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College Football Games and Crime

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There is a great deal of anecdotal evidence that college football games can lead to aggressive and destructive behavior by fans. However, to date, no empirical study has attempted to document the magnitude of this phenomenon. We match daily data on offenses from the National Incident-Based Reporting System to 26 Division I-A college football programs to estimate the relationship between college football games and crime. Our results suggest that the host community registers sharp increases in assaults, vandalism, arrests for disorderly conduct, and arrests for alcohol-related offenses on game days. Upsets are associated with the largest increases in the number of expected offenses.

Keywords: *college football; crime; aggression; alcohol; drinking*

> Fierce fighting on the football field and in the streets of this town for two hours was the result this afternoon of the game . . . members and followers of both teams were cut by blows from clubs, bricks, canes, and any other weapons that were handy, townsfolk and students joining in the melee.
>
> *New York Times, Nov. 22, 1903*

Introduction

College football is enormously popular in the United States, and there is evidence that its appeal is growing. In 1998, college football games attracted 37.4 million spectators. By 2006, attendance had risen to 47.9 million.[1] Of the 20 largest stadiums located in the United States, 19 are devoted to the sport, and there are plans to expand the capacity at a number of college football stadiums in the coming years.[2]

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As the popularity of college football increases, so do concerns with regard to the behavior of its fans. According to observers, the charged "winner-take-all" atmosphere often leads to violent behavior and even riots (MacDonald, 2004). In an effort to discourage heavy drinking and "associated unruliness" during and after games, the majority of Division I-A schools currently prohibits stadium sales of alcoholic beverages (Wieberg, 2005). In August of 2005, the National Collegiate Athletic Association (NCAA, 2005) recommended that all schools ban the sale of alcohol at sporting events.

A number of previous studies have attempted to estimate the benefits that accrue to communities from hosting sporting events. We know much less about the economic and social costs associated with hosting sporting events.[3] For instance, despite anecdotal reports of physical altercations during and after college football games, there has been no attempt to systematically document the relationship between college football games and criminal/delinquent behaviors. Moreover, there has been surprisingly little study of the relationship between other types of sporting events and such behaviors, although a number of psychological theories suggest that sporting events in general, and especially those that involve high levels of violence, might cause fans to act more aggressively than they would otherwise.[4]

In this study, we examine daily offense data from 26 police agencies over the course of six football seasons (2000-2005). Each of these agencies had jurisdiction over a community in which a Division I-A college football team played its home games. Our interest is in whether assaults and other offenses such as vandalism departed from their normal pattern on game days. Specifically, we examine *changes* in the number of offenses reported by a particular police agency when the football program located in the community under its jurisdiction played a home game and *changes* in offenses when the program played an away game. In addition, we investigate whether the outcome of the game affects the estimated relationship between game days and offenses and explore the role of team rank. Finally, we experiment with introducing lags into the empirical model.

Our results suggest that the host community registers sharp increases in assaults on game days. In addition, there is evidence that vandalism, arrests for disorderly conduct, and alcohol-related arrests increase on game days, but no support for the hypothesis that away games are related to offenses. The largest estimated effects are found when an upset occurs, defined as when an unranked team beat a ranked team or when a lower ranked team beat a higher ranked team.

Some portion of the relationship between home games and offenses may be mechanical in nature because of the fact that home games often attract a temporary, but substantial, influx of people from outside the host community. However, the results with regard to upsets suggest that fans react to the outcome of games. In the next section, we discuss the potential links between sporting events and crime, paying special attention to the psychological theories of spectator aggression and the potential role of alcohol consumption.

Sporting Events, Aggression, and Drinking

Clemson University is located in the small town of Clemson, South Carolina. Approximately 17,000 students attend Clemson University, and the town has a population of approximately 12,000. Yet, Clemson Memorial Stadium, which can seat more than 80,000 football fans, is often filled to capacity.

Obviously, college football games have the potential to draw thousands of spectators into relatively small communities. As the number of individuals in a community increases, so too do the opportunities for disputes and altercations having nothing to do with football. Our interest, however, goes beyond this sort of mechanical relationship. If away games, which presumably do not draw many spectators from outside the local community, are associated with changes in the number of offenses reported, this would suggest a more complex relationship between sporting events and crime. A similar argument could be made if the outcome of a game is found to affect the number of offenses.

Several theories from psychology offer explanations for aggressive, even criminal, fan behavior. For instance, according to the social learning theory (Bandura, 1973), under the right circumstances, simply observing a sporting event can be enough to trigger an act of aggression, regardless of the outcome of the event.[5] In contrast, the frustration-aggression hypothesis, first proposed by Dollard, Doob, Miller, Mowrer, and Sears (1939), predicts that fans will react aggressively only when their favorite team loses.[6]

Researchers have also explored the role played by alcohol consumption at sporting events. Although a large body of research documents that alcohol consumption can lead to aggressive behavior, there is no consensus as to why (Bushman & Cooper, 1990; Ito, Miller, & Pollock, 1996; Pederson, Aviles, Ito, Miller, & Pollock, 2002). There is, however, evidence that frustration intensifies the effect of alcohol on aggressive behavior (Ito et al., 1996), and speculation that, given certain triggers, intoxicated individuals will be more likely to exhibit what has been termed "displaced aggression" (Pederson et al., 2002).

College football games are often accompanied by daylong parties and heavy drinking. Neal and Fromme (2007) examined the data collected from students attending The University of Texas at Austin. They found that football game days were associated with substantial increases in the amount of alcohol consumed. Similarly, Glassman, Werch, Jobli, and Bian (2007) found that college football game days were associated with higher alcohol consumption than other "drinking occasions."

University administrators and NCAA committee members are clearly concerned about the problems caused by excessive drinking at sporting events. In fact, all the football programs represented in our sample had banned the sale of alcohol in their stadiums before the year 2000.

There is some evidence that banning alcohol can dampen the relationship between football games and aggressive fan behavior. After the University of Colorado, Boulder, prohibited stadium alcohol sales, game-day arrests, assaults, and ejections decreased significantly (Bormann & Stone, 2001). Another study showed a decrease in game-day drunk-driving arrests after Arizona State University implemented a ban on stadium sales of alcohol (Boyes & Faith, 1993). However, Spaite et al. (1990) found no change in the number of injuries or illnesses reported by medical aid stations after the consumption of alcohol was prohibited in the stadium of a popular collegiate football team.[7]

Data

There are 119 Division I-A NCAA football programs in the United States. We successfully matched daily offense data from the National Incident-Based Reporting System (NIBRS) with 26 of these programs for the period 2000-2005. The remaining programs were located in communities under the jurisdiction of a police agency that did not participate in the NIBRS data collection effort.[8]

Our sample is composed of college football programs of varying sizes and ranks from across a large swath of the United States. Table 1 presents descriptive information for the 26 programs examined. Most were located in small- to medium-sized communities (population <100,000), and most had stadiums that could seat between 30,000 and 70,000 spectators. Eleven programs were located in the Midwest, 10 were located in the South, and five were located in the West; 6 were ranked among the top 25 football programs in the United States by the College Football Data Warehouse for the period 2000-2005, 15 were ranked outside the top 25, and five were unranked.

College football teams typically start their seasons in late August or early September, and play their final regular-season games in late November or early December. Championship games are played in early December. With this schedule in mind,[9] we analyzed offenses occurring between August 20 and December 10. In all, 18 football programs in our sample were located in communities under the jurisdiction of an agency that reported daily offense data for the entire period under study. Of the 26 agencies, 8 provided data to the NIBRS for only a portion of this period.[10]

The final data set is composed of 14,926 agency days. A total of 1,516 football games are observed. Of these games, 92% were played on a Saturday, but no game was played on 35% of the Saturday observations; 4.8% of the games took place on a Thursday, and 4.0% took place on other days of the week (Table 2). In the empirical analysis below, we exploit this variation to distinguish day-of-the-week effects from the effect of game days on two Group A offenses (for which incident data are

Table 1
Characteristics of Schools/Football Programs in Sample

	Number
Region	
Southeast	7
Midwest	11
Southwest	3
West	5
Northeast	0
Community population	
<50,000	9
50,000–100,000	7
100,000–200,000	4
200,000–500,000	4
>500,000	2
Stadium size	
<30,000	2
30,000–50,000	9
50,000–70,000	7
70,000–90,000	6
>90,000	2
Ranking (2000-2006)	
1–25	6
25–50	6
50–75	4
75–125	5
Not ranked	5

available) and three Group B offenses (for which arrest data are available). These offenses are listed below.[12]

Group A Offenses
$Assault_{it}$ = assaults reported by agency *i* on day *t*.
$Vandalism_{it}$ = vandalism offenses reported by agency *i* on day *t*.
Group B Offenses
DUI_{it} = arrests for driving under the influence (DUI) reported by agency *i* on day *t*.
$Disorderly_{it}$ = arrests for disorderly conduct reported by agency *i* on day *t*.
$Liqour\ law_{it}$= arrests for liquor law violations reported by agency *i* on day *t*.[13]

Estimation

We estimate a negative binomial regression model as described by, for instance, Cameron and Trivedi (1986) and Grootendorst (2002), in which the number of

Table 2
Distribution of Game Days by Day of the Week

Day of Week	Games	Observations
Saturday	1,382	2,138
Sunday	5	2,132
Monday	1	2,133
Tuesday	7	2,135
Wednesday	12	2,137
Thursday	73	2,113
Friday	36	2,138
Total	1,516	14,926

offenses reported, y_{it}, is related to whether a college football game was played by the following equation:

$$\ln E(y_{it}) = \alpha + \delta_0 Home_{it} + \delta_1 Away_{it} + \beta' \mathbf{X}_{it} + v_i + \varepsilon_{it}, \quad (1)$$

where $Home_{it}$ is equal to 1 if the football program located in the community under agency i's jurisdiction played a home game on day t (and equal to 0 otherwise), and $Away_{it}$ is equal to 1 if the program located in the community under agency i's jurisdiction played an away game on day t (and equal to 0 otherwise); X_{it} includes controls for Thanksgiving and Labor Day as well as controls for day of the week, holiday weekends, month, and year; v_i is a vector of agency fixed effects,[14] which capture the influence of the time-invariant factors such as region; and $\exp(\varepsilon_{it})$ follows a γ distribution with mean of 1 and variance σ. If σ is assumed to equal 0, then the negative binomial reduces to the Poisson regression model, which is designed, and commonly used, for count data (Grootendorst, 2002). However, because the hypothesis $\sigma = 0$ was consistently rejected at the .01 level, we used the negative binomial regression model.

Results

Estimated negative binomial regression coefficients are reported in Table 3. Our interest is on the relationship between game days and the number of offenses reported in the NIBRS. Although not shown, controls for Thanksgiving, Labor Day, day of the week, holiday weekends, month, and year are included. Agency fixed effects are also included as covariates. Their inclusion on the right-hand side of the estimating equation ensures that the negative binomial regression coefficients are identified by within-agency variation over time.

Table 3
College Football Games and Number of Offenses

	Assaults	Vandalism	DUIs	Disorderly Conduct	Liquor Law Violations
Home game	0.086***	0.161***	0.126***	0.346***	0.566***
	(0.027)	(0.032)	(0.040)	(0.072)	(0.077)
Away game	0.007	0.025	0.017	−0.002	−0.051
	(0.027)	(0.033)	(0.041)	(0.075)	(0.079)
Agency fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	14,926	14,926	14,926	14,926	14,926
Groups	26	26	26	26	26
Log likelihood	−27,755.23	−28,259.54	−16,959.61	−15,035.21	−18,973.57

Notes: Estimated coefficients from a negative binomial regression model are reported. Standard errors are in parentheses. Although not shown, controls for day of the week, Thanksgiving, Labor Day, holiday weekends, month, and year are included. DUI = driving under the influence.
***$p \leq .01$.

There is no evidence that playing an away game influences the expected number of offenses reported by agency *i*. However, home games are associated with a 9% increase in assaults ($e^{0.086} = 1.090$), our best measure of aggressive behavior, and are associated with an 18% increase in vandalism ($e^{0.161} = 1.175$).[15]

There is also evidence of a relationship between home games and the number of Group B offenses reported. Specifically, home games are associated with a 13% increase in arrests for drunk driving, a 41% increase in arrests for disorderly conduct, and a 76% increase in arrests for liquor law violations.

The results presented in Table 3 strongly suggest that, in keeping with news reports and other anecdotal evidence, college football games impose a cost on the host community in the form of additional crime. We now address the question of whether the magnitude of this cost can be predicted by the outcome of the game.

Our first step in exploring whether the outcome of a game affects the number of offenses reported is to replace the variables $Home_{it}$ and $Away_{it}$ in equation (1) with four mutually exclusive indicator variables defined as follows:

$Home\ Game\ Win_{it} = 1$ if the program located in the community under agency *i*'s jurisdiction won a home game on day *t*, and = 0 otherwise.
$Home\ Game\ Loss_{it} = 1$ if the program located in the community under agency *i*'s jurisdiction lost a home game on day *t*, and = 0 otherwise.
$Away\ Game\ Win_{it} = 1$ if the program located in the community under agency *i*'s jurisdiction won an away game on day *t*, and = 0 otherwise.
$Away\ Game\ Loss_{it} = 1$ if the program located in the community under agency *i*'s jurisdiction lost an away game on day *t*, and = 0 otherwise.

Table 4
Winning Versus Losing

	Assaults	Vandalism	DUIs	Disorderly Conduct	Liquor Law Violations
Home game win	0.077***	0.150***	0.094**	0.345***	0.619***
	(0.029)	(0.036)	(0.043)	(0.079)	(0.085)
Home game loss	0.109***	0.186***	0.212***	0.351***	0.442***
	(0.042)	(0.049)	(0.061)	(0.104)	(0.111)
Away game win	0.014	0.029	0.024	−0.083	0.017
	(0.036)	(0.043)	(0.052)	(0.100)	(0.105)
Away game loss	0.001	0.022	0.012	0.054	−0.099
	(0.033)	(0.039)	(0.049)	(0.087)	(0.092)
Agency fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	14,926	14,926	14,926	14,926	14,926
Groups	26	26	26	26	26
Log likelihood	−27,754.91	−28,259.29	−16,957.90	−15,034.46	−18,971.97

Note: Estimated coefficients from a negative binomial regression model are reported. Standard errors are in parentheses. Although not shown, controls for day of the week, Thanksgiving, Labor Day, holiday weekends, month, and year are included. DUI = driving under the influence.
$^{**}p \leq .05$. $^{***}p \leq .01$.

The results of this exercise are reported in Table 4. The estimated negative binomial coefficients of *Away Game Win*$_{it}$ and *Away Game Loss*$_{it}$ are never statistically significant at conventional levels, a pattern of results that lead us to focus on home games, where there is evidence that losses lead to larger increases in the number of offenses than wins. For instance, home game losses are associated with a 12% increase in assaults, but home game wins are associated with only an 8% increase in assaults. To take another example, home game losses are associated with a 24% increase in DUIs, but home game wins are associated with only a 10% increase in DUIs. However, the results presented in Table 4 do not provide definitive evidence that the outcome of the game matters. In fact, in four of the five cases we cannot reject the hypothesis that estimated negative binomial coefficient of *Home Game Loss*$_{it}$ is equal to the estimated coefficient of *Home Game Win*$_{it}$. Losses at home are associated with more arrests for DUI than wins at the .10 level.

Every Sunday during the college football season, the Associated Press publishes a ranking of the top 25 football programs in the United States. It is based on voting by 65 sportswriters and broadcasters from across the country and is updated weekly.[16] In an effort to further explore the relationship between home games and offenses documented in Tables 3 and 4, we used the Associated Press rankings to distinguish upsets from other possible outcomes.

An upset win was defined as having occurred if the program located in the jurisdiction of agency *i* was unranked and beat a program ranked in the top 25 on day *t*, or

Table 5
The Relationship Between Upsets and Number of Offenses

	Assaults	Vandalism	DUIs	Disorderly Conduct	Liquor Law Violations
Home game upset win	0.308***	0.376***	0.572***	0.656***	0.782***
	(0.112)	(0.127)	(0.136)	(0.234)	(0.266)
Non-upset home game win	0.063**	0.108***	0.046	0.224***	0.419***
	(0.032)	(0.039)	(0.047)	(0.086)	(0.094)
Home game upset loss	0.755***	0.476***	0.451*	0.963***	0.263
	(0.141)	(0.182)	(0.243)	(0.331)	(0.376)
Non-upset home game loss	0.057	0.137***	0.202***	0.182	0.375***
	(0.045)	(0.052)	(0.065)	(0.112)	(0.119)
Agency fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	14,926	14,926	14,926	14,926	14,926
Groups	26	26	26	26	26
Log likelihood	−27,734.19	−28,240.85	−16,944.42	−15,014.53	−18,952.48

Note: Estimated coefficients from a negative binomial regression model are reported. Standard errors are in parentheses. Although not shown, controls for day of the week, Thanksgiving, Labor Day, holiday weekends, month, and year are included. In addition, indicators for away game outcomes are included. DUI = driving under the influence.
$^{*}p \leq .10$. $^{**}p \leq .05$. $^{***}p \leq .01$.

if the program located in the jurisdiction of agency i beat a higher ranked team on day t. An upset loss was defined as having occurred when the program located in the jurisdiction of agency i was ranked in the top 25 and was beaten by an unranked program on day t, or the program located in the jurisdiction of agency i was beaten by a lower ranked team on day t.

Table 5 presents estimates of equation (1) modified, so that the effect of upsets at home on offenses can be distinguished from the effect of other possible outcomes.[17] Although not shown, away games are also divided into upsets and non-upsets.[18]

Turning first to the Group A offenses, there is evidence that upsets lead to larger increases in assaults and vandalism than non-upsets. Expected assaults more than double with an upset loss at home, and increase by 36% with an upset victory. In contrast, non-upset losses at home are associated with a (statistically insignificant) 6% increase in assaults, and non-upset wins are associated with a 7% increase.[19]

The results for vandalism exhibit a similar pattern. Expected vandalism increases by 61% with an upset loss at home and by 46% with an upset win. Games played at home that did not produce an upset are associated with statistically significant but much smaller increases in vandalism.[20]

The Group B results provide additional evidence that fan reactions are much stronger when upsets occurred. Expected arrests for disorderly conduct more than double with an upset loss at home and increase by 93% with an upset victory; non-upset losses at home are associated with a (statistically insignificant) 20%

increase in arrests for disorderly conduct, and non-upset wins are associated with a 25% increase in arrests for disorderly conduct.[21] Expected DUIs increase by 77% with an upset win at home and by 57% with an upset loss; non-upset wins at home are associated with a (statistically insignificant) 5% increase in DUIs, and non-upset losses are associated with a 22% increase.[22] Similarly, expected arrests for liquor law violations are highest in the event of an upset win or loss.[23]

Lagged Effects

Because previous studies by Phillips (1983) and Miller, Heath, Molcan, and Dugoni (1991) have argued that a sporting event can affect behavior days after it takes place, we introduce lagged values of the game variables to our analysis in Table 6. Specifically, we examine the effect of upsets and non-upsets at home with lags of 1 and 2 days. Again, our focus is on home games because up to this point in the analysis there has been little evidence that an away game played by the football program located in agency *i*'s jurisdiction affects the number of offenses reported by agency *i*.

Table 6 presents estimated negative binomial coefficients from a model with lags, and, for the purposes of comparison, estimated coefficients from a model without lags (originally presented in Table 4). In general, there is little support for the hypothesis that football games affect the number of offenses committed beyond the actual day they take place, although there is evidence that expected vandalism increases by 42% the day after an upset loss, and expected liquor law violations increased by 34% the day after a non-upset loss. These results raise the possibility that games may, under certain circumstances, affect the behavior of fans beyond midnight and into the following day.

Robustness Checks

A number of robustness checks were conducted. For instance, we interacted day of the week with the month indicators, and, in separate regressions, we controlled for agency-specific linear trends by interacting agency and year with a variable equal to 1 in August, 2 in September, 3 in October, and so forth. None of these experiments produced results qualitatively different from those discussed above. In addition, we created three region variables (Midwest, Southwest, Southeast) that were interacted with the day of the week and month indicators. Again, the negative binomial estimates were qualitatively equivalent to those reported above.

Estimates of the standard Poisson model produced results that were consistent in terms of magnitude with those presented in Tables 3–6 , but the estimated standard errors were typically much smaller. Previous researchers (see, for instance,

Table 6
Adding Lags to the Model

	Assaults		Vandalism	
Home game upset win$_t$	0.308*** (0.112)	0.255** (0.116)	0.376*** (0.127)	0.326** (0.132)
Home game upset win$_{t-1}$		0.113 (0.096)		0.171 (0.108)
Home game upset win$_{t-2}$		0.056 (0.080)		0.008 (0.103)
Non-upset home game win$_t$	0.063** (0.032)	0.025 (0.038)	0.108*** (0.039)	0.059 (0.046)
Non-upset home game win$_{t-1}$		0.013 (0.041)		0.044 (0.049)
Non-upset home game win$_{t-2}$		0.016 (0.036)		−0.007 (0.044)
Home game upset loss$_t$	0.755*** (0.141)	0.692*** (0.145)	0.476*** (0.182)	0.423** (0.185)
Home game upset loss$_{t-1}$		−0.003 (0.115)		0.349** (0.142)
Home game upset loss$_{t-2}$		0.071 (0.132)		−0.062 (0.153)
Non-upset home game loss$_t$	0.057 (0.045)	0.023 (0.049)	0.137*** (0.052)	0.090 (0.057)
Non-upset home game loss$_{t-1}$		0.017 (0.049)		0.071 (0.059)
Non-upset home game loss$_{t-2}$		0.057 (0.045)		−0.017 (0.056)
Agency fixed effects		Yes		Yes
Observations		14,926		14,926
Groups		26		26
Log likelihood		−27,719.3		−28,213.88

	DUIs		Disorderly Conduct		Liquor Law Violations	
Home game upset win$_t$	0.572*** (0.136)	0.531*** (0.144)	0.656*** (0.234)	0.545** (0.250)	0.782*** (0.266)	0.661** (0.289)
Home game upset win$_{t-1}$		0.189 (0.134)		−0.102 (0.265)		0.009 (0.273)
Home game upset win$_{t-2}$		−0.207 (0.137)		−0.276 (0.240)		−0.396 (0.270)
Non-upset home game win$_t$	0.046 (0.047)	0.007 (0.057)	0.224*** (0.086)	0.126 (0.113)	0.419*** (0.094)	0.258* (0.136)
Non-upset home game win$_{t-1}$		0.082 (0.064)		0.198 (0.122)		0.260* (0.151)
Non-upset home game win$_{t-2}$		−0.035 (0.063)		−0.010 (0.105)		−0.120 (0.122)

(continued)

Table 6 (continued)

	DUIs		Disorderly Conduct		Liquor Law Violations	
Home game upset $loss_t$	0.451* (0.243)	0.385 (0.248)	0.963*** (0.331)	0.840** (0.347)	0.263 (0.376)	−0.010 (0.394)
Home game upset $loss_{t-1}$		−0.012 (0.158)		0.432 (0.290)		0.162 (0.389)
Home game upset $loss_{t-2}$		−0.160 (0.183)		−0.430 (0.391)		−0.349 (0.354)
Non-upset home game $loss_t$	0.202*** (0.065)	0.159** (0.072)	0.182 (0.112)	0.087 (0.135)	0.375*** (0.119)	0.216 (0.156)
Non-upset home game $loss_{t-1}$		0.088 (0.074)		0.031 (0.143)		0.292* (0.169)
Non-upset home game $loss_{t-2}$		0.021 (0.074)		−0.073 (0.125)		−0.008 (0.143)
Agency fixed effects		Yes		Yes		Yes
Observations		14,926		14,926		14,926
Groups		26		26		26
Log likelihood		−16,933.28		−14,997.25		−18,922.09

Note: Estimated coefficients from a negative binomial regression model are reported. Standard errors are in parentheses. Although not shown, controls for day of the week, Thanksgiving, Labor Day, holiday weekends, month, and year are included. In addition, indicators for away game outcomes with lags are included. DUI = driving under the influence.
*$p \leq .10$. **$p \leq .05$. ***$p \leq .01$.

Cameron & Trivedi, 1986) have shown that estimated standard errors from a Poisson regression are biased downward in the presence of overdispersion (i.e., when the conditional mean of the count variable is different than the conditional variance). Tests clearly indicated the presence of overdispersion for all five of the offenses considered.[24]

Restricting the sample to only those football programs that were ranked in the top 25 by the Associated Press at some point during the period 2000-2005 produced results that were very similar to those presented in Tables 3–6 . Estimated negative binomial coefficients for the 11 programs that were never ranked during this period were much less precise but nevertheless were of similar magnitude to those presented in Tables 3–6 . This pattern of results suggests that the estimates in Tables 3–6 are not being driven by a small subset of programs that are perennially ranked.

Conclusion

Coates and Depken (2006) found that the typical college football game generates more than US$20,000 in sales tax revenue and argued that, for a small community, this figure represents a "tidy sum."[25] Of course, college football games also impose costs on the host community. For instance, Coates and Depken (2008, p. 17) noted that the host community, unless it can persuade the state or neighboring communities to help, must pay for the increased security and traffic management associated with college football games.

This analysis provides evidence that college football games are associated with an additional cost, heretofore largely unrecognized. Specifically, we show that college football games lead to increases in assaults and vandalism. Home games are associated with a 9% increase in assaults, our best measure of aggressive behavior, and an 18% increase in vandalism. For the typical agency in our sample, these estimates would translate into an additional 0.5 reports of assault and an additional report of vandalism on a Saturday when a home game was played as compared with a Saturday when no game was played.

It could easily be argued that these effects, although precisely estimated, are quite modest in terms of magnitude.[26] However, we find that upset losses and wins can lead to much larger increases in these types of offenses. According to our estimates, expected assaults increase by 112% with an upset loss at home and by 36% with an upset victory. For the typical agency in our sample, this would translate into an additional 6.7 reports of assault in the case of an upset loss on a Saturday, and an additional 2.2 reports of assault in the case of an upset win. An upset loss at home on a Saturday is associated with an additional 3.4 reports of vandalism; an upset win at home is associated with an additional 2.6 reports of vandalism.

The fact that upsets lead to substantially larger increases in assaults and vandalism than non-upsets suggests that social learning theory, which posits that fans are simply mimicking the violence they view on the field, cannot by itself explain why college football and aggressive/destructive behaviors are connected. In addition, the results with regard to upsets can be seen as evidence against the hypothesis that temporary surges in population on game days are the sole factor behind the positive relationship between offenses and home games.

Moreover, our results are not entirely consistent with explanations of fan aggression, which predict that fans will be more likely to react aggressively to a loss than to a win (Dollard et al., 1939; Cialdini et al., 1976; Branscombe & Wann, 1992; Wann, 1993). For instance, if fan aggression at football games were simply the result of frustration, then games in which the home team won in an upset (where presumably more spectators were rooting for the home team than for the visiting team) would be associated with fewer assaults than non-upset losses at home. However, the data clearly reject this hypothesis. Although there is evidence that upset losses are associated with a larger increase in assaults than upset wins, our results clearly indicate that expectations, and what happens to fans' behavior when they are not met, should be explicitly built into future attempts to model the relationship between aggression and sporting events.

Finally, our results indicate that college football games lead to increased arrests for the alcohol-related offenses and disorderly conduct (the Group B offenses). Home games are associated with a 13% increase in arrests for drunk driving, a 41% increase in arrests for disorderly conduct, and a 76% increase in arrests for liquor law violations.

Again, in the event of an upset, these figures can be much larger. For instance, upset losses are associated with a 162% increase in arrests for disorderly conduct, and upset wins are associated with a 93% increase in arrests for disorderly conduct. For the typical agency in our sample, these figures correspond to an additional 1.5 arrests for disorderly conduct in the event of a Saturday upset loss and an additional 0.9 arrests for disorderly conduct in the event of an upset win.

The positive relationship between home games and arrests may, in part, be due to communities choosing to provide extra police protection on game days. Heightened security should increase the probability that, for instance, a drunk driver is caught and arrested. However, if this were the only mechanism at work, then it is unlikely that game outcomes such as upsets would be related to the number of Group B offenses, unless the police themselves are reacting to the outcome of the game.

Extra police protection and other policy interventions could also influence the likelihood of committing an offense. According to the economic model of crime developed by Becker (1968), individuals can be thought of as rationally weighing the expected benefits against the expected costs of engaging in crime. If, for instance, heightened security on game days increases the probability of being caught drunk driving, then fans, in theory, should react by either drinking or driving less. The fact that expected arrests for the alcohol-related offenses and disorderly conduct are much higher in the event of upset wins than in the event of non-upsets suggests that fans may be engaging celebratory drinking despite alcohol bans in stadiums and increased security on game days.

Finally, our results suggest a possible strategy for reducing the violence associated with college football games. Although upsets are difficult to predict, host communities could focus on responding quickly when an upset occurs or seems likely to occur. For instance, if at half time an unranked team is beating a team ranked in the top 25, dispatching additional resources aimed at discouraging drunk driving could result in a substantial improvement in road safety. Moreover, if upsets lead to increases in crime, it seems plausible that games between rivals could also have a similar effect. Although not addressed in this study, future research might address the effect of games between rivals on assault, vandalism, and drunk driving.

Appendix
Descriptive Statistics for Count Variables

	All Days	No Game	Home Game	Away Game
Assaults	5.32 (10.07)	5.21 (9.90)	6.63 (12.30)	6.00 (10.42)
0.25 quantile	0	0	1	1
0.50 quantile	2	2	2	2
0.75 quantile	6	6	7	7
0.90 quantile	13	12	15	15
Vandalism	4.87 (11.11)	4.73 (11.00)	6.62 (12.98)	5.73 (10.88)
0.25 quantile	0	0	1	1
0.50 quantile	2	2	3	2
0.75 quantile	5	4	7	6
0.90 quantile	11	11	15	15
DUIs	1.35 (2.63)	1.24 (2.42)	2.49 (3.86)	2.26 (3.95)
0.25 quantile	0	0	0	0
0.50 quantile	0	1	1	1
0.75 quantile	2	1	3	3
0.90 quantile	4	3	7	6
Disorderly conduct	0.77 (1.51)	0.72 (1.42)	1.36 (2.21)	1.01 (1.93)
0.25 quantile	0	0	0	0
0.50 quantile	0	0	0	0
0.75 quantile	1	1	2	1
0.90 quantile	2	2	4	3
Liquor law violations	1.62 (4.65)	1.39 (3.94)	4.99 (11.00)	2.35 (4.31)
0.25 quantile	0	0	0	0
0.50 quantile	0	0	1	1
0.75 quantile	1	1	5	3
0.90 quantile	4	4	13	7

Note: Standard deviations in parentheses. DUI = driving under the influence.

Notes

1. These figures are provided by the National Collegiate Athletic Association. See www.ncaa.org.-stats/football/attendance.

2. Information on stadium capacity in the Unites States is available from Brown and Morrison (2007). Bunkley (2006) reported on plans to add seating to the University of Michigan's football stadium, already the largest in the nation. See also Raley (2007) and Wieberg (2007).

3. Recent studies that have attempted to estimate the benefits to the host community include: Lentz and Laband (2008); Baade, Baumann, and Matheson (2007); Coates and Depken (2006); Coates and Humphreys (2002); Baade and Matheson (2001); and Hudson (1999).

4. In fact, previous empirical research provides only limited support for the hypothesis that sporting events are causally related to violent or aggressive acts. For instance, Drake and Panday (1996) examined data on child abuse cases from Missouri in 1992. They found no evidence of a relationship between play-off games in the four major professional sports and reports of child abuse. See also Sachs and Chu (2000), who examined the association between professional football games and domestic violence dispatches, and

White, Katz, and Scarborough (1992), who examined the relationship between professional football games and emergency room admissions. Perhaps the best evidence of a link between sporting events and fan violence comes from two studies of prizefights and homicides (Miller, Heath, Molcan, & Dugoni 1991; Phillips, 1983).

5. See Bandura (2007) and Wann, Melnick, Russell, and Pease (2001, pp. 108-120) for a review of social learning theory.

6. For an in-depth discussion of the frustration–aggression hypothesis, see Berkowitz (1989). According to the frustration-aggression hypothesis, acts of violence or aggression are the result of being thwarted in an effort to attain a goal. Cialdini et al. (1976), Branscombe and Wann (1992), and Wann (1993) also predicted that fans would be more likely to commit an aggressive or violent act in the event of a loss than in the event of victory.

7. There is strong evidence of a causal link between alcohol consumption and crime outside of the university setting (Carpenter, 2005; Joksch & Jones, 1993; Saffer, 2001). For instance, Carpenter (2005) used the adoption of restrictive drunk-driving laws to estimate the effect of heavy alcohol use on nuisance crimes (vandalism, drunkenness, disorderly conduct). Consistent with other research in this area, he found a decrease in these types of crime after these laws were implemented.

8. The NIBRS data are available from the National Archive of Criminal Justice Data provided by the Inter-university Consortium for Political and Social Research (ICPSR). According to the Bureau of Justice Statistics, 5,271 police agencies from 23 different states and representing 16% of the U.S. population were reporting the incident-level crime data to the NIBRS as of December 2003 (www.ojp.gov/bjs/nibrsstatus.htm). The police agencies (and respective schools) included in the analysis are Akron (The University of Akron), Ames (Iowa State University), Ann Arbor (The University of Michigan), Athens (Ohio University), Austin (The University of Texas at Austin), Blacksburg (Virginia Polytechnic Institute and State University), Boise (Boise State University), Clemson (Clemson University), Colorado Springs (United States Air Force Academy), Columbia (The University of South Carolina), Columbus (The Ohio State University), Denton (The University of North Texas), East Lansing (Michigan State University), Fayetteville (University of Arkansas), Huntington (Marshall University), Iowa City (The University of Iowa), Jonesboro (Arkansas State University), Kalamazoo (Western Michigan University), Lawrence (The University of Kansas), Logan (Utah State University), Lubbock (Texas Tech University), Morgantown (West Virginia University), Moscow (The University of Idaho), Mount Pleasant (Eastern Michigan University), Murfreesboro (Middle Tennessee State University), and Provo (Brigham Young University). Although campus police agencies can report to the NIBRS, our focus is on the larger community. Of the 26 universities represented in our sample, 12 had campus police agencies that reported offense data to the NIBRS.

9. Bowl games, which typically take place in late December or early January, were not included in the analysis.

10. Ann Arbor did not provide data for the period January 1, 2000 to December 31, 2002; Austin did not provide data for the period August 20, 2004 to December 31, 2005; Akron did not provide data for the period January 1, 2000 to December 31, 2002; Columbus did not provide data for the period January 1, 2000 to August 19, 2004; Denton did not provide data for the period January 1, 2000 to December 31, 2001; Fayetteville did not provide data for the period January 1, 2000 to November 30, 2003; Jonesboro did not provide data for the period January 1, 2000 to August 19, 2003; and Lawrence did not provide data for the period January 1, 2000 to December 31, 2001.

11. Game data set were drawn from the College Football Data Warehouse Web site (www.cfbdatawarehouse.com). Championship games are coded as away games because they typically take place in a neutral venue. A total of 156 games took place between football programs in the sample and therefore appeared twice in the data: once as a home game for the football program located in the community in which the game was played, and once as an away game. Deleting these games from the data has no appreciable effect on the results reported below.

12. Table of the appendix provides descriptive statistics for the variables used in the analysis.

13. According to the *Federal Register* (April 29, 1994), liquor law offenses include "maintaining unlawful drinking places; bootlegging, operating a still; furnishing liquor to a minor or intemperate person; using a vehicle for illegal transportation of liquor; drinking on a train or public conveyance; and all attempts to commit any of the aforementioned."

14. Levitt (2001) describes the advantages of controlling for fixed effects within the context of identifying the link between unemployment and crime.

15. If b is the estimated negative binomial coefficient, then $[\exp(b)-1] \times 100$ can be interpreted as the average percentage change in $E(y_{it})$ from a one-unit change in X_{it}, the covariate of interest. In the case of assaults, the estimated binomial coefficient of $Home_{it}$ is 0.086, and $(e^{0.086}-1) \times 100 = 9.0$. In the case of vandalism, the estimated binomial coefficient of $Home_{it}$ is 0.161, and $(e^{0.161}-1) \times 100 = 17.5$. Although Tables 3–7 present estimated negative binomial coefficients, these coefficients are converted to percentage changes when the results are discussed in the text.

16. The data are available at: www.appollarchive.com/football/index.

17. It might be noted that, by definition, games that resulted in an upset involved at least one ranked football program, and as a consequence might have generated more interest and drawn more spectators than games between two unranked teams. To control this phenomenon, we include 10 additional variables in X_{it}. The first five are based on the ranking of the football program located in the jurisdiction of agency i: an indicator equal to 1 on game day if the program was ranked in the top 5, and equal to 0 otherwise; an indicator equal to 1 on game day if the program was ranked 6–10, and equal to 0 otherwise; an indicator equal to 1 on game day if the program was ranked 11–15, and equal to 0 otherwise; an indicator equal to 1 on game day if the program was ranked 16–20, and equal to 0 otherwise; and an indicator equal to 1 on game day if the program was ranked 21–25, and equal to 0 otherwise. We also include the following five measures of the opponent's ranking: an indicator equal to 1 on game day if the opponent was ranked in the top 5, and equal to 0 otherwise; an indicator equal to 1 on game day if the opponent was ranked 6–10, and equal to 0 otherwise; an indicator equal to 1 on game day if the opponent was ranked 11–15, and equal to 0 otherwise; an indicator equal to 1 on game day if the opponent was ranked 16–20, and equal to 0 otherwise; and an indicator equal to 1 on game day if the opponent was ranked 21–25, and equal to 0 otherwise. Allowing for interactions between these sets of ranking measures produced similar results to those reported in Table 5.

18. With two exceptions, the away game estimates are not statistically significant. Away game upset wins are associated with a 43% increase in vandalism reported by agency i, and away game upset losses are associated with a 27% decrease in vandalism.

19. The hypothesis that upsets at home had the same effect on assaults as games at home that did not produce an upset is easily rejected. The hypothesis that upset losses at home had the same effect on assaults as upset wins at home is rejected ($p = .01$), as is the hypothesis that upset wins at home had the same effect as non-upset losses ($p = .03$).

20. The hypothesis that upsets at home had the same effect on vandalism as games at home that did not produce an upset is rejected at the 0.01 level. However, the hypothesis that upset losses at home had the same effect on vandalism as upset wins at home cannot be rejected at conventional levels.

21. The hypothesis that upsets at home had the same effect on arrests for disorderly conduct as games at home that did not produce an upset is rejected at the 0.01 level. However, the hypothesis that upset losses at home had the same effect on arrests for disorderly conduct as upset wins at home cannot be rejected ($p = .42$).

22. The hypothesis that upsets at home had the same effect on arrests for driving under the influence (DUI) as games at home that did not produce an upset is rejected at the 0.01 level. However, the hypothesis that upset wins at home had the same effect on arrests for DUI as upset losses at home cannot be rejected ($p = .65$).

23. However, the hypothesis that upsets at home had the same effect on arrests for liquor law violations as games at home that did not produce an upset cannot be rejected ($p = .30$).

24. Overdispersion is indicated if the hypothesis $\sigma = 0$ cannot be rejected, where σ is the variance of $\exp(\varepsilon_{it})$ from equation (1). See Grootendorst (2002).

25. Coates and Depken (2006) used monthly sales tax data from 126 communities in Texas. They found that college football games played in large cities such as Houston or Dallas had little impact on revenues, but "in the smaller college football towns, a game may raise between US$20,000 and US$35,000 in sales tax revenues" (p. 8). Lentz and Laband (2008) explored the effect of college athletics revenues on hotel and restaurant employment. They found evidence that college athletic revenues in excess of US$40 million per year are positively related to employment in these industries. In contrast, Baade et al. (2007) found no evidence that college football games were related to economic activity.

26. Ziliak and McClosky (2004) cautioned against focusing exclusively on statistical significance. They wrote, "[t]he main point of economic science is to discover the magnitudes of the relations between economic variables and then argue about them" (p. 673).

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