)	(0.049)	(0.049)	(0.047)	(0.044)	(0.044)
Chains	# of Marginally License Eligible Neighbors	0.050	0.021	0.019	-0.003	0.002	0.000	-0.003	0.011	0.011	-0.004
		(0.063)	(0.036)	(0.033)	(0.031)	(0.026)	(0.021)	(0.021)	(0.019)	(0.018)	(0.016)
	Baseline Entry Probability	0.901***	0.924***	0.924***	0.940***	0.946***	0.955***	0.955***	0.945***	0.940***	0.957***
		(0.056)	(0.030)	(0.025)	(0.022)	(0.020)	(0.017)	(0.018)	(0.018)	(0.018)	(0.017)
	# of Neighbors in the Bandwidth FE	x	x	x	x	x	x	x	x	x	x
	N	96	208	295	369	433	516	572	628	690	737

Notes: This table presents results of a linear regression of a licensure dummy on a constant and the interaction between a chain store dummy and the number of neighbors who are within the relevant distance and who are above the $10{,}000ft^2$ licensure threshold, but below $15{,}000ft^2$. All specifications include fixed effects for the total number of stores $5{,}000$-$15{,}000ft^2$ and who are also within the relevant distance. The sample is restricted to stores who are not former state liquor stores, are eligible to sell liquor, and have at least one neighbor within the relevant distance. Robust standard errors with clustering at the zip code level in parentheses. Coefficients are significant at the * 10%, ** 5% and *** 1% levels.

Table 8: Effect of License Eligibility of Nearby Stores on Own Entry Decisions

additional license-eligible rival is statistically insignificant across specifications, and the point estimates are small. This result dovetails with the full compliance finding in the previous section: to first order, license-eligible chain stores always enter. Table A.2 replicates this analysis following the specification in equation 3, and finds results that are consistent with the previous analysis.

3.3 Effect of License Eligibility on Liquor Sales

3.3.1 Empirical Strategy

In this section, we adopt the RD-style argument above to study how entry affects market outcomes, such as liquor prices and quantity sold. Our empirical strategy compares changes in these outcome in markets with an existing beer or wine merchant just above $10{,}000ft^2$ ("treatment" markets) to those markets with an existing merchant just below ("control" markets). We argue that conditional on the existence of a store sized approximately $10{,}000ft^2$, treatment and control markets are otherwise similar. Our basic specification is a difference-in-differences estimator that exploits the granularity of Nielsen's Consumer Panel Dataset, which lives at the household level and contains information on pre-liberalization purchases. Our identification assumption is therefore weaker than required for the entry regressions: absent deregulation, any pre-period differences in panelists' purchases across treatment and control markets would have continued on the same trend. Our basic estimating equation has the following form:

$$y_{ht} = \beta \cdot \sum_{z} \text{MargEligible}_z \times 1\left[z_{ht}\right] \times \text{Post}_t + \alpha \cdot \sum_{z} \text{MargEligible}_z \times 1\left[z_{ht}\right] \quad (4)$$
$$+ \sum_{z} \left(1\left[z_{ht}\right] \times \sum_{k=1}^{11} \lambda_k \cdot 1[\text{InBand}_z = k] \right) + \delta_t \times 1\left[\text{Month}_t\right] + \epsilon_{ht}.$$

The dependent variable is a purchasing outcome y for household h in month t, such as an indicator for purchasing hard liquor. Post_t is an indicator for post-liberalization (May 1, 2012), and $1[\text{Month}_t]$ are month fixed effects that control for state-wide time variation in liquor supply or demand. MargEligible_z is the number of 2011 beer/wine licensees in zip code z that were marginally eligible for a liquor license; that is, the number sized 10,000-15,000ft^2. $1[z_{ht}]$ is an indicator for whether household h resided in zip code z in month t. Approximately 5.7% of households switch zip codes at least once during the six year panel. InBand_z is the number of 2011 beer/wine licensees in zip code z that are in the neighborhood of the licensure threshold (sized 5,000-15,000ft^2). We dummy out InBand_z, so that all of our comparisons condition flexibly on the number of stores near the threshold. The main parameter of interest is β, which captures the effect of an additional license-eligible firm on household outcomes.

Our main regressions employ store characteristics within a panelist's zip-code as explanatory variables. While it is typical in IO studies to group consumers into larger markets, such as metropolitan areas, we look more narrowly for three reasons: first, there are relatively few cities within Washington state; second, earlier work demonstrates that most consumers shop close to home; and third, our results on rival entry suggest firms beyond 0.6 miles distance have limited impact on rivals' decisions in this context. If consumers shop further afield than their own zip code, then we would tend to underestimate the effect license-eligibility, as some households in the "control group" - those who reside in zip codes without a marginally eligible store - would in fact be "treated," as their correctly-defined liquor market would include a potential entrant. Since our natural experiment induces variation at the zip code level, but the data lives at the household level, we cluster standard errors by zip code.

3.3.2 Covariate Balance for Zip Codes

Before turning to estimates of (4), we first test whether zip codes with a marginally eligible versus ineligible store differ on observable characteristics. Characteristics from the 2010 census include log population, percent White, log median income, and log median age. As an example, the coefficient in column (6) implies that treatment zip codes boast 1.02% higher median income than control zip codes, but this difference is not statistically significant. Table 9 shows these covariates are balanced between treatment and control zip codes. Zip codes are also similar in terms of representation in the Nielsen Panel (number of households

Covariate Balance of Zip Code Characteristics by Store Eligibility							
	# Households	# Stores	# WSLCB Stores	Log Population	% White	Log Median Income	Median Age
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Number of Marginally License-Eligible Firms	1.618	1.012	-0.008	0.112	-0.132	0.019	0.176
	(1.840)	(0.660)	(0.028)	(0.074)	(1.173)	(0.026)	(0.490)
Number of Stores in the Bandwidth FE	X	X	X	X	X	X	X
N	302	302	302	302	302	302	302

Notes: Sample includes zip codes with at least one store in the bandwidth (5,000-15,000 square feet). Coefficients are statistically significant at the *10%, **5%, and ***1% level.

Table 9: Zip Code Covariate Balance

residing in the zip), the number of beer and wine licensees in 2011, and the number of WSLCB stores pre-liberalization, which correspond to columns 1, 2, and 3 respectively. While we cannot test whether zip codes differ on unobservables, it is reassuring that they look similar both in terms of census population demographics and beer/wine market configurations before deregulation.

We next test whether treatment and control zip codes boast similar households in the consumer panel. Table 10, panel A shows comparisons between households that live in treated and control zip codes across the entire sample period. Point estimates are small and statistically insignificant for differences in income levels and race, although heads of household in treated zip codes are 7% less likely to be married, a difference that is significant at the 5% level. As marital status seldom varies over time for a given household, this difference should wash out in the difference-in-differences specification. Panel B shows differences in characteristics we measure using pre-liberalization data: annual number of shopping trips (for any product), liquor purchase probabilities and total liquor expenditures. As an example, teated panelists are 0.1% more likely to purchase liquor, but this difference is neither statistically nor economically significant. Panel B contains a proper subset of the households in panel A, as some households included in panel A enter the dataset after 2012 and have no pre-liberalization data. Overall, households do not appear different in their shopping behavior across zip codes with stores just-above versus -below the licensure threshold.

3.3.3 Quantity Effects

Table 11 shows our results for the marginal effect of a license-eligible firm on quantities, measure three ways: purchase likelihood, liquor expenditures ($), and volume purchased (liters). All outcomes are measured in levels, as many observations are zeros and would be omitted in a log specification (the average household purchases liquor less than once a year). For each outcome, we estimate two specifications: a simple difference that uses only post-liberalization data and a difference-in-differences with month fixed effects, which corresponds to (4). As an example, comparing purchases only after deregulation, we find that panelists in

Covariate Balance of Panelist Characteristics by Local Store Eligibility					
Panel A: Full Sample Covariates (N=2,065)					
	(1)	(2)	(3)	(4)	(5)
				Income	
	Married	White	<25k	50k-100k	100k+
Number of Marginally License-Eligible Firms in Zip Code	-0.047***	-0.013	-0.009	-0.012	0.014
	(0.013)	(0.009)	(0.010)	(0.009)	(0.009)
Constant	0.673***	0.865***	0.176***	0.199***	0.131***
	(0.016)	(0.011)	(0.012)	(0.012)	(0.011)
Number of Stores in the Bandwidth FE	X	X	X	X	X
Panel B: Pre-Liberalization Covariates (N=1,542)					
	(6)	(7)	(8)		
	# Shopping Trips	Purchase Probability	Liquor Expenditures		
Number of Marginally License-Eligible Firms in Zip Code	0.236	0.001	-0.604		
	(0.272)	(0.014)	(0.646)		
Constant	12.545***	0.312***	4.240***		
	(0.350)	(0.018)	(0.976)		
Number of Stores in the Bandwidth FE	X	X	X		

Notes: Panel A includes panelists in Washington State in the Nielsen sample from 2010-2015. Panel B includes panelists in Washington State in the sample from 2010-2012. Both samples exclude panelists which switch zip codes during this six year period (5.71% of households).

Table 10: Covariate Balance for Panelists in Zip Codes with Marginally Eligible v Ineligible Firms

treated zip codes spend \$0.44 more on liquor each month, as reported in column 4, but the difference is not statistically significant. The difference-in-differences estimate (column 5), which exploits the full dataset, is \$1.09 and significant at the 10% level. We prefer the difference-in-differences specification as it controls for baseline differences across households and so increases precision. We find a similar, marginally significant boost in liters purchased (column 10). Taken together, the estimates in table 11 hint at a positive effect on liquor expenditures and volume purchased (on the order of 10-15%), but the estimates are only marginally significant. To aid in interpretation, column 1 shows results of a regression on the number of liquor licensees in 2012 on eligibility. It confirms the own- and rival-entry results that an extra license-eligible firm corresponds to additional realized entry - on the order of a switch from quadropoly to quintopoly.

To understand whether the effects of eligibility depends on the number of competitors, we re-estimate (4) separately for zip codes with above- and below- median number of large potential entrants. That is, we split the sample depending on whether four or more beer or wine merchants sized at least 20,000ft^2 operated within the zip code in 2011. Of course, variation in the number of large stores is not exogenous. As shown in table 12, zip codes with fewer than four large stores are lower income (8 percentage points), less populous, less racially diverse and older. However, within each group we have a quasi-experiment in the number of

Effect of License Eligibility on Purchasing							
	# of Liquor Outlets	Purchase Indicator		Liquor Expenditures		Liters Purchased	
	Diff	Diff	D-i-D	Diff	D-i-D	Diff	D-i-D
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
# of Marginally License-Eligible Stores × Post	0.577**	-0.002	0.004	0.439	1.093*	0.003	0.036*
	(0.224)	(0.005)	(0.005)	(0.821)	(0.592)	(0.029)	(0.021)
# of Marginally License-Eligible Stores	_	_	-0.006	_	-0.787	_	-0.037
			(0.006)		(0.743)		(0.030)
# of Stores in the Bandwidth FE	X	X	X	X	X	X	X
Month FE			X		X		X
N	51854	51854	87672	51854	87672	51854	87672
Mean at Baseline	4.429	0.094	0.089	7.181	6.551	0.263	0.231

Notes: Observations are at the panelist-month level for 2010-2015. Standard errors are clustered at the zip code level, and coefficients are statistically significant at the * 10%, ** 5%, and ***1% level. Columns 1, 2, 4, and 6 are limited to the post period (May 2012-December 2015). All specifications include a post-liberalization indicator. There is no difference-in-differences specification for the # of liquor outlets, as these only came into existence after liberalization and they do not vary from month-to-month.

Table 11: Effect of License Eligibility on Purchasing

marginally license eligible stores. Results are presented in table 13, and they suggest significant heterogeneity in treatment effects. In markets with fewer large competitors, an additional eligible firm boosts liquor sales. The likelihood of purchase increases by 17%, expenditures rise by 24%, and volume increases by 25%. In contrast, point estimates for markets with many large competitors are economically small and statistically insignificant, even at the 10% level.

Differences in the intensity of treatment offer one explanation for the disparate treatment effects between more- and less-concentrated zip codes. While a marginally eligible store translates, on average, to 0.8 more liquor-selling outlets in both samples, this boost constitutes a larger percentage change for zip codes with few large stores. These zip codes average 2.11 outlets at baseline, compared to 5.55 liquor-selling outlets for their more-concentrated counterparts. Our results suggest that transition from two to three firms matters a great deal, while the switch from five to six is less significant.

Figure 5 displays the difference in purchasing behavior between households in treatment and control zip codes for each quarter in our sample. That is, it shows means and 95% CIs that correspond to coefficient estimates from (4) if we estimated treatment effects separately by quarter, rather than for the entire post period. Importantly, the graphs are consistent with our parallel trends assumption; the difference between treatment and control households is very stable from 2010 through May 2012. If anything, the graphs show a lag, where treatment and control households appear to diverge only in the final quarter of 2012. There absence of action in first few months after liberalization suggests that nascent markets may equilibrate over time.

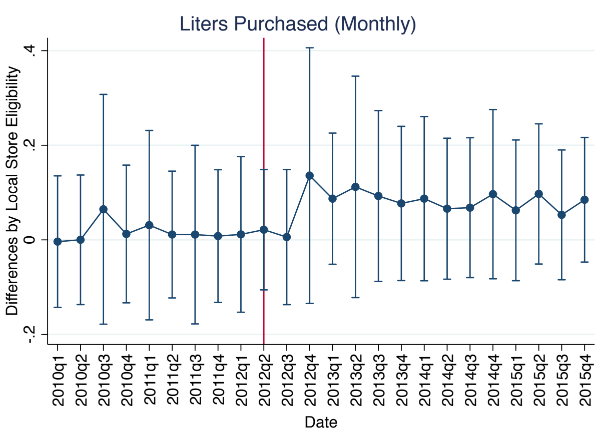
Table 12: Zip Code Demographics by Number of Competitors

Zip Code Demographics by Number of Competitors		
	Number of Large Stores	
	≥ 4	< 4
Population	30,023	11,903
	(1,100)	(829)
% White	80.98	86.48
	(1.21)	(1.02)
Log Median Income	10.95	10.86
	(0.03)	(0.02)
Median Age	36.71	40.48
	(0.45)	(0.57)
N	111	191

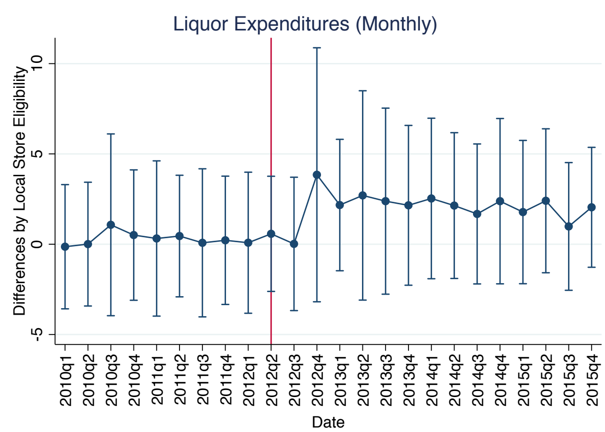
Notes: Sample includes zip codes with at least one store in the bandwidth (5,000-15,000 square feet). Large stores are beer/wine licensees sized 20,000+ square feet.

Figure 5: Difference-in-Differences Specification

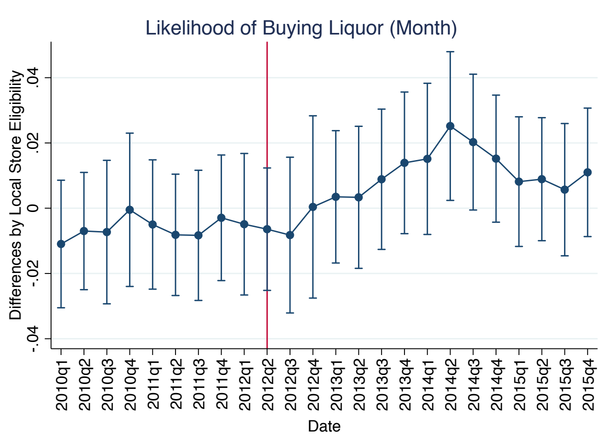
(a) Volume (L)



(b) Likelihood of Purchase



(c) Likelihood of Purchase



Effects of License Eligibility on Purchasing by Number of Competitors								
	Fewer than 4 Large Stores				4 or More Large Stores			
	# Liquor Outlets	Purchase Indicator	Expenditures ($)	Volume (L)	# Liquor Outlets	Purchase Indicator	Expenditures ($)	Volume (L)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
# of Marginally License Eligible Firms × Post	0.807***	0.015***	1.778***	0.063***	0.735***	-0.005	0.666	0.016
	(0.102)	(0.004)	(0.516)	(0.021)	(0.204)	(0.005)	(0.844)	(0.027)
# of Marginally License Eligible Firms	-0.148	-0.006	0.288	0.016	-0.156	-0.006	-1.329	-0.057
	(0.122)	(0.009)	(1.881)	(0.080)	(0.105)	(0.007)	(0.927)	(0.036)
# of Firms in the Bandwidth FE	X	X	X	X	X	X	X	X
Month FE		X	X	X		X	X	X
N	32316	32316	32316	32316	55356	55356	55356	55356
Mean at Baseline	2.110	0.088	7.363	0.248	5.548	0.093	6.196	0.229

Notes: Standard errors clustered at the zip code level, and coefficients are statistically significant at the *10%, **5%, and ***1% level. Large stores are beer and wine stores operating in 2011 sized at least 20,000.4 is the median number of large stores in the sample. Columns (1) and (5) include a Post indicator. Baseline is calculated for the post-liberalization period setting the interaction of marginally license eligible firms and post to zero.

Table 13: Effect of License Eligibility on Purchasing by Number of Competitors

These results show how spirits purchases change as the number of retailers grows, which is particularly relevant to policy-makers concerned about negative externalities. Indeed, the WSLCB adopted the licensure threshold that we exploit precisely to curb liquor consumption. Some feared that if every corner store could sell hard liquor – potentially increasing convenience and lowering prices – the resultant bump in consumption could increase DUIs.[10] We find at least some basis for these fears; in markets with fewer stores, consumption does increase markedly with entry.

We next consider how entry affects consumption for different types of consumers. In particular, we investigate whether it encourages teetotal households to begin consuming alcohol or simply boosts consumption among households already at the high-end of the purchasing spectrum. We classify households according to their spirits purchasing behavior January 2010 through May 2012. Households are deemed "teetotal" if they never purchase liquor, "drinkers" if they purchase at least once, and "heavy drinkers" if they are in the top decile of households in per-person volume purchased. We estimate a simpler version of (4), which compares treatment and control zip codes using data after liberalization. The data from pre-liberalization is used to define the sample, rather than to control for differences at baseline. Results are displayed in table 14. The coefficient reported in columns 1 captures the difference between spirits expenditures for heavy drinking households with a marginally eligible retailer; these households spend $29.07 more per month, but the difference is not significant, even at the 10% level. However, when we focus on the sample in zip codes with few competitors (column 2), we find the effect doubles to an estimated $62.78 boost with a t-stat of 2.02.

[10] Harry Esteve. November 8, 2011. "Washington voters OK sales of liquor in big grocery stores." *The Oregonian.* `http://www.oregonlive.com/politics/index.ssf/2011/11/washington_voters_ok_sales_of.html`

Effect of License-Eligibility on Alcohol Expenditures by Pre-Liberalization Drinking Behavior						
Panelists	Heavy Drinkers		Drinkers		Teetotalers	
# Large Stores	Any	<4	Any	<4	Any	<4
	(1)	(2)	(3)	(4)	(5)	(6)
Number of Marginally License-Eligible Stores	29.069	62.776*	-0.924	1.719	0.720	0.330
	(17.182)	(30.771)	(2.872)	(6.860)	(0.576)	(0.394)
Month FE	X	X	X	X	X	X
Number of Stores in the Bandwidth FE	X	X	X	X	X	X
N	1036	525	12387	5097	39467	14348
Mean at Baseline	78.656	62.336	23.338	23.669	2.249	2.677

Notes: Samples include data on alcohol purchases after liberalization. The heavy drinker sample includes households in the top decile of annual per-person alcohol consumption before liberalization (excluding household members under 21). Drinkers include households that purchased spirits at least once before liberalization.

Table 14: Effect of License Eligibility on Alcohol Expenditures by Pre-Liberalization Alcohol Purchases

In contrast, there is virtually no difference between teetotal households in post-liberalization in treatment and control zip codes, even in concentrated zip codes (column 6). These results suggest that entry operates on the intensive, rather than extensive margin. From a public health perspective, a large response on the intensive margin is particularly worrying, as it may lead to more alcohol-related fatalities.

3.3.4 Price Effects

We next examine whether, and to what extent, license-eligibility provides lower prices for consumers. A rich theory literature suggests that entry may have widely different effects on market conduct depending on the nature of competition. Predictions range from static Bertrand, where duopoly achieves the perfectly competitive outcome, to perfect collusion, where additional entrants merely share in monopoly rents. Table 15 provides evidence on these effects in the liquor market context. We modify (4), as the level of observation is at the product- rather than household-level. The new specification is:

$$
\begin{aligned}
p_{jzt} = {} & \beta \cdot \text{MargEligible}_z \times \text{Post}_t + \alpha \cdot \text{MargEligible}_z \\
& + \sum_{k=1}^{11} \lambda_k \cdot 1\left[\text{InBand}_z = k\right] + \delta_t \times 1\left[\text{Month}_t\right] + \gamma_j \times 1\left[\text{Prod}_j\right] + \epsilon_{ht}
\end{aligned} \tag{5}
$$

where p_{jzt} is price of product j purchased by a household residing in zip code z in month t. We estimate (5) with and without a set of product fixed effects (UPC). Estimates without product fixed effects describe how the average price paid by households changes with license-eligibility, which captures both changes in prices for the same good but also selection. Regression estimates with product fixed effects use only within-UPC variation in prices, allowing us to examine whether households in zip codes with a marginally-eligible firm

Effect of License-Eligibility on Price ($)						
Sample	Full		< 4 Large Stores		4+ Large Stores	
	(1)	(2)	(3)	(4)	(5)	(6)
Number of Marginally License-Eligible Stores × Post	0.929*	0.202	-0.272	0.088	1.792**	0.361
	(0.522)	(0.292)	(0.369)	(0.447)	(0.887)	(0.283)
Number of Marginally License-Eligible Stores	0.706	-0.089	0.887	-0.318	-0.099	-0.164
	(0.575)	(0.294)	(0.887)	(0.525)	(0.776)	(0.288)
Constant	18.201***	20.682***	17.547***	21.378***	19.522***	20.334***
	(1.091)	(0.412)	(1.419)	(0.591)	(1.746)	(0.562)
UPC FE		X		X		X
Number of Stores in the Bandwidth FE	X	X	X	X	X	X
Month FE	X	X	X	X	X	X
N	14297	14297	5932	5932	8365	8365
Mean at Baseline	25.488	25.946	27.505	26.757	24.189	25.280

Notes: Standard errors clustered at the zip code level, and coefficients are statistically significant at the *10%, **5%, and ***1% levels. Observations are panelist liquor transactions. Large stores are those with 20,000+ square feet of space.

Table 15: Effect of License-Eligibility on Prices

pay lower prices for the same goods.

Results, presented in table 15, indicate that households with a marginally eligible firm spend more on each liquor purchase. Column 1 shows that the effect is relatively modest - approximately $1 more on top of a $25.50 base price - and statistically significant only at the 10% level. What's more, product selection seems to drive the effect, as the point estimate shrinks and loses significance in column 2, where the product-level fixed effects are added. Households in areas with more entry spend more per bottle, but they buy different products. The effect appears salient only for households that reside in zip codes with above-median number of large stores (columns 5 and 6). These households spend about 7% more per bottle when they live in the same zip as a marginally-eligible store. In contrast, effects are tiny for households with few competitors (columns 3 and 4).

Our results on price contrast markedly with Goolsbee and Syverson [2008] and Bresnahan and Reiss [1991], both of whom find substantial price declines with entry. One key difference across our settings is the importance of spatial differentiation. Goolsbee and Syverson [2008] consider prices on the same route, comparing American and SouthWest Airlines fares for the same departure and destination airports. In contrast, a marginal entrant in liquor sales offers a different physical location, reducing travel times and distances for a subset of consumers, and potentially leading to price increases. For example, in Thisse and Vives [1988], equilibrium duopoly prices exceed monopoly levels, as the competing firms segment consumers. A large role for convenience is consitent with Seo [2016], who highlights its importance in Washington's privatized market along a different dimension. She finds substantial consumer valuation in one-stop shopping

Effect of License-Eligibility on Purchase Categories in Areas with Limited Competition								
	# Unique	Purchase Indicator						
	UPCs	1.75L Bottle	.05L Bottle	High Proof	Expensive (R)	Expensive	Cheap (R)	Cheap
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
# of Marginally License-Eligible Firms × Post	0.046***	0.011*	0.001***	0.003**	0.005**	0.013**	0.005***	0.001*
	(0.011)	(0.006)	(0.000)	(0.001)	(0.002)	(0.005)	(0.002)	(0.000)
# of Marginally License-Eligible Firms	-0.026	-0.004	0.001	-0.000	0.000	-0.006	-0.002	0.001
	(0.029)	(0.008)	(0.002)	(0.002)	(0.003)	(0.008)	(0.006)	(0.001)
# of Firms in the Bandwidth FE	X	X	X	X	X	X	X	X
Month FE	X	X	X	X	X	X	X	X
N	32316	32316	32316	32316	32316	32316	32316	32316
Mean at Baseline	0.171	0.045	0.003	0.011	0.011	0.037	0.026	0.003

Notes: Observations are at the panelist-month level for 2010-2015. Sample includes panelists living in zip codes with at least one store in the bandwidth and no more than 3 stores of 20,000+ft^2. High proof is an indicator for whether a panelist buys a bottle above the 75th percentile in proof relative to liquor purchases by all panelists in the sample period. Expensive (R) (Cheap (R)) are indicators for whether a purchase is above (below) the 75th (25th) percentile in WSLCB list price within its size category. Expensive (Cheap) are indicators for whether a purchase is above (below) the 75th (25th) percentile for across all WSLCB product offerings 02/2010-05/2012.

Table 16: Effect of License-Eligibility on Product Selection

for groceries and liquor. We next examine product-entry as another method of differentiation.

3.3.5 Product Selection Effect

Our results from regressions on price suggest that entry affects product choice. Households in zip codes with an additional license-eligible firm have more liquor outlet options - and they spend more, on average, for a bottle of spirits. But they do not spend more for the same products. Their choices are different from their counterparts in zip codes with a marginally ineligible firm. How are the purchasing patterns of treated households different?

A first finding, displayed in column 1 of table 16, is that households buy a wider variety of products. Rather than buying larger quantities of the same goods, there is 25% increase in the number of products bought by treatment households. Product entry is an important characteristic of the privatized market. Figure 6 shows that the fraction of panelist purchases which correspond to new products (UPCs the WSLCB did not stock 2010-2012) increases dramatically each year post-liberalization. These new products are disproportionately small formats, like nips (.05 L bottles), high proof, and more expensive. We deem products as expensive if the WSLCB priced them among the top 25% of products under the state monopoly. Since the WSLCB applied a uniform markup rule to pricing, expensive products are essentially those with high manufacturer prices.

These results suggest that multi-product retailers soften competition through product differentiation. In a standard entry model, firms respond to entry by lowering their prices. In Washington state, liquor retailers

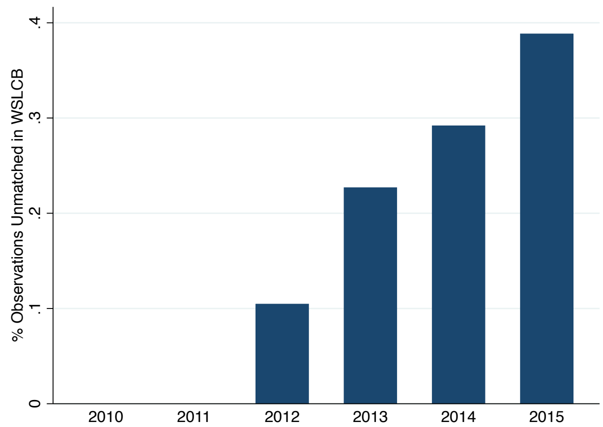


Figure 6: Incidence of New Liquor Products Purchased by Panelists

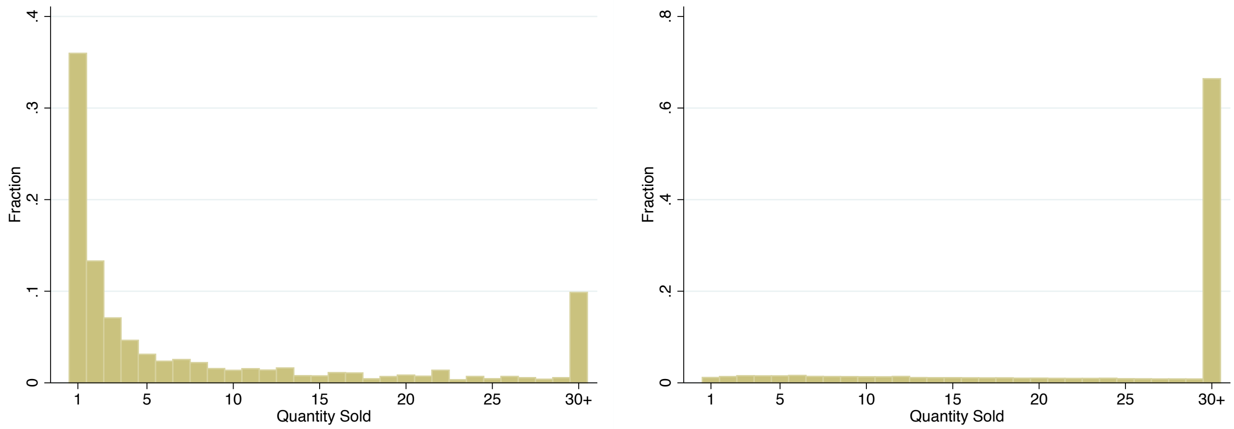
maintain prices by diversifying product offerings.

3.3.6 Evidence on Price & Product Variety in Scanner Data

The above analysis, based on data from the Nielsen Consumer Panel dataset, demonstrates that entry affects how much and what kinds of liquor consumers purchase. In a sense, these are the outcomes most relevant for those crafting policies to mitigate liquor externalities. Our panelist analysis shows that limiting entry reduces liquor consumption. However, the focus on a subset of transactions potentially misses part of the action. We therefore turn to the Nielsen Scanner dataset to augment our principal analysis.

The Consumer Panel provides data on the prices of products that households in the panel purchase. Because there are only 2,700 panelists in Washington state, many products are purchased infrequently in the panel data, limiting the scope of our analysis. As an example, we cannot discern the impact on demographic groups underrepresented in the panel if they purchase alternative products. Figure 7 shows the distribution of quantity sold by UPC in the Consumer Panel (at the zip code level) and in the Scanner Dataset (at the store level). As an example, over 60% of products sell at least 30 units anually per store in the Scanner data. Relative to the Consumer Panel, very few products are sold in small quantities in the Scanner Dataset, suggesting that there are few products on shelves that are not transacted. Selection is therefore less of a concern in the Scanner dataset.

Inference about absolute price levels using the Consumer Panel is also limited. If household A purchases good k at p_k^A and household B purchase good l at price p_l^B where $p_k^A < p_l^B$, we cannot infer whether household B faced higher absolute prices ($p_l^A < p_l^B$ and $p_k^A < p_k^B$) or lower prices ($p_l^B < p_l^A$ and $p_l^B < p_l^A$). Instead, we learn that the relative price of product k to l was lower for household A. The Nielsen Scanner dataset includes all transactions at 663 retailers in Washington State, including but not limited to panelist purchases.



(a) Consumer Panel - by Zip Code

(b) Scanner - by Store

Figure 7: Annual Quantity Sold by UPC

Two salient facts emerge from the Scanner dataset: first, there is little variation in prices across stores, and second, variation in product selection is substantial. These industry descriptives support our findings from the consumer panel dataset, but we do not re-estimate (4) using the scanner dataset for two reasons: first, to protect retailer anonymity, Nielsen does not release store locations, except at the 3-digit zip code level. There are only fourteen 3-digit zip codes within Washington State (compared to 773 5-digit zip codes), and our entry regression results indicate this is far too wide a band to learn about competition. Second, the Scanner dataset includes prices and quantities only for a subset of stores, and in particular only for chain stores.

There are nine chains in the Scanner dataset that sell liquor in Washington state, which boast an average of 85 outlets a piece. These are large retailers, which sell an average of 1.84 million bottles of spirits annually following liberalization. Table 17 shows that the average coefficient of variation (CoV) for price, across the whole sample, is a mere 9%. To calculate the CoV, we find the mean sales price for each UPC for every store in each year. We then divide the standard deviation by the mean to get the COV for that particular product. We report the average CoV across products, which gives us a sense of the variation in pricing relative to price levels. Most of this variation is across chains. The average within-chain (i.e. across stores within the same chain) CoV is 3%.[11]

In contrast, retail outlets sell widely different varieties. On average, chains sell 678 different UPCs each year, but the average store sells only 327. This figure varies substantially across outlets. The coefficient of variation for the number of products sold annually is 47%, five-times larger than the coefficient of variation

[11]Note that the sample size for this measure is the number of chain-years where there are multiple stores per chain (29 observations in our data).

Price and Product Variation within and across Chains						
Variable		# Observations	Mean	SD	Min	Max
# Outlets per Chain		30	85.37	51.14	1	169
Annual Quantity Sold (mil)		30	1.84	1.77	0.00	6.17
Annual # Products - Chain		30	678	403	49	1,676
Annual # Products - Store		2,561	327	158	19	1,274
Coefficient of Variation	Price	6,442	0.09	0.09	0	1.24
	Price - within Chain	29	0.03	0.03	0	0.11
	# Products	4	0.47	0.03	0.44	0.51
	# Products - within Chain	29	0.18	0.14	0.02	0.43
Overlap - within Chain		8	0.81	0.12	0.63	0.94

Notes: Based on the sales of 9 retail chains in the Nilesen Scanner data operating in Washington State May 2012 - December 2015. Coefficient of variation for price is the average across UPCs of the following quotient: standard deviation of price divided by its mean. To calculate the with-in chain coefficient of variation, we recalculate the CoV separately by chain and then report the average across chains. "Overlap - within Chain" is a measure of similarity between intenvtories of two stores within the same chain. For any two stores within the same chain, we calculate the share of the smaller store's inventory also carried in the larger store, and then average that measure across branches within the chain.

Table 17: Price and Product Variety for Scanner Stores

for prices. Even within chain, the coefficient of variation for the number of products is 18%.

What drives differences in product variety? Our analysis of the Consumer Dataset suggests that retail outlets tailor their product selection to local demand conditions. But it is also possible that differences across outlets simply reflects differences in store size, driven, for instance, by real estate costs. To disentangle these possibilities, we investigate product overlap between retail outlets in the same chain in the Scanner Dataset. We examine whether low-variety stores sell a subset of the inventory of stores with greater selection or if their product offerings are distinct. For each pair of stores in each retail chain, we calculate the overlap in inventory: the fraction of the smaller store's products also sold at the larger store. If inventory simply expands with store size, then this ratio is one. It is zero if the intersection of the two inventories is empty. The average overlap across chains is our sample is 81%, which means that one in five products carried by a small store is not available at larger outlets. In sum, the patterns in prices and varieties in the Scanner Dataset corroborate our analysis of the Consumer Panel Data: spirits retailers engage in product, not price, localization.

4 Conclusion

This paper finds that entry in duopoly liquor markets increases purchasing - 30% higher volume, 20% more products - but does not affect prices. We establish causality using a foible of Washington state's deregulation of liquor sales in 2012. Before 2012, only state stores could sell spirits, but private retailers were allowed to sell beer and wine. At privatization, these retail outlets could apply for a spirits license, but only if they were above 10,000ft^2 in size. We compare outcomes in zip codes with a retailer just-above versus just-below the threshold.

The results highlight heterogeneity in entry effects across market configurations. We find no effect of entry in markets with four or more large competitors. We also find that the entry decisions of firms are interdependent, but only for independent retailers. That is, chain stores choose to sell spirits regardless of their neighbors' entry decisions. In contrast, independent stores are 60% less likely to enter when facing a marginally-eligible rival within a 0.3 miles driving distance. This figure drops by half when the distance doubles, and then disappears at larger distances. Competition in retail liquor sales therefore appears highly local, suggesting that narrow market definitions could be important for correctly gauging concentration and competition for similar industries.

Two facts from Scanner data on retail chains in Washington support our finding that entry disciplines markets through product localization rather than price competition. First, there is almost no variation - either within or across chains - in spirits prices. Second, there is considerable variation in product offerings. Firms appear to soften price competition through differentiation, as Seim [2006] finds for video retailer location choice.

From a policy perspective, the licensure threshold appears a blunt instrument for limiting the negative externalities of liquor consumption. Reducing entry does curb liquor purchases, but only for some markets, and it is not clear whether consumers substitute toward other forms of consumption (e.g. drinking in bars or restaurants). An important caveat, however, is that our findings speak to the marginal effect of entry. Removing the licensure threshold altogether would constitute a much larger shock to market configuration. As an example, the threshold forecloses convenience stores, including 242 7-Eleven outlets selling beer or wine in Washington State. Perhaps it is unsurprising that Costco, whose stores average 140,000ft^2, spent $22 million on advertising to support an incarnation of the referendum with this particular entry requirement.[12]

[12]Melissa Allison. July 18, 2011. "Costco revamps liquor-sales initiative." *The Seattle Times.* `http://www.seattletimes.com/seattle-news/costco-revamps-liquor-sales-initiative/`

References

Steven Berry and Joel Waldfogel. Do mergers increase product variety? evidence from radio broadcasting. *The Quarterly Journal of Economics*, 116(3):1009–1025, 2001.

Steven T Berry. Estimation of a Model of Entry in the Airline Industry. *Econometrica*, 60(4):889–917, 1992.

Timothy F. Bresnahan and Peter C. Reiss. Entry and Competition in Concentrated Markets. *Journal of Political Economy*, 99(5):977–1009, 1991.

Sebastian Calonico, Matias D. Cattaneo, and Rocio Titiunik. Robust nonparametric confidence intervals for regression-discontinuity designs. *Econometrica*, 82(6):2295–2326, 2014.

Sebastian Calonico, Matias D Cattaneo, Max H Farrell, and Rocıo Titiunik. rdrobust: Software for regression discontinuity designs. *The Stata Journal*, 17(2):372–404, 2017.

Andrew Chamberlain. Urban Crime and Spatial Proximity to Liquor: Evidence from a Quasi-Experiment in Seattle. 2014.

Paul Champsaur and Jean-Charles Rochet. Multiproduct duopolists. *Econometrica*, 57(3):533–557, 1989.

Federico Ciliberto and Elie Tamer. Market Structure and Multiple Equilibria in Airline Markets. *Econometrica*, 77(6):1791–1828, 2009.

Christopher T Conlon and Nirupama S Rao. Wholesale Prices, Retail Prices and the Lumpy Pass-Through of Alcohol Taxes. 2015a.

Christopher T Conlon and Nirupama S Rao. The Price of Liquor is Too Damn High: Alcohol Taxation and Market Structure. 2015b.

Alon Eizenberg. Upstream innovation and product variety in the u.s. home pc market. *The Review of Economic Studies*, 81(3):1003–1045, 2014.

Natalia Fabra and Juan Pablo Montero. Quality choice and price discrimination in markets with search frictions. 2017.

Ying Fan. Ownership consolidation and product characteristics: A study of the us daily newspaper market. *American Economic Review*, 103(5):1598–1628, August 2013.

Austan Goolsbee and Chad Syverson. How do incumbents respond to the threat of entry? Evidence from the major airlines. *Quarterly Journal of Economics*, 123(November):1611–1633, 2008.

Harold Hotelling. Stability in competition. *The Economic Journal*, 39(153):41–57, 1929.

Panle Jia Barwick. What Happens When Wal-Mart Comes to Town: An Empirical Analysis of the Discount Retailing Industry. *Econometrica*, 76(6):1263–1316, 2008.

Lorenzo Magnolfi and Camila Roncoroni. Estimation of discrete games with weak assumptions on information. 2017.

Justin McCrary. Manipulation of the running variable in the regression discontinuity design: A density test. *Journal of Econometrics*, 142(2):698 – 714, 2008. The regression discontinuity design: Theory and applications.

Brian McManus. Nonlinear pricing in an oligopoly market: the case of specialty coffee. *The RAND Journal of Economics*, 38(2):512–532, 2007.

Jeffrey Milyo and Joel Waldfogel. The effect of price advertising on prices: Evidence in the wake of 44 liquormart. *American Economic Review*, 89(5):1081–1096, 1999.

Eugenio J Miravete, Katja Seim, and Jeff Thurk. Complexity, Efficiency, and Fairness of Multi-Product Monopoly Pricing. 2014.

Steven C. Salop. Monopolistic Competition with Outside Goods. *The Bell Journal of Economics*, 10(1): 141–156, 1979.

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

Katja Seim and Joel Waldfogel. Public Monopoly and Economic Efficiency: Evidence from the Pennsylvania Liquor Control Board's Entry Decisions. *American Economic Review*, 103(2):831–862, April 2013.

Boyoung Seo. Firm scope and the value of one-stop shopping in washington state's deregulated liquor market. *Kelley School of Business Research Paper*, (16-70), 2016.

Lars A. Stole. Chapter 34 price discrimination and competition. volume 3 of *Handbook of Industrial Organization*, pages 2221 – 2299. Elsevier, 2007.

Andrew Sweeting. The effects of mergers on product positioning: evidence from the music radio industry. *The RAND Journal of Economics*, 41(2):372–397, 2010.

Andrew Sweeting. Dynamic product positioning in differentiated product markets: The effect of fees for musical performance rights on the commercial radio industry. *Econometrica*, 81(5):1763–1803, 2013.

Jacques Thisse and Xavier Vives. On the strategic choice of spatial price policy. *American Economic Review*, 78(1):122–137, 1988.

Thomas Wollmann. Trucks without bailouts: Equilibrium product characteristics for commercial vehicles.

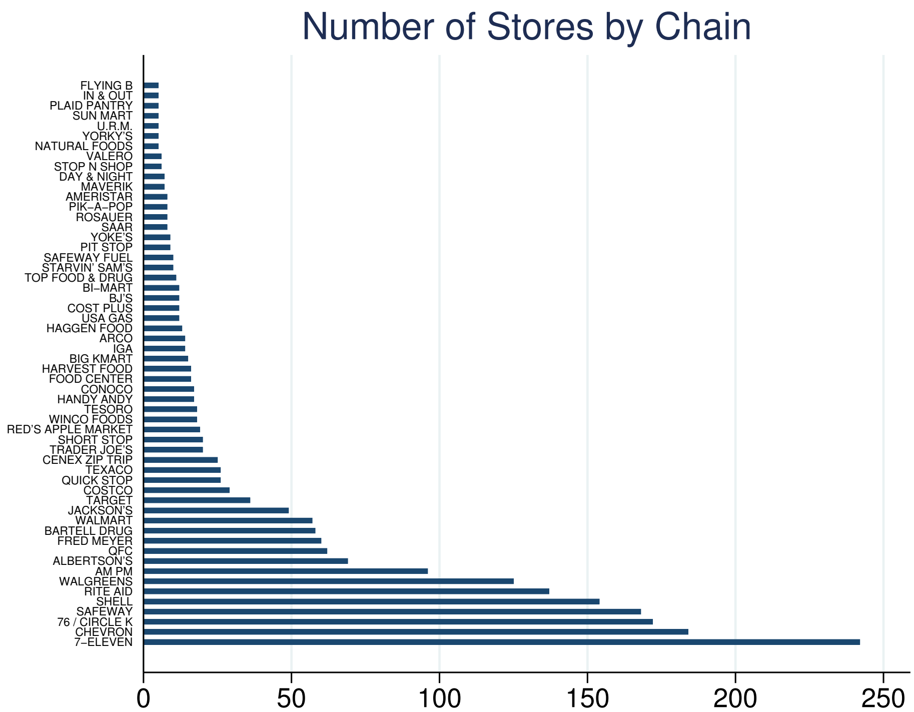


Figure A.1: Chain Sizes

A Appendix Figures and Tables

Covariate Balance Across License-Eligible Stores with Differing Numbers of License-Eligible N-Nearest Neighbors Bandwidth = 5000 square feet											
	Neighbors Included:	1	2	3	4	5	6	7	8	9	10
Own Square Footage	Independents	-6,623	-12,791***	-751	-799	-1,070	-1,525	-2,419	762	-347,019	-299,824
		(4,151.)	(4,310.)	(4,450.)	(3,540.)	(4,096.)	(3,382.)	(3,364.)	(4,128.)	(344,864.)	(298,388.)
	Chains	-8,854	-12,008**	-4,714	-3,894	-2,851	-3,281	-2,222	-2,768	19,657	18,689
		(9,138.)	(5,626.)	(4,299.)	(3,804.)	(3,256.)	(3,181.)	(2,810.)	(2,762.)	(21,635.)	(20,011.)
Latitude	Independents	-0.064	0.138	0.158	0.218	0.172	0.103	0.068	0.075	0.088	0.058
		(0.304)	(0.187)	(0.178)	(0.177)	(0.152)	(0.151)	(0.141)	(0.129)	(0.111)	(0.097)
	Chains	-0.033	0.033	0.077	0.116	0.102	0.110	0.083	0.109	0.118	0.112
		(0.137)	(0.105)	(0.092)	(0.080)	(0.080)	(0.078)	(0.076)	(0.078)	(0.076)	(0.073)
Longitude	Independents	1.006	0.431	-0.020	-0.432	-0.438	-0.216	-0.141	-0.142	-0.138	-0.183
		(0.701)	(0.420)	(0.310)	(0.392)	(0.335)	(0.288)	(0.268)	(0.245)	(0.238)	(0.200)
	Chains	-0.416	-0.306	-0.556**	-0.449**	-0.265	-0.248	-0.250	-0.249	-0.324**	-0.268*
		(0.390)	(0.242)	(0.219)	(0.188)	(0.174)	(0.169)	(0.173)	(0.167)	(0.151)	(0.150)
Has Beer / Wine Specialty Shop License	Independents	-0.069	0.027	0.019	0.029	0.049	0.057	0.056	0.064**	0.056*	0.068**
		(0.049)	(0.061)	(0.045)	(0.040)	(0.038)	(0.036)	(0.035)	(0.030)	(0.032)	(0.031)
	Chains	-	-0.011	-0.008	-0.009	-0.003	-0.003	-0.002	-0.002	0.000	0.003
		-	(0.010)	(0.007)	(0.009)	(0.007)	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)
Has Beer / Wine Grocery Store License	Independents	0.106	-0.059	-0.031	-0.043	-0.082*	-0.104**	-0.095**	-0.093**	-0.072**	-0.083**
		(0.099)	(0.061)	(0.050)	(0.045)	(0.047)	(0.043)	(0.042)	(0.036)	(0.036)	(0.034)
	Chains	-	0.019	0.013	0.014	0.007	0.006	0.004	0.004	0.004	0.000
		-	(0.014)	(0.009)	(0.009)	(0.007)	(0.006)	(0.006)	(0.006)	(0.005)	(0.004)
Has Wine Retailer / Reseller License	Independents	-0.002	-0.013	-0.018	-0.007	-0.002	-0.007	-0.015	-0.014	-0.003	-0.013
		(0.082)	(0.045)	(0.032)	(0.027)	(0.029)	(0.028)	(0.026)	(0.028)	(0.025)	(0.022)
	Chains	-	0.079	0.076	0.051	0.058	0.049	0.037	0.043	0.057*	0.051*
		-	(0.065)	(0.053)	(0.046)	(0.044)	(0.038)	(0.036)	(0.034)	(0.029)	(0.027)
Earliest Alcohol Licensure Date (Days)	Independents	-52.890	-151.693	-72.965	112.093	107.402	75.993	74.182	206.621	100.396	190.449
		(521.408)	(388.138)	(323.258)	(279.610)	(250.899)	(211.457)	(203.265)	(197.221)	(178.492)	(164.476)
	Chains	-	47.465	0.976	94.793	90.609	42.612	108.042	46.462	-29.318	-2.358
		-	(247.677)	(205.852)	(173.383)	(160.785)	(142.228)	(131.383)	(125.201)	(118.218)	(115.482)
N		132	276	399	495	586	668	733	775	856	887

Notes: For a given retailer, define N-nearest neighbors as the N closest stores to it. This table presents results of a linear regression of different store characteristics on a constant and the interaction between a chain store dummy and the count of the N-nearest neighbors who are above the 10,000 square foot licensure threshold, but below 15,000 square feet. All specifications include fixed effects for the total number of stores between 5,000 and 15,000 square feet. The sample is restricted to stores who are not former state liquor stores, are elegible to sell liquor, and have at least one neighbor in the bandwidth. Robust standard errors with clustering at the zip code level in parentheses. Coefficients are significant at the * 10%, ** 5% and *** 1% levels.

Table A.1: Covariate Balance Across License-Eligible Stores with Differing Numbers of License-Eligible N-Nearest Neighbors

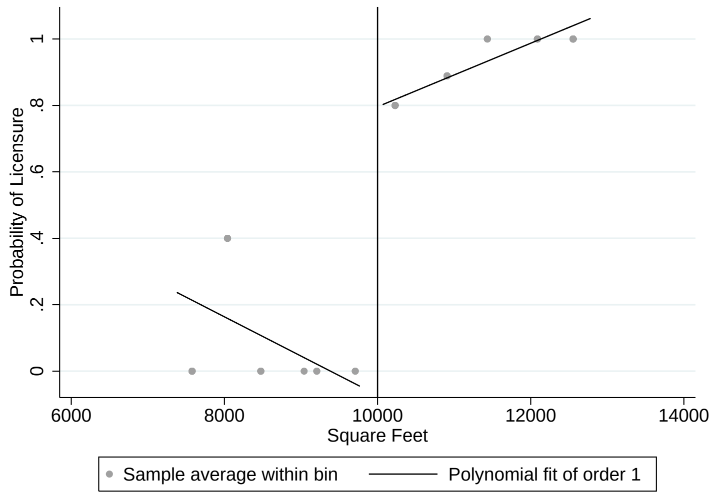


Figure A.2: Regression Discontinuity Plot, Chains with 10 or More Stores

Effect of N-Nearest Neighbors' License Eligibility on Own Entry Decision

Bandwidth = 5000 square feet

	Neighbors Included	1	2	3	4	5	6	7	8	9	10
Independents	# of Marginally License Eligible Neighbors	-0.044	-0.141	-0.145*	-0.127*	-0.137**	-0.134**	-0.139***	-0.127***	-0.103**	-0.092**
		(0.140)	(0.099)	(0.077)	(0.069)	(0.064)	(0.055)	(0.052)	(0.049)	(0.044)	(0.041)
	Baseline Entry Probability	0.310***	0.370***	0.381***	0.386***	0.388***	0.389***	0.392***	0.395***	0.377***	0.359***
		(0.079)	(0.062)	(0.052)	(0.049)	(0.046)	(0.045)	(0.042)	(0.041)	(0.038)	(0.037)
Chains	# of Marginally License Eligible Neighbors	-0.017	0.021	0.008	0.018	0.005	0.000	-0.005	0.003	-0.004	-0.001
		(0.063)	(0.036)	(0.026)	(0.026)	(0.023)	(0.021)	(0.020)	(0.020)	(0.018)	(0.016)
	Baseline Entry Probability	0.917***	0.910***	0.936***	0.928***	0.937***	0.944***	0.949***	0.947***	0.952***	0.953***
		(0.041)	(0.029)	(0.020)	(0.020)	(0.017)	(0.015)	(0.014)	(0.015)	(0.013)	(0.013)
# of Neighbors in the Bandwidth FE		x	x	x	x	x	x	x	x	x	x
N		132	276	399	495	586	668	733	775	856	887

Notes: For a given retailer, define N-nearest neighbors as the N closest stores to it. This table presents results of a linear regression of a licensure dummy on a constant and the interaction between a chain store dummy and the count of the N-nearest neighbors who are above the 10,000ft^2 licensure threshold, but below 15,000ft^2. All specifications include fixed effects for the total number of stores 5,000-15,000ft^2. The sample is restricted to stores who are not former state liquor stores, are eligible to sell liquor, and have at least one neighbor in the bandwidth. Robust standard errors with clustering at the zip code level in parentheses. Coefficients are significant at the * 10%, ** 5% and *** 1% levels.

Table A.2: Effect of License Eligibility of N-Nearest Stores on Own Entry Decisions

B Sample Restrictions

B.1 Corelogic Tax Records

This subsection describes the sample restrictions and variable definitions used to create Table 5, which studies covariate balance across the 10,000 square foot licensure threshold using CoreLogic data. We access the 2015-04-22 version of the CoreLogic Tax Records dataset, which contains parcel-level property tax records for the entire United States. This dataset includes information regarding building square footage ("Universal Building Square Feet"), the construction year of the original building ("Year Built") and the first year the building was assessed with its current components ("Effective Year Built"). We code a parcel as "Ever Renovated" if the first year the building was assessed with its current components is greater than the construction year of the original building.

Our goal is to extract from these records a subset of parcels that contains the set of potential liquor retailers, and to study whether there is any significant variation in observables across the licensure threshold. To do so, we rely on three additional variables from the CoreLogic dataset: "Property Indicator Code", described as a "CoreLogic general code used to easily recognize specific property types (e.g. Residential, Condominium, Commercial)."; "Land Use Code", described as a "CoreLogic established land use code converted from various county land use codes to aid in search and extract functions"; and "Building Code", described as "the primary building type (e.g. Bowling Alley, Supermarket)." Using different restrictions on the values of these variables, we construct three samples: "All Potential Alcohol Retail Records", "Selected Land Use Codes" and "Selected Building Codes".

Table B.1 describes on the sample restrictions used to create the first sample, "All Potential Alcohol Retail Records", from the full set of Corelogic records. For each code described in the previous paragraph, we exclude all parcels with non-commercial code values, as well as parcels with commercial code values that are not associated with alcohol sales. We also exclude parcels with no square footage records and parcels that were built after 2012. This reduces the sample from 2,538,477 records to the 19,902 records that make up the "All Potential Alcohol Retail Records" sample.

Table B.2 presents the values for the Property Indicator Code, Land Use Code, and Building Code variables in the "All Potential Alcohol Retail Records" sample. As is discussed in the main text, this sample aims to include the full set of potential liquor-selling outlets, perhaps erring on

Restriction	Observations	Excluded Values
Number of Records for Washington	2,538,477	
Excluding Non-Commercial Property Indicator Codes	190,268	Miscellaneous, Single Family Residence, Condominium, Industrial, Industrial Light, Industrial Heavy, Transport, Utilities, Agricultural, Vacant, Exempt
Excluding Selected Commercial Property Indicator Codes	155,704	Hotel/Motel, Service, Office Building, Warehouse, Financial Institution, Hospital, Parking, Amusement/Recreation
Excluding Non-Commercial Land Use Codes	77,137	Apartment/Hotel, Apartment, Duplex, Residence Hall/Dormitories, Multi Family 10 Units Plus, Multi Family 10 Units Less, Multi Family Dwelling, Mixed Complex, Mobile Home Park, Quadruplex, Group Quarters, Triplex, Time Share
Excluding Selected Commercial Land Use Codes	67,396	Auto Equipment, Auto Repair, Auto Sales, Condotel, Salvage Imprv, Auto Wrecking, Business Park, Cemetery, Convention Center, Department Store, Greenhouse, Kennel, Medical Building, Medical Condo, Laboratory, Office Condo, Public Storage, Store Franchise, Misc. Improvements
Excluding Non-Commercial Building Codes	28,484	Type Unknown, Agricultural, Fruit, Building, House, Storage, Out Building, Equipment Building, Equipment Shed, Barn, Barn Pole, Creamery, Storage Building, Shed, Utility, Utility Storage, Farm, Cocktail Lounge, Caf, Fast Food, Club, Lounge/Nite Club, Fraternal, Tavern, Bar, Bar Cocktail Lounge, Basketball Court, Clubhouse, Country Club, Convention Center, Fitness Center, Recreation, Restaurant, Theater, Theater/Cinema, Gymnasium, Health Club, Skating Rink, Arcade, Government, City Club, Fire Station, Community Center, Community Service, Post Office, Elderly/Senior Housing, Loading Dock, Multi Family, Multi Family Low Rise, Multi-Plex, Apartment, Apartment Low Rise, Condo Apartment, Duplex, Rooming/Boarding House, Triplex, Residential, Manufactured Home, Cabin/Cottage, Cabin/Apartment, Mobile Home, Mobile Home Single Wide, Mobile Home Double Wide, Single Family, Hangar, Hangar Maintenance, Truck Terminal, Truck Stop, Distribution, Cold Storage, Industrial Light, Industrial Office, Processing, Industrial Condo, Bulk Storage, Food Storage, Manufacturing, Manufacturing Heavy, Manufacturing Light, Other, Research & Development, Warehouse, Warehouse Distribution, Mini Warehouse, Warehouse Storage, Mixed Type, Group Home, Auditorium/Gymnasium, Classrooms, Center, Convalescent, Dental, Museum, University, Veterinarian, Medical, Surgical Center, Office Medical, Office Dental, College, Church/Synagogue, Day Care Center, Hospital, Hospital Convalescent, Hospital Public, Veterinary Hospital, Dormitory, Kennel, Kennel Veterinary, Fraternity, Library, Library Museum, Nursing Home, Retirement Home, Mortuary, School, School Classroom, Elementary School, Clinic Dental, Dispensary, Dispensary Medical, Ymca/Ywca, Telephone, Mixed Use, Condo & Single Family Residenc, Miscellaneous Industrial, Office/Shop, Apartments & Residential
Excluding Selected Commercial Building Codes	22,287	Storage, Commercial Greenhouse, Lumber Store, Lumber Storage, Office, Medical Office, Auto, Auto Agency, Auto Showroom, Auto Sales, Auto Sales & Service, Auto Service, Laundromat/Dry Cleaners, Bank, Garage, Repair Garage, Barber Shop, Barber & Beauty Shop, Shop Office, Retail Office, Car Wash, Car Wash Drive Thru, Car Wash Automatic, Car Wash Self Service, Parking, Parking Garage, Marina, Hotel, Hotel/Motel, Motel, Department Store, Auto Repair, Garage Service
Excluding Parcels with Missing Square Footage or Missing Year Built	18,451	
Excluding Parcels Built After 2011	18,224	

Table B.1: CoreLogic Sample Restrictions the side of including too many outlets but without including any values that can be immediately dismissed, such as auto sales or department stores. The "Selected Land Use Codes" sample further restricts the "All Potential Alcohol Retail Records" sample by using only parcels with "Supermarket", "Food Store" or "Wholesale" land use code values. Finally, the "Selected Building Code" sample further restricts the "All Potential Alcohol Retail Records" sample by using only parcels with "Market", "Supermarket", "Food Stand", "Convenience Market", "Convenience Store", "Pharmacy" or "Warehouse Store" building code values. These two sets of restrictions aim to generate a sample of parcels for which the probability of selling alcohol is high, and who may have the greatest incentive to game their square footage in order to become license-eligible.

Corelogic Code Values – All Potential Alcohol Retail Records Sample		
Panel A: Property Indicator Code		
Type	Frequency	Percentage
Commercial	5,583	30.64%
Commercial Condominium	203	1.11%
Retail	12,438	68.25%
Panel B: Land Use Code		
Type	Frequency	Percentage
Commercial (NEC)	3,542	19.44%
Multiple Uses	10	0.05%
Commercial Building	391	2.15%
Commercial Condominium	203	1.11%
Misc. Building	103	0.57%
Misc. Commercial Services	1,398	7.67%
Shopping Center	590	3.24%
Strip Commercial Center	297	1.63%
Store Building	755	4.14%
Retail Trade	9,742	53.46%
Supermarket	167	0.92%
Food Stores	887	4.87%
Wholesale	139	0.76%
Panel C: Building Code		
Type	Frequency	Percentage
Commercial	7,078	38.84%
Market	309	1.70%
Supermarket	247	1.36%
Commercial Condo	96	0.53%
Store	17	0.09%
Food Stand	56	0.31%
Service	1	0.01%
Service Station	13	0.07%
Service Garage	180	0.99%
Shops	185	1.02%
Retail	4,445	24.39%
Retail Store	3,821	20.97%
Convenience Market	408	2.24%
Convenience Store	260	1.43%
Shopping Center	345	1.89%
Discount	339	1.86%
Discount Store	269	1.48%
Pharmacy	15	0.08%
Retail & Warehouse	12	0.07%
Warehouse Store	128	0.70%

Table B.2: CoreLogic Codes for "All Potential Alcohol Retail Records" Sample

B.2 Nielsen Consumer Panel

Nielsen's Consumer Panel tracks household purchases of a wide array of products (including both food and non-food items), and it contains an entire product module labeled "liquor." Unfortunately, the liquor module corresponds only loosely to the WSLCB definition of spirits. For our principal analysis, we are interested in products formerly sold exclusively by the state monopoly. We therefore restrict our sample based on the following three criteria:

Coolers

Products that Nielsen describes as coolers ($product\_module\_descr$ = "COOLERS – REMAINING") are not included, some 1,627 UPCs. 99.8% of these observations were not sold by WSLCB stores under the state monopoly, and none have an associated proof. 51% of cooler purchases before liberalization correspond to stores with 2-digit zip codes within Washington state, so it appears that Washington households purchased these goods at non-state stores before deregulation. Further, purchases by panelists in border and interior counties were equally likely to fall under the cooler category under the WSLCB (t-stat of 0.108). We therefore conclude these are products that were legally sold by Washington state supermarkets before liberalization.

Prior Purchases

Products purchased by households before liberalization that were not sold by the WSLCB state monopolist are not included in the sample. The WSLCB provides monthly price lists for products sold in state liquor stores from February 2010 – May 2012. These lists include 3,973 unique products (UPCs). We merge WSLCB prices with the Nielsen panelist dataset on UPC. Observations without WSLCB prices either correspond to spirits bought out-of-state or to products the WSLCB does not classify as spirits (and therefore potentially bought in-state). In the latter case, these products experience no regulatory changes and therefore ought to be excluded from our principal analysis. In the former case, we would tend to lose power by excluding part of the sample. To differentiate these theories, we check whether any of these products were purchased at retailers with non-Washington 3-digit zip codes: none do.

However, Nielsen notes that store zip codes are sometimes imputed from a panelist's home zip code, so we cannot rule out inter-state shopping trips. In total, 78.52% of purchases are matched to WSLCB prices - 86.67% have matches before liberalization 69.94% have matches after liberalization. This pattern is consistent with the introduction of new products in the private market post-liberalization.

Proof

We use regular expressions to extract proof from the Nielsen *upc_descr* string. We exclude 4,067 observations that correspond to product that are less than 48 proof, as per the state definition of spirits.

C Google Maps Square Footage Calculations

This appendix section presents further details on our square footage calculations using Google Maps Developers' Square Footage Calculator and Amazon Mechanical Turk. Google Maps Developers' Square Footage Calculator allows us to overlay a tool for calculating square footage on top of Google Maps, as shown in Figure C.1. Over an XX week period in May, 2017, we hired workers on Amazon Mechanical Turk to perform this calculation for each store in our sample. In total, XX different workers, cost $XX. We believe that the Mechanical Turk platform opens the door to research requring extensive data-gathering.

Selecting Workers

We hired workers on a per-task basis. To ensure high quality responses, we screened out workers whose acceptance rate for previous work was lower than 98%, and required them to have performed at least 1,000 tasks in the past. Furthermore, workers who wanted to work with us had to pass a qualification test, where they were asked to calculate the square footage of a set of 5 stores that we had previously done ourselves and found to require attention to detail. Finally, we announced (and paid out) bonuses for the 10 most accurate workers.

Task Design

A task consists of calculating the square footage of a given store. Upon accepting a task, workers clicked-through to the Google Map Developers' Area Calculator website and inputted the store address. Then, they had to zoom in to an appropriate distance from the store, check that the store name appeared in the map, calculate the area, and enter the square footage into a text box. In cases where the store name did not appear on the map, workers could click-through to a new instance of the square footage calculator website where the store name had been inputted into the search box. If the store was still not found, the workers returned to the address-based search and calculated square footage for the given address.

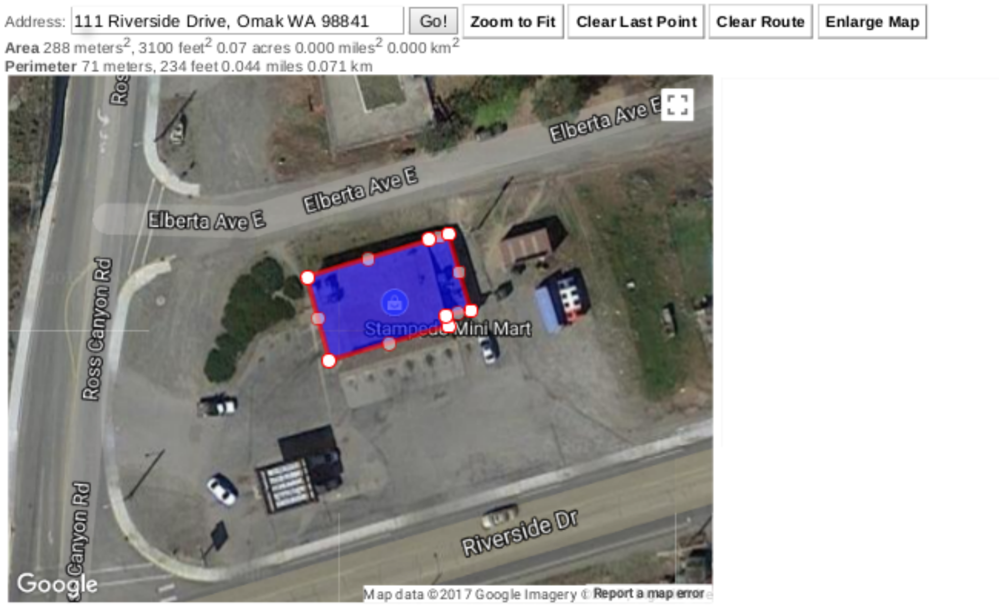


Figure C.1: Example of a Square Footage Calculation

The instructions used for the qualification test is found at the end of this Appendix section. Instructions for other stores were mostly the same, but sometimes tailored to the specific characteristics of the store type. For example, we added instructions not to consider the pumps for calculating gas station square footage.

Website data collection - Instructions (Click to collapse)

Click the link below to review the Website. Collect the following information if it's available:

- Go to the link below
- Copy and paste the Address, then click "Go!"
- Zoom into the pin and confirm the label matches the Store Name
- Outline the store by clicking on the corners.
- Corners can be rearranged with the white and grey circles
- Record the area in square feet as it appears below the address bar

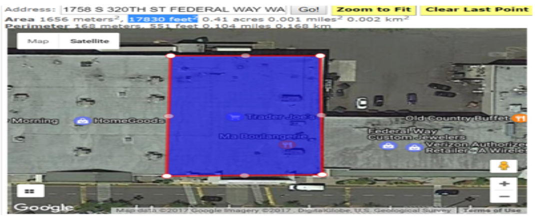
Store Name	Address
STAMPEDE MINI MARKET	111 RIVERSIDE DR OMAK WA 98841

The store can sometimes be away from the pin:

Store Name	Address
HAROLD'S GENERAL MERCHANDISE	4080 HARRAH RD HARRAH WA 98933

Stores can sometimes share a building. Use Streetview (the yellow person icon) to approximate the store size:

Store Name	Address
TRADER JOE'S #134	1758 S 320TH ST FEDERAL WAY WA 98003



Link to the Website:

Mapping Tool (http://www.mapdevelopers.com/area_finder.php)

Store Name:

${store_name}

Copy and Paste this Address:

${store_address}

Questions:

Is store name on map?

- ○ Yes
- ○ No

Comments? (optional) [ ]