

THE EFFECT OF LEGALIZING SPORTS BETTING ON LOTTERY SALES

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

August 2025

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ACKNOWLEDGEMENTS

I would like to acknowledge my advisor, Dr. Isaac Swensen, for his mentorship throughout the process of writing this thesis. I would also like to acknowledge the rest of my committee members, Dr. Wendy Stock and Dr. Chris Stoddard, for their insights. Finally, I would like to thank my family and friends for their support and encouragement.

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ABSTRACT

The 2018 Supreme Court decision overturning the federal ban on sports betting has led states to legalize sports betting. Most states already permit other forms of gambling such as the lottery which is an important source of revenue for state governments. This study exploits the legalization of sports betting to analyze the effect on lottery sales. Evidence using a staggered difference-in-differences framework shows that legalizing sports betting is associated with a decrease in lottery sales.

INTRODUCTION

In 2018, the United States Supreme Court lifted the federal ban on sports betting by overturning the Professional and Amateur Sports Protection Act (PASPA). This ruling gave state governments the authority to determine the legality of sports betting. Since the federal ban was lifted, sports betting has exploded in popularity. In the seven years since the ruling, 38 states have legalized sports betting and \$149.6 billion was wagered on sports betting in 2024 (Altruda, 2025). Figure 1.1 shows how the amount wagered on sports on a per capita basis has increased over time. Much of this increase is due to sports betting becoming more established overtime with the creation of different platforms and sports betting systems. This rapid expansion raises concerns about the effect this will have on consumer behavior such as financial health and gambling addiction as well as public finance since the lottery is a long-established source of revenue for state governments.

The lottery is a popular form of gambling and important source of revenue in the United States. In 2023, \$113.3 billion was spent on lottery tickets (Phaneuf, 2025). Approximately 20-30% of the revenue goes to state governments who typically allocate it to specific programs such as education (Airi et al., 2024). Figure 1.2 shows how the sales of Powerball and Mega Millions on a per capita basis have increased overtime. While there are dips overtime, including one in 2018 when the *Murphy* decision occurred, it is likely due to macroeconomic factors rather than legal sports betting causing a substitutionary effect. Because of this, it is important to understand whether sports betting and the lottery are substitutes or complement goods. If sports betting is a substitute good to the lottery, legalization could decrease an important revenue stream for state governments. However, this could be offset from the creation of another stream of revenue from

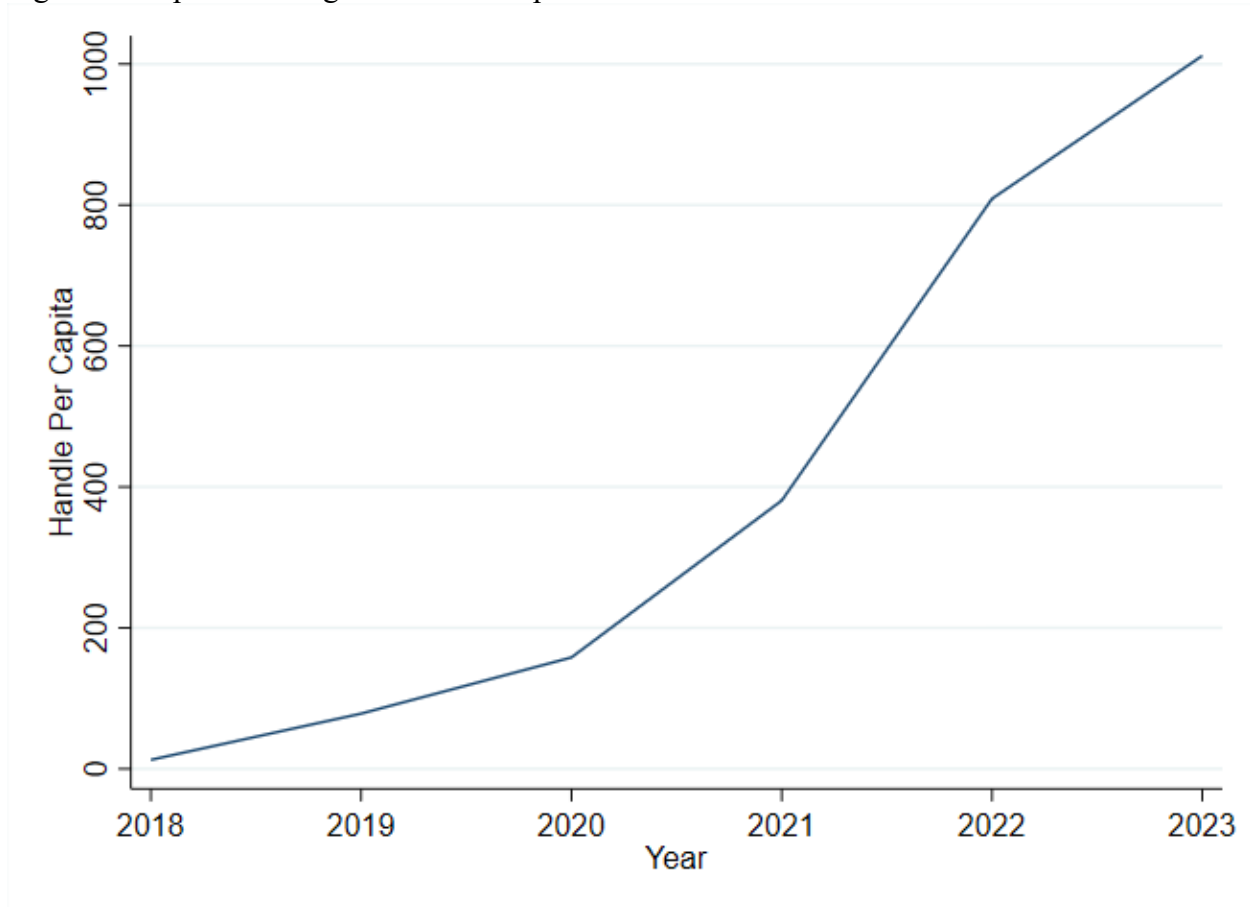
taxing bookmakers. If sports betting is a complement good to the lottery, legalization could increase an important revenue stream for state governments and create a new revenue stream for governments. Aside from public finance implications, participation in the lottery is known to have harmful effects on consumers. Lottery participation has been found to crowd out other household consumption (Kearney, 2005) and increase problem gambling (Shepherd et al., 1998). If sports betting is a substitute good to the lottery, legalization could decrease the harmful effects of lottery participation. However, sports betting may cause other harmful effects on consumers. If sports betting is a complement good to the lottery, legalization could exacerbate the known harmful effects of lottery participation.

To better understand these tradeoffs and potential consequences, I exploit state-level variation in sports betting legality in 14 states to investigate the effect of sports betting legality on per capita sales of two national lottery games, Powerball and Mega Millions. Using a difference-in-differences framework, I estimate the effect of legalizing sports betting on per capita lottery sales. I also investigate the effect of states legalizing online sports betting rather than in person only sports betting to understand the role ease of access has. I also conduct analyses on the impact of legalizing online sports betting and examining how it may differentially affect various groups, such as counties with a high proportion of urban residents. I find a 4.11% decrease in lottery sales per capita after a state legalizes sports betting with the effect being more pronounced in urban areas.

This paper contributes to the existing body of literature in multiple ways. Primarily, it contributes to the emerging body of literature on sports betting, particularly the effect legalizing sports betting has on other forms of gambling. Other researchers have found that legalizing

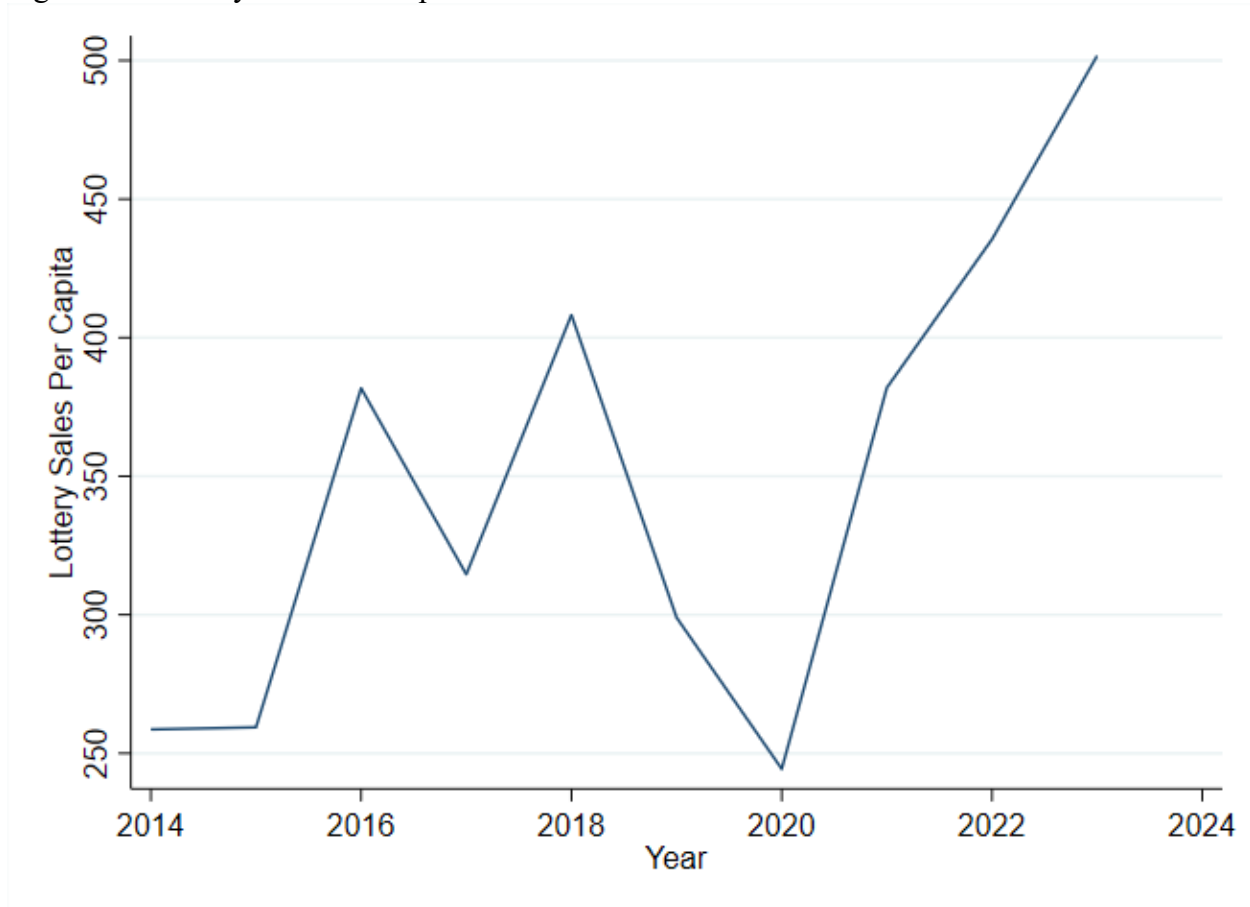
sports betting does influence other forms of gambling including the lottery (Humphreys, 2021; Can et al., 2023; Baker et al., 2024; Matheson et al., 2024). Prior research has found conflicting results on how legalizing sports betting affects lottery sales (Baker et al., 2024; Matheson et al., 2024). Secondly, it contributes to the literature on what drives demand for the lottery. Other researchers have found that jackpot size is an important determinant for lottery demand and socioeconomic factors such as race, age, gender, and income level are important determinants of who plays the lottery (Clotfelter and Cook, 1989; Blalock et al., 2007; Forrest et al., 2002; Clotfelter and Cook, 1990; Whitney, 1991).

Figure 1.1: Sports Betting Handle Per Capita Over Time



Notes: Handle is defined as the amount wagered on sports.

Figure 1.2: Lottery Sales Per Capita Over Time



Notes: Lottery sales is defined as the combined sales of Powerball and Mega Millions lottery tickets.

BACKGROUND

The Lottery

State-facilitated lotteries have been around in the United States since 1612, where Jamestown residents used the lottery to finance the colony (Dunstan, 1997). Later in the 1700's the lottery flourished and was used to fund roads, bridges, churches, and colleges. Starting in the 1800's, religious and moral sensibilities started to turn the tide against gambling of all forms. By the late 1800's all lotteries disappeared with Congress banning interstate promotion and sale of lottery tickets in 1890. By 1894, legal lotteries were no longer held in the United States. State-facilitated lotteries started to make a comeback in the 1960's due to post World War II prosperity and to fund government services without raising taxes (Neuman, 2023). By the 1980's many states followed suit since if they did not offer the lottery, their residents would travel to a nearby lottery offering state. This caused the state government to lose out on potential revenue. In 1985, Maine, Vermont, and New Hampshire formed the first multistate lottery game, the Tri-State lottery. The main goal of this and by extension all multistate lottery games was to draw in players with larger jackpots than their single state lottery game could offer (Cohen, 2016). In 1988, the Multi-State Lottery Association (MSLA) was founded which created lottery games offered in multiple states that became the de facto national lottery games. Powerball (formerly known as LottoAmerica) was established the same year the MSLA was founded. Today, 45 states operate lotteries and all 45 states offer Powerball and Mega Millions, which effectively function as the national lottery. Prior to 2009, states had to offer either Powerball or Mega Millions out of concern for splitting the player pool and jackpots which was the primary justification for creating multistate lottery games.

Both games are similar in how they operate. They consist of a drawing of five white balls with a selected range of values and a drawing of either the Powerball or Mega Ball (depending on the game) with a selected range of values. The jackpot is awarded to the player who matches all the numbers drawn. If there is no winner, the jackpot is rolled over into the next drawing. This causes substantial variation in jackpot size overtime. Over time the cost of a lottery ticket and the odds of winning have changed, see Table A.2.1 and Table A.2.2 for a timeline.

Sports Betting

Sports betting first took shape in the United States with horse racing in the 1600's. The first racetrack was established in 1665, and betting was done informally among the social elites. There was immense growth in horse racing during the 1700's and betting became more formalized. During the 1800's sports betting started to decline due to religious and moral sensibilities (Dunstan, 1997). During the early 1900's sports betting was driven underground and was largely controlled by organized crime. To overcome the Great Depression, Nevada legalized gambling in 1931. Following this, sports betting saw increased regulation with Nevada emerging as the primary hub. In 1992, the Professional and Amateur Sports Protection Act (PASPA), prevented states from legalizing sports betting. However, the law provided exemptions for states who already had sports betting systems in place and permitted a one-year window to enact a sports betting system (Bonesteel, 2022). In 2018, the Supreme Court ruled that states can determine the legality of sports betting. Prior to this, sports betting was effectively illegal in all states but Nevada¹. Since PASPA was overturned, 38 states have legalized sports betting in various ways. Some states legalized in person only betting, other states legalized online sports

betting, and some states placed restrictions on what sports can be bet on. For example, Oregon does not allow bets to be placed on collegiate athletics.

Sports betting has also created a new stream of revenue for state governments. Not only does the revenue come from taxing the winnings of bettors but also on the sportsbooks. The tax rate on sportsbooks varies by state, with Nevada and Iowa taxing sportsbooks at 6.75% and New Hampshire, New York, and Rhode Island taxing sportsbooks at 51%. Since the legalization of sports betting, around \$8 billion of revenue has been generated by state governments (Altruda, 2025). Since legalizing sports betting has important implications for public finance, it is necessary to know the tax rates for each state and revenue generated by each state to understand whether legalizing sports betting increases or decreases state government revenue.

Sports betting operates by placing a bet with a bookmaker who sets the odds reflecting the likelihood of the outcome occurring. These odds determine the payout a bettor will receive. The more likely an outcome will occur, the lower the payout and the less likely an outcome will occur, the higher the payout. However, bookmakers set the odds so in the long run the bettor will receive a negative expected value on all their bets. With more bookmakers operating in a state, fairer odds need to be set to entice bettors to place bets with them rather than their competitors.

LITERATURE REVIEW

The Lottery

The effect of sports betting and the lottery have been investigated by previous researchers. The topics have been primarily investigated separately but since sports betting's legalization researchers have begun to investigate them together. These papers give us insight into determinants of lottery participation such as demographics and jackpot size. These papers also give us insight into the harmful effects of lottery participation and potential ramifications of an increase or decrease in lottery participation may have on individuals.

Prior research has examined why individuals choose to participate in the lottery and the types of individuals who take part. Clotfelter and Cook (1989) found that 50% of purchases are made by the top 10% of players (in terms of frequency). They also found that men, African Americans, Hispanics, 25–65 year olds, and Catholics are more likely to play the lottery than their counterparts. Blalock et al. (2007) found that per capita lottery sales increased by about \$2.30 for each percentage point increase in the poverty rate. This shows that low-income households represent an outsized proportion of all lottery play. Moreover, since the lottery is often justified as a source of public revenue as discussed previously, this means it serves as a regressive tax.

Another important factor in the demand for lottery participation is jackpot size. Forrest et al. (2002) found that expected value is not as important as jackpot size for participation. Clotfelter and Cook (1990) found that a \$1,000 increase in jackpot size increases sales by \$333. Whitney (1991) found that after the California state lottery reformatted their game, which caused a decrease in the chance of winning the jackpot, the demand for lottery tickets was estimated to

have been reduced by 35% which resulted in a loss of \$24 million in net revenue. While jackpot size won't play an important role in my data given the model I employ, jackpot size being an important determinant matters because it explains the substantial variation in lottery sales per capita over time.

The lottery is a source of tax revenue for state governments and states use this to fund education as well as other programs. Therefore, researchers have studied the effect of the lottery on overall societal welfare. In a theoretical paper, Morgan (2000) found the lottery could increase the provision of a public good, be welfare improving, and provides close to the optimal level of the public good as the jackpot increases. However, the researchers caveat that this study ignores distributional considerations and since lotteries are regressive, adverse distributional effects may exceed allocative gains. Borg and Mason (1988) found that the lottery raises funding for education, which benefits low-income households but the regressive nature outweighs the benefits to low-income households.

Kearney (2005) using consumer expenditure data from 1982 to 1998 found that household lottery consumption decreases other household consumption by approximately \$38 per month. These results suggest that one form of gambling can crowd out other forms of gambling. Researchers have investigated how the lottery affects gambling addiction. Shepherd et al. (1998) found that after the United Kingdom implemented a national lottery, self-reported symptoms of gambling addiction increased but the number of gambling addicts did not increase. These results suggest that more potential ways to gamble will primarily affect those who are already addicted. Since sports betting is a new form of gambling it would be expected that it primarily affects people who are already gambling addicts.

Sports Betting

Sports betting research is an emerging topic in economics. Previous research has found sports betting acts as either a substitute or complement good to different types of gambling. They have also found that the presence of online sports betting amplifies the effect on their outcome of interest. Research has also found that sports betting increases irresponsible gambling behavior.

Baker et al. (2024) estimate a two-way fixed effects difference-in-differences regression, exploiting the staggered rollout of sports betting legalization for the 38 states that legalized between June 2018 and September 2023. Their data came from a proprietary dataset of U.S. consumer transactions which includes over 60 million Americans and is measured at the quarterly-by-household level. They found that legalizing sports betting causes a \$1.14 increase in household lottery consumption. However, they do not observe any demographic characteristics which is a concern due to omitted variable bias since race, age, and gender have been found to be correlated with lottery participation. The dataset also does not constitute a random subset of consumers. They are also concerned that they might not observe a complete set of household financial accounts for all users which could bias their measures of household income, spending, and investment. Their paper examines the effect legalizing sports betting has on households and does not examine potential broader public finance implications of legalizing sports betting.

Hollenbeck et al. (2024) uses a difference-in-differences framework, exploiting the staggered rollout of sports betting legalization for the 33 states that legalized it between June 2018 and January 2023. To avoid biased estimates from the staggered rollout they estimate Callaway and Sant'Anna's (2021) proposed method. Their data came from the University of California Consumer Credit Panel which includes 7 million Americans and is measured at the

quarterly-by-individual level. They find that legalizing sports betting harms consumer financial health. Average credit scores decreased by 0.3% and other indicators of excessive debt increased. The effects were also more pronounced in states that legalized online gambling compared to states that did not legalize online gambling. The paper by Hollenbeck et al. (2024) does not examine potential public finance implications of legalizing sports betting.

Arnesen and Matsuzawa (2024) examine the relationship between legalized sports betting, upset losses, and intimate partner violence. They extend Card and Dahl's (2011) model using crime data from NIBRS from 2011-2022. They found that legalized sports betting increases the impact of upset losses on intimate partner violence by 10 percentage points. This suggests that financial losses during upset losses amplify emotional reactions. The effects were also more pronounced in states the legalized online gambling compared to states that did not legalize online gambling.

Humphreys (2020) estimates an instrumental variable model and difference-in-differences model to analyze the effect of legalizing sports betting and timing of sportsbooks opening on other casino gambling. The data came from the West Virginia Lottery Corporations weekly gambling reports which contains revenue data at each casino. He found that each dollar spent on sports betting reduced spending on video lottery terminals by four dollars but has no effect on spending on table games. This shows that sports gambling has a displacement effect on other forms of gambling.

Matheson et al. (2024) estimates an ordinary least squares model to analyze the relationship between legalizing sports betting on lottery sales. The data comes from the New York State Gaming Commission. They found that for every \$100 in sports betting handle, sales

of lottery tickets fell by \$3.13. Since they only have data for New York and they have no control group, this cannot be interpreted as causal.

Can et al. (2023) estimate a model to examine the effect of legalizing sports betting on other forms of gambling including the lottery. The lottery data comes from Iowa, Pennsylvania, and Rhode Island. They find that each dollar spent on sports betting is associated with a \$0.16 increase in lottery revenue. However, their data is restricted to the three states mentioned above whereas my paper has more states including states that do not legalize sports betting.

This body of evidence shows that sports betting can serve as a complement or substitute for other forms of gambling and that it is a complement to lottery play. It also shows that ease of access to sports betting is important since Arnesen and Matsuzawa (2024) and Hollenbeck et al. (2024) found that legalizing online sports betting amplified the effect they were studying. While I use a similar methodology, my paper contributes to the literature by observing lottery sales data on a more granular level than previous papers. Since I observe lottery sales data at the county level, I can examine responses to sports betting legalization as they affect groups at a sub-state level such as counties with larger than average share of residents in urban areas. To address potential spillovers, I can indicate whether a county in an untreated state borders a treated state. To further examine the role that ease of access has I can indicate if a county has a retail sports betting location in it. I also observe demographic information whereas Baker et al. (2024) does not and observe 14 states whereas Can et al. (2023) observes 3 states. My paper also focuses on broader public finance implications rather than on consumers. Since the lottery is an important source of revenue for state governments and it is known what percentage of lottery revenue goes

to state governments I can directly speak to any potential increase or decrease of revenue that may occur.

DATA

Lottery Data

In this study, I use county-by-month level sales data for Powerball and Mega Millions from January 1, 2014 to December 31, 2023. This data was provided by state lottery commissions after individual requests to each state's commission administrators. I combined Powerball and Mega Millions sales since I am interested in the aggregate effect on public finance. I then divided sales by the total population to calculate lottery sales per capita. This outcome, expressed as dollars per person, standardizes the lottery sales data to account for population differences between counties. I then log transformed lottery sales per capita to examine relative changes since each county has varying levels of lottery sales. For example, a \$0.20 decrease in lottery sales per capita in a county averaging \$1 is not equivalent to the same \$0.20 decrease in lottery sales per capita in a county averaging \$10. However, a 10% decrease is consistent across counties, regardless of their average lottery sales per capita. Table 4.1 is a table showing how much data there is for each state and that I have an unbalanced panel. Since I do not have many never treated states, the pre-treatment months are an important part of my counterfactual which later informs how I test for pre-treatments trends using a dynamic specification model. Figure 4.1 is a map showing lottery sales per capita by county. In 94% of counties, mean lottery sales per capita are less than \$3 with a handful of outliers. The most notable outlier is Oneida county, Idaho with \$134.51 lottery sales per capita. This is partly due to Utahans traveling to Idaho to buy lottery tickets since Utah does not offer the lottery. The next highest mean lottery sales per capita is Franklin county, Idaho with \$14.57 lottery sales per capita. This is also due to Utahans buying lottery tickets in that county (Davidson, 2009). There

is also no data for 11 counties in South Dakota since it was not provided to me by the South Dakota Lottery Commission.

Handle Data

I gathered state-by-month handle data from Sports Handle which compiles reported figures from betting sites (Altruda, 2025). This handle data is from when legalization occurred in a state to December 31, 2023. Prior to legalization, each state's total handle is zero since no legal sports betting occurred. This dataset provides a way to examine the intensive margins of legalizing sports betting since we cannot assume states are uniform in betting behavior. Figure 4.2 is a map showing sports betting handle per capita by state. Of the states that legalized sports betting in my sample, there is no reported data for Washington, Florida, and North Carolina. Idaho and Missouri also has no reported data which is expected since they do not legalize sports betting during my sample period.

Sports Betting Laws

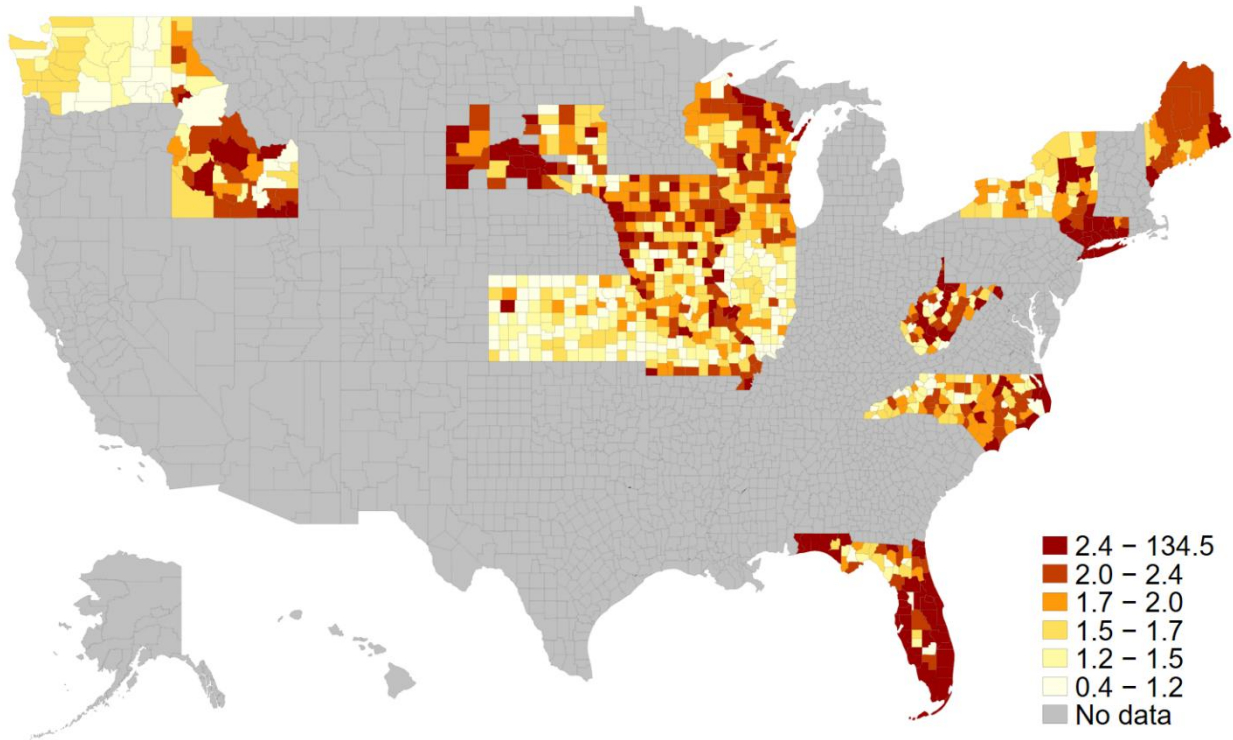
In this study, I exploit state-by-month variation in the legality of sports betting. I collected information on when sports betting was launched from the American Gaming Association and supplement this information with additional internet searches (American Gaming Association, 2025). My sample consists of 14 states, 12 legalize sports betting during my sample period and 2 never legalize sports betting during my sample period. Table 4.2 contains a list of when sports betting started in a state and if sports betting is in person, online, or both for states in my sample. I consider when a state launches retail betting and/or online betting

as being a treated state. I also have data on which counties have a retail sports betting location from betting.us (Betting.us, 2025).

Supporting Data

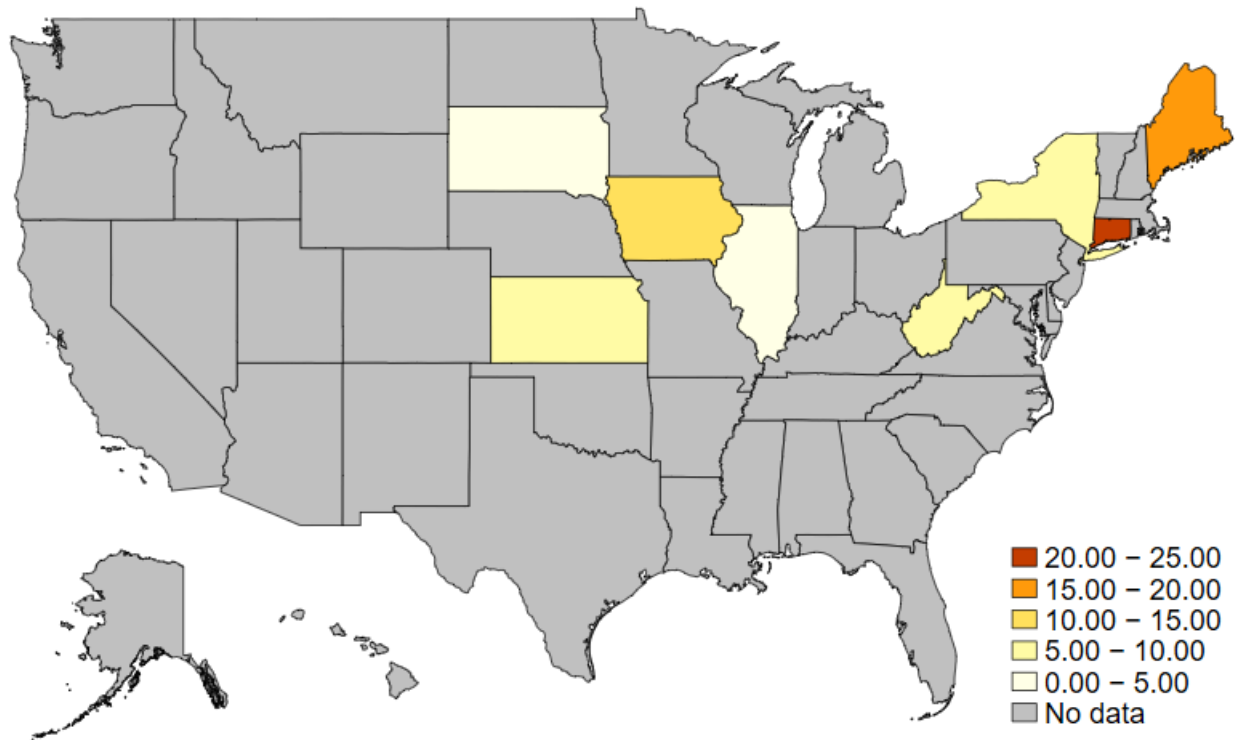
Prior research has indicated that socioeconomic factors are important determinants for lottery ticket demand. County-by-year population and demographic data came from the National Institutes of Health's Surveillance, Epidemiology, and End Results (SEER) program from 2014 to 2023. This data provides information on total population, race (white, black, Hispanic, or other), age (less than 10 years old, 18-24 years old, 25-54 years old, 55-64 years old, and greater than 65 years old), and gender (National Cancer Institute, n.d.). County-by-year poverty and income data came from the U.S. Census Bureau (Small Area Income and Poverty Estimates). This includes median household income and poverty rate (U.S. Census Bureau, n.d.). County-by-year unemployment rate data came from the U.S. Bureau of Economic Analysis (Bureau of Economic Analysis, n.d.). Table 4.3 presents summary statistics in 2017 (the year before states began legalizing sports betting) for these covariates for the full sample, treated states, and untreated states. The appendix contains graphs of the covariates overtime. Each state exhibits similar trends to one another.

Figure 4.1: Lottery Sales Per Capita by County



Notes: Mean lottery sales per capita by county across the sample. The primary outlier is Oneida County, Idaho with \$134.51 lottery sales per capita.

Figure 4.2: Sports Betting Handle Per Capita by State



Notes: Mean sports betting handle per capita by state across the sample.

Table 4.1: Number of Observations Per State

State	Observations	Counties	Data Start	Pre Treatment Months	Post Treatment Months
West Virginia	6,600	55	Jan 2014	56	63
New York	7,440	62	Jan 2014	66	53
Iowa	11,880	99	Jan 2014	67	52
Illinois	12,240	102	Jan 2014	74	45
North Carolina	12,000	100	Jan 2014	86	33
South Dakota	5,005	55	June 2016	63	27
Washington	4,680	39	Jan 2014	92	27
Connecticut	944	8	Jan 2014	93	26
Wisconsin	8,640	72	Jan 2014	94	25
Kansas	6,825	105	Aug 2018	49	15
Florida	8,040	67	Jan 2014	118	1
Maine	1,920	16	Jan 2014	118	1
Idaho	5,280	44	Jan 2014	-	-
Missouri	13,800	115	Jan 2014	-	-

Notes: Number of observations, counties, pre period, post period, and when data starts for each state. South Dakota has 66 counties, but the South Dakota Lottery Commission only provided data for 55 counties.

Table 4.2: Sports Betting Legalization Dates

State	In-Person Betting	Online Betting	Retail Launch	Online Launch
West Virginia	Yes	Yes	Sep 2018	Dec 2018
New York	Yes	Yes	Jul 2019	Jan 2022
Iowa	Yes	Yes	Aug 2019	Aug 2019
Illinois	Yes	Yes	Mar 2020	Jun 2020
North Carolina	Yes	No	Mar 2021	-
South Dakota	Yes	No	Sep 2021	-
Washington	Yes	No	Sep 2021	-
Connecticut	Yes	Yes	Oct 2021	Oct 2021
Wisconsin	Yes	No	Nov 2021	-
Kansas	Yes	Yes	Sep 2022	Sep 2022
Florida	Yes	Yes	Nov 2023	Dec 2023
Maine	No	No	-	Nov 2023
Idaho	No	No	-	-
Missouri	No	No	-	-

Notes: What type of sports betting is allowed and when sports betting started for each state in the sample.

Table 4.3 Descriptive Statistics by Treatment Group (2017)

State	Overall	Ever Treated	Never Treated
Population	96,100,000 (24,700,000)	88,200,000 (24,000,000)	7,846,854 (4,378,824)
Proportion White	0.6513 (0.0090)	0.6372 (0.0093)	0.8093 (0.0026)
Proportion Black	0.1325 (0.0043)	0.1355 (0.0047)	0.0986 (0.0098)
Proportion Hispanic	0.1581 (0.0057)	0.1665 (0.0059)	0.0628 (0.0070)
Proportion Other	0.0582 (0.0024)	0.0608 (0.0026)	0.0293 (0.0002)
Proportion Less than 10 Years Old	0.1175 (0.0006)	0.1167 (0.0006)	0.1268 (0.0012)
Proportion 18-24 Years Old	0.0910 (0.0004)	0.0908 (0.0004)	0.0941 (0.0004)
Proportion 25-54 Years Old	0.3920 (0.0010)	0.3931 (0.0011)	0.3795 (0.0010)
Proportion 55-64 Years Old	0.1335 (0.0004)	0.1336 (0.0004)	0.1326 (0.0011)
Proportion Greater than 65 Years Old	0.1653 (0.0015)	0.1660 (0.0017)	0.1583 (0.0008)
Proportion Male	0.4927 (0.0004)	0.4924 (0.0004)	0.4952 (0.0007)
Median Household Income	\$59,854.88 (666.5683)	\$60,875.63 (754.6130)	\$54,240.73 (70.4723)
Poverty Rate	12.73% (0.1781)	12.69% (0.2099)	12.99% (0.0811)
Unemployment Rate	4.06% (0.0622)	4.16% (0.0693)	3.51% (0.0572)

Notes: Summary statistics by treatment group in the year prior to the Murphy decision (2017). Standard errors are reported in parentheses.

EMPIRICAL STRATEGY

Analysis 1: State Level Legalization

The state-level legalization of sports betting provides variation in access to sports betting. I utilize a staggered difference-in-differences framework to study the effect of sports betting legalization on per-capita lottery participation. This allows me to control for unobserved, time-invariant heterogeneity between states. The primary assumption and drawback for difference-in-difference models is parallel trends. This means that treated and untreated states would have similar trends in lottery sales per capita in the absence of treatment. This assumption cannot be directly tested. However, in later analyses I show evidence from a dynamic specification that supports the notion that this critical assumption holds. The general form of my approach is shown in equation 1 below.

$$\ln(\text{Sales per capita})_{scym} = \alpha + \beta * \text{Treat}_{sym} + \kappa * \chi_{cy} + \gamma_{cm} + \delta_{my} + \varepsilon_{scym} \quad (1)$$

Where $\ln(\text{Sales per capita})$ is the natural log of lottery sales in per capita terms in state s in county c in year y and month m . I measure the outcome using log per capita sales to normalize the outcome by population and examine relative changes. I also measure the outcome in different ways, which I show in later robustness analyses. Treat is an indicator equal to 1 if sports betting is legal in state s in year y and month m . χ_{cy} is a vector of county-by-year control variables including race, age, gender, median household income, poverty rate, and unemployment rate since prior research has shown socioeconomic factors are important determinants of demand for the lottery (Clotfelter and Cook, 1989; Blalock, et al., 2007). γ_{cm} are county-by-month fixed

effects to control for county specific seasonal patterns. For example, counties with a high proportion of people who bet on sports may bet on sports more during certain periods such as the football season. δ_{my} are month-by-year fixed effects to control for time varying factors that are not specific to counties, including jackpot size, institutional changes to the lottery, and inflation. β represents the percent change in lottery sales per capita after state-level legalization occurs. In robustness analyses, I also consider estimates using unweighted and weighted regressions by population. As these results highlight important differences when using population weights, I later run heterogeneity analyses based on the percentage of the population that lives in urban areas. I cluster my standard errors at the state level since repeated observations from the same state are likely correlated.

Event Study Analysis

The primary assumption with difference-in-differences models is the parallel trends assumption. This means that treated and untreated states would have similar trends in lottery sales per capita in the absence of treatment. It is possible that trends in lottery sales may have differed between treated and untreated states due to those states' unobservable characteristics. Perhaps in one state gambling became more socially acceptable, which changed behavior regarding purchasing lottery tickets and led to the legalization of sports betting. In that instance, a difference-in-differences model may yield biased estimates. While this assumption is not directly testable since we can never directly observe what would have happened in the absence of treatment, an event study can ease some of these concerns by observing the trends in treated and untreated states prior to treatment. To examine the trends in the pre-treatment period, I include a series of mutually exclusive lag and lead terms for the months before and after sports

betting is legalized. Since the treatment is staggered, some of these lags and leads are unbalanced. If the lead terms are statistically significant it would indicate that the treated and untreated counties differ in the pre-treatment period, providing evidence against the parallel trends assumption. This also allows me to examine the dynamic treatment effects in the months after sports betting is legalized.

Analysis 2: Sports Betting Handle

The state-level legalization of sports betting provides variation in access to sports betting, but we cannot assume that sports betting behavior is uniform across states following legalization. In this analysis I use state-by-month handle data which provides information on precisely how many dollars are being wagered on sports. Using variation in legalization this analysis provides an estimate of the effect of a dollar increase in sports on lottery sales. I utilize a similar model as before but use variation in sports betting handle as my treatment variable rather than a treatment indicator. Prior to the legalization of sports betting, the amount wagered on sports is reported as zero in the dataset since I do not observe any wagers that may have been placed illegally. The general form of my approach is shown below in equation 2.

$$\begin{aligned} \ln(\text{Sales per capita})_{sym} = & \alpha + \beta * \ln(\text{Handle per capita})_{sym} + \kappa * \chi_{sy} + \gamma_{sm} + \delta_{my} + \\ & \varepsilon_{scym} \quad (2) \end{aligned}$$

Where $\ln(\text{Sales per capita})$ is the natural log of lottery sales in per capita terms in state s in year y and month m . $\ln(\text{Handle per capita})$ is the natural log of sports betting handle in per capita terms in state s in year y and month m . χ_{sy} is a vector of state-by-year control variables

including race, age, gender, median household income, poverty rate, and unemployment rate since prior research has shown socioeconomic factors are important determinants of demand for the lottery (Clotfelter and Cook, 1989; Blalock, et al., 2007). γ_{sm} is state-by-month fixed effects to control for state specific seasonal patterns. For example, states with a high proportion of people who bet on sports may bet on sports more during certain periods such as the football season. δ_{my} are month-by-year fixed effects to control for time varying factors that are not specific to counties. Such time varying factors are jackpot size, institutional changes to the lottery, and inflation. β represents the percentage change in lottery sales per capita for each one percent increase in sports betting handle. I cluster my standard errors at the state level since repeated observations from the same state are likely correlated.

RESULTS

Main Model

Table 6.1.1 and Table 6.1.2 present results from more parsimonious models as I build towards my main model. Table 6.1.1 presents the difference-in-differences estimates of the relationship between state legality of sports betting and lottery sales where I vary my fixed effects specifications, starting with a parsimonious baseline. Based on these estimates, state level legalization of sports betting causes a 8.26% (county, month, and year fixed effects), 5.53% (county and month-by-year fixed effects), and 5.71% (county-by-month and month-by-year fixed effects) decrease in lottery sales per capita. Since the confidence intervals overlap with each other, I proceed with the model that uses county-by-month and month-by-year fixed effects since it allows for the greatest amount of flexibility. Table 6.1.2 presents the difference-in-differences estimates of the relationship between state legality of sports betting and lottery sales where I gradually introduce county-by-year control variables into the model. Based on these estimates, state level legalization of sports betting causes a 5.71% (no controls), 5.02% (demographic controls), 4.11% (demographic and economic controls) decrease in lottery sales per capita. The large decrease in the estimated effect once control variables are introduced suggests that socioeconomic factors which have the potential to bias the results are likely a concern.

Event Study

The validity of the result from my main model relies on the assumption that counties in treated states and counties in untreated states would have followed similar trends in lottery sales per capita in absence of treatment. This is not a testable assumption since we can never directly

observe what would have happened in the absence of treatment. But to provide indirect evidence of this, I conduct an event study specification with mutually exclusive lag and lead terms for the months before and after state level legalization of sports betting. Figure 6.1.1 through Figure 6.1.5 shows the estimated coefficients for each lag and lead term, plotted over time. Since an important part of my counterfactual are treated states prior to treatment I start by omitting all but one of my lead terms, then gradually include more lead terms. As I gradually add more lead terms (up to one year), the lead terms are not statistically different from zero. I also add up to two years of lead terms which are shown in the appendix in Figure A.6.1.1 through Figure A.6.1.4. This provides evidence that ever-treated counties did not experience differing trends in lottery sales per capita prior to treatment.

Robustness Checks

Table 6.2 presents the main model unweighted (Column 1) and weighted by county population (Column 2). Based on the unweighted estimate, I find no statistically significant effect of legalizing sports betting on lottery sales per capita. Since the estimate from the unweighted regression is much smaller than the population weighted regression and not precisely estimated, it indicates that population size is an important factor. I further examine this in a heterogeneity analysis in the next subsection.

Table 6.3.1 presents the main model measuring the outcome as per capita sales (Column 1), log per capita sales (Column 2), total sales (Column 3), and log total sales (Column 4). Based on these estimates, legalizing sports betting causes a \$0.22 decrease in lottery sales per capita, a 4.11% decrease in lottery sales per capita, a \$461,855 decrease in lottery sales, and a 6.12% decrease in lottery sales, respectively. Table 6.3.2 presents the main model, without population

weights, measuring the outcome as per capita sales (Column 1), log per capita sales (Column 2), total sales (Column 3), and log total sales (Column 4). The estimates from these models are all much smaller than the estimates from the weighted models and are not statistically significant providing more evidence of the importance of urbanicity.

Table 6.4 presents the main model with border counties (Column 1) and without border counties (Column 2). I define border counties as counties without legal sports betting that border counties with legal sports betting. There is potential for spillovers from border counties since people are not required to be residents of the state they place a bet in. Based on this estimate, when border counties are excluded, there is a 5.05% decrease in lottery sales per capita compared to a 4.11% decrease in lottery sales per capita when border counties are included. These estimates confidence intervals overlap, easing concerns about potential spillovers. Since cross-border spillovers are minimal, this suggests that there is moderate cross border substitution and policymakers should not be compelled to legalize sports betting in their states to capture potential revenue.

Table 6.5 presents the main model with the months of November to December 2023 (Column 1) and without the months of November to December 2023 (Column 2). This is because Florida and Maine both launched sports betting in November 2023 and there may be not enough post period data for either state. Based on this estimate, when November to December 2023 is excluded, there is a 4.34% decrease in lottery sales per capita compared to a 4.11% decrease in lottery sales per capita when November to December 2023 is included. These estimates are not statistically different from each other, easing concerns about these two states having a disproportionate influence on my main results.

Additional Analyses

Heterogeneity Analysis

To explore the difference in the estimates between the weighted and unweighted model I employ a heterogeneity analysis based on the percentage of the county that resides in an urban area. Table 6.6 presents a heterogeneity analysis based on the percentage of the population in urban areas. Column 1 restricts the sample to counties with less than 34% of the population in urban areas and Column 2 restricts the sample to counties with greater than or equal to 34% of the population. These cutoffs were chosen based on the median value. Based on these estimates, legalizing sports betting causes a 1.08% decrease and a 4.46% decrease in lottery sales per capita, respectively. Column 3 is interacting the treat term with the percentage of the county that lives in an urban area. Based on this estimate, when a county is 0% urban there is no effect on lottery sales per capita since I find a null result. However, the point estimate suggests that sports betting is a complementary good to the lottery. For every one percentage point increase in urban population of a county, lottery sales per capita increase by 0.067% indicating that in urban areas sports betting acts as a substitute good to the lottery. For example, if 20% of a county's population lives in an urban area, then the estimated effect on lottery sales per capita is a 0.41% decrease. This was found by adding the coefficient on treat to the coefficient on the interaction between treat and percentage urban, multiplied by 20. The effect being more salient in urban areas is likely due factors such as better access due to mobile connectivity, demographic differences since urban areas are likely to have younger people and higher incomes, and unobservable cultural and social factors which can entice more people to bet on sports. Further

research needs to be done to understand the exact mechanisms that make the effect more salient in urban areas.

Sports Betting Access Analyses

To explore the heterogeneity in the access to sports betting I employ two analyses. The first analysis is the effect of a state at any point legalizing online sports betting. The second analysis is the effect of a county at any point having a retail sports betting location in it.

Table 6.7.1 presents the difference-in-differences estimates of the relationship between a state legalizing online sports betting at any point in time and lottery sales. While I find a null result it is worth mentioning that the point estimates suggest that the presence of online sports betting could amplify the effect. Table 6.7.2 presents the difference-in-differences estimates of the relationship between a county having a retail sports betting location at any point in time and lottery sales. While I find a null result it is worth mentioning that the point estimates suggest that the presence of a retail sports betting location in a county could amplify the effect.

Intensive Margin Analysis

Since I cannot assume that sports betting behavior is uniform among states, I explore the intensive margins by employing an analysis to examine the relationship between sports betting handle and lottery sales. Table 6.8 presents the estimates of the relationship between sports betting handle on lottery sales. The result of this analysis is null. This is likely due to sports betting behavior being highly correlated with economic activity which is picked up by my fixed effects which causes imperfect collinearity which increases my standard errors.

Table 6.1.1: Estimates of the Effect of State Legalization of Sports Betting on Lottery Sales Per Capita

	(1) Ln(Sales Per Capita)	(2) Ln(Sales Per Capita)	(3) Ln(Sales Per Capita)
Treat	-0.0826*** (0.0264)	-0.0553** (0.0204)	-0.0571** (0.0215)
Mean Lottery	\$2.36	\$2.36	\$2.36
N	105,294	105,294	105,294
County FE	Yes	Yes	No
Month FE	Yes	No	No
Year FE	Yes	No	No
County-by-Month FE	No	No	Yes
Month-by-Year FE	No	Yes	Yes
Demographic Controls	No	No	No
Economic Controls	No	No	No

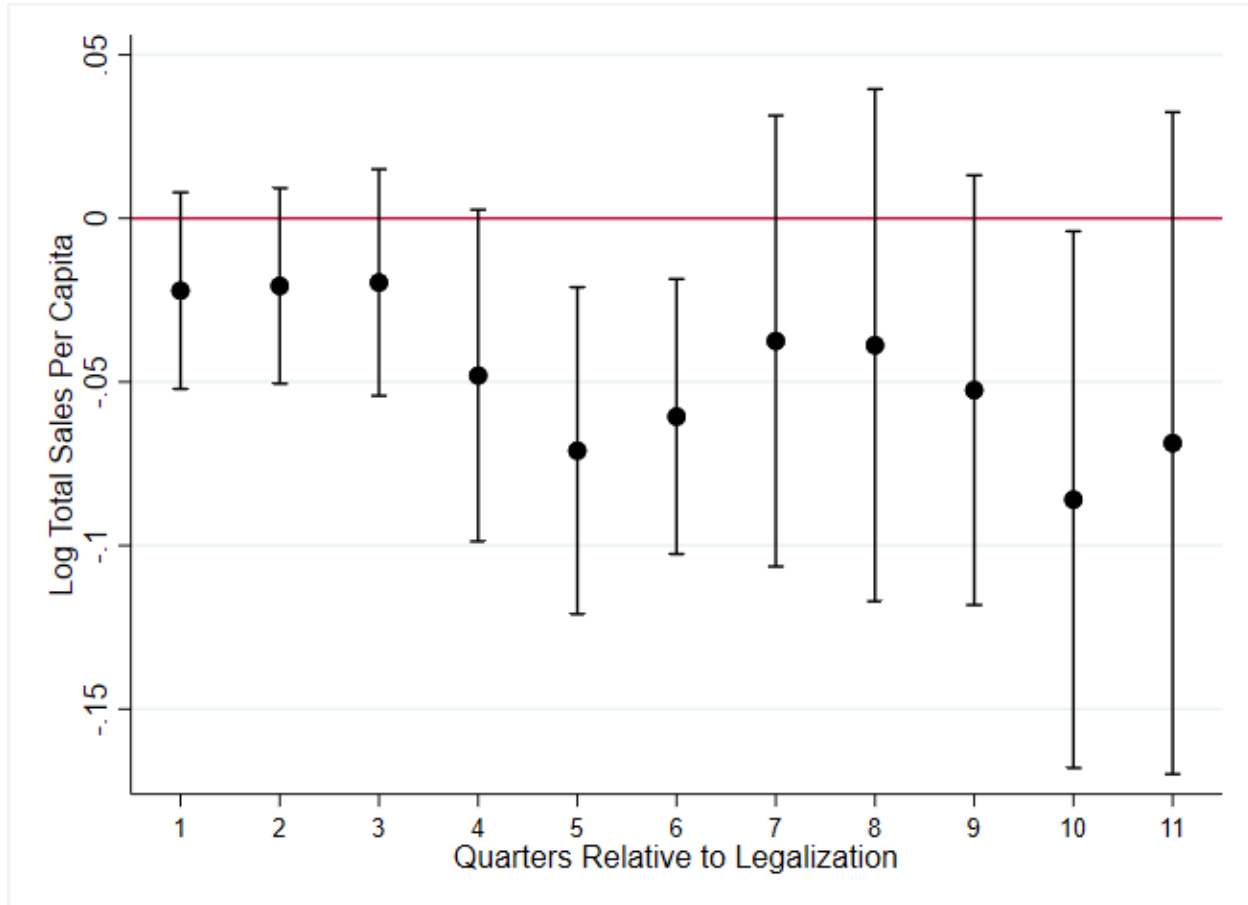
Notes: The estimated coefficients are from a model where the treatment variable of interest is whether the state a county is in legalized sports betting. The outcome variable is the natural log of the sum of Powerball and Mega Millions sales per capita at the county level. County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. All regressions are weighted by county population. Standard errors are clustered at the state level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

Table 6.1.2: Estimates of the Effect of State Legalization of Sports Betting on Lottery Sales Per Capita

	(1) Ln(Sales Per Capita)	(2) Ln(Sales Per Capita)	(3) Ln(Sales Per Capita)
Treat	-0.0571** (0.0215)	-0.0502** (0.0186)	-0.0411** (0.0189)
Mean Lottery	\$2.36	\$2.36	\$2.36
N	105,294	105,294	105,294
County FE	No	No	No
Month FE	No	No	No
Year FE	No	No	No
County-by-Month FE	Yes	Yes	Yes
Month-by-Year FE	Yes	Yes	Yes
Demographic Controls	No	Yes	Yes
Economic Controls	No	No	Yes

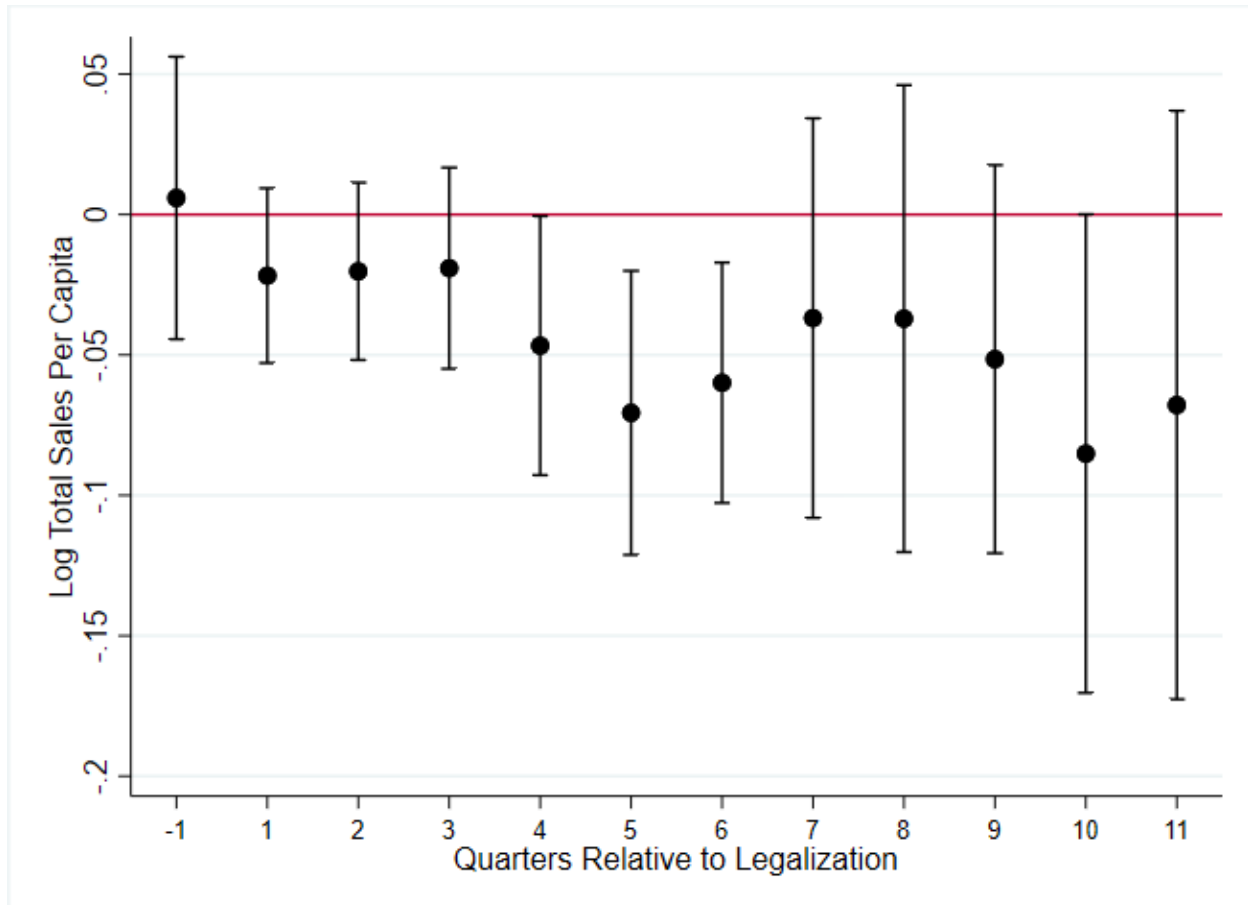
Notes: The estimated coefficients are from a model where the treatment variable of interest is whether the state a county is in legalized sports betting. The outcome variable is the natural log of the sum of Powerball and Mega Millions sales per capita at the county level. Demographic controls include percentages of a county's population by race, gender, and age. Economic controls include the county's median household income, county unemployment and poverty rate. All regressions are weighted by county population. Standard errors are clustered at the state level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

Figure 6.1.1: Dynamic Specification Lag and Lead Coefficients Pre and Post State Legalization of Sports Betting



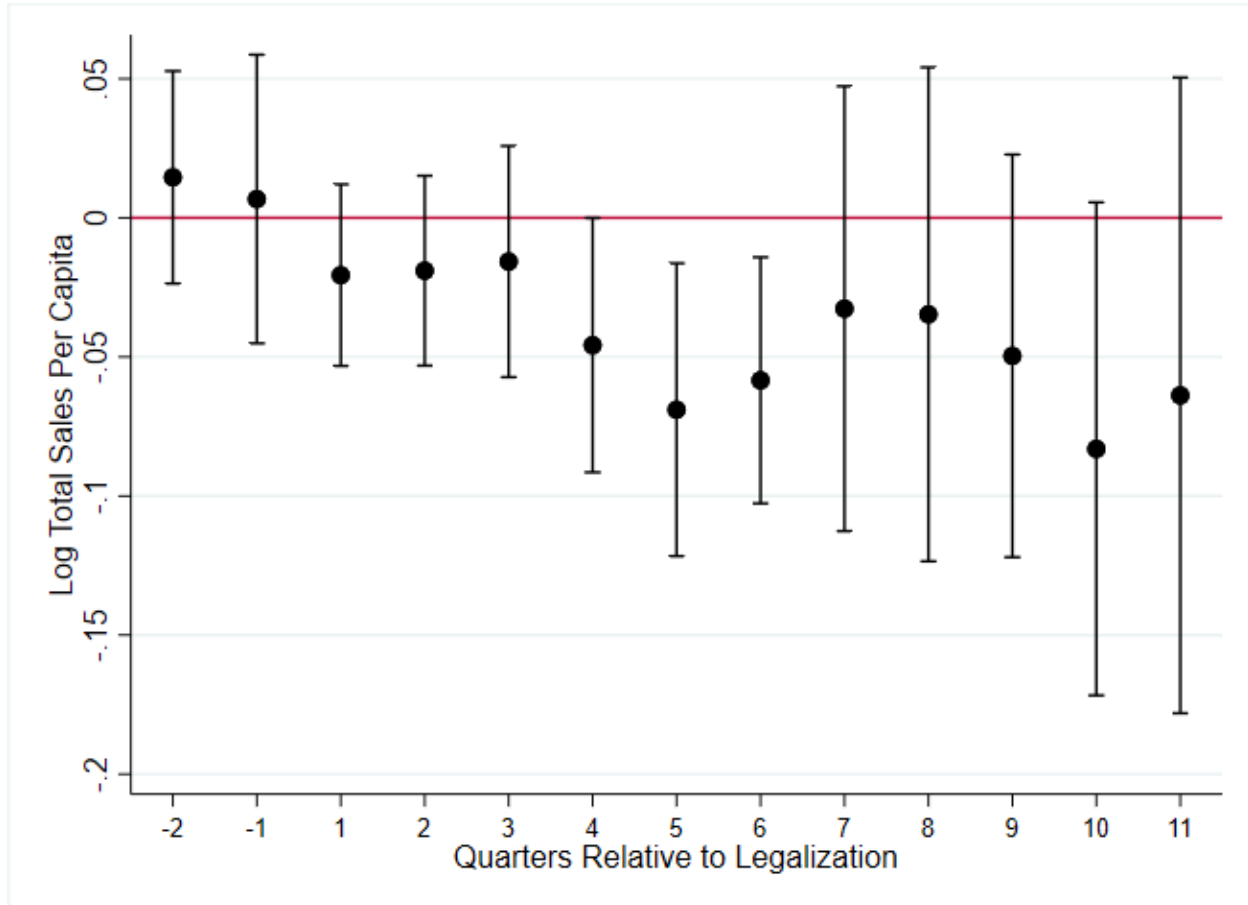
Notes: Estimates for lag term 11 quarters post state legalization of sports betting (and their 95% confidence intervals) are reported. Florida and Maine drop out of sample after 1 quarter. Kansas drops out of sample after 5 quarters. Other states, starting with Wisconsin, drop out of sample after 8 quarters. The dependent variable is equal to the natural log of lottery sales per capita at the county level. County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. Regressions are weighted by county population. Standard errors are clustered at the state level.

Figure 6.1.2: Dynamic Specification Lag and Lead Coefficients Pre and Post State Legalization of Sports Betting



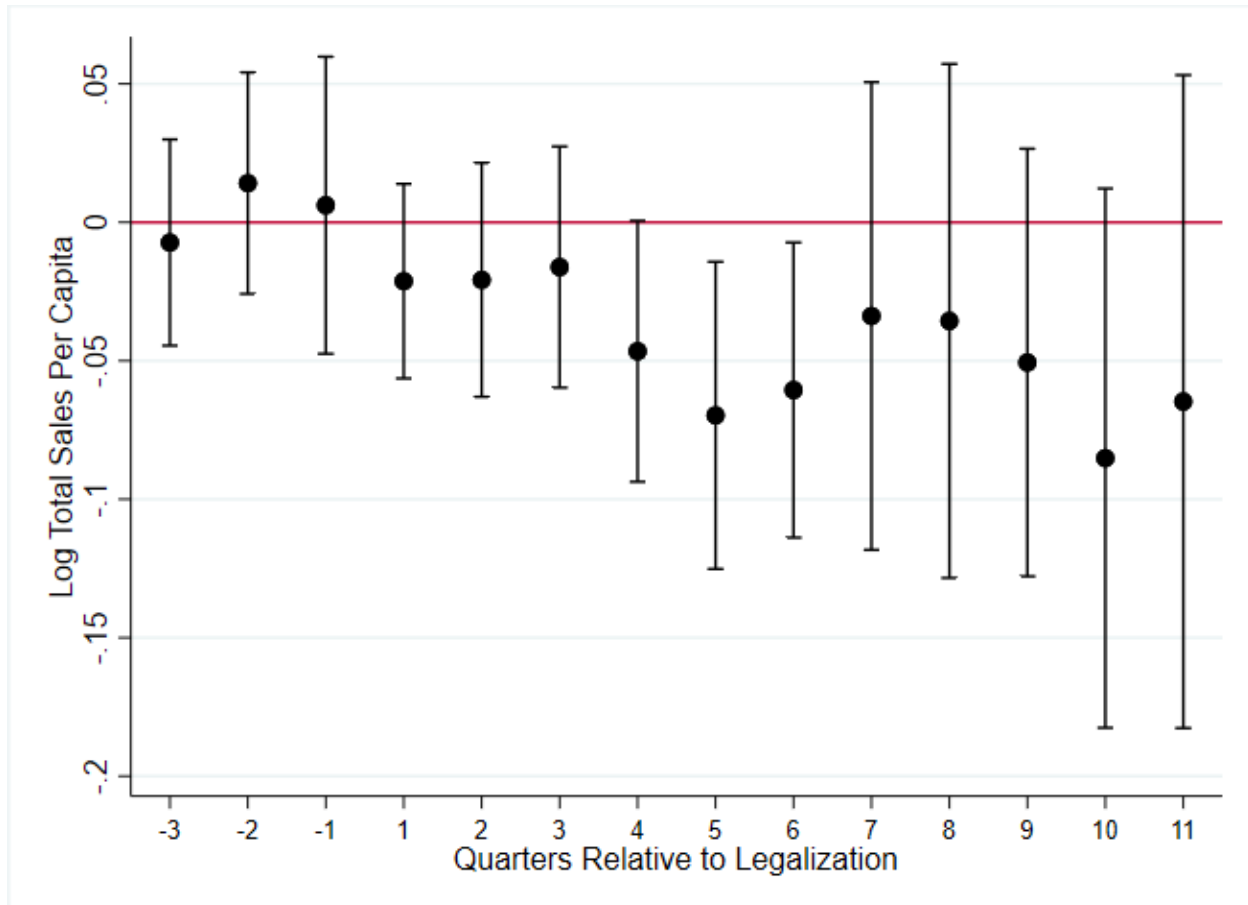
Notes: Estimates for lag and lead term 1 quarter pre and 11 quarters post state legalization of sports betting (and their 95% confidence intervals) are reported. Florida and Maine drop out of sample after 1 quarter. Kansas drops out of sample after 5 quarters. Other states, starting with Wisconsin, drop out of sample after 8 quarters. The dependent variable is equal to the natural log of lottery sales per capita at the county level. County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. Regressions are weighted by county population. Standard errors are clustered at the state level.

Figure 6.1.3: Dynamic Specification Lag and Lead Coefficients Pre and Post State Legalization of Sports Betting



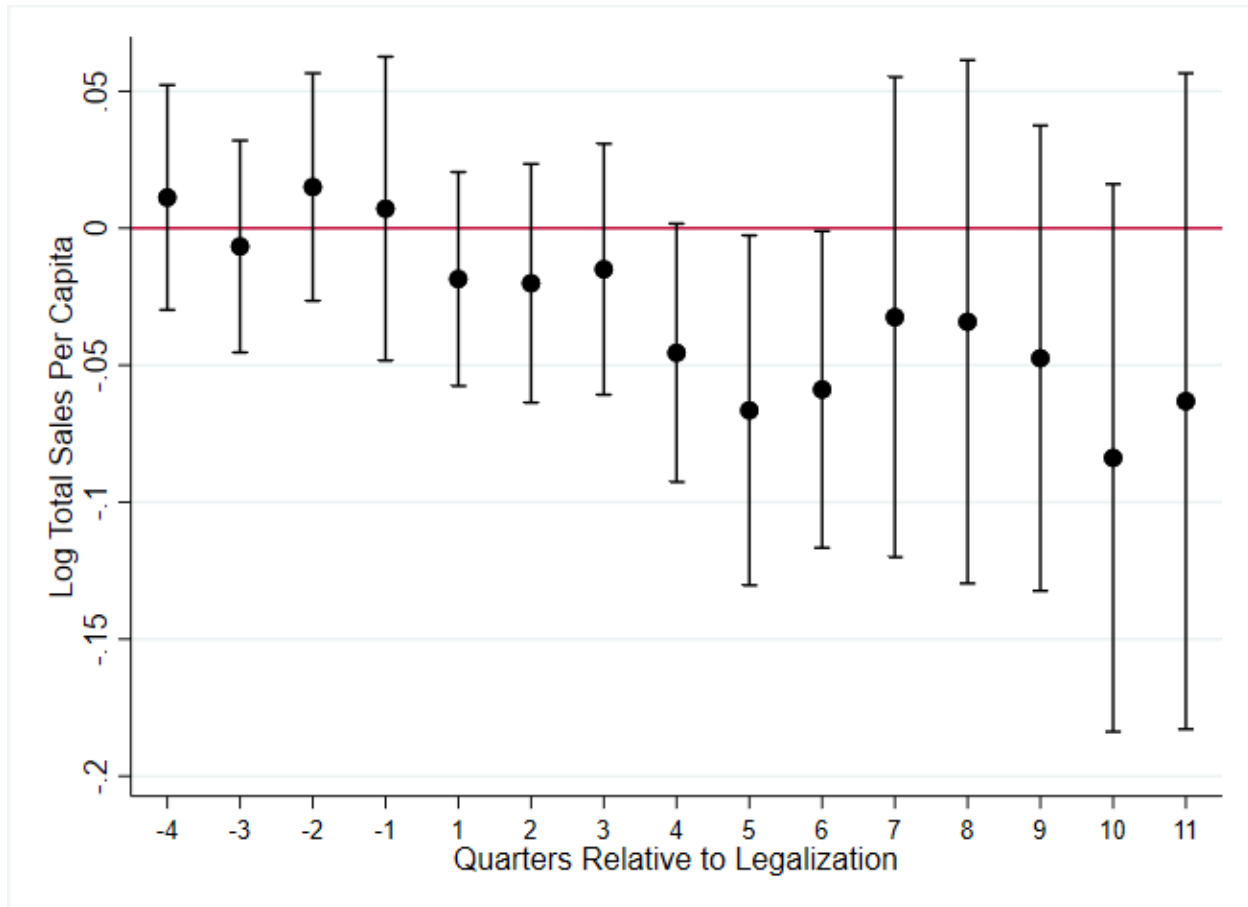
Notes: Estimates for lag and lead term 2 quarters pre and 11 quarters post state legalization of sports betting (and their 95% confidence intervals) are reported. Florida and Maine drop out of sample after 1 quarter. Kansas drops out of sample after 5 quarters. Other states, starting with Wisconsin, drop out of sample after 8 quarters. The dependent variable is equal to the natural log of lottery sales per capita at the county level. County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. Regressions are weighted by county population. Standard errors are clustered at the state level.

Figure 6.1.4: Dynamic Specification Lag and Lead Coefficients Pre and Post State Legalization of Sports Betting



Notes: Estimates for lag and lead term 3 quarters pre and 11 quarters post state legalization of sports betting (and their 95% confidence intervals) are reported. Florida and Maine drop out of sample after 1 quarter. Kansas drops out of sample after 5 quarters. Other states, starting with Wisconsin, drop out of sample after 8 quarters. The dependent variable is equal to the natural log of lottery sales per capita at the county level. County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. Regressions are weighted by county population. Standard errors are clustered at the state level.

Figure 6.1.5: Dynamic Specification Lag and Lead Coefficients Pre and Post State Legalization of Sports Betting



Notes: Estimates for lag and lead term 4 quarters pre and 11 quarters post state legalization of sports betting (and their 95% confidence intervals) are reported. Florida and Maine drop out of sample after 1 quarter. Kansas drops out of sample after 5 quarters. Other states, starting with Wisconsin, drop out of sample after 8 quarters. The dependent variable is equal to the natural log of lottery sales per capita at the county level. County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. Regressions are weighted by county population. Standard errors are clustered at the state level.

Table 6.2: Estimates of the Effect of State Legalization of Sports Betting on Lottery Sales Per Capita With and Without Population Weights

	(1) Ln(Sales Per Capita)	(2) Ln(Sales Per Capita)
Treat	-0.0411** (0.0221)	-0.00559 (0.0150)
Mean Lottery	\$2.36	\$2.02
N	105,294	105,294
County-by-Month FE	Yes	Yes
Month-by-Year FE	Yes	Yes
County Controls	Yes	Yes
Weighted by Population	Yes	No

Notes: The estimated coefficients are from a model where the treatment variable of interest is whether the state a county is in legalized sports betting. The outcome variable is the natural log of the sum of Powerball and Mega Millions sales per capita at the county level. County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. Standard errors are clustered at the state level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

Table 6.3.1: Estimates of the Effect of State Legalization of Sports Betting on Lottery Sales Using Different Outcome Measurements

	(1) Sales Per Capita	(2) Ln(Sales Per Capita)	(3) Total Sales	(4) Ln(Total Sales)
Treat	-0.224** (0.0857)	-0.0411** (0.0189)	-461,855*** (119,316)	-0.0612 (0.0388)
Mean Lottery Sales	\$2.36	\$2.36	\$2,507,910.00	\$2,507,910.00
N	105,294	105,294	105,294	105,294
County-by-Month FE	Yes	Yes	Yes	Yes
Month-by-Year FE	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes

Notes: The estimated coefficients are from a model where the treatment variable of interest is whether the state a county is in legalized sports betting. The outcome variable is measured as sales per capita (Column 1), log sales per capita (Column 2), total sales (Column 3), and log total sales (Column 4). County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. All regressions are weighted by county population. Standard errors are clustered at the state level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

Table 6.3.2: Estimates of the Effect of State Legalization of Sports Betting on Lottery Sales Using Different Outcome Measurements

	(1) Sales Per Capita	(2) Ln(Sales Per Capita)	(3) Total Sales	(4) Ln(Total Sales)
Treat	-0.127 (0.0865)	-0.00559 (0.0150)	-54,537 (38,602)	0.00689 (0.0467)
Mean Lottery Sales	\$2.02	\$2.02	\$263,573.10	\$263,573.10
N	105,294	105,294	105,294	105,294
County-by-Month FE	Yes	Yes	Yes	Yes
Month-by-Year FE	Yes	Yes	Yes	Yes
County Controls	Yes	Yes	Yes	Yes
Weighted by Population	No	No	No	No

Notes: The estimated coefficients are from a model where the treatment variable of interest is whether the state a county is in legalized sports betting. The outcome variable is measured as sales per capita (Column 1), log sales per capita (Column 2), total sales (Column 3), and log total sales (Column 4). County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. Standard errors are clustered at the state level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

Table 6.4: Estimates of the Effect of State Legalization of Sports Betting on Lottery Sales Per Capita Including and Excluding Border Counties

	(1) Ln(Sales Per Capita)	(2) Ln(Sales Per Capita)
Treat	-0.0411** (0.0189)	-0.0505*** (0.0156)
Mean Lottery	\$2.36	\$2.36
N	105,294	96,894
County-by-Month FE	Yes	Yes
Month-by-Year FE	Yes	Yes
County Controls	Yes	Yes
Border Counties	Yes	No

Notes: The estimated coefficients are from a model where the treatment variable of interest is whether the state a county is in legalized sports betting. The outcome variable is the natural log of the sum of Powerball and Mega Millions sales per capita at the county level. County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. All regressions are weighted by county population. Standard errors are clustered at the state level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

Table 6.5: Estimates of the Effect of State Legalization of Sports Betting on Lottery Sales Per Capita Including and Excluding November and December 2023

	(1) Ln(Sales Per Capita)	(2) Ln(Sales Per Capita)
Treat	-0.0411** (0.0189)	-0.0434** (0.0200)
Mean Lottery	\$2.36	\$2.36
N	105,294	103,416
County-by-Month FE	Yes	Yes
Month-by-Year FE	Yes	Yes
County Controls	Yes	Yes
With Nov and Dec 2023	Yes	No

Notes: The estimated coefficients are from a model where the treatment variable of interest is whether the state a county is in legalized sports betting. The outcome variable is the natural log of the sum of Powerball and Mega Millions sales per capita at the county level. County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. All regressions are weighted by county population. Standard errors are clustered at the state level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

Table 6.6: Estimates of the Effect of State Legalization of Sports Betting on Lottery Sales Per Capita by Percent Urban

	(1) Ln(Sales Per Capita)	(2) Ln(Sales Per Capita)	(3) Ln(Sales Per Capita)
Treat	-0.0108 (0.0157)	-0.0446** (0.0189)	0.00929 (0.0375)
Treat*Urban %	-	-	-0.000667* (0.000330)
Mean Lottery	\$2.36	\$2.36	\$2.36
N	52,748	52,546	105,294
County-by-Month FE	Yes	Yes	Yes
Month-by-Year FE	Yes	Yes	Yes
County Controls	Yes	Yes	Yes
Percent Urban	<34%	≥34%	-

Notes: The estimated coefficients are from a model where the treatment variable of interest is whether the state a county is in legalized sports betting. The outcome variable is the natural log of the sum of Powerball and Mega Millions sales per capita at the county level. County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. All regressions are weighted by county population. Standard errors are clustered at the state level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

Table 6.7.1: Estimates of the Effect of State Legalization of Online Sports Betting on Lottery Sales Per Capita

	(1) Ln(Sales Per Capita)	(2) Ln(Sales Per Capita)
Treat	-0.0524** (0.0227)	-0.0373* (0.0196)
Treat*Online	-0.0119 (0.0306)	-0.0104 (0.0325)
Mean Lottery	\$2.36	\$2.36
N	105,294	105,294
County-by-Month FE	Yes	Yes
Month-by-Year FE	Yes	Yes
County Controls	No	Yes

Notes: The estimated coefficients are from a model where the treatment variable of interest is whether the state a county is in legalized online sports betting. The outcome variable is the natural log of the sum of Powerball and Mega Millions sales per capita at the county level. County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. All regressions are weighted by county population. Standard errors are clustered at the state level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

Table 6.7.2: Estimates of the Effect of Retail Location Presence on Lottery Sales Per Capita

	(1) Ln(Sales Per Capita)	(2) Ln(Sales Per Capita)
Treat	-0.0439 (0.0256)	-0.0361 (0.0221)
Treat*Retail	-0.0303 (0.0190)	-0.0160 (0.0198)
Mean Lottery	\$2.36	\$2.36
N	105,294	105,294
County-by-Month FE	Yes	Yes
Month-by-Year FE	Yes	Yes
County Controls	No	Yes

Notes: The estimated coefficients are from a model where the treatment variable of interest is whether the state a county is in has a retail sports betting location. The outcome variable is the natural log of the sum of Powerball and Mega Millions sales per capita at the county level. County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. All regressions are weighted by county population. Standard errors are clustered at the state level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

Table 6.8: Estimates of the Effect of Increasing Sports Betting Handle Per Capita on Lottery Sales Per Capita

	(1) Ln(Sales Per Capita)	(2) Ln(Sales Per Capita)
Ln(Handle Per Capita)	0.0145 (0.0150)	0.00214 (0.00627)
Mean Lottery Sales	\$2.36	\$2.36
N	1,114	1,114
State-by-Month FE	Yes	Yes
Month-by-Year FE	Yes	Yes
State Controls	No	Yes

Notes: The estimated coefficients are from a model where the treatment variable of interest is the natural log of sports betting handle per capita at the state level. The outcome variable is the natural log of the sum of Powerball and Mega Millions sales per capita at the state level. State level controls include percentages of a states' population by race, gender, and age, state median household income, state unemployment and poverty rate. All regressions are weighted by state population. Standard errors are clustered at the state level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.

CONCLUSION

In this study, I exploit data on sports betting legality and county level lottery sales to provide an estimate of the causal effect of sports betting access on lottery consumption. This paper expands on existing research examining the relationship between sports betting and other forms of gambling such as the lottery. I find evidence that legalizing sports betting is associated with a decrease in lottery sales per capita for Powerball and Mega Millions. This finding is notable since previous research such as Baker et al. (2024) and Can et al. (2023) found a positive association. My findings likely diverge from Baker et al. (2024) due to differences in our models, data sources, and sample sizes. When I attempted to replicate their model by adjusting fixed effects, clustering standard errors differently, and modifying the treatment timing for Maine, the results aligned closely with my main model and the confidence intervals overlap (as seen in Table A.7.1). My data, sourced directly from the lottery commission, contrasts with Baker et al. (2024) use of aggregated financial data from banks and credit card companies, which may not capture a complete view of individuals financial accounts. Additionally, I focus solely on Powerball and Mega Millions, while Baker et al. (2024) includes a broader range of lottery games, such as scratch off tickets which function differently than Powerball and Mega Millions. Finally, my dataset covers only 14 states up to December 2023, limiting variation and observations compared to Baker et al. (2024) comprehensive 50 state dataset up to September 2023. My findings also diverge from Can et al. (2023) likely due to similar reasons, but Baker et al. (2024) is a more well identified paper since they have 47 more states and never treated states in their sample, so I choose to focus on that. Future research should focus on gathering more states as well as focus on why the effect is more pronounced in urban areas.

Sports betting legality in the United States is determined at the state level since the Supreme Court's Murphy decision in May 2018. State level legalization provides a natural experiment; I first examine the effect of state level sports betting legality on lottery consumption. The legalization of sports betting at the state level is associated with an estimated 4.11% decrease in lottery sales per capita with the effects being more pronounced in urban areas. I also explore other analyses such as the legalization of online sports betting, the presence of a retail sports betting location in a county, and the amount being wagered on sports betting. I find null results when exploring the legalization of online betting, presence of a retail location, and increasing sports betting handle per capita by one percent are all null results.

Finally, there are interesting public finance implications of legalizing sports betting. By doing a back of the envelope calculation I find that, given a 4.11% decrease in lottery sales per capita, legalizing sports betting decreases state revenue from the lottery by approximately \$30 million a year. This was found by multiplying the mean lottery sales per capita by the 4.11% decrease which results in an approximately 9 cent decrease in lottery sales per capita. Then multiplying the 9 cent decrease in lottery sales per capita by the total population of the ever-treated states which results in an approximately \$8.5 million decrease in total lottery sales per month, then multiplying \$8.5 million decrease in total lottery sales per month by 12 months. Sports betting increases state revenue by approximately \$485 million, which washes out the losses. This was found by calculating the monthly average tax revenue from sports betting among the treated states in my sample from Sports Handle (Altruda, 2025). I also do not observe state revenue from sports betting for Florida, Washington, and North Carolina so that estimate is likely higher. So, if states wish to maximize revenue from gambling, they should legalize sports

betting since there is a net increase in revenue. Since there is a slight decrease in lottery sales per capita, the negative effects associated with lottery play should not be expected to increase.

However, there are other concerns that need to be accounted for. Previous researchers have found that legalizing sports betting increases intimate partner violence when upset losses occur (Arnesen and Matsuzawa, 2024), harm consumers financial health by decreasing average credit score and increasing indicators of excessive debt (Hollenbeck et al., 2024), and increases credit card balances, reduces available credit, and decreases net investments in financial markets (Baker et al., 2024). Policymakers need to carefully weigh the costs and benefits of these potential effects when determining the legality of sports betting.

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APPENDICES

APPENDIX

Supplementary Figures and Tables

Table A.2.1 Changes to Mega Millions Format

Year	Drawing Frequency	White Ball Field	Mega Ball Field	Jackpot Odds	Ticket Price
1996	1x Weekly	5:50	1:25	1 in 52.9 million	\$1
1998	2x Weekly	5:50	1:25	1 in 52.9 million	\$1
2002	2x Weekly	5:52	1:52	1 in 135.1 million	\$1
2005	2x Weekly	5:56	1:46	1 in 175.7 million	\$1
2013	2x Weekly	5:75	1:15	1 in 258.9 million	\$1 (\$2 with Megaplier)
2017	2x Weekly	5:70	1:25	1 in 302.6 million	\$2 (\$3 with Megaplier)

Notes: Institutional changes to Mega Millions up to 2023.

Table A.2.2 Changes to Powerball Format

Year	Drawing Frequency	White Ball Field	Mega Ball Field	Jackpot Odds	Ticket Price
1988	1x Weekly	7:40	N/A	~1 in 18.6 million	\$1
1992	2x Weekly	5:45	1:45	1 in 54.9 million	\$1
1997	2x Weekly	5:49	1:42	1 in 80.1 million	\$1
2002	2x Weekly	5:53	1:39	1 in 120.5 million	\$1
2005	2x Weekly	5:55	1:42	1 in 146.1 million	\$1
2009	2x Weekly	5:59	1:39	1 in 195.2 million	\$1
2012	2x Weekly	5:59	1:35	1 in 175.2 million	\$2 (\$3 with Power Play)
2015	2x Weekly	5:69	1:26	1 in 292.2 million	\$2 (\$3 with Power Play)
2021	3x Weekly	5:69	1:26	1 in 292.2 million	\$2 (\$3 with Power Play; \$4 with Power Play + Double Play)

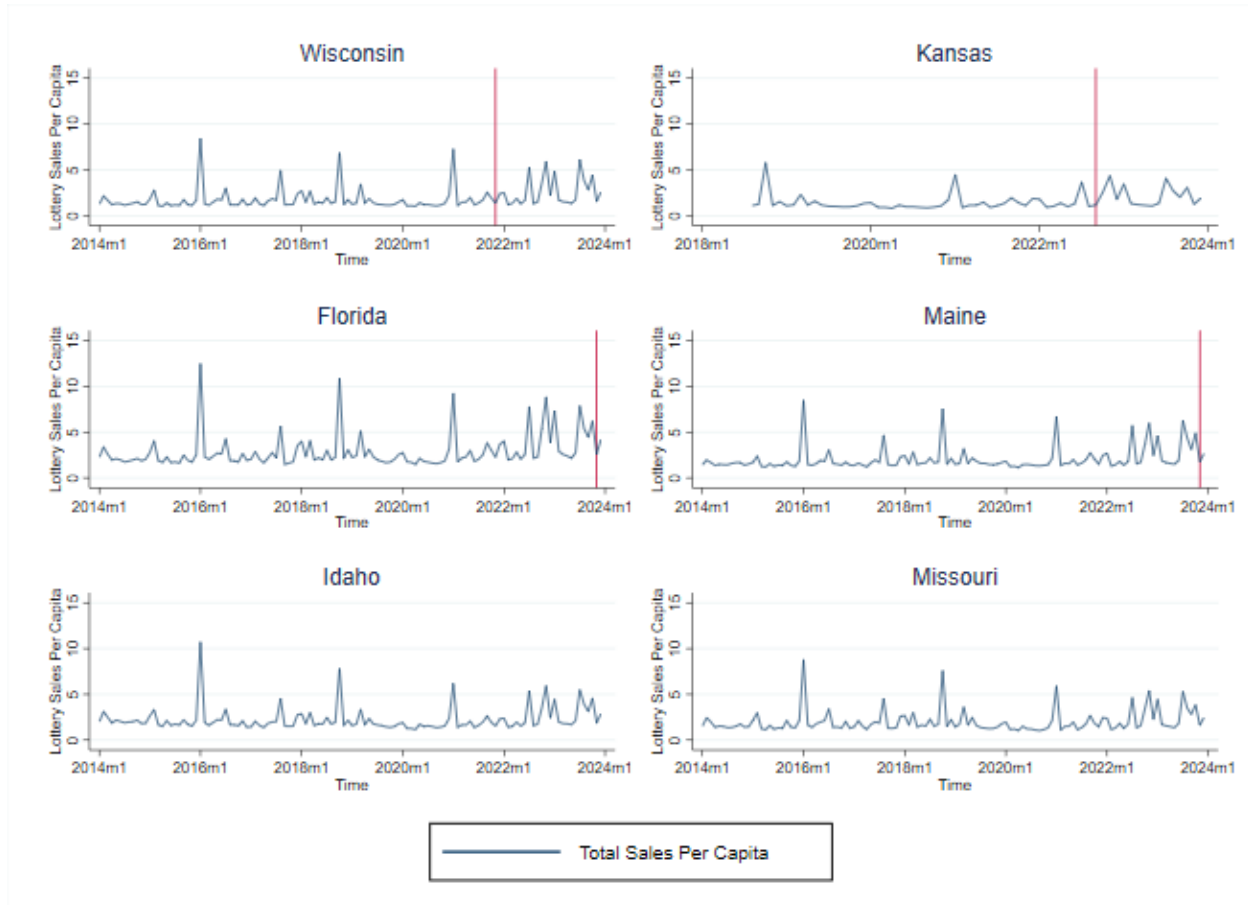
Notes: Institutional changes to Powerball up to 2023.

Figure A.4.1.1: Lottery Sales Per Capita Over Time



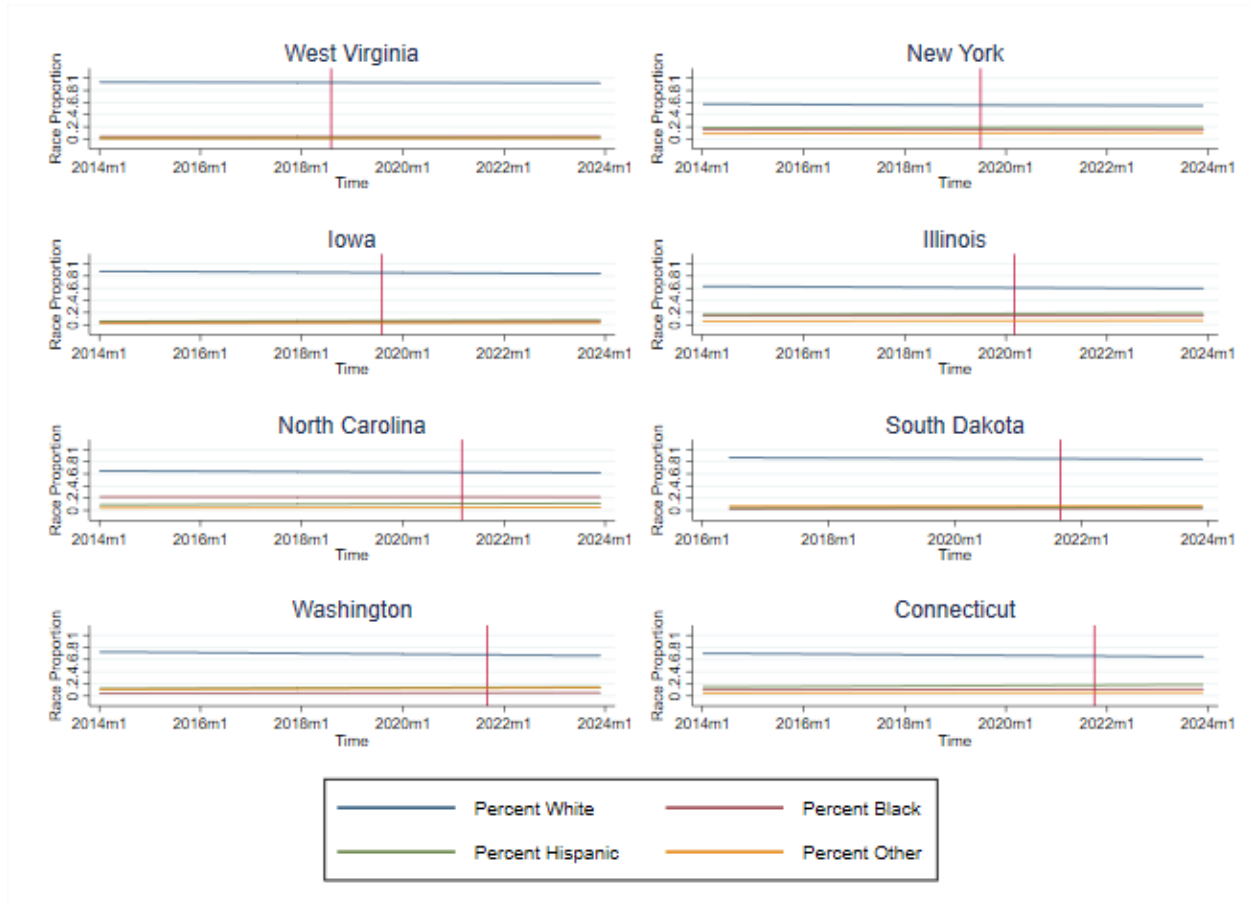
Notes: Lottery sales per capita for West Virginia, New York, Iowa, Illinois, North Carolina, South Dakota, Washington, and Connecticut plotted over time. The red line indicates when legalization occurs in each state.

Figure A.4.1.2: Lottery Sales Per Capita Over Time



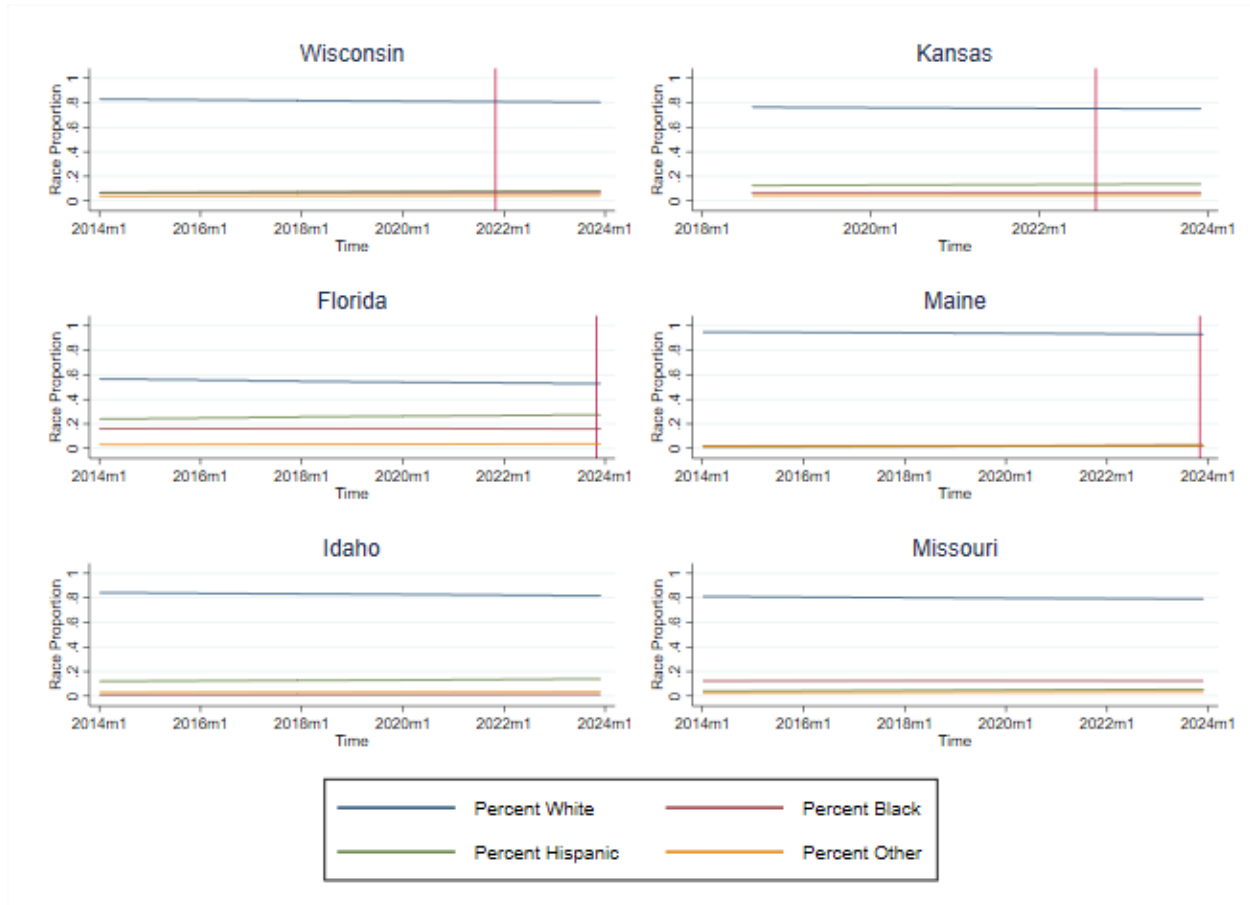
Notes: Lottery sales per capita for Wisconsin, Kansas, Florida, Maine, Idaho, and Missouri plotted over time. The red line indicates when legalization occurs in each state.

Figure A.4.2.1: Race Demographics Over Time



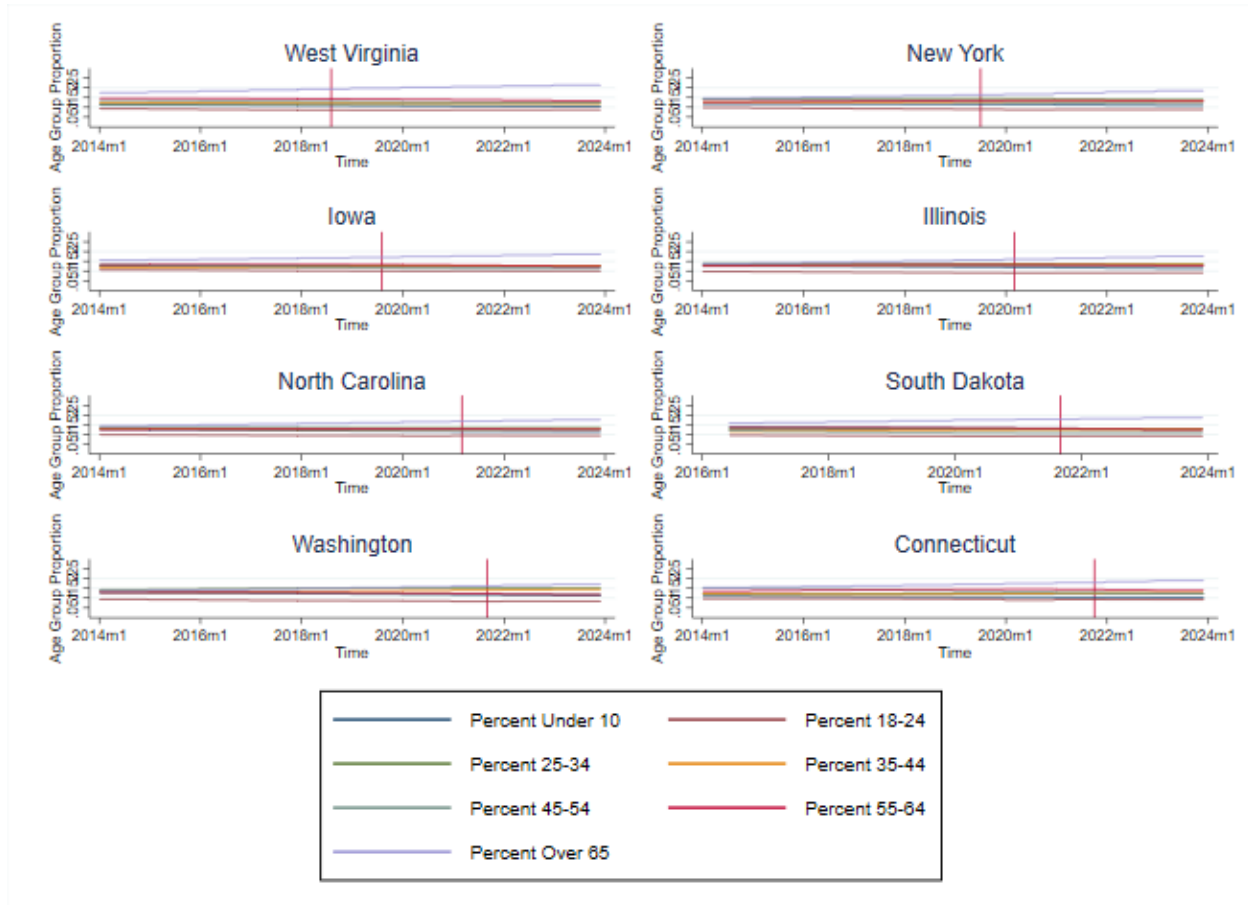
Notes: Race demographics for West Virginia, New York, Iowa, Illinois, North Carolina, South Dakota, Washington, and Connecticut plotted over time. The red line indicates when legalization occurs in each state.

Figure A.4.2.2: Race Demographics Over Time



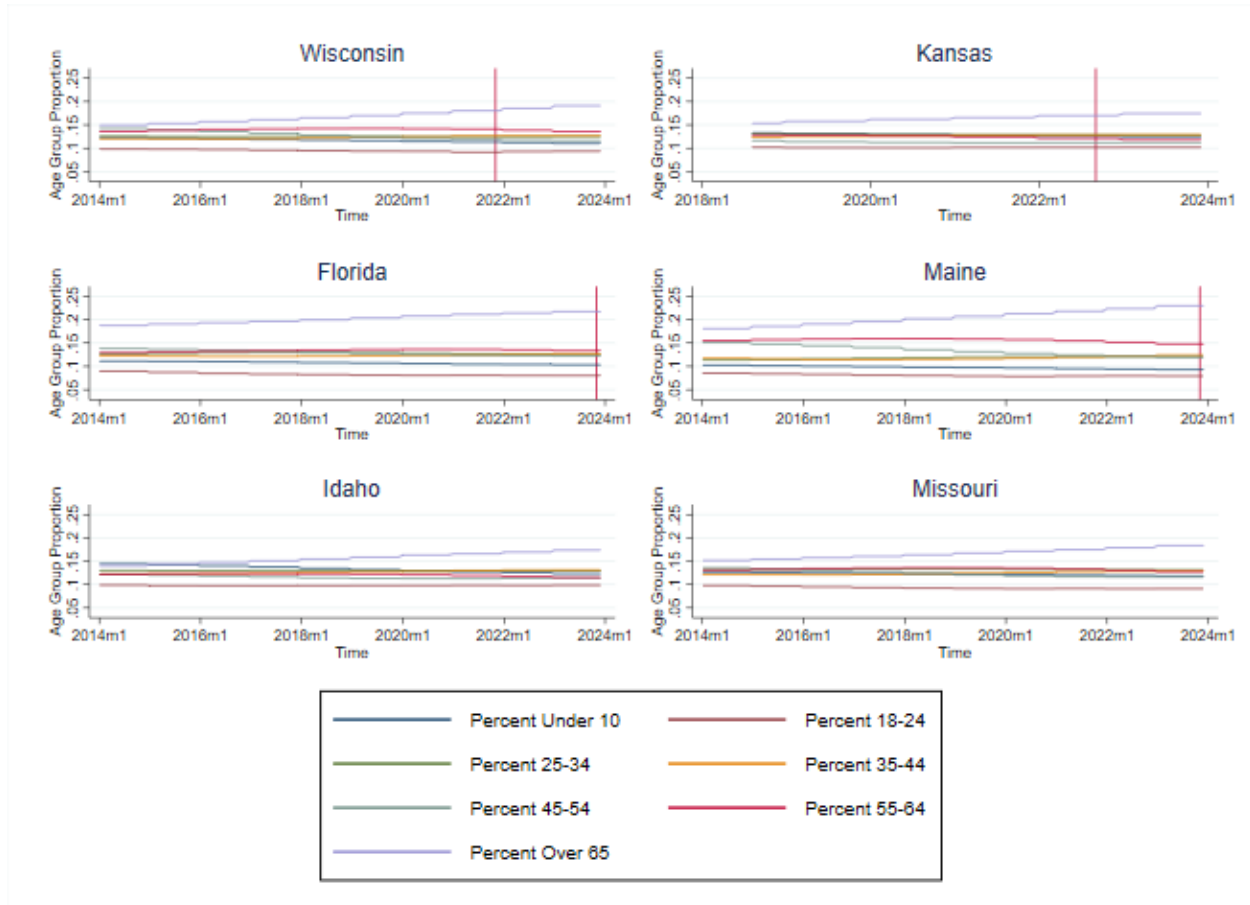
Notes: Race demographics for Wisconsin, Kansas, Florida, Maine, Idaho, and Missouri plotted over time. The red line indicates when legalization occurs in each state.

Figure A.4.3.1: Age Demographics Over Time



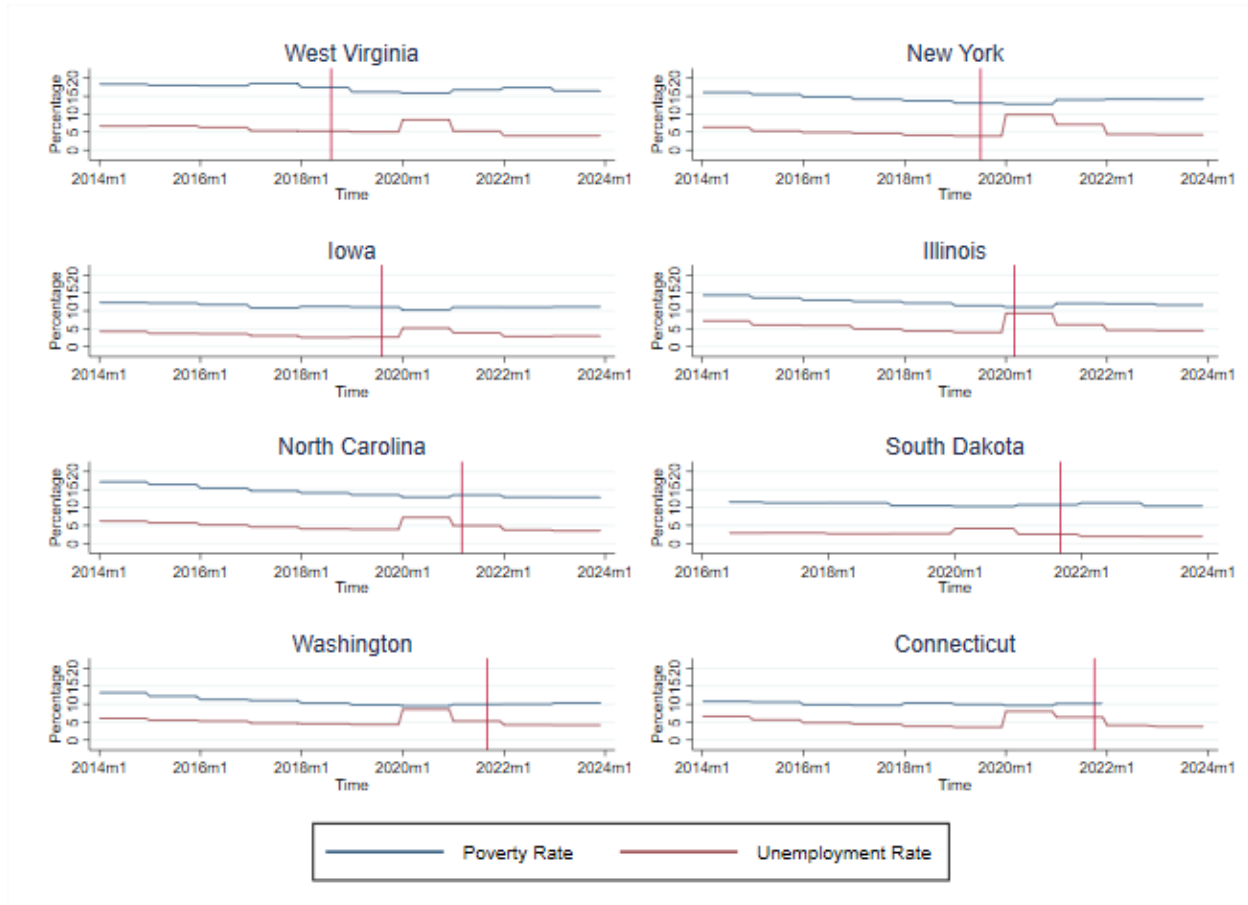
Notes: Age demographics for West Virginia, New York, Iowa, Illinois, North Carolina, South Dakota, Washington, and Connecticut plotted over time. The red line indicates when legalization occurs in each state.

Figure 4.3.2: Age Demographics Over Time



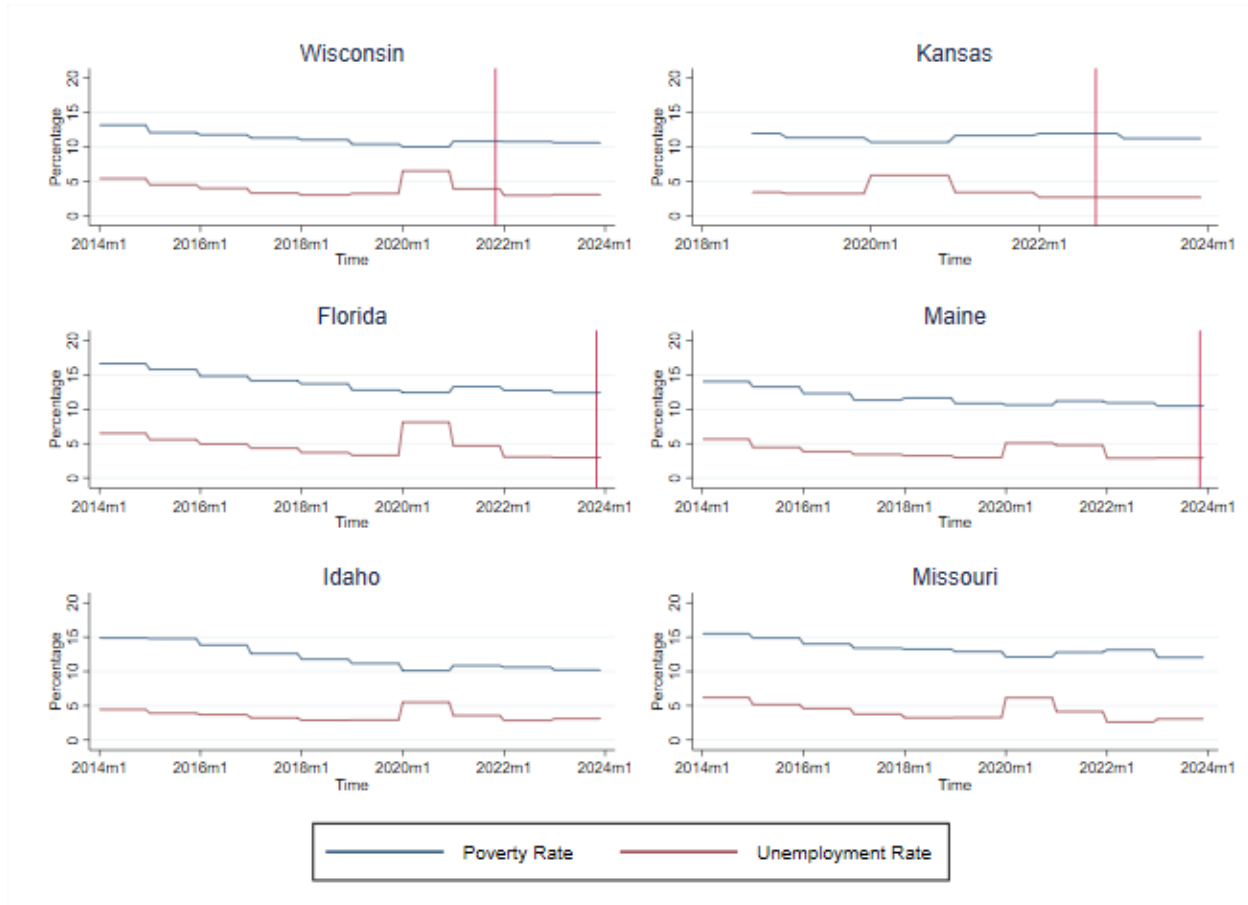
Notes: Age demographics for Wisconsin, Kansas, Florida, Maine, Idaho, and Missouri plotted over time. The red line indicates when legalization occurs in each state.

Figure A.4.4.1: Poverty and Unemployment Rate Over Time



Notes: Poverty and unemployment rate for West Virginia, New York, Iowa, Illinois, North Carolina, South Dakota, Washington, and Connecticut plotted over time. Connecticut's missing data is due to Connecticut switching from reporting at the county level to the planning region level in 2022. The red line indicates when legalization occurs in each state.

Figure A.4.4.2: Poverty and Unemployment Rate Over Time



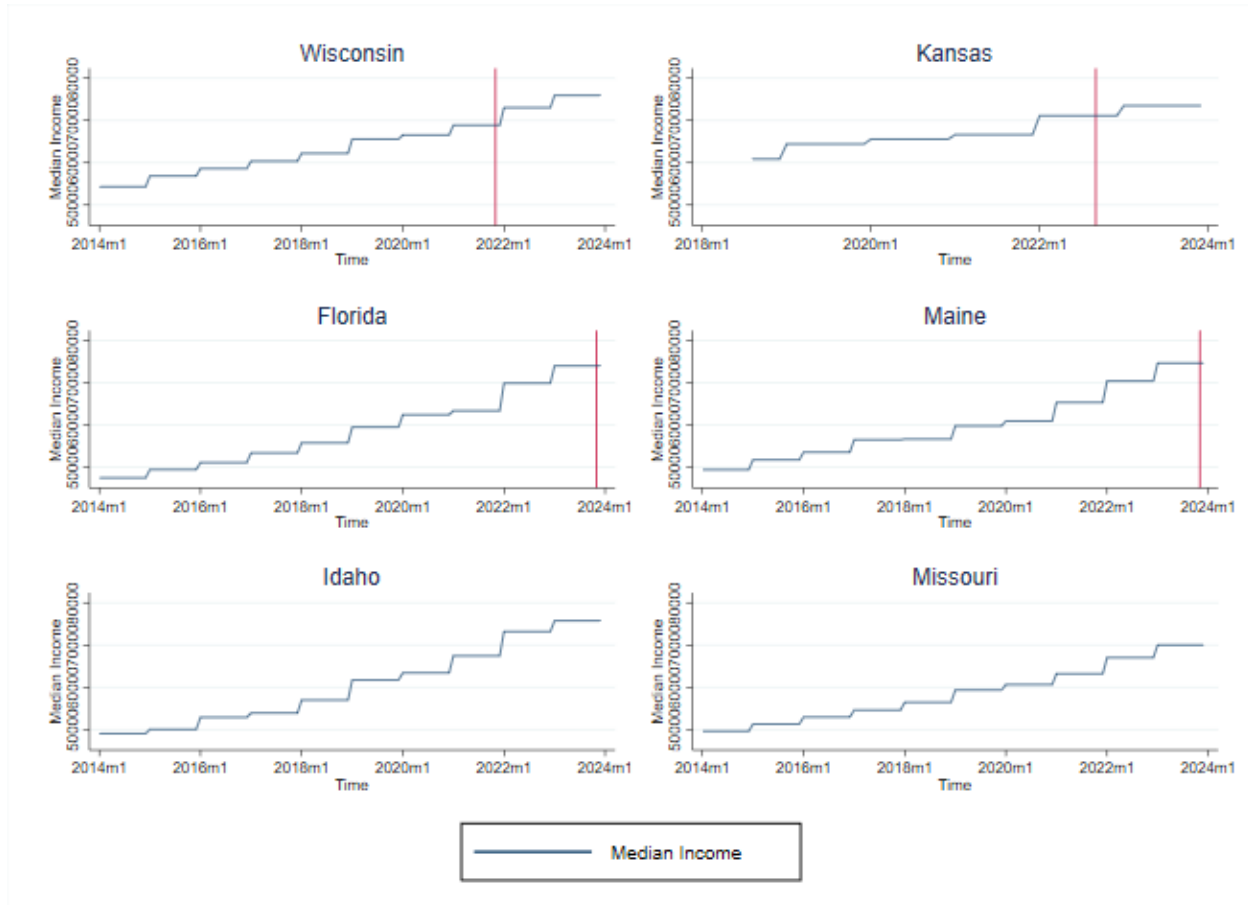
Notes: Poverty and unemployment rate for Wisconsin, Kansas, Florida, Maine, Idaho, and Missouri plotted over time. The red line indicates when legalization occurs in each state.

Figure A.4.5.1: Median Income Over Time



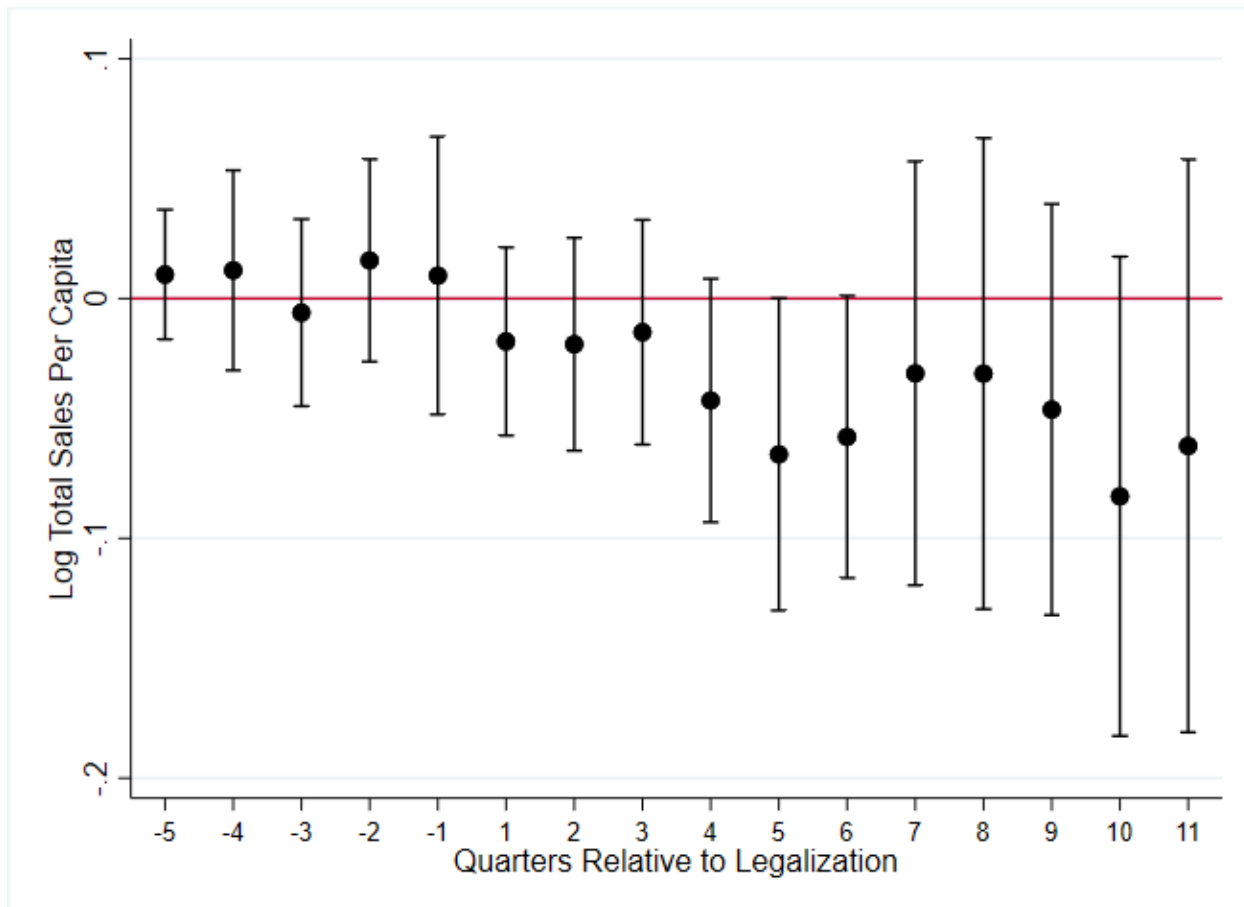
Notes: Median income for West Virginia, New York, Iowa, Illinois, North Carolina, South Dakota, Washington, and Connecticut plotted over time. Connecticut's missing data is due to Connecticut switching from reporting at the county level to the planning region level in 2022. The red line indicates when legalization occurs in each state.

Figure A.4.5.2: Median Income Over Time



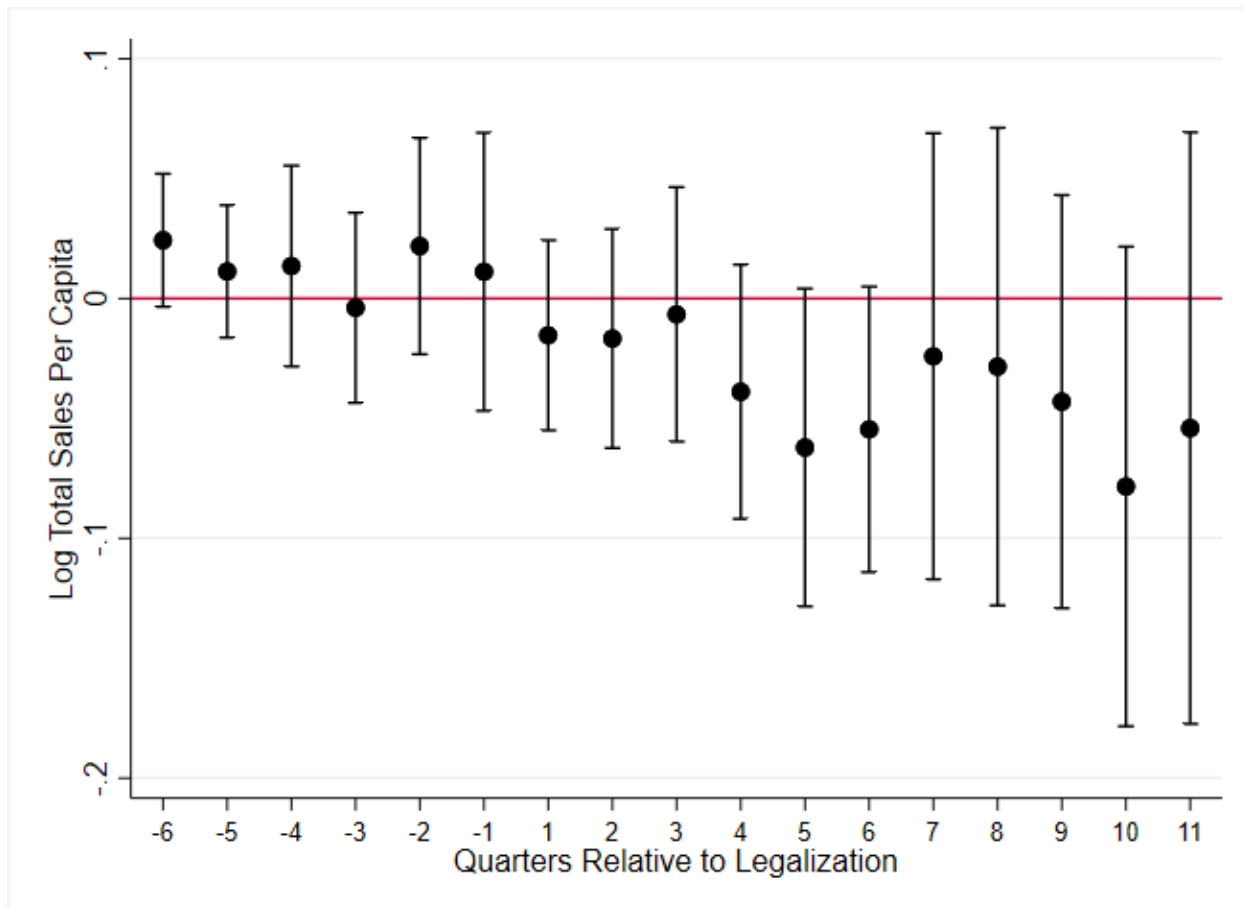
Notes: Median income for Wisconsin, Kansas, Florida, Maine, Idaho, and Missouri plotted over time. The red line indicates when legalization occurs in each state.

Figure A.6.1.1: Dynamic Specification Lag and Lead Coefficients Pre and Post State Legalization of Sports Betting



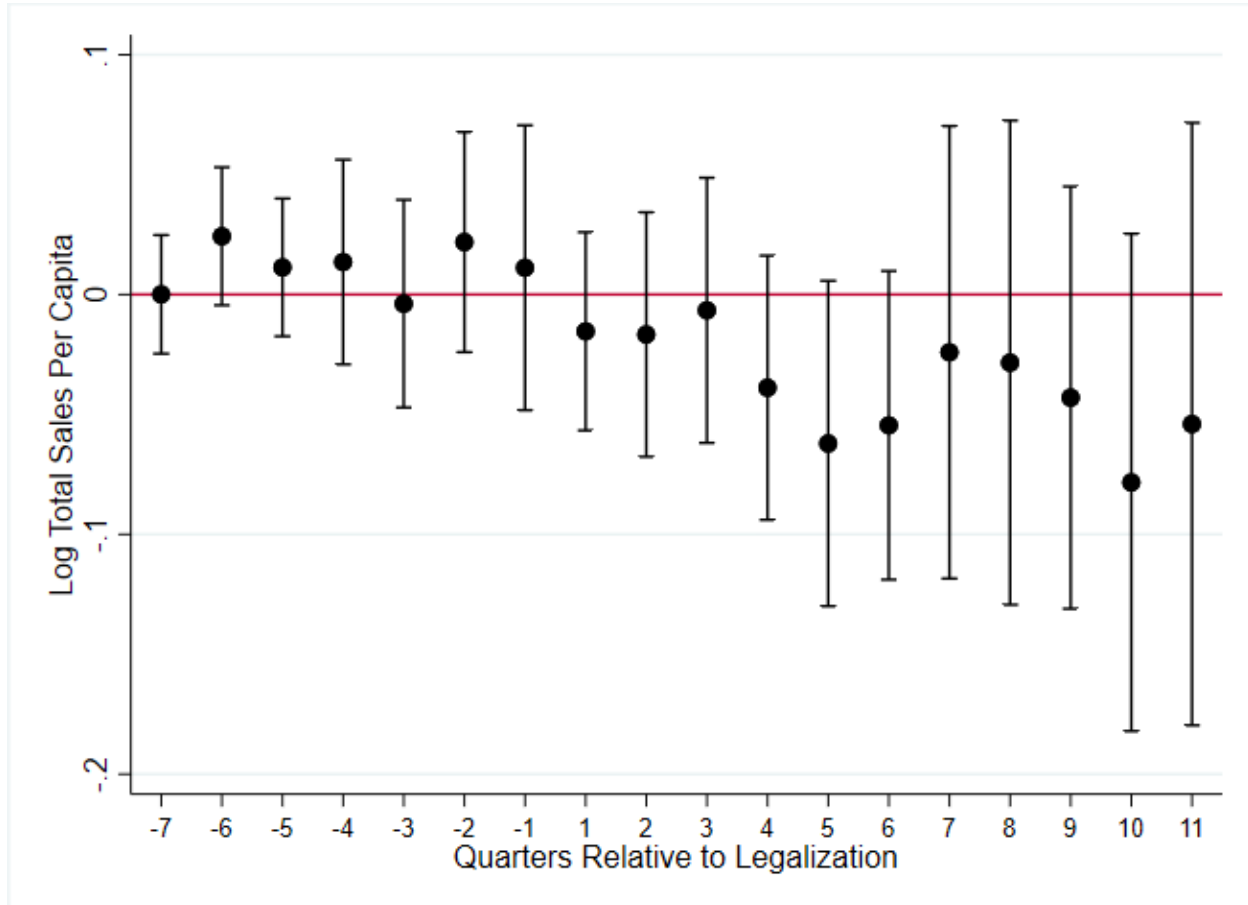
Notes: Estimates for lag and lead term 5 quarters pre and 11 quarters post state legalization of sports betting (and their 95% confidence intervals) are reported. Florida and Maine drop out of sample after 1 quarter. Kansas drops out of sample after 5 quarters. Other states, starting with Wisconsin, drop out of sample after 8 quarters. The dependent variable is equal to the natural log of lottery sales per capita at the county level. County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. Regressions are weighted by county population. Standard errors are clustered at the state level.

Figure A.6.1.2: Dynamic Specification Lag and Lead Coefficients Pre and Post State Legalization of Sports Betting



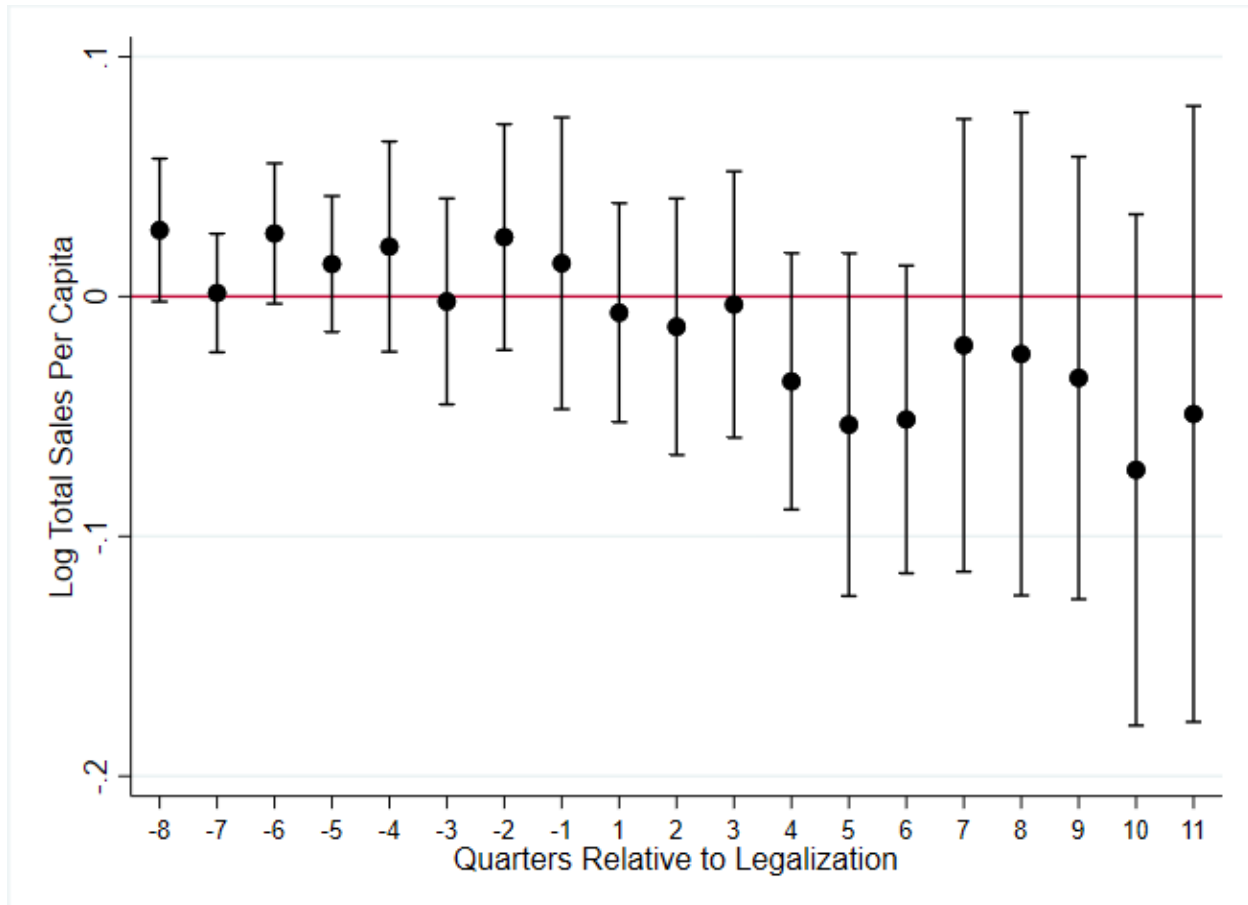
Notes: Estimates for lag and lead term 6 quarters pre and 11 quarters post state legalization of sports betting (and their 95% confidence intervals) are reported. Florida and Maine drop out of sample after 1 quarter. Kansas drops out of sample after 5 quarters. Other states, starting with Wisconsin, drop out of sample after 8 quarters. The dependent variable is equal to the natural log of lottery sales per capita at the county level. County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. Regressions are weighted by county population. Standard errors are clustered at the state level.

Figure A.6.1.3: Dynamic Specification Lag and Lead Coefficients Pre and Post State Legalization of Sports Betting



Notes: Estimates for lag and lead term 7 quarters pre and 11 quarters post state legalization of sports betting (and their 95% confidence intervals) are reported. Florida and Maine drop out of sample after 1 quarter. Kansas drops out of sample after 5 quarters. Other states, starting with Wisconsin, drop out of sample after 8 quarters. The dependent variable is equal to the natural log of lottery sales per capita at the county level. County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. Regressions are weighted by county population. Standard errors are clustered at the state level.

Figure A.6.1.4: Dynamic Specification Lag and Lead Coefficients Pre and Post State Legalization of Sports Betting



Notes: Estimates for lag and lead term 8 quarters pre and 11 quarters post state legalization of sports betting (and their 95% confidence intervals) are reported. Florida and Maine drop out of sample after 1 quarter. Kansas drops out of sample after 5 quarters. Other states, starting with Wisconsin, drop out of sample after 8 quarters. The dependent variable is equal to the natural log of lottery sales per capita at the county level. County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. Regressions are weighted by county population. Standard errors are clustered at the state level.

Table A.7.1: Baker et al. (2024) replication

	(1) Ln(Sales Per Capita)	(2) Ln(Sales Per Capita)
Treat	-0.0426*** (0.0108)	-0.0411** (0.0189)
Mean Lottery	\$2.36	\$2.36
N	102,447	105,294
County-by-Month FE	Yes	Yes
Month-by-Year FE	Yes	Yes
County Controls	Yes	Yes
Baker Replication	Yes	No

Notes: The estimated coefficients are from a model where the treatment variable of interest is whether the state a county is in legalized sports betting. The outcome variable is the natural log of the sum of Powerball and Mega Millions sales per capita at the county level. County level controls include percentages of a county's population by race, gender, and age, county median household income, county unemployment and poverty rate. Standard errors are clustered at the state level. *, **, and ***, indicate statistical significance at the ten-, five-, and one-percent levels, respectively.