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Abstract

We estimate the impact sporting events have on local crime rates using the technique developed in Arellano and Bond (2001). For events, we consider the presence of MLB, NBA, NFL, and NHL franchises as well as whether a city held one of the respective championships, the Olympics, or World Cup matches. We find little to no evidence that sporting events are correlated with either property or violent crime.

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Introduction

It is a common refrain among sports boosters, city officials, and professional teams and leagues that sports teams and major athletic events bring significant economic windfalls to host cities. For example, estimates for the annual economic impact of a major league professional sports franchise often exceed $100 million (Oregon Baseball Campaign, 2002; Associated Press, 2000) while organizers of sporting events claim impacts ranging from the tens of millions for league all-star games (Selig, Harrington, and Healey, 1999) to the hundreds of millions for major championships like the Super Bowl or the college football championship game (National Football League, 1999; Fiesta Bowl, 2007) and even into the billions for the largest of the so-called “mega-events” such as the Olympics or World Cup (Humphreys and Plummer, 1995).

In addition to the direct economic impact, we investigate whether sporting events have positive indirect effects. In particular, do they reduce violent and property crime? In comparison to the direct economic impact, we calculate violent and property crime costs on average $150 million per year per city, a conservative estimate that only includes direct losses and the pain and suffering of victims.[1] As such, if the diversion of sporting events reduces crime rates by even a small fraction, then they could be providing large unaccounted for gains to the cities that sponsor them. For instance, if a professional sports franchise reduced crime by 5%, then the estimated benefits are 7.5% greater than the cited $100 million. On the other hand, if they increased crime by 5%, then the estimates would be overstating the positive impact.

[1] To be conservative, we have excluded unreported crime as well as other expenditures including police, judicial costs, and detention. We use the dollar value of direct costs and pain and suffering found in Cohen (1988) to calculate the weighted average of the total cost each city incurs per year. The dollar value is in 2008 dollars.

There are numerous reasons why sporting events could increase or decrease crime. First, if the events decrease local unemployment or increase wages, then the opportunity costs of committing crime will rise and thus crime rates will fall. Furthermore, sporting events could provide a distraction from illegal activities and create an anchor for neighborhood or city revitalization. On the other hand, large influxes of visitors may increase the pool of potential criminals and victims. In addition, excess alcohol consumption and unruly crowds are associated with sporting events and these situations are known to be a major factor in perpetrating crime (Schnepel, 2009; Greenfeld, 1998).

We generally find no significant evidence that sporting events are correlated with crime, either positively or negatively. The findings are in line with the related academic research investigating whether sports bring direct economic gains. Specifically, *ex post* examinations of the direct economic impact of sports teams, stadiums, and events on observable economic variables such as employment (Baade and Matheson, 2001; 2002), personal income or personal income per capita (Coates and Humphreys, 2002; Baade, Baumann and Matheson, 2008), taxable sales (Baade and Matheson, 2001; Baade, Baumann and Matheson, 2008; Coates and Depken, 2009) and tourist arrivals (Baumann, Matheson, and Muroi, 2009) have nearly uniformly found that professional sports has little to no measurable effect on the economy.

Since the literature has provided little evidence that sporting events have a direct economic impact, our investigation is important in determining whether they have an indirect effect. Other researchers have suggested, for example, that sporting events or franchises are a source of civic pride, serve as a cultural amenity, and may increase social capital in important ways. As noted by former Minnesota governor Rudy Perpich, "Without professional sports, Minneapolis would just be a cold Omaha." On the opposite end of the temperature spectrum, the Hawaii Tourism Authority sounds a similar note by suggesting that subsidizing the Pro Bowl and local Professional Golfers Association (PGA) events improves the quality of life of the Island's residents by allowing them opportunities to watch or participate in major sporting events. (HTA, 2008).

Carlino and Coulsen (2004) address whether sporting events indirectly impact the local community by examining rental housing prices in NFL cities. They find them to be 8% higher than in non-NFL cities. While their methodology has been questioned (e.g. Coates, Humphreys, and Zimbalist, 2006), the basic finding would support the hypothesis that professional sports make cities more attractive places to live because renters are willing to pay a premium to live in NFL cities. Numerous other studies have also studied the connection between housing prices and sports (Tu, 2005; Feng and Humphreys, 2008; Ahlfeldt and Maennig, 2007; Dehring, Depken and Ward, 2008; Coates and Matheson, 2009; Kiel, Matheson, and Sullivan, 2009) with distinctly mixed results.

Others have used contingent valuation to assess the value of sporting teams and events in the absence of observable economic data. Here, too, the data is mixed. While most studies of new stadiums and arenas (Groothius, Johnson, and Whitehead, 2004), professional franchises (Johnson, Groothius, and Whitehead, 2001; Johnson, Mondello, and Whitehead; 2006), and mega-events (Atkinson, et al., 2008; Walton, Longo, and Dawson, 2008) find that citizens are willing to pay for sports teams and events beyond just purchasing tickets, several of the studies also demonstrate that this willingness to pay is far less than the subsidy granted to the sports entity.

The connection between direct and indirect economic benefits is perhaps best summed up by Maennig (2007) who concludes in his ex post analysis of the 2006 World Cup in Germany that claims of "increased turnover in the retail trade, overnight accommodation, receipts from tourism and effects on employment [are] mostly of little value and may even be incorrect. Of more significance, however, are other (measurable) effects such as the novelty effect of the stadiums, the improved image for Germany and the feel good effect for the population." (Maennig, 2007, p. 1)

To reiterate, we add to the discussion on whether sporting events have an indirect effect by examining their effects on the city-level incidence of crime. The results generally indicate no positive or negative benefit along the crime dimension.

Model & Data

After the first attempts of modeling criminal behavior in Becker (1968), Ehrlich (1973), Sjoquist (1973), and Block and Heineke (1975), several empirical analyses followed. Most empirical approaches test whether crime is influenced by some measure of wealth, such as unemployment (Cantor and Land, 1985; Gould, Weinberg, and Mustard, 2002), wages (Grogger, 1998; Levitt, 1999), and education (Lochner, 2004; Buonanno and Leonida, 2009) to name only a few. In these cases, crime is modeled as a substitute for working. Each individual compares the expected return to criminal activity against expected punishment and foregone wages from legitimate employment. This produces a reduced-form equation where crime is a function of wealth and punishment. Other studies include demographic controls such as racial/ethnic, gender, and age distribution since these tend to influence the amount of crime.

We add controls for the presence and success of franchises in the four American major sports leagues—National Football League (NFL), Major League Baseball (MLB), National Basketball Association (NBA), and National Hockey League (NHL)—to determine whether these franchises affect crime. If a connection between the presence of a sports team and a reduction in crime can be identified, sports franchises may provide indirect economic benefits to their host cities that would not necessarily be captured in observable economic data such as income, employment or taxable sales.

We use the Federal Bureau of Investigation's Uniform Crime Reports (UCR) to measure crime. UCR data are available annually from 1981 to 2006 at the county-level. Because UCR data are compiled from local police reports, they only include reported crime. This creates two problems. First, the total amount of crime is underestimated since unreported crime is not measured. Second, Levitt (1998) notes reporting and classification tendencies differ across police stations. However, UCR data are by far the most common aggregate data set in the literature. The other alternative is victimization data, and the most common is the National Crime Victimization Survey (NCVS). But the only geographic information in the NCVS is four broad regions of the U.S., which makes it impossible to merge the NCVS with franchise location data.

UCR provide data on eight types of crime, which we combine into two larger groups. Violent crime, which is committed with force, consists of murder/manslaughter, rape, robbery, and assaults. Property crime, which is not done with force and typically when the victim is not present, consists of burglaries, larceny, arson, and motor vehicle theft. Both types of crime are scaled so that each is per 100,000 people to control for differences in population.

Our measure of wealth is per capita income, which is available at the MSA level from the Bureau of Economic Analysis (BEA). We use a sample of 56 metropolitan standardized areas (MSAs) between 1981 and 2006. With a few exceptions[2], these MSAs represent the largest cities in United States and include all MSAs that host a NFL, MLB, NHL, or NBA franchise. This list also includes cities without a franchise in any of the four major sports leagues to serve as part of our control group, e.g. Austin, Las Vegas, and Riverside. While cities without a franchise tend to be smaller, the other portion of our control group includes cities whose franchise status changes. The largest MSA in this group is Los Angeles, which once had two NFL teams but lost them both to relocation by 1995. In addition, Washington, D.C. did not have a MLB team until 2005. In addition, there are several MSAs with franchises in some but not all of the four major sports, e.g. Houston (no NHL), St. Louis (no NBA), and Portland, Oregon (no MLB).

Since UCR data is county-level, we aggregate the UCR data to the MSA level using the county compositions of the MSAs provided by the BEA. This creates a sample of 56 MSAs over the time period 1981 to 2006. Table 1 provides summary statistics for the data.

The following is our baseline model:

$$C_{it} = \beta_0 + \beta_1 INC_{it} + \beta_2 F_{it} + \beta_3 NF_{it} + \beta_4 S_{it} + \beta_5 H_{it} + \alpha_i + \gamma_t + \varepsilon_{it} \qquad (1)$$

Because the motivations for property and violent crime are different, we present separate estimations for property and violent crime. INC_{it} is the per capita income level. F_{it} is a vector of four dummy variables that indicates whether the MSA has a franchise in each of the four major sports leagues. NF_{it} is a vector of four dummy variables that equal one the

[2] Because of inconsistencies in the UCR data, we omit Akron, Ohio, Chicago and Champaign, Illinois MSAs from the data.

first year a franchise is in the MSA. This variable captures any novelty effect that a new franchise has on crime. S_{it} is a vector of four dummy variables that indicates whether the MSA has a franchise that made the finals, i.e. the Stanley Cup finals, NBA Finals, World Series, and Super Bowl. Although there are many ways to measure success, the finals are the pinnacle of each league and should have a larger effect than, say, winning percentage or making the playoffs. In addition, changing the specification of S_{it} to winning percentage or making the playoffs has no substantial impact on the results. H_{it} is a vector of dummy variables that equal one is the MSA hosted the Super Bowl, Olympics, or World Cup. Finally, controls for each year (γ_t) and MSA (α_i) are included to capture any MSA-specific or year-specific effects on crime. The MSA controls are particularly important since they account for time-invariant reporting and classification tendencies specific to the MSA (see Levitt, 1998).

We use a variety of tests to check for unit roots in property crime, violent crime, and per capita income. First, we perform Dickey-Fuller and Phillips-Perron tests on each MSA. These tests do not reject the existence of a unit root in nearly every MSA for all three variables. Second, we test for unit roots using panel data tests from Levin, Lin, and Chu (2002) and Im, Pesaran, and Shin (2003). These tests allow the entire data to be tested at once, and allow each MSA to have their own time trend and autoregressive path. Both tests do not reject the existence of a unit root in all three variables. However, the same tests reject the existence of a unit root for the first difference of each variable. For this reason, the first difference of property crime, violent crime, and per capita income is used in all estimations.

Autocorrelation is a concern in this model since it is likely the unexplained portion of crime in a given period is correlated with the unexplained portion of crime in the previous period. In the presence of autocorrelation, the least squares estimates will be consistent but the standard errors will be wrong. Wooldridge (2002) suggests testing for autocorrelation using two steps. First, estimate the baseline model at (1). Second, generate the residuals and estimate $\hat{\varepsilon}_{it} = \rho\hat{\varepsilon}_{i,t-1} + u_{it}$. If there is no autocorrelation, then $\rho = -0.5$. For both the property crime and violent crime models, we reject the hypothesis that $\rho = -0.5$ which suggests the model has autocorrelation.

We correct for autocorrelation by including an autoregressive term to (1):

$$\Delta CRIME_{it} = \beta_0 + \beta_1 \Delta CRIME_{it-1} + \beta_2 \Delta INC_{it} + \beta_2 F_{it} + \beta_3 S_{it} + \alpha_i + \gamma_t + \varepsilon_{it} \qquad (2)$$

The first differences of crime and per capita income are included to ensure unit roots do not produce a spurious correlation. In the presence of a lagged dependent variable, least squares estimates are likely to be biased because of the correlation between $\Delta CRIME_{it-1}$ and ε_{it}. Instead, we use the Arellano and Bond (1991) technique which produces consistent estimates. Other descriptions of this technique can be found in Bond (2002) and Roodman (2006). The Arellano and Bond (1991) technique differences the entire model, which eliminates the MSA fixed effect α_i. Next, higher-order lags of the dependent variable are used to instrument for the endogenous $\Delta CRIME_{it-1}$. This technique also allows any other endogenous or predetermined independent variables (i.e., variables independent to the current error but not previous errors) to be instrumented. Since it is plausible that per capita income is also endogenous (or at least predetermined), we instrument for ΔINC_{it}.

Our original sample frame ranges from 1981 to 2006. However, we use the first difference of the data to guard against unit roots, and the lag of the already first-differenced dependent variable is included to account for autocorrelation. This changes the sample frame to 1983 to 2006. Since T = 24, there are 22 higher-order lags of the dependent variable that could serve as instruments. These higher-order lags create missing values, e.g. if t = 1985 then the third lag and higher of $\Delta CRIME_{it}$ are not defined since the sample frame begins in 1983. Nevertheless, Holtz-Eakin, Newey, and Rosen (1988) point out that each higher-order lag is a useful moment condition. In this scenario, the moment condition is $E[Z_{it}^{'}\Delta\varepsilon_{it}] = 0$, where $Z_{it}^{'}$ is a vector that contains the higher-order lags of the dependent variable. For the second order lag, $\sum_i y_{i,t-2}\Delta\varepsilon_{it} = 0$ if $t \geq 3$; for the third-order lag, $\sum_i y_{i,t-3}\Delta\varepsilon_{it} = 0$ if $t \geq 4$; and so on.

These moment conditions require the error term to be independently and identically distributed. This is unlikely in panel data because the error variance probably differs across MSAs. For this reason, a weighting matrix W is included in the moment condition that asymptotically corrects this problem: $W = \frac{1}{N}\sum_i (\vec{Z}_i^{'}\Delta\vec{\varepsilon}_i\Delta\vec{\varepsilon}_i^{'}\vec{Z}_i)$, where $\vec{Z}_i$ and $\Delta\vec{\varepsilon}_i$ are MSA-specific vectors with (T – 2) elements. The weighting matrix is $W = \frac{1}{N}\sum_i (\vec{Z}_i^{'}\Delta\vec{\varepsilon}_i\Delta\vec{\varepsilon}_i^{'}\vec{Z}_i)$. Since the weighting matrix includes $\Delta\vec{\varepsilon}_i$, the model must be estimated in two steps. First, a second weighting matrix $W_1 = \frac{1}{N}\sum_i (\vec{Z}_i^{'}H\vec{Z}_i)$ is used to produce $\Delta\vec{\varepsilon}_i$, where H is a (T – 2) square matrix with 2 on the diagonal, -1 on all of the immediate off-diagonals, and zero elsewhere. Once $\Delta\vec{\varepsilon}_i$ is estimated, the second step minimizes $\left(\frac{1}{N}\sum_i \Delta\vec{\varepsilon}_i^{'}\vec{Z}_i\right)W^{-1}\left(\frac{1}{N}\sum_i \vec{Z}_i^{'}\Delta\vec{\varepsilon}_i\right)$ to produce the estimates.

Finally, several works (Arellano and Bond, 1991 and Blundell and Bond, 1998, to name only two) note the two-step estimation process causes the standard errors to be downward biased. Windmeijer (2005) offers a finite-sample correction which we use here.

Results

Table 2 presents the estimation results for the property crime model. The Arellano-Bond tests for autoregressive errors suggest only a first order autoregressive term is necessary. We also present the result from a Hansen (1982) test to determine whether the model is over-identified. We use Hansen tests to determine the ideal number of higher-order lags to use as instruments. In the property crime model, the Hansen test suggests the second- and third-order lags do not over-identify the model. We also suppress the results for the year dummies for brevity, but these are available upon request.

The only sports variable that is statistically significant is Olympics location. Hosting the Olympics raises property crime by about 445 per 100,000 people or an increase of about 10%. The other sports estimates suggest there is no effect of a franchise or its success on property crime rates. While the Olympics result may simply be a spurious correlation that is the result of the inclusion of a large number of sports-related variables, it is noteworthy that the Olympics are far and away the largest sports mega-event drawing a far larger number of visitors than any other sporting event. An increase in reported crime fits the hypothesis that a rise in visitors raises the crime rate by increasing the number of potential victims and criminals. Alternative specifications of success, e.g. winning percentage or making the playoffs, do not substantially change the results. Per capita income has a negative and statistically significant effect on property crime, meaning higher wealth is correlated with lower property crime.

Table 3 presents the estimation results for the violent crime model. The Arellano-Bond tests for autoregressive errors again suggest a first order autoregressive term is appropriate, and the Hansen (1982) test allows for the second- through fifth-order lags to serve as instruments. The only sports variable that is statistically significant is the Super Bowl location, which decreases violent crime by about 17.5 per 100,000 people, a decrease of about 2.5%. Similar to property crime, the other sports estimates suggest there is no effect of a franchise or its success on violent crime. One difference between the property and violent crime models is the effect of per capita income. For violent crime, the effect is positive, suggesting higher wealth correlates with more violent crime. There are several possible explanations for this result. Since the UCR data only collect reported crime, it is possible that an increase wealth also increases reporting habits. In addition, the motivations of violent crime tend to be psychological rather than pecuniary, which means there is no ex ante expectation of the relationship between wealth and violent crime.

Again, the one significant sports variable is noteworthy. The Super Bowl, along with the Olympics, is among the few mega-events for which cities can plan in advance. For example, the World Series or NBA finals are played in the cities of the teams involved, so their locations are only known as teams advance in the playoffs. The Super

Bowl, however, is held at a neutral site designated well in advance. Knowing that the eyes of the world will be on the host city, the local law enforcement agencies may take steps to “clean up the town” in advance of the big game, and these crime eradication efforts carry through for some time after the event.

Conclusion

The results of this paper overall suggest no significant link between crime and the presence of professional sports teams, stadiums, or events at the metropolitan-area wide level with two notable exceptions. The Olympics Games are associated with roughly a 10% increase in property crimes while the Super Bowl is associated with a 2.5% decrease in violent crime. In the whole, however, spectator sports do not seem to automatically carry with them any improvements in criminal behavior.

Further research is required to examine nuisance crimes, arrests versus reports of crime, the geographic distribution of crime within a city, the effect of new stadiums, and the changes in crime rates in years leading up to planned events such as the Olympics.

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Table 1: Summary Statistics

Variable	Mean (Standard Deviation)
Property Crimes per 100,000 people	4,748.71 (1,503.01)
Violent Crimes per 100,000 people	618.74 (263.11)
Per capita income	$31,687.08 ($5,618.73)
MSA has NHL team	0.267
MSA has NBA team	0.413
MSA has NFL team	0.481
MSA has MLB team	0.372
NHL team appeared in Stanley Cup finals	0.024
NBA team appeared in finals	0.031
NFL team appeared in Super Bowl	0.035
MLB team appeared in World Series	0.030
MSA hosted Olympics	0.002
MSA hosted World Cup	0.006

Note: (1) There are two observations that hosted the Olympics: Los Angeles in 1984, Atlanta in 1996, and Salt Lake City in 2002.
(2) Eight MSAs in the sample hosted World Cup games in 1994: Boston, Dallas, Detroit, Los Angeles, New York City, Orlando, San Jose, and Washington, D.C.

Table 2: Arellano-Bond Results for Property Crime Model

Variable	Estimate (Standard Error)
per capita income	-0.1220* (0.0479)
NHL Franchise	144.198 (148.207)
NBA Franchise	65.872 (207.342)
NFL Franchise	-72.159 (111.676)
MLB Franchise	-62.795 (220.749)
New NHL Franchise	11.688 (168.393)
New NBA Franchise	-33.464 (133.225)
New NFL Franchise	-20.874 (75.113)
New MLB Franchise	77.971 (155.470)
Stanley Cup Finals	139.156 (105.910)
NBA Finals	51.952 (42.954)
Super Bowl Team	-12.679 (84.402)
World Series Team	20.251 (106.680)
Super Bowl Location	-106.195 (82.423)
Olympics Location	445.489* (185.293)
World Cup Location	-108.053 (151.294)

Arellano-Bond test for AR(1)	Z = -2.84 p = 0.005
Arellano-Bond test for AR(2)	Z = -0.65 p = 0.513
Instruments (lags of differenced dep. var.)	2,3
Hansen test for over-identification	χ^2 = 2.09 p = 0.553

Note: (1) * indicates the estimate is statistically significant at $\alpha = 0.05$.
(2) Year dummies are included in the model but not presented here. These estimates are available upon request.

Table 3: Arellano-Bond Results for Violent Crime Model

Variable	Estimate (Standard Error)
per capita income	0.0255* (0.0054)
NHL Franchise	17.008 (19.568)
NBA Franchise	6.669 (16.018)
NFL Franchise	6.559 (16.119)
MLB Franchise	-24.286 (37.538)
New NHL Franchise	-24.894 (22.984)
New NBA Franchise	-12.821 (19.898)
New NFL Franchise	-2.054 (15.492)
New MLB Franchise	4.979 (18.267)
Stanley Cup Finals	8.898 (15.490)
NBA Finals	-10.196 (10.282)
Super Bowl Team	-1.383 (12.463)
World Series Team	-1.264 (12.463)
Super Bowl Location	-17.567* (9.935)
Olympics Location	0.1892 (14.631)
World Cup Location	-20.763 (23.185)

Arellano-Bond test for AR(1)	Z = -3.69 p = 0.000
Arellano-Bond test for AR(2)	Z = 0.84 p = 0.400
Instruments (lags of differenced dep. var.)	2,3,4,5
Hansen test for over-identification	$\chi^2 = 5.64$ p = 0.228

Note: (1) * indicates the estimate is statistically significant at $\alpha = 0.05$.
(2) Year dummies are included in the model but not presented here. These estimates are available upon request.