THE EFFECT OF LOCAL ALCOHOL ACCESS ON LOTTERY PURCHASES

by

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A thesis submitted in partial fulfillment
of the requirements for the degree

of

Master of Science

in

Applied Economics

MONTANA STATE UNIVERSITY
Bozeman, Montana

May 2022

DEDICATION

This thesis is dedicated to my parents, Scott and Ellen Peterson, for their unending love and support throughout my academic career. You inspired me to attend graduate school. By challenging me to become a better version of myself, fostering my desire to learn, and supporting me in all my pursuits, you made me the person I am today.

ACKNOWLEDGEMENTS

I would like to thank my thesis chair, Dr. Isaac Swensen for his guidance and leadership throughout the creation of this thesis. His support has been invaluable throughout the process of researching this topic. I would also like to recognize Dr. Mark Anderson and Dr. Carly Urban for their assistance and insights. I would also like to thank my friends and classmates Ian Callen, Anthony Clark, Conner McCollum, Willard Robinson, and Hannah Wing for the support they provided throughout the past two years, and for making graduate school such a lively time.

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ABSTRACT

The relationship between gambling and drinking has attracted significant attention from researchers but has been primarily explored in the limited context of laboratory experiments and cross-sectional surveys. In this thesis, I exploit variation in county and city-level "wet" laws in the state of Texas to estimate the causal effect of local alcohol access on gambling, using per-capita expenditures on two major lottery games, Powerball and Mega Millions, as a measure of gambling consumption. I find that the passage of a city or county-level wet law is associated with a large and significant increase in lottery consumption. While this increase in lottery purchases is observed following the legalization of any alcoholic beverages at the county level, at the city level the effect appears to be driven by laws legalizing the sale of beverages for on-premise consumption. While I cannot distinguish the mechanism by which alcohol availability may affect lottery sales, the implication of this finding is consistent with existing research which finds complementarity between alcohol and gambling.

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INTRODUCTION

Among other risky behaviors, drinking has been correlated with an increased willingness to gamble. Randomized controlled trials have consistently found that alcohol consumption increases gambling and intent to gamble, and cross-sectional surveys have found a correlation between alcohol abuse and pathological gambling at the individual level. However, no study to date has directly examined the effect of the availability of alcohol on long-term gambling outcomes. While controlled experiments estimate the immediate causal relationship between alcohol consumption and gambling behavior, they are limited in the fact that they can only observe short term responses, and do not observe participants in a natural setting. Likewise, cross-sectional surveys do not distinguish a true causal relationship from spurious correlation. This study, by utilizing a natural experiment, seeks to examine how long-term gambling behavior is directly affected by alcohol legalization.

This study focuses on a common form of legal gambling in the United States: state-run lottery games. State-facilitated lotteries are unique among gambling products in that they are not only legally sanctioned, but represent a significant source of state revenue. Because of this, participation in lotteries has significant public finance implications.[1] In addition to exploring the more general relationship between alcohol and gambling, this thesis contributes to the large existing economic literature surrounding the demand for state-sponsored lottery products.

In recent years, participation in national lottery games has been a major form of legalized gambling in the United States. In 2016, Americans spent $73.5 billion on traditional

[1]The Texas Lottery Commission generated a total of nearly $81 million in revenue from all lottery games in Fiscal Year 2020. The majority of this money was distributed between educational, healthcare and veterans' funds.

lottery tickets.[2] Approximately 50 to 60 percent of the revenue from the lottery is distributed as prizes. The rest of this revenue, according to state and local governments, is invested in the public. In 2016, $16.7 billion of this total lottery revenue was spent on education, $2.5 billion was invested in state general funds, and the remaining amount was invested in other government programs. However, it could be argued that state-sponsored lottery games, as a form of gambling, have a potential for great economic cost. Estimates indicate that gambling addictions cost the United States upwards of $54 billion per year in 2004 (Grinols, 2009). There is evidence that the implementation of lottery games can increase symptoms of problem gambling (Shepherd, Ghosde, and London, 1998). Research has also indicated that state lottery games may be associated with an increase in crime (Mikesell and Pirog-Good, 1990). Because of this, factors that influence lottery participation may have significant economic impacts outside of the revenue collected by the state.

In this study, I exploit local-level variation in alcohol legality in the state of Texas to explore the effect of alcohol access on per-capita spending in two large lottery games, Mega Millions and Powerball. Specifically, I utilize county and city-level restrictions, commonly known as dry laws, which prohibit or restrict alcohol sales, as a measure of alcohol access. In a difference-in-difference framework, I estimate the effect of repealing a dry law on on city-level reported per-capita lottery consumption. Furthermore, I explore the effect of alcohol access in varying contexts by also distinguishing between laws restricting the sale of alcohol for consumption off-premises (packaged drinks sold in retail stores), and on-premise (drinks sold in bars and restaurants).

I find evidence that access to any alcoholic beverages at the county level is associated with a significant increase in per capita lottery purchases. Namely, cities located in previously dry counties that legalize alcohol sales at the county level report an estimated 23

[2]Isidore (2017)

percent increase in per-capita lottery purchases following the legalization of alcohol.[3] This estimated effect remains statistically significant when controlling for observable county-level socioeconomic variables, including median household income and percentages of a county's population by race, gender, and age groups.

The state of Texas also allows individual cities to determine legality of alcoholic beverages within city limits. I find that the legalization of alcohol at the city level is also associated with an increase in lottery sales. After separately estimating the effect of county and city-level legality, I find the passage of municipal wet laws are associated with an 8-9 percent increase in lottery spending.

I also find evidence that the effect of alcohol access on lottery consumption varies by the type of beverage sales legalized. Because most of the counties that become wet during my panel (2010-2019) legalize on-premise and off-premise beverages simultaneously, it is unlikely that I can distinguish between the effect of legalizing off-premise and on-premise beverages at the county level. However, significant heterogeneity in recent wet laws at the city level allows me to identify differences in the effect of municipal legality of on-premise and off-premise beverages. At this level, legalization of alcohol for consumption off-premise is not associated with a statistically significant change in lottery sales, whereas legality of on-premise beverages is correlated with an increase in purchases.

Lastly, I find evidence that the effect of alcohol access is heterogeneous across cities, with larger and more statistically precise per-capita effects observed in cities located with larger populations. Similarly, larger effects are seen in cities located in counties where more than 50 percent of the population lives in urban areas.

By estimating the causal effect of alcohol legalization on lottery spending, this study adds to the existing literature in several ways. Firstly, while other research in laboratory

[3]Some counties and cities were defined as "partially wet" or "mostly wet" prior to countywide liberalization of alcohol sales. In most of my specifications, these jurisdictions are considered already "wet" before the countywide vote.

settings has estimated the short-run effects of alcohol consumption on gambling, this study examines the long-term gambling response to alcohol availability by exploiting multi-year panel data. Secondly, this study focuses exclusively on the demand for 'Lotto'-style lottery games, which may respond differently to alcohol access than other types of gaming observed in existing research. By examining lottery games, this study synthesizes the body of research examining the link between alcohol and risky behavior and the large existing literature on the economics of lotteries. Lastly, this study distinguishes itself from previous research studying local alcohol laws by exploiting both county and city-level restrictions.

The structure of the rest of this paper is as follows. Chapter 2 will provide background on local alcohol laws as well as historic and modern lottery games in the United States, Chapter 3 will provide an overview of the existing literature, including the existing research studying the relationship between alcohol and gambling as well as papers that have specifically studied both local alcohol laws and lottery games, Chapter 4 will explore the theoretical mechanisms by which alcohol access could influence lottery consumption, Chapter 5 will introduce the data used in this study, Chapter 6 will outline the empirical strategy, Chapter 7 will discuss results, alternative specifications, and robustness checks, and Chapter 8 will conclude.

BACKGROUND

History of Alcohol Restrictions

The legal status of alcohol has a long and tumultuous history in the U.S. In the 18th and 19th centuries, there was little regulation regarding the sale and consumption of alcoholic beverages, and Americans drank heavily.[1] However, American attitudes toward drinking began to shift in the late 19th Century with the rise of the Temperance Movement, which blamed alcohol consumption for a number of moral and social ills. The movement was ultimately successful with the 18th Amendment in 1919, which ushered in the era of Prohibition. The 18th Amendment, which explicitly prohibited the "manufacture, sale or transportation of intoxicating liquors"[2] was repealed by the 21st Amendment 14 years later. However, the 21st Amendment did not preclude state and local authorities from regulating or outright prohibiting the sale of alcoholic beverages[3], and this provision led to many localities to continue to restrict alcohol sales in some form. By the 21st Century, the majority of dry communities were located in the South.

In the state of Texas, local alcohol laws vary greatly. Initially following Prohibition, the state required a jurisdiction wishing to vote on alcohol laws to get signatures from 35 percent of the jurisdiction's registered voters and these signatures needed to match the signatures on the voters' ID card. This rule made it challenging for jurisdictions to get local option elections on the ballot. However, House Bill 1199, passed in 2003, relaxed this restriction, requiring only that a jurisdiction receive signatures from 35 percent of voters who voted in the last gubernatorial election, and eliminating the requirement that the signature match the signature on the voter's ID.[4] Since the passage of HB 1199, nearly 950 local option elections

[1] Gershon (2016).
[2] U.S. Constitution, Amendment XVIII.
[3] U.S. Constitution, Amendment XXI, Section 2.
[4] Texas HB 1199

were held, with nearly 80 percent of the jurisdictions transitioning from "dry" to "wet."[5] In total, the number of completely dry counties has fallen from 53 in 1996 to 5 in 2019. However, this does not mean that alcohol sales are unrestricted in the rest of the state. In many jurisdictions, alcohol sales are limited to beer and wine, while others restrict sales to those for off-premise consumption only, or restrict on-premise sales to restaurants with food and beverage certificates.

History of Lottery Games

Much like the country's laws regulating alcoholic beverages, legal and cultural attitudes toward gambling in the United States have shifted dramatically throughout the country's history. Perhaps no type of gambling has a more storied history in America than government-facilitated lotteries. In the colonial and early post-Independence era, lotteries were sanctioned as a form of entertainment and source of revenue. As early as 1612, the residents of Jamestown used lottery games to finance their colony.[6] Religious sentiment and concerns that the games were targeting the poor lead to popular support for lotteries decreasing in the 19th century, with every state except Delaware and Louisiana prohibiting lotteries by 1890. However, in the 20th century, states began to re-establish lottery games, and in 1988 the Multi-State Lottery Association (MSLA) was established, creating the framework for games offered in multiple states that serve as de facto national lottery games. The first of these games, Lotto America (later renamed Powerball), was established that year.

[5]Marks, M. T. S. (2018, December 21). Texas Has Just Five Dry Counties Left. Why Is That? Houston Public Media. https://www.houstonpublicmedia.org/articles/news/texas/2018/12/27/315663/texas-has-just-five-dry-counties-left-why-is-that/

[6]Dunstan, R. (1997, January). History of Gambling in the United States : Free download, Borrow, and streaming. Internet Archive. Retrieved October 18, 2021, from https://archive.org/details/perma$_c c_7 FJ9 - RRYK$.

Modern Multi-State Lottery Games

Today, 45 states, the District of Columbia, Puerto Rico, and the U.S. Virgin Islands operate state lotteries. While each state operates their own lotteries, two games, Mega Millions and Powerball, are offered by all of these jurisdictions, and function as de facto national lottery games. Both of these games are structurally similar 'Lotto'-style lotteries that consist of biweekly drawings of a set of 5 numbered balls selected from a limited set of numbers (between 50 and 70) plus one distinct ball of a different color from a smaller set of numbers (the eponymous Powerball in Powerball, and the Mega Ball in Mega Millions). Prizes of increasing value are awarded based on the number of a player's chosen numbers that match the drawings, with the ultimate prize, the jackpot, being awarded to a player who matches all 5 numbered balls plus the Powerball or Mega Ball. If no player wins the jackpot after a given drawing, the prize "rolls over" and increases in value. This attribute of the can lead to unusually large jackpots that receive substantial media attention. The size of the set from which the balls are drawn from, and therefore the probability of winning, has occasionally been adjusted for each game since its inception. See Table A.1 and Table A.2 for a timeline of formats and jackpot odds for each game.

LITERATURE REVIEW

Alcohol and Gambling

Economic researchers using cross-sectional data have generally found alcoholic beverages and lottery products to be complements in use. Using a nationally-representative survey of adults in the United States, French et al. (2008) finds a positive correlation between alcohol consumption and the likelihood of experiencing gambling-related problems. Fleissig (2020) studies the price elasticities of substitution between several "sin" goods, including beer, wine, spirits, tobacco, and lottery and casino gambling, and finds that distilled spirits and wine appear to be complements to lottery gambling.

Much of the literature that has explored the link between alcohol and gambling has focused on the co-morbidity of alcohol abuse and the likelihood of engaging in gambling behavior, including problem gambling. Studies that have exploited individual-level survey data have often found a positive correlation between excessive drinking and addictive gambling. Hodgins and Racicot (2013) find that college students who drink to cope and have other indicators of alcohol abuse are more likely to gamble. However, this relationship cannot necessarily be attributed to a causal effect, as it is plausible that the same personality traits that lead an individual to be a heavy drinker may also lead them to become a problem gambler.[1] [2]

Other studies have attempted to explore the short-term causal relationship between alcohol consumption and gambling outcomes through randomized controlled trials. Ellery et al. (2005) compare gamblers playing video lottery terminal (VLT) poker games after being

[1] Analysis of the executive function of alcohol dependents and pathological gamblers has found common neurocognitive deficits in both groups, including inhibition, attention deficit, and antisocial personality disorder (see Goudriaan et al. (2006), Lawrence et al. (2009)).

[2] Slutske et al. (2013) finds that there may be a shared genetic vulnerability to alcohol use disorder and gambling.

served alcohol to gamblers served nonalcoholic control beverages, and find that players served alcohol played the games for a longer time, were more likely to make power bets, and were more likely to play losing hands. Similarly, Kyngdon and Dickerson (1999) find that alcohol consumption was associated with players persisting for on average twice as many gaming trials as the control group, and being more likely to spend their entire cash stake. While these experiments in a controlled setting indicate that alcohol consumption can cause a change in gambling behavior in the immediate aftermath, they have several limitations; they do not observe participants in their natural setting nor do they measure long-term changes in gambling behavior. Because of these limitations, these studies may not accurately reflect the relationship between alcohol and gambling in a real-world setting.

Wet and Dry Laws in the Literature

Wet laws have been exploited by researchers, often in a difference-in-difference framework, to measure the effect of alcohol access on a variety of outcomes. Baughman et al. (2001) examine the effect of wet laws on highway safety, using county-level data from Texas. In this study, the authors examine county-level variation by beverage, as well as by type of sales (off versus on-premise). Anderson et al. (2017), utilize an instrumental variable approach, using county wet/dry status as a plausibly exogenous predictor of the number of licensed establishments within a county, and find that an instrumented increase in drinking establishments is associated with an increase in violent crime. Conlin et al. (2005) evaluate the effect of county-level alcohol access on illicit-drug related crimes using data from Texas between 1978 and 1996. Other researchers have exploited wet-dry variation only using cross-sectional data. Berman et al. (2000) exploit cross-sectional variation in alcohol control policies in Alaskan Native communities to study the relationship between alcohol access and injury deaths.

Some researchers have also investigated the demographic attributes of a jurisdiction that

influence its likelihood to become wet. Brown et al. (1996) explore the potential endogeneity of wet laws in Texas, and find alcohol legality is positively predicted by the percent of a county's population living in urban areas, the percentage of a county's population that are Catholic, the percentage of a county's population who are Democrats and the percentage who are employed in the tourism industry, whereas prohibition is positively associated with the percentage of a county's population who are Baptist.[3]

The Economics of Lotteries

Several studies have explored factors impacting the demand for lottery products. Much of this research has focused on the demographics of lottery players. Clotfelter and Cook (1989) find that while most people play lottery games at least once, the majority of lottery sales are driven by a small minority of gamblers, with the top 10 percent of players in terms of frequency accounting for 50 percent of purchases. The authors find that race, religion, age, and income are all significant predictors of lottery play, with men participating more than women, African-Americans and Hispanics playing more than non-Hispanic whites, individuals between 25 and 65 playing more than younger or older adults, and Catholics playing significantly more than Protestants. One of the most consistent findings regarding lotteries is that they are disproportionally played by low-income households, and therefore, as a source of public revenue function as a regressive tax (Blalock et al., 2007, Miyazaki, 1998, Price and Novak, 1999.).

Other research has explored the effect of game-specific factors on lottery demand. There is some evidence that lottery players are sensitive to changes in the actual or perceived odds of winning. Whitney (1991) finds that a reformatting of California's state lottery in 1990, including changes that decrease the likelihood of winning a jackpot, reduced demand for the

[3]Gotwalt (2008) finds similar associations when examining wet laws in Virginia.

game and decreased net revenues.

Jackpot size is consistently found to be a significant predictor of demand in state lotteries. Forrest et al. (2002) find that jackpot size plays a large role in lottery demand, more so than the expected value of purchasing a lottery ticket, because the possibility of "winning big" drives lottery participation. The author hypothesizes that demand for lotteries is driven by utility arising from gambling itself. Clotfelter and Cook (1990), examining the Massachusetts State Lottery, estimate that for a $1,000 increase in the jackpot size, sales increase by $333. Garrett and Sobel (1999) model gambler utility as a function of the skewness of potential winnings. In doing so, they conclude that gamblers are generally risk averse, but this risk aversion is outweighed by the possibility of winning a very large prize.

The current literature indicates that the ultimate welfare outcomes of lottery games are ambiguous. Morgan (2000) finds that a theoretical lottery equilibrium could increase the provision of a public good, when compared to voluntary contributions. However, while lottery revenues are often earmarked for certain public investments, primarily education, the intended recipients may not benefit from lottery revenue as much as intended. Borg and Mason (1988), using data from Illinois, find that while the educational funding raised by lottery revenue benefits low-income households, these benefits are still outweighed by the regressive nature of the lotteries themselves. Bowden and Elrod (2004) examine policies used by 18 states to use lottery revenue to increase access to post-secondary education, and find that this funding does not lead to equal access to education for low-income and minority groups.

Outside of their implications as a source of public revenue, lotteries may have other repercussions for overall welfare as well. Kearney (2005) finds that household lottery spending crowds out approximately $38 per month in other household consumption. Mikesell and Pirog-Good (1990) find that the adoption of a state lottery is associated with an increase in crime rates.

Other research has been conducted on the link between lottery games and problem gambling. There is some evidence that the availability or attractiveness of lottery games may itself lead to pathological or addictive gambling. Shepherd, Ghosde, and London (1998), studying the implementation of the National Lottery in the U.K., find that self-described symptoms of pathological gambling increased in survey respondents 6 months following the launch of the lottery, although the number of pathological gamblers did not increase.[4] Guryan and Kearney (2010) use the plausibly exogenous shock of a winning lottery ticket in the same ZIP code to study the effect of an increase in short-term demand on later consumption. The researchers find that approximately half of the initial increase in lottery sales attributed to this demand shock persists after 6 months, indicating that factors increasing lottery demand in the short run may lead to increased long-term consumption. The researchers hypothesize that this persistence may be due to the addictive nature of gambling.

[4]Similarly, Grun and McKeigue (2002) find that the introduction of the National Lottery increased excessive gambling. They also find that this increase in gambling is most pronounced in low-income households

THEORY

Alcohol access may influence total lottery consumption in two major ways. It may lead to an increase in total spending via an increase in the number of gamblers playing the lottery, and/or it may lead to current lottery players spending a greater amount on lottery tickets. The most plausible link by which alcohol access may affect gambling is via the effects of intoxication. Medical research indicates that there is a pharmacological relationship between drinking and increased gambling behavior. Evidence from controlled studies indicates that alcohol consumption may increase gambling behavior or willingness to gamble in the short term.[1] More generally, alcohol consumption has been linked to an increase in risky behavior (Lane et al., 2004). By increasing a person's willingness to take risks, drinking alcohol could lead to intoxicated consumers to be less mindful of the low probability of winning the lottery and thus more likely to purchase tickets.

The effect of alcohol access on lottery sales may differ depending on the context in which alcohol is made available. Alcoholic beverages are typically sold in two contexts, for consumption on-premise and consumption off-premise. On-premise sales refers to beverages sold in an establishment for consumption at the establishment (for example, drinks sold at a bar), while off-premise consumption refers to beverages sold intended for consumption outside of the establishment, such as alcohol sold at a liquor store, convenience store, or supermarket. Dry laws can restrict off-premise sales, on-premise sales, or both. Legalizing the sale of on-premise beverages may have a different effect than legalizing off-premise beverages. There is evidence that retail stores that begin offering packaged alcohol experience an increase in sales of non-alcohol items (Rickard, 2012; Seo, 2016). Because off-premise beverages and lottery tickets are often sold in the same location[2], these locations may see an increase in

[1] See Ellery et al. 2005; Kyngdon and Dickerson, 1999, Phillips and Ogeil, 2007

[2] The top 10 sellers of Powerball and Mega Millions tickets in Texas in 2019 included gas stations, supermarkets, and a specialty store that sells board games (Texas Lottery Commission). The majority

customers when they are able to start selling alcohol, and this may lead to an increase in lottery sales if outlets are marketing lottery games to customers intending to purchase other goods.

The effect of legalizing on-premise alcohol is more ambiguous. It may be that the social context surrounding drinking alcohol on-premise (drinking with friends in a public setting) may facilitate a greater likelihood to gamble than drinking at home. In this case, on-premise legalization will lead to an increase in gambling. Alternatively, if on-premise alcohol is a substitute for off-premise alcohol, the legalization of on-premise beverages may lead to a decrease in foot traffic in stores that sell both off-premise beverages and lottery tickets. If this is the case, on-premise alcohol access may lead to a decrease in lottery consumption.

It is also possible that wet laws affect lottery consumption because they reduce the stigma surrounding "vices", such as drinking and gambling. Aranda et al. (2021) finds some evidence of spillover effects to other "vice" products following medical marijuana legalization.[3][4] In this case, the repeal of local dry laws may lead to a decrease in the stigma surrounding gambling. This perceived change in the social acceptability of gambling may lead more individuals to engage in lottery play.

of these establishments had active off-premise licenses at the time (Texas Alcoholic Beverage Commission).

[3]While state-level medical marijuana legalization is not a perfect analogy to local-level alcohol legalization, this study does suggest that liberalization of previously illicit substances may have spillover effects to other risky behaviors

[4]This study finds that spillovers to other vice activities were limited to activities that touted a "health safety" attribute similar to medical marijuana. Little research has investigated more general spillover effects between vices.

DATA

Lottery Data

In this study, I exploit weekly city-level sales data (in nominal dollars) for two national lottery games, Powerball and Mega Millions, reported between the dates of January 2nd 2010-May 11th 2019. These data are provided by the Texas Lottery Commission.

To account for county-level wet laws, the cities reported in the lottery sales data were matched to counties using city-county crosswalk data from the Missouri Census Data Center (MCDC). The cities in the sales data were matched to 250 of the 254 counties in the state of Texas.[1] For cities that reside in multiple counties (for example, the city of Pearland, Texas has portions in Brazoria, Fort Bend, and Harris counties), the data sourced from the MCDC included the percentage of the city's population living in each county.[2]

I gather yearly estimated city-level population data for all years 2010-2019 from the U.S. Census Bureau. 987 cities with reported lottery sales had population data for all nine years.

Wet-Dry Laws

I collect data on all changes to the legal status of alcoholic beverages at the county, Justice of the Peace Precinct, and city level between 2010 and 2019 from the Texas Alcoholic Beverage Commission (TABC). For each local vote, these data includes the jurisdiction name, the beverages legal for sale prior to the vote (if any), and the beverages legalized by the local referendum.

[1] No cities in Borden, Kenedy, King, or Loving County reported any sales of Mega Millions or Powerball between 2010 and 2019 according to the Texas Lottery Commission.

[2] Some city names are ambiguous as several cities in Texas share the same name. For these cities, the reported lottery sales were attributed to the city with that name with the largest population in 2010 as reported by the MCDC. There are 14 city names in the lottery sales data that could be referring to multiple cities. Omitting all cities with ambiguous names from the analysis altogether yields similar results.

In this data, I distinguish between wet laws legalizing sale of alcohol for off-premise consumption (packaged beer, wine, or liquor sold in stores) and laws legalizing the sale of alcohol for on-premise consumption (drinks consumed at the location where they are sold). For on-premise wet laws, I do not distinguish between laws that allow for on-premise permits for any establishment and those that require an establishment to derive 60 percent of their receipts or less from alcoholic beverages.[3] [4]

The biggest limitation of this historical data is that there is not explicit information on the legal status of alcohol in cities that did not hold a local option election at the city level. According to Texas state law, these cities are by default wet, unless they are located in a county or precinct that is dry. Because of this, cities in a county that becomes wet, barring city-level information, are considered to become wet at the city level simultaneously with the county-level vote. Additionally, many local option elections during the period from 2010-2019 were held at the Justice of the Peace Precinct level. The state of Texas does not provide a universal data source linking cities to Justice of the Peace Precinct boundaries. Because of this, it is not possible to link city-level lottery sales data to precinct-level law changes. To address this concern, I run specifications where cities located in counties with precinct-level variation during the panel are omitted.

Supporting Data

Time-varying controls were collected from a variety of sources. Yearly demographics data at the county level was collected from the National Institutes of Health's Surveillance, Epidemiology, and End Results (SEER) program. This includes the percentage of a county's population by race (white, black, Hispanic, or other), gender, and age groups (less than 10

[3] Texas Alcoholic Beverage Code

[4] When examining on-premise licenses in Kansas, Anderson et al. (2017) note that many establishments operating under food sales percentage requirements essentially function in practice as bars during evening hours.

years, 16-24 years, 25-54 years, 55-65 years, and 65+ years). County-level poverty and income data were collected from the U.S. Census Bureau (Small Area Income and Poverty Estimates). This includes the median household income and the percentage of the population in poverty at the county level. I also include the percentage of a county's population that resides in urban areas, according to the 2010 Census. Table 9.10 presents summary statistics in 2010 (the start of my panel) for these covariates for the full sample of cities and by group; cities that voted to change at least one alcohol restriction during the period between 2010 and 2019 (Change to Wet Laws), cities that were wet or partially wet before the panel begins and did not vote to change any alcohol laws between 2010 and 2019 (Wet with No Change), and cities that remained dry for the entire panel (Dry for Entire Panel).

METHODOLOGY

The passage of local-level wet laws provides variation in access to alcohol across jurisdictions over time that is plausibly exogenous to lottery gambling. I use a difference-in-difference framework to study the effect of changes to local alcohol laws at the county and city level on per-capita lottery participation. The strength of the difference-in-difference framework is that it allows a researcher to control for time-invariant differences in lottery consumption between cities as well as any time-specific shocks to lottery consumption that affect all cities. The general form of my approach is as follows in 1.

$$Ln(SalesPerCapita)_{icgwy} = \alpha + \beta_1 WetTreatment_{icwy} + \chi_{cy} + \phi_i + \theta_{wy} + \mu_g + \epsilon_{igcwy} \quad (1)$$

Where *Ln(SalesPerCapita)* is the natural log[1] of lottery sales in dollars per capita for game g in city i in week w and year y, and *WetTreatment* is an indicator equal to 1 if alcoholic beverage sales are legal in city i in week w and year y. Research has indicated that demographics and income are significant predictors of lottery participation (Clotfelter and Cook, 1989). As legalization of alcohol is determined by a vote of the people, some literature has found that demographics may also be correlated with a city's likelihood of becoming wet (Brown et al. 1996; Gotwalt, 2008). If changing demographics lead to changes in lottery consumption and simultaneously lead to changes in alcohol legality, the estimates of the causal effect of a wet law itself on lottery consumption could be biased. To account for this potential source of omitted variable bias, I include χ, a vector of time-varying county-level controls, including percentages of a county's population by race, gender and

[1] I choose to use the natural log of per capita sales as my primary dependent variable to estimate the average percentage increase in sales.

age, as well as county median household income. μ_g is an indicator variable for each game (Powerball or Mega Millions). Individual cities also may inherently differ in lottery spending due to city-level characteristics, such as the immediate local accessibility of lottery tickets, city-specific differences in demographics and income, and local cultural norms surrounding gambling. ϕ is a vector of city fixed effects to control for any time-invariant differences in per-capita lottery consumption across cities. Lastly, θ is a vector of fixed effects for each historical week to account for time-varying factors that may affect lottery consumption in all cities during a given historical week in the panel, such as jackpot size, inflation, and changes to game price and format. In all specifications, I employ weighted-least-squares estimation, using city population as weights. Confidence intervals around estimates are calculated using heteroskedasticity-robust standard errors, and to account for the fact that repeated observations from the same city are likely correlated I cluster these standard errors at the city level.

Analysis 1: County Level Wet Laws:

Any Wet Law: County Level:

In my first analysis, I exclusively examine the effect of county-level legalization of alcohol on lottery consumption. County-level laws are plausibly the most binding alcohol restrictions, as they determine alcohol sales across the largest geographic area. To examine the effect of countywide legalization of alcohol, I include a single indicator, *CountyWet* following the passage of a county-level wet law in a previously dry county. In 2, the coefficient β_1 identifies the causal effect of county-level legalization of alcoholic beverages in a previously

entirely dry county.[2]

$$Ln(SalesPerCapita)_{icgwy} = \alpha + \beta_1 CountyWet_{cwy} + \chi_{cy} + \phi_i + \theta_{wy} + \mu_g + \epsilon_{igcwy} \quad (2)$$

County On and Off Premise:

It may be that legalizing alcohol for sale for off-premises consumption yields a different effect than legalizing alcohol sales in on-premise establishments. I will also modify the specification in 2 to include indicators for heterogeneity in county-level policies; whether county c in week w and year y allows for the sale of alcoholic beverages off-premises (packaged beer, wine, and liquor sold in stores) and on-premises (alcohol sold in bars and restaurants). In 3, *CountyOff* and *CountyOn* are binary variables that equal 1 if the county is wet for any off-premise beverages and any on-premise beverages, respectively.

$$Ln(SalesPerCapita)_{icgwy} = \alpha + \beta_1 CountyOff_{cwy} + \beta_2 CountyOn_{cwy} + \chi_{cy} + \phi_i + \theta_{wy} + \mu_g + \epsilon_{igcwy} \quad (3)$$

Analysis 2: County and City Level Wet Laws:

Any Wet Law: City and County Level:

While county-level dry laws are the most geographically encompassing local alcohol restrictions in the state of Texas, laws at the city and Justice of Peace precinct level make up the majority of variation in wet dry laws in recent years.[3] In the absence of county-level restrictions, a city is by default wet, but can restrict alcohol sales by local vote. In the

[2]It is important to note that some de facto "dry" counties effectively transitioned from "dry" to "partially wet" due to city or precinct-level votes, and some "partially wet" counties became "wet throughout" due to county-level votes, during the course of my panel. This binary variable strictly becomes 1 when countywide prohibition is repealed by a county-level vote in an explicitly "dry" county, and thus does not capture the transition from "dry" to "partially wet" or "partially wet" to "wet throughout".

[3]In total, 291 cities ended at least some form of alcohol restrictions between 2010 and 2019.

period between 2010 and 2019, the majority of dry to wet transitions occurred at the city or precinct level, as cities and Justice of the Peace Precincts that had historically chosen to be dry in some capacity voted to end these alcohol restrictions. To examine the imapct of city-level wet laws, in my third specification I include an indicator variable, *CityWet* that equals 1 if a city is wet for any alcohol sales. In 4 each treatment (*CityWet* and *CountyWet*) is a binary variable that equals 1 if any alcoholic beverages are legal at the city or county level respectively. By definition, if a city is wet, the county it is located in is at least partially wet. Therefore, the set of cities where *CityWet* equals one is a subset of the set of cities where *CountyWet* equals 1. In this specification, *CountyWet* estimates the effect of the county that city i is located in becoming wet when city i is dry, and *CityWet* estimates the differential treatment effect of city i itself legalizing alcoholic beverages.

$$Ln(SalesPerCapita)_{icgwy} = \alpha + \beta_1 CountyWet_{cwy} + \beta_2 CityWet_{iwy} + \chi_{cy} + \phi_i + \theta_{wy} + \mu_g + \epsilon_{igcwy} \tag{4}$$

City and County On and Off-Premise:

Additionally, I will also relax this specification to include indicators for heterogeneity in county and city-level policies; whether county c in week w and year y allows for the sale of alcoholic beverages off-premises and on-premises, and whether city i in week w and year y allows for the sale of alcoholic beverages off-premises and on-premises. In 5, each off-premise treatment (*CityOff* and *CountyOff*) is a binary variable that equals 1 if any off-premise alcoholic beverages are legal at the city or county level respectively, and each on-premise treatment (*CityOn* and *CountyOn*) is a binary variable that equals 1 if any on-premise alcoholic beverages are legal at the city or county level respectively.

$$Ln(SalesPerCapita)_{igcwy} = \alpha + \beta_1 CountyOff_{cwy} + \beta_2 CountyOn_{cwy} + \beta_3 CityOff_{iwy} + \beta_4 CityOn_{iwy} + \chi_{cy} + \phi_i + \theta_{wy} + \mu_g + \epsilon_{igcwy} \quad (5)$$

Event Study Analysis:

One may be concerned that trends in lottery sales in treated and untreated jurisdictions may have differed even in the absence of treatment, due to inherent differences in areas that become wet and those that do not. For instance, one could be concerned that changing attitudes toward both drinking and gambling influenced an increase in lottery sales and the repeal of a dry law. If this is the case, a simple difference-in-difference approach would yield biased estimates. While the validity of parallel trends in the absence of treatment is fundamentally not testable, one can assess the plausibility of this assumption by comparing trends in lottery consumption between treated and untreated cities prior to treatment. To examine these pre-trends, I will also include an event study where I include a series of mutually-exclusive lag and lead terms for the years prior to and following a wet law. As cities are treated at different times during the period of interest, some of these lags and leads will be unbalanced.[4] If the lead variables are statistically significant, it would indicate that the treated and untreated cities differ in the pre-treatment period, casting doubt on the parallel trends assumption. Additionally, by estimating the lagged effect of wet laws, this framework allows me to examine the persistent effects of treatment in the years following a change in alcohol access.

[4]The earliest treated city will have 9 year lagged terms, and the latest treated city will have 9 lead terms.

RESULTS

County Level Wet Laws

Any Wet Law

Table 9.1 presents difference-in-difference estimates of the relationship between county legality of any alcoholic beverages and lottery sales. Based on this estimate, the passage of a county-level wet law in a previously dry county causes an estimated 23 percent increase in per-capita sales. This estimated effect persists when controlling for time-varying county characteristics, including household median income and population percentages by gender and race (Column 2). As socioeconomic factors have been found to be correlated both with the likelihood of a county prohibiting alcohol, and the demand for lottery products, one may be concerned that changes in demographics within a county over time are driving a spurious correlation between alcohol access and lottery consumption. However, the fact that the estimated effect is not statistically different following the inclusion of these controls should reassure readers concerned about this potential source of omitted variable bias.

The causal interpretation of this result relies on the assumption that cities in treated counties and those in untreated counties would have followed similar trends in lottery sales in the absence of treatment. To supplement this analysis, I conduct an event study specification with mutually-exclusive lag and lead terms for the nine years prior to and following the countywide legalization of any alcoholic beverages.[1] Figure 8.1 shows the estimated coefficients for each lag and lead plotted over time. Three of the eight lead terms are negative and statistically different from the omitted period (1 year prior to treatment), providing weak evidence that to-be-treated counties experienced differing trends in lottery

[1] I include countywide wet laws passed in previously "partially wet" counties in the event study to increase statistical power for the lead terms. Of the 8 counties that were entirely dry prior to countywide legalization, only two (Collingsworth and Delta Counties) became wet after 2014, and each of these counties only has one city (Wellington and Cooper, respectively) report lottery sales data.

sales prior to treatment. This potential violation of pre-trends suggest that pre-treated counties may have began to increase in lottery consumption prior to alcohol legalization. If this is the case, the estimated coefficients seen in Table 9.1 would be biased upward. However, several pieces of evidence should reassure readers that this finding does not invalidate the causal interpretation of the main results. Firstly, the lead terms do not display a clear upward trend as time approaches treatment. Secondly, of the 8 lead terms, only 3 are statistically different from zero. Lastly, while the lead coefficients are negative in sign, they are relatively small in magnitude. In contrast, the lag terms are consistently different from zero, large in magnitude, and display a clear upward trend following treatment, indicating a dramatic change in trends following the passage of a wet law.

Partially Wet Counties

In addition to the 8 entirely dry counties that passed countywide ordinances legalizing some form of alcohol sales between 2010 and 2019, 15 counties described as "partially wet" also passed county-level laws legalizing countywide alcoholic beverage sales, becoming wet throughout. To compare the effect of countywide alcohol legalization in these counties to the effect in entirely dry counties, I interact the passage of a county-level wet law with whether a county was described as entirely "dry" prior to countywide legalization. Table 9.2 presents estimates for the interaction of pre-treatment status with county-level treatment. The treatment variable in this specification estimates the effect of countywide legalization of alcoholic beverages for counties that were defined as partially wet prior, while the interaction term estimates the difference in treatment effects for counties explicitly described as dry prior to treatment. While this interaction is not statistically different from zero, it is positive in magnitude, indicating that the effect of countywide legalization is larger for counties that were previously dry.

County Off-Premise and On-Premise

Next, I relax my initial specification to differentiate between county laws legalizing alcohol for off-premise consumption (packaged alcohol sold for consumption in a location other than the point of sale) and on-premise consumption (drinks sold in bars and restaurants intended for consumption at the outlet). Of the 8 entirely dry counties that became wet by countywide ordinance between 2010-2019, 6 legalized both on-premise and off-premise sales simultaneously, while 2 counties only legalized off-premise sales. Additionally, 3 counties that were wet or partially wet for off-premise sales prior to 2010 legalized on-premise beverages between 2010-2019.

Table 9.3 presents estimates of the effect of county-level access to on-premise and off-premise beverages on lottery sales. I find that the legalization of off-premise beverages at the county level is associated with a 22-24 percent increase in lottery sales, but simultaneous or subsequent county legalization of on-premise beverages is not associated with an increase in lottery sales. However, it is important to note that the ability to distinguish between the effect of on and off-premise wet laws at the county level may be limited by the small number of county-level votes in recent years and the fact that the majority of these votes legalized on-premise and off-premise beverages simultaneously.

County and City-Level Wet Laws

Any Wet Law

Apart from county level ordinances, cities in Texas often have restrictions on alcoholic beverage sales. Between 2010 and 2019 a large number of dry or "partially wet" cities relaxed these restrictions. In Table 9.4., I estimate the effect of county and city-level alcohol legalization on lottery consumption. Namely, I include one indicator variable for if the county a city is located in is wet for any alcohol sales, and one indicator variable for if the city itself

is wet for any alcohol sales. Once again, I consider any partially wet cities and counties to be wet in this specification. I find that legalization of any alcoholic beverages at the county level is associated with a 15 percent increase in per-capita lottery sales, and legalization of alcoholic beverages is associated with an 8-9 percent increase in per capita sales. The estimates for both city and county-level legalization are not statistically different following the inclusion of time-varying county characteristics (Column 2).

To address the parallel trends assumption, I conduct an event-study of city-level wet laws beverages. Figure 8.2 presents lag and lead coefficients for the nine years prior to and following city-level legalization of any alcoholic beverages. I find that none of the lead terms are statistically different from zero, consistent with the assumption that untreated and treated cities would have followed similar trends in the absence of citywide legalization. The estimated lagged terms indicate that per-capita lottery sales increase 1-6 years following citywide legalization of any alcoholic beverages. However, after 6 years, these estimates decrease and are no longer statistically different from zero. This may suggest that the effect of legalizing beverages at the city level dissipates following initial treatment.

Off-Premise and On-Premise

Next, I incorporate heterogeneity in both county- and city-level wet laws. Specifically, I include indicators as to whether the county/counties a city is located in are wet for the sale of off-premise and on-premise alcohol and whether a city itself is wet for beverages sold off-premises and on-premises. Table 9.5 presents estimates for the effect of county and city level legality of on-and off-premise alcohol.

Firstly, I find that county-level legalization of off-premise beverages remains statistically significant in all specifications. Secondly, I find that county level on-premise legalization is negative in sign, but not statistically different from zero. Once again, due to the limited heterogeneity in treated counties, I caution any meaningful economic interpretation in the

differing estimates of off and on-premise legalization at the county level.

In contrast to county-level wet laws, municipal wet laws between 2010 and 2019 display significant heterogeneity in the timing of on-and-off-premise legalization, with some municipalities legalizing on and off-premise sales simultaneously, others legalizing only off-premise sales, and others legalizing off and on-premise sales at different times. This significant variation in city wet laws allows for separate identification of the effect of on-and-off-premise laws at the city level. I find that city-level legalization of off-premise alcohol is not associated with a significant change in lottery sales, whereas city-level legalization of on-premise sales is associated with a 6 percent increase in lottery consumption.

Auxiliary Analyses and Robustness Checks

First Stage Analysis of Licensed Establishments

My primary analysis is grounded in the assumption that a jurisdiction legalizing alcohol sales meaningfully increases alcohol access for residents within that jurisdiction. To test whether the passage of wet laws increases the ease of purchasing alcohol, I estimate the effect of city-level alcohol legalization on the total number of establishments per 1,000 population licensed to sell alcoholic beverages for either on-premise or off-premise consumption within a city. Figure 8.3 shows plotted coefficients for the number of licenses for the 9 years prior to and following passage of a city-level wet law. The number of licenses dramatically increases following the passage of a wet law at time T=0, and continues to increase in the years following. This indicates that the passage of a wet law has a substantial effect on the number of locations where alcohol can be purchased.

Analysis By Percentage in Urban Areas and City Population

Table 9.6 presents results from regressions where I restrict my sample to cities located in counties defined as (1) less than 50 percent urban, (2) greater than 50 percent urban, (3)

less than 20 percent urban, and (4) greater than 80 percent urban, respectively as defined by the United States Census. I find that when restricting the analysis to cities in counties that are defined as less than 50 percent urban, the estimates of both city-level and county-level access are smaller in magnitude, approximately 3 and 6 percent respectively (Column 1). When the analysis is restricted to cities in counties defined as more than 50 percent urban, the estimates respectively grow to 35 percent and 10 percent (Column 2). The estimate of county-level access remains significant when restricting the sample to only cities in counties greater than 80 percent urban (Column 4). In Table 9.7, restricting the analysis to (1) cities with populations less than 5,000, and (2) with populations greater than 5,000, yields similar results, with larger estimates in cities with greater populations, and smaller estimates in cities with lower populations. The effect of a city level wet law remains statistically significant when restricting the sample to cities greater than 10,000 in population (Column 4).[2]

Analysis by Game

Table 9.8 presents regression results for county and city level wet laws separated by lottery game. In general, both county and city-level wet laws appear to have a larger effect on Powerball consumption than Mega Millions, and the effect of county-level wet laws is no longer statistically different from zero when the analysis is limited strictly to Mega Millions sales. The legalization of alcoholic beverages at the county level is associated with a 11 percent increase in Mega Millions purchases and a 20 percent increase in Powerball purchases. The passage of a wet law at the city-level is associated with a 7 percent increase in Mega Millions purchases, and a 11 percent increase in Powerball purchases, respectively.

[2]There are no cities with populations greater than 10,000 located in counties that enacted county-level wet laws during the time period.

Analysis Without Partially Wet, Always Treated, and Precinct-Treated Jurisdictions

Table 9.9 presents estimates of the effect of city and county wet laws where I exclude cities where the legal status of alcohol may be somewhat uncertain prior to or following treatment.

In Column 1, I eliminate all treated cities that were described by the TABC as "partially wet" prior to becoming "wet throughout." In most of my main results above, I do not distinguish between wet and partially wet status at the county or city level. Jurisdictions that are "partially wet" at the start of the panel but later become "entirely wet" are defined as wet for the entire panel. However, if a city transitioning from partially wet to entirely wet increases alcohol access for residents, these cities may not be a valid comparison group, and treating them as entirely wet for the entire length of the panel will fail to pick up this change in access and bias the estimates away from the true effect.

In Column 2, I restrict the sample of cities further by retaining only cities that were completely dry at the start of the panel. In this specification, both "partially wet" cities that later became entirely wet and cities that were entirely wet throughout the entire panel are omitted.

Lastly, in Column 3, I restrict the panel to cities that were both dry prior to treatment and not located in counties where any Justice of the Peace Precincts pass wet laws between 2010 and 2019. The fact that individual voting precincts within counties often legalize alcohol independent of county or city-level statutes represents a potential source of omitted variable bias. There is no universal source mapping Texas JP precincts to cities within a county, so it is not feasible to determine which cities are affected by a precinct-level statute. Because of this limitation, cities in the comparison group may have experienced an increase in alcohol access that I do not observe. If this is the case, the estimated effect of city-level access will be biased downward.

The estimated effects of both county and city level legalization shrink in magnitude, but

remain positive in magnitude and statistically different from zero following these exclusions. In the most restrictive specification (Column 3) I find that legalization of any alcohol at the county level is associated with a 12 percent increase in per-capita lottery sales, whereas city level legalization of any alcohol is associated with a 6 percent increase in per-capita sales.

CONCLUSION

In this study, I exploit panel data on local alcohol restrictions and city-level lottery sales to provide an estimate of the causal effect of local alcohol access on lottery consumption. This paper expands on existing laboratory and cross-sectional studies examining the relationship between alcohol and gambling. I find evidence that allowing the sale of previously prohibited alcoholic beverages is associated with a significant increase in per-capita spending in the Powerball and Mega Millions lottery games. This finding is notable, as while previous work has found that drinking may cause short-term increases in risky behavior and that alcohol abuse and problem gambling are correlated, this study indicates that the availability of alcohol may directly cause an large and sustained increase in gambling.

Alcohol restrictions in Texas are determined at the county, Justice of Peace precinct, and city level. As county-level alcohol laws affect the largest geographic area, they are likely to be the most binding restrictions for alcohol access, I first examine the effect of any county-level alcohol legality on lottery consumption. The legalization of any alcoholic beverages at the county level is associated with an estimated 23 percent increase in per capita lottery sales in a county that was previously described as entirely dry. This result persists after controlling for time-varying county level characteristics. When I explore heterogeneity in the contexts of where alcoholic beverages are legal for sale, I find that legalization of off-premise beverages at the county level (packaged beverages sold in stores) is associated with an increase in lottery sales, whereas county-level legalization of on-premise beverages (beverages consumed at the establishment where they are sold, such as at a bar) is not associated with a change in sales. However, there are a limited number of county-level votes between 2010 and 2019, and the majority of these counties legalize on-premise and off-premise sales simultaneously. Because of this limited variation in county-level laws, this finding may be due to a lack of statistical power.

In the state of Texas, individual cities can also vote to become "wet" or "dry" independent of county-level status. Between 2010 and 2019, 291 cities legalized previously prohibited alcoholic beverages. A city being wet for any alcoholic beverage sales is associated with an estimated 8-9 percent increase in lottery sales per capita, independent of county-level legality. I also explore city-level wet laws by off or on-premise sales. At the city level I find that legalization of on-premise beverages is associated with an increase in lottery sales, but legalization of off-premise beverages is not.

Plausibly, differing travel costs for off-premise and on-premise purchases may lead county-level restrictions to represent a more binding restriction for off-premise alcohol sales, whereas city-level restrictions may be more binding for on-premise sales. Consumers buying packaged alcohol can consume it at a time and place of their choosing, and feasibly "stock up" on drinks, and would therefore would be willing and able to travel a longer distance for purchases. Contrarily, consumers may be less likely to travel a long distance to purchase alcohol for on-premise consumption, such as at bars and restaurants, because they can only consume these drinks at the establishment they buy it from. Because of this, legalization of off-premise beverages may have a larger effect on total alcohol consumption when enacted at the county level, while on-premise laws may have a more salient effect when enacted at the city level. If this is the case, and the effect on consumption increases consumers' willingness to play lottery games, one would expect off-premise laws to have the greatest effect on lottery consumption when enacted at the county level, and on-premise laws to have the greatest effect on lottery consumption when enacted at the city level.

Because alcohol legality is determined by local vote, and local option elections are held during May and November of each year, one may be concerned that legalization of alcohol at the local level could be correlated with other local initiatives or ordinances passed simultaneously that may directly or indirectly affect local lottery consumption. For instance it is possible that local option elections are correlated with changes to local taxes or business

regulations that may impact lottery consumption via changes to income or the availability of lottery tickets for purchase. Ultimately, I cannot rule out the possibility of this spurious correlation being present in my findings.

Because of the limitations of my data, this study does not yield insights into the individual behavior of gamblers following alcohol legalization. It may be that increased alcohol availability drives an increase in gambling behavior due to the psychological effect of intoxication on risky behavior. This mechanism is consistent with evidence from randomly controlled trials involving alcohol consumption and gambling. It also may be that the legalization of a previously prohibited "vice", in this case, alcohol, decreases the social stigma around participating in other "vices" such as gambling. In this case, consumers who initially were unlikely to gamble due to the perceived social acceptability of such behaviors may be more willing to engage in gambling behavior. Because I only observe aggregate lottery sales reported at the city level, I cannot distinguish whether this increase in sales is driven by additional players playing the lottery or existing players spending more on lottery products. While this study provides new insights into the relationship between alcohol and games of chance, more research is needed to understand the direct mechanism by which alcohol availability affects lottery play and other forms of gambling.

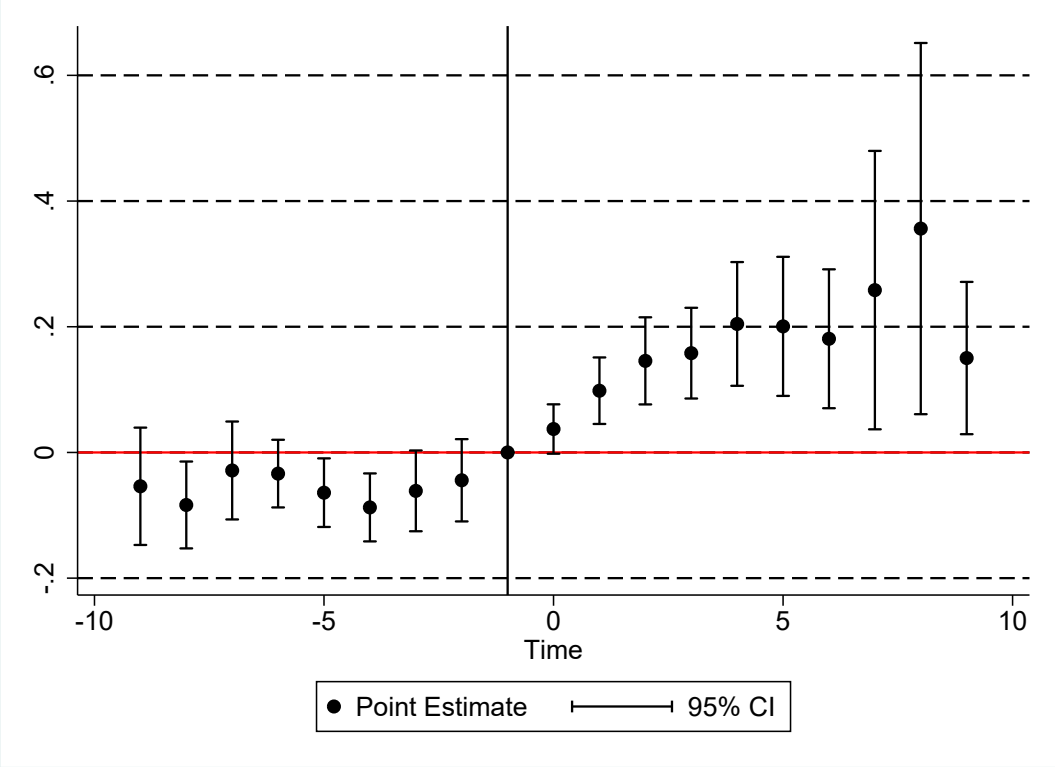
I identify 49 distinct dry cities with lottery sales data and estimated population data in the last year of my panel, 2019. These include three cities located in entirely dry counties (Canadian, Miami, and Throckmorton), as well as cities that are dry as a result of city-level restrictions. Average weekly per-capita sales in 2019 for these dry cities was $0.431, according to the Texas Lottery Commission. Using my most conservative estimate in Column 3 of Table 9.9, I find that the legalization of any alcoholic beverages in a previously dry city, whether due to county or city-level vote, is associated with an estimated 6.35 percent increase in per-capita sales. According to this estimate, had all of these cities became wet in 2019, the average person in these cities would have spent an estimated additional $0.027 per week

on lottery games. Based on the total population living in these cities in 2019, 78,804, net sales would have hypothetically increased by $2,157 per week, or $112,151 annually, as a result of all of these cities repealing their dry laws. However, this back-of-the-envelope calculation does not consider all potentially dry areas in Texas, as individual Justice of the Peace precincts in some Texas counties remain dry, and some cities were omitted from the analysis due to missing population or lottery sales data. This calculation also does not take into account the effects of currently "partially wet" cities becoming entirely wet or legalizing additional types of alcoholic beverage sales. Consequently, this value is almost certainly a lower-bound estimate of the increase in lottery revenue were every jurisdiction in Texas to repeal all alcohol restrictions.

Finally, the potential economic implications of increased lottery consumption are not limited to the revenue collected from lottery purchases. The increase in gambling consumption may lead to an increase in the prevalence of gambling addictions in cities that become wet. More importantly, increased lottery gambling is just one result associated with increased alcohol access. Local alcohol legality has been shown to also influence other outcomes that affect social welfare, such as traffic fatalities (Baughman et. al, 2001), illicit drug use and drug-related crimes (Conlin et. al, 2005), and violent and property crime (Anderson et. al, 2017). Voters and policymakers must carefully weigh the costs and benefits of these potential effects when determining local alcohol laws.

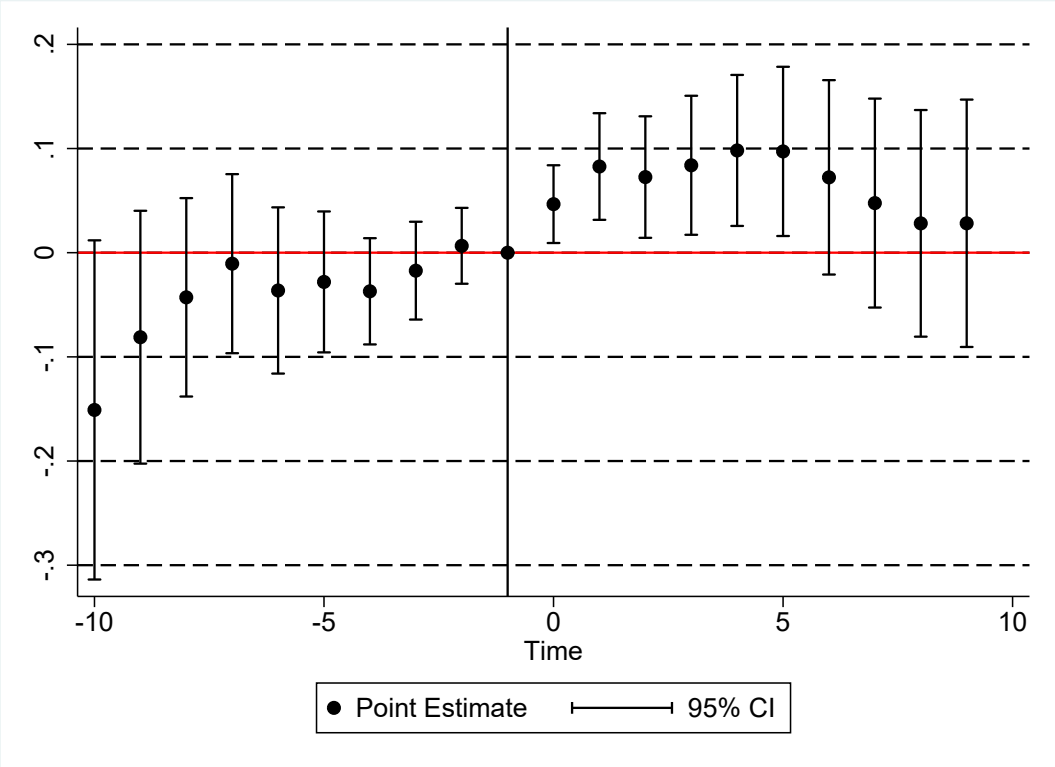
MAIN TABLES AND FIGURES

Figure 9.1: Event study lag and lead coefficients prior to and following countywide legalization of any alcoholic beverages



Notes: Estimates for each lag and lead term prior to and following countywide alcohol legalization (and their 95% confidence intervals) are reported. The dependent variable is equal to the natural log of per-capita lottery sales as reported at the city level. Regressions are weighted by city population and standard errors are clustered at the city level. Controls are included for county-level demographics and city and date fixed effects.

Figure 9.2: Event study lag and lead coefficients prior to and following city legalization of any alcoholic beverages



Notes: Estimates for each lag and lead term prior to and following city-level legalization of alcoholic beverages (and their 95% confidence intervals) are reported. The dependent variable is equal to the natural log of per-capita lottery sales as reported at the city level. Regressions are weighted by city population and standard errors are clustered at the city level. Controls are included for county-level demographics and city and date fixed effects.

Table 9.1: Estimates of the effect of county legalization of any alcoholic beverages on per-capita lottery sales

	(1)	(2)
	Ln(Sales Per Capita)	Ln(Sales Per Capita)
County Wet	0.231***	0.236***
	(0.0726)	(0.0862)
Cities	987	987
N	917,224	917,224
City FE	Yes	Yes
Week FE	Yes	Yes
County and Lottery Controls	No	Yes

Notes: Estimates are based on weekly city-level sales data for Mega Millions and Powerball lottery games provided by the Texas Lottery Commission. The estimated coefficients are from a weighted least-squares regression model where the treatment variable of interest is whether the county/counties a city is located in is/are wet (entirely or partly) for the sale of any alcoholic beverages during the week of sales. The outcome variable is the natural log of the total net lottery sales per capita at the city level. Week Fixed Effects refer to individual fixed effects for each historical week in the panel. County-level and lottery controls include percentages of a county's population by race and gender, county median household income, and controls for game (Mega Millions or Powerball). All regressions are weighted by city population. Standard-error estimates are clustered at the city level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively

Table 9.2: Estimates of the effect of countywide legalization of any alcoholic beverages interacted with prior partly wet status

	(1)	(2)
	Ln(Sales Per Capita)	Ln(Sales Per Capita)
Countywide Wet Law	0.104***	0.105***
	(0.0344)	(0.0344)
Countywide Wet Law*Previously Entirely Dry	0.127	0.120
	(0.0796)	(0.0907)
Cities	987	987
N	917,224	917,224
City FE	Yes	Yes
Week FE	Yes	Yes
County and Lottery Controls	No	Yes

Notes: Estimates are based on weekly city-level sales data for Mega Millions and Powerball lottery games provided by the Texas Lottery Commission. The estimated coefficients are from a two-way fixed effects model where the treatment variable of interest is whether the county/counties a city is located in is/are entirely wet for the sale of any alcoholic beverages during the week of sales. The interaction term indicates heterogeneity in treatment effects for counties describes as "partly wet" for some alcoholic beverages prior to countywide legalization. The outcome variable is the log of the total net lottery sales per capita at the city level. Week Fixed Effects refer to individual fixed effects for each historical week in the panel. County-level and lottery controls include percentages of a county's population by race and gender, county median household income, and controls for game (Mega Millions or Powerball). All regressions are weighted by city population. Standard-error estimates are clustered at the city level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

Table 9.3: Estimates of the effect of county legalization of on and off-premise alcoholic beverages on lottery consumption

	(1)	(2)
	Ln(Sales Per Capita)	Ln(Sales Per Capita)
County Wet for Off-Premise Beverages	0.242**	0.222**
	(0.0984)	(0.109)
County Wet for On-Premise Beverages	-0.0124	0.00284
	(0.0946)	(0.102)
Cities	987	987
N	917,224	917,224
City FE	Yes	Yes
Week FE	Yes	Yes
County and Lottery Controls	No	Yes

Notes: Estimates are based on weekly city-level sales data for Mega Millions and Powerball lottery games provided by the Texas Lottery Commission. The estimated coefficients are from a two-way fixed effects model where the treatment variables of interest are whether the county/counties a city is located in is/are wet for the sale any beverages for consumption off-premises, and whether the county/counties a city is located in is/are wet for the sale any beverages for consumption on-premises. Counties described as partly wet are considered wet. The outcome variable is the log of the total net lottery sales per capita at the city level. Week Fixed Effects refer to individual fixed effects for each historical week in the panel. County-level and lottery controls include percentages of a county's population by race and gender, county median household income, and controls for game (Mega Millions or Powerball). All regressions are weighted by city population. Standard-error estimates are clustered at the city level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

Table 9.4: Estimates of the effect of legalization of any alcoholic beverages at the county and city level on per-capita lottery sales

	(1)	(2)
	Ln(Sales Per Capita)	Ln(Sales Per Capita)
County Wet	0.149**	0.153*
	(0.0757)	(0.0882)
City Wet	0.0832***	0.0859***
	(0.0240)	(0.0243)
Cities	987	987
N	917,224	917,224
City FE	Yes	Yes
Week FE	Yes	Yes
County and Lottery Controls	No	Yes

Notes: Estimates are based on weekly city-level sales data for Mega Millions and Powerball lottery games provided by the Texas Lottery Commission. The estimated coefficients are from a two-way fixed effects model where the treatment variables of interest are whether the county a city is located in is/are wet for the sale of any alcoholic beverages during the week of sales, and whether the city is itself wet for any alcoholic beverages. For cities that do not explicitly establish wet or dry status, city-level status follows county-level status. The outcome variable is the log of the total net lottery sales per capita at the city level. Week Fixed Effects refer to individual fixed effects for each historical week in the panel. County-level and lottery controls include percentages of a county's population by race and gender, county median household income, and controls for game (Mega Millions or Powerball). All regressions are weighted by city population. Standard-errors are clustered at the city level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

Table 9.5: Estimates of the effect of county and city legalization of off-premise and on-premise beverages on lottery sales

	(1)	(2)
	Ln(Sales Per Capita)	Ln(Sales Per Capita)
County Wet for Any Off-Premise Beverages	0.243**	0.236**
	(0.0988)	(0.105)
County Wet for Any On-Premise Beverages	-0.0740	-0.0649
	(0.0956)	(0.0941)
City Wet for Any Off-Premise Beverages	-0.00228	0.00336
	(0.0233)	(0.0231)
City Wet for Any On-Premise Beverages	0.0644***	0.0649***
	(0.0186)	(0.0180)
Cities	987	987
N	917,224	917,224
City FE	Yes	Yes
Week FE	Yes	Yes
County and Lottery Controls	No	Yes

Notes: Estimates are based on weekly city-level sales data for Mega Millions and Powerball lottery games provided by the Texas Lottery Commission. The estimated coefficients are from a weighted least squares regression model where the treatment variables of interest are whether the county/counties a city is located in is/are wet for the sale of off-and on-premise alcoholic beverages during the week of sales, and whether the city is itself wet for off-and-on premise alcoholic beverages. City and historical date fixed effects are included in all models. For cities that do not explicitly establish wet or dry status, city-level status follows county-level status. The outcome variable is the log of the total net lottery sales per capita at the city level. Week Fixed Effects refer to individual fixed effects for each historical week in the panel. County-level and lottery controls include percentages of a county's population by race and gender, county median household income, and controls for game (Mega Millions or Powerball). All regressions are weighted by city population. Standard-errors are clustered at the city level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

Table 9.6: Estimates of the effect of county and city legalization of any alcoholic beverages, by percent of county population in urban areas

	(1)	(2)	(3)	(4)
	Ln(Sales Per Capita)	Ln(Sales Per Capita)	Ln(Sales Per Capita)	Ln(Sales Per Capita)
County Wet	0.0631	0.345***	0.0463	0.327***
	(0.0422)	(0.0501)	(0.0631)	(0.0980)
City Wet	0.0256	0.100**	0.0259	0.128
	(0.0189)	(0.0450)	(0.0527)	(0.0918)
Cities	410	577	114	322
N	378,893	538,331	108,308	303,519
City FE	Yes	Yes	Yes	Yes
Week FE	Yes	Yes	Yes	Yes
County and Lottery Controls	Yes	Yes	Yes	Yes
Percent of Population in Urban Areas	<50	>50	<20	>80

Notes: Estimates are based on weekly city-level sales data for Mega Millions and Powerball lottery games provided by the Texas Lottery Commission. The estimated coefficients are from a two-way fixed effects model where the treatment variable of interest is whether the county/counties a city is located in is/are wet (entirely or partly) for the sale of any alcoholic beverages during the week of sales. The outcome variable is the log of the total net lottery sales per capita at the city level. County-level and lottery controls include percentages of a county's population by race and gender, county median household income, and controls for game (Mega Millions or Powerball). County Percent Urban is defined as the percentage of a county's population residing in urban areas as defined by the United States Census. All regressions are weighted by city population. Standard-error estimates allow for clusters at the city level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

Table 9.7: Estimates of the effect of county and city legalization of any alcoholic beverages, analysis restricted by city population

	(1)	(2)	(3)	(4)
	Ln(Sales Per Capita)	Ln(Sales Per Capita)	Ln(Sales Per Capita)	Ln(Sales Per Capita)
County Wet	0.0463	0.354***	0.0754	0
	(0.0388)	(0.0486)	(0.0466)	(.)
City Wet	0.0250	0.104**	0.0431	0.0479**
	(0.0186)	(0.0423)	(0.0287)	(0.0238)
Cities	652	354	444	239
N	583,203	334,021	376,770	220,220
City FE	Yes	Yes	Yes	Yes
Week FE	Yes	Yes	Yes	Yes
County and Lottery Controls	Yes	Yes	Yes	Yes
Population	<5000	>5000	<2000	>10000

Notes: Estimates are based on weekly city-level sales data for Mega Millions and Powerball lottery games provided by the Texas Lottery Commission. The estimated coefficients are from a two-way fixed effects model where the treatment variable of interest is whether the county/counties a city is located in is/are wet (entirely or partly) for the sale of any alcoholic beverages during the week of sales. The outcome variable is the log of the total net lottery sales per capita at the city level. Week Fixed Effects refer to individual fixed effects for each historical week in the panel. County-level and lottery controls include percentages of a county's population by race and gender, county median household income, and controls for game (Mega Millions or Powerball). City population figures are from annual estimates sourced from the United States Census. All regressions are weighted by city population. Standard-error estimates allow for clusters at the city level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

Table 9.8: Estimates of the effect of county legalization of any alcoholic beverages on per-capita lottery sales, by game (Mega Millions or Powerball)

	(1)	(2)
	Ln(Sales Per Capita)	Ln(Sales Per Capita)
County Wet	0.105	0.196*
	(0.0702)	(0.103)
City Wet	0.0665***	0.107***
	(0.0234)	(0.0272)
Cities	986	985
N	460,948	456,274
City FE	Yes	Yes
Week FE	Yes	Yes
County Level Controls	No	Yes
Game	Mega Millions	Powerball

Notes: Estimates are based on weekly city-level sales data for Mega Millions and Powerball lottery games provided by the Texas Lottery Commission. The estimated coefficients are from a weighted least-squares regression model where the treatment variable of interest is whether the county/counties a city is located in is/are wet (entirely or partly) for the sale of any alcoholic beverages during the week of sales. The outcome variable is the natural log of the total net lottery sales per capita at the city level. Week Fixed Effects refer to individual fixed effects for each historical week in the panel. County-level controls include percentages of a county's population by race and gender and county median household income). All regressions are weighted by city population. Standard-error estimates are clustered at the city level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively

Table 9.9: Estimates of the effect of legalization of any alcoholic beverages at the county and city level on per-capita lottery sales

	(1)	(2)	(3)
	Ln(Sales Per Capita)	Ln(Sales Per Capita)	Ln(Sales Per Capita)
County Wet	0.145*	0.134*	0.124*
	(0.0855)	(0.0693)	(0.0657)
City Wet	0.0770***	0.0536**	0.0635**
	(0.0272)	(0.0218)	(0.0276)
Cities	912	234	179
N	846,490	217,671	165,670
City FE	Yes	Yes	Yes
Week FE	Yes	Yes	Yes
County and Lottery Controls	Yes	Yes	Yes
Cities Partially Wet Before Treatment	No	No	No
Cities Wet at Start of Panel	Yes	No	No
Cities in Precinct-Treated Counties	Yes	Yes	No

Notes: Estimates are based on weekly city-level sales data for Mega Millions and Powerball lottery games provided by the Texas Lottery Commission. The estimated coefficients are from a two-way fixed effects model where the treatment variables of interest are whether the county a city is located in is/are wet for the sale of any alcoholic beverages during the week of sales, and whether the city is itself wet for any alcoholic beverages. For cities that do not explicitly establish wet or dry status, city-level status follows county-level status. In Column 1, all cities in the treatment group defined as "partially wet" prior to treatment are excluded. Column 2 restricts the sample further by eliminating all jurisdictions defined as wet or partially wet prior to treatment. Column 3 restricts the sample to only cities described as dry prior to the start of the panel and located in counties where no Justice of the Peace precincts became wet between 2010 and 2019. The outcome variable is the log of the total net lottery sales per capita at the city level. County-level and lottery controls include percentages of a county's population by race and gender, county median household income, and controls for game (Mega Millions or Powerball). All regressions are weighted by city population. Standard-errors are clustered at the city level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

Table 9.10: Descriptive statistics by treatment group (2010)

	Full Sample	Change to Wet Laws	Dry For Entire Panel	Wet with No Change
Population	19,741.1	16,265.5	1,498.6	23,333.1
Net Sales	$2,990.3	$2,382.3	$234.4	$3,580.8
Sales Per Capita	$0.271	$0.232	$0.224	$0.298
Proportion White	0.590	0.660	0.704	0.541
Proportion Black	0.088	0.091	0.083	0.087
Proportion Other	0.025	0.022	0.013	0.028
Proportion Hispanic	0.296	0.227	0.201	0.345
Proportion Less than 10 Years	0.142	0.139	0.135	0.144
Proportion 16-24 Years	0.122	0.120	0.116	0.124
Proportion 25-54 Years	0.393	0.392	0.379	0.396
Proportion 55-64 Years	0.118	0.120	0.124	0.116
Proportion 65+ Years	0.138	0.144	0.160	0.133
Proportion Male	0.500	0.501	0.500	0.500
Median Household Income	4.5e+04	4.5e+04	4.2e+04	4.6e+04

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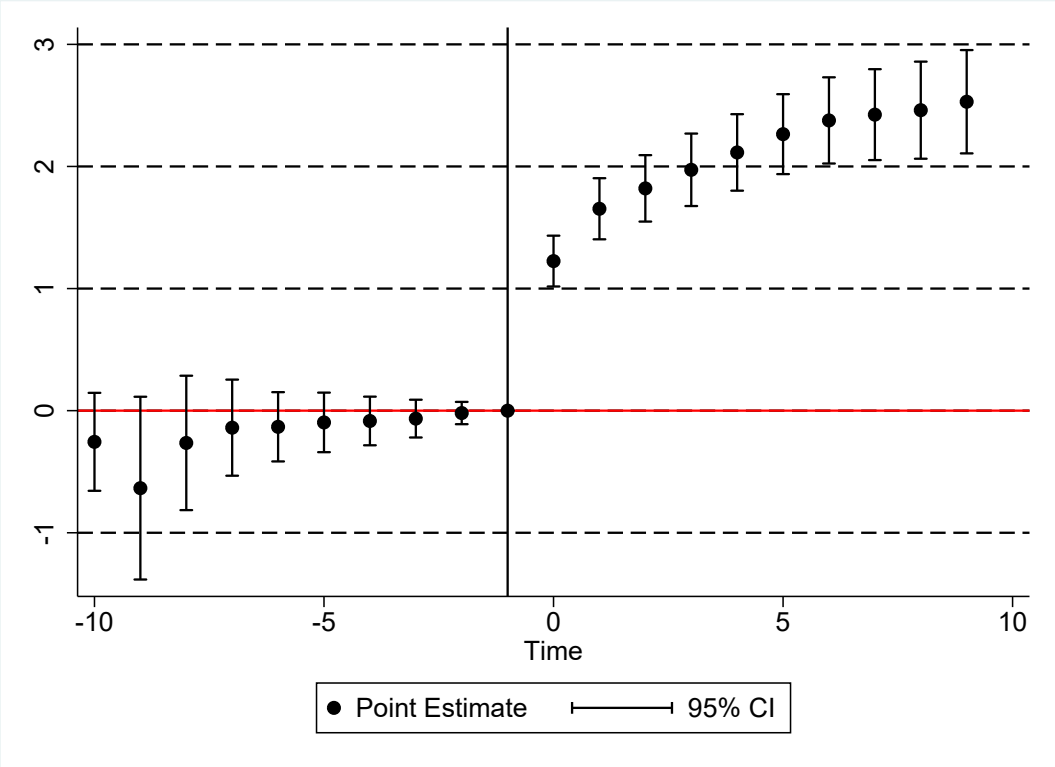
APPENDICES

APPENDIX A

SUPPLEMENTARY TABLES AND FIGURES

Figure A.1: Number of establishments licensed to sell alcohol prior to and following city legalization of any alcoholic beverages



Notes: Estimates for each lag and lead term prior to and following city-level legalization of alcoholic beverages (and their 95% confidence intervals) are reported. The dependent variable is equal to the number of establishments located within a city licensed to sell alcoholic beverages (both on and off-premise) per 1000 population. Regressions are weighted by city population and standard errors are clustered at the city level. Controls are included for county-level demographics and city and date fixed effects.

Table A.1: Changes to Mega Millions format, price, and jackpot odds

Starting Date	Pick 5 White Balls From Field of	Pick 1 Mega Ball From Field of	Jackpot Odds	Minimum Price to Play
September 6, 1996	50	25	1: 52,969,000	$1
January 13, 1999	50	36	1: 76,275,360	$1
May 15, 2002	52	52	1: 135,145,920	$1
June 22, 2005	56	46	1: 175,711,536	$1
October 19, 2013	75	15	1: 258,890,850	$1
October 28, 2017	70	25	1: 302,575,350	$2

Table A.2: Changes to Powerball format, price, and jackpot odds

Starting date	Pick 5 White Balls from Field of	Pick 1 Powerball from Field of	Jackpot Odds	Minimum Price to Play
April 22, 1992	45	45	1:54,979,154	$1
November 5, 1997	49	42	1:80,089,127	$1
March 7, 2001	49	42	1:80,089,127	$1
October 9, 2002	53	42	1:120,526,769	$1
August 28, 2005	55	42	1:146,107,961	$1
January 7, 2009	59	39	1:195,249,054	$1
January 15, 2012	59	35	1:175,223,510	$2
January 19, 2014	59	35	1:175,223,510	$2
October 7, 2015	69	26	1:292,201,338	$2

Table A.3: County Level Local Option Elections, 2010-2019

	Off-Premise Beer and Wine	Off-Premise Distilled Spirits	On-Premise Beer and Wine	On-Premise Mixed Beverages	Partially Wet Before Treatment
ARMSTRONG	2013	2013	.	.	0
BAILEY	2016	.	.	.	1
BROWN	2018	2018	2018	2018	1
BURNET	2015	2015	2015	2015	1
CLAY	2017	2017	2017	2017	1
COLEMAN	2014	.	2014	2014	1
COLLINGSWORTH	2017	2017	2017	2017	0
CONCHO	2010	.	2010	.	1
CRANE	.	.	.	2019	1
CROSBY	2013	2013	2013	2013	0
DELTA	2015	.	.	.	0
DONLEY	2013	2013	2013	2013	1
FISHER	2013	2013	2013	2013	0
FREESTONE	2012	.	2012	2012	1
GLASSCOCK	.	2018	.	.	1
GONZALES	2010	2010	2010	2010	1
NOLAN	.	.	.	.	1
OCHILTREE	2013	2013	2013	2013	0
OLDHAM	.	.	2010	2010	1
SAN SABA	2011	2011	2011	2011	1
SHERMAN	2012	2012	2012	2012	0
STERLING	2014	.	2014	.	0
WALLER	.	.	.	2015	1

Figure A.2: Proportion of Cities Wet By Year