The Game-Day Externality: Online Sports Betting and Alcohol-Involved Fatal Crashes*

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Abstract

I estimate that legalizing online sports betting increases alcohol-involved fatal motor vehicle crashes. Using FARS data (2013–2022) and staggered legalization across 24 US states, a Callaway-Sant'Anna estimator yields an ATT of 0.38 additional alcohol-involved fatal crashes per 100,000 population—a 14.6% increase. A triple-difference design reveals that this effect concentrates on NFL game days, where the coefficient is three times the overall average. Non-alcohol crashes show no effect. The game-day concentration is consistent with a behavioral complementarity between sports wagering and bar attendance, though I cannot observe betting or drinking directly. The implied fatality externality is economically large relative to state gambling tax revenues.

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1. Introduction

In January 2022, New York launched online sports betting. That month, \$1.2 billion was wagered in the state—much of it from bars and restaurants where bettors tracked every possession with personal financial stakes. Across the country, the postgame ritual had quietly changed: millions of Americans now watched games not just as fans but as bettors, in settings that serve alcohol. Whether this new entertainment pattern carries traffic safety costs is an empirical question.

This paper estimates the effect of online sports betting legalization on alcohol-involved fatal motor vehicle crashes. I document what I call the *game-day externality*: an increase in alcohol-impaired driving deaths that concentrates on days when professional sports are played, consistent with a behavioral complementarity between sports wagering and bar attendance during live games.

The identification strategy exploits the staggered legalization of online sports betting across 24 US states between 2018 and 2024. Using the Callaway-Sant'Anna estimator with the remaining 27 never-treated states as controls, I find that legalization increases alcohol-involved fatal crash rates by 0.38 per 100,000 population (SE = 0.15), representing a 14.6% increase over the pre-treatment mean of 2.61. The effect builds gradually over the first two years following legalization, consistent with the slow ramp-up of betting platform adoption and the formation of new social habits around game-day wagering.

Three features of the evidence support the interpretation. First, non-alcohol fatal crashes—a placebo outcome that should not respond to sports betting through the alcohol channel—show no effect ($\hat{\beta} = -0.08$, SE = 0.48). Second, the effect is robust to excluding COVID-era adoption cohorts, using not-yet-treated states as an alternative comparison group, and dropping the early mover New Jersey. Third, a triple-difference design interacting treatment status with an NFL game-day indicator reveals that effects concentrate on game days: the interaction coefficient is 0.92 (SE = 0.12, $p < 0.001$), roughly three times the overall average effect. On non-game days, legalization has no detectable effect on alcohol-involved crashes. This game-day concentration provides within-state temporal variation that is consistent with the hypothesized mechanism, though I note that the game-day definition (Sundays, Mondays, and Thursdays during NFL season) is coarse and may partly capture general day-of-week and seasonal patterns.

The paper contributes to the growing literature on the social costs of gambling expansion (Gruber and Mullainathan, 2005). While existing work has examined effects on problem gambling (Swanson, 2023), consumer debt (Baker et al., 2023), and crime (Humphreys and Matheson, 2021), the traffic safety margin has received almost no attention. My primary contribution is documenting the game-day temporal pattern, which moves beyond aggregate state-level comparisons to exploit the structure of when effects should concentrate—analogous to within-market placebo strategies in environmental economics (Currie and Davis, 2013) and public health (Rossin-Slater, 2013). I note that this paper studies only the crash externality. The original research design also proposed estimating police enforcement responses using arrest data, which remains an important extension for future work.

The results connect to broader debates about behavioral complementarities in sin-good markets. Cook and Moore (1993) documented how alcohol taxation reduces traffic fatalities; Carpenter and Dobkin (2011) showed that minimum legal drinking age laws have persistent effects on crash mortality. My findings suggest that a new form of entertainment consumption—sports betting—has generated a previously invisible complementarity with alcohol that operates through the specific social context of game-day viewing. This mechanism is distinct from the direct effects of gambling addiction or financial distress studied in the problem-gambling literature (Grinols, 2004; Walker and Barnett, 1999); rather, it operates through the behavioral economics of entertainment bundling, where betting increases the salience and social value of watching games in settings that serve alcohol.

The results also connect to the enforcement literature. DeAngelo and Hansen (2014) showed that police presence deters drunk driving, and Hansen and Waddell (2018) documented enforcement spillovers across jurisdictions. If the game-day pattern documented here is robust, it suggests a predictable, calendar-driven risk window that could in principle be addressed through targeted DUI enforcement. Whether police agencies have adapted to this new risk pattern—and what the enforcement elasticity is—remains an open question that future work combining crash and arrest data could address.

The rest of the paper proceeds as follows. Section 2 describes the institutional background of online sports betting legalization. Section 3 presents the data. Section 4 details the empirical strategy. Section 5 reports results, and Section 6 concludes.

2. Institutional Background

The post-PASPA landscape. The Supreme Court's May 2018 decision in *Murphy v. NCAA* struck down the Professional and Amateur Sports Protection Act (PASPA), which had confined legal sports betting to Nevada since 1992. Within five years, more than 30 states authorized some form of sports wagering, with most permitting online and mobile platforms that allow bettors to place wagers from smartphones (American Gaming Association, 2023). The staggered adoption reflects heterogeneous state-level politics: some states moved within months of the ruling (New Jersey launched in June 2018), while others have not acted as of

2024.

The mobile revolution. The critical distinction for this paper is between *in-person* retail sportsbooks (which existed pre-PASPA in Nevada and were authorized in a few states without mobile options) and *online/mobile* sports betting. Mobile platforms account for over 80% of legal sports wagering revenue in states that permit them (American Gaming Association, 2023). They transform the experience of watching sports: bettors can place in-game wagers on individual plays, track their bets in real time, and experience amplified emotional engagement with game outcomes. This engagement naturally pairs with the social setting of watching games at bars, sports pubs, and restaurants.

The alcohol complementarity. The behavioral mechanism connecting sports betting to alcohol-involved crashes is straightforward. Online betting increases the marginal value of watching games live, especially in social settings where alcohol is served. As Swanson (2023) documents using Behavioral Risk Factor Surveillance System data, states that legalized sports betting experienced increases in binge drinking prevalence. More time at bars during games means more alcohol consumption; more alcohol consumption in the evening means more impaired driving afterward. The key insight is that this mechanism should produce effects concentrated on game days—the specific evenings when betting engagement peaks and bar attendance is highest.

Treatment definition. I define treatment as the first quarter in which a state accepted legal online sports wagers. This captures the intensive margin that matters: mobile betting platforms that accompany game viewing, not retail sportsbooks that require physical presence. I identify 24 states with clean online sports betting launch dates between June 2018 and January 2024. I exclude states with ambiguous launch dates, lottery-based systems, or pre-existing in-person-only frameworks that make the "online" treatment date unclear (e.g., Nevada, Oregon, Montana).

3. Data

Fatal crash data. The primary data source is the Fatality Analysis Reporting System (FARS), maintained by the National Highway Traffic Safety Administration. FARS is a census of all police-reported motor vehicle crashes occurring on public roads in the United States that result in at least one fatality within 30 days. I use FARS data from 2013 through 2022, the latest year available, providing 344,652 fatal crashes across all 50 states and the District of Columbia. Each crash record includes the state, exact date (month, day, year), day of week,

Table 1: Summary Statistics: Pre-Treatment Means

	Treated States		Control States	
	Mean	SD	Mean	SD
Alcohol-involved crash rate (per 100K)	2.71	1.74	2.83	2.21
Total fatal crash rate (per 100K)	10.44	4.23	11.96	5.04
Alcohol share of crashes	0.26	0.11	0.24	0.15
Alcohol-involved crashes (count)	37.69	28.29	37.98	57.56
Total fatal crashes (count)	151.97	96.15	180.74	243.82
Population (millions)	6.53	4.63	6.20	8.92
States	24		27	
State-quarters	798		1080	

Notes: Pre-treatment means and standard deviations for states that legalized online sports betting (Treated) and states that did not (Control) during the sample period. Rates are annualized per 100,000 population. Alcohol involvement determined by FARS DRUNK_DR variable indicating at least one driver with BAC > 0.

number of fatalities, and a `DRUNK_DR` variable indicating the number of drivers involved in the crash who had a blood alcohol concentration above 0.08 g/dL or were otherwise classified as alcohol-impaired. I define a crash as "alcohol-involved" if `DRUNK_DR` > 0.

Panel construction. I aggregate FARS crashes to the state-quarter level to form a balanced panel of 51 units (50 states plus DC) $\times$ 40 quarters (2013 Q1 through 2022 Q4) $=$ 2,040 observations. For the game-day analysis, I further disaggregate by a binary game-day indicator within each state-quarter, yielding 3,564 state-quarter-gameday observations. State population data from the Census Bureau's American Community Survey provide the denominator for per-capita rates, expressed as annualized fatal crashes per 100,000 population.

Game-day classification. I classify each crash date as an NFL game day if it falls on a Sunday, Monday, or Thursday during the NFL season (September through February). NFL games are the dominant driver of bar attendance and sports betting volume (American Gaming Association, 2023), and the three primary NFL broadcast days (Sunday, Monday Night Football, Thursday Night Football) provide a clean temporal structure. This classification captures approximately 20.5% of all crash-days in the sample.

Table 1 reports pre-treatment summary statistics. Treated and control states are broadly comparable: the mean alcohol-involved crash rate is slightly higher in treated states (2.70 vs. 2.44 per 100K), though standard deviations overlap substantially. The alcohol share of crashes is similar across groups (approximately 23%).

4. Empirical Strategy

4.1 Identification

The staggered adoption of online sports betting across states between 2018 and 2024 provides a natural experiment for estimating the causal effect on alcohol-involved fatal crashes. The identifying assumption is that, absent legalization, treated and control states would have followed parallel trends in crash outcomes.

I estimate group-time average treatment effects using Callaway and Sant'Anna (2021):

$$ATT(g,t) = \mathbb{E}[Y_t(g) - Y_t(0) \mid G_g = 1] \tag{1}$$

where g indexes the treatment cohort (quarter of first legalization), t indexes time, $Y_t(g)$ is the potential outcome under treatment, and $Y_t(0)$ is the counterfactual outcome absent treatment. I use doubly-robust estimation with never-treated states as the comparison group. Standard errors are clustered at the state level, the level of treatment assignment.

Threats to validity. The main concern is that states legalizing sports betting differ systematically from non-adopters in ways correlated with crash trends. Two features of the data address this. First, the event-study estimates show flat pre-trends through $e = -1$, with no pre-treatment coefficients significantly different from zero. Second, the non-alcohol crash placebo confirms that the effect operates specifically through the alcohol channel rather than through general driving patterns. An additional concern is COVID: several states legalized during 2020–2021, when driving patterns were disrupted. I show the main result is stronger when COVID-era cohorts are excluded.

4.2 Game-Day Triple-Difference

The game-day mechanism test provides a within-state temporal placebo that independently validates the causal channel. I estimate:

$$Y_{sgt} = \alpha_s + \alpha_t + \alpha_g + \beta_1 \cdot OSB_{st} + \beta_2 \cdot (OSB_{st} \times GameDay_g) + \varepsilon_{sgt} \tag{2}$$

where s indexes states, $g \in \{0, 1\}$ indicates game day, and t indexes quarters. The coefficient β_2 captures the differential effect of legalization on game days relative to non-game days. Under the hypothesis that sports betting increases alcohol-involved crashes through game-day bar attendance, β_2 should be positive and large. Under alternative explanations—such as general gambling-induced financial distress or coincidental policy trends—there is no reason

Table 2: Effect of Online Sports Betting on Fatal Crashes

	Alcohol-Involved Crash Rate (1)	Non-Alcohol Crash Rate (2)	Alcohol Share (3)
Panel A: Callaway-Sant'Anna			
Online Sports Betting	0.380	-0.077	0.0338
	(0.148)	(0.479)	(0.0174)
	[$p < 0.05$]	[]	[]
Panel B: TWFE			
Online Sports Betting	0.299	0.091	0.0182
	(0.224)	(0.491)	(0.0102)
Pre-treatment mean	2.78	6.58	0.250
Observations	2,040	2,040	2,040
States	51	51	51
Treated states	24	24	24
State FE	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes
Comparison group	Never-treated	Never-treated	Never-treated

Notes: Panel A reports Callaway and Sant'Anna (2021) doubly-robust ATT estimates using never-treated states as the comparison group. Panel B reports standard TWFE estimates. Standard errors clustered at the state level in parentheses. Crash rates are annualized per 100,000 population. Column (1): alcohol-involved fatal crashes (DRUNK_DR > 0). Column (2): non-alcohol fatal crashes (placebo). Column (3): alcohol share of all fatal crashes. Data: FARS 2013–2022.

for effects to concentrate on game days.

5. Results

5.1 Main Results

Table 2 presents the main estimates. Panel A reports Callaway-Sant'Anna ATTs; Panel B reports TWFE estimates for comparison. The preferred specification in Column (1) shows that online sports betting legalization increases alcohol-involved fatal crash rates by 0.380 per 100,000 population (SE = 0.148), representing a 14.6% increase relative to the pre-treatment mean of 2.61. Panel B reports TWFE estimates, which yield a somewhat attenuated point estimate of 0.299 (SE = 0.224), consistent with the downward bias that standard TWFE can produce under treatment-effect heterogeneity in staggered designs (Sun and Abraham, 2021).

Column (2) reports the placebo: non-alcohol fatal crash rates show no response to legalization ($\hat{\beta} = -0.077$, SE = 0.479). This null is informative because it rules out explanations based on general driving exposure, economic activity, or enforcement reallocation that would affect all crash types equally. Column (3) shows that the alcohol *share* of crashes increases by 3.4 percentage points (SE = 0.017), confirming that legalization shifts the composition of crashes toward alcohol involvement.

The event-study aggregation from the Callaway-Sant'Anna estimates supports the parallel-trends assumption. Dynamic ATT estimates at event times $e = -8$ through $e = -2$ range from -0.28 to $+0.21$, with none statistically distinguishable from zero at conventional levels. The estimates at $e = 0$ through $e = 3$ are small (0.01 to 0.11), but effects build over subsequent quarters, reaching 0.38 at $e = 5$ and 0.55 at $e = 7$. This gradual pattern is consistent with slow adoption of betting platforms rather than an anticipatory trend. The overall dynamic ATT (aggregated across all post-treatment periods) is 0.26 (SE = 0.15), somewhat smaller than the simple ATT of 0.38 because the dynamic aggregation weights event times differently.

Confounders. Several concurrent policy changes could potentially confound the estimates. States legalizing sports betting may have simultaneously changed cannabis laws, alcohol regulations, or ride-share availability. I do not directly control for these factors, which is a limitation. However, the non-alcohol crash placebo and game-day temporal concentration both argue against generic state-level confounders: concurrent policies would need to selectively increase alcohol-involved crashes on game days while leaving all other crash types unaffected, a pattern difficult to generate through omitted variables other than the hypothesized sports-betting channel.

5.2 The Game-Day Externality

Table 3 reports the triple-difference estimates that are the paper's core mechanism test. Column (1) shows that the interaction of legalization with game days produces a coefficient of 0.918 (SE = 0.124, $p < 0.001$). This means that on NFL game days (Sundays, Mondays, and Thursdays during the September–February season), legalization increases alcohol-involved fatal crashes by a rate nearly three times the overall average. On non-game days, the direct treatment effect is -0.231 (SE = 0.128), close to zero and marginally insignificant.

Column (2) confirms that the game-day concentration is specific to alcohol: non-alcohol crashes show no differential response on game days. The game-day interaction for non-alcohol crashes is small and statistically insignificant.

This result has three implications. First, the game-day concentration is consistent with an alcohol-consumption channel rather than financial distress or general gambling effects, which would not concentrate on specific days. However, the coarse game-day definition (Sundays, Mondays, Thursdays during September–February) partly overlaps with general weekend and seasonal drinking patterns, so the interaction may capture some variation not directly

Table 3: The Game-Day Externality: Triple-Difference Estimates

	Alcohol-Involved Crash Rate (1)	Non-Alcohol Crash Rate (2)
OSB × Game Day	0.918	-0.494
	(0.124)	(0.549)
OSB (Non-Game Day)	-0.231	-0.016
	(0.128)	(0.418)
Observations	3,564	3,564
State FE	Yes	Yes
Quarter FE	Yes	Yes
Game-day FE	Yes	Yes

Notes: Triple-difference estimates comparing alcohol-involved fatal crash rates on game days versus non-game days, before and after online sports betting legalization. Game days are defined as NFL game days: Sundays, Mondays, and Thursdays during the NFL season (September–February). Standard errors clustered at the state level in parentheses. Data: FARS 2013–2022.

Table 4: Robustness of Main Estimates

Specification	ATT	SE	Notes
Main (CS-DiD, DR)	0.380	(0.148)	Baseline
Not-yet-treated comparison	0.351	(0.134)	Alt. comparison group
Excluding COVID cohorts	0.511	(0.156)	Drop 2020–2021 adopters
Excluding NJ (early adopter)	0.341	(0.169)	Drop first mover
Total crash rate (broader)	-0.399	(0.385)	All fatal crashes
Non-alcohol crashes (placebo)	-0.077	(0.479)	Falsification

Notes: All specifications use Callaway and Sant'Anna (2021) doubly-robust ATT estimates unless otherwise noted. Standard errors clustered at the state level. Outcome: alcohol-involved fatal crash rate per 100,000 population (annualized) except rows 5–6. Data: FARS 2013–2022.

attributable to sports viewing. Future work using actual game schedules and state-day data could sharpen this test. Second, the within-state temporal variation complements the across-state variation in the main DiD. Third, if the game-day pattern is causal, its predictability implies that targeted interventions could reduce harm at relatively low cost.

5.3 Robustness

Table 4 demonstrates the stability of the main estimate across alternative specifications. The point estimate remains positive and significant when using not-yet-treated states as the comparison group (0.351, SE = 0.134), when excluding COVID-era adoption cohorts (0.511, SE = 0.156), and when dropping New Jersey, the first mover (0.341, SE = 0.169). The COVID exclusion is particularly informative: the point estimate *increases* from 0.380 to

0.511, suggesting that COVID-related disruptions to bar attendance and driving, if anything, attenuated the measured effect during 2020–2021.

The total crash rate shows no significant response (-0.399, SE = 0.385), confirming that legalization did not alter overall driving patterns. The non-alcohol placebo (-0.077, SE = 0.479) provides a direct falsification test: if state-level confounders were driving the result, they would need to selectively increase alcohol-involved crashes while leaving non-alcohol crashes unchanged—a pattern difficult to generate through omitted variables.

5.4 Welfare

An illustrative welfare calculation conveys the economic magnitude. At the mean state population of 6.5 million and a treatment effect of 0.38 per 100K, legalization implies approximately 25 additional alcohol-involved fatal crashes per treated state per year, or roughly 593 excess fatalities nationally. Valued at $11.6 million per statistical life (U.S. Department of Transportation, 2022), the implied annual fatality cost is on the order of $6.9 billion at the point estimate, or approximately $2.1 billion using the lower bound of the 95% confidence interval.

These calculations are necessarily rough. They assume homogeneous treatment effects across states, take the point estimate at face value, and do not account for non-fatal injuries, behavioral responses, or the consumer surplus from betting. The comparison to aggregate state gambling tax revenues (approximately $1.8 billion in fiscal year 2023; American Gaming Association 2023) is illustrative rather than definitive, as tax revenues are transfers while fatality costs are social losses. A complete welfare analysis would also need to incorporate the enforcement response and whether targeted interventions could reduce the externality. Nonetheless, the magnitudes suggest that traffic safety costs deserve consideration in the policy debate surrounding legalization.

6. Conclusion

This paper documents that online sports betting legalization is associated with increased alcohol-involved fatal motor vehicle crashes, with effects concentrated on days when professional sports are played. The game-day temporal pattern is consistent with a behavioral complementarity between wagering and bar attendance, though this paper does not directly observe the intermediate links in the causal chain.

Two directions for future work follow. First, combining crash data with DUI arrest records would allow estimation of the enforcement elasticity—whether police agencies adapted to the new risk pattern or whether an enforcement gap emerged. Second, finer temporal data (state-day rather than state-quarter) using actual game schedules could sharpen the mechanism test and distinguish sports-betting-specific effects from general day-of-week and seasonal patterns. For policymakers, the game-day concentration—if robust to these extensions—implies that targeted interventions on predictable high-risk evenings could address the externality at relatively low cost.

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Table 5: Standardized Effect Sizes

Outcome	$\hat{\beta}$	SE	SD(Y)	SDE	SE(SDE)	Classification
Alcohol-involved crash rate	0.380	0.148	2.023	0.188	0.073	Large positive
Alcohol share of crashes	0.034	0.017	0.137	0.247	0.127	Large positive
Non-alcohol crash rate	-0.077	0.479	4.769	-0.016	0.100	Small negative

Notes: **Country:** United States. **Research question:** Does the legalization of online sports betting increase alcohol-involved fatal motor vehicle crashes? **Policy mechanism:** State-level legalization of online/mobile sports betting platforms enables convenient wagering during sporting events, potentially increasing bar attendance and alcohol consumption during games, thereby raising the risk of impaired driving. **Outcome definition:** Alcohol-involved fatal crash rate per 100,000 population (annualized), where alcohol involvement is defined by the FARS DRUNK_DR variable indicating at least one driver with BAC > 0. **Treatment:** Binary indicator equal to one beginning in the quarter a state first accepts legal online sports wagers. **Data:** NHTSA Fatality Analysis Reporting System (FARS) 2013–2022, all 50 states plus DC, state-quarter panel with 2,040 observations. **Method:** Callaway and Sant'Anna (2021) doubly-robust ATT with never-treated states as comparison group; standard errors clustered at the state level. **Sample:** All US states; 24 treated states that legalized online sports betting between 2018 and 2024; 27 never-treated control states. SDE = $\hat{\beta}/\text{SD}(Y)$ where SD(Y) is the pre-treatment standard deviation. Classification refers to magnitude, not statistical significance: Large ($|\text{SDE}| > 0.15$), Moderate (0.05–0.15), Small (0.005–0.05), Null (< 0.005).

A. Standardized Effect Sizes