

## Alcohol: Regulation of Outlet Density

### Summary Evidence Table

Author, year Design suitability Quality of execution (limitations) Study type	Location Study period Population	Intervention	Outcome	Findings	Analysis
<b>LICENSING</b>					
Blose/Holder, 1987 Greatest Good (1) Panel Cross-Sectional Time Series	North Carolina 1973–1982 Counties implementing Liquor-by-the-Drink (LBD). Three counties (Early Change Counties) implemented LBD in Nov 1978 and eight counties (Late Change Counties) implemented LBD in Jan 1979. Groups of counties chosen as unit of analysis	Change to licensing regulation in 1978 allowing the sale of spirits for on-premises consumption. Number of establishments where spirits could be purchased increased from 344 to 900 between 1977 and 1980. Change impacts on-premises outlets	Spirit sales	+ 8.3% (Early change counties) + 4.2% (Late change counties)	Interrupted Time-Series Analysis using ARIMA technique. The time of issuance of licenses used as the intervention point and not the time that legislation was passed. Each LBD county was matched on % change in per capita income (1970–1980), and % change in population (1970–1980) with an appropriate non-LBD county
			Alcohol-related crashes <u>LBD counties</u> - Had been drinking +23.6% - Male single vehicle nighttime crashes (SVNC) ≥21 years +15.7% - Male SVNC <21 years – 0.9% <u>Non-LBD Counties</u> - Had Been Drinking +15.8% - Male Single Vehicle Nighttime Crashes (SVNC) ≥21 years – 0.1% - Male SVNC <21 years –5.6%		

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Makela, 2002 Moderate Fair (2) Before-and-After	Finland 1968–1969 Cohort of 1720 men and women 15–69 years of age	1969 legislation ending the monopoly of state owned retail stores on selling medium strength (<4.7% alcohol by volume) beer. Medium strength beer became available in grocery stores and cafes. Additionally, the ban on Alko stores (state-operated retail stores) in the rural countryside ended. The number of state-owned Alko stores increased 22% from <b>132</b> to <b>161</b> stores. The number of restaurants licensed to sell medium strength beer increased 46%, from <b>940</b> to <b>1372</b> . Additionally medium strength beer could be sold in <b>17,431 grocery stores</b> and <b>2716 cafes</b> . It also became easier to establish new licensed restaurants	Annual volume of alcohol consumed	Consumption category (cl of alcohol) BL      Change 0        26 1–49    67 50–199 184 200+    103 All       85 Findings represent absolute change in consumption from baseline (BL) by baseline consumption category	Change in ethanol consumed by baseline consumption level
Wagennar, 1995 Greatest Moderate (3) Time Series, no control	New Zealand 1983–1993 (7 years pre-intervention) (3 years post-intervention) National population	The New Zealand Sale of Liquor Act of 1989. This legal policy change allowed for the introduction of table wine to be sold in grocery stores. In first 27 months after intervention 608 newly licenses off-premises alcohol outlets opened	Percent change in: - Total ethanol - Wine ethanol - Spirits ethanol - Beer ethanol	–1.6 (CI <sub>95%</sub> –7.3, 4.6) 15.6 (CI <sub>95%</sub> 6.7, 25.2) –7.9 (CI <sub>95%</sub> –19.8, 5.7) –4.1 (CI <sub>95%</sub> –8.9, 1.0)	Box-Jenkins intervention-analysis with ARIMA model for each dependent time-series variable. Intervention model adjusted for the effects of economic conditions as measured by the unemployment rate
Olafsdottir, 2002 Moderate Good (1) Before-and-After	Iceland Sales Data: 1950–1999 Self-report Consumption: 1988, 1989, 1992 Sample of 15–69-year-olds for three different years (N = 1195, N = 1118, N = 1163)	In 1989 Iceland allowed the sale of medium strength beer in grocery stores. Number of monopoly stores increased from 6 to 12 in Reykjavik, liquor license increased 49% in Reykjavik and 16% in rural areas	Alcohol sales Percent of population by sex who changed self-reported level of consumption between 1988–1992	+24% (CI <sub>95%</sub> 9.4, 40.6) Low-moderate consumers (0.1–351cl pure alcohol per 6 mo) Men –4.8% Women +0.8% High consumers (>351cl pure alcohol per 6 mo) Men +42.6% Women –7.3%	Two analyses. One modeling changes in sale of alcohol and the other measuring changes in self-reported consumption. ARIMA Time Series analysis. The model adjusts for legalization of beer (dummy coded as 0 from 1950–88 then 1 thereafter) and disposable income. It assesses the impact on alcohol sales after beer was introduced into state monopoly stores Descriptive statistics (i.e. Averages) used for three self-report cross-sectional surveys stratifying by age, gender, education, region, and drinking habits

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Gruenewald, 2006 Greatest Good (1) Panel Cross-Sectional Time Series	California 1995–2000 581 zip code areas Descriptive Statistics zip code means - Population n = 23,340 - Percentage male: 50.09 - Median Household Income: \$41,280 - Median age: 34.71 yr - African American: 6.83% - Hispanic: 27.17% - Asian: 10.31%	The study examines the temporal association between changes in alcohol outlet density and violence and theoretical formulations of the social processes that support violence in these community settings that include alcohol outlets. Overall during the six year period off-premise outlets decreased 0.43%, restaurants increased 5.3%, and bars decreased 4.0%.	Assaults requiring hospitalization per 1000 total population	A 1% increase in the outlet types below is associated with a given percent change in assault rates in a given local setting and in neighboring settings: Local off-premises 0.167% Local restaurants -0.074% Local bars 0.064% Neighboring off-premises ns Neighboring restaurants ns Neighboring bars 0.142%	Two random-effects models (one taking into account spatial relations between adjacent zip codes, the other not) produced - To address the possibility of cross-sectional differences between units biasing coefficient estimates of the longitudinal relationships, a comparison was made between a LSDV regression model and the REM model. Hausman test results were non-significant meaning that the REM model coefficients could be interpreted as an unbiased estimate. -The Non-Spatial REM model controlled for spatial auto-correlated error. - The Spatial REM model controlled for group heteroskedasticity
Hoadley, 1984 Greatest Good (1) Panel Cross-Sectional Longitudinal Design	48 U.S. states 1955–1980 284 cases (48 states X 6 5-year study periods, minus 4 cases of totally dry states) A study period consisted of a 5 year increment between 1955 and 1980 U.S. population	This study looked at a variety of state regulation and control measures and their impact on distilled spirits consumption.	Per capita spirits consumption	No. of alcohol outlet licenses per 1000 was significantly associated with spirits consumption $b = .027$ ( $p < .01$ )	A pooled regression model with dummy variables for regional and time differences allowing for a uniform shift (upward or downward) for any particular region or year. Four geographical regions were created (South, Midwest, Northeast, West). Change in time was assessed every five years between 1955–1980
McCornac, 1984 Greatest Good (1) Panel Cross-Sectional Longitudinal Design	50 US states and DC 1970–1975 Population not described, but study is population based	The study examines the association across time between alcohol outlet density, other societal variables, and spirits consumption	Per capita spirits consumption	A 1% increase in outlet density was associated with a 0.14% ( $p < .01$ ) increase in spirits consumption	OLS regression

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Markowitz, 2003 Greatest Good (1) Panel Cross-Sectional Longitudinal Design	50 US states and DC 1976–1999 Study population consisted of youth 10–24 years of age. Multiple demographic, policy, and price variables	Study analyzes the impact of changes in alcohol policy and social factors over a 24 year period. Hypothesis tested is whether or not alcohol regulatory policies are associated with youth suicides	Suicide rates for population aged 10–24 years	A 1% increase in the outlet density was associated with a given percent change in suicide rates: Male suicide 10–14 years 0.121 ns 15–19 years 0.098 (p<.05) 20–24 years 0.051 ns  Female suicide 10–14 years 0.104 ns 15–19 years –0.014 ns 20–24 years –0.029 ns	Negative Binomial Regression based on a simple demand model of the demand for health with an imbedded health production function with alcohol as a negative input in the production of health with suicide the outcome of interest. A linear specification of the reduced form demand function specifies that suicides for each gender-age group, in a state, at a point in time is a function of state alcohol regulatory variables, other state characteristics, state effects, year effects, and an error term. T-Statistics adjusted for effect of suicide clustering by year
Blake, 1997 Greatest Good (1) Panel Cross-Sectional Longitudinal Design	United Kingdom 1952–1992 Population not described, but study is population based	The study assesses the association between on- and off-premises density and its impact along with other economic and non-economic variables	Alcohol consumption	A 1% increase in the outlet types below is associated with a given percent change in alcohol consumption On-premises cider +3.1%  Off-premises cider –4.1%  Beer 2.4%	The AIDS (Almost Ideal Demand System) model using OLS regression analysis that relates alcohol expenditure to economic and non-economic variables assuming separate budgeting procedures
Xie, 2000 Greatest Good (1) Panel Cross-Sectional Longitudinal Design	Canada 1968–1986 Population described on a variety of social and economic variables	The study assesses the association between changes in alcohol availability, rates of AA membership, economic and demographic measures with liver cirrhosis rate.	- Alcohol consumption - Alcohol liver cirrhosis mortality	The number of retail outlets or agencies per 10,000 adult population was significantly associated with alcohol consumption. b = 0.19 (p<.01) but not significantly associated with liver cirrhosis mortality b = –0.85 (p>.05) when controlled for alcohol consumption	Least squares dummy variables regression model. Provincial dummy variables included to control for differences between provinces and year dummy variables used to control for differences over time

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McCarthy, 2003 Greatest Fair (2) Panel Cross-Sectional Longitudinal Design	111 small cities in California with populations not exceeding 50,000 during eight year study period 1981–1989 mean population 9014	The study examines the association across time between changes in alcohol outlet density and other exposure variables and its association with alcohol related traffic crashes and fatalities	Alcohol-related traffic crashes	1% increase in the outlet types below are associated with a given percent change in total alcohol related crashes: General off-premise density –12.6% General on-premise density +11.2%  Mean outlet density for both on and off-premise is 2.2 outlets per square mile	Negative binomial regression models. Each model includes a set of county-specific and month-specific dummy variables in order to reduce the effects of cross-section heterogeneity and serial correlation
McCarthy, 2005 Moderate Good (0) Time-Series, no control	California 1981–1989 Drivers $\geq 60$ years of age	The study examines the association across time between changes in alcohol outlet density and other exposure variables and its association to crashes in drivers aged $\geq 60$ years	Alcohol-related motor vehicle crashes	1% increase in outlet density associated with changes in: Fatality +1.70% Injury –0.81 ns Total 0.11 ns	Autoregressive models estimated to analyze monthly crashes involving older drivers. Assuming multiple degrees of autocorrelation the general model specification uses a vector of explanatory variables, a serially correlated error term, a normally distributed error term and explanatory variables to predict traffic accidents
Norstrom, 2000 Moderate Fair (2) Time-Series, no control	Norway 1960–1995 Population based study of individuals $\geq 15$ years of age	The study examines the change in on-premises outlet density over time and its relation to violent crime. Outlet density increased slowly from 1960 to 1982, then rapidly from 1983 to 1995	- Violent crime investigations (preferred measure) - Violent crime convictions	One unit increase in outlet density associated with a 0.51% increase in violent crime convictions ( $p=.057$ ) and a 0.45% increase in violent crimes investigated ( $p=.028$ )	ARIMA time series analysis. Analysis performed on the differenced series (yearly changes analyzed as opposed to raw series data). Model includes outlet density and adjusts for a noise term. Box-Ljung test for residual autocorrelation and Chow test to determine if the parameter estimates are stable during the study period
<b>BANS</b>					
Baughman, 2001 Greatest Fair (2) Panel Cross-Sectional Longitudinal Design	All 254 counties in Texas 1975–1996 Study is a comparison between dry and wet counties and counties that implemented change to alcohol policy during study period	At the start of 1975, 87 of Texas' 254 counties were dry; 33 of these legalized some type of alcohol sales by 1996. There were 32 other changes in which already non-dry counties liberalized alcohol control policies	Alcohol-related motor vehicle crashes	A 1% decrease in outlet density is associated with a 5.3% ( $p<.05$ ) increase in alcohol-related MVCs	Linear mean regression model that accounts for observed and unobserved county-specific characteristics

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Berman, 2000 Least Fair (2) Before-and-After	Alaska 1980–1993 97 small communities with predominantly Alaska Native population. All had 1990 population of less than 5000 and all but two had fewer than 1000 residents	Alaska communities that used the state local option law to restrict alcohol (went “dry” or “damp”) at some point between 1980 and 1993”	- Injury - Suicides - Homicides	Percent change: Injury –9.0% Suicide –0.5% Homicide –58.8%	Percent change
Bowerman, 1997 Least Fair (NR) Before-and-After	Barrow, Alaska 1992–1995 Jan 1992– Apr 1994 (pre-ban) Nov 1994– Mar 1995 (post-ban) Pregnant women in Barrow Alaska in both the pre and post ban era. Both groups received the same standard prenatal care with fetal alcohol syndrome education	A local option was passed banning the possession of alcohol in Barrow, Alaska making it the largest community in Alaska to prohibit the possession of alcohol. Prior to this legislative change, alcohol was banned in all regional villages surrounding Barrow	Self-report alcohol and substance use	% alcohol abuse during pregnancy Pre-ban / Post-ban Trimester 1 43% vs 11% Trimester 2 17% vs 7% Trimester 3 14% vs 5% Only the trimester 1 change was significant: –75%, CI <sub>95%</sub> –93, –6  Prenatal alcohol abuse in surrounding regional area Pre-ban / Post-ban 42% vs 9%	Percent change and relative risk
Chui, 1997 Moderate Fair (NR) Before-and-After with Retrospective Time Series	Barrow, Alaska 1993–1996 61% Inupiat, 24% Anglo, 15% other ethnic groups mostly Asian or Asian- American	Ban on alcohol sale, importation, and possession was: Enacted on November 1, 1994 Repealed on November 1, 1995 Re-imposed importation ban on March 1, 1996 Re-imposed possession ban Apr 1, 1996	Average monthly number of alcohol-related outpatient visits	Nov 1993– Oct 1994 90 Nov 1994 – Oct 1995 16 (ban1) Nov 1995 – Feb 1996 62 Mar 1996 – Jul 1996 17 (ban 2)  After implementation of ban 1, visits decreased 82% and after implementation of ban 2, visits decreased 72%	Autoregressive Integrated Moving Average (ARIMA) time-series analysis. Internal parameters at lags 1 and 12 months. The ban was 0 during baseline and 1 during first ban, reset to zero ban being repealed, and reset to one when re-enacted

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May, 1975 Moderate Fair (3) Before-After-Before, no control	Great Plains, US 1969–1971 Border county: 7285 residents, 95% White. Only 4.3% of residents in border county are Native American, consequently it is assumed that the Native Americans in the border county were there primarily on transient business	Legalization of the sale of beer, wine, and liquor in June 1970 that lasted until the end of July 1970	Native American arrests in border counties and by tribal police	Native American arrests in the border county were 47% higher during ban period and arrests by tribal police were 20% higher in ban period relative to period without ban	Z-test for proportion and chi- square
Smart, 1976 Greatest Fair (2) Natural Experiment with control community	Owen Sound, Ontario 1970–1974 Owen Sound population 18,469 (experimental population) Collingwood population 9775 (control population)	First lounge (on-premises establishment) opened in Owen Sound Jan 15, 1973, and three more lounges opened during that same year. This was the last “dry” city in Southern Ontario	Alcohol impaired motor vehicle crashes (BAC $\geq$ .08)	114% ( $p < .05$ ) increase in alcohol-involved crashes after the removal of the ban of on-premises establishments	Methods not described Chi Square test in results section
<b>PRIVATIZATION</b>					
Holder, 1990 & 1991 Greatest Fair (2) ARIMA Time Series with Control	Iowa & West Virginia 1968–1989 (Iowa) 1968–1987 (WV) NR	Iowa privatized retail wine sales in 1985 and spirits sales in 1987 West Virginia privatized retail wine sales in 1981	Alcohol consumption	Effect of wine privatization on consumption (Iowa): Spirits $-5.4\%$ ( $\pm 4.7$ ) Wine $+93.1\%$ ( $\pm 24.8$ ) Beer $-3.1\%$ ( $\pm 5.0$ )  Effect of spirits privatization on consumption (Iowa) Spirits $+9.5\%$ ( $\pm 6.0$ ) Wine $-12.1\%$ ( $\pm 8.5$ ) Beer $+1.3\%$ ( $\pm 16.3$ )  Effect of wine privatization (West Virginia) Spirits $-13.8$ ( $\pm 5.9$ ) Wine $+48.2$ ( $\pm 12.3$ ) Beer $+12.0$ ( $\pm 3.7$ )	Multiple Time Series Analysis - To control for national patterns of change in consumption of beer, wine, and spirits over time, monthly nationwide sales figures (less Iowa sales) were included as a covariate in the time- series models for each beverage when estimating intervention effects - Used Auto Regressive Integrated Moving Average (ARIMA) and intervention models to control for autocorrelation in alcohol sales and consumption data

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MacDonald, 1986 Moderate Fair (3) Time-Series without control	Idaho, Maine, Washington NR NR	Retail wine sales privatization in each of the four states occurring between 1961–1971	Wine consumption	Idaho (privatized in 1971) 190% increase (p<.05) Maine (privatized in 1971) 305% increase (p<.05) Washington (privatized in 1969) 26% increase	Regression Analysis Note that the type of regression analysis used would not account for seasonality or serial auto-correlation which can result in over-inflated confidence limit estimates
Mulford, 1992 Greatest Fair (NR) ARIMA time series with control	Iowa 1980–1990 Population not described, but study is population based	Retail wine privatization in 1985 and retail spirits privatization in 1987	Wine and spirits consumption	Wine +0.5% (±15.9) Spirits +0.7% (±5.3)	ARIMA time series, excluding alcohol content from wine coolers
Ramstedt, 2002 Moderate Fair (2) Time Series without control	Sweden 1973–1981 Population not described, but study is population based	Repeal of sales of medium strength beer in grocery stores in Sweden. Prior to intervention the product was available in 11,550 grocery stores to anyone aged ≥18 years. After intervention sales were restricted to slightly more than 300 retail monopoly stores and to individuals aged ≥20 years	Suicide, motor vehicle crashes, falls, and alcohol-related hospitalizations	Significant increases were reported for Alcohol-related hospitalization for those aged 10–19 years and motor vehicle crashes for all ages except 20–39 years	ARIMA model that includes variables adjusting for repeal of medium-strength beer, decriminalization of public drunkenness, and a noise term estimating other etiological factors. Box-Ljung Q-Stat used to test that no significant temporal structure remained after model estimation
Smart, 1986 Greatest Fair (2) Time Series with control	Quebec, Canada 1967–1983 NR	Introduction of wine to grocery stores increased the number of retail outlets from 353 to ~9000. At initial time of deregulation 30 locally produced wines were sold; this number increased to 55	Wine sales	Relative percent change (compared to Ontario-control province) in wine consumption = 2.7%. The increase was not significant	Ordinary Least Squares (OLS) Regression model. Saturated model included three main effects and four related interaction terms 1. Phase of intervention 2. Time (a linear term measured in 0.5 increments and centered at the point of intervention) 3. Province 4. Four interaction terms
Trollidal, 2005 Greatest Fair (2) Time Series with control population	Alberta, Canada 1950–2000 Population not described but study is population based. Rest of Canada used as control population	Privatization of wine and spirit retailing occurred in staged process between 1985 and 1994	Alcohol consumption	Spirits +12.7% (±10.5) Wine –1.0% (±17.6) Beer –1.0% (±7.4)	Time Series analysis. Variables used in analysis were differenced to remove long-term trends and avoid spurious relationships. Privatization variable given value between 0 and the value of this variable was raised incrementally from 0 to 1 as larger parts of the market became privatized. Model also adjusts for price and disposable income



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Wagenaar, 1995 Greatest Fair (2) Time Series with Control	Alabama, Idaho, Maine, Montana, New Hampshire 1968–1991 Population not described but study is population based	Retail wine privatization in Alabama in 1980, Idaho eliminated public monopoly on wine in 1971, Maine privatized sale of wine in 1971, Montana privatized wine sales in 1979, New Hampshire privatized retail wine sales in 1978.	Wine consumption	Alabama 42.0 (CI <sub>95%</sub> 13.4, 77.7) Idaho 150.1 (CI <sub>95%</sub> 129.2, 172.9) Maine 136.7 (CI <sub>95%</sub> 112.6, 163.5) Montana 75.3 (CI <sub>95%</sub> 56.9, 96.0) New Hampshire 13.0 (CI <sub>95%</sub> 1.2, 26.2)	Box-Jenkins with identification or specification of a parsimonious ARIMA model

AIDS Almost Ideal Demand System; ARIMA Autoregressive Integrated Moving Average; BAC blood alcohol concentration; cl centiliter(s); LBD liquor by the drink; LSDV Least Squares Dummy Variable; mo month(s); MVC motor vehicle crash; OSL Ordinary Least Squares; REM Random effects model; yr year(s)