



# Sobering Up After the Seventh Inning: Alcohol and Crime Around the Ballpark

Jonathan Klick<sup>1</sup> · John MacDonald<sup>2</sup> 

Accepted: 12 February 2021 / Published online: 8 March 2021

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## Abstract

**Objectives** This study examines the impact of alcohol consumption in a Major League Baseball (MLB) stadium on area level counts of crime. The modal practice at MLB stadiums is to stop selling alcoholic beverages after the seventh inning. Baseball is not a timed game, so the duration between the last call for alcohol at the end of the seventh inning and the end of the game varies considerably, providing a unique natural experiment to estimate the relationship between alcohol consumption and crime near a stadium on game days.

**Methods** Crime data were obtained from Philadelphia for the period 2006–2015 and geocoded to the area around the MLB stadium as well as popular sports bars. We rely on difference-in-differences regression models to estimate the change in crime on home game days around the stadium as the game time extends into extra innings to other areas of the city and around sports bars in Philadelphia relative to days when the baseball team plays away from home.

**Results** When there are extra innings and more game-time after the seventh inning alcohol sales stoppage crime declines significantly around the stadium. The crime reduction benefit of the last call alcohol policy is undone when a complex of sports bars opens in the stadium parking lot in 2012. The results suggest that alcohol consumption during baseball games is a contributor to crime.

**Conclusions** The findings provide further support for environmental theories of crime that note the congregation of people in places with excessive alcohol consumption is a generator of violent crime in cities. The consumption of alcohol in MLB stadiums appears to increase crime.

**Keywords** Crime generators · Stadium · alcohol and crime · Crime and place

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✉ John MacDonald  
johnmm@sas.upenn.edu

<sup>1</sup> Carey Law School, University of Pennsylvania, Philadelphia, PA, USA

<sup>2</sup> Department of Criminology, University of Pennsylvania, 558 McNeil Building, 3718 Locust Walk, Philadelphia, PA 19104-6286, USA

## Introduction

A growing body of literature finds that alcohol consumption is a contributor to crime (Carpenter and Dobkin 2011). Excessive alcohol consumption, for example, influences cognition and suppresses moral prohibitions that act as inhibitors of aggression (Exum 2002). Alcohol consumption may also place individuals who drink in excess at greater risk for victimization, as criminal offenders may see inebriated people as easier targets for robbery and assault (Sherman 1992). The consumption of alcohol in group settings may also fuel crime by increasing the number of social contacts, making people more talkative and increasing social interactions between motivated offenders and victims (Carpenter and Dobkin 2011). In general, evidence suggests that alcohol increases the risk of crime through offender, victim, and group setting channels.

It is not surprising then that alcohol-reduction policies have long been part of public health campaigns to reduce accidents, injuries, and violent crimes associated with its use (Fagan 1990). The primary public policy approaches to reducing alcohol consumption have been to raise prices by imposing excise taxes on alcohol beverages, setting minimum age restrictions on the purchase and consumption of alcohol, limiting the times (hours and days of week) when alcoholic beverages can be sold, and regulating the places where alcohol can be sold and consumed in public settings (Carpenter and Dobkin 2011).

While carefully done studies of alcohol restrictions around places generally suggest that reducing alcohol consumption lowers interpersonal crimes, these studies face standard identification problems. The place and time restrictions, for example, are often set up in response to concerns with crime and other negative externalities, or they may be implemented as part of a broader effort to curb the connection between alcohol and crime. Restrictions to close bars and taverns at earlier times of the day, or on given days of the week, are often a result of a concern with the crime and disorder facilitated at given locations that are hot spots for crime (Sherman 1992).

In England and Wales, for example, in 2005 the government removed restrictions on the closing time for bars to reduce crowding of intoxicated individuals on streets that were thought to be a primary contributor to assaults (Humphreys and Eisner 2010). More generally, regulations that seek to reduce consumption of alcohol in specific places may be endogenously related to concerns with crime and other negative externalities of excessive alcohol use. At the same time, there is an appreciable amount of literature suggesting that alcohol consumption in group settings, like sporting events, may be crime generators. However, this literature generally suffers from methodological flaws. Alcohol consumption in group settings, for example, may be endogenously related to assaults. People who like to drink and fight may be more inclined to do both when they are with peers and at a sporting event. While prior literature estimates the effect of sporting events where people are consuming alcohol on crime (Billings and Depken 2011; Kurland et al. 2014; Marie 2016; Kurland and Johnson 2019), it does not identify the causal effect of alcohol consumption within sporting events on crime. This is an important limitation in the literature, as alcohol restrictions are instituted in many sports arenas for the fear that it will contribute to rowdiness.

In this paper, we rely on a novel natural experiment to provide causal estimates of the impact of alcohol consumption during Major League Baseball (MLB) games on crime near a stadium. MLB teams stop selling alcohol in their stadiums at a fixed time during game play (for most teams, after the seventh inning). This provides an especially useful natural experiment to examine the impact of alcohol consumption on crime, because baseball is

not a timed game. The game duration from the end of the seventh inning to the end of the game can be short or long. An inning could be as short as six pitches or it could go on indefinitely. Further, since there are no ties in MLB games, games can be as short as eight and a half innings or can go into effectively unlimited extra innings. This aspect of MLB games allows us to examine a wide range of time spans during which spectators are limited in their ability to drink alcohol. Thus, we can compare game days with non-game days when the game is at home or away, and when the time from the end of the seventh inning extends allowing fans who are in attendance more time to sober up.

We examine Philadelphia Phillies games because the Citizens Bank Park (CBP) stadium provides an additional quasi-experiment for us to exploit. In March 2012, the Xfinity Live!<sup>1</sup> complex opened in the stadium parking lot. This entertainment venue contains several bars and restaurants that sell alcohol until 2 a.m. each evening, effectively undoing any potential effect of the alcohol sale stoppage in the stadium at the end of the seventh inning.

We find that home games that are relatively lengthy after the seventh inning and games with extra innings generate lower crime around CBP, as compared to other areas around the city. For the average game, it appears that the alcohol sales restriction reduces assaults by 40 to 70 percent. These effects are concentrated within the first hour after the game, with little additional crime reduction occurring after that, and in a relatively small area around CBP. We do not observe similar effects around a selection of popular sports bars in other areas of the city where no seventh inning restriction on alcohol sales applies. These effects largely vanish after the Xfinity Live! complex opened and allowed fans to continue to drink alcohol after the seventh inning in the stadium parking lot, further suggesting the link between the stadium alcohol restrictions and crime is causal. If fans were simply self-selecting into CPB to drink and fight then the opening of Xfinity Live! in the stadium parking lot would not have any impact on the stadium alcohol restrictions estimates.

In the following sections we briefly highlight prior literature on the effects of age, time, and place-based alcohol restrictions and sporting events on crime. We then discuss how theories of environmental criminology explain the mechanism through which alcohol consumption in places that gather people for legitimate social contact generates crime. This section is followed by an explanation of our unique methodology that allows us to provide causal estimates of the effect of alcohol sales on crime during baseball games. Our results and analyses follow. Finally, we discuss the implications of this research for theories on criminality of places and crime prevention policy.

## Age, Time, and Place Restrictions on Alcohol

Alcohol has long been thought to be a contributor to violent crime, with the most pronounced effects being for assaults. However, the historical empirical evidence for the physiological effects of intoxication as a direct cause of aggression has not been particularly convincing (see Fagan 1990 for a review). More recently, scholars have turned to examining the impact of different alcohol restriction policies on crime. Studies have examined the effect of excise taxes imposed on alcohol sales, minimum age of alcohol access restrictions, and spatial/temporal restriction of alcohol availability. Multiple studies show when excise taxes on alcohol are raised alcohol consumption and violent crime

<sup>1</sup> See <https://www.xfinitylive.com>.

drop (Cook and Moore 2002; Cook and Moore 1993; Matthews et al. 2006; Sivarajas-ingam et al. 2006). This literature is, however, limited because states seldom change excise tax rates on alcohol, so most of these effects are estimated from cross-sectional differences in taxes between states (see Cook and Durrance 2013 for an exception).

The empirical evidence of a link between alcohol consumption and crime is the strongest from studies that examine age restrictions. Studies have taken advantage of the fact that the minimum alcohol drinking age of 21 in the United States is the only policy that discretely impacts people at this age. Several carefully done studies find that alcohol consumption jumps sharply at age 21 (see Carpenter and Dobkin 2011 for a review). Carpenter and Dobkin (2015), for example, find that arrests in California jump by a significant 6% for individuals after turning age 21. This increase in arrests is mostly attributable to a rise in assaults, alcohol-related offenses, and nuisance crimes.

Studies on time and place restrictions also find that limiting alcohol sales to given times (days or hours of operation) and places also reduces crime (Carpenter and Dobkin 2011). Several studies have capitalized on natural experiments and examined what happens when there is a change in the times when alcohol can be sold, or the locations of alcohol establishments. Olsson and Wikstrom (1982) find that a 3-month prohibition of Saturday sales of alcohol in state-run liquor stores in Sweden reduced weekend public-order crimes, domestic disturbances, and assaults. Norström and Skog (2005), in a follow-up study, find that the repeal of the Saturday alcohol-sales ban in Sweden had no impact on assaults on Saturdays, despite a clear increase in alcohol sales. However, the number of assaults was so low at the time that this study may have been underpowered to detect effects. More recently, Heaton (2012) finds that the repeal of the Sunday alcohol-sales ban that was applied to only a set of jurisdictions in Virginia in 2004 and 2008 led to significant increases in minor and serious alcohol-related crimes on Sundays. The increase in alcohol-related offenses on Sunday also occurred in the afternoon when stores were open, suggesting that it is the consumption of alcohol shortly after stores open that generates the additional crime. Han et al. (2016), however, show that the lifting of Sunday sales prohibitions on alcohol in state-run stores in Pennsylvania has only a modest impact on crime in high poverty neighborhoods in Philadelphia. These studies, therefore, do not provide clear guidance on the effect of alcohol time and locations restrictions on crime.

Although the density and location of alcohol outlets are a known correlate of violent crime (Weisburd et al. 2012), most studies of alcohol outlets and violence are cross sectional making drawing causal inferences problematic. There are, however, a growing number of studies that examine what happens to crime after the opening or closing of alcohol outlets. Teh (2008), for example, finds that the opening of alcohol outlets in Los Angeles was associated with an increase in crimes around stores located in high poverty neighborhoods. Anderson et al. (2018) find that law changes in counties in Kansas that lifted prohibitions of selling alcohol to the public for on-premise consumption was associated with an increase in violent crime. The increase in violent crime also appears to be largest in counties that do not require a percentage of food to be sold at a bar, suggesting that the consumption of alcohol in bars is the primary contributor to the increase in violent crime. Evidence that opening bars is associated with an increase in violent crime is consistent with the widely-shared belief in criminology that bars are a common feature of violent crime hot spots in cities (Sherman et al. 1989; Weisburd et al. 2012; Haberman and Ratcliffe 2015; Tillyer et al. 2020). However, it is possible that individuals with a higher propensity for violence choose to drink at bars and that it is the gathering place for public drinking rather than the alcohol itself contributing to the rise in violence.

Large social events that involve alcohol consumption are also associated with increased risk of crime. Research on crime around college football stadiums, for example, shows that arrests for assaults and disorder offenses increase significantly on game days (Rees and Schepel 2009; Merlo et al. 2010). Several studies also find that crime increases in areas surrounding sports stadiums on home game days (Billings and Depken 2011; Kurland et al. 2014; Marie 2016; Kurkland and Johnson 2019), when a stadium is present versus torn down (Vandeviver et al. 2019), and on days that sport stadiums are used (Campaniello 2013; Munyo and Rossi 2013).<sup>2</sup> Kurkland and Johnson (2019), for example, examine changes in crime levels around five soccer (football) stadiums in the United Kingdom. They find that crime is higher on game days than other days of the week, and that the increase in crime is highest in neighborhoods closer to the stadiums and those with bars or restaurants.

While the presence of bars near sports stadiums appears to be a crime generator, studies on the criminality of places typically do not estimate the causal effect of alcohol availability on crime. Alcohol consumption in bars near soccer (football) stadiums may be endogenously related to assaults if people prone to fight choose to go to bars with friends to watch sporting events. The closest study that alludes to the link between alcohol consumption and crime around sporting events is Kurland and Johnson (2019), as they find that crime increases in neighborhoods with bars near soccer stadiums. However, this study cannot separate out the influence of alcohol consumption from the increase in the number of patrons who come to sports bars to watch the soccer games.

In general, studies that examine the impact of sports stadiums on crime cannot separate out whether the sporting events impact crimes like assaults because of gathering more people together, or because of the excessive alcohol consumption. At college football games, for example, alcohol sales are already generally banned in stadiums, so fans tend to drink alcohol just outside the stadium prior to the game and subvert the impact of sales restrictions. There are, however, criminological theories that explain why limiting alcohol sales in specific times and places may help thwart crime in settings that bring groups of people together for social contact.

## Environmental Criminology: Situational Opportunities Theories

Environmental criminology provides a clear framework for understanding how the place in which alcohol is consumed can be a facilitator of crime (Wilcox and Gialopsos 2015). Environmental criminology assumes that crime patterns in space are distributed according to how the environment of a place at a given time influences the volume and types of criminal opportunities. Theories that fall within the framework of environmental criminology articulate mechanisms by which alcohol consumption in specific places may interact to generate crime.

Alcohol consumption affects cognition and vulnerability. Impaired individuals are more likely to be aggressive or appear vulnerable to would-be offenders. Clarke's (1995) situational crime prevention theory argues that offending may be influenced by alcohol consumption, as excessive alcohol consumption makes people myopic and may change their perceptions of the crime opportunity structure. This may be particularly true in the context

<sup>2</sup> Kurland and Johnson (2019) provide detailed review of this literature.

of alcohol-fueled offenses such as assaults, where group dynamics of excessive drinking may lead to more potential opportunities for fights. Similarly, there may be dynamics of places at a given time of day (e.g., when bars close) where an increase in the number of inebriated people on the streets provides a target-rich environment for potential confrontations. Weisburd et al. (1992), for instance, find that calls about public drinking are one of the main correlates of robbery hot spots. Multiple studies find that excessive alcohol consumption prior to closing time and crowding in the streets after bars close are risk factors for assaults (Graham & Homel 2012).

Cohen and Felson's (1979) routine activity theory also explains how the movement of people between places influences the presence of motivate offenders, suitable targets, and guardianship to thwart crime. Alcohol consumed in social settings, like sports stadiums and bars, may create larger flows of inebriated people in the streets and provide more opportunities for robberies and assaults between people. Recreational drinking of alcohol at places where people gather to watch sporting events may also generate more public-order offenses and assaults by increasing the number of motivated offenders, as inhibitions against violence and disorderly behavior are lowered when people are intoxicated.

Within the context of places themselves, crime pattern theory provides a clear typology for explaining how the activity patterns around places that gather people together for legitimate uses, like watching a sporting event in a bar or stadium, becomes a crime generator. As Brantingham and Brantingham (1995) explain, sports stadiums and other venues that bring large numbers of people together for reasons "unrelated to any particular level of criminal motivation" can become crime generators by creating sufficient concentrations of people in a setting that allows people to "exploit criminal opportunities" (pp. 7–8). Intoxicated people in greater numbers near each other provide more available opportunities for interpersonal crimes like assaults, as drunk individuals get "swept up into fights" (p.11). Rowdy bars are particularly prone environments for assaults to occur (Graham et al. 2006).

In summary, environmental criminology perspectives suggest alcohol consumption in group settings may fuel crimes of interpersonal violence like assaults.

## Last Call for Alcohol Sales

Although Major League Baseball (MLB) does not mandate rules regarding the sale of alcohol at individual sports stadiums, most MLB teams adopt a host of sales restrictions.<sup>3</sup> The focus of this paper is the rule about when alcohol sales cease during baseball games. All MLB stadiums stop selling alcohol prior to the end of the game. The Philadelphia Phillies ballpark, Citizens Bank Park (CBP), ceases sales at the end of the seventh inning.<sup>4</sup> This is the most common policy among MLB teams, though some stop sales as late as the end of the eighth inning (e.g., Baltimore Orioles for concession stand sales) and others as early as the middle of the seventh inning (e.g., New York Yankees for concession stand and hawker sales). Other alcohol restrictions include limits on how many alcoholic drinks an individual

<sup>3</sup> Major League Baseball is a member of Team Coalition (along with the other major U.S. sports leagues) which does provide a list of best practices regarding alcohol sales. See <https://teamcoalition.org/training/policies/>

<sup>4</sup> See <https://fansdontletfansdrivedrunk.org/team/mlb/philadelphia-phillies/#1442768220251-8edb53aa-bec4d832-ba39ff22-02f5>.

can purchase at a time (generally two, as is the case for the Phillies) and maximum cup sizes (24 oz. for the Phillies).

The logistics of an MLB baseball game seventh inning sales cut off creates quasi-randomization regarding how long people are prohibited from purchasing alcohol. Because baseball is not a timed game, the duration from the end of the seventh inning to the end of the game (when spectators generally leave the ballpark) is variable game-to-game.

Putting aside games affected by rain delays (excluded from our analysis) which can cause a game to end during any inning, a baseball game can have as few as eight and a half innings (when the home team is winning after the visiting team bats in the top of the 9th inning) or can extend to effectively limitless innings since a baseball game cannot end in a tie.<sup>5</sup> Beyond that, an inning itself has no fixed time duration, ending only after each team has recorded three outs. The minimum number of pitches that could end an inning is six (or 3 if it is the 9th inning, and the home team is ahead), although that has not happened.<sup>6</sup> On the other end of things, the number of pitches thrown in an inning is limitless. For example, in the top of the second inning in a July 26, 1999 San Francisco Giants game, pitcher Russ Ortiz threw 63 pitches to retire the St. Louis Cardinals and then Jose Jimenez threw 32 pitches to retire the Giants in the bottom of the inning.<sup>7</sup> In one instance, a pitcher threw 21 pitches to get a single batter out.<sup>8</sup> Further, there is no restriction on how long it takes a pitcher to throw a pitch.<sup>9</sup>

This variability inherent in the game of baseball allows us to examine changes in crime when spectators are prohibited from buying alcohol for a long period of time versus games where the prohibition ends up being quite short. Focusing on the Phillies CBP stadium also allows us to exploit an additional source of variation. In March of 2012, the Xfinity Live! entertainment complex was opened on the corner of Pattison Avenue and 11th Street directly opposite the Southwest corner of CBP, about 300 feet from the ballpark gates in what was previously part of the stadium parking lot.

Xfinity Live! includes, among other bars and restaurants, the Broad Street Bullies Pub and the Victory Beer Hall. These establishments serve alcohol nightly until 2 a.m. Because these places effectively undo the CBP seventh inning cut-off, as spectators can either leave a game early and walk 0.05 miles to continue drinking or, if they stay in the ballpark for the final out, fans can easily resume drinking in what is basically the ballpark's parking lot. Given this, if alcohol consumption in stadiums increases crime, we should see any effect of the ballpark alcohol cut off on crime diminish substantially after Xfinity Live! opens in the 2012 baseball season.

<sup>5</sup> The longest game in MLB history was 25 innings and lasted eight hours and six minutes on May 8, 1984 between Chicago White Sox and the Milwaukee Brewers.

<sup>6</sup> There have been fewer than 200 total instances where an individual pitcher has thrown just three pitches in an inning, but none of these instances occurred in the same inning by two opposing pitchers. See [https://www.baseball-almanac.com/feats/3\\_pitch\\_inning.shtml](https://www.baseball-almanac.com/feats/3_pitch_inning.shtml).

<sup>7</sup> <https://www.baseball-reference.com/boxes/SFN/SFN199907260.shtml>.

<sup>8</sup> San Francisco Giant Brandon Belt faced a total of 21 pitches from Los Angeles Angels pitcher Jaime Barria in the 1st inning of the April 22, 2018 match. See <https://www.baseball-reference.com/boxes/ANA/ANA201804220.shtml>.

<sup>9</sup> The advanced statistic PACE provides some measure of how fast pitchers work. In some years, based on the PACE metric, the difference between the fastest and slowest working pitchers may be as much as 10 s per throw.

## Methods

### Data

We use crime incident data provided by the Philadelphia Police Department.<sup>10</sup> These data cover each reported crime in the city and include the location (latitude and longitude as well as street block), date, and time the crime was reported. The data are available starting in 2006 and are updated regularly. This study covers the 2006 to 2015 baseball season. We aggregate the daily crime counts overall and by subcategories (assault, theft, liquor violations, disorderly conduct) to the census block level as our primary geographic unit of analysis. We designate the census block where CBP is located as our treatment area.<sup>11</sup> The census designation effectively covers the stadium and its nearby parking lots, but this means the eastern boundary is coincident with the wall of the stadium and does not capture any crimes committed to the east of the stadium. Although the census blocks are a sensible unit for measuring crime around CBP, in addition to this eastern boundary problem, it also includes the Philadelphia Eagles practice facility which is inaccessible to the public (West of Broad Street). In subsequent analyses, we also examine the Philadelphia Police Department's Police Service Areas (PSA) as a unit of analysis.<sup>12</sup> These geographic units are significantly larger than the census block designations. We include the entire PSA in which the CBP stadium is located (District 3; PSA 3)<sup>13</sup> as the treatment area in those analyses. Finally, to provide an additional geographic measure of crime, we also aggregate crime to the natural transportation nodes around CBP. Three of these boundaries are major highways or arterial roads (I-95 is 1900 feet to the South of the CBP southern wall, I-76 is 1500 feet to the North of the CBP northern wall, and Broad Street is 1500 feet to the West of the CBP western wall). Only the eastern boundary has no comparable transportation border. For the eastern boundary, we measured 1500 feet from the eastern CBP wall. Any crime that occurred within the PSA serving the CPB but outside of this boundary was assigned to a separate geographic unit. We perform analyses on this natural CBP geographic unit as compared to all other PSAs in the city. The approach of counting crime around a node network is consistent with studies that use road networks to examine the spatial patterns of crime (Davies and Johnson 2015).

To provide an additional comparison, we also measured boundaries of comparable dimensions around popular sports bars in Philadelphia. Specifically, we take the center point of each sports bar and draw an equal distance in feet (1500 North, West, East, and 1900 South). These bars draw Phillies fans on game nights but do not stop selling alcoholic beverages at the end of the seventh inning. This comparison allows us to examine whether game-specific dynamics (e.g., especially exciting games) affect crime among drinking sports fans independent of the alcohol service policy in ways that might be coincidentally related to game duration. Admittedly, any choice of what sports bars to compare with CBP

<sup>10</sup> <https://www.opendataphilly.org/dataset/crime-incidents>.

<sup>11</sup> The block designated 9806 on this map [https://www2.census.gov/geo/maps/dc10map/tract/st42\\_pa/c42101\\_philadelphia/DC10CT\\_C42101\\_003.pdf](https://www2.census.gov/geo/maps/dc10map/tract/st42_pa/c42101_philadelphia/DC10CT_C42101_003.pdf).

<sup>12</sup> There are 66 PSAs in Philadelphia. PSAs are police patrol boundaries within police districts that were designed to be reflective of neighborhood boundaries as part of the Philadelphia Police Department's shift to community police.

<sup>13</sup> <https://www.phillypolice.com/districts/3rd/index.html>.

will be arbitrary. While the choice of sports bars is ad hoc, any game-induced drinking and crime effect should be exhibited around most sports bars.

To aggregate across time, we defined the relevant time period for each day's crime as being the time of the game's last out plus 1 h.<sup>14</sup> For days where no game was played, we define the time window as 10 p.m. to 11 p.m. which approximates the hour-long period after a standard game (which generally runs from 7 p.m. to 10 p.m.). In subsequent analyses, we expanded this window to include the game time itself as well as the 2, 3, 4, and 5-h windows after the last pitch. For away games, which we use as comparisons, we used the same timing approach but shift the time if the game was played outside of the Eastern Time Zone. We drop days in which double-headers are played and those that were delayed because of rain.<sup>15</sup> We only examine days during baseball's regular season from April through October, omitting pre-season games and playoff games.

The available data on baseball games does not provide a specific time when innings begin (other than the 1st) or end (other than the last). There is no way from public data to reliably measure how much of a game's duration occurs after the seventh inning.<sup>16</sup> To address this limitation, we measure game length using two proxies. First, we examine whether the game goes into extra innings because the score was tied at the end of the 9th inning. As shown in Fig. 1, extra-inning games are substantially longer, clocking in at an average of 228 min compared to 174 min for games without extra innings. The difference of almost 1 h would allow an average person the ability to process about one more alcoholic drink,<sup>17</sup> suggesting that some share of spectators could sober up and reduce the effects of alcohol consumption on crime.

We included a measure the number of pitches thrown after the seventh inning as a proxy for the length of the game after alcohol sales cease. The number of pitches thrown in an inning is a good proxy for duration, as the correlation coefficient between the duration of a game and total pitches thrown exceeds 0.90, and complete pitch counts by inning are publicly recorded.

Table 1 provides descriptive statistics for crime counts per day for the period lasting from the end of the baseball game to 1 h later (10 p.m. to 11 p.m. for non-game days) in the CBP census block and all other census blocks for both the baseball season period and days when a home game is played in Philadelphia. While crime is generally higher around CBP during baseball season, the differential is much larger in the CBP census block on home game days.<sup>18</sup>

<sup>14</sup> The generally available baseball game data have a specific time of first pitch and a total time of game from the first pitch to the final out, but do not include a time of the last out. To determine the time of the last out, we added the game time to the first pitch time.

<sup>15</sup> The generally available baseball statistics do not note which games have rain delays. We purchased information on rain delay time from Stats Perform (formerly Stats LLC), a data provider for MLB. From 2006–2015, the Phillies played 54 games where there was rain delay time. While it might be interesting to include the variation induced by rain delays (with post seventh inning delays adding to the time when alcohol is not sold), the Stats Perform data do not note specifically when the delay time occurs. Also, since many fans leave the stadium when there is a rain delay, crime data on those days is likely not comparable.

<sup>16</sup> While time stamped pitches are now available for more recent years, they are not available throughout our sample period.

<sup>17</sup> See, for example, <https://www.nhs.uk/common-health-questions/lifestyle/how-long-does-alcohol-stay-in-your-blood/>.

<sup>18</sup> A simple difference-in-difference estimate (i.e., the coefficient on the CBP and home game interaction using the CBP indicator and home game indicator as covariates) yields the following coefficients and robust standard errors: total 0.136 (0.024); assault 0.035 (0.010); theft 0.011 (0.005); liquor 0.014 (0.007); and disorderly conduct 0.009 (0.006).

In our subsequent empirical analyses, in addition to comparing the CBP census block to the other census blocks in the city and comparing games that are relatively long after the seventh inning to those that are not, we also exploit comparing home and away games since the underlying alcohol policy obviously will be irrelevant on days the game is not played at CBP. To support the home and away game comparison, Table 2 provides descriptive statistics about Phillies games during our sample period broken down by home and away games. For most measures, home and away games are comparable.

## Empirical Models

To estimate the impact of alcohol consumption on crime around the Citizens Ball Park (CBP) we employ a differences-in-differences type design, which compares changes in crime around CBP on home game days when they extend into extra innings to away game days and to other areas of Philadelphia not located near CBP between 2006 and 2015. We estimate changes in total reported crime, assaults, theft, liquor violations, and disorderly conduct. We focus on these subcategories of total crime as they are most likely to be influenced by excessive alcohol consumption in stadiums. As previously noted our geographic unit of analysis (denoted by  $i$ ) are aggregations of crime counts at the census block, PSA, road network, and boundary distance for each day of observation. We use only days (denoted by  $t$ ) during the baseball regular season (April–October) and drop days entirely if the Philadelphia Phillies played a double header (24 days) or a game that had any rain delay time (54 games). Our primary specification estimates the count of crime on a given game day ( $t$ ) within a specific geographic unit ( $i$ ) around the CPB according to the following form:

$$Y_{it} = \alpha + \beta_1 Extra_t * CBP_i * Home_t + \beta_2 Extra_t * CBP_i + \beta_3 CBP_i * Home_t + \sum_{i=1}^N \mu_i + \sum_{t=1}^T \tau_t + \varepsilon_{it} \quad (1)$$

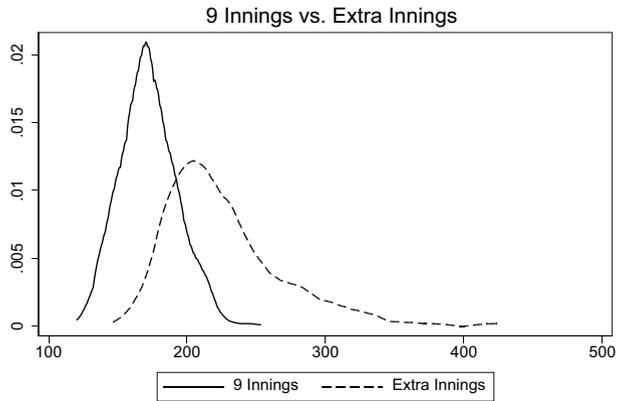
For model (1)  $Y_{it}$  represents the count of crimes, and  $\beta_1$  captures the treatment effect of the extra innings during home game days at CBP. Model (1) also accounts for the potential effect of average differences in crime on days with extra-inning games ( $\beta_2$ ). This effect is necessary since an extra inning game will push the observation window later in the day. If crime in the CBP area exhibits time of day heterogeneity, this term will adjust for that effect. Model (1) also includes an interaction that allows for differential crime in the CBP area on home game days ( $\beta_3$ ), and fixed effects for the day ( $t$ ) and geographic unit ( $i$ ) in the sample to control for period and geographic specific differences in crime. Standard errors are clustered at the location level to account for dependence within areas.

While it is not generally possible, using historic public data, to parse out how much game time occurs after the seventh inning, it is possible to know how many pitches were thrown by inning. Because of the high correlation between pitches thrown and the game's duration ( $\rho > 0.9$ ), we can use pitches thrown after the seventh inning as a time proxy for the extra-game time.<sup>19</sup> To estimate the effect extra-pitches after the seventh inning we estimate a second model according to the following form:

$$Y_{it} = \alpha + \beta_1 PitchesAfter7th_t * CBP_i * Home_t + \beta_2 PitchesAfter7th_t * CBP_i + \beta_3 CBP_i * Home_t + \sum_{i=1}^N \mu_i + \sum_{t=1}^T \tau_t + \varepsilon_{it} \quad (2)$$

<sup>19</sup> We only focus on game days since non-game days cannot provide us with a pitches thrown number or a reliable proxy.

**Fig. 1** Game length (in min)



**Table 1** Crime descriptive statistics (Citizens Bank Park Census Block vs. Other Philadelphia Census Blocks)

Time Period Equals Game End Time Plus One Hour

Time period equals 10 p.m. through 11 p.m. for non-game days

(standard deviations in parentheses)

	CBP Block	Non-CBP Blocks	Difference	CBP Block	Non-CBP Blocks	Difference
	Entire baseball season period			Home game days only		
Total crime	0.1322 (0.4774)	0.0243 (0.1959)	0.1079 (0.0103)	0.2179 (0.5998)	0.0241 (0.1935)	0.1937 (0.0213)
Assault	0.0360 (0.2099)	0.0037 (0.0631)	0.0323 (0.0045)	0.0579 (0.2544)	0.0038 (0.0642)	0.0579 (0.0090)
Theft	0.0107 (0.1031)	0.0017 (0.0422)	0.0090 (0.0022)	0.0176 (0.1317)	0.0018 (0.0427)	0.0159 (0.0047)
Liquor Violations	0.0065 (0.1331)	0.0001 (0.0178)	0.0064 (0.0029)	0.0151 (0.2065)	0.0001 (0.0189)	0.0150 (0.0073)
Disorderly Conduct	0.0131 (0.1216)	0.0005 (0.0239)	0.0126 (0.0026)	0.0189 (0.1536)	0.0005 (0.0245)	0.0184 (0.0055)
Observations	2,140	2,856,900		794	1,059,990	

Data provided by Philadelphia Police Department and available publicly at <https://www.opendataphilly.org/dataset/crime-incidents>. Data cover 2006–2015. Baseball Season covers April through October. Only regular season games are included in game data. For games played in the Eastern time zone, the time period covered is the time of the last pitch plus one hour. For games played in different time zones, the time period covered is the time of the last pitch converted to Eastern time plus one hour. For non-game days, the time period covers 10:00 p.m. to 11 p.m

In model (2)  $\beta_1$  captures the treatment effect of extra-pitches after the seventh inning during home games at CBP. Model (2) also includes the two-way interaction terms for pitches thrown after the 7th inning\* CBP ( $\beta_2$ ) and home games\*CBP ( $\beta_3$ ), so that we are identifying changes in crime in CBP on home games and after pitches extend into the seventh inning.

**Table 2** Descriptive statistics for Phillies games (Home v. Away)

	Home	Away
Phillies' record	0.545 (0.498)	0.503 (0.500)
Total pitches – mean	293 (45)	294 (41)
Pitches after seventh inning – mean	68 (37)	68 (32)
Duration in minutes – mean	178 (30)	178 (28)
Attendance – mean	38,440 (8,293)	31,735 (9,793)
Start time – mode	7:07 p.m	7:09 p.m
Games – total	741	778
Extra inning games – total	75	81

Data compiled from <https://www.baseball-reference.com/teams/PHI/> game logs. Data cover 2006–2015. Only regular season games are included in game data. Game days that include a double header or games with rain delay time are excluded from the data. Standard deviations in parentheses

There are potential concerns with inference drawn from using the length of a game. First, a longer game associated with more pitches will push the end of the game analysis period to later in the day. If the CBP census block experiences a differential crime profile by time of day from the other census blocks, we might be confounding this effect with our treatment effect, even though the two-way interaction of for pitches after the 7th inning \* CPB somewhat adjusts for the time of day effect. Second, fans might be more apt to leave before the last out for very long games or games that extend relatively late into the night. To examine these issues, we also estimate regressions with the following form<sup>20</sup>:

$$\begin{aligned}
 Y_{it} = & \alpha + \beta_1 PitchesAfter7th_t * CBP_i * Home_t + \beta_2 PitchesAfter7th_t * CBP_i \\
 & + \beta_3 CBP_i * Home_t + \beta_4 Length_t * CBP_i * Home_t \\
 & + \beta_5 Length_t * CBP_i + CBP_i \sum_{h=14}^{29} EndHour_h + \sum_{i=1}^N \mu_i + \sum_{t=1}^T \tau_t + \varepsilon_{it}
 \end{aligned}
 \tag{3}$$

Model 3 adds in a control for length of game interacted with CBP and home game indicators ( $Length_t * CBP_i * Home_t$ ), the length of game and CBP interaction ( $Length_t * CBP_i$ ), and a separate set of dummy variables for the hour in which each game ended (games end anywhere from 2 p.m. eastern through 5 a.m. eastern) interacted with the CBP indicator.

Developments In the field of econometrics suggest there are reasons to be concerned with standard inference approaches in difference-in-differences estimators when there are only a few treatment units, likely resulting in an under-rejection of the null hypothesis (Cameron et al. 2008; Conley and Taber 2011; MacKinnon and Webb 2019). With this in mind, we present one and two-sided *p* values<sup>21</sup> that arise from running the regressions repeatedly (1336 times; one for each census block) and using each non-CBP census block

<sup>20</sup> We also examined specifications that use total pitches to proxy for game duration, observing similar results.

<sup>21</sup> We present the *p*-values from the *t* statistics as suggested by MacKinnon and Webb (2019), though inferences are largely unchanged if we relied on placebo coefficients.

as a placebo treatment geographic unit (*i*). This approach is often referred to as randomization inference (MacKinnon and Webb 2018) or permutation tests for generating a reference distribution, dating back to Fisher's idea of exact inference (Ernst 2004).<sup>22</sup>

## Results

Table 3 shows the estimated effect of extra innings on total crime, assaults, theft, liquor, and disorder offenses from model (1) at the census block level. The results show that crime is reduced substantially in the CBP census block when the baseball game goes into extra innings. This is consistent with the hypothesis that a longer time without alcohol (because of the seventh inning sale stoppage) lowers crime. The only exception is in the assault specification that restricts the sample to game days only, which actually exhibit a positive coefficient but is not statistically significant according to the permutation tests.

To further examine this hypothesis, we exploit the creation of the Xfinity Live! complex in the CBP parking lot in March 2012. The opening of this massive collection of bars potentially undercuts the alcohol sales stoppage rule, as spectators can easily continue their drinking a few feet away from the baseball stadium. To isolate the differential effect of the rule before Xfinity Live!, we estimate our regression adding terms interacted with a pre-2012 indicator (for the treatment effect and the lower level interactions to allow for the possibility that these effects change in the 2012 plus period). We also allow for pre and post-2012 census block fixed effects, which allows for the possibility that baseline crime changes by census block in the post-2012 period. Essentially, the treatment effect for the pre-2012 period tells us how much more of an effect of extra innings there was before 2012 compared to the overall effect of extra innings.

Table 4 focuses on assaults, given their importance in the literature on alcohol and crime, but results are qualitatively similar if we examine the other crime categories as well.

Overall, the effect of extra innings is to raise crime on home game days in the CBP area, but this effect is more than offset in the period where the alcohol policy increases the time people are kept from drinking. That is, the magnitude of the negative pre-2012 effect is statistically larger than the magnitude of the positive baseline effect ( $p < 0.01$ ). This suggests that opening Xfinity Live completely undoes the crime-reducing effects of the alcohol stoppage policy in the ballpark.

As previously noted in Fig. 1, focusing on just extra-inning games ignores substantial variation in actual game times. While extra-inning games are longer on average, there is considerable overlap in the distributions of game duration between 9-inning games and extra-inning games that could be usefully examined. Table 5 shows the results for model (2) that estimates the effect of pitches after the seventh inning. As with the extra innings specification, the baseline effect of games that are longer after the 7th inning (as proxied by pitches thrown after the 7th inning) is to increase crime, but the pre-2012 pitches after the 7th inning effect more than counteracts this baseline. The magnitude of the pre-2012 after the 7th pitches effect is significantly larger than the overall late pitches effect ( $p < 0.01$ ).

<sup>22</sup> Randomization inference or permutation tests are increasingly being used in criminology applications like this one (see Kurland et al. 2014; Ridgeway & MacDonald 2017).

**Table 3** Effect of extra innings on crime

	Dependent variable [mean for CBP below]					Observations
	Total	Assaults	Theft	Liquor	Disorder	
	[0.13]	[0.03]	[0.01]	[0.01]	[0.01]	
	Coefficients					
All days included	−0.14*** (0.0008)	−0.02*** (0.0002)	−0.02*** (0.0002)	−0.02*** (0.00006)	−0.02*** (0.00008)	2,760,176
permutation <i>p</i> (t Stat) 1-sided	<0.001	<0.005	<0.006	<0.001	<0.001	
Permutation <i>p</i> (t stat) 2-sided	<0.003	<0.032	<0.015	<0.004	<0.007	
Only game days included	−0.06*** (0.0010)	0.01*** (0.0003)	−0.01*** (0.0002)	−0.02*** (0.00006)	−0.01*** (0.0001)	2,029,384
permutation <i>p</i> (t Stat) 1-sided	<0.058	<0.198	<0.060	<0.001	<0.033	
Permutation <i>p</i> (t stat) 2-sided	<0.101	<0.456	<0.110	<0.004	<0.057	

Each cell represents the coefficient on the treatment interaction (Extra Inning \* Home Game \* CBP) from a separate regression. All models include two-way interactions (Extra Inning\*CBP and Home Game\*CBP) and fixed effects for census block and calendar dates (Data cover 2006–2015. Only regular season games are included in game data. Game days that include a double header or games with rain delay time are excluded from the data. For games played in the Eastern time zone, the time period covered is the time of the last out plus one hour. For games played in different time zones, the time is converted to Eastern time. For non-game days, the time period covers 10:00 p.m. to 11 p.m.). Standard errors are clustered at census block level

\*\*\* $p < 0.01$  (against two-tailed test of zero effect)

\*\* $p < 0.05$  (against two-tailed test of zero effect)

\* $p < 0.10$  (against two-tailed test of zero effect)

Since it seems fairly clear that the effect we posit is a pre-Xfinity Live! effect, in the following analyses, we limit attention to the pre-2012 period.

As we suggested before, our effect might be confounded by the fact that, all other things equal, games that go longer after the 7th inning will end later in the evening. Since our period of investigation begins when the game ends, perhaps we are merely picking up lower crime later in the evening. This may occur because of an idiosyncratic temporal crime profile in CBP or because fans tend to leave longer games earlier which could manifest as lower crime rates at the end of a game.

To examine this, Table 6 shows the estimated effect of extra innings pitches on assaults from model (3) at the census block level for the pre-2012 period that includes controls for time effects. In these specifications, we explicitly adjust for the time-of-day effect by either including CBP-specific dummy variables for the hour the game ends, a CBP-specific covariate capturing how long the entire game was, or both of these. The results show a negative relationship between the number of pitches thrown after the 7th inning and assaults, suggesting that the effects of extra pitches after the seventh inning on reducing assaults is not being driven either by differential time profiles in the CBP census block or by fans leaving longer games early.

**Table 4** Effect of extra innings on assaults

Before and After Xfinity Live! Opens			
	Baseline extra innings effect	Additional pre-2012 extra innings effect	Observations
Extra innings*Home game*CBP coefficient	0.04*** (0.0004)	-0.05*** (0.0006)	2,029,384
Permutation <i>p</i> (t stat) 1-sided	<0.028	<0.022	
Permutation <i>p</i> (t stat) 2-sided	<0.064	<0.047	

The regression includes the baseline extra innings effect (Extra Innings\*Home Game\*CBP) and the lower-level interactions (Extra Innings \* CBP and Home Game\*CBP) as well as each of those interacted with a pre-2012 indicator (Pre-2012\*Extra Innings\*Home Game\*CBP, Pre-2012\*Extra Innings\*CBP, and Pre-2012\*Home Game\*CBP). The regression also includes date fixed effects and separate fixed effects for each census block for the pre and post-2012 period (i.e., two separate fixed effects for each census block). Only game days are included in the sample

\*\*\* $p < 0.01$  (against two-tailed test of zero effect)

\*\* $p < 0.05$  (against two-tailed test of zero effect)

\* $p < 0.10$  (against two-tailed test of zero effect)

**Table 5** Effect of Pitches After 7th Inning on Assaults

Before and after Xfinity Live! Opens			
	Baseline late pitches effect	Additional pre-2012 late pitches effect	Observations
Pitches after 7th inning*Home game*CBP coefficient	0.0006*** (0.000004)	-0.001*** (0.000005)	2,029,384
Permutation <i>p</i> (t stat) 1-sided	<0.003	<0.001	
Permutation <i>p</i> (t stat) 2-sided	<0.007	<0.001	

The regression includes the baseline late pitches effect (Pitches After 7th Inning\*Home Game\*CBP) and the lower-level interactions (Pitches After 7th Inning \* CBP and Home Game\*CBP) as well as each of those interacted with a pre-2012 indicator (Pre-2012\*Pitches After 7th Inning\*Home Game\*CBP, Pre-2012\*Pitches After 7th Inning\*CBP, and Pre-2012\*Home Game\*CBP). The regression also includes date fixed effects and separate fixed effects for each census block for the pre and post-2012 period (i.e., two separate fixed effects for each census block). Only game days are included in the sample

\*\*\* $p < 0.01$  (against two-tailed test of zero effect)

\*\* $p < 0.05$  (against two-tailed test of zero effect)

\* $p < 0.10$  (against two-tailed test of zero effect)

Using the post 7th inning pitch count average of 68, these specifications indicate that the alcohol sales policy generally reduces assaults by between 40 and 70 percent, relative to the CBP game day assault average pre-2012.

**Table 6** Effect of pitches after 7th inning on assaults including time effects

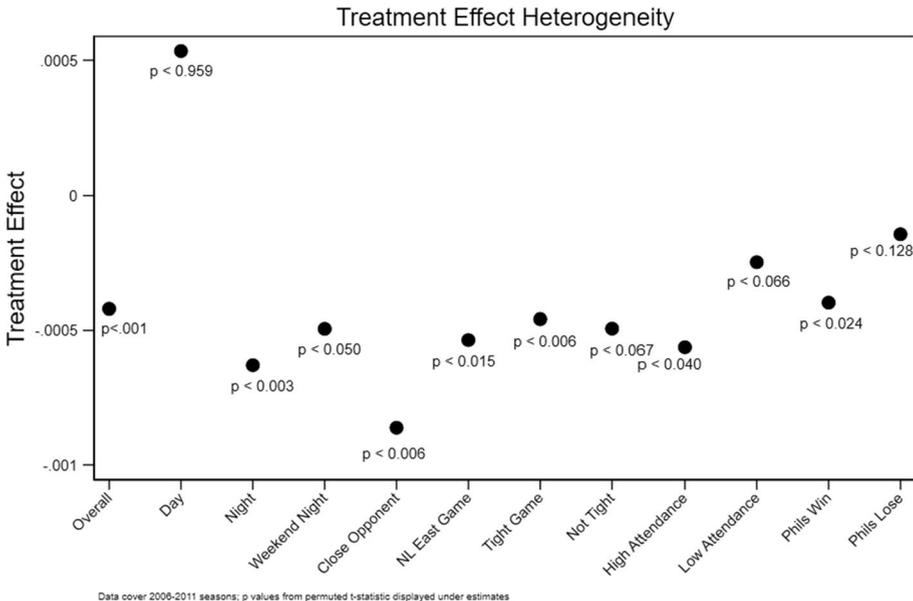
	Pre-2012 game days only		
Pitches after 7th inning * Home game * CBP	-0.0005*** (0.000003)	-0.0007*** (0.000005)	-0.0008*** (0.000005)
permutation <i>p</i> (t stat) 1-sided	<0.001	<0.003	<0.002
permutation <i>p</i> (t stat) 2-sided	<0.006	<0.009	<0.003
Ending hour dummies	Yes	No	Yes
Length of game controls	No	Yes	Yes
Implied reduction in Assaults for average game	-0.03	-0.05	-0.06
Implied percentage Reduction	-42%	-58%	-69%
Observations	1,205,072		

Each cell represents the coefficient on the treatment interaction (Pitches After 7th Inning \* Home Game \* CBP) from a separate regression. All models include two-way interactions (Extra Inning\*CBP and Home Game\*CBP) and fixed effects for census block and calendar dates. The length of game controls include the interaction between the length of the game in minutes and the CBP and home game indicators as well as the interaction between the length of the game in minutes and the CBP indicator alone. The ending hour dummies are separate dummies for each hour in which a game ends interacted with the CBP indicator. Standard errors clustered at census block level

\*\*\**p* < 0.01 (against two-tailed test of zero effect)

\*\**p* < 0.05 (against two-tailed test of zero effect)

\**p* < 0.10 (against two-tailed test of zero effect)



**Fig. 2** Treatment effect heterogeneity

## Effect Heterogeneity

Figure 2 presents evidence from variants of model (3) for whether there is effect heterogeneity of pitches after the seventh inning on assaults by day games (perhaps because day games often involve substantial tailgating in the parking lots during which alcohol is often consumed), night games, weekend nights, games against geographically close opponents<sup>23</sup> (more visiting team fans could add to alcohol-induced aggression), tight games (decided by three or fewer runs<sup>24</sup>), high game attendance (above the 75th percentile),<sup>25</sup> and when the Phillies win or lose. The point estimates show a larger effect when the game has high attendance, which presumably increases the likelihood of problematic encounters. Figure 2 also shows the one-sided (left-hand tail) *p* values for the *t* statistics from the estimates generated from permutation. We do not observe a difference in the effects estimated in games that have close scores or games that are less competitive. This is important since fans are less likely to leave a close game early, suggesting that our results are not driven by fans departing longer games before the final out.

## Different Time Windows

Although it seems sensible to examine the period just after the baseball game ends, the effects of the alcohol policy could extend through longer time periods. If we were to observe growing effects as time goes on, it would cast doubt on the causal interpretation of our findings. Figure 3 shows the treatment effect estimates from our Eq. 2 specification during the pre-2012 period for the previously examined 1 h after the game, as well as the inclusive periods extending through 2, 3, 4, and 5 h after the last out. We also provide an estimate for the period the game is played. As expected, the largest implied assault reduction is for the hour immediately following the game, and the estimated proportionate reduction declines from there. Also, we find virtually no treatment effect while the game is being played, suggesting that we are not merely finding a coincidental correlation between low crime days and games that happen to go long.

## Different Geographic Boundaries

While the census block region is a useful starting point since CBP is wholly contained within a specific census block, we also examine the larger Philadelphia police service areas (PSAs) to assess if the treatment effect estimates expands beyond the area immediately surrounding CBP. We also rely on the geographic unit that follows the natural transportation network as previously described.<sup>26</sup> This bespoke unit covers much of the CBP census block but it cuts off the largely inaccessible NovaCare Complex (Philadelphia Eagles practice facility) and extends its boundary farther East (as the census block's eastern boundary lies

<sup>23</sup> The New York Mets, New York Yankees, Baltimore Orioles, and Washington Nationals are all within a 2.5 h drive of CBP.

<sup>24</sup> This margin is used by the MLB to designate a game as a save situation.

<sup>25</sup> We use the 75th percentile attendance figure of 45,135 to designate a game as high attendance.

<sup>26</sup> We constructed a CBP treatment area that better approximated the natural boundaries of the stadium. We aggregate crime in the area around the ballpark between I-76 in the North, I-95 in the South, Broad Street to the West, and a 1500 feet distance to the East. We then keep all of the other census blocks constant. This re-organizing of the data allows us to construct a tighter boundary around the ballpark, perhaps shoring up confidence that any observed effect is driven by the drinking policy.

exactly on the eastern edge of the stadium itself). Figure 4 presents the pre-2012 treatment effects from the three different geographic aggregations (census blocks, PSAs, bespoke CBP region and other census blocks) for the Eq. 2 specification.

As expected, the larger PSA unit exhibits both a smaller proportional effect and substantially less precision in its estimate. The bespoke area shows a coefficient that is larger in magnitude and a larger proportional effect. These results suggest that the effect we identify is tightly concentrated around the ballpark.

Table 7 shows the results from the final comparison of the effect around CPB to 10 sports bars throughout the city.<sup>27</sup> This comparison is particularly useful since sports bars will attract baseball spectators, but unlike CPB, bars do not stop serving alcohol after the seventh inning. We find comparable statistically significant negative effects on assault even in this more tightly constructed comparison of sports bars. Though the small number of bars limits the usefulness of a permutation inference approach here, it is possibly worth noting that the CBP effect is more negative than every placebo effect.

## Conclusions

This paper set out to examine the causal effect of alcohol consumption on crime around a sports stadium. The seventh inning last call on alcohol sales provides a natural experiment to examine alcohol consumption and crime around a sporting event. The untimed nature of baseball games means that at some home games fans will have hours to sober up from drinking, whereas in others they may have only minutes from the last drink to when they depart from the stadium. Philadelphia offers an additional natural experiment in that the Xfinity Live! complex opened in 2012 effectively undoing the limit on alcohol sales near the stadium. Our analysis included multiple comparisons of crime around the CBP stadium, all showing that assault offenses generally drop on home game days that extend into extra-innings. The effects are most pronounced during time windows closest to the end of the game, and the effect appears to be undone by the arrival of Xfinity Live! that allows fans to continue to purchase and drink alcohol on the stadium grounds. Like other crime and place studies (Kurland and Johnson 2019), we examine crime at multiple geographic levels, which allows us to see how robust the results are to different levels of aggregation.

Considering that assaults are considerably higher on game days near the CPB stadium when alcohol consumption and the end of the game are closer in time, this suggests that alcohol is a generator of assaults around the stadium that result in calls to the police. The

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<sup>27</sup> Data cover 2006–2011. Only regular season games are included in game data. Game days that include a double header or games with rain delay time are excluded from the data. Non-game days are excluded for games played in the Eastern time zone, the time period covered is the time of the first pitch to the end of the game plus one hour. For games played in different time zones, the time period covered is the time of the first pitch converted to Eastern time through the end of the game plus one hour. Xfinity Live opened in the South Philadelphia Sports Complex (which includes Citizens Bank Park) parking lot in March 2012. The area around Citizens Bank Park goes West to Broad Street, South to I-95, North to I-76, and East for 1,500 feet. Comparisons are similar distances in each direction around the following sports bars: Cavanaugh's (Center City); Cavanaugh's (University City); Chickie's and Pete's (Robbins Avenue); Chickie's and Pete's (Roosevelt Avenue); Garage Fishtown; Leneghan's Crusader Inn (Northeast); the Manayunk Tavern; McGillin's Olde Ale House (Center City); Pub Webb (North Philadelphia); and Standard Tap (Northern Liberties).

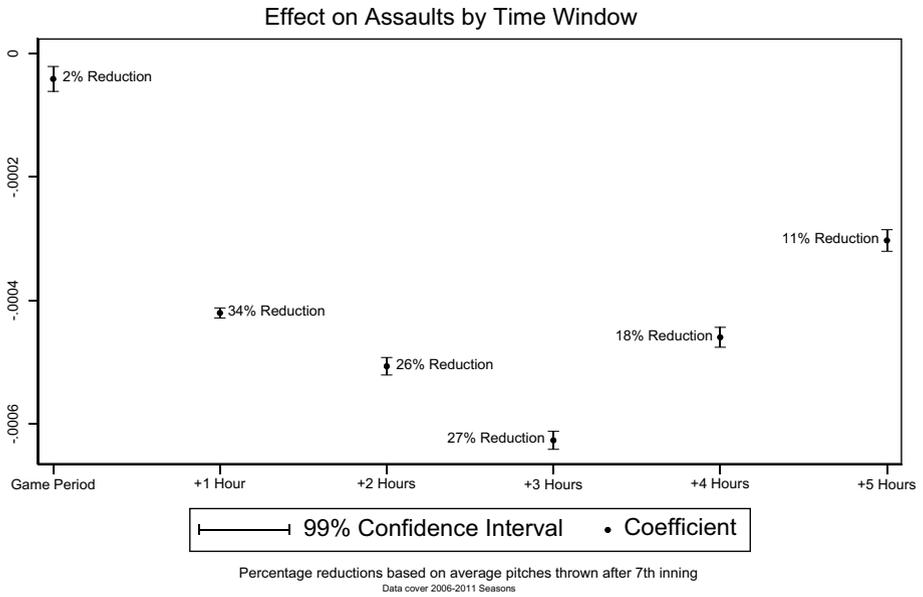


Fig. 3 Effect on assaults by time window

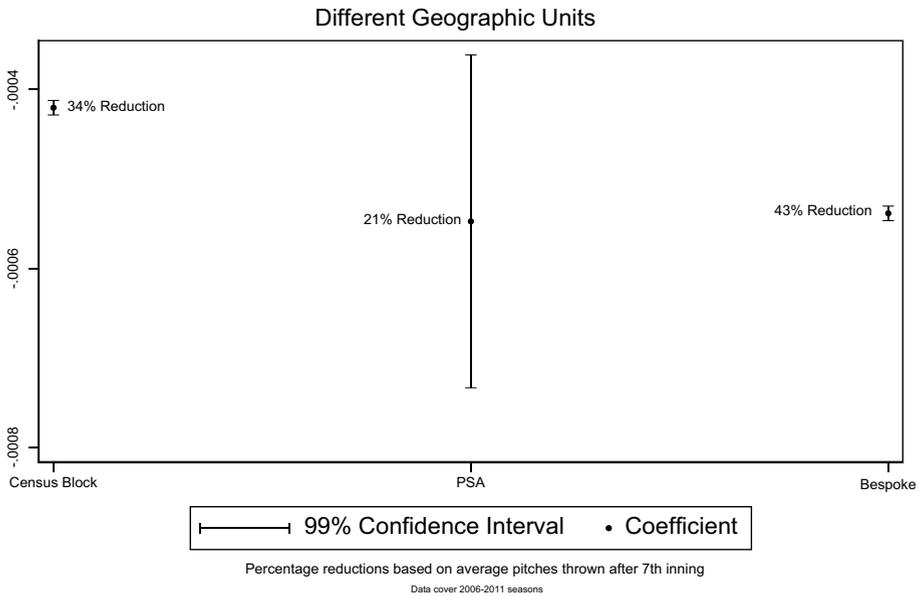


Fig. 4 Different geographic units

effect is clear given that we see no similar reduction in crime around sports bars or other areas of Philadelphia when games go relatively long after the seventh inning. This work extends other research in suggesting that sports stadiums are crime generators (Billings and

**Table 7** Assault effect in CBP area compared with sports bars

Late Pitches * Home * CBP Natural boundary	-0.0005*** (0.0001)	-0.0006*** (0.0001)	-0.0007*** (0.0002)	-0.0008*** (0.0002)
Ending hour dummies	No	Yes	No	Yes
Length of game controls	No	No	Yes	Yes
Implied reduction in Assaults for average game	-0.03	-0.04	-0.05	-0.06
Implied percentage reduction	-38%	-44%	-56%	-64%
Observations	9,800			

Each regression includes controls for “Late Pitches \* CBP,” “Home \* CBP,” “Total Pitches \* Home \* CBP,” and “Total Pitches \* CBP” terms, as well as date and bar area fixed effects. The length of game controls includes the interaction between the length of the game in minutes and the CBP and home game indicators, as well as the interaction between the length of the game in minutes and the CBP indicator alone. The ending hour dummies are separate dummies for each hour in which a game ends interacted with the CBP indicator. Standard errors clustered at bar level

\*\*\* $p < 0.01$  (against two-tailed test of zero effect)

\*\* $p < 0.05$  (against two-tailed test of zero effect)

\* $p < 0.10$  (against two-tailed test of zero effect)

Depken 2011; Kurland et al. 2014; Marie 2016; Kurkland and Johnson 2019; Vandeviver et al. 2019; Campaniello 2013; Munyo and Rossi 2013), an effect that our estimates imply are caused by alcohol consumption. Stadiums with alcohol may then be considered one of many episodic crime generators in a city, much like bars that serve multiple drinks to patrons just before closing and let crowds hang around outside afterward (Graham et al. 2006; Graham and Homel 2012). These results lend further support for environmental criminology theories that emphasize situational opportunities that increase the risk for criminal offenses (Wilcox and Cullen 2018). Like the work by others that find sports stadiums are facilitators of crime nearby (Kurland and Johnson 2019), this work suggests that serving alcohol during MLB games closer to the end of the game generates crime.

This study suggests policy implications for curtailing violence associated with drinking alcohol at baseball games. Considering the influence that serving alcohol closer to the end of the game has for amplifying assaults on home game days, with no evidence of similar effects elsewhere in Philadelphia, this implies a few potential avenues for policy. One implication is that more effort may be needed to minimize loitering of drunk people outside of the stadium at the end of the game. Additionally, the presence of police in specific locations outside the stadium may be warranted. Reducing queuing outside bars with rowdy patrons has been noted as an effective approach to reducing assaults (Graham and Homel 2012). Hot spot policing experiments show that placing police temporarily in high crime locations helps thwart crime (Weisburd et al. 2012). Whether such approaches would be effective for reducing assaults around MLB stadiums warrants controlled field experiments, as both approaches may prove to be less costly than curtailing alcohol sales in stadiums.

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