DISSERTATION

THREE ESSAYS ON HORIZONTAL REGULATION LIMITING ALCOHOL SALES

Submitted by

Nathan Palardy

Department of Agricultural and Resource Economics

In partial fulfillment of the requirements

For the Degree of Doctor of Philosophy

Colorado State University

Fort Collins, Colorado

Spring 2022

Doctoral Committee

Advisor: Marco Costanigro

Joe Cannon
Josh Berning
Jude Bayham

ABSTRACT

THREE ESSAYS ON HORIZONTAL REGULATION LIMITING ALCOHOL SALES

This dissertation considers the impact of loosening horizontal regulations that limit competition among alcohol retailers on producers, retailers, and consumers. A recent trend towards the liberalization of alcohol retail has led many states, including Washington, Tennessee, Oklahoma, Utah, Kansas, and Colorado, to relax horizontal restrictions and allow for the sale of alcohol at grocery and convenience stores. Prior to the law changes, the sale of almost all alcoholic beverages was restricted to liquor stores. The new retail channels have created opportunities and challenges for alcohol producers and traditional retailers while creating more choices for consumers. The first chapter provides a brief overview of the alcohol industry and regulation in the U.S.

The second chapter examines how the legalization of full-strength beer sales in grocery and convenience stores impacted craft brewers in Colorado, a core region for craft beer production. A statewide survey of the marketing strategies of craft breweries revealed that the new retail channels brought limited change to how craft breweries sell beer. Large breweries appear able to leverage their scale and brand recognition to gain access to the grocery stores, while smaller breweries face significant logistical and distribution barriers. Grocery stores captured a substantial share of craft beer sales at the expense of liquor stores. Sales of craft beer in convenience stores remain negligible.

The third chapter investigates the effect of liberalized beer sales on Colorado liquor stores. While prior research has examined the effects of alcohol liberalization on liquor stores at the state-level,

the impact may vary between rural and urban communities. I exploit a novel dataset containing firm-level foot traffic patterns from SafeGraph Inc. to investigate the impact of liberalizing beer sales on liquor store foot traffic using two empirical approaches: interrupted time series analysis and state space forecasting. The policy change caused liquor store foot traffic to substantially decline in urban counties, but had no impact in rural counties, suggesting that rural liquor store shoppers did not substantially change shopping behavior. I discuss the implications for alcohol retailers, producers, and consumers.

In my final chapter, I broaden my analysis of the effect of liberalized alcohol sales on liquor stores to include two additional states: Oklahoma and Kansas. I exploit heterogeneity in state policy to determine whether different levels of alcohol liberalization (e.g. legalizing beer and wine sales outside of liquor stores vs legalizing beer sales only) impacts the magnitude of the effect on consumers' decision to shop at liquor stores. I estimate the effect in each state using firm-level foot traffic data from SafeGraph Inc. and a novel difference-in-differences estimator. I find that alcohol liberalization had a substantial negative impact on liquor store foot traffic in all states, however, my ability to differentiate the impact of different levels of alcohol liberalization was limited. Results can help policy makers weigh the costs to liquor stores against the benefit to consumers.

ACKNOWLEDGEMENTS

This work was supported by the Federal State Marketing Improvement Program, Agricultural Marketing Services, United States Department of Agriculture, and the Colorado Brewers Guild.

Agreement No. AM180100XXXXG152

I thank Charlie Hoxmeier at Gilded Goat Brewing Company, Kevin Frasure with Odell Brewing Company, Tim and Carol Cochran with Horse & Dragon Brewing Company, Mat Dinsmore with Wilbur's Total Beverage, Steve Findley with the Colorado Beer Distributors Association, Steve Nichols with High Country Beverage, Robert Butker with Crooked Stave Artisans, and Grier Bailey with the Colorado Wyoming Petroleum Marketers Association for taking the time to be interviewed and providing vital insight into Colorado's beer supply chain. I also thank the Colorado Brewers Guild for assistance with developing and distributing our brewery marketing mix survey.

TABLE OF CONTENTS

CHAPTER 1 LITERATURE REVIEW

A Brief History of US Alcohol Regulation

Alcohol regulation in the US has a long and contentious history, dating back to the Whiskey Rebellion in 1791 against alcohol taxes levied to pay for America's Revolutionary War debt (Riggs 2015b). Prior to 1919, alcohol regulation was much more relaxed than it is today. Neither the federal government nor many states imposed a minimum drinking age, producers could sell directly to retailers, and breweries often owned taverns that sold exclusively their own products. These establishments, known as saloons, were notorious for anticompetitive business practices, predatory marketing tactics, and were blamed for overconsumption and a host of social ailments that ultimately led to prohibition in 1919 (Kurtz and Clements 2014; Riggs 2015a). It would eventually become clear that, while prohibition succeeded at curbing alcohol consumption, it also greatly reduced federal tax revenue and fueled a rise in organized crime (Riggs 2015a). In 1933, the power to regulate the production, distribution, and sales of alcohol was delegated to the states by the twenty first amendment, creating the patchwork of alcohol regulation that exists today (Lam 2014).

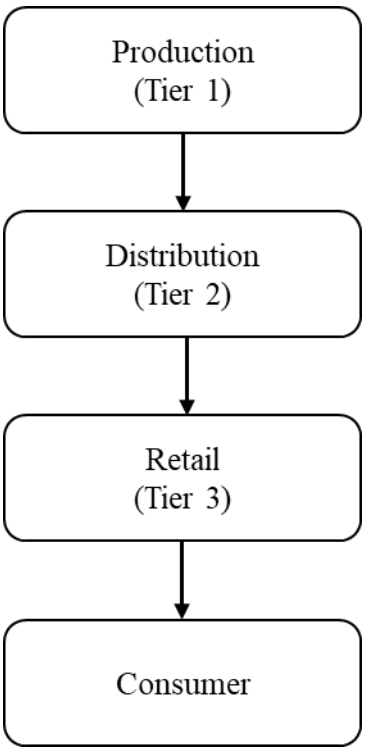

Figure 1.1. Standard representation of the three-tier system

Heterogeneity aside, all states apply some form of the three-tier system to accomplish the following objectives: generate revenue for the state, encourage responsible consumption, and facilitate state and local control of the alcohol supply chain (Lam 2014; Kurtz and Clements 2014). In its purest form, shown in Figure 1.1, the three-tier system mandates the divorcement of production, distribution, and retail, meaning that an entity in one tier may not have ownership or financial interest in an entity belonging to a different tier (Zolton 2020). These goals are not necessarily synergistic (e.g. lower alcohol consumption also means less revenue) and states must balance competing objectives.

Modern structure of the US beer supply chain

According to Elzinga (2011), modern beer production in the US went through two distinct periods: 1) a period of consolidation spanning the end of prohibition to the end of 70's and 2) a period of fragmentation starting in the 80's and continuing today. The period of consolidation

following prohibition is attributed to firms exploiting economies of scale (Tremblay and Tremblay 2005; Elzinga 2013) and the use of mass advertising to gain a competitive advantage over rivals (Tremblay and Tremblay 2005). The current fragmentation period is thought to be driven by a shift in consumer preferences towards higher quality and a greater selection of beer (Elzinga 2011). To illustrate the degree of fragmentation that has occurred since the 80's, the number of firms in the production tier increased from a low of 48 total breweries in 1980 up to 6,400 in 2019 (National Beer Wholesalers Association 2020; Elzinga 2011). However, concentration as measured by market share remains high, with 78.9% of beer sales by volume coming from the top 5 producers in 2019 and only 3% of volume share coming from the bottom 95% of producers (National Beer Wholesalers Association 2020).

Coinciding with the fracturing of the production tier was a period of consolidation among beer distributors. The number of distributors declined from around 4,500 in 1980 to around 3,000 in 2019 (National Beer Wholesalers Association 2020). One explanation is that consumer's demand for variety and novelty fueled economies of scales among distributors. To illustrate, the average distributor carried 185 SKUs in 1999, compared to 1,174 in 2018. The costs associated with carrying more brands are more easily offset when spread over greater volume. Additionally, retailers may find it more efficient to buy from fewer distributors. One may argue that the overall number of distributors in the US remains large. However, most distributors operate within one state and distribution territories frequently do not cover an entire state. This implies that distributors compete on a regional and local scale rather than at the national level.

Regarding the retail tier, the number of alcohol retailers in the US increased from almost 532,000 in 2008 to around 634,000 in 2019 (National Beer Wholesalers Association 2020) and implies low industry concentration. However, the increase in alcohol retailers from 2008 to 2019 can be

partially attributed to some states liberalizing alcohol sales at grocery and convenience stores. Nationally, 73% of US beer sales are from grocery stores, convenience stores, or mass merchants. The national data indicates that, when a state transitions from alcohol sales at liquor store only to alcohol sales at grocery and convenience stores, the liquor store sector will likely lose a substantial share of the alcohol market.

Political economy and the three-tier system

Recent studies have found that the current system of alcohol regulation favors some members of the supply chain over others (Lafontaine and Slade 2008; Burgdorf 2019; Williams 2017; Riekhof and Sykuta 2005). Challenges to current regulatory framework have become contentious political issues as groups representing public and private interests compete to shape the regulatory environment, resulting in a complex bargaining process with the outcome difficult to predict. The private-interest theory of regulation (see Stigler (1971), Posner (1974), and Becker (1983)) suggests that regulation will reflect the interests of groups that most efficiently generate political pressure. Empirical work by Kroszner and Strahan (1999) and Riekhof and Sykuta (2005) support the private-interest theory, concluding that the *relative* political strength of groups with competing economic interests explain regulatory changes. Further, rent seeking theory, pioneered by Tullock (1967) and Kruegar (1974), implies that firms may expend resources to create, protect, or transfer rents by manipulating the political system rather than engaging in productive activity. The lobbying efforts evident in the alcohol industry indicate efforts by firms to pursue and protect rents created by regulation. Rent seeking and rent protecting activities are unproductive: no new value is created, and valuable resources are consumed (Tollison 2012).

Regulations in the alcohol sector can be subdivided by regulations on vertical relationships and regulations on horizontal competition. For example, the three-tier system formally regulates integration and dealings between upstream and downstream firms. Similarly, some states regulate horizontal competition in alcohol retail by restricting license eligibility to certain business types. Though our analyses focus on retail license restrictions, vertical and horizontal regulations coexist and interact, necessitating a more general discussion.

There is a long running debate among economists on the competitive effects of vertical regulation. Some evidence suggests they lead to efficiency improvements by aligning the incentives of manufacturers and retailers (Sass 2005; Sass and Saurman 1996; Shughart 1990) while other studies reveal potential anticompetitive effects (Slade 1998; Ornstein and Hanssens 1987; Culbertson and Bradford 1991). LaFontaine and Slade (2008) review the empirical literature in a number of industries and compare the impact of privately imposed vertical restrictions on consumer welfare to the impact of government mandated vertical restrictions. The authors generally find positive consumer welfare effects when members along a supply chain privately impose a vertical restriction on another member (e.g. exclusive dealing between a seller and buyer). In contrast, the authors found that government intervention in vertical relationships tend to reduce consumer welfare. Specific to the beer industry, a recent study by Burgdorf (2019) concludes that government mandated exclusive territories for beer distributors creates artificial rents by protecting wholesalers, increasing the costs of distribution for manufacturers and reducing competition by discouraging new breweries from entering. Similarly, a paper by Williams (2017) argues that beer franchise laws, which require a brewery to demonstrate "just cause" before terminating contract with a distributor, provide the distributor with an grace period to address the cause, and provide a distributor with compensation upon the termination of a

contract (Sorini 2014), stymy the growth of small craft breweries. To summarize, the literature suggests that government mandated vertical restraints disproportionately favor distributors and disadvantage small breweries.

In a bid to reshape the system, state and national craft brewery associations are lobbying to allow breweries producing below a threshold to self-distribute (Kurtz and Clements 2014; Williams 2017). Depicted in Figure 1.2, limited self-distribution provides an exception to the mandated divorcement of the first and second tier, allowing a brewery to sell directly to a retailer and capture the markup that would go to a third-party distributor. Self-distribution does not preclude a brewery from contracting with a distributor, provided the parties establish exclusive territories. Empirical evidence shows that legalizing self-distribution increases the number of breweries (Malone and Lusk 2016), which suggests and increase in expected returns and entry.

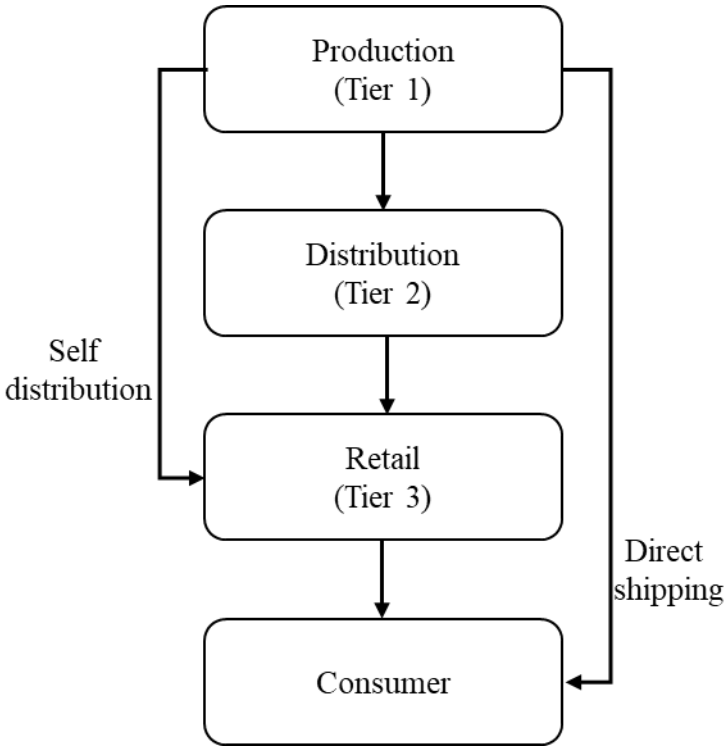

Figure 1.2. Common exceptions to the three-tier system

A few states, such as Oregon and Vermont, legalized the direct shipment of beer to consumers by small breweries, allowing them to bypass the three-tier system entirely (see Figure 1.2) (Zolton 2020). Unsurprisingly, a coalition of national breweries and distributors jointly oppose laws allowing direct beer shipments, perceiving it as a threat to the protections they enjoy under the three-tier system (Kurtz and Clements 2014). However, the direct shipment of wine from producers to consumers, which accounted for 10% of all wine sales 2017, is already legal in 43 states, provided that the winery produces under a specified threshold (Zolton 2020). The reason for the discrepancy between wine and beer policy is likely because many states, starting with California, voted to allow the direct shipment of wine to consumers in the 80s and 90s, just as the number of craft breweries was starting to rise. A similar movement may happen for beer as the industry becomes larger and more efficient at generating political pressure.

Retail license restrictions that limit horizontal competition are a similarly controversial. States fall into one of two categories with respect to alcohol retail regulation: license states and control states. License states are the most common and use a licensing system to regulate businesses in the three-tiers as well as raise revenue (Kurtz and Clements 2014). Among license states, different degrees of horizontal regulation limit which retailers can sell beer for off-premise consumption. For example, Minnesota restricts all off-premise alcohol sales to liquor stores while Arizona permits beer sales at grocery and convenience stores. Conversely, in the 18 control states, the government directly owns and operate businesses in the distribution tier, the retail tier, or both.

A recent push by a coalition of grocery stores, convenience stores, distributors, and national breweries to remove horizonal regulation that would expand the retail tier to include grocery and

convenience stores has seen some success in several states[1], as shown in Figure 1.3. The coalition argues that limiting alcohol sales to liquor stores is anticompetitive, constrains consumer choice, and results in higher prices (Staaf, Hunt, and Findley 2017; Heck 2016; Sealover 2018c). In a modern bootleggers and Baptists alliance, liquor stores and social interest groups counter that expanding alcohol sales will provide minors with more access to alcohol, hurt small businesses, limit consumer choice, and result in higher social costs (Akkam 2009; National Alcohol Beverage Control Association 2016; Sealover 2018c). Consumers are somewhat sidelined in the bargaining process as they can only indirectly participate through advocacy groups and politicians. Additionally, there may be little incentive for consumers to mobilize if the effect on an individual is small despite there being a large aggregate welfare effect. Even ballot initiatives, which on the surface may appear to be citizen-driven, are dominantly underwritten financially and organizationally by vested special interests (Ellis 2002).

[1] In the past decade Colorado, Kansas, Utah, Oklahoma, Tennessee, and Washington have liberalized alcohol retail.

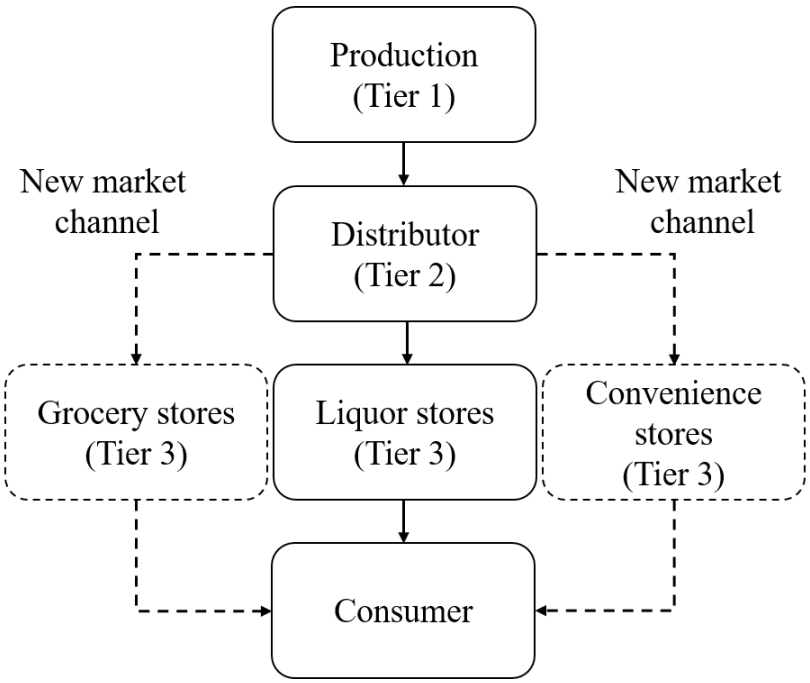

Figure 1.3. Removal of horizontal restrictions creates new market channels in the retail tier

The response from craft breweries to lifting horizontal regulation on alcohol licenses has been mixed and depends on state-specific nuances. In Colorado, the Brewers Guild was neutral while individual breweries supported either side (Sealover 2018a; 2018b). Supporters argued grocery and convenience stores would provide increased access to consumers whereas other breweries were concerned that national retailers would exercise bargaining power over self-distributing breweries, demand preferential terms of trade, and deny shelf space to smaller brands lacking established demand. Meanwhile, the Craft Brewers Association of Oklahoma supported expanding alcohol retail after multiple provisions were added to the bill, including one that would allow craft breweries to self-distribute to retailers (Gillock 2018). The Utah Brewers Guild took a stance in opposition of alcohol retail liberalization in their state, arguing that a provision imposing a 5% ABV cap on beer available in grocery stores would primarily benefit macrobreweries and decrease craft sales due to lower foot traffic at state-run liquor stores (Alder

2019). In summary, the legislative process and the new market channels present both challenges and opportunities that makes the overall impact of liberalization on craft producers ambiguous.

The controversy over liberalization has attracted the attention of scholars and led to the creation of a growing body of empirical research. Costanigro, Rickard, and Garg (2013) find that allowing beer and wine sales at grocery stores increases consumption and decreases prices for consumers, implying that license restrictions may be anticompetitive. Byrne and Nizovtsev (2017) estimate that expanding alcohol sales beyond liquor stores will have a negative impact on employment, wages, and the number of stores in the liquor store sector without a compensating increase in grocery and convenience stores, providing evidence that liberalization may harm small businesses. In a study anticipating the transitional costs of expanding wine retail to grocery stores in New York, Rickard (2012) predicts an increase in revenue for wineries and grocery stores, an increase in tax revenue for the state, and a fall in revenue for liquor stores. Finally, national level data shows that convenience stores, grocery stores, and mass merchants account for 73% of off-premise beer sales (Beer Institute 2018), suggesting that expanding alcohol sales in states that only sell beer at liquor stores may lead to a significant share of sales being captured by other market channels. Part of the challenge in identifying the causal effects of alcohol policy is that the three-tier system and the curtain of intricate state-specific clauses, licenses, vertical restraints, and exemptions effectively mask the political and economic forces at play and make ex ante predictions difficult.

Dissertation structure

This dissertation contains three essays on the impact of loosening horizontal regulations that restrict competition among alcohol retailers. The second chapter provides an in-depth analysis of the effect of deregulating alcohol sales on Colorado's craft beer producers. On January 1st, 2019,

the state legalized the sale of full-strength beer in grocery and convenience stores, which before could only sell "near-beer" below 3.2% ABW. I provide a detailed description of the regulatory environment specific to Colorado before characterizing the marketing strategies (product, packaging, promotion and distribution) of breweries before and after full-strength beer entered grocery and convenience stores. I use primary data collected from a statewide survey of craft breweries conducted in the second half of 2019 to show how breweries ranging in size from small taprooms to regional giants adapted to the new retail environment. I discuss major challenges faced by the sector and provide targeted recommendations based on brewery size.

In the third chapter I investigate the effect of liberalized beer sales on Colorado liquor stores with specific attention given to variation between rural and urban areas. While prior research has examined the effects of alcohol liberalization at the state-level, there is reason to think that rurality may moderate the impact. Rural consumers, who tend to prefer macro beer over other alcohol types (Hart and Alston 2020), may opt to shop more in the grocery channel where macro beer is readily available. On the other hand, competition between liquor stores and major grocery chains, and therefore the impact on liquor store foot traffic, may be greater in suburban and urban areas due to outlet proximity and density. A decline in foot traffic and the potential closure of liquor stores would potentially have a greater effect on rural alcohol producers where there are fewer off-premise alcohol retailers. I investigate the impact of liberalizing beer sales on liquor store foot traffic using two empirical approaches: interrupted time series analysis (ITSA) and state space forecasting. I find that the policy change caused liquor store foot traffic to substantially decline in urban counties, but no impact in rural counties, suggesting that rural liquor store shoppers did not substantially change shopping behavior. I discuss the implications for alcohol retailers, producers, and consumers.

In my final chapter, I broaden my analysis of liquor store foot traffic to include three states: Oklahoma, Colorado, and Kansas. In contrast to chapter 3, which focuses on intrastate variation, the objective of chapter 4 is to determine how different degrees of alcohol liberalization enacted by each state impacts consumers' decision to shop at liquor stores. I hypothesize that trips to liquor stores and the new market channels will become closer substitutes under more liberal alcohol retail reform, thereby leading to a greater impact on liquor stores in the states that expanded alcohol sales to a greater degree. I estimate the impact of the policy change in each state using a new difference-in-differences estimator robust to an evolving treatment effect. In addition to providing a robustness check for the state-level results from my second chapter, my third study makes several contributions. First, it assesses the claim made by liquor store associations that any liberalization of alcohol retail will have a devastating impact on the liquor store sector. By estimating the losses to liquor stores resulting from the policy change, I enable policy makers in other states considering similar legislation to weigh the potential costs against the benefits. The second contribution is quantifying the extent to which consumer market channel choice is constrained by alcohol retail restrictions, thereby evaluating the claim made by advocates for alcohol liberalization that consumers are the primary beneficiaries. My final contribution is the introduction of a novel dataset of consumer foot traffic that can provide timely insight on consumer shopping behavior.

REFERENCES

Akkam, Alia. 2009. "Last Store on Main Street Coalition Continues the Fight Against Wine in Supermarkets." *Beverage Media*, March 2009.

Alder, Carolyn Webber. 2019. "Utah Breweries Opposed to Bill to Allow Full-Strength Beer in Grocery Stores." *Park Record*, February 16, 2019, sec. Business. https://www.parkrecord.com/news/business/utah-breweries-opposed-to-bill-to-allow-full-strength-beer-in-grocery-stores/.

Becker, Gary S. 1983. “A Theory of Competition Among Pressure Groups for Political Influence.” *The Quarterly Journal of Economics* 98 (3): 371–400.

Beer Institute. 2018. “Annual Report 2018: Brewing Results.” https://www.beerinstitute.org/wp-content/uploads/2018/12/Beer-Institute-Annual-Report-2018.pdf.

Burgdorf, Jacob. 2019. “Impact of Mandated Exclusive Territories in the US Brewing Industry: Evidence from Scanner Level Data.” *International Journal of Industrial Organization* 63 (March): 376–416. https://doi.org/10.1016/j.ijindorg.2018.12.001.

Byrne, Paul, and Dmitri Nizovtsev. 2017. “Exploring the Effects of State Differences in Alcohol Retail Restrictions.” *International Review of Law and Economics* 50 (June): 15–24. https://doi.org/10.1016/j.irle.2017.04.001.

Culbertson, W. Patton, and David Bradford. 1991. “The Price of Beer: Some Evidence from Interstate Competition.” *International Journal of Industrial Organization* 9 (2): 275–89. https://doi.org/10.1016/S0167-7187(05)80008-6.

Ellis, Richard (Richard J.). 2002. *Democratic Delusions : The Initiative Process in America*. *Democratic Delusions : The Initiative Process in America*. Studies in Government and Public Policy. Lawrence: University Press of Kansas.

Elzinga, Kenneth G. 2011. “The U.S. Beer Industry: Concentration, Fragmentation, and a Nexus with Wine.” *Journal of Wine Economics* 6 (2): 217–30. https://doi.org/10.1017/S1931436100001619.

———. 2013. “The Beer Industry.” In *The Structure of American Industry*, 12th ed. Waveland Press.

Gillock, Shea. 2018. “The Real End of Oklahoma’s Prohibition.” *Localites OKC* (blog). October 9, 2018. https://www.localitesokc.com/happenings-blog/cbaoblog.

Heck, Josh. 2016. “Uncork Kansas Pushing New Alcohol-Sales Legislation.” *Wichita Business Journal*, April 2016. https://www.bizjournals.com/wichita/blog/2016/04/uncork-kansas-pushing-new-alcohol-sales.html.

Kroszner, R. S., and P. E. Strahan. 1999. “What Drives Deregulation? Economics and Politics of the Relaxation of Bank Branching Restrictions.” *The Quarterly Journal of Economics* 114 (4): 1437–67. https://doi.org/10.1162/003355399556223.

Krueger, Anne O. 1974. “The Political Economy of the Rent-Seeking Society.” *The American Economic Review* 64 (3): 291–303. https://doi.org/10.1007/978-3-540-79247-5_8.

Kurtz, Barry, and Bryan H Clements. 2014. “Beer Distribution Law as Compared to Traditional Franchise Law.” *Franchise Law Journal* 33 (3): 13.

Lafontaine, Francine, and Margaret Slade. 2008. “Exclusive Contracts and Vertical Restraints: Empirical Evidence and Public Policy.” In *Handbook of Antitrust Economics*, 391–414.

MIT Press. http://masonlec.org/site/rte_uploads/files/GAI/Readings/Economics%20Institute/LaFontaine%20and%20Slade_Exclusive%20Contracts.pdf.

Lam, Tammy. 2014. “Brew Free or Die: A Comparative Analysis of U.S. and E.U. Craft BeerRegulations.” *Cardozo Journal of International and Comparative Law* 23 (1): 197–xviii.

Malone, Trey, and Jayson L. Lusk. 2016. “Brewing up Entrepreneurship: Government Intervention in Beer.” *Journal of Entrepreneurship and Public Policy* 5 (3): 325–42. https://doi.org/10.1108/JEPP-02-2016-0004.

National Alcohol Beverage Control Association. 2016. “Grocery and Convenience Stores as Alcohol Outlets.” https://www.nabca.org/sites/default/files/assets/publications/white_papers/GroceryStoresPaper.pdf.

National Beer Wholesalers Association. 2020. “Industry Fast Facts.” NBWA: America’s Beer Distributors. 2020. https://www.nbwa.org/resources/industry-fast-facts.

Ornstein, Stanley I., and Dominique M. Hanssens. 1987. “Resale Price Maintenance: Output Increasing or Restricting? The Case of Distilled Spirits in the United States.” *The Journal of Industrial Economics* 36 (1): 1–18.

Posner, Richard A. 1974. “Theories of Economic Regulation.” *The Bell Journal of Economics and Management Science* 5 (2): 335. https://doi.org/10.2307/3003113.

Rickard, Bradley J. 2012. “The Economics of Introducing Wine into Grocery Stores.” *Contemporary Economic Policy* 30 (3): 382–98. https://doi.org/10.1111/j.1465-7287.2011.00272.x.

Rickard, Bradley J., Marco Costanigro, and Teevrat Garg. 2013. “Economic and Social Implications of Regulating Alcohol Availability in Grocery Stores.” *Applied Economic Perspectives and Policy* 35 (4): 613–33. https://doi.org/10.1093/aepp/ppt018.

Riekhof, Gina M., and Michael E. Sykuta. 2005. “Politics, Economics, and the Regulation of Direct Interstate Shipping in the Wine Industry.” *American Journal of Agricultural Economics* 87 (2): 439–52. https://doi.org/10.1111/j.1467-8276.2005.00733.x.

Riggs, Thomas, ed. 2015a. “Prohibition.” In *Gale Encyclopedia of U.S. Economic History*, 2nd ed., 2:1063–66. Farmington Hills, MI: Gale. https://link.gale.com/apps/doc/CX3611000729/GVRL?u=coloradosu&sid=GVRL&xid=ad155dcb.

———, ed. 2015b. “Whiskey Rebellion.” In *Gale Encyclopedia of U.S. Economic History*, 2nd ed., 3:1471–72. Farmington Hills, MI: Gale. https://link.gale.com/apps/doc/CX3611000984/GVRL?u=coloradosu&sid=GVRL&xid=0aa02671.

Sass, Tim R. 2005. “The Competitive Effects of Exclusive Dealing: Evidence from the U.S. Beer Industry.” *International Journal of Industrial Organization* 23 (3–4): 203–25. https://doi.org/10.1016/j.ijindorg.2005.01.006.

Sass, Tim R., and David S. Saurman. 1996. “Efficiency Effects of Exclusive Territories: Evidence from the Indiana Beer Market.” *Economic Inquiry* 34 (3): 597–615. https://doi.org/10.1111/j.1465-7295.1996.tb01399.x.

Sealover, Ed. 2018a. “A 2-Year-Long Battle over Beer Sales Comes to a Head Monday at the Colorado Capitol.” *Denver Business Journal*, April 20, 2018. https://www.bizjournals.com/denver/news/2018/04/20/a-2-year-long-battle-over-beer-comes-to-a-head.html.

———. 2018b. “Beer-Sales Regulations for Grocery and Convenience Stores Pass Colorado Senate by a Wide Margin.” *Denver Business Journal*, May 1, 2018. https://www.bizjournals.com/denver/news/2018/05/01/beer-sales-regulations-pass-colorado-senate-by-a.html.

———. 2018c. “Shockwaves Expected in Industry as Full-Strength Beer Hits Colorado Grocery Store Shelves Jan. 1.” *Denver Business Journal*, December 31, 2018. https://www.bizjournals.com/denver/news/2018/12/31/colorado-full-strength-beer-grocery-stores.html.

Shughart, William F., II. 1990. *The Organization of Industry*. Homewood, Ill.: RD Irwin.

Slade, Margaret E. 1998. “Beer and the Tie: Did Divestiture of Brewer-owned Public Houses Lead to Higher Beer Prices?” *The Economic Journal* 108 (448): 565–602. https://doi.org/10.1111/1468-0297.00305.

Sorini, Marc E. 2014. “Beer Franchise Law Summary.” Craft Brewers Association.

Staaf, Kris, Bob Hunt, and Steve Findley. 2017. *Senate Bill 16-197 Working Group Legislative Report Recommendation Form Rec 197-023*. https://www.colorado.gov/pacific/sites/default/files/Rec%20197-023.pdf.

Stigler, George J. 1971. “The Theory of Economic Regulation.” *The Bell Journal of Economics and Management Science* 2 (1): 3. https://doi.org/10.2307/3003160.

Tollison, Robert D. 2012. “The Economic Theory of Rent Seeking.” *Public Choice* 152 (1–2): 73–82. https://doi.org/10.1007/s11127-011-9852-5.

Tremblay, Victor J., and Carol Horton Tremblay. 2005. *The U.S. Brewing Industry: Data and Economic Analysis*. MIT Press.

Tullock, Gordon. 1967. “The Welfare Costs of Tariffs, Monopolies, and Theft.” *Economic Inquiry* 5 (3): 224–32. https://doi.org/10.1111/j.1465-7295.1967.tb01923.x.

Williams, Alistair. 2017. “Exploring the Impact of Legislation on the Development of Craft Beer.” *Beverages* 3 (2): 18. https://doi.org/10.3390/beverages3020018.

Zolton, Mitchell. 2020. “Direct Shipping for Michigan Beer? Wine Not.” *Michigan State Law Review* 2: 509–46.

CHAPTER 2 THE LIBERALIZATION OF BEER RETAIL IN COLORADO: A SURVEY ON THE MARKETING STRATEGIES OF CRAFT BREWERIES

Executive summary

Motivation and Premise: Before January 1, 2019, Colorado only allowed the sale of full-strength (rather than 3.2% max ABW) beer through liquor stores (LS). Following a tumultuous, multi-year negotiation among grocery store chains, wholesale distributors, LS and consumer associations, and the local guild representing craft brewers' interest, the Colorado legislature passed a law allowing full-strength beer in grocery and convenience stores (GS and CS). At the time of implementation, in January 2019, the extent to which this change would affect Colorado manufacturing breweries was unknown, and its effects are still evolving. This study investigates how breweries adapted marketing strategies (product, packaging, promotion and distribution) to the new regulatory environment, and the implications for the craft brewing sector

Methods: Our statewide survey, conducted in the second half of 2019, asked 184 craft manufacturing breweries about their marketing strategies before and after full-strength beers entered GS and CS. We received 76 usable responses, broadly representative of the Colorado craft brewing industry and including 57 nanobreweries (under 1,000 barrels, or bbls), 16 microbreweries (1,000 bbls to 14,999 bbls), and 3 regional breweries (15,000 bbls to 6,000,000 bbls). Producers beyond 6 million barrels are not considered craft brewers and were not included in the survey.

Selected Results:

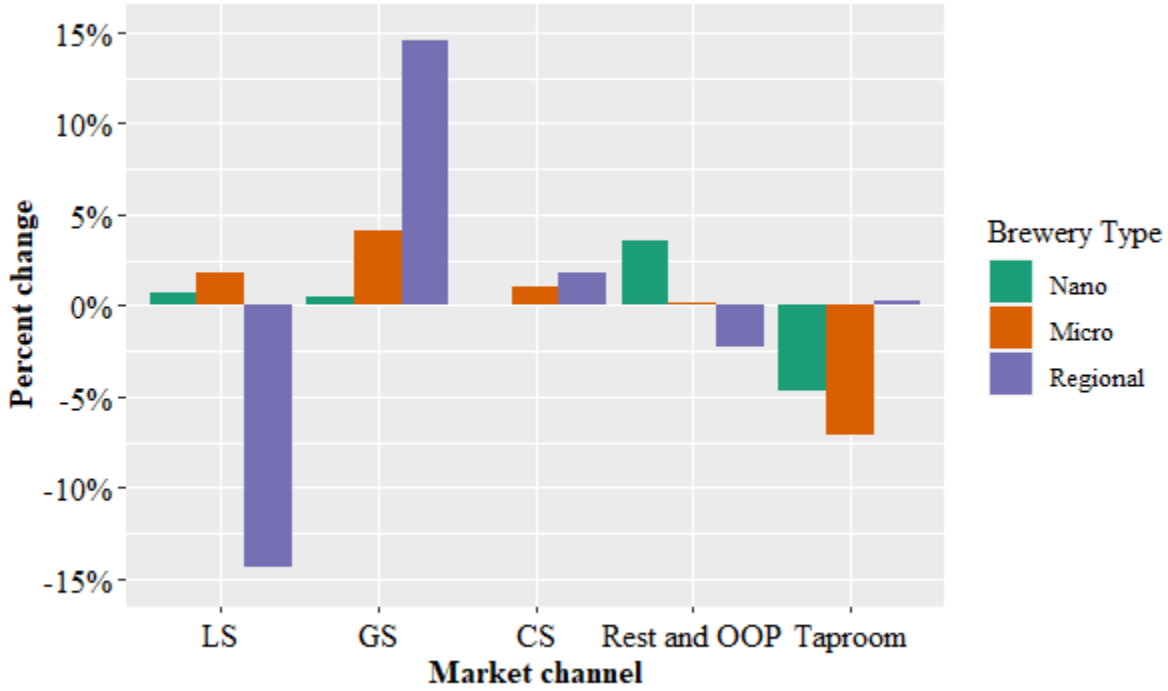

Figure 2.1. Change in distribution by brewery type: 2017 vs. 2019
Note: Market channels are defined as liquor stores (LS), grocery stores (GS), convenience stores (CS), restaurant and other on-premise retailers (Rest and OOP), and brewery taprooms (Taproom). Brewery categories are based on annual production.

- About 10 percent of craft beer sales moved from LS to GS, while CS sales did not materialize. The total percentage of breweries reporting sales in GS increased from 5% (2017) to 24% (2019). In terms of share of total volume, GS sales increased from 4% to 14%, while LS sales decreased by a similar amount (45% to 33%). CS played a marginal role in distributing craft brews, with only 3% of the total craft volume in 2019.

- Nanobreweries remain anchored to business models reliant on taprooms. Even though the percentage of firms reporting to have access to GS increased from 2% to 11%, the volume nanobreweries sold through GS and CS in 2019 can be rounded down to zero. When

nanobreweries entered the 3-tier distribution system (3TDS), it was generally by self-distributing to LS.

- Microbreweries continue to distribute mostly through LS. The percentage of microbreweries working with a distributor almost doubled to 43%, and the volume sold through distribution contracts increased from 31% to 36%. However, the importance of GS and CS remained rather marginal for this market segment. Half of the firms reported having access to GS sales, but only 5% of volume was sold through this channel in 2019, and CS sales are negligible. Meanwhile, LS volume increased from 33% to 35%.

- Regional breweries are most successful at distributing in GS. The three regional brewers in our dataset expanded in the GS channel, with volumes jumping from 5% to almost 20% of total sales between 2017 and 2019, whereas the share of volume sold at LS contracted from 52% to 38%. CS, on the other hand, was of marginal importance, accounting for only 3% of volume sold in 2019.

- The research suggests the bottleneck in distributing to GS and CS is not access to packaging equipment, but rather in logistics. GS and CS sales channels are not well-suited for self-distribution by craft brewers or small volume niche distributors. Breweries of all sizes reported challenges selling beer to GS, including lack of personal relationships, lack of trained salesforce at GS, onerous and/or costly paperwork burden, unfeasible service expectations, expensive insurance requirements, difficulties keeping beer stocked, and problems with distributor performance.

- Successful marketing strategies focus on adapting to specific market segments. High involvement consumers seek experiences and variety, which they find at the taproom and in the

LS. Consumers in GS tend to be low involvement beer buyers, more likely to stick with known brand with broad consumer recognition. Building brand awareness with low involvement consumers requires significant investment in advertising and promotion, which may be out of reach for nano- and microbrewers.

Introduction

In the biggest change to Colorado's regulation of alcohol retail since the end of prohibition, full-strength beer sales at GS and CS stores were legalized on January 1st, 2019. Grocery outlets include traditional GS, mass merchandisers (e.g. Target), and club stores. The new regulations allowed beer to be sold at more than 3,000 additional outlets in addition to existing LS (Sealover 2018d). When the law took effect, the extent to which this change would affect Colorado manufacturing breweries was largely unknown, and the effects are still unfolding. Predicting the impact of legislative changes in the U.S. alcoholic beverage market is a bit like reading the tea leaves. The reason is the complexity of the three-tier distribution system used in most U.S. states, mandating the separation between alcohol production, distribution, and retailing; and the intricate fabric of state-specific clauses, exceptions, and exemptions regulating the sector. We surveyed Colorado craft breweries and studied how firms modified marketing strategies (product lines, packaging, distribution channel and promotion) to develop an initial assessment of how breweries have adapted or are changing in response to the transition in Colorado's regulations.

The road to the (partial) liberalization of alcohol retail in Colorado was a tortuous one. Under the prior regulatory framework, the sale of full-strength beer, wine, and spirits was largely restricted to LS. The only exception was a provision that allowed drug stores as well as grocery chains, mass-merchandisers, and club stores with pharmacies (e.g. King Soopers, Walmart, Costco, etc.) to operate a single (in the entire state) liquor-licensed point of sale offering beer, wine, and spirits. For all other locations, GS, mass merchandisers, club stores and CS could obtain a fermented malt beverage (FMB) license to sell beer less than 3.2% alcohol by weight (ABW). The first change to the status quo occurred in 2016 when SB16-197 was passed to deter a ballot initiative (sponsored by GS and CS) that would have asked voters to legalize the sale of full-

strength beer and wine in GS and CS stores (Vela 2016). A compromise bill, SB16-197 delayed the entry of full-strength beer into GS and CS stores until January 1st, 2019 and created a statutory working group to make recommendations on how to implement the transition. When the working group failed to reach a consensus, SB18-243, sponsored by the trade association for LS, was introduced to mitigate potential losses (Sealover 2018c). The most salient impacts of these two pieces of legislation expanding retail opportunities for craft breweries are as follows:

1. As of January 1st, 2017, GS, mass-merchandisers, and club stores with pharmacies can obtain additional licenses to operate up to four liquor-licensed drugstore locations in Colorado. Such locations can sell beer, wine, and liquor. This implies a relatively minor change, as GS chains such as King Soopers, which operates 152 stores in Colorado (Laxen, 2018), would be allowed only four liquor-license drugstore locations.

2. Starting January 1st, 2017, LS owners can obtain an additional liquor license and operate up to two locations. The provision balances the GS allowance, and was included to help LS compete on a level playing field against other alcohol retailers.

3. As of January 1st, 2019, retailers with 3.2% FMB (a.k.a. near beer) licenses can now sell full-strength beer under the same license, but not wine or liquor. This is the most consequential change, and significantly alters the Colorado alcohol retail market.

These changes are better understood in the context of the existing laws stipulating a brewery's ability to sell directly to a retailer (self-distribution). Colorado allows breweries to obtain a distributor license and sell directly to retailers anywhere in the state irrespective of the size of the brewery (Colorado Revised Statutes §44-3-402 (2018)). Hybrid models are also allowed, whereby a self-distributing brewery can contract with an independent distributor, with the one

caveat that the distribution territory of the brewery and that of the distributor may not overlap (Brewers Association 2019).

Liberalizing beer retail received a mixed response among Colorado craft brewers. The Colorado Brewers Guild was officially neutral on the bill, with individual breweries supporting either side (Sealover 2018b; 2018a). Some large craft breweries suggested GS and CS would increase access to consumers, whereas smaller producers were concerned about access to shelf space at national retailers, especially for smaller brands lacking established demand, and the potential closure of LS, traditionally an important retail outlet (Kessinger 2019). However, breweries of all sizes were concerned that the change would result in a mere transfer of sales from LS to a potentially to a higher cost market channel dominated by macrobreweries. The debate among craft breweries highlight the ambiguity on how beer in GS and CS would impact niche producers.

To understand the retail environment, we first examined publicly available excise tax data from Colorado's Liquor Enforcement Division on the volume sold of beer, wine, and spirits before and after the transition, summarized in Table 2.1. We found the total volume sold in all three alcohol categories experienced modest, single-digit growth in the three years preceding the expansion of beer sales in 2019. After the transition, however, the volume of wine and spirits sold fell by 7% and 5%, respectively, while the volume of beer sold continued to grow by 4%. If the divergence in alcohol sales by category is driven by consumers transferring some of their alcohol purchases to GS and CS stores, then access to the GS and CS channel may determine the winners and losers of the policy transition among distributing craft breweries. This begs the question of which craft breweries can be successful in GS and CS, and the marketing strategies necessary to access this new distribution channel.

Table 2.1. Volume sold of beer, wine, and spirits in Colorado before and after the transition

Alcohol Category	Year				
	2015	2016	2017	2018	2019
Beer					
Vol sold (gal)	111,460,900	115,728,500	117,582,100	119,269,000	124,465,500
% change	-	4%	2%	1%	4%
Wine					
Vol sold (gal)	17,620,500	18,162,400	18,484,300	18,879,600	17,572,700
% change	-	3%	2%	2%	-7%
Spirits					
Vol sold (gal)	12,440,000	12,860,300	13,401,900	14,072,500	13,313,700
% change	-	3%	4%	5%	-5%

Motivation

A concern is that the craft brewing sector may fail to fully capitalize on the opportunity offered by the new distribution channels. To understand, one should consider that the craft brewing industry in Colorado is quite fragmented, with over 400 small firms producing limited volumes. This segment is the sector with significant potential for growth: 60.8% of all craft firms are microbreweries, producing less than 15,000 barrels annually. In terms of market share, however, a small number (3.2% of all craft) of regional breweries (between 15,000 and 6,000,000 barrels) dominate the craft brewing landscape, selling 70.6% of the total craft volume share (Brewers Association 2018). Therefore, the primary goal of our study is to provide actionable information to craft breweries of all sizes that will allow them to successfully navigate the new regulatory environment, requiring engagement with the craft sector at every step of the research process.

The first step to accomplishing our objective was to compile a clear picture of the existing market chain connecting craft brewers to consumers, how marketing strategies differ between different types of breweries, and understand how current institutions and market forces generated the existing distribution chain. We achieved this by conducting in-person interviews with the owners of craft breweries, wholesalers, LS, and the professional organizations representing them,

acquiring crucial institutional knowledge and a nuanced understanding the vertical and horizontal relationships between firms in the three tier system in the process. Our next step was to use the information gained from the interviews to create a survey that would capture the marketing strategies of breweries before and after the policy change. An initial version of our survey was sent to the technical committee of the Colorado Brewers Guild for feedback, which was then incorporated into the final version of our survey. The last step was to communicate the findings of our study with the craft sector. We presented our preliminary results and solicited feedback from breweries at the annual Colorado Craft Brewers Summit in 2019. Our final results were presented at the Brewers Summit in 2020. We also produced an industry paper, disseminated through the state guild, emphasizing the key takeaways for craft breweries. Lastly, we crafted a personalized report for each brewery that participated in our survey comparing their distribution strategy to that of other breweries.

Another study objective was to collect data for more generalizable academic research. While this was a secondary objective, it allowed us to build novel connections to foot traffic data during the pre- and post-implementation phase of the policy change, and leverage the natural experiment to draw conclusions that are generalizable outside the state and of value to the broader food marketing literature and community of applied researchers.

Survey description and results

Our statewide survey[2] (see appendix A), conducted in the second half of 2019, asked 184 craft manufacturing breweries about their marketing mix before and after full-strength beers entered GS and CS. The objective is to identify not only how SB16-197 changed where craft beer is sold,

[2] All craft manufacturing breweries, or breweries that are not considered brewpubs, in Colorado that opened prior to January 1st, 2017 and were still operating were sent a survey.

but also its effects on product lines, packaging and promotion. We received 76 usable responses from 57 nanobreweries (under 1,000 barrels, or bbls), 16 microbreweries (1,000 bbls to 14,999 bbls), and 3 regional breweries (15,000 bbls to 6,000,000 bbls). While we have few responses from regional breweries, our sample is consistent with and representative of the number of firms in Colorado, which in 2017 numbered 123 nanobreweries, 55 micro, and 11 regional breweries[3] (Brewers Association 2020). Again, it is important to note that macrobreweries were not included in the survey. We first describe industry-wide changes in product, promotion and distribution strategies, and then refine our analysis by market segment to reveal scale-dependent heterogeneity in marketing strategies.

We present findings on how total volume, type of beer, and product packaging changed between 2017 and 2019 for the breweries in our sample (Table 2.2). In aggregate, the average reported production increased by approximately 30,000 bbls, or about 12%. The percentage of breweries reporting to have a 3.2% ABW beer in their production mix actually increased, perhaps unexpectedly given the waiver of the 3.2 requirement for GS. This may be explained by a growing number of breweries in the U.S. that are producing low calorie, low carb, and low alcohol "lifestyle" beers for the active and health-conscious consumer (Kitsock 2019; Watson 2019b). We also find that the nationwide packaging trend away from bottles and toward cans (Watson 2020) is clearly present and ongoing in Colorado. In the U.S., the volume of craft beer sold in cans has steadily increased and is projected to overtake bottle sales in 2020 (Watson

[3] A Komolgorov-Smirnov test did not reject the hypothesis that our sample is consistent with the distribution of breweries across market segments in Colorado. Survival bias should also be considered, since our survey only included breweries that survived from 2017 to 2019. Using national level data from the Brewers Association (Brewers Association 2020), we determine that around 3% of breweries producing < 15,000 bbls shut down in each year of our study period, suggesting that the potential effect of survival bias is low.

2020). Craft manufacturing breweries in Colorado already sold more volume in cans in 2017 than in bottles and the gap continued to widen in 2019 (47% in cans vs. 12% in bottles). Our findings also show that, on average, breweries increased the width of their product lines; with average number of year-round beers increasing from 5 to 6 and the average number of seasonal and single-release beers increasing from 24 to 32.

Table 2.2. Sales volume, product lines, and packaging of craft breweries: 2017 vs. 2019

Indicator	Year	
	2017	2019
Total volume* (bbls)	252,308	283,508
% firms offering 3.2 beer	5%	9%
Avg number year-round beers	5	6
Avg number seasonal and single-release beers	24	32
% firms using packaging equipment	51%	60%
% vol serving tanks	4%	4%
% vol kegs	37%	37%
% vol bottles	22%	12%
% vol cans	37%	47%

Notes: *sum (across all breweries) of all estimated volume of production

We next examine how distribution strategies changed following SB18-243 (Table 2.3). The percentage of breweries reporting sales in GS increased from 5% (2017) to 24% (2019), implying that craft breweries are entering the new distribution outlets. In interpreting our results, one should note that we report share of total volume by year to emphasize relative magnitudes, but one should keep in mind that in 2019 total sales increased. In terms of share, GS sales increased from 4% to 14%, while LS store sales decreased by a nearly symmetrical amount (45% to 33%). However, CS played a marginal role in distributing craft brews (only 3% of the total craft volume in 2019).

It is also evident that selling in GS does not suit all breweries. Some of this is certainly owed to intentional marketing choices (e.g. focus on the taproom and keg sales), but even when we exclude non-distributing breweries (i.e. no sales in LS in 2017), we find that barely half of them

entered the GS channel in 2019. The results from the market segment analysis will provide more context.

Table 2.3. Distribution strategy of craft breweries: 2017 vs. 2019

	Indicator	Year	
		2017	2019
Access to market	% firms with taproom	97%	99%
	% firms in restaurant & OOP*	91%	92%
	% of firms in the LS channel	51%	62%
	% of firms in the GS channel	5%	24%
	% firms in CS channel	3%	8%
% Volume by distribution channel	% vol taproom	18%	20%
	% vol restaurant & OOP*	32%	30%
	% vol LS	45%	33%
	% vol GS	4%	14%
	% vol CS	1%	3%
Third party distribution	% of firms with distributor	14%	18%
	% total vol through distributor	69%	64%
	% vol restaurant & OOP*	27%	23%
	% vol LS	37%	27%
	% vol GS	3%	12%
	% vol CS	1%	2%
Self-distribution	% vol restaurant & OOP*	6%	7%
	% vol LS	8%	6%
	% vol GS	0%	2%
	% vol CS	0%	0%

Notes: OOP* = other off-premise retailer.

While the data revealed some significant changes in product, packaging, and distribution, promotional activities remained relatively stable between 2017 and 2019 (Table 2.4). The increase in median advertising budget from $2,750 to $5,000/year is notable; but breweries kept focusing on digital advertising, maintained a strong presence in local community events, and strengthened the network of collaborations through special release brews.

Table 2.4. Promotional activities of breweries: 2017 vs. 2019

Promotional activity	Year	
	2017	2019
% firms with full-time sales representative	45%	47%
% firms offering volume discounts	29%	34%
% firms produced collaboration beer	68%	72%
% firms sponsored off-premise tasting event	53%	55%
% firms sponsored tap-takeover event	58%	70%
% firms participated in a community event	93%	99%
% firms participated in the GABF	83%	74%
Avg effort rating digital advertising*	3.25	3.55
Avg effort rating print advertising*	1.88	1.87
Avg effort rating broadcast advertising*	1.2	1.38
Avg effort rating out-of-home advertising*	1.14	1.17
Avg advertising budget	$24,955	$26,125
Median advertising budget	$2,750	$5,000

Notes: Advertising effort was rated on a likert scale from 1 to 5, with 1 representing "no effort at all" and 5 representing "an extreme amount of effort".

We compare the product sales and packaging choices by brewery type (Table 2.5), and distribution strategies (Table 2.6). For each brewery type, we first describe the dominant marketing strategies in 2017, and then identify any significant changes from 2017 to 2019

Table 2.5. Sales volume, product types, and packaging by brewery type: 2017 vs. 2019

Indicator	Nano		Micro		Regional	
	2017	2019	2017	2019	2017	2019
Total volume (bbls)	25,454	38,331	43,854	61,927	183,000	183,250
% firms offering 3.2 beer	4%	8%	0%	6%	67%	67%
Avg number year-round beers	5	6	6	6	6	7
Avg number seasonal and single-release beers	25	33	19	23	45	50
% firms using packaging equipment	44%	50%	66%	87%	100%	100%
% vol serving tanks	21%	17%	9%	8%	0%	0%
% vol kegs	63%	63%	40%	39%	33%	31%
% vol bottles	10%	8%	3%	4%	28%	16%
% vol cans	6%	12%	48%	49%	39%	53%

Table 2.6. Distribution strategy by brewery type: 2017 vs. 2019

	Indicator	Nano		Micro		Regional	
		2017	2019	2017	2019	2017	2019
Access to market	% firms with taproom	96%	98%	100%	100%	100%	100%
	% firms in rest. & OOP	88%	89%	100%	100%	100%	100%
	% of firms in the LS channel	44%	55%	69%	81%	100%	100%
	% of firms in the GS channel	2%	11%	13%	50%	33%	100%
	% firms in CS channel	0%	2%	6%	19%	33%	67%
% Volume by distribution channel	% vol taproom	81%	76%	41%	34%	5%	5%
	% vol rest. & OOP	13%	16%	25%	25%	37%	34%
	% vol LS	7%	7%	33%	35%	52%	38%
	% vol GS	0%	0%	1%	5%	5%	19%
	% vol CS	0%	0%	0%	1%	2%	3%
Third party distribution	% of firms with distributor	7%	7%	25%	43%	100%	100%
	% vol sold through a distributor	2%	2%	31%	36%	86%	86%
	% vol rest. & OOP	1%	1%	11%	11%	33%	32%
	% vol LS	1%	1%	19%	20%	46%	35%
	% vol GS	0%	0%	1%	4%	5%	16%
	% vol CS	0%	0%	0%	1%	2%	3%
Self-distribution	% vol rest. & OOP	12%	15%	14%	14%	3%	3%
	% vol LS	6%	7%	14%	15%	6%	3%
	% vol GS	0%	0%	0%	1%	0%	3%
	% vol CS	0%	0%	0%	0%	0%	1%

Table 2.7. Promotion strategy by brewery type: 2017 vs. 2019

Promotional activity	Nano		Micro		Regional	
	2017	2019	2017	2019	2017	2019
% firms with full-time sales representative	32%	33%	81%	88%	100%	100%
% firms offering volume discounts	18%	25%	56%	56%	100%	100%
% firms produced collaboration beer	58%	63%	100%	100%	100%	100%
% firms sponsored off-premise tasting event	45%	45%	75%	81%	100%	100%
% firms sponsored tap-takeover event	44%	60%	100%	100%	100%	100%
% firms participated in a community event	91%	98%	100%	100%	100%	100%
% firms participated in the GABF	77%	67%	100%	94%	100%	100%
Avg effort rating digital advertising*	3.21	3.56	3.38	3.38	3.33	4.33
Avg effort rating print advertising*	1.80	1.88	1.94	1.75	3.00	2.33
Avg effort rating broadcast advertising*	1.13	1.40	1.31	1.25	1.67	1.67
Avg effort rating out-of-home advertising*	1.10	1.12	1.12	1.00	2.00	3.00
Avg advertising budget (000s)	$4.4	$7.0	$43.7	$17.9	$300.0	$403.3
Median advertising budget (000s)	$1.0	$2.0	$8.5	$11.5	$200.0	$350.0

Notes: Advertising effort was rated on a likert scale from 1 to 5, with 1 representing "no effort at all" and 5 representing "an extreme amount of effort".

Nanobreweries (under 1,000 bbls)

The business model of nanobreweries is anchored in the taproom and other sales for on-premise consumption (restaurants, bars, etc.), as the sum of these two distribution channels accounts for over 90% of the volume sold by nanobrewers. This strategy is also visible in the packaging choices: while about half of the breweries have access and use packaging equipment, the vast majority of volume is moved through kegs and serving tanks. It follows that nanobreweries are only weakly connected to the 3TDS, with the vast majority of brewers choosing to self-distribute, or not distribute at all to off-premise retailers.

The most significant change from 2017 to 2019 for the nanobrewing sector appeared in its growth, with an average 51% increase in total volume sold (or 12,000 bbls). The growth of the nano- sector fits the national trend reported by the Brewers Association, who find that recent increases in craft sales are largely owed to smaller, newly opened breweries (Gatza and Watson 2019; Watson 2020). Based on our data, it is safe to say that this success has little to do with

access to the GS and CS channel. Even though the percentage of firms indicating access to the grocery channel increased from 2% to 11%, the volume sold through GS and CS in 2019 can be rounded down to zero. When nano-breweries enter the 3TDS, it is generally by self-distributing to LS, which remained rather stable around 7% of total volume.

There are multiple explanations for why nanobreweries lag the rest of the sample in terms of distributing to GS. The most obvious is that, for most small firms, the taproom-centric business model is the best fitting, and entering GS and CS is simply unappealing. Niche nanobreweries distributing to off-premise retailers may not see GS as a good fit for their brand. That being said, the comment section of our survey (see Appendix B) provides some evidence that nanobreweries interested in selling in the GS channel faced significant barriers, citing onerous paperwork, expensive insurance requirements, and unfeasible service expectations.

In addition, promotional efforts lag breweries operating at larger scales. Successful sales to GS may require a full-time salesperson—an investment made by only about a third of nanobreweries. For GS, brands with a loyal following offer less risk, something less likely with smaller nanobrewery brands. Developing brand awareness requires advertising and other forms of promotion; as shown in Table 2.7. While there was an uptick in average and median advertising budgets, the investments lag behind micro- and regional breweries. Nanobrewers also do not appear to have significantly increased efforts in other forms of promotion. The administrative, logistical, and brand awareness barriers to enter the GS channel required significant investment of financial and human resources that were scarcer to the typical nanobrewery operation.

> Excerpt 1: "…We have not attempted distribution to grocery stores even though we recognize a portion of the retail market has shifted there. This is due to relationships with smaller retailers, difficulty in stocking requirements in larger

> stores, lack of personal relationships with these retailers, and a lack of a knowledgeable sales force within these retailers." – Nanobrewery Respondent

Microbreweries (1,000 bbls to 14,999 bbls)

Microbreweries in Colorado display a complex and eclectic mix of marketing strategies. The status quo in 2017 shows significant share of sales through the taproom (41% of volume) and other on-premise accounts (25% of volume). However, the micro-sector in 2017 already had strong connections to the 3TDS: 69% of firms declared having access to LS, with about a third of total volume (33%) being sold through this channel. In addition, about a quarter of microbreweries contracted with a distributor for off-premise sales. This multipronged distribution strategy is reflected in the packaging mix, with about half of overall volume sold in kegs and serving tanks, and the other half in bottle and cans.

In 2019 microbreweries reported an average 41% increase in total sales by volume, or 18,000 bbls. Our data also shows that this market segment has become more embedded in the 3TDS: the percentage of microbreweries working with a distributor almost doubled from 25% to 43%, and the volume sold through distribution contracts increased from 31% to 36%. The importance of sales through the taproom declined in relative terms, from 41% to 34 % of volume, perhaps as a result of increased competition from the nano-sector. Even though off-premise sales increased, the importance of GS and CS remained somewhat marginal for this market segment. Half of the firms reported having access to GS sales, but only 5% of volume was sold through this channel in 2019, and CS sales are negligible.

Based on our results, it is clear that off-premise sales for microbrewers are still anchored to LS sales, which actually increased to 35% by volume. So why did microbrewers fail to succeed, at least so far, in the GS and CS environment? Packaging is certainly not the culprit, since the vast

majority of firms (87% in 2019) have bottling or canning capability. The bottleneck is possibly in the distribution model, as microbreweries are still somewhat reliant on self-distribution (about two-thirds of volume is self-distributed). The little volume sold in GS (5%), was virtually all placed by third party distributors, and survey comments suggest that small distributors specializing in craft beer have been struggling to succeed in the GS environment.

> Excerpt 2: "…we do not distribute to grocery stores because of the difficulty in dealing with them… One of the huge issues we are finding with the bigger grocery stores are the amount of insurance we have to have in order just to distribute to them." – Microbrewery respondent.

The bigger reason may lie in the failure of microbreweries to adequately promote and build broad awareness for their brands. GS typically view adding new products to store shelves as risky and thus seek to lower the risk by choosing brands with strong existing consumer demand; which is often built through advertising (White, Troy, and Gerlich 2000). As shown in Table 2.7, microbrewers in our sample did not significantly increase advertising efforts or budgets between 2017 and 2019. Microbrewers continue to rely on events targeting the highly engaged craft beer drinker, who may not shop in the GS channel. We suspect that the typical craft beer purchase in the GS channel is more likely to choose a brand they know; whereas the LS shopper is likely to be aware of more brands and more willing to experiment with a brand they have not experienced before (Watson 2019a).

Regional Breweries (15,000 bbls to 6,000,000 bbls)

The large production volume defining regional breweries necessitates a mass distribution strategy fully leveraging the 3TDS. All regional breweries in our sample already had distribution contracts in place in 2017, with 86% of total volume sold through distributors and a pivotal role of LS as the main point of sale (52% volume share). This strategy is also evident in the product packaging data, with only a third of the beer kegged, and the remaining volume

either canned or bottled. Notably, one of the three regional brewers in our sample was already selling 3.2 ABW beer in GS in 2017, but two were not. Overall, it is clear that, among all craft brewers, the regional segment was best situated to make the most out of the opportunities from SB18-243; and we find that indeed access to GS and CS had a profound impact.

All three firms in our dataset entered the GS channel, with the volume share jumping from 5% to 19%, while LS sales contracted the same 14%, falling from 52% to 38% of total volume. CS, on the other hand, grew only slightly from 2% to 3% of sales volume, a channel of marginal importance even for regional craft brewers. This is not to say that SB18-243 resulted in a sudden bonanza. Following the general national trend for this sector (Gatza and Watson 2019; 2019), production remained virtually flat between 2017 and 2019, which is in stark contrast with the growth observed in the nano- and micro- sectors. While our regional breweries had success in the GS channel, each commented on higher costs associated with distributing to these demanding retailers.

> Excerpt 3: "The biggest issue in 2019 is stocking and rotating in chain stores. They expect the same level of service as their direct store delivery vendors (chips, soda, tortillas) but their business model is set up that way. Ours is not. [It is] very costly making sure our beer is always stocked and accessible to customers." – Regional brewery respondent

The greater success of regional brewers relative to smaller breweries in the GS channel likely follows from their higher level of awareness across both highly engaged and less engaged craft beer drinkers. The advertising budgets of regional breweries saw significant increases between 2017 and 2019 and dwarf those of micro- and nanobreweries. As noted in the previous section, we suspect that less engaged craft beer drinkers are more likely to purchase in the GS channel—and may favor brands they have experience with or know by name (Zondag and Watson 2017).

Conclusion and marketing considerations

When the Colorado Brewers' Guild declared itself neutral on bringing full strength beer into GS and CS, there was substantial uncertainty over the challenges and opportunities for craft breweries in the new distribution channels. While the effects of the legislation are still emerging, our survey provides an early picture of how craft brewers adapted to the new distribution environment. The opening of the GS and CS channels to craft brewers changed market dynamics, creating both opportunities and threats for craft brewers. Our assessment is that, overall, SB18-243 handed Colorado craft brewers a glass half-full. The new channel appears to have stimulated demand for beer—sales relative to wine and spirits jumped in 2019. However, nano-, micro-, and regional breweries differ in how they perceived and responded to the new market.

On one hand, regional breweries gained a solid foothold in GS, with 19% of total volume sold through GS in 2019, and there may still be room for growth. This is certainly a success, especially when one considers that regional breweries account for a large share of the craft market. However, growth in the GS outlet was counterbalanced by a similar decrease of sales in LS, resulting in a mere transfer of sales from LS to GS and no evident net gain. Of course, it is still possible that regional brewers' sales would have decreased without access to GS. The survey only involved Colorado craft breweries, and we simply don't know what would have happened without SB18-283. We also cannot determine how the transfer of sales from LS to GS affects overall profitability, as we have no data on whether costs and profit margins differ across the two channels.

The new channels appear to be demanding. Simply getting on the shelf requires significant sales and administrative hurdles for brewers and their distribution partners. Once on the shelf, stocking

and service demands appear to be much greater than in traditional channels. All of these costs—sales, logistics, servicing, advertising and promotion—are largely fixed costs. Regional breweries can spread these costs over a larger sales volume. But on a per barrel basis, we suspect micro- and nanobreweries may find entry into the GS or CS channels significantly less profitable than their larger competitors. This may be less of an issue for nano- and microbreweries that have good working relationships with distributors and have already incurred some of these investments. That said, nano- and microbreweries may want to proceed with caution in moving toward this channel—the required investments may not produce the desired revenue.

For micro- and nanobreweries, which account for the vast majority of firms, sales in the GS sectors remained negligible. This is no surprise in the case of nanobreweries, which generally rely on a taproom-focused business model (76% of nanobrewery volume share was sold through the taproom in 2019); but it is somewhat unexpected for the microbrewing segment. In 2017, microbreweries had good access to the 3TDS, the capacity to bottle or can their products, and significant volumes sold in LS rather than on-premise. And yet, off-premise sales for microbreweries remained solidly anchored in the LS channel (35% of volume), and only 5% of volume share sold in GS. The major challenges to selling in GS are (at least) threefold: 1) getting on the GS shelf, 2) ongoing servicing requirements, and 3) getting into the consumer's shopping cart. The first two challenges, in part, require a good distribution system and strong distribution partners (Zondag and Watson 2017). Microbreweries tend to either self-distribute or work with smaller distributors specializing in the craft market, and neither of these strategies can meet the demands of GS, which include product rotation, restocking and large sale volumes by shelf space. The GS salesforce is generally untrained and lacks craft-specific expertise, so niche products tend not to fare well. Once a craft beer brand gets on the store shelf, they must get the

attention of the GS shopper—who may be more likely to choose well-known brands. Microbrewers have usually not made investments in the advertising needed to achieve higher levels of brand awareness. To attract GS consumers, who make a decision at the shelf, an alternative strategy may be to choose packaging or brand names that capture customers' attention. Further research of the GS craft buyer should be conducted to determine whether more adventurous beer drinkers will choose unknown brands at the point of purchase, and what qualities appeal to them.

To our surprise, the CS channel failed to bring any significant craft beer sales, with a mere 3% share of total craft volume. Craft brewers face two obstacles when attempting to sell in CS. One is once again distribution: the sheer number of CS points of sale impose a capillary distribution network. The second is brand recognition. According to the National Association of Convenience Stores, the average time it takes a customer to walk in, purchase an item and depart is between 3 and 4 minutes (NACS 2018). This quick in-and-out implies that CS are more suited for beer brands with mass recognition, generally owned by macrobreweries and large corporations.

While the opening of GS and CS to craft brewers created opportunities for new sales, it appears that, at this time, the bulk of sales in those channels went to regional brewers. From a consumer perspective, we conjecture that increased competition likely lowered prices and forced LS to specialize on offering product choices and on-site services. While the nano- and microbreweries didn't gain many sales in GS and CS, these two craft beer sectors continued to grow between 2017 and 2019. Our data also shows that LS lost a significant share of regional breweries volume to GS competitors. In the long run, this may cause LS closures, and a loss of shelf space and access to the market for microbrewers. Drawing on the results of our surveys and related

interviews, we offer some informed speculation about how regional, micro- and nanobreweries might adapt marketing strategies moving forward.[4]

Marketing strategy recommendations

The growth in beer sales (relative to wine and spirits) in 2019 suggests increased demand and consumption of beer overall (Table 2.1). Further, the greatest growth among the three craft beer sectors in Colorado was reported by the nano- (+51% 2017 to 2019, see Table 2.5) and microbrewery (+41%, Table 2.5) sectors. While craft brewers appear to have done quite well in the new market environment, our survey highlights a certain level of confusion and disappointment. There may be opportunities for further growth if breweries adopt more intentional marketing strategies.

Understanding the target market and consumer is key to developing successful marketing strategies. There are at least two segments of craft beer consumers. The low involvement craft beer consumer may be new to the craft beer scene or possibly not as sophisticated about beer consumption. These customers are less likely to try something new, and tend to stick to known or familiar brands, favoring the regional (and national—though that segment was not part of this study) brewers and brands they know from advertising. The opening of the GS and CS channels has likely been most beneficial to this beer consumer, triggering growth in this market segment. More involved craft beer drinkers tend to be more adventurous and engage in variety seeking. A report by the Brewers Association (2015), noted that Millennials (age 21-35) drinking craft beer weekly averaged 5.1 different brands per month. This same study found 47% of purchases by Millennial males were for brands they had never seen advertised or never heard of before. The

[4] Our interviews and survey occurred prior to the massive business closings related to the pandemic and these recommendations do not consider its impact directly.

buoyancy of microbreweries in LS outlets has likely been supported by this type of more involved consumers.

Brewers need to decide which of these two market segments they want to serve—or if they want to try to serve both. Nanobrewers may want to ignore the GS channel completely and double down on their taproom distribution model. Even with the opening of the GS channel, most nanobrewers stuck to the taproom (98% use this channel, 76% of volume), or restaurants and other on-premise retailers (89% use this channel, 16% of volume). More nanobrewers moved to LS (44% in 2017, rising to 55% in 2019), which may simply reflect a natural outcome of a smaller but growing brewery. Nanobrewers' access to the GS channels remained modest, rising from 2% to 11%. This reflects the challenges faced with getting into GS. We suggest that the necessary investment in administration, sales, and advertising to successfully compete may not be a good investment for most (if not all) nanobrewers. The Millennial consumer values experiences, which the taproom provides. Developing a more pleasant taproom environment, while offering a wider range and higher quality food products and possibly more types of beer may be the best strategy for nanobreweries appealing to the high involvement, experience-focused craft beer consumer.

Microbreweries have a more difficult strategy decision to make. Some microbreweries may have the resources and brand awareness to pursue both market segments, or they may have a long term strategy to grow and become a regional brewery. The GS channel offers an opportunity for microbrewers to gain more awareness, reach a broader consumer market, and grow sales from additional shelf space. That said, this strategy may require an increase in advertising and promotion to grow brand awareness among less involved consumers; and our data shows that most microbreweries are currently not doing this. Currently, while 50% of our sample of

microbrewers has access to GS, the channel represents just 5% of their volume. Like the nanobrewers, microbrewers (which at one time were likely nanobrewers) have traditionally focused on the high involvement craft beer drinker and emphasized the taproom experience. Microbrewers should recognize the additional caveat that this strategy may cannibalize off-premise sales in bars and restaurants.

Increasing investment in ties to the LS channel may create a potential opportunity for nano- and microbreweries to grow their base, high involvement market segment. Currently, LS are losing sales of regional brewers to the GS channel of distribution, which may make many LS more willing to promote an extensive line of craft beer as a point of differentiation. The downside of appealing to this market segment is its low loyalty and tendency to try many different beers. Part of such a strategy may require expanding the product line to offer these beer drinkers the variety they seek.

Regional brewers in our study have found an opportunity in the GS channel—with 19% of sales coming from this channel in 2019. As already noted, GS customers may be more likely to choose brands they have heard of—so regional brewers should consider increasing advertising. It may make sense to promote a flagship brand while also promoting the umbrella (brewery name) brand. Such an umbrella branding strategy may encourage low-involvement craft consumers to experiment with new types of beer within a brand they already trust. This suggests regional brewers might increase the use and promotion of variety packs and seasonal beers. Colorado brewers like Odell and New Belgium already employ this strategy and have grown beyond their flagship brands. The risk is that loyal customers may evolve to highly involved craft beer drinkers who are often less loyal to particular brands or breweries.

Limitations, ongoing work and future research

Our survey presents a picture of how craft breweries in Colorado changed after SB18-283, but the transformation of the Colorado alcohol industry is still ongoing, and many important aspects could not be examined with our survey. First, it is important to note that our results do not give a causal explanation of the impact of SB18-283 as we are not controlling for other possible confounding factors that could have influenced a brewery's marketing mix over the study period. Our current efforts are focusing on expanding the scope of our analysis to include neighboring states where laws similar to SB18-283 were passed, plus control states where beer remained unavailable in GS and CS. Rather than surveying brewers, we plan to gather new data to study consumer shopping behavior and product prices. We are already analyzing anonymized foot traffic data from SafeGraph to uncover how shopping trips to alcohol point of sales have changed from 2017 to 2020. In addition to sales, it is important to understand how LS adapt to competition from GS and CS, especially in terms of the variety of products they decide to stock and the location where stores are opened.

The big elephant in the room is, of course, the devastating impact of COVID-19 on the craft brewing industry. Based on this survey, it is easy to predict that non-distributing breweries (i.e. nano- and, to some extent, micro- are the most affected by social distancing measures, but early data suggest that overall alcohol consumption has increased during quarantine. We will be coordinating with the Brewers Association and the Colorado Brewers Guild to identify the most pressing research questions.

REFERENCES

Brewers Association. 2015. "6 Characteristics of Millennial Beer Drinkers You Need to Know." *Brewers Association* (blog). October 5, 2015. https://www.brewersassociation.org/brewing-industry-updates/6-characteristics-of-millennial-beer-drinkers-you-need-to-know/.

———. 2018. "State Craft Beer Sales & Production Statistics, 2018." *Colorado's Craft Beer Sales & Production Statistics, 2018* (blog). 2018. https://www.brewersassociation.org/statistics-and-data/state-craft-beer-stats/.

———. 2019. "State Laws." June 25, 2019. https://www.brewersassociation.org/government-affairs/state-laws/.

———. 2020. "May/June The New Brewer Tables 2019 Data." Brewers Association. https://www.brewersassociation.org/statistics-and-data/brewery-production-data/.

Colorado Revised Statutes. 2018. *§ 44-3-402*.

Gatza, Paul, and Bart Watson. 2019. "Challenge and Resilience in 2018." *The New Brewer*, June 2019.

Kessinger, Derek. 2019. "Are Grocery Store Beer Sales Killing Colorado's Liquor Stores?" *5280*, October 16, 2019, Online edition. https://www.5280.com/2019/10/are-grocery-store-beer-sales-killing-colorados-liquor-stores/.

Kitsock, Greg. 2019. "The Rise of Lifestyle Beer: Crafting a Beverage for Health-Concious Patrons." *The New Brewer*, October 2019.

Laxen, Jacob. n.d. "King Soopers Company Adding 600 Jobs in Colorado." Coloradoan. Accessed May 13, 2020. https://www.coloradoan.com/story/money/business/2018/04/12/king-soopers-company-adding-600-jobs-colorado/510326002/.

NACS. 2018. "Time to Shop." https://www.convenience.org/getattachment/Research/Consumer-Insights/Time-to-Shop/White-Paper.pdf.

Sealover, Ed. 2018a. "A 2-Year-Long Battle over Beer Sales Comes to a Head Monday at the Colorado Capitol." *Denver Business Journal*, April 20, 2018. https://www.bizjournals.com/denver/news/2018/04/20/a-2-year-long-battle-over-beer-comes-to-a-head.html.

———. 2018b. "Beer-Sales Regulations for Grocery and Convenience Stores Pass Colorado Senate by a Wide Margin." *Denver Business Journal*, May 1, 2018. https://www.bizjournals.com/denver/news/2018/05/01/beer-sales-regulations-pass-colorado-senate-by-a.html.

———. 2018c. “Colorado Beer-Sales Regulations Bill Is Gutted by State House Committee in Unusually Volatile Hearing.” *Denver Business Journal*, May 5, 2018. https://www.bizjournals.com/denver/news/2018/05/05/beer-sales-regulations-bill-is-gutted-in-unusually.html.

———. 2018d. “Shockwaves Expected in Industry as Full-Strength Beer Hits Colorado Grocery Store Shelves Jan. 1.” *Denver Business Journal*, December 31, 2018. https://www.bizjournals.com/denver/news/2018/12/31/colorado-full-strength-beer-grocery-stores.html.

Vela, Vic. 2016. “Hickenlooper Signs Bill Allowing Grocery Store Liquor Sales.” *Colorado Public Radio*, October 6, 2016. https://www.cpr.org/2016/06/10/hickenlooper-signs-bill-allowing-grocery-store-liquor-sales/.

Watson, Bart. 2019a. “Midyear Scan Data Shows Craft Drinkers Demand for New and More.” *Brewers Association* (blog). July 17, 2019. https://www.brewersassociation.org/insights/midyear-scan-data-shows-craft-drinkers-demand-for-new-and-more/.

———. 2019b. “Hard Seltzers and Small Brewers.” *Brewers Association* (blog). October 1, 2019. https://www.brewersassociation.org/insights/hard-seltzers-and-small-brewers/.

———. 2020. “2019 Craft Beer Packaging Trends Recap.” *Brewers Association* (blog). January 15, 2020. https://www.brewersassociation.org/insights/2019-craft-beer-packaging-trends-recap/.

White, J. C., L. C. Troy, and R. N. Gerlich. 2000. “The Role of Slotting Fees and Introductory Allowances in Retail Buyers’ New-Product Acceptance Decisions.” *Journal of the Academy of Marketing Science* 28 (2): 291–98. https://doi.org/10.1177/0092070300282009.

Zondag, Marcel, and Bart Watson. 2017. “White-Paper-Who-Is-the-Craft-Beer-Shopper.Pdf.” Brewersassociation.Org. September 2017. https://s3-us-west-2.amazonaws.com/brewersassoc/wp-content/uploads/2017/09/White-Paper-Who-Is-the-Craft-Beer-Shopper.pdf.

CHAPTER 3 IMPLICATIONS OF EXPANDED ALCOHOL RETAIL ON LIQUOR STORES AND CRAFT BREWERIES IN RURAL AND URBAN AREAS: A COLORADO CASE STUDY

Introduction

Approximately 1,580 small, independent liquor stores operated in Colorado prior to a policy change allowing full strength beer sales to be sold at grocery and convenience stores (Colorado Department of Revenue 2020). Liquor stores contribute substantially to Colorado's economy, bringing in $1.9 billion in revenue, employing 7,500 workers and 2,500 proprietors (Summit Economics, LLC 2009), and provide shelf space to small breweries, wineries, and distilleries.

Colorado's limited expansion of alcohol sales resulted in an additional 1,700 grocery and convenience stores selling full-strength beer, more than doubling the amount of beer-selling retail establishments and redistributing beer revenues among the market channels. It is not surprising that such a restructuring was accompanied by substantial controversy. Supporters of deregulation argued that the prior policy was anticompetitive and that expanding alcohol sales to grocery and convenience stores would benefit consumers in the form of increased convenience and lower prices, while critics countered that any expansion of alcohol sales would hurt liquor stores—which tend to be small, independent, locally owned businesses—lower product diversity, and increase alcohol access to minors (Sealover 2018; National Alcohol Beverage Control Association 2016; Staaf, Hunt, and Findley 2017).

Academic studies that investigate the impact of expanding alcohol sales generally analyze the issue at the national and state level. Liberalizing alcohol sales may increase revenue for alcohol producers, lower revenue for liquor stores (Rickard 2012) and reduce the number of firms,

wages, and employment in the liquor store sector (Byrne and Nizovtsev 2017). However, it is unclear whether the impact will vary across rural and urban counties.

On one hand, rural residents tend to consume more alcohol and prefer beer, particularly macro beer, compared to their urban cousins (Hart and Alston 2020). Consequently, we may see a greater substitution of grocery store visits for liquor store visits in rural areas after the expansion of full-strength beer sales. Since grocery stores are frequently owned by regional or national companies, whereas liquor stores in Colorado tend to be small, independent businesses, a redistribution of revenues from liquor stores to grocery stores could increase the money leaking out of local economies. Additionally, a decline in sales and traffic at liquor stores could have a disproportionate impact on alcohol producers in rural areas due to the limited number of local off-premise retailers.

On the other hand, competition between liquor stores and major grocery chains, and therefore the impact on liquor store foot traffic, may be greater in suburban and urban areas. Haltiwanger and Krizan (2010) find that big box stores, which tend to locate in higher-income urban and suburban areas (Ellickson and Grieco 2013), negatively impact smaller retail business only when they are located in the immediate area and compete in the same detailed industry. Walmart's tendency to locate in less densely populated areas and rely on a greater catchment area is an exception (Ellickson and Grieco 2013).

Figure 3.1 provides a map of all alcohol producers, liquor stores, and major grocery stores[5] in Colorado and indicates whether they reside in a rural or an urban county. County classification is

[5]Major grocery stores belong one of the five most prevalent grocery chains in the state: Walmart, Safeway, the Kroger Family of Companies (King Soopers and City Market), Whole Foods, and Costco.

based on the US Office of Management and Budget metropolitan-nonmetropolitan classification (Cromartie 2019). Of the 720 alcohol producers in Colorado (Colorado Department of Revenue 2020), 171 (24%) are in rural counties. Looking exclusively at the 444 breweries and brewpubs, 95 (21%) are in rural counties. Chapter 2 revealed that the majority of the manufacturing breweries in Colorado are small-scale producers that find it challenging to get on grocery store shelves, while the 159 wineries 117 distilleries in the state rely entirely on liquor stores and taprooms for off-premise sales (Colorado Department of Revenue 2020). The map on the right side of Figure 3.1 reveals that some rural counties have only a few liquor stores, suggesting that a decline in foot traffic or the closure of firms would leave alcohol producers in these counties with limited local alternatives for selling off-premise. However, it also shows that many rural counties have only one or no major grocery store, suggesting rural liquor stores may not face the same level of competition from the grocery channel as their urban counterparts.

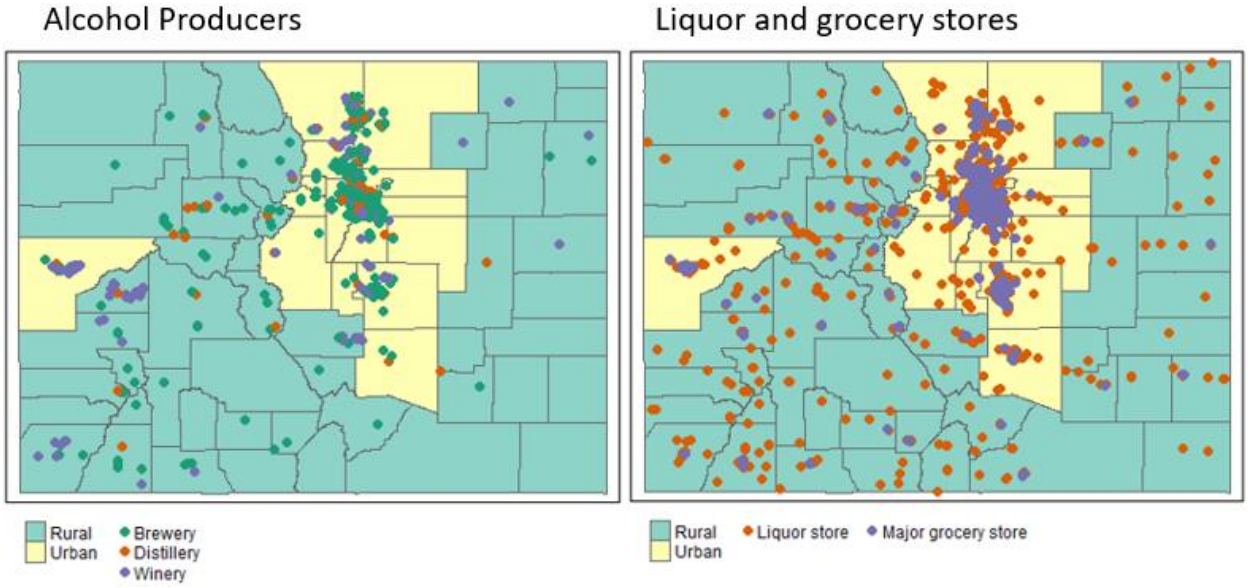

Figure 3.1. Map of Colorado alcohol producers, liquor stores, and major grocery stores
Note: Counties are classified as rural (blue) and urban (yellow) based on the US Office of Management and Budget metropolitan-nonmetropolitan classification (Cromartie 2019). Firm location is based on active alcohol licenses obtained from the Colorado Department of Revenue (2020).

State and local policy makers concerned with economic development may be interested in the implications of our study considering the potential disproportionate impact on rural alcohol producers of liberalized alcohol sales and the ambiguity of the differential effect on rural vs urban liquor stores. The objective of our research is twofold. First, we quantify the impact of liberalizing beer sales on Colorado liquor store foot traffic at the state-level using two empirical approaches: interrupted time series analysis (ITSA) and state space forecasting. ITSA uses regression analysis to determine the immediate impact of the policy change whereas we use state space forecasting to generate a counterfactual forecast of liquor store foot traffic over the entire post-policy period. Our second objective is to determine if the impact varies between rural and urban areas. Again, using ITSA and state space forecasting, we compare liquor store foot traffic patterns in rural and urban counties to determine whether the effect varies. We accomplish our objectives using cellphone tracking data from Colorado as well as Minnesota, whose alcohol retail laws are identical to Colorado's pre-policy change. Our cellphone tracking data, obtained from SafeGraph, is updated monthly and contains many liquor stores in each state, providing a timely and comprehensive dataset.

Conceptual framework

We expect to see a decline in liquor store visits as consumers shift purchases to grocery stores due to increased convenience and lower prices. Prior work finds that the price of alcohol tends to decline with the loosening of horizontal regulations on the retail tier (Rickard, Costanigro, and Garg 2013). The marketing literature suggests that the grocery and convenience retail environment benefits consumers making low involvement[6] purchase decisions, which tend to be based on the price and brand of the product (Hollebeek et al. 2007; L. S. Lockshin, Spawton, and

[6] Involvement can be defined as the level of interest in an activity, such as purchasing beer, wine, or spirits

Macintosh 1997; Aurifeille et al. 2002). For example, grocery and convenience stores tend to carry a limited selection of well-known brands (White, Troy, and Gerlich 2000), display little information beyond price at the shelf, and often employ discounts as a promotion strategy (Hollebeek et al. 2007; L. Lockshin and Corsi 2012; Ritchie, Elliott, and Flynn 2010). In contrast, price is less important in high involvement purchase decisions (Hollebeek et al. 2007; L. S. Lockshin, Spawton, and Macintosh 1997), which are more likely to be motivated by perceived quality and novelty of a product (Dodd, Pinkleton, and Gustafson 1996; Olsen et al. 2016; Aurifeille et al. 2002). We therefore hypothesize that liquor stores—which provide product diversity, quality cues, and expertise not available at grocery stores—are likely to lose a substantial share of low involvement consumers and retain consumers for whom purchasing alcohol is a high involvement decision.

Less clear are the differential impacts on rural and urban liquor stores. Recent research by Hart and Alston (2020) find that rural residents consume more alcohol on average and demand more macro beer and compared to their urban counterparts. When one also considers that macro beer brands (e.g. Bud Light) have high levels of brand familiarity and that grocery stores devote more shelf space to brands with higher established demand (White, Troy, and Gerlich 2000), it seems intuitive that liberalizing alcohol sales would cause more consumers to shift alcohol purchases to grocery stores in rural areas compared to urban areas. However, as discussed earlier, major grocery chains and big box stores tend to locate in higher-income suburban and urban areas not found in rural counties (Ellickson and Grieco 2013) and only compete with retailers located in the immediate area (Haltiwanger, Jarmin, and Krizan 2010), suggesting that urban liquor stores will be disproportionately impacted. In sum, the differential impact of liberalizing alcohol sales on rural and urban liquor stores *a priori* is ambiguous.

Data

We investigate the impact of liberalized beer sales on consumers' decision to shop at liquor stores using the SafeGraph Patterns dataset from SafeGraph Inc, a geospatial data company. The dataset contains foot traffic patterns for 3.6 million points-of-interests using anonymized geolocation data gathered from approximately 10% of all cellular devices in the U.S. (Squire 2019). SafeGraph panel members voluntarily join by accepting the terms and conditions of various mobile apps. The Safegraph panel corresponds to ~10% of the population in Colorado and ~9% in Minnesota over the study period. The proportion of SafeGraph panel members in each county closely correlates with the overall population, suggesting the data does not suffer from geographic bias (Squire 2019). SafeGraph updates the panel each month, making it timelier and more comprehensive compared to other datasets, such as Nielsen scanner data.

Our dataset contains firm characteristics such as store name, NAICS code, geographical coordinates, and monthly observations of the number of visits to each point-of-interest. We identify liquor stores in the data using NAICS code 445310, defined as specialized retailers selling almost exclusively alcohol products (U.S. Census Bureau 2017). The study period begins in January 2017 and ends February 2020 to avoid potential confounding from public safety concern and restrictions due to COVID-19.

The foot traffic data is extremely detailed but also somewhat noisy and requires cleaning. SafeGraph occasionally assigns a points-of-interest the incorrect NAICS code so we first validate the liquor stores in our data against a list of liquor stores provided by the state. Second, while opening and closures are certainly a useful indicator in their own merit, the zero visits observed for not yet opened or shut down businesses could also be the result of temporary closures due to remodeling or data collection issues. Accordingly, we balanced the panel by eliminating store

identifiers with no visit data for the first two or last two consecutive time periods (13% of observations), thereby reducing store opening and closures. Consequently, our results should be interpreted as only applying to firms surviving for the entire study period and the exclusion of firms that close means our results are a conservative estimate of the effect of the policy. Third, a limited number of firms exhibit extreme, implausible variation between months that we could not attribute to seasonality. To filter outliers, we calculated the percentage change between periods[7] for each firm and dropped the firms with a percentage change outside of three standard deviations from the average per-period change. This results in a further loss of 10% of observations for liquor stores.

After cleaning the data to include only liquor stores open throughout the entire study period, we create the state-level time series by aggregating the foot traffic at all liquor stores in each month of our study period in Colorado and Minnesota. Time series for rural and urban liquor stores are created by separately aggregating foot traffic from stores in rural and urban counties. Each time series has 38 observations, 24 in the pre-policy period spanning January 2017 to December 2018 and 14 in the post-policy period from January 2019 to February 2020.

To identify rural and urban counties we use the US Office of Management and Budget metropolitan-nonmetropolitan classification where metro areas are 1) central counties with one or more urbanized areas with 50,000 or more people or 2) outlying counties economically tied to the urbanized core, defined by at least 25% of the population within the county commuting to the central county or 25% of employment in the county consisting of workers coming from central

[7] The lowest recorded number of visits in any period is five, with lower visits counts appearing as NA (SafeGraph 2020). We assign all months with NA visits a value of one in order to calculate the percentages.

counties (Cromartie 2019). Metro counties are considered urban and nonmetro counties are considered rural. We use the host county to determine whether a liquor store is rural or urban.

Finally, to control for the impact that monthly fluctuations in the number of devices participating in the SafeGraph panel may have on monthly liquor store foot traffic, we normalize the monthly time series of liquor store foot traffic using the number of SafeGraph visits to all points-of-interest in a state, as shown in equation 3.1:

$$NormLSVisits_{st} = LSVisits_{st} * \frac{NumVisits_{sT}}{NumVisits_{st}} \, . \tag{3.1}$$

$LSVisits_t$ is the count of visits to all liquor stores in state s in month t, $NumVisits_{st}$ is the number of visits to all points-of-interests in state s in month t, and T is the final month of the panel. Normalizing liquor store foot traffic controls for potential confounding caused by structural changes to the SafeGraph panel and improves our ability to identify the effect of the policy change.

Summary statistics of the aggregated monthly liquor store foot traffic in Colorado and Minnesota in each year of the study period are presented in Table 3.1. Overall, Colorado has more liquor stores compared to Minnesota, but both have approximately the same number of liquor stores located in rural counties, indicating that Minnesota has a higher proportion of liquor stores located in rural areas. By dividing the mean of the monthly visits in each year by the number of liquor stores, we find that stores in Minnesota generally receive slightly more visits on average compared to Colorado, suggesting these stores may be slightly larger. We also find that rural liquor stores generally have less foot traffic on average compared to their urban counterparts, indicating that rural stores may be smaller. State-level foot traffic to liquor stores is

approximately 20,000 higher in Colorado and declined in both states in each year of the study period, suggesting a broad, negative trend in liquor store foot traffic independent of alcohol policy changes. When broken into rural and urban categories, the average monthly foot traffic appears to decline only at liquor stores located in urban counties in both states and increases at liquor stores located in rural counties in Minnesota. This is counter to our expectation that the decline in foot traffic would be greater in rural areas due to higher demand for beer and overall alcohol consumption among rural consumers (Hart and Alston 2020).

Table 3.1. Summary statistics of aggregated monthly liquor store foot traffic* in each full year of the study period

Year	Mean	Median	SD	Min	Max	Firm count	Avg monthly visits per store
				Colorado overall			
2017	69,261	67,837	3,046	65,952	74,493	601	115
2018	68,601	68,992	2,823	61,940	72,466	601	114
2019	65,833	64,837	2,934	61,090	70,385	601	110
				Colorado rural			
2017	11,706	11,713	1,298	9,266	14,431	129	91
2018	11,069	10,849	1,129	9,578	13,961	129	86
2019	11,259	11,010	1,194	9,948	14,120	129	87
				Colorado urban			
2017	57,555	56,901	2,636	53,987	61,988	472	122
2018	57,532	58,061	2,450	51,934	59,762	472	122
2019	54,574	54,144	2,298	51,142	58,092	472	116
				Minnesota overall			
2017	49,404	48,202	3,319	45,736	57,282	408	121
2018	48,384	47,664	2,844	45,214	53,794	408	119
2019	46,803	45,778	3,723	41,323	54,192	408	115
				Minnesota rural			
2017	13,937	13,237	1,724	12,343	17,968	126	111
2018	14,501	13,998	1,491	13,200	17,978	126	115
2019	14,906	14,610	1,954	12,335	18,796	126	118
				Minnesota urban			
2017	35,467	34,962	1,807	32,790	39,313	282	126
2018	33,883	33,882	1525	31,744	36,286	282	120
2019	31,898	31,626	1,910	28,984	35,395	282	113

Methods

We use two quasi-experimental techniques to test our hypotheses: ITSA and state-space forecasting. ITSA is a standard technique used by policy and public health researchers (Livingston et al. 2017; Cook and Campbell 1979; Cruz, Bender, and Ombao 2017) that uses time series data from the pre- and post-treatment period to identify if there is an immediate

change in the level or a change in the trend after an intervention (Linden 2015). State-space forecasting is a univariate forecasting technique that uses data from the pre-treatment period to train a model and generate a forecast that serves as a counterfactual for observations in the post-treatment period. State space techniques have been used to forecast tourism demand (Jorge-González et al. 2020), the price of Bordeaux (Bazen and Cardebat 2018), and alcohol consumption (Voon and Fogarty 2019). Our application of state space forecasting is most closely related to the work of Bridge et al. (2020), who use exponential smoothing to create a counterfactual forecast of suicide rates following the release of the Netflix documentary *13 Reasons Why.*

The two estimation approaches are complementary: in addition to providing a robustness check, ITSA estimates the *immediate* impact of the policy change while we use the state space approach to estimate an *average* effect over the observed post-policy period as well examine how the policy impact evolves over time. We use ITSA and state space forecasting to analyze state-level time series of liquor store foot traffic as well as separate time series for foot traffic at liquor stores in rural and urban counties.

ITSA

We use two ITSA models, each with its own strengths and weaknesses. Single-group ITSA uses the pre-policy trend projected into the post-treatment period as counterfactual and relies on the identifying assumption that no systematic factors affects the observed unit other than the treatment itself. An advantage of the single-group approach is that it limits potential confounding due to between group differences. The single-group ITSA regression model takes the following form:

$$Y_t = \beta_0 + \beta_1 T_t + \beta_2 Treat_t + \beta_3 Treat_t * (T_t - 25) + \sum_{j=1}^{S-1} \gamma_j D_{jt} + \epsilon_t \qquad (3.2)$$

where Y_t is the normalized foot traffic to liquor stores aggregated at the state-level or for either rural or urban counties in time period t and T_t is a linear time trend. Note that $Treat_t * (T_t - 25)$ is 0 in all periods prior to the policy change and begins sequentially at 0 in the period immediately following the policy change. D_{jt} are dummy variables for each month and account for seasonality. The coefficient β_2 captures the immediate effect and the level change that results from expanded retail outlets whereas the coefficient β_3 captures difference in the slope between the pre- and post-policy period.

Instead of relying on the pre-treatment trend, the multi-group ITSA compares the change observed in the treatment group to that observed in control group (Minnesota). The identifying assumption is that, in the absence of the policy change, the difference between the treated and the control group would have remained constant and is more commonly known as the parallel trends assumption. Invoking the parallel trends assumption is plausible when there is not a statistical difference in pre-treatment trends. If the parallel trends assumption can be invoked, multi-group ITSA has the advantage of controlling for unobserved time-varying effects that impact liquor store foot traffic in both states.

The multi-group ITSA regression model is only slightly more complex:

$$Y_t = \beta_0 + \beta_1 T_t + \beta_2 Treat_t + \beta_3 Treat_t * (T_t - 25) + \beta_4 Z + \beta_5 Z * T_t + \beta_6 Z * Treat_t + \beta_7 Z * Treat_t * (T_t - 25) + \sum_{j=1}^{S-1} \gamma_j D_{jt} + \epsilon_t \quad (3.3)$$

where Z is an indicator variable that equals 1 when the observation belongs to the treated state (Colorado). Therefore, β_4 is the difference in the level between treated and control (Minnesota), β_5 is the difference in the slope between the treated and control, β_6 is the change in the

difference of the level between the treated and control in the period immediately following the policy change, and β_7 is the change in the difference of the slope between the treated and control in the post-policy period. The policy effect is captured by is captured by β_2 and β_3 in the single-group ITSA, and by β_6 and β_7 in the multi-group ITSA.

State space forecasting

If there are no structural breaks in the time series before the treatment is administered, a forecast generated using a model trained on the pre-policy time period can serve as a plausible counterfactual (Linden 2018). Following Hyndman et al. (2008), a general state-space model can be expressed as

$$y_t = w(x_{t-1}) + r(x_{t-1})\epsilon_t \tag{3.4}$$

$$x_t = f(x_{t-1}) + g(x_{t-1})\epsilon_t \tag{3.5}$$

where y_t is the observed value at time t and $x_t = (l_t, b_t, s_{t-1}, \dots, s_{t-m+1})$ is a state vector containing equations for l_t, b_t, and s_t, which denote the level, slope, and seasonal components at time t. ϵ_t, called innovations in the literature, is a normally distributed white noise process with variance σ^2. The first term of equation 3.4 captures the effect of past observations on y_t, whereas the first term in 3.5 describe how the state vector evolves over time.

We examine the decomposition of our time series of overall, rural, and urban foot traffic in the pre-policy period (see appendix C) and determine that a model with an additive seasonal and trend component, also known as an additive Holt-Winters' model (Bermúdez, Segura, and Vercher 2007), is most appropriate.

Consistent with an additive Holt-Winters' model with multiplicative errors, our state-space equations take the following form:

$$\mu_t = l_{t-1} + b_{t-1} + s_{t-m} \tag{3.6}$$

$$l_t = l_{t-1} + b_{t-1} + \alpha(l_{t-1} + b_{t-1} + s_{t-m})\epsilon_t \tag{3.7}$$

$$b_t = b_{t-1} + \beta(l_{t-1} + b_{t-1} + s_{t-m})\epsilon_t \tag{3.8}$$

$$s_t = s_{t-m} + \gamma(l_{t-1} + b_{t-1} + s_{t-m})\epsilon_t \tag{3.9}$$

where α, β, and γ are estimated smoothing parameters, m is an index for the months in a year, and $\epsilon_t \sim NID(0, \sigma^2)$. We estimate values for the smoothing parameters $\theta = (\alpha, \beta, \gamma)$ and initial states $x_0 = (l_0, b_0, \ s_0, s_{-1}, \dots, s_{-m+1})$ using observations in the pre-policy period and Maximum Likelihood estimation:

$$\mathcal{L}(\theta, x_0) = n \log\left(\sum_{t=1}^{n} \epsilon_t^2\right) + 2\sum_{t=1}^{n} \log\ |r(x_{t-1}). \tag{3.10}$$

We use our estimates of l_t, b_t, and s_t, as well as α, β, and γ, to generate a point forecast for the post-policy period using the following set of equations:

$$\hat{Y}_{t+h} = l_t + hb_t + s_{t-m+h_m^+} \tag{3.11}$$

$$l_t = \alpha(Y_t - s_{t-m}) + (1-\alpha)l_{t-1} \tag{3.12}$$

$$b_t = \beta^*(l_t - l_{t-1}) + (1-\beta^*)b_{t-1} \tag{3.13}$$

$$s_t = \gamma(Y_t - l_{t-1} - b_{t-1}) + (1-\gamma)s_{t-m} \tag{3.14}$$

where $h_m^+ = [(h-1) \bmod m] + 1$.

Following Ord et al. (1997) and Hyndman et al. (2002), we calculate a prediction interval for the point estimates by simulating multiple ($M = 5{,}000$) forecasting paths conditional on the final (pre-treatment) state x_n and random draws of the disturbance, and identify the 0.025 and 0.975 quantiles of the simulated values. The policy effect on overall, rural, and urban liquor store foot traffic is measured as the difference between the observed post-treatment trajectory and simulated forecasts.

Results

Figure 3.2 provides a visual comparison of the aggregated monthly liquor store foot traffic in Colorado and Minnesota before and after the policy change. Overall foot traffic patterns in Colorado and Minnesota exhibit relatively flat, stable trends and similar seasonality in the pre-policy period, which improves the credibility of both the single-group and multi-group ITSA (Linden 2015). As with the post-policy average in Table 3.1, the negative trend in the post-policy period in Figure 3.2 may be driven by the seasonal decline in visits embedded in our last two observations. Seasonality is again similar in Colorado and Minnesota when we separately examine rural foot traffic, but the pre-treatment trends noticeably diverge. Rural foot traffic in Minnesota has a positive trend while the trend in Colorado appears negative. Urban foot traffic diverges even further, with Minnesota foot traffic exhibiting less seasonal variation and having a negative trend compared to a positive trend in Colorado. The visual comparison of rural and urban foot traffic patterns indicates that we need to exercise caution when using rural and urban foot traffic in Minnesota as a counterfactual in out multi-group ITSA, but our analysis using single-group ITSA and state space forecasting do not rely on parallel trends and therefore remain robust.

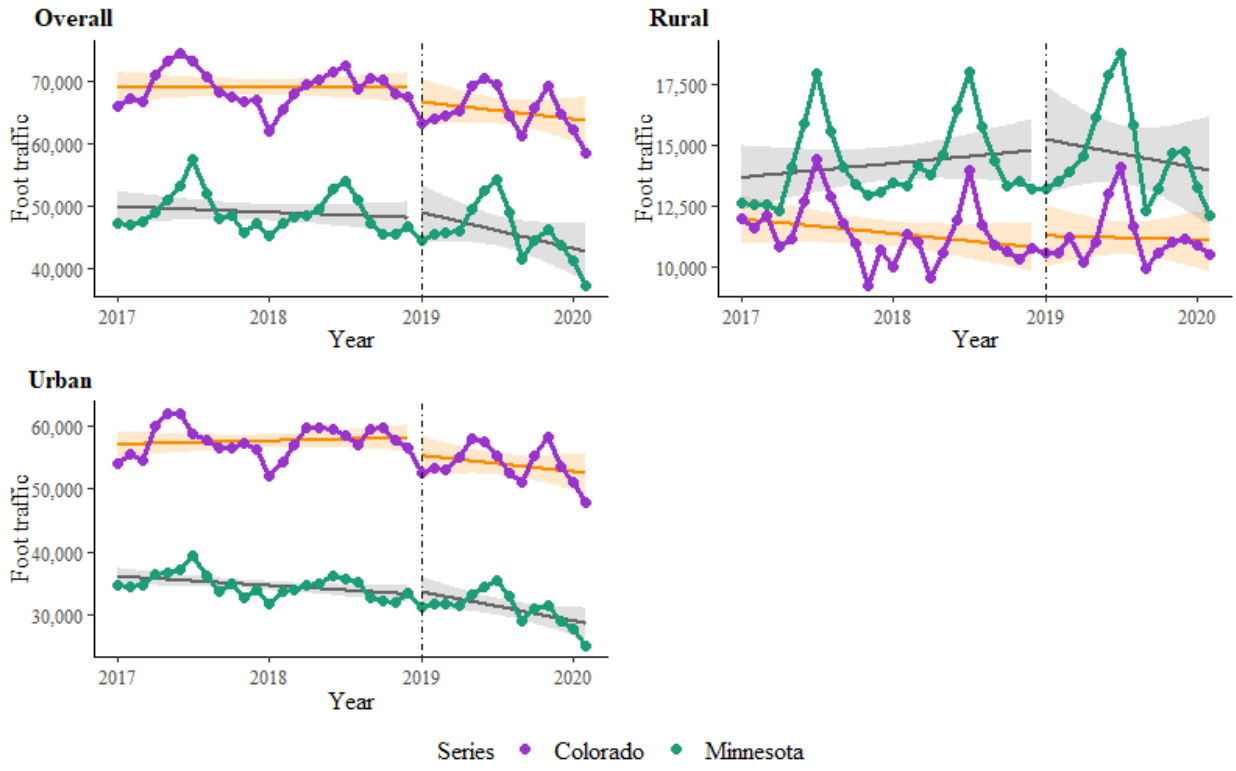

Figure 3.2. Aggregated liquor store foot traffic trends in Colorado and Minnesota
Note: The purple (green) line represents the aggregated liquor stores foot traffic in Colorado (Minnesota). The orange and grey lines depict the linear time trend in Colorado and Minnesota, respectively. The vertical line indicates when Colorado implemented the policy change.

ITSA

The results for the single- and multi-group ITSA (Table 3.2) provide evidence that the policy change had an immediate, negative effect on overall liquor store foot traffic. The coefficient on $Treat$ in the single-group regression, which captures the immediate effect of the policy change, corresponds to a 2% decline in the level of foot traffic. The single-group ITSA limits selection bias due to between-group differences but is vulnerable to threats from unobserved events that coincide with the policy change (Bernal, Cummins, and Gasparrini 2018). We can account for these threats with a multi-group ITSA that uses a time series of liquor store foot traffic in Minnesota as a control provided that we are also willing to assume parallel trends in foot traffic prior to the policy change. The multi-group ITSA results for overall foot traffic are qualitatively

similar: the coefficient on $Z * Treat$ indicates that foot traffic in Colorado declined by almost 5%. We do not find any change in the slope of foot traffic from the pre-policy to the post-policy period. Importantly, the coefficient on $Z * T$ is small and insignificant, indicating that there is no substantial difference in the pre-policy slope of foot traffic between Colorado and Minnesota and supports our use of Minnesota as a control.

We limit the interpretation of our ITSA results for rural and urban foot traffic to the single-group analysis because, in addition to the visual evidence that pre-policy trends may differ, the coefficient on $Z * T$ for the rural and urban multi-group analyses are significant, providing statistical evidence that the parallel trends assumption does not hold. The single-group ITSA results show that the policy impact diverged between rural and urban liquor stores. For rural liquor stores, our estimate of the policy effect is insignificant, suggesting there was no immediate impact of the policy on foot traffic. In contrast, our estimate of the impact in urban counties corresponds to a 3.2% decline in foot traffic, which is larger in magnitude compared to our estimate of the impact on overall foot traffic. Taken together, our ITSA results suggest that liberalizing alcohol sales had an immediate and negative impact on liquor store foot traffic, and that the impact was entirely borne by urban liquor stores. This is counter to our hypothesis that rural liquor stores would be disproportionately impacted.

Table 3.2. ITSA results for aggregated overall, rural, and urban liquor store foot traffic

	Overall		Rural		Urban	
	Single-group	Multi-group	Single-group	Multi-group	Single-group	Multi-group
Treat	-1,351.359**	1,647.094**	524.340	438.763	-1,875.699***	1208.331*
	(549.455)	(776.358)	(327.349)	(659.303)	(508.711)	(703.928)
$Treat * T$	-112.887	-289.270***	56.973	-106.323	-169.860**	-182.947***
	(100.832)	(77.065)	(28.901)	(82.845)	(81.694)	(67.511)
$Z * T$	-	71.527	-	-97.723***	-	169.250***
		(50.434)		(32.863)		(49.739)
$Z * Treat$	-	-3,276.071***	-	104.802	-	-3380.874***
		(840.050)		(769.151)		(960.759)
$Z * Treat * T$	-	181.879	-	180.980*	-	0.899
		(126.092)		(91.798)		(130.506)
Observations	38	38	38	38	38	38
Avg visits pre-policy	68,931	68,931	11,387	11,387	57,544	57,544
Percent change in visits	-1.9	-4.7	4.6	0.9	-3.2	-5.8
Newey-West SE	YES	YES	YES	YES	YES	YES
Autocorrelation *p-value*	0.050 (11^{th} order)	0.025 (9^{th} order)	0.039 (1^{st} order)	0.008 (3^{rd} order)	0.007 (12^{th} order)	0.007 (3^{rd} order)
F	197.24***	953.14***	112.93***	39.33***	72.37***	818.06***

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors are reported in parenthesis. All regressions contain a constant and seasonal dummies. We use the Cumby-Huizinga general test to check for autocorrelation up to 12 lags. We report the highest order autocorrelation with a significant p-value.

State space forecasting

The left side of Figure 3.3 provides a visual representation of the state-space forecast[8] and the rights side depicts the treatment effect in each month after the policy change in Colorado. The estimate of the treatment effect in each month is obtained by subtracting the point forecast from the observed values and the corresponding 95% confidence interval. For overall foot traffic, the counterfactual forecast is consistently above the observed foot traffic after January 1st, 2019, and the observed values often lie beneath the 95% prediction interval, providing evidence that the policy had a substantial negative effect on overall foot traffic. Additionally, our graph of the policy effect shows that the impact is larger in warmer months (April through October), which coincides with peak demand for beer (Hirche, Haensch, and Lockshin 2021). The average treatment effect (ATE), which is the average effect of the policy over the entire post-policy period, is -3,194 (95% CI [-365, -6,707]) and corresponds to a 4.9% decline in monthly liquor store foot traffic. Note that the ATE is similar in magnitude to the effect estimated by the multi-group ITSA, providing strong evidence of a moderate, negative effect on liquor store foot traffic.

The results from our state space forecast for rural and urban liquor store foot traffic are qualitatively similar to our ITSA results. The post-policy observed foot traffic at rural liquor stores falls within the prediction interval of the forecast and the confidence interval on the ATE (-842 (95% CI [947, -2,841]) includes zero, suggesting that the policy change had little impact on rural consumers decision to shop at liquor stores. This contrasts starkly with the results for urban liquor store foot traffic, where, as with overall foot traffic, the forecast is consistently above the observed visits. The confidence interval for the treatment effect does not include zero

[8] Our smoothing parameter estimates are all < 0.3, indicating there is little random change in the level and seasonality.

in 10 of the 14 months following the policy change traffic and the ATE (-3,725 (95% CI [-896, -8,074]) represents an even larger 6.4% decline in monthly liquor store foot traffic.

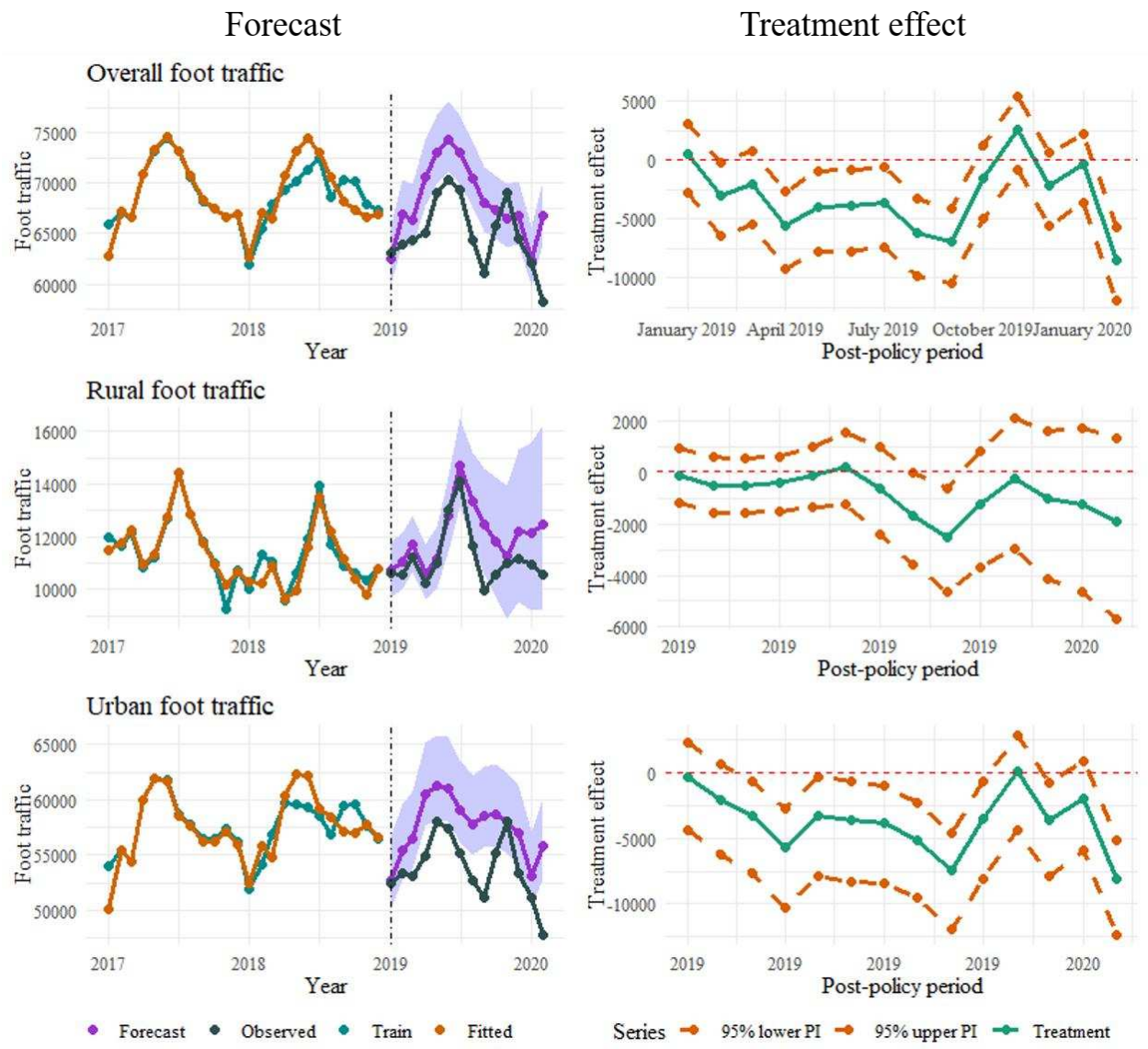

Figure 3.3. State space forecast and treatment effect for Colorado liquor store foot traffic
Note: The left column presents our state space forecasts, where the orange line represents the model trained on observed foot traffic (blue) in the pre-policy period, the purple line is the point forecast with a 95% prediction interval, and the green line indicates the observed values in post-policy period. The right column presents a visualization of the estimated policy effect and 95% prediction interval in each month of the post-policy period.

We test the robustness our state space forecast by performing a placebo analysis on liquor store foot traffic in Minnesota, where we would not expect to see any impact from Colorado's policy

change. The Minnesota forecasts, provided in Figure 3.4, do not systematically differ from the observed visits in the post-treatment period and the ATE's do not significantly differ from zero (see Table 3.3). The null results from our placebo analysis suggests that state space forecasting can credibly predict liquor store foot traffic in the absence of a policy change and supports our findings in Colorado.

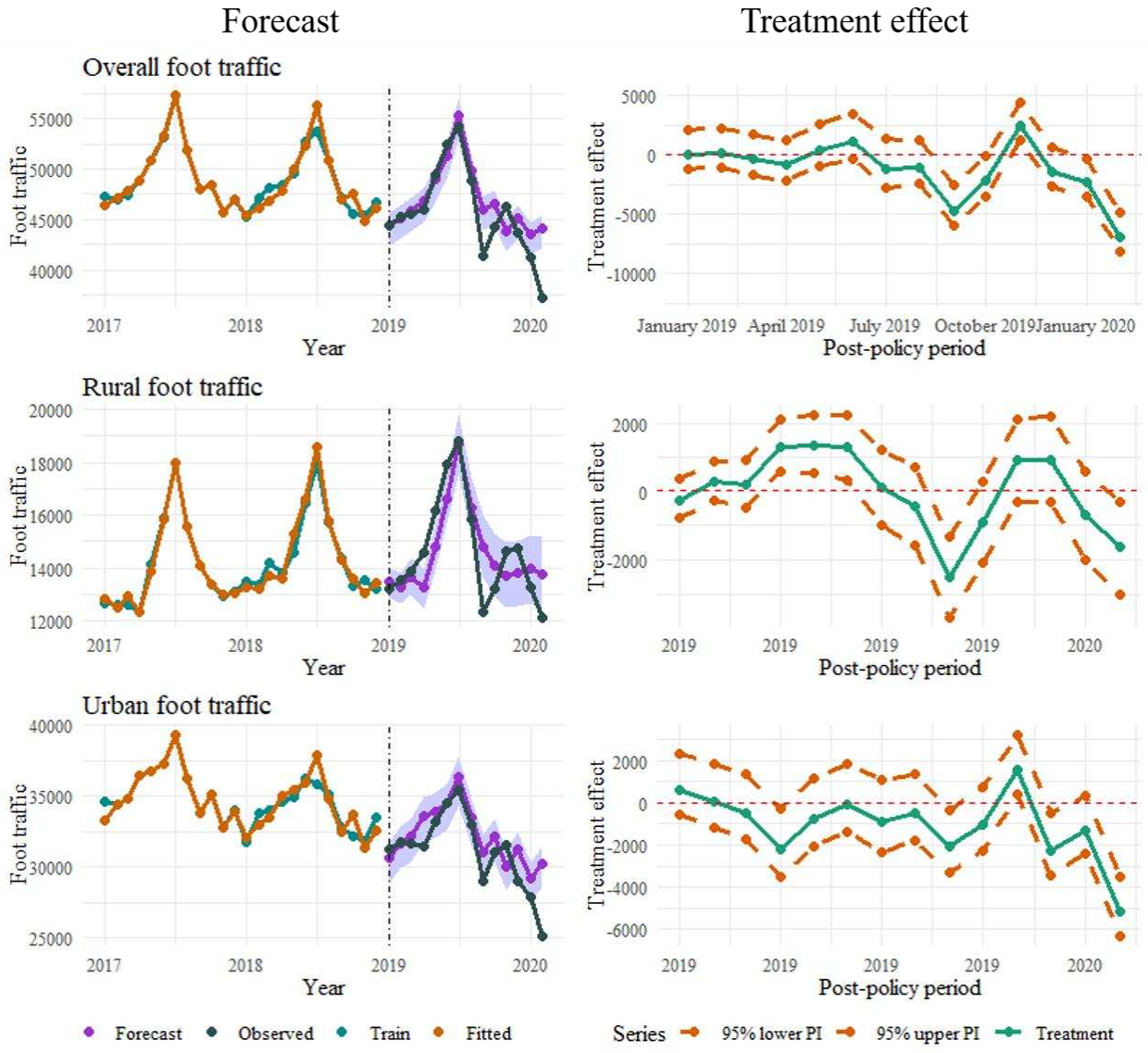

Figure 3.4. State space forecast and treatment effect for Minnesota liquor store foot traffic
Note: The left column presents our state space forecasts, where the orange line represents the model trained on observed foot traffic (blue) in the pre-policy period, the purple line is the point forecast with a 95% prediction interval, and the green line indicates the observed values in post-

policy period. The right column presents a visualization of the estimated policy effect and 95% prediction interval in each month of the post-policy period.

Table 3.3. ATE's for liquor store foot traffic in Minnesota

Class	ATE	95% CI upper bound	95% CI lower bound
Overall	-1,196	938	-2,516
Rural	5	1,022	-1,001
Urban	-1,034	767	-2,276

Discussion and conclusion

Colorado's liberalization of full-strength beer sales in the grocery and convenience channels changed market dynamics and the implications for craft breweries was largely unknown. The two different quasi-experimental techniques we applied to liquor store foot traffic yielded qualitatively similar results, providing strong evidence that consumers decided to shop less at liquor stores located in urban counties following the policy change. Even though the effects of the legislation are still unfolding, our analysis of liquor store foot traffic provides an estimate of the magnitude of the immediate impact on rural and urban liquor stores and allows us to infer some implications for alcohol retailers and alcohol producers.

The moderate decline in overall liquor store foot traffic suggests that liberalizing full-strength beer sales had a negative impact on the liquor store sector, as expected, but it is unlikely to trigger the feared wave of mass closures (Sealover 2018). The key factor is that liquor stores retained exclusive rights on liquor and wine sales, which likely minimized the effect of the increase in competition. Interestingly, both empirical approaches suggest that the policy change had a substantial negative impact on consumers' decision to shop at liquor stores in urban counties, but had no discernable impact on consumers' decision to shop at liquor stores in rural counties. The asymmetric impact could be caused by the greater number of major grocery stores in close proximity to liquor stores in urban and suburban areas.

Another implication is that grocery and convenience stores clearly benefitted from the liberalization of full-strength beer sales. The decline in foot traffic at liquor stores, especially in urban counties, combined with an increase in the volume of beer sold in Colorado following the policy change (Table 2.1 from Chapter 2) implies that the new market channels captured a substantial share of the alcohol market. The restructuring of Colorado's alcohol retail environment also may have benefitted consumers. Though we do not observe prices, prior literature provides empirical evidence that alcohol liberalization reduces prices (Rickard, Costanigro, and Garg 2013), and the change in foot traffic indicates that pre-change distribution laws constrained consumers' choice of market channel. Full-strength beer in grocery and convenience stores provide consumers with more choices in where to shop and allows them to weigh the convenience of one-stop shopping against the greater variety and expertise offered by liquor stores.

The implication for Colorado alcohol producers is mixed. Consumers in the new market channels are more likely to make purchase decisions based on brand familiarity and price (L. S. Lockshin, Spawton, and Macintosh 1997; Hollebeek et al. 2007), which favors macrobreweries and regional craft breweries. In addition, our findings with respect to rural liquor store foot traffic is a positive for rural alcohol producers selling at off-premise retailers. However, the substantial negative impact on urban liquor store foot traffic may impact the growth of small urban breweries in the future. Finally, though we do not have sales data on wineries and distilleries, we can infer that lower foot traffic in liquor stores, the exclusive off-premise retailer for these producers, will hurt sales and make expansion difficult.

Our results have important implications for the craft beer sector in three neighboring states that also amended alcohol retail laws. Because Utah and Kansas only expanded the sale of beer up to

5% and 6% ABV, respectively, the impact is likely to be similar to what we found in Colorado. Oklahoma, meanwhile, expanded full-strength beer and wine, which may have a greater effect on liquor stores. Based on our analysis, this may disproportionately impact small craft breweries that are unable to offset a decline at liquor stores by shifting sales to the grocery channel.

While our findings provide important insight, our study is only a step towards a full understanding of how liberalizing alcohol retail laws impacts craft breweries and other industry players. Substantive limitations include having only two years of pre-policy foot traffic data to train our state-space forecast, a lack of sales data, knowledge of how profits are distributed across the marketing channels, and direct access to information about macro beers sales. Another concern is anticipation effects: liquor stores may have increased marketing efforts to boost foot traffic and consumer loyalty. Our estimate of the policy effect may be biased downward if efforts were widespread and successful enough to influence foot traffic in the pre-policy period. Similarity in Colorado foot traffic from 2017 to 2018, as well as similarity to Minnesota's foot traffic prior to the policy change, suggests little to no anticipation effects, but we are unable to rule them out entirely.

More research is needed to confirm and broaden our results. In the next chapter, I broaden my analysis of liquor store foot traffic to include two additional states—Oklahoma and Kansas—that also recently liberalized alcohol retail. In addition to providing a robustness check, expanding my analysis to other states increases the external validity of my findings. Other future work could explore how the proximity of a liquor store to a grocery store moderates the impact liberalizing alcohol sales, investigate the value of liquor stores before and after the policy change, or use scanner data to evaluate the impact on the macro beer segment, which is likely where the biggest shifts occur. One large unknown is the impact of COVID-19 on the craft

brewing industry. Future studies should investigate the relationship between market channels and alcohol producers' resiliency to the COVID shock.

REFERENCES

Aurifeille, J-M., P.G. Quester, L. Lockshin, and T. Spawton. 2002. "Global vs International Involvement-based Segmentation: A Cross-national Exploratory Study." *International Marketing Review* 19 (4): 369–86. https://doi.org/10.1108/02651330210435672.

Bazen, Stephen, and Jean-Marie Cardebat. 2018. "Forecasting Bordeaux Wine Prices Using State-Space Methods." *Applied Economics* 50 (47): 5110–21. https://doi.org/10.1080/00036846.2018.1472740.

Bermúdez, J.D., J.V. Segura, and E. Vercher. 2007. "Holt–Winters Forecasting: An Alternative Formulation Applied to UK Air Passenger Data." *Journal of Applied Statistics* 34 (9): 1075–90. https://doi.org/10.1080/02664760701592125.

Bernal, James Lopez, Steven Cummins, and Antonio Gasparrini. 2018. "The Use of Controls in Interrupted Time Series Studies of Public Health Interventions." *International Journal of Epidemiology* 47 (6): 2082–93. https://doi.org/10.1093/ije/dyy135.

Bridge, Jeffrey A., Joel B. Greenhouse, Donna Ruch, Jack Stevens, John Ackerman, Arielle H. Sheftall, Lisa M. Horowitz, Kelly J. Kelleher, and John V. Campo. 2020. "Association Between the Release of Netflix's 13 Reasons Why and Suicide Rates in the United States: An Interrupted Time Series Analysis." *Journal of the American Academy of Child & Adolescent Psychiatry* 59 (2): 236–43. https://doi.org/10.1016/j.jaac.2019.04.020.

Byrne, Paul, and Dmitri Nizovtsev. 2017. "Exploring the Effects of State Differences in Alcohol Retail Restrictions." *International Review of Law and Economics* 50 (June): 15–24. https://doi.org/10.1016/j.irle.2017.04.001.

Colorado Department of Revenue. 2020. "2020 Annual Report." Colorado Department of Revenue. https://cdor.colorado.gov/data-and-reports/cdor-annual-reports.

Cook, Thomas D., and Donald T. Campbell. 1979. *Quasi-Experimentation: Design & Analysis Issues for Field Settings*. Boston: Houghton Mifflin.

Cromartie, John. 2019. "What Is Rural?" USDA Economic Research Service. October 2019. https://www.ers.usda.gov/topics/rural-economy-population/rural-classifications/what-is-rural.aspx.

Cruz, Maricela, Miriam Bender, and Hernando Ombao. 2017. "A Robust Interrupted Time Series Model for Analyzing Complex Health Care Intervention Data." *Statistics in Medicine* 36 (29): 4660–76. https://doi.org/10.1002/sim.7443.

Dodd, Tim H, Bruce E. Pinkleton, and A. William Gustafson. 1996. "External Information Sources of Product Enthusiasts: Differences between Variety Seekers, Variety Neutrals, and Variety Avoiders." *Psychology and Marketing* 13 (3): 291–304.

Ellickson, Paul B., and Paul L. E. Grieco. 2013. "Wal-Mart and the Geography of Grocery Retailing." *Journal of Urban Economics* 75 (May): 1–14. https://doi.org/10.1016/j.jue.2012.09.005.

Haltiwanger, John, Ron Jarmin, and C. J. Krizan. 2010. "Mom-and-Pop Meet Big-Box: Complements or Substitutes?" *Journal of Urban Economics*, Special Issue: Cities and Entrepreneurship, 67 (1): 116–34. https://doi.org/10.1016/j.jue.2009.09.003.

Hart, Jarrett, and Julian M. Alston. 2020. "Evolving Consumption Patterns in the U.S. Alcohol Market: Disaggregated Spatial Analysis." *Journal of Wine Economics* 15 (1): 5–41. https://doi.org/10.1017/jwe.2019.14.

Hirche, Martin, Juliane Haensch, and Larry Lockshin. 2021. "Comparing the Day Temperature and Holiday Effects on Retail Sales of Alcoholic Beverages – a Time-Series Analysis." *International Journal of Wine Business Research* 33 (3): 432–55. https://doi.org/10.1108/IJWBR-07-2020-0035.

Hollebeek, Linda D., Sara R. Jaeger, Roderick J. Brodie, and Andrew Balemi. 2007. "The Influence of Involvement on Purchase Intention for New World Wine." *Food Quality and Preference* 18 (8): 1033–49. https://doi.org/10.1016/j.foodqual.2007.04.007.

Hyndman, Rob J, Anne B Koehler, Ralph D Snyder, and Simone Grose. 2002. "A State Space Framework for Automatic Forecasting Using Exponential Smoothing Methods." *International Journal of Forecasting* 18 (3): 439–54. https://doi.org/10.1016/S0169-2070(01)00110-8.

Jorge-González, Elisa, Enrique González-Dávila, Raquel Martín-Rivero, and Domingo Lorenzo-Díaz. 2020. "Univariate and Multivariate Forecasting of Tourism Demand Using State-Space Models." *Tourism Economics* 26 (4): 598–621. https://doi.org/10.1177/1354816619857641.

Linden, Ariel. 2015. "Conducting Interrupted Time-Series Analysis for Single- and Multiple-Group Comparisons." *The Stata Journal: Promoting Communications on Statistics and Stata* 15 (2): 480–500. https://doi.org/10.1177/1536867X1501500208.

———. 2018. "Using Forecast Modelling to Evaluate Treatment Effects in Single-Group Interrupted Time Series Analysis." *Journal of Evaluation in Clinical Practice* 24 (4): 695–700. https://doi.org/10.1111/jep.12946.

Livingston, Melvin D., Tracey E. Barnett, Chris Delcher, and Alexander C. Wagenaar. 2017. "Recreational Cannabis Legalization and Opioid-Related Deaths in Colorado, 2000–2015." *American Journal of Public Health* 107 (11): 1827–29. https://doi.org/10.2105/AJPH.2017.304059.

Lockshin, Lawrence, and Armando Maria Corsi. 2012. "Consumer Behaviour for Wine 2.0: A Review since 2003 and Future Directions." *Wine Economics and Policy* 1 (1): 2–23. https://doi.org/10.1016/j.wep.2012.11.003.

Lockshin, Lawrence S., Anthony L. Spawton, and Gerrard Macintosh. 1997. "Using Product, Brand and Purchasing Involvement for Retail Segmentation." *Journal of Retailing and Consumer Services* 4 (3): 171–83. https://doi.org/10.1016/S0969-6989(96)00048-3.

National Alcohol Beverage Control Association. 2016. "Grocery and Convenience Stores as Alcohol Outlets." https://www.nabca.org/sites/default/files/assets/publications/white_papers/GroceryStoresPaper.pdf.

Olsen, Janeen E, Tom Atkin, Liz Thach, and Steve S Cuellar. 2016. "Variety Seeking by Wine Consumers in the Southern States of the US." *International Journal of Wine Business Research* 27 (4): 260–80.

Ord, J. K., A. B. Koehler, and R. D. Snyder. 1997. "Estimation and Prediction for a Class of Dynamic Nonlinear Statistical Models." *Journal of the American Statistical Association* 92 (440): 1621–29. https://doi.org/10.1080/01621459.1997.10473684.

Rickard, Bradley J. 2012. "The Economics of Introducing Wine into Grocery Stores." *Contemporary Economic Policy* 30 (3): 382–98. https://doi.org/10.1111/j.1465-7287.2011.00272.x.

Rickard, Bradley J., Marco Costanigro, and Teevrat Garg. 2013. "Economic and Social Implications of Regulating Alcohol Availability in Grocery Stores." *Applied Economic Perspectives and Policy* 35 (4): 613–33. https://doi.org/10.1093/aepp/ppt018.

Ritchie, Caroline, Gary Elliott, and Mike Flynn. 2010. "Buying Wine on Promotion Is Trading-up in UK Supermarkets: A Case Study in Wales and Northern Ireland." *International Journal of Wine Business Research* 22 (2): 102–21. https://doi.org/10.1108/17511061011061685.

Sealover, Ed. 2018. "Shockwaves Expected in Industry as Full-Strength Beer Hits Colorado Grocery Store Shelves Jan. 1." *Denver Business Journal*, December 31, 2018. https://www.bizjournals.com/denver/news/2018/12/31/colorado-full-strength-beer-grocery-stores.html.

Squire, Ryan Fox. 2019. "'What about Bias in Your Dataset?' Quantifying Sampling Bias in SafeGraph Patterns." October 2019. https://colab.research.google.com/drive/1u15afRytJMsizySFqA2EPlXSh3KTmNTQ#offline=true&sandboxMode=true.

Staaf, Kris, Bob Hunt, and Steve Findley. 2017. *Senate Bill 16-197 Working Group Legislative Report Recommendation Form Rec 197-023*. https://www.colorado.gov/pacific/sites/default/files/Rec%20197-023.pdf.

Summit Economics, LLC. 2009. "Economic Impact of Replacing 3.2 Beer Sales with Full Strength Beer Sales." 2009. https://kaobr.wildapricot.org/Resources/Documents/Colorado_32_beer_study.16170004.pdf.

U.S. Census Bureau. 2017. “American Community Survey, 2017 American Community Survey 5-Year Estimates.”

Voon, Derby, and James Fogarty. 2019. “A Note on Forecasting Alcohol Demand.” *Journal of Wine Economics* 14 (2): 208–13. https://doi.org/10.1017/jwe.2019.15.

White, J. C., L. C. Troy, and R. N. Gerlich. 2000. “The Role of Slotting Fees and Introductory Allowances in Retail Buyers’ New-Product Acceptance Decisions.” *Journal of the Academy of Marketing Science* 28 (2): 291–98. https://doi.org/10.1177/0092070300282009.

CHAPTER 4 LIBERALIZATION IN MODERATION: THE PARTIAL LIBERALIZATION OF ALCOHOL SALES AND CONSUMER MARKET CHANNEL CHOICE

Introduction

Over the past decade, a wave of alcohol retail liberalization has swept across the U.S. as many states, including Washington, Tennessee, Oklahoma, Utah, Kansas, and Colorado, repealed or amended post prohibition-era laws limiting the licensing of alcohol retailers. Prior to the law changes, the sale of almost all alcoholic beverages were restricted to liquor stores[9]. Under the new regulatory frameworks, other retailers, such as grocery and convenience stores, compete directly with liquor stores for the sale of certain types of alcohol. The U.S. alcohol retail market is massive, with beer accounting for $116 billion in sales (Brewers Association 2020) and wine and spirits accounting for another $75 billion and $90 billion, respectively (Wine Institute 2020; Harfmann 2020), and the redistribution of alcohol sales to the new market channels is likely to have a profound impact on the alcohol retail sector. A regulatory nuance of the liquor store sector is that states often restrict the number of liquor stores an individual or entity may own, leading to a sector comprised of many small, independent businesses.

The size of the U.S. alcohol market makes the repeal or modification of alcohol retail licensing laws controversial, and regional variation in laws governing alcohol sales and distribution are known to play a pivotal role in the success of the craft beverage sector around the country (Malone and Lusk 2016). Following the twenty first amendment in 1933, the federal government established the basic principles of the three-tier system, separating alcohol production,

[9] One notable exception is that Colorado allowed grocery and pharmacy chains to operate a limited number of liquor-licensed drugstores prior to partial alcohol liberalization.

distribution, and retailing, but delegating to individual states the power to regulate alcohol sales (Lam 2014). Local authorities, in turn, struck different balances between temperance and the promotion of a local alcoholic beverage sector, creating a patchwork of regulatory ecosystems which supported the alcohol industry in some states, while stifling it in others. In addition to harming mom and pop liquor stores and damaging public health, critics of alcohol liberalization argue that alcohol licensing restrictions foster the development of the craft beverage industry, and that removing these restrictions will stymy growth in this regionally important economic sector, particularly for small craft beverage producers unable to compete on grocery store shelves (Sealover 2018b; Akkam 2009; National Alcohol Beverage Control Association 2016).

The objective of this study is to determine how alcohol retail liberalization impacts consumers' decision to shop at liquor stores and assess the impact on the liquor store sector. We expect that trips to liquor stores and new market channels will become substitutes under more liberal alcohol retail reform, thereby leading to a negative impact on liquor stores. We accomplish our objective by estimating the effect of the policy change on liquor store foot traffic in three states that liberalized their alcohol retail laws (Oklahoma, Kansas, and Colorado). We exploit a novel dataset containing firm-level foot traffic patterns from SafeGraph Inc. because traditional metrics of consumer shopping behavior, such as scanner data, provide limited coverage of independent liquor stores.

In a modern bootleggers and Baptist alliance, liquor stores and social interest groups lobbied to defend regulation that limits alcohol retail, arguing that deregulation will hurt small businesses, limit consumer choice by reducing market access for niche producers, and increase alcohol access to minors (Akkam 2009; National Alcohol Beverage Control Association 2016). However, some studies suggest that liquor stores benefit from limited alcohol retail at the

expense of consumers (Smith 1982; Ornstein and Hanssens 1985). This is consistent with research showing that consumers benefit from expanded alcohol retail in the form of lower prices (Rickard, Costanigro, and Garg 2013) and an increase in the consumption of the liberalized alcohol type (Wagenaar and Langley 1995). Research on deregulating alcohol market channels found that counties allowing on-premise sales at breweries have higher wages (Malone and Hall 2017) and more breweries (Malone and Lusk 2016).

In a prior study with a similar research objective to our own, Rickard (2012) used a simulation model to predict the economic impact of proposed legislation to allow the sale of wine in grocery stores. The author found that revenue for liquor store owners would decrease by 28% and revenue for in-state wineries would increase by 13%. However, the proposed policy change was never passed by the New York legislature. Our study expands on the work of Rickard (2012) by 1) exploiting a natural experiment in multiple states that enacted alcohol sale liberalization, 2) investigating the magnitude of the impact under different degrees of alcohol liberalization, and 3) using a novel dataset containing liquor store foot traffic patterns and a new difference-in-differences estimator.

Our primary contribution is quantifying the effect of liberalizing alcohol retail on the liquor store sector, thereby enabling policy makers to weigh the costs against the potential benefits to consumers. The controversy surrounding alcohol retail liberalization emanates from concern that grocery and convenience stores will seize a sizable share of the alcohol market and trigger the mass exit of mom and pop liquor stores. Industry groups on both sides engaged in expensive lobbying efforts in an attempt to sway policy makers: grocery and convenience stores emphasized that alcohol liberalization would benefit consumers and increase state revenue from licensing fees (Heck 2016), while liquor store associations warned it would devastate small

businesses and harm craft beverage producers (Sealover 2018b). This study provides a neutral assessment of the most controversial cost: the impact on liquor stores.

A secondary contribution of the paper is quantifying the extent to which consumer choice of market channel is constrained by alcohol retail restrictions, thereby evaluating the claim by proponents of alcohol liberalization that consumers are the primary beneficiaries. Alcohol liberalization added new retailers and introduced new shopping choices for consumers: grocery and convenience stores offer one-stop convenience and lower prices whereas liquor stores offer more variety and higher quality service. The new choice set allows consumers to weigh the benefits of one-stop shopping in the form of time-saving and reduced travel costs (Seo 2019; Reimers and Chao 2014) against their preferences for variety and novelty (Gronau and Hamermesh 2008; Kahn 1995; McAlister and Pessemier 1982).

A final contribution is the introduction of a novel dataset that provides timely insight on consumer shopping behavior. Traditional sources of data on consumer shopping patterns, such as scanner data from Neilsen and IRI, are costly, offer limited coverage of small, independent businesses, and academics must often wait a year before data becomes available. By contrast, data on foot traffic patterns from SafeGraph Inc. is free for academic use, covers most businesses in the U.S. (Squire 2019), and is usually available the following month. To the best of our knowledge, our study is the first to use SafeGraph data to investigate how a change in alcohol retail policy impacts consumer shopping behavior.

Conceptual framework

In this section we draw on the private-interest theory of regulation and marketing research on consumer involvement to generate two testable hypotheses:

H1: Partial liberalization will have a negative impact on liquor store sales

H2: The impact of partial liberalization on liquor stores sales will increase as the degree of alcohol liberalization increases

The private-interest theory of regulation holds that regulation is a product demanded by various interest groups to enhance the well-being of their members (Becker 1983; Stigler 1971; Posner 1974). Politicians, political parties, and voters are assumed to transmit pressure from interest groups (e.g. donations to politicians or launching ad campaigns to sway voters) rather than be sources of pressure themselves. Competition among interest groups determines the regulatory structure, which will favor interest groups that are relatively more efficient at generating political pressure (Becker 1983). Empirical work by Kroszner and Strahan (1999) and Riekhof and Sykuta (2005), who investigate state regulations on direct wine shipments and branching restrictions on banks, respectively, find support for private-interest theory, concluding that the relative political strength of groups with competing economic interests explain regulatory changes. Indeed, in all states examined by our analysis, grocery and convenience stores lobbied in support of expanding alcohol sales while liquor stores lobbied against it.

Becker (1983) also argues that, because regulation is the result of a complex bargaining process among competing interest groups, the result will not reflect the most desired outcome for any one group. In our context, it appears that liquor stores were able to limit the deregulation of alcohol sales by varying amounts in each state (see Table 4.1). For example, it may be that liquor stores were more effective in applying political pressure in Kansas, which only allows beer up to 6% ABV to be sold outside of liquor stores, and were less effective in Oklahoma, where full strength beer and wine is now available in grocery and convenience stores. States that allow higher ABV

beer and wine to be sold outside of liquor stores will have more alcohol products available at alternative retailers, increasing the substitutability of visits. We therefore expect a smaller negative impact on liquor stores in states with a more modest expansion of alcohol retail.

Table 4.1. Current and former 3.2 states

State	Date of transition	Change to the regulatory environment
Minnesota	-	Only 3.2% ABW beer may be sold in grocery or convenience stores
Kansas	April 1st, 2019	Beer up to 6% ABV may be sold in grocery or convenience stores
Colorado	January 1st, 2019	Full-strength beer may be sold in grocery or convenience stores
Oklahoma	October 1st, 2018	Full-strength beer and wine may be sold in grocery or convenience stores

Notes: In all states, alcohol sales above 3.2% ABW could only be sold by liquor stores prior to the law change.

The marketing literature suggests that the new alcohol retail environment may particularly benefit low involvement[10] alcohol consumers. These consumers invest minimal effort and tend to make purchase decisions based on the price and brand of a product (Hollebeek et al. 2007; L. S. Lockshin, Spawton, and Macintosh 1997; Aurifeille et al. 2002). Grocery stores, which generally have less variety relative to liquor stores due to limited shelf space, prefer to carry well-known brands with established consumer demand (White, Troy, and Gerlich 2000) and employ price discounts as a promotion strategy (Hollebeek et al. 2007; L. Lockshin and Corsi 2012; Ritchie, Elliott, and Flynn 2010). On the other hand, high involvement consumers place less importance on price (Hollebeek et al. 2007; L. S. Lockshin, Spawton, and Macintosh 1997) and are more likely to seek variety and novelty (Dodd, Pinkleton, and Gustafson 1996; Olsen et al. 2016; Aurifeille et al. 2002) by shopping in a specialized liquor store. Taken together, prior marketing

[10] Involvement can be defined as the level of interest in an activity, such as purchasing beer, wine, or spirits

research supports our hypothesis that expanding alcohol retail will negatively impact liquor stores as low involvement consumers shift alcohol purchases to grocery stores.

Data

Due to the atomized nature of the industry, representative sales data from liquor stores is unavailable from traditional sources (e.g. IRI, Nielson, etc.). We overcome the lack of sales data by exploiting a novel dataset on consumer foot traffic available from SafeGraph Inc. Sociodemographic variables are aggregated at the county level and taken from the U.S. Census Bureau's 2017 5-year American Community Survey (2017).

We analyze liquor store foot traffic using a unique and relatively new dataset from SafeGraph Inc, a geospatial data company. The SafeGraph Patterns dataset tracks foot traffic patterns at over 3.6 million points-of-interest using anonymized geolocation data from approximately 10% of mobile devices (such as phones) in the United States (Squire 2019). Points-of-interest are mapped using polygons and a visit is attributed to a point-of-interest when the location of a mobile device belonging to the SafeGraph panel registers as being inside the polygon. (Hoffman 2018). The distribution of the SafeGraph panel is closely correlated to the distribution of the overall population of the U.S. at the county level, suggesting there is little geographic bias (Squire 2019). In addition to covering virtually all retailers, the SafeGraph panel has the advantage of being updated each month and is, therefore, timelier and more comprehensive compared to other datasets, such as Nielsen scanner data[11].

[11] Recent studies use SafeGraph data to investigate how social distancing efforts to control COVID-19 in one region are affected by policies in neighboring regions (Cook, Newberger, and Smalling 2020; Holtz et al. 2020).

Our dataset spans from January 2017 to February 2020 and includes four states: Colorado Kansas and Oklahoma, which amended 3.2 laws to expand alcohol retail, and Minnesota, which kept its 3.2 laws in place[12]. The dataset includes firm characteristics such as store name, parent brand, NAICS code[13], and geographical coordinates. We identify liquor stores using the North American Industry Classification System (NAICS) code 445310, which contains establishments primarily engaged in retailing packaged alcoholic beverages. We end our study period in February of 2020 to avoid potential confounding of our results from public safety concerns and stay-at-home orders due to COVID-19.

The data cleaning process consists of removing locations mislabeled as liquor stores, firms that may have opened or closed over the study period, and firms with inconsistent visit counts. Non-liquor stores appear because SafeGraph incorrectly classifies the NAICS code of some businesses and were removed by keeping only stores in the SafeGraph data that matched an official record of licensed liquor stores kept by each state. Zeros observed may be due to a store not yet opened or a shut-down business, but could also be the result of temporary closures due to remodeling or data collection issues[14]. Accordingly, we balanced the panel by eliminating stores with no foot traffic for the first two or last two consecutive months of the panel (13% of observations), thereby avoiding store opening and closures confounding our results. Consequently, our results apply only to liquor stores observed during the entire study period. We also removed firms with unreliable visit counts. A subset of firms in each state exhibit extreme

[12] Utah also expanded alcohol retail in November 2019 but there are insufficient observations after the policy change to include it in our analysis.
[13] SafeGraph uses machine learning to guess the NAICS code for each point-of-interest
[14] The lowest recorded number of visits in any period is five, with lower visits counts appearing as NA (SafeGraph 2020). We assign all months with NA visits a value of one to calculate the percentages.

variation between months that we could not attribute to seasonality. We identify and remove these firms by calculating the percentage change between periods for each firm and dropped the firms with percentage change outside of three standard deviations from the average per-period change, resulting in the removal of an additional 10% of observations.

A consequence of balancing our panel is that our results are generalizable only to liquor stores that survive the entire study period. Excluding exits may lead to an underestimate of the losses to the liquor store sector because these stores may also experience the largest decline in foot traffic. Data from the Colorado Department of Revenue (2020) shows that, the number of active liquor store licenses declined by only 3.8% over the study period, suggesting that the number of exits and the impact of excluding them is small, at least for Colorado.

Empirical approach

Two-way fixed effects

I use two difference-in-differences (DiD) approaches to estimate the effect of the expansion of alcohol sales to grocery and convenience stores: two-way fixed effects (TWFE) and an estimator developed by Callaway and Sant'Anna (2020b), which I will refer to as the CS estimator.

I use three equations to estimate the effect of policy change using TWFE, one for each treatment state (Oklahoma, Kansas, and Colorado). Observations of liquor store foot traffic in Minnesota act as a control in each equation. Consider the following generic equation for each treatment state:

$$y_{it} = \beta_1 Treated_i + b_t\gamma + \beta_2(Time_t * Treated_i) + \epsilon_{it} \quad (4.1)$$

Where y_{it} is the foot traffic to liquor store i in month t, $Treated_i$ is a dummy variable equal to 1 if liquor store i is in the treatment state, b_t is a vector of dummy variables for each monthly time

period, and $Time_t$ is a dummy variable equal to 1 in all months after the policy change. β_1 captures state fixed-effects: the effect of unmeasured, time invariant characteristics unique to each state, γ is a coefficient vector that captures time-varying, state-invariant effects (time-fixed effects), and β_2 captures the effect of the policy change.

Recent studies demonstrate that the TWFE estimator is biased when there is staggered treatment timing and dynamic treatment effects (Goodman-Bacon 2018; de Chaisemartin and D'Haultfœuille 2020)**.** The bias comes from improper comparisons between newly treated and already treated units, which will include treatment effect dynamics. In the context of our study, we avoid the issue of staggered treatment timing by estimating the effect alcohol liberalization in each of the treatment states separately.

Additionally, the parallel trends assumption may hold only after conditioning on covariates. Conditioning on covariates is necessary if a) the distribution of a covariate is different for liquor stores that are treated and those belonging to the control, and b) when the path of outcomes, in our case monthly liquor store foot traffic, depends on the covariate in absence of treatment. The goal of conditioning on covariates is to compare stores in the treatment and control that are similar to one another with respect to the covariates and therefore would have experienced similar outcomes in the absence of treatment. Including state-level time-invariant covariates in TWFE is not possible due to fixed effects. Even when covariates are store-level or vary over time, including covariates in TWFE requires two additional strong assumptions: 1) that the treatment does not change the effect of a given covariate on the outcome variable, and 2) parallel trends in covariates in the treatment and control group (Sant'Anna and Zhao 2020).

CS estimator

The DiD estimator developed by Callaway and Sant'Anna (2020b) is robust to the limitations of TWFE and has three primary advantages: 1) it allows us to simultaneously estimate the treatment effect in all three states, 2) the not-yet-treated firms in the treatment states can be included in the control group, and 3) we can condition the parallel trends assumption on covariates using propensity score matching and outcome regressions, which corrects for an imbalance in baseline covariate levels between the treated and not-yet-treated firms.

A key concept of the Callaway Sant'Anna (2020b) estimator is the group-time average treatment effect on the treated ($ATT(s,t)$). Group membership s is defined by the time period when a firm first receives treatment. In our study, time periods occur at monthly intervals beginning in January 2017 and ending in February of 2020 for a total of 38 time periods. To illustrate how groups are determined, liquor stores in Oklahoma were treated in October 2018, the 22nd time period in our study, therefore $s = 22$ for all liquor stores in Oklahoma, $s = 24$ for liquor stores in Colorado, and $s = 29$ for liquor stores in Kansas. Conceptually, the $ATT(s,t)$ captures the average effect of the treatment on units belonging to group s in time period t and can be expressed as

$$ATT(s,t) = E\left[Y_{i,t}(s) - Y_{i,t}(0) \middle| S_{i,s} = 1\right] \tag{4.2}$$

where $Y_{i,t}$ is the number of visits liquor store i receives in period t, $Y_{i,t}(0)$ is firm i's potential outcomes if left untreated, and $S_{i,s}$ is an indicator variable equal to 1 when firm i belongs to group s.

The $ATT(s,t)$'s are identified if five assumptions are met: 1) the data is panel or repeated cross-sectional, 2) the treatment is irreversible, 3) no anticipation by firms, 4) a common support

assumption that, over the range of propensity scores, there exists firms in both the treated and not-yet-treated group, and 5) the parallel trends assumption holds either unconditionally or after conditioning on pre-treatment covariates X_i (Callaway and Sant'Anna 2020b). For all time periods $t \geq s$, Assumption 5 amounts to

$$E\left[Y_{i,t}(0) - Y_{i,t-1}(0) \middle| X_i, S_{i,s} = 1\right] = E\left[Y_{i,t}(0) - Y_{i,t-1}(0) \middle| X_i, D_{i,t} = 0, S_{i,s} = 0\right] \quad (4.3)$$

where $D_{i,t}$ is an indicator variable equal to 1 in all time periods after a liquor store becomes treated. The expression states that the average untreated potential outcomes for liquor stores treated in time s and the not-yet-treated liquor stores would have followed parallel paths, conditional on covariates X_i, in the absence of a policy change. Note that X_i does not vary over time. The CS estimator uses baseline values of covariates to control for covariate dependent trends and does not accommodate time-varying covariates. Also note that all firms untreated in period t where $t \geq s$ belong to the control group, including not-yet-treated firms in states that later become treated. Descriptive statistics in the next section suggest that including the not-yet-treated firms in the control group increases the similarities with the treated group, leading to more informative inference (Callaway and Sant'Anna 2020b). The tradeoff to including not-yet-treated firms in the control is an additional assumption that the evolution of liquor store foot traffic is the same across all states, not just between the treatment and control states (Marcus and Sant'Anna 2021). We justify the assumption by noting that liquor stores in all states operated under the same 3.2 laws prior to partial liberalization.

Assumptions 1 and 2 are met in our context: the policy change, once applied, cannot be removed, and we have panel data. We justify making assumption 3 based on 1) the inability of firms to choose whether to be treated and 2) the atomized nature and small firm size characterizing the

liquor store sector makes it unlikely that mom and pop retailers systematically implemented marketing strategies that substantially altered the path of foot traffic prior to the policy change[15]. Meeting assumption 4 is a precondition to estimating the $ATT(s,t)$'s, and we perform model diagnostics to assess the plausibility of assumption 5. If all assumptions are met then, for all $t \geq s$, the $ATT(s,t)$'s are identified and can be expressed as

$$ATT(s,t) = E\left[Y_{i,t} - Y_{i,s-1} \middle| X_i, S_{i,s} = 1\right] - E\left[Y_{i,t} - Y_{i,s-1} \middle| X_i, D_{i,t} = 0, S_{i,s} = 0\right]. \qquad (4.4)$$

Callaway and Sant'Anna (2020b) develop an estimator for the $ATT(s,t)$'s by extending the doubly robust approach developed by Sant'Anna and Zhao (2020) to accommodate multiple treatment groups. The doubly robust approach combines the outcome regression DiD approach from Heckman, Ichimura, and Todd (1997) and the inverse propensity weighting approach from Abadie (2005). Doubly robust estimation requires either the outcome path of the control group or the propensity score model to be correctly specified, but not necessarily both.

The outcome regression approach allows us to condition the parallel trends assumption by correcting for matching discrepancies between the treatment and comparison group, that is, treated and not-yet-treated firms with different distributions of the observed covariates.

Intuitively, the outcome regression approach estimates the difference-in-differences by weighting the outcomes of the not-yet-treated firms using the specific values of the conditional covariates of these firms. First, let $m_{s,t}(X_i, \beta_{i,t}) = E\left[Y_{i,t} - Y_{i,s-1} \middle| X_i, D_{i,t} = 0, S_{i,s} = 0\right]$ be the population outcome regression for firms not-yet-treated by time t. Next, let $\mu_{0,t}(X_i)$ be a model for

[15] Our estimates may underestimate pure effect of alcohol liberalization if, for example, liquor stores engaged in widespread and successful promotional efforts to encourage consumer loyalty in anticipation of the policy change. This seems quite unlikely.

$E\left[Y_{i,t}\middle|X_i, D_{i,t}=0, S_{i,s}=0\right]$, where the subscript 0 denotes the not-yet-treated group. If we regress the not-yet-treated outcomes $Y_{i,t}$ onto conditional covariates X_i, we can calculate $\hat{\mu}_{0,t}(X_i) = X_i\hat{\beta}_{i,t}$ using the estimated coefficients and inserting the values of conditional covariates X_i for each firm. Once we have $\hat{\mu}_{0,t}(X_i)$ and $\hat{\mu}_{0,s-1}(X_i)$ for every firm in the not-yet-treated group, we can use the mu terms to calculate $\hat{m}_{s,t}\left(X_i, \hat{\beta}_{i,t}\right)$, which maps to the second term in equation 4.4. The outcome regression approach accounts for matching discrepancies because, rather than using the sample means for the not-yet-treated units, it uses the predicted values based on the values of X_i.

The inverse probability weighting approach weights the long difference (the difference between the base period $s-1$ and period t) using the inverse of the propensity score $p_{i,s}(X) = P\left(S_{i,s}=1\middle|X_i,\ S_{i,s}+D_{i,t}=1\right)$, which is the conditional probability of first receiving the treatment in period s, conditional on covariates X_i. If we assume that the probabilities are based on the cumulative logistic distribution:

$$p_{i,s}(X) = F(\beta_0 + \gamma Treated_i + \alpha X_i) \tag{4.5}$$

where $F() = \frac{e}{1+e}$. Intuitively, inverse probability weighting places less weight on the long difference of not-yet-treated firms with overrepresented covariate values (not-yet-treated firms with low $\frac{P(S_{i,s}=1|X_i)}{P(S_{i,s}=0|X_i)}$), and more weight on the long-difference of firms with underrepresented covariate values (untreated firms with high $\frac{P(S_{i,s}=1|X_i)}{P(S_{i,s}=0|X_i)}$) (Abadie 2005). The result imposes the same distribution of covariates on the not-yet-treated group as the treated group, balancing the groups on observables.

With $p_{i,s}(X)$ and $m_{s,t}(X_i)$ defined, the doubly robust estimand can be written as

$$ATT(s,t) = E\left[\left(\frac{S_{i,s}}{E[S_{i,s}]} - \frac{\frac{p_{i,s}(X_i)(1-D_{i,t})(1-S_{i,s})}{1-p_{i,}(X_i)}}{E\left[\frac{p_{i,s}(X_i)(1-D_{i,t})(1-S_{i,s})}{1-p_{i,s}(X_i)}\right]}\right)\left(Y_{i,t} - Y_{i,s-1} - m_{s,t}(X_i)\right)\right] \quad (4.6)$$

The first term in parentheses is the inverse propensity weighted component and the second term incorporates Heckman et al.'s (1997) outcome regression approach.

If there is no anticipation and the parallel trend assumption holds unconditionally, equation 4.6 collapses to

$$ATT(s,t) = E\left[Y_t - Y_{s-1}\middle|S_{i,s} = 1\right] - E\left[Y_t - Y_{i,s-1}\middle|D_{i,t} = 0\right] \quad (4.7)$$

Which is simply the change between the current period and the base period experienced by firms in the treatment group adjusted by the change experienced over the same period by firms in the not-yet-treated group.

We operationalize equation 4.6 using a two-step strategy to estimate $\widehat{ATT}(s,t)$. In the first step we estimate the propensity score and the coefficients for the outcome regression models to obtain $\hat{p}_{i,s,t}\left(X_i\,;\hat{\pi}_{s,t}\right)$ and $\hat{m}_{i,t}\left(X_{i,};\hat{\beta}_{i,s,t}\right)$. We use equation 4.5 to estimate the propensity score $\hat{p}_{i,s,t}\left(X_i\,;\hat{\pi}_{i,s,t}\right)$ where $\hat{\pi}_{i,s,t}$ are the fitted values estimated using maximum likelihood. We estimate the covariate coefficients $\hat{\beta}_{i,t}$ for the outcome regression using OLS. In the second step we plug the fitted values into our $\widehat{ATT}(s,t)$ estimator:

$$\widehat{ATT}(s,t) = \left[\left(\widehat{w}_s^{\,treat} - \widehat{w}_s^{\,ny}\right)\left(Y_{i,t} - Y_{i,s-1} - \hat{m}_{s,t}\left(X_{i,};\hat{\beta}_{i,t}\right)\right)\right] \quad (4.8)$$

where

$$\widehat{w}^{treat} = \frac{S_{i,s}}{\frac{1}{n}\sum_{i=1}^{n}(S_{i,s})}, \quad \widehat{w}^{ny} = \frac{\frac{\hat{p}_{i,s,t}(X_i\,;\hat{\pi}_{s,t})(1-D_{i,t})(1-S_{i,s})}{1-\hat{p}_{i,s,t}(X_i\,;\hat{\pi}_{s,t})}}{\sum_{i=1}^{n}\left[\frac{\hat{p}_{i,s,t}(X_i\,;\hat{\pi}_{s,t})(1-D_{i,t})(1-S_{i,s})}{1-\hat{p}_{i,s,t}(X_i\,;\hat{\pi}_{s,t})}\right]}$$

Finally, we can aggregate the $\widehat{ATT}(s,t)$'s to obtain the average effect of the partial liberalization of alcohol retail on all liquor stores in group s using the following equation:

$$\hat{\theta}_{sel}(s) = \frac{1}{\mathrm{T}-s+1}\sum_{t=2}^{\mathrm{T}=38}\mathbf{1}\{s \le t\}\widehat{ATT}(s,t) \tag{4.9}$$

$\hat{\theta}_{sel}(s)$ is the average effect of alcohol policy change enacted by a state on liquor stores in that state across the entire post treatment period.

Descriptive Statistics

Figure 4.1 shows how the SafeGraph panel membership (left) and visits to liquor stores (right) changes over the study period. Panel membership, as measured by the number of devices in the SafeGraph panel residing in each state in each month of the study, is largest in Colorado and smallest in Kansas. In all states, the panel appears to slowly grow or remain relatively stable until early 2018, when there is a sharp increase in all states, after which membership stabilizes again. Minnesota and Colorado have a notable spike in membership in September of 2019. Looking at the graph on the right, visits to liquor stores are highest in Colorado and lowest in Kansas, and appear to increase in all states throughout the study period. All states exhibit similar seasonal patterns, with a foot traffic peaking in summer and experiencing a smaller bump in the winter holiday season. Notably, a distinct level change in visits at the beginning of 2018 corresponds to the level change in the number of panel devices, but the spike in device counts in September 2019 in Minnesota and Colorado is not mirrored by a similar spike in liquor store visits.

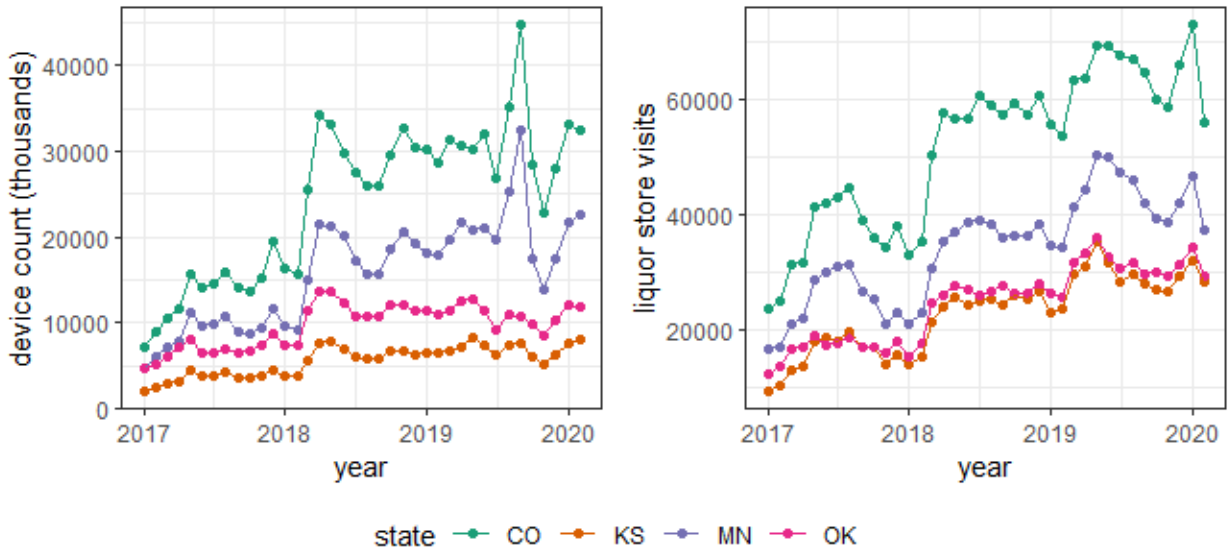

Figure 4.1. Aggregated safegraph device count and liquor store foot traffic for each state
Note: The Y axis on the left plot measures how many thousands of SafeGraph devices belong to residents in a state in each month of the study period. The Y axis on the right plot measures the aggregate number of visits to liquor stores in a state in each month of the study period.

Unlike in the prior chapter, we do not normalize liquor store foot traffic to account for the impact of the SafeGraph panel changing over time on liquor store foot traffic. This is because, under the parallel trends assumption, we assume that changes to the SafeGraph panel are state-invariant and, therefore, the impact on liquor store foot traffic is differenced out by the difference-in-differences estimator. Figure 4.2 shows that state-level trends of the percent of the population belonging to the SafeGraph panel are generally parallel over the study period and supports our argument that normalization is not needed because changes to the SafeGraph panel are state-invariant.

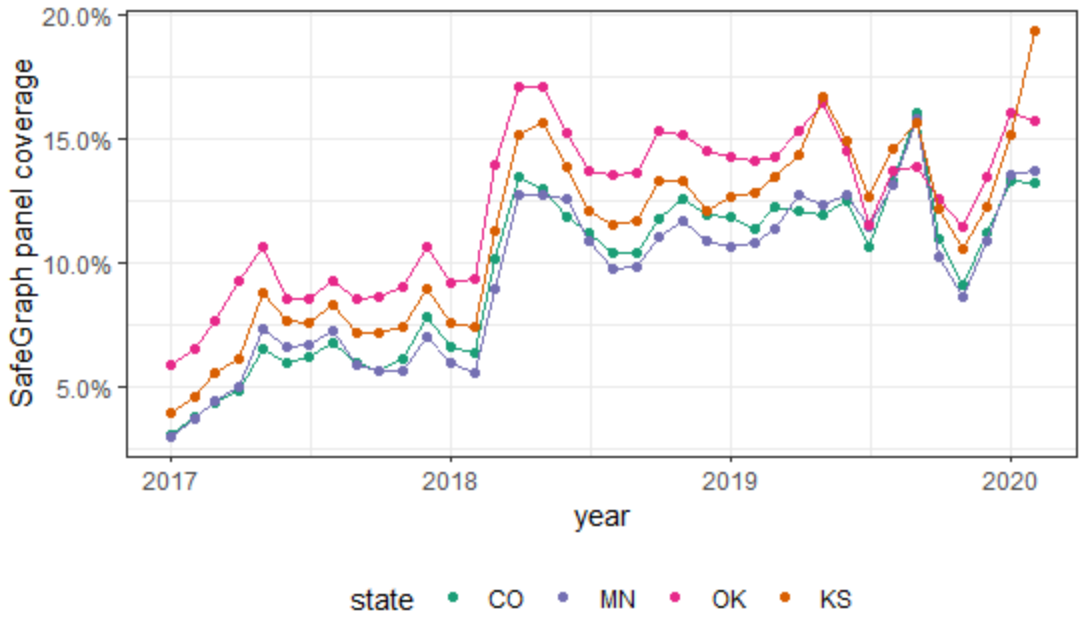

Figure 4.2. Percent of the population belonging to the SafeGraph panel in the treatment and control states
Note: The Y axis indicates the percent of the population represented by SafeGraph devices and was calculated by dividing the number of devices residing in a state by the population of that state.

Figure 4.3 visualizes the monthly average visits to a liquor store in each treatment state along with the average visits to a liquor store in the control state, Minnesota. The vertical line indicates when the policy change took effect in each treatment state. Trend lines are created by regressing average visits on time separately for the pre- and post-policy periods. Figure 4.3 reveals that the average foot traffic to liquor stores increases in all states throughout the study period and that stores in Colorado, Kansas, and Minnesota have roughly the same amount of foot traffic on average. The downward sloping trend in Kansas is likely due to the policy change coinciding with the spring/summer peak in liquor store foot traffic. In contrast, Oklahoma stores have higher foot traffic on average. A common check of the parallel trends assumption is to visually inspect if trends in the pre-treatment period are parallel in the control and treatment groups. As shown in Figure 2, the pre-treatment trend lines move together but considerable noise and seasonality limit

what we can conclude from a visual inspection. We explore whether the parallel trends assumption holds in greater detail in the results section.

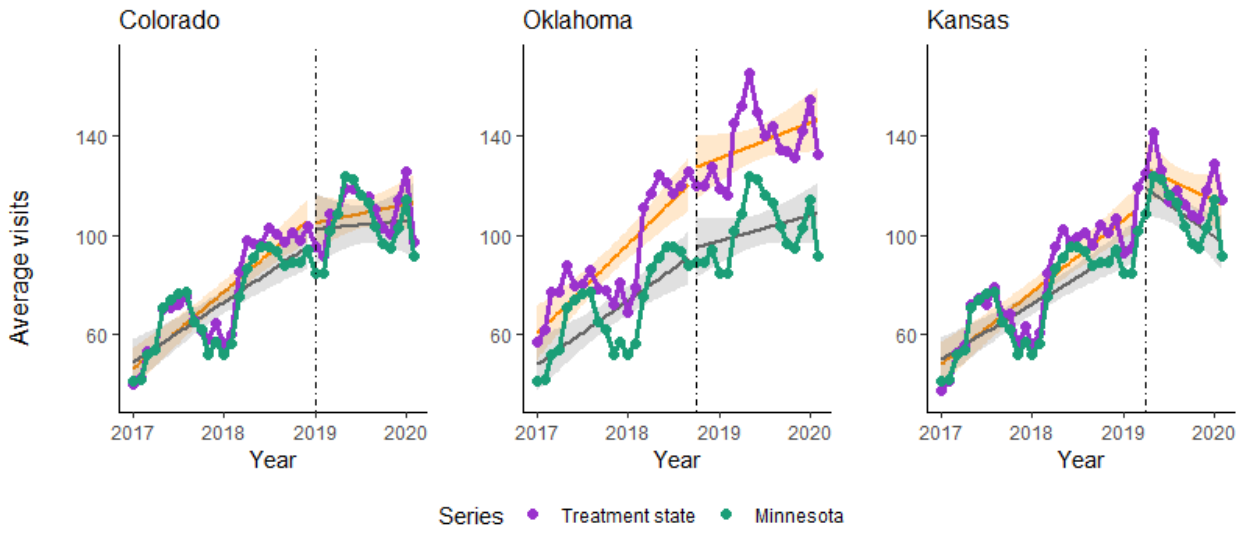

Figure 4.3. Average monthly liquor store visits in the treatment and control states
Note: The purple line represents the average visits in the treatment state and the green lines represents the average visits in the control state. The orange and gray lines depict the linear time trend in the treatment and control state, respectively. The vertical line indicates when the policy change took effect in the treatment state.

Table 4.2 presents the summary statistics on the number of monthly liquor store visits in the pre- and post-treatment period in the treated states and control state. The policy change occurred at different times in each state, therefore, the months used to calculate the summary statistics in the pre- and post-period will vary. The summary statistics tell a similar story as Figure 4.3: foot traffic is higher on average after the policy change in all states, and foot traffic appears higher in Oklahoma compared to the other states. The standard deviation is also higher in Oklahoma, suggesting greater variation in the number of visits. Inspecting the number of firms in the SafeGraph data and the average foot traffic shows that as the number of firms increases, the average number of visits declines, suggesting that fewer liquor store options may cause an increase in foot traffic.

Table 4.2. Monthly foot traffic to liquor stores in treatment states pre- and post-policy change

State	Treatment	Average	Median	SD	Min	Max	Firms
CO	pre	76	55	67	1	509	601
CO	post	109	84	88	1	581	601
MN	pre	72	59	53	1	366	408
MN	post	104	89	70	1	442	408
OK	pre	90	71	72	1	464	213
OK	post	137	114	96	1	591	213
MN	pre	69	56	51	1	349	408
MN	post	102	87	68	1	442	408
KS	pre	81	63	65	1	454	253
KS	post	119	100	86	1	491	253
MN	pre	75	62	55	1	398	408
MN	post	108	91	72	1	442	408

As mentioned earlier, variables that a) differ in distribution between the treatment and control states, and b) impact the future path of liquor store foot traffic in the absence of alcohol retail liberalization pose a threat to the (unconditional) parallel trends assumption. Such variables include the size of a liquor store, the population density of the area around a liquor store, and the number of other liquor stores nearby. If the parallel trends assumption holds only after conditioning on covariates X_i, TWFE will not identify the treatment effect. The CS estimator, however, allows us to condition the parallel trends assumption on the pretreatment, or baseline, value of covariates.

We investigate how the baseline of covariates differ across the states in our study using SafeGraph data as well as data from the 2017 U.S. Census Bureau's 5-year American Community Survey (U.S. Census Bureau 2017). Observed covariates include the number of unique visitors to a liquor store (proxy for store size), the population density[16] of the host county containing the liquor store, and the total number of liquor stores in the host county. We also measure the number of liquor stores and the proportion of SafeGraph devices in each county to

[16] Measured by dividing the population of the county by the area in square kilometers.

the actual population. A comparison of the covariates, presented in Table 4.3, reveals some notable differences between the treated and control states. Oklahoma and Kansas counties have a substantially lower population density on average compared to Minnesota, while Colorado counties tend to have more liquor stores. The differences between treatment and control states suggest that conditioning on the observed covariates may be necessary for the parallel trends assumption to hold.

Table 4.3. Baseline covariate values for each state

State	Avg number of unique visitors	Avg population Density (per km^2)	Avg number of liquor stores per county
OK	72	182	20
CO	60	339	39
KS	57	132	15
MN	54	322	24

Notes: Population density is calculated using estimates from the U.S. census bureau's 2017 5-year American Community Survey (U.S. Census Bureau 2017) and reflects the number of people per square kilometer.

Results and discussion

TWFE

Table 4.4 shows our estimate of the effect of liberalizing alcohol retail on liquor store foot traffic in Oklahoma, Colorado, and Kansas using TWFE. We estimate the effect in each of the three treatment states using separate equations. Each equation includes state and month fixed effects and account for group-specific, time invariant effects and group invariant trends that evolve over time, respectively. Unlike with the CS estimator, the comparison group contains only never-treated stores in Minnesota. The results using TWFE counterintuitively suggest that the expansion of alcohol retail resulted in a large increase in liquor store foot traffic in Oklahoma, a modest increase in Kansas, and no substantial effect in Colorado. The treatment effect estimated using TWFE may be biased if the parallel trends assumption holds only after conditioning on covariates and may account for the counterintuitive results.

Table 4.4. TWFE treatment effect and test of group-specific trends

	OK	CO	KS
β_3	13.887***	0.679	5.900*
	(3.447)	(2.093)	(3.038)
State fixed-effects	YES	YES	YES
Time fixed-effects	YES	YES	YES

Notes: * $p < 0.1$,** $p < 0.05$, *** $p < 0.001$, standard errors are clustered at the state level.

CS estimator

Results from the CS estimator, obtained using the did package in R (Callaway and Sant' Anna 2020a), explore the relationship between liberalized alcohol retail and liquor store foot traffic under two different identification strategies. The first assumes that the parallel trends assumption holds unconditionally and the other assumes the parallel trends assumption holds only after conditioning on covariates. Our $ATT(\mathrm{s},\mathrm{t})$'s are estimated using equation 4.8 where $Y_{i,t}$ is the number of visits liquor store i receives in period t. Under the unconditional parallel assumption, X_i contains only a constant. Under the conditional parallel trends assumption, X_i is a vector of the following time-invariant covariates: the total number of liquor stores in the host county, the population density of the host county, and the number of unique visitors to the store in first month of the study. The first three columns of Table 4.5 provides results under the unconditional parallel trends assumption while the last three columns provide results under the conditional assumption.

The confidence bands are calculated simultaneously using a multiplier bootstrap procedure that accounts for the dependency across the group-time $ATT(s,t)$'s (Horowitz 2019). Recent literature suggests that the decision to make cluster adjustments should be based on whether there exists an experimental design issue that arises when clusters of units are assigned a treatment as opposed to individual units (Abadie et al. 2017). In our study, the treatment assignment mechanism is whether a state liberalizes alcohol retail, therefore, we cluster at the

state level in all specifications. A concern is that the number of clusters in our study (4) is too few, which may lead to confidence bands that are overly narrow. However, if we cluster at the county level and if the errors are correlated within-state and cross-county, which is likely, then ignoring the correlation will lead to incorrect inference (Cameron and Miller 2015). We present our unconditional and conditional results clustered at the county level in appendix D.

The results from the unconditional model align with our first hypothesis that we would find a negative effect in all states, but contrary to our second hypothesis, the effect is smallest and insignificant in Oklahoma, which liberalized alcohol retail the most. In Colorado and Kansas, the decline in foot traffic corresponds to a 4.4% and 4.8% loss, respectively. We use the scale factors to translate our results to the decline in actual foot traffic[17] and find the treatment effect reflects an average ~61 less actual liquor store visits per month in both states. Taken together, the results imply that the liberalization of alcohol retail had a moderate negative impact on the liquor store sector in Colorado and Kansas, but did not result in major shift in consumer market channel choice.

[17] We create scale factors following the procedure recommended by Huntington-Klein (2020). We first divide the population of each state by the number of SafeGraph devices residing in each state in each period. In the second step, we average the quotients in all time periods in each state, yielding the average ratio of the population to SafeGraph devices. The scale factor for Oklahoma, Colorado, and Kansas are 8.75, 12.12, and 10.21, respectively. Multiplying the treatment effect by the scale factor yields an estimate of the average policy effect on actual liquor store foot traffic.

Table 4.5. Average treatment effect for each state using the CS estimator

	OK (U)	CO (U)	KS (U)	OK (C)	CO (C)	KS (C)
$\theta_{sel}(s)$	-3.204 (3.247)	-4.997* (1.862)	-5.969* (1.045)	-8.803* (3.602)	-3.990* (1.642)	-6.404* (1.491)
95% CI	(-10.190, 3.783)	(-8.246, -1.749)	(-7.847, -4.091)	(-14.033, -3.574)	(-6.883, -1.207)	(-9.286, -3.522)
Treatment exposure (months)	17	14	10	17	14	10
Covariates included	NO	NO	NO	YES	YES	YES
$\lvert\theta_{sel}(s)\rvert$ + Avg foot traffic in the post-policy period	140.204	113.997	124.969	145.803	112.990	125.404
% change in foot traffic	-2.3	-4.4	-4.8	-6.0	-3.5	-5.1

Notes: * 95% CI does not include 0, bootstrapped standard errors are clustered at the state level and calculated using 5,000 iterations. Liquor store characteristics include baseline measures of the number of unique visitors to a store, the total number of liquor stores in the county, and the population density of the county.

Our second identification strategy assumes that only liquor stores with the same observed characteristics would follow the same outcome path in the absence of alcohol sale liberalization. We control for the number of unique visitors for each firm, the population density of the county, and the number of liquor stores in the county.

The results from the conditional model remain qualitatively the same for Colorado and Kansas while the result for Oklahoma become substantially more negative, corresponding to a 6% decline in foot traffic and a ~77 decline in actual monthly visits. The results for Oklahoma provide tentative support for our second hypothesis that the effect would be largest in the state that liberalized alcohol sale to the most. However, the 95% confidence intervals of the treatment effect in each state overlap, limiting our ability differentiate the impact of different degrees of alcohol retail liberalization.

We examine whether the effect evolves over time by examining the post policy $ATT(s,t)$'s, shown in blue in Figure 4.4. Under both identification strategies, we observe a similar pattern in

Oklahoma, Colorado, and Kansas where the effect is substantially more negative in warmer months compared to colder months (June through August correspond to periods 30-32 on the x-axis). The results align with our expectations that the largest effect of partial alcohol liberalization would coincide in peak beer demand (Hirche, Haensch, and Lockshin 2021). An additional implication of the dynamic treatment effect is that the estimates using TWFE are likely biased (de Chaisemartin and D'Haultfœuille 2020; Goodman-Bacon 2018).

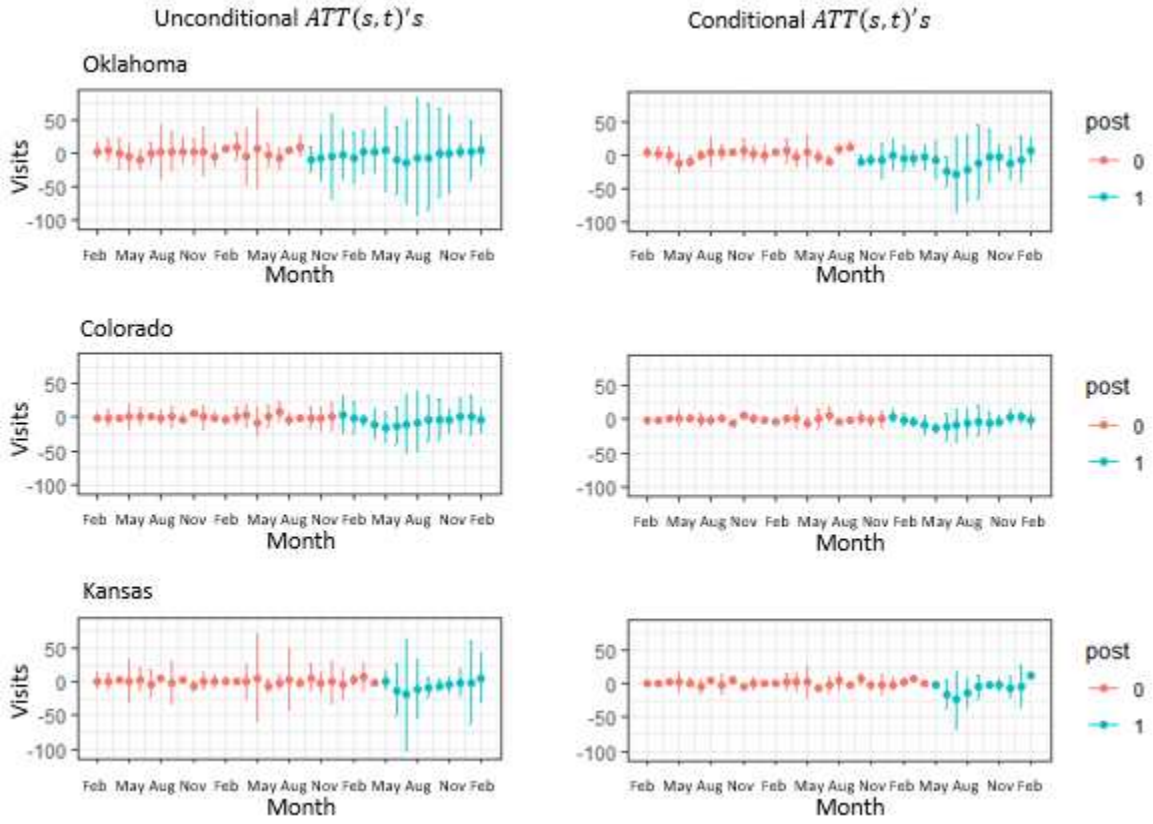

Figure 4.4. Unconditional and conditional estimates of the ATT(s,t)'s
Notes: Estimates in the left column reflect the unconditional parallel trends assumption while estimates in the right column reflect the conditional identification strategy. Red indicates pre-treatment $ATT(s,t)$'s and blue indicates post-treatment $ATT(s,t)$'s.

Robustness

The validity of the unconditional and conditional parallel trends assumption can be checked by examining the pre-treatment $ATT(s,t)$'s, shown in red in Figure 4.4, which should be

approximately 0 before alcohol retail is liberalized (Callaway and Sant'Anna 2020b). Estimates that deviate from 0 provide evidence against making either the unconditional or conditional parallel trends assumption. In the unconditional model shown in the left side of Figure 4.4, the pre-treatment $ATT(s,t)$'s are centered on 0 and nearly all include 0 in the confidence bands, lending credibility to our results. However, the number of pre-treatment $ATT(s,t)$'s that are significantly different from 0 increases in Oklahoma under the conditional identification strategy, largely as a result of smaller confidence bands around the $ATT(s,t)$'s, and provides some evidence of pre-treatment trends among stores with similar levels of the observed covariates in this state. The deviation could be due to liquor stores in Oklahoma attracting more consumers in the final months before the policy change, perhaps due to closeout out sales or intensified marketing efforts, but we do not see a similar pattern before the policy change in Colorado or Kansas.

An event study can help determine the plausibility of the conditional and unconditional parallel trends assumption. For the event study, the $ATT(s,t)$'s are aggregated based on relation to treatment timing, as demonstrated in equation 4.10:

$$\hat{\theta}_{es}(e) = \sum_{s \epsilon S} \mathbf{1}\{s + e \leq \mathrm{T}\} P(S = s | S + e \leq \mathrm{T}) \widehat{ATT}(s, s + e) \qquad (4.10)$$

where e is the number of periods exposed to the treatment. As before, aggregated $ATT(s,t)$'s that systematically deviate from 0 prior to the policy change provide evidence against making the parallel trends assumption. The unconditional and conditional event study results, provided in Figure 4.5, show no systematic differences between treated and not-yet-treated firms prior to the treatment and increase our confidence in both the parallel trends assumptions.

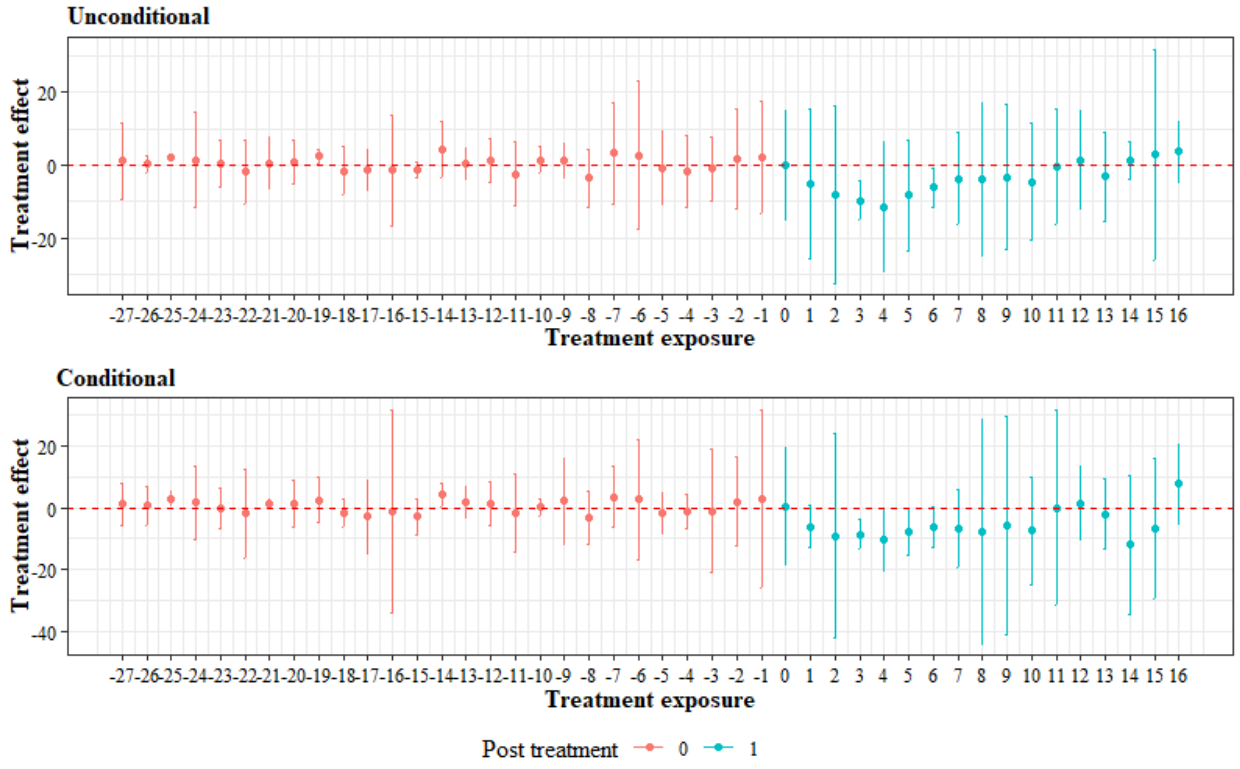

Figure 4.5. Unconditional and conditional event study estimates
Notes: Estimates in the top graphic reflect the unconditional parallel trends assumption while estimates in the bottom graphic reflect the conditional parallel trends assumption. Red indicates pre-treatment *ATT*'s and blue indicates post-treatment *ATT*'s.

It is also possible that conditioning the parallel trends assumption on additional covariates would yield different results. However, we are not able to include all possible covariates and satisfy the common support assumption, meaning that the entire range of propensity scores is not represented in both the not-yet-treated and control group when additional covariates are included. Instead, we run auxiliary models that condition the parallel trends assumption on the observed covariates we did not able to include in our primary results, namely the county level income per capita and proportion of the population that is white. The auxiliary results, contained in appendix E, show that our primary findings for Colorado and Kansas are stable across specifications. The results for Oklahoma remain negative but vary in magnitude depending on the covariates chosen.

Conclusion

The controversy surrounding the liberalization of alcohol retail arises from the potential losses to liquor stores, a sector comprised primarily of small, independent businesses. We exploit a natural experiment—three former 3.2 states liberalizing alcohol sales—and use a novel DiD estimator to quantify the immediate impact on liquor stores. Our analysis allows us to identify some winners and losers of alcohol liberalization.

As expected, the policy change had an immediate negative impact on consumers' decision to shop in the liquor store channel. However, even in Oklahoma, which liberalized full-strength beer and wine, our conditional model identified a moderate 6% decline in average monthly foot traffic. The reduction in liquor store foot traffic is substantial, but it does not align with the 28% loss in annual revenue identified by Rickard (2012) and suggests that the impending wave of mass closures suggested by the liquor store associations may be overstated (Sealover 2018a; Akkam 2009). Our estimate of the policy impact on monthly liquor store foot traffic in Colorado and Kansas is slightly lower (3.5% and 5%, respectively). Though our estimate of the impact is largest in Oklahoma, our confidence intervals in all states overlap, limiting our ability to differentiate the policy impact by degree of alcohol liberalization.

The impact on alcohol producers is heterogenous and scale dependent. Fewer consumers shopping at liquor stores possibly means a drop in sales for producers of the non-liberalized alcohol types (e.g. wineries and distilleries in Colorado). Even for producers of the liberalized alcohol type, lower-involvement shoppers in grocery and convenience stores are likely to favor brands that are less expensive and more familiar (L. S. Lockshin, Spawton, and Macintosh 1997; Hollebeek et al. 2007). An important implication is that large, well-known alcohol producers

able to leverage scale and brand-awareness will have a distinct advantage in the new market channels over smaller firms.

Grocery and convenience stores are the clear beneficiaries of the policy change. The loss in foot traffic at liquor stores can be attributed to consumers making alcohol purchases in alternative market channels. This suggests that the increase in channel choices benefits consumers, who can now weigh the convenience of purchasing alcohol at grocery or convenience stores against greater variety and customer service at liquor stores. Prior literature suggests that consumers may gain additional benefits from lower prices as alcohol liberalization has been shown to increase competition between market channels (Rickard, Costanigro, and Garg 2013).

Our neutral assessment of the effect on liquor stores will help policy makers account for the most controversial aspect of liquor store liberalization. Policy makers can use this information to develop compensation provisions for liquor stores that can make the passage of future changes less acrimonious. The decline in foot traffic at liquor stores also suggests that limiting alcohol sales to liquor stores restricts consumer choice and supports an argument put forward by grocery and convenience stores for expanding alcohol retail. As a third contribution, we introduce a novel dataset on consumer foot traffic patterns and demonstrate how it can be used to gain insight on the impact of a policy change on consumer market channel choice.

While our study provides new and important insight on how liberalizing alcohol retail effects liquor stores, it is but one piece of evidence. Limitations include a modest set of available covariates, a lack of information on actual liquor store sales, and a limited time period before the onset of COVID-19, which led to behavioral and policy changes that influenced liquor store foot traffic.

More research is needed to understand how the liberalization of alcohol sales will affect liquors stores in the long run. Our study calculates the average effect in three states, but little is known about the distributional effect on liquor stores of different sizes. Hedonic analysis could yield insight on how liberalizing alcohol sales changes the value of liquor stores and liquor licenses. Firm survival, another important transitional issue, can be investigated using data firm entry and exit. An analysis of scanner data can yield insight on which products are driving alcohol sales in grocery and convenience stores.

The policy debate around liberalizing alcohol sales is controversial, with stakeholders on both sides putting forward economic arguments. The primary contribution of our study is an independent analysis of the immediate effect of partial alcohol liberalization on liquor stores that can be used by policy makers to make informed decisions. Our results suggest that the partial liberalization of alcohol retail has a moderate negative impact on liquor stores and that policy makers can balance the concerns of liquor store owners with the interests of grocery and convenience stores by limiting alcohol liberalization to just one alcohol type. Large alcohol producers with a high level of brand awareness likely benefit when their products can be sold in grocery and convenience stores, but the marketing literature and chapter 1 of my dissertation suggest that smaller alcohol producers may struggle to find success in the new market channels. Finally, the shift in foot traffic away from liquor stores indicates that consumers benefit from the increase in market channel choices. The benefit to consumers, who often lack the organizational capabilities to lobby policy makers, should also be considered.

REFERENCES

Abadie, Alberto. 2005. "Semiparametric Difference-in-Differences Estimators." *The Review of Economic Studies* 72 (1): 1–19. https://doi.org/10.1111/0034-6527.00321.

Abadie, Alberto, Susan Athey, Guido Imbens, and Jeffrey Wooldridge. 2017. "When Should You Adjust Standard Errors for Clustering?" w24003. NBER Working Paper Series. Cambridge, MA: National Bureau of Economic Research. https://doi.org/10.3386/w24003.

Akkam, Alia. 2009. "Last Store on Main Street Coalition Continues the Fight Against Wine in Supermarkets." *Beverage Media*, March 2009.

Aurifeille, J-M., P.G. Quester, L. Lockshin, and T. Spawton. 2002. "Global vs International Involvement-based Segmentation: A Cross-national Exploratory Study." *International Marketing Review* 19 (4): 369–86. https://doi.org/10.1108/02651330210435672.

Becker, Gary S. 1983. "A Theory of Competition Among Pressure Groups for Political Influence." *The Quarterly Journal of Economics* 98 (3): 371–400.

Brewers Association. 2020. "National Beer Sales & Production Data." *Brewers Association* (blog). 2020. https://www.brewersassociation.org/statistics-and-data/national-beer-stats/.

Callaway, Brantly, and Pedro H.C. Sant'Anna. 2020a. "Difference-in-Differences with Multiple Time Periods." *Journal of Econometrics*, December, S0304407620303948. https://doi.org/10.1016/j.jeconom.2020.12.001.

Callaway, Brantly, and Pedro H.C. Sant'Anna. 2020b. "did: Difference-in-Differences." R package version 2.0.0. https://bcallaway11.github.io/did/.

Cameron, A. Colin, and Douglas L. Miller. 2015. "A Practitioner's Guide to Cluster-Robust Inference." *Journal of Human Resources* 50 (2): 317–72. https://doi.org/10.3368/jhr.50.2.317.

Campbell, Carla Alexia, Robert A. Hahn, Randy Elder, Robert Brewer, Sajal Chattopadhyay, Jonathan Fielding, Timothy S. Naimi, Traci Toomey, Briana Lawrence, and Jennifer Cook Middleton. 2009. "The Effectiveness of Limiting Alcohol Outlet Density As a Means of Reducing Excessive Alcohol Consumption and Alcohol-Related Harms." *American Journal of Preventive Medicine* 37 (6): 556–69. https://doi.org/10.1016/j.amepre.2009.09.028.

Chaisemartin, Clément de, and Xavier D'Haultfœuille. 2020. "Two-Way Fixed Effects Estimators with Heterogeneous Treatment Effects." *American Economic Review* 110 (9): 2964–96. https://doi.org/DOI: 10.1257/aer.20181169.

Colorado Department of Revenue. 2020. “2020 Annual Report.” Colorado Department of Revenue. https://cdor.colorado.gov/data-and-reports/cdor-annual-reports.

Cook, Jonathan, Noah Newberger, and Sami Smalling. 2020. “The Spread of Social Distancing.” *Economics Letters* 196 (November): 109511. https://doi.org/10.1016/j.econlet.2020.109511.

Dodd, Tim H, Bruce E. Pinkleton, and A. William Gustafson. 1996. “External Information Sources of Product Enthusiasts: Differences between Variety Seekers, Variety Neutrals, and Variety Avoiders.” *Psychology and Marketing* 13 (3): 291–304.

Goodman-Bacon, Andrew. 2018. “Difference-in-Differences with Variation in Treatment Timing.” w25018. Cambridge, MA: National Bureau of Economic Research. https://doi.org/10.3386/w25018.

Gronau, Reuben, and Daniel S Hamermesh. 2008. “The Demand for Variety: A Household Production Perspective.” *The Review of Economics and Statistics* 90 (3): 562–72.

Harfmann, Barbara. 2020. “Spirits Grow Market Share for 10th Straight Year.” *Beverage Industry*, April 6, 2020. https://www.bevindustry.com/articles/92981-spirits-grow-market-share-for-10th-straight-year?v=preview.

Heck, Josh. 2016. “Uncork Kansas Pushing New Alcohol-Sales Legislation.” *Wichita Business Journal*, April 2016. https://www.bizjournals.com/wichita/blog/2016/04/uncork-kansas-pushing-new-alcohol-sales.html.

Heckman, James J., Hidehiko Ichimura, and Petra Todd. 1997. “Matching As An Econometric Evaluation Estimator.” *Review of Economic Studies* 64 (2): 605–54. https://doi.org/10.1111/1467-937X.00044.

Hirche, Martin, Juliane Haensch, and Larry Lockshin. 2021. “Comparing the Day Temperature and Holiday Effects on Retail Sales of Alcoholic Beverages – a Time-Series Analysis.” *International Journal of Wine Business Research* 33 (3): 432–55. https://doi.org/10.1108/IJWBR-07-2020-0035.

Hoffman, Auren. 2018. “Introducing SafeGraph Places: The Source of Truth about Physical Places.” *Introducing SafeGraph Places: The Source of Truth about Physical Places* (blog). July 25, 2018. https://www.safegraph.com/blog/introducing-safegraph-places-the-source-of-truth-about-physical-places.

Hollebeek, Linda D., Sara R. Jaeger, Roderick J. Brodie, and Andrew Balemi. 2007. “The Influence of Involvement on Purchase Intention for New World Wine.” *Food Quality and Preference* 18 (8): 1033–49. https://doi.org/10.1016/j.foodqual.2007.04.007.

Holtz, David, Michael Zhao, Seth G. Benzell, Cathy Y. Cao, Mohammad Amin Rahimian, Jeremy Yang, Jennifer Allen, et al. 2020. “Interdependence and the Cost of Uncoordinated Responses to COVID-19.” *Proceedings of the National Academy of Sciences* 117 (33): 19837–43. https://doi.org/10.1073/pnas.2009522117.

Horowitz, Joel. 2019. “Bootstrap Methods in Econometrics.” *Annual Review of Econometrics*. 11: 193-224. https://doi.org/10.1146/annurev-economics-080218-025651.

Huntington-Klein, Nick. 2020. “Calculating Absolute Visit Counts in SafeGraph Data.” Unpublished.

Kahn, Barbara E. 1995. “Consumer Variety-Seeking among Goods and Services.” *Journal of Retailing and Consumer Services* 2 (3): 139–48. https://doi.org/10.1016/0969-6989(95)00038-0.

Kroszner, R. S., and P. E. Strahan. 1999. “What Drives Deregulation? Economics and Politics of the Relaxation of Bank Branching Restrictions.” *The Quarterly Journal of Economics* 114 (4): 1437–67. https://doi.org/10.1162/003355399556223.

Lam, Tammy. 2014. “Brew Free or Die? A Comparative Analysis of U.S. and E.U. Craft Beer Regulations.” *Cardozo Journal of International and Comparative Law* 23 (1): 197-230.

Lockshin, Lawrence, and Armando Maria Corsi. 2012. “Consumer Behaviour for Wine 2.0: A Review since 2003 and Future Directions.” *Wine Economics and Policy* 1 (1): 2–23. https://doi.org/10.1016/j.wep.2012.11.003.

Lockshin, Lawrence S., Anthony L. Spawton, and Gerrard Macintosh. 1997. “Using Product, Brand and Purchasing Involvement for Retail Segmentation.” *Journal of Retailing and Consumer Services* 4 (3): 171–83. https://doi.org/10.1016/S0969-6989(96)00048-3.

Malone, Trey, and Josh Hall. 2017. “Can Liberalization of Local Food Marketing Channels Influence Local Economies? A Case Study of West Virginia’s Craft Beer Distribution Laws.” *Economics and Business Letters* 6 (2): 54-58.

Malone, Trey, and Jayson L. Lusk. 2016. “Brewing up Entrepreneurship: Government Intervention in Beer.” *Journal of Entrepreneurship and Public Policy* 5 (3): 325–42. https://doi.org/10.1108/JEPP-02-2016-0004.

Marcus, Michelle, and Pedro H. C. Sant’Anna. 2021. “The Role of Parallel Trends in Event Study Settings: An Application to Environmental Economics.” *Journal of the Association of Environmental and Resource Economists* 8 (2): 235–75. https://doi.org/10.1086/711509.

McAlister, Leigh, and Edgar Pessemier. 1982. “Variety Seeking Behavior: An Interdisciplinary Review.” *Journal of Consumer Research* 9 (3): 311-322. https://doi.org/10.1086/208926.

National Alcohol Beverage Control Association. 2016. “Grocery and Convenience Stores as Alcohol Outlets.” https://www.nabca.org/sites/default/files/assets/publications/white_papers/GroceryStoresPaper.pdf.

Olsen, Janeen E, Tom Atkin, Liz Thach, and Steve S Cuellar. 2016. "Variety Seeking by Wine Consumers in the Southern States of the US." *International Journal of Wine Business Research* 27 (4): 260–80.

Ornstein, Stanley I., and Dominique M. Hanssens. 1985. "Alcohol Control Laws and the Consumption of Distilled Spirits and Beer." *Journal of Consumer Research* 12 (2): 200-213. https://doi.org/10.1086/208509.

Posner, Richard A. 1974. "Theories of Economic Regulation." *The Bell Journal of Economics and Management Science* 5 (2): 335. https://doi.org/10.2307/3003113.

Reimers, Vaughan, and Fred Chao. 2014. "The Role of Convenience in a Recreational Shopping Trip." *European Journal of Marketing* 48 (11/12): 2213–2236. https://doi.org/10.1108/EJM-12-2012-0734.

Rickard, Bradley J. 2012. "The Economics of Introducing Wine into Grocery Stores." *Contemporary Economic Policy* 30 (3): 382–98. https://doi.org/10.1111/j.1465-7287.2011.00272.x.

Rickard, Bradley J., Marco Costanigro, and Teevrat Garg. 2013. "Economic and Social Implications of Regulating Alcohol Availability in Grocery Stores." *Applied Economic Perspectives and Policy* 35 (4): 613–33. https://doi.org/10.1093/aepp/ppt018.

Riekhof, Gina M., and Michael E. Sykuta. 2005. "Politics, Economics, and the Regulation of Direct Interstate Shipping in the Wine Industry." *American Journal of Agricultural Economics* 87 (2): 439–52. https://doi.org/10.1111/j.1467-8276.2005.00733.x.

Ritchie, Caroline, Gary Elliott, and Mike Flynn. 2010. "Buying Wine on Promotion Is Trading-up in UK Supermarkets: A Case Study in Wales and Northern Ireland." *International Journal of Wine Business Research* 22 (2): 102–21. https://doi.org/10.1108/17511061011061685.

SafeGraph. 2020. "Places Manual." SafeGraph. April 2020. https://docs.safegraph.com/v3.0/docs/places-manual.

Sant'Anna, Pedro H.C., and Jun Zhao. 2020. "Doubly Robust Difference-in-Differences Estimators." *Journal of Econometrics* 219 (1): 101–22. https://doi.org/10.1016/j.jeconom.2020.06.003.

Sealover, Ed. 2018a. "Colorado Beer-Sales Regulations Bill Is Gutted by State House Committee in Unusually Volatile Hearing." *Denver Business Journal*, May 5, 2018. https://www.bizjournals.com/denver/news/2018/05/05/beer-sales-regulations-bill-is-gutted-in-unusually.html.

———. 2018b. "Colorado Legislature Reaches Last-Day Compromise on Full-Strength-Beer-Sales Regulations." *Denver Business Journal*, May 24, 2018. https://www.bizjournals.com/denver/news/2018/05/10/legislature-reaches-last-day-compromise-on-beer.html.

Seo, Boyoung. 2019. “Firm Scope and the Value of One-Stop Shopping in Washington State’s Deregulated Liquor Market.” *Kelley School of Business Research Paper No. 16-70*, April. https://doi.org/10.2139/ssrn.2863094.

Smith, Janet Kiholm. 1982. “An Analysis of State Regulations Governing Liquor Store Licensees.” *Journal of Law & Economics*, no. 2: 301–20.

Squire, Ryan Fox. 2019. “‘What about Bias in Your Dataset?’ Quantifying Sampling Bias in SafeGraph Patterns.” October 2019. https://colab.research.google.com/drive/1u15afRytJMsizySFqA2EPlXSh3KTmNTQ#offline=true&sandboxMode=true.

Stigler, George J. 1971. “The Theory of Economic Regulation.” *The Bell Journal of Economics and Management Science* 2 (1): 3. https://doi.org/10.2307/3003160.

U.S. Census Bureau. 2017. “American Community Survey, 2017 American Community Survey 5-Year Estimates.”

Wagenaar, Alexander C, and John D Langley. 1995. “Alcohol Licensing System Changes and Alcohol Consumption: Introduction of Wine into New Zealand Grocery Stores.” *Addiction* 90: 773–83.

White, J. C., L. C. Troy, and R. N. Gerlich. 2000. “The Role of Slotting Fees and Introductory Allowances in Retail Buyers’ New-Product Acceptance Decisions.” *Journal of the Academy of Marketing Science* 28 (2): 291–98. https://doi.org/10.1177/0092070300282009.

Wine Institute. 2020. “California Wine Sales Reach $43.6 Billion in U.S. Market in 2019.” Wine Institute. July 9, 2020. https://wineinstitute.org/press-releases/california-wine-sales-reach-43-6-billion-in-u-s-market-in-2019/.

Colorado State University

COLORADO BREWERS GUILD

Impact Assessment of SB 18-243 (Full-strength Beer in Grocery and Convenience Stores) on Colorado Breweries

This survey is being conducted to understand the impacts of SB 18-243, which legalized the sale of full-strength beer at grocery and convenience stores on January 1st, 2019, on breweries within the state of Colorado. **Your brewery's responses are very important and are completely confidential.** Your participation is voluntary, so you may stop participating at any time. Thank you for your time!

1. **What is your position at your brewery? Please check all the boxes that apply.**
   - ☐ Brewery Owner
   - ☐ Marketing Officer
   - ☐ Sales Director
   - ☐ CEO
   - ☐ Other (please describe your position on the provided line)

   _____

The following questions regard your brewery's distribution:

2. **Please indicate if your brewery signed a distribution contract with a new wholesaler between January 1st, 2017 and currently in 2019.**
   - ☐ Yes, my brewery signed a distribution contract with a new wholesaler
   - ☐ No, my brewery did not sign a contract with a new wholesaler
3. **Please indicate if your brewery ended a distribution contract with a wholesaler between January 1st, 2017 and currently in 2019.**
   - ☐ Yes, my brewery ended a distribution contract with a wholesaler
   - ☐ No, my brewery did not end a distribution contract with a wholesaler
4. **Please indicate if your brewery renegotiated its self-distribution territory with a wholesaler between January 1st, 2017 and currently in 2019.**
   - ☐ Yes, my brewery renegotiated its self-distribution territory with our wholesaler
   - ☐ No, my brewery did not renegotiate an existing distribution contract
5. **Please estimate how many total retail accounts you self-distributed to in 2017 and 2019**

   ☐ Retail accounts self-distributed to in 2017

   ☐ Retail accounts self-distributed to in 2019

Colorado State University

COLORADO BREWERS GUILD

6. **Please estimate the percentage of your total volume that went into each distribution channel in 2017 and the percentage you expect to go into each channel 2019. Please make sure the total of each column sums to 100.**

Distribution Channel	In 2017, ___% of my brewery's total volume was …	In 2019, ___% of my brewery's total volume was …
sold to customers through the taproom	☐%	☐%
directly sold and self-distributed to on-premise retailers, such as bars or restaurants	☐%	☐%
directly sold and self-distributed to retail liquor stores	☐%	☐%
directly sold and self-distributed to grocery stores	☐%	☐%
directly sold and self-distributed to convenience stores	☐%	☐%
sold to a wholesaler for distribution	☐%	☐%
Total	**100**	**100**

7. ***If you sold beer to a wholesaler in either 2017 or 2019,* please estimate the percentage of the product that your brewery sold to them that went into each distribution channel in 2017 and 2019. Please make sure the total of each column sums to 100. *Please skip if you did not sell beer to a wholesaler in either 2017 or 2019.***

Distribution Channel	In 2017, my wholesaler distributed ___% of the product my brewery sold to them…	In 2019, my wholesaler distributed ___% of the product my brewery sold to them…
to on-premise retailers, such as bars or restaurants	☐%	☐%
to retail liquor stores	☐%	☐%
to grocery stores	☐%	☐%
to convenience stores	☐%	☐%
Total	**100**	**100**

Colorado State University

COLORADO BREWERS GUILD

8. ***If you self-distribute to a grocery store,*** **please assess how challenging doing business with grocery stores was/is across the following categories in 2017 and 2019, using the scale where 1 = "not at all challenging" and 5 = "extremely challenging".** ***Please skip if you did not self-distribute to a grocery store in either 2017 or 2019.***

Category	Challenge in 2017 *1 = Not at all challenging* *2 = Somewhat challenging* *3 = Moderately challenging* *4 = Very challenging* *5 = Extremely challenging* Challenge Rating (1 – 5)	Challenge in 2019 *1 = Not at all challenging* *2 = Somewhat challenging* *3 = Moderately challenging* *4 = Very challenging* *5 = Extremely challenging* Challenge Rating (1 – 5)
Communication	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Product promotion	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Stocking shelves	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Coordinating deliveries	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Constructing displays	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Overall challenge	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5

The following questions regard your brewery's product mix:

9. **Please check the box if your brewery produced or sold a 3.2% alcohol by weight beer in 2017 or 2019.**

   ☐ 2017

   ☐ 2019

10. **Please estimate how many flagship beers your brewery produced in 2017 and how many you expect to produce in 2019.**

    ☐ Flagship beers produced in 2017

    ☐ Flagship beers expected to be produced in 2019

11. **Please estimate how many seasonal and specialty beers your brewery produced in 2017 and how many you expect to produce in 2019.**

    ☐ Seasonal and specialty beers produced in 2017

    ☐ Seasonal and specialty beers expected to be produced in 2019

Colorado State University

COLORADO BREWERS GUILD

12. **Please check the box if your brewery possessed, purchased or utilized any of the packaging line options below in 2017 or 2019.**

Packaging Line	In 2017, my brewery possessed/ purchased/ utilized …	In 2019, my brewery possessed/ purchased/ utilized …
a bottling line	☐	☐
a canning line	☐	☐
a mobile packaging line	☐	☐

13. **Please estimate the percentage of your brewery's total volume sold in each type of packaging in 2017 and the percentage you expect to be sold in each type of packaging in 2019. Please make sure the total of each column sums to 100.**

Packaging type	In 2017, ___% of my brewery's total volume was sold as …	In 2019, ___% of my brewery's total volume was sold as …
Kegs	☐%	☐%
Other draught (e.g. serving tanks)	☐%	☐%
Bottles	☐%	☐%
Cans	☐%	☐%
Total	**100**	**100**

The following questions regard how your brewery prices your beer:

14. **Between January 1st, 2017 and presently in 2019, has the MSRP of a draught pint of your flagship beer increased, decreased, or stayed the same?**

☐ Increased ☐ Stayed the same

☐ Decreased ☐ My beer is not available in this form

- **If the MSRP of a draught pint of your flagship beer has changed between January 1st, 2017 and presently in 2019, please estimate the percentage that it has changed.**

☐% change in MSRP

Colorado State University

COLORADO BREWERS GUILD

15. Between January 1st, 2017 and presently in 2019, has the MSRP of a six-pack of your flagship beer increased, decreased, or stayed the same?

☐ Increased ☐ Stayed the same

☐ Decreased ☐ My beer is not available in this form

- **If the MSRP of a six-pack of your flagship has changed between January 1st, 2017 and presently in 2019, please estimate the percentage that it has changed.**

☐% change in MSRP

The following questions regard your brewery's marketing and advertising:

16. Please check the boxes if your brewery has made or plans to make the marketing efforts listed below in 2017 and 2019.

Marketing Effort	In 2017 my brewery	In 2019 my brewery .....
had at least one full-time sales representative	☐	☐
offered volume discounts to retail accounts	☐	☐
produced a collaboration beer with another brewery	☐	☐
had a tasting event at an off-premise retailer	☐	☐
had a tap takeover event at an on-premise retailer	☐	☐
participated in at least one local community event, such as a festival or charity event	☐	☐
participated in either the Great American Beer Festival or the World Beer Cup	☐	☐

17. Please assess the level of effort your brewery expended on each of the following types of advertising in 2017 and 2019, using the scale where 1 = "no effort at all" and 5 = "an extreme amount of effort".

Type of Advertising	Effort in 2017 *1 = No effort at all* *2 = A small amount of effort* *3 = A moderate amount of effort* *4 = A lot of effort* *5 = An extreme amount of effort* Effort Rating (1 – 5)	Effort in 2019 *1 = No effort at all* *2 = A small amount of effort* *3 = A moderate amount of effort* *4 = A lot of effort* *5 = An extreme amount of effort* Effort Rating (1 – 5)
Digital advertising	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Print advertising	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Broadcast advertising (radio, television, etc.)	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Out-of-home advertising (billboards, etc.)	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5

Colorado State University

COLORADO BREWERS GUILD

18. Considering your answers to the prior questions regarding marketing effort and advertising, please estimate your total budget for advertising in 2017 and 2019

$ _____ Advertising budget in 2017

$ _____ Advertising budget in 2019

The following question regards the overall operations of your brewery:

19. Please estimate your brewery's total volume produced in 2017 in barrels, and what the expected total volume that will be produced in 2019?

_____ Barrels produced in 2017

_____ Barrels produced in 2019

20. Please assess the effectiveness of your overall marketing and distribution strategies in 2017 and 2019. Circle the level of effectiveness for each strategy in each year using a scale where 1 = "not effective at all" and 5 = "extremely effective".

Strategy	Effectiveness in 2017 *1 = Not at all effective* *2 = Somewhat effective* *3 = Moderately effective* *4 = Very effective* *5 = Extremely effective* Effectiveness Rating (1 – 5)	Effectiveness in 2019 *1 = Not at all effective* *2 = Somewhat effective* *3 = Moderately effective* *4 = Very effective* *5 = Extremely effective* Effectiveness Rating (1 – 5)
Marketing strategy	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5
Distribution strategy	1 - 2 - 3 - 4 - 5	1 - 2 - 3 - 4 - 5

21. Please indicate how confident you are in the answers you provided, using a scale where 1 = "not confident at all" and 5 = "extremely confident". Please circle one number.

	Not confident at all	Somewhat confident	Moderately confident	Very confident	Extremely confident
Answer confidence	1	2	3	4	5

Colorado State University

COLORADO BREWERS GUILD

22. Please share any additional thoughts you have regarding the impact of SB 18-243 on your distribution strategy in the box provided:

23. Please share any comments or suggestions you have regarding this survey in the box provided:

Thank you for taking the time to complete the survey!

If you have any additional questions, please contact Nathan Palardy at Colorado State University
npalardy@colostate.edu

APPENDIX B: BREWERY SURVEY COMMENTS

Brewery Size	Comment
Nano	I view this initiative as an opportunity for small producers to enter a larger stage and for the local quality package store to become more of a business with service and quality at the forefront much like small breweries. This is simply a change that will prove beneficial once the industry adjusts. I've operated in 2 other states (NY/IN) where these types of laws were very complementary to the craft sector.
Nano	We sell to 2 grocery stores belonging to the same chain but in different locations.
Nano	It hasn't appeared to have any effect on our distribution, but we don't can or bottle for off premise.
Nano	Difficult to work with grocery stores as a small brewer with self-distribution. Stores have preferred to fill shelves with multiple products from one or two large distributors instead of multiple small guys.
Nano	too small of a system to distribute so advertising is mostly a waste at this point
Nano	we've seen a downturn in off-premise sales and an unwillingness from grocery store buyers to deal with small self-distributing breweries
Nano	really no effect yet, too early to tell. We will be affected when small/independent stores begin to close
Nano	I am ok with the bill. It has opened space in independent liquor stores.
Nano	It’s been fairly easy to get into some grocery stores but frustratingly difficult to navigate the application forms from others. In my opinion the convenience store/ grocery store alcohol sales have only given us more mediocrity in the overall quality of stores. They have beer, but no help or knowledge.
Nano	With our size and the types of beer we make it has zero impact on us
Nano	We are in a small rural town in NE Colorado and although we haven’t noticed a big change in our sales, of the six liquor stores in our town, 1 has permanently closed, 2 are for sale, and 1 has changed ownership. It is very sad to see.
Nano	I do not personally purchase beer at the grocery store. I enjoy the interaction between the small business owner and myself
Nano	We are small and don’t really want to distribute to stores, we are concentrating on other forms of distribution.
Nano	We are not in grocery stores. SB 18-243 guarantees we will never be.
Nano	Regional breweries control the state and the guild. Small breweries don’t have a chance unless you have a niche.

Nano	We are a small independent brewery running for nearly 10 years. After self-distributing for so long, recent changes are driving us towards a distributor. However, small craft distributors are also getting forced out of the market, so it is difficult to try to join a profile.
Nano	Retail stores now dealing with lots of nationwide distributors bringing in tons of their brands from east coast and west coast. Colorado beer presence seems "smaller" in stores. Pricing higher? (branding?) I see the craft shelves in the "box stores" not restocked - empty, yet commercial shelves full.
Nano	It has had no impact on us as we are a taproom focused brewery with 70% on site draft sales and have hyper local (5-mile radius) self-distribution tap accounts off-site. No packaging other than crowlers and limited bottles to go from taproom.
Nano	As a self-distributing brewery, we have been unable to sell to larger grocery store chains. Our grocery store sales are limited to smaller chains with a limited amount of stores.
Nano	We have no distribution other than keg accounts so impact on us has been minimal
Nano	Full strength beer in grocery stores effectively kills the opportunity for small producers to enter that channel and has squeezed more traditional RLS accounts as they lose beer as an overall percentage of their overall sales, causing a loss of shelf space to wine and spirits. We face more competition from other craft centric breweries in Craft-focused liquor stores, making shelf space harder to obtain.
Nano	I think it hurts small craft beer in a big way, long term it takes small breweries out of the distribution game.
Nano	We have reduced plans for distribution.
Nano	The small size of our brewery has caused us to pull back on our distribution. We do not have the resources to take advantage with SB 18-243. We are specifically "sitting on the sidelines" regarding distribution. Instead we are focusing on building our brand through other methods.
Nano	The ability to produce beer below 4.0 ABV has been useful. We have not attempted distribution to grocery stores even though we recognize a portion of the retail market has shifted there. This is due to relationships with smaller retailers, difficulty in stocking requirements in larger stores, lack of personal relationships with these retailers, and a lack of knowledgeable sales force within these retailers.
Nano	Drove more taproom and to-go sales. Not enough volume for our strategy of rotational SKU's.
Nano	Small taproom, not much impact.
Nano	We had a distributor from 2013 to 2018. They clearly shifted focus to packaged/ off-premise vs draft/on-premise. Within the off-premise accounts they also shifted focus to large accounts (natural) and started gearing up for grocery store accounts before they left the distribution business. As a generality SB 18-243 appears to have helped the mid-large sized packaging brewers and hurt us small/micro packaged brewers.

	Go big or go home. We are now focused on taproom and draft-only self-distribution and profitability is now much better.
Nano	Considering our size and our focus on taproom sales, we have experienced little to no impact from 18-243
Micro	Do not currently distribute in cans so have not had an impact, yet.
Micro	We were proactive in getting out of self-distribution operation in late 2015 to expand our volume and to state-wide distribution. Other factor in this decision was to get into distribution system in advance of law change and grocery channel sales. We did not want to service grocery/c-stores via self-distribution.
Micro	Retail sales is not an important part of our business. Although retail sales have increased, we will be scaling back, due to decreased sales in retail accounts. Packaging was not a consideration in 2017 and 2019 further solidifies our position to continue to not package beers in the future. We believe the SB 18-243 represents an opportunity for us to expand our sales to on-premise retailers such as bars and restaurants. There is some backlash from on-premise retailers against breweries expanding multiple locations and now directly competing in the bar/restaurant space. We also believe that SB 18-243 represents a detriment for us to expand taproom sales.
Micro	Our strategy has not changed, as we do not plan to be in grocery stores for some time. We are seeing our small liquor stores struggle with overall beer sales.
Micro	Question #2 2019 numbers are estimated as we just signed on with Colorado Craft Distributor last month and that's what we expect to do. Question #8 is blank, we do not distribute to grocery stores because of the difficulty in dealing with them. The answer would be 5 straight across plus the additional insurance required by each retailer is too high for what we would expect to sell. One of the huge issues we are finding with the bigger grocery stores are the amount of insurance we have to have in order just to distribute to them. We would have to pay an additional $5000 to just to distribute to them.
Regional	Less billbacks, hand sales and tasting money spent. General marketing efforts need to increase. Dedicated staff for chain relationships and sales.
Regional	The biggest issue in 2019 is stocking and rotating in chain stores. They expect the same level of service as their DSD vendors (chips, soda, tortillas) but their business model is set up that way. Ours is not. Very costly making sure our beer is always stocked and accessible to customers.
Regional	Our distributor partners do not execute well since SB 18-243, they are doing a poor job with the difficult tasks at chains and completely dropping the ball at independent retailers. It was a challenge they are not adequately prepared for and are struggling at.

APPENDIX C: STATE SPACE FORECASTING

A decomposition of the time series for overall foot traffic in Colorado (left) and Minnesota (Right) is provided in Figure C1. The decomposition reveals that both time series have a clear seasonal pattern as well as a negative trend, with the trend more pronounced in Minnesota. Note that a fourier transformation assumes seasonality to be fixed. Based on the decomposition, we determine that a model with an additive seasonal and trend component is appropriate. We repeated the same process with the rural and urban time series and arrived at the same conclusion.

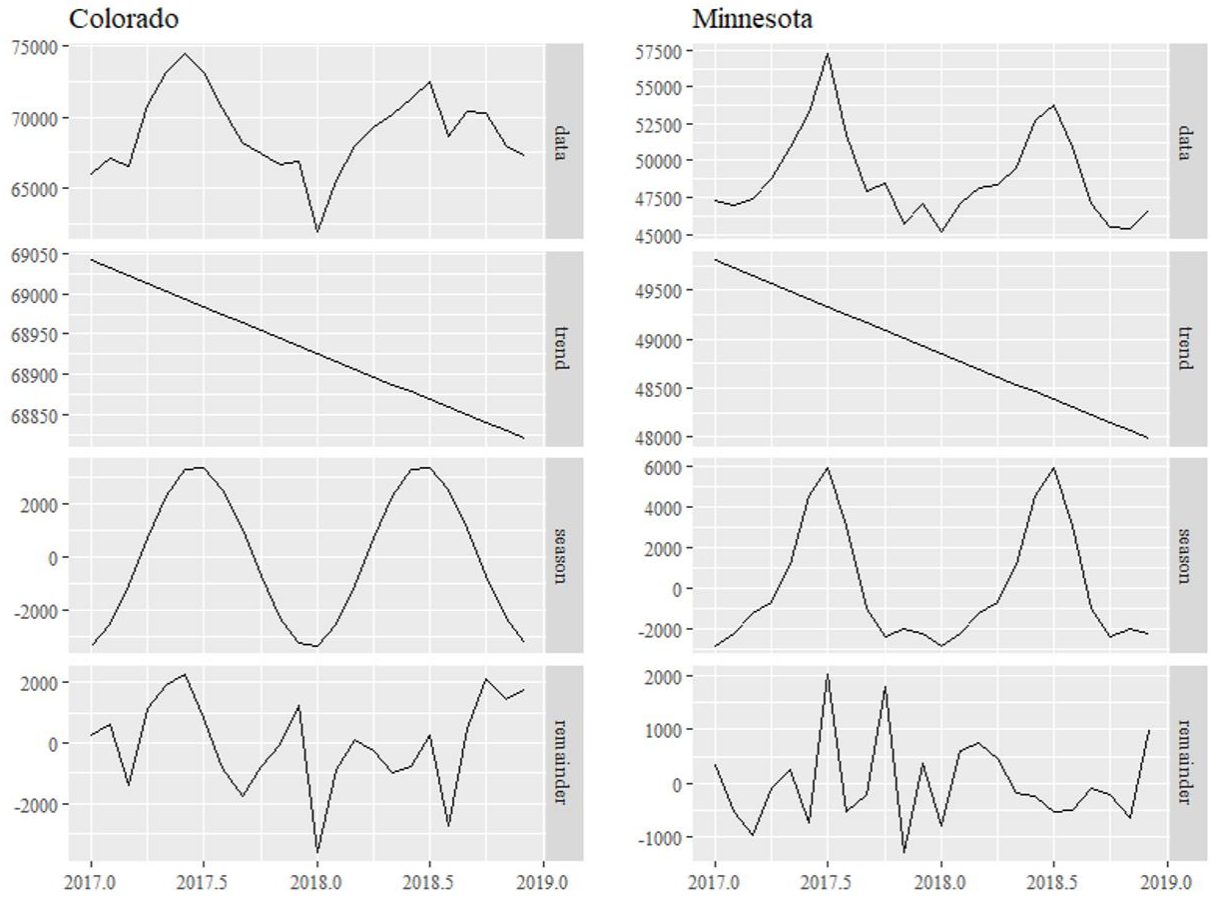

Figure C1. Decomposition of Colorado and Minnesota time serries pre-policy change
Note: We decompose the time series, shown in the top row, into trend and seasonal components using a linear regression model with trend and fourier terms. The optimal number of fourier terms (1 for Colorado and 3 for Minnesota) was determined based on the AICc.

APPENDIX D: UNCONDITIONAL AND CONDITIONAL ESTIMATES CLUSTERED AT THE COUNTY LEVEL

Results from the unconditional and conditional models with the calculation of the simultaneous confidence bands clustered at the county level are presented in Table D1. The confidence bands are wider and insignificant in all cases except for the unconditional treatment effect in Colorado. However, as noted earlier, if there is correlation in the error within-state and cross-county, clustering at the county level will lead to incorrect inference.

Table D1. CS estimator results with standard errors clustered at the county level

	OK (U)	CO (U)	KS (U)	OK (C)	CO (C)	KS (C)
$\theta_{sel}(s)$	-3.204	-4.997*	-5.969	-8.803	-3.990	-6.404
	(4.150)	(1.666)	(2.782)	(4.460)	(2.045)	(3.052)
Includes liquor store characteristics	NO	NO	NO	YES	YES	YES

Notes: * 95% CI does not include 0, bootstrapped standard errors are clustered at the county level and calculated using 5,000 iterations. Liquor store characteristics include baseline measures of the number of unique visitors to a store, the total number of liquor stores in the county, and the population density of the county.

APPENDIX E: AUXILIARY REGRESSION RESULTS USING ALTERNATIVE COVARIATES

Table E1 contains the results from auxiliary models conditioned on the observed covariates not included in our conditional identification strategy. The results from Colorado and Kansas in the auxiliary regressions are consistent with the main results and lend credibility to our conclusions regarding the effect in these states. The results for Oklahoma are negative but vary in strength depending on which covariates are included in the model.

Table E1. Auxiliary results using alternative specification of covariates

	OK	CO	KS	OK	CO	KS
$\theta_{sel}(s)$	-7.055	-4.696*	-5.290*	-0.305	-4.719*	-6.265*
	(3.879)	(1.643)	(2.085)	(3.602)	(1.642)	(0.966)
Income per capita	YES	YES	YES	NO	NO	NO
Proportion white	NO	NO	NO	YES	YES	YES

Note: * 95% CI does not include 0. Bootstrapped standard errors are calculated using 5,000 iterations and clustered at the state level.