Institut d'Economia de Barcelona

Document de treball de l'IEB 2015/15

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MEASURING THE NEGATIVE EXTERNALITIES OF A PRIVATE LEISURE ACTIVITY: HOOLIGANS AND PICKPOCKETS AROUND THE STADIUM *

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ABSTRACT: Given the recent increase observed in crime and violence related to sport activities and the subsequent need for governments to devote more resources to deter this pattern, this article presents empirical evidence that could justify the possibility of taxing the negative externalities associated with the staging of football matches. Focusing specifically on theft (mainly pick pocketing) and assault (interpersonal violence or hooliganism), we seek to determine the extent to which this private leisure activity is responsible for negative crime externalities on a urban context. Drawing on data for the matches played by Football Club Barcelona (FCB) and geocoded crime data for the city of Barcelona (Spain), we assess whether there is an increase in thefts and assaults across the city of Barcelona. Then, conducting an Exploratory Spatial Data Analysis (ESDA) and a spatial regression at the census tract level, we determine the effect of football matches on crime by comparing crime rates during home and away matches. We find an increase in the number of thefts across the whole city but, especially, in those census tracts within a 700-meter radius of the stadium, indicating that despite the increase in the number of police officers on duty in the vicinity of the stadium, potential offenders are attracted to crowds where rewards are likely to be higher and the probability of being apprehended lower. These results are confirmed by the relatively low number of crimes committed during away matches in the census tracts around the stadium. A similar spatial pattern is found for assaults, although the overall impact across the city is not significant. Our results, therefore, provide evidence of a displacement effect of violent supporters (hooligans) towards the census tracts closest to the FCB stadium on football days.

JEL Codes: K42, H27, R1, L83

Keywords: Crime, football, hooliganism, negative externalities, police forces

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* We would like to thank the Catalan police, Mossos d'Esquadra, for giving us access to the dataset and providing us with very helpful comments and insights regarding the data. We would also like to thank Mr. Sergi Sansano for his excellent research assistance and tireless support in the geocoding process. Daniel Montolio acknowledges support from grant ECO2013-41886-R from the Spanish Ministerio de Economía y Competitividad.

1. Introduction

With over 52 million followers on Facebook, 11 million followers on Twitter and a long history of sporting success, Football Club Barcelona (FCB, hereafter) is one of the world's leading football teams. Its current popularity is reflected in an average gate of over 70,000 spectators at its home games. Indeed, the attraction of FCB would appear to represent a sizeable economic benefit for the well-known city and its citizens. For instance, it seems probable that the club's home matches attract a higher number of tourist arrivals and boost levels of consumption in the retail sector with a consequent positive impact on job creation and tax revenues.

However, despite these positive economic effects, a number of negative externalities may affect the city as a result of its being home to such a major team and its hosting of such large events on a regular basis. Above all, the presence of FCB might promote criminal activity. Large crowds are likely to increase the number of potential targets, thus attracting more offenders, especially those "specialized" in property crimes (such as pick pocketing). Moreover, the increase in the number of social interactions, the high consumption of alcohol combined with the euphoria of a victory or despair of defeat can increase levels of interpersonal violence (Card and Dahl, 2011 and Montolio and Planells-Struse, 2015). Additionally, celebrations may result in other types of illegal behavior, including vandalism and the assault of police officers. These various forms of interpersonal violence are usually known as hooliganism, especially when a sport event is closely related.

Violence related to football matches in Spain has recently attracted the attention of the media outlets and the public opinion in general. The killing of a supporter in an internet planned riot between the radical supporters of Atlético de Madrid (called *Frente Atlético*) and those of the Deportivo de la Coruña (called *Los Suaves*) in Madrid the day that both teams were going to play a domestic league match (29th of November 2014)[1] focused the media attention and raised many questions regarding the negative externalities of football matches on unlawful behavior. Few days later in Barcelona (11th of December 2014), and after a Champions League match played by FCB against Paris Saint Germain, two PSG supporters were stabbed close to the Camp Nou Stadium.[2] This

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[1] http://www.lavanguardia.com/deportes/20141130/54420902745/muere-aficionado-deportivo-ultras-atletico.html (last accessed 10 April 2015).

[2] http://www.lavanguardia.com/sucesos/20141211/54421303752/apunalado-seguidor-psg-camp-nou.html (last accessed April 2015).

event fuelled further the discussion regarding the close relation between football and violence (inside and outside stadiums).[3] In this sense, and despite the efforts of FCB to eradicate violent behaviour inside the stadium, a violent group of radical FCB supporters (called *Boixos Nois*) continues to gather outside the stadium on match days to "warm up" the atmosphere. Note, however, that as previously mentioned excitement and alcohol consumption, among others, could also influence violent behaviour of non-radical football fans.

Precisely to prevent the occurrence of such violent incidents, to guarantee the security of citizens and also to prevent other types of criminal attitudes, large numbers of police officers are usually mobilized on match days. For instance, the police force engaged in security issues in Barcelona and its region (*Mossos d'Esquadra*) estimates that an average of 246 police officers are required to police "high risk" games, such as those between FCB and its historic rival Real Madrid CF. However, this deployment of officers and police resources generates an additional cost and one, moreover, induced by a private activity that has to be borne by the whole of society via general taxation.

In response, various European governments have attempted to levy a tax to cover the negative externalities attributable to large-scale events in the form of higher crime rates. In the UK, with a long-lasting record of hooliganism, the South Yorkshire Deputy Chief Constable and lead on football policing for the Association of Chief Police Officers (ACPO), Andy Holt, has stated that football clubs should cover the full cost of policing football matches, and not just those incurred within and around a certain distance of the stadiums as is current practice, given that the impact of a match affects a much larger area.[4]

In Spain, where public finances are currently under considerable stress and there is a need to seek alternative sources of revenue, the debate remains ongoing. In 2014 the Catalan regional government budgeted a tax to cover extra policing resources for high

[3] This issue is, unfortunately, well spread around the world and we can find many (recent) examples in countries such Argentina and Chile (http://www.marca.com/2015/02/17/futbol/futbol_internacional/argentina/1424213985.html, last accessed April 2015) or in other European cities such as an aggression of Chelsea fans to an individual in the previous hours of a Championship match between PSG and Chelsea. (http://www.elmundo.es/internacional/2015/02/18/54e44545268e3e4a728b4572.html, last accessed April 2015).

[4] The ACPO found a statistically significant increase in the number of crimes up to 1 km away from UK football grounds. British media pays attention to the debate: http://www.channel4.com/news/should-clubs-pay-more-to-police-football-matches (last accessed April 2015).

risk events.[5] The cost of a police officer is estimated at 35 euros per hour, which means policing a "high risk" match costs 54,798 euros; 35,000 of which are to be met by FCB in concept of extra policing costs. The Catalan Home Office estimates that an annual revenue of around 200,000 euros will result from this tax. However, such estimates are not based on the actual impact of a football match on the city's security and this would require an analysis of their full effects on crime counts. Even in UK, recent high-profile disputes between football clubs and the police over the charges levied by the police have highlighted a lack of clarity regarding the cost of policing football matches. Football clubs report difficulties around the fringes of what is clear, transparent and consistent about what relates to the total policing deployment and the chargeable element which comes from that (see, Home Affairs Committee, 2009).

The aim of this paper, therefore, is to conduct an in-depth analysis of the impact of FCB matches on different types of crime in an urban context. The use of geocoded data, the approach adopted and the techniques employed make an innovative contribution to the literature. Our results allow us to characterize in full the impact of the football matches of a leading European team on crime in a major European city.

More specifically, we study the respective impact of FCB's home and away matches on property crime (e.g., theft) and on crime against the person (e.g., assault). Drawing on a panel dataset (containing daily and census tract information), we present a descriptive analysis employing GIS techniques to show that FCB's matches impact crime patterns not just around its stadium, but throughout the city of Barcelona. We also present a spatial confirmatory analysis of the effect of the club's matches on crime around the stadium by analyzing the extent to which the agglomeration of people impacts each type of crime. To ensure the robustness of our results, we carry out various checks for crime patterns on those days when FCB play away (and when the spatial impacts should not be found).

The rest of the paper is structured as follows. Section 2 reviews the existing literature that accounts for the potential effects of football on crime. Section 3 presents the datasets used and the matching process applied to the data prior to conducting the empirical estimations. Section 4 presents the methodology for estimating the impact of football matches on crime and the spatial analysis used. Section 5 shows the empirical

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[5] See, the Bill for fiscal, administrative and financial measures that accompanies the regional budget for 2014 of the *Generalitat de Catalunya*: http://www15.gencat.net/ecofin_wpres14/pdf/VOL_P_MES.pdf (last accessed, April 2015).

results from the regression analysis. Section 6 presents the descriptive and confirmatory spatial results. Finally, section 7 sums up the paper and concludes.

2. The multiple effects of football on crime: an examination of the existing literature

A major sporting event can have a variety of impacts. In the case of football, studies have focused on the effects of a competition such as the FIFA World Cup on employment, tourism, sales, overnight stays (Allmers and Maennig, 2009; Matheson and Baade, 2004; Hagn and Maennig, 2008) and on psychological aspects, such as individual perceptions about economic prospects, both at a personal and economy-wide level (Dohmen *et al.*, 2006; Süssmuth *et al.*, 2010). Additionally, there is evidence of the effect of football on illegal behaviors. Kurland *et al.* (2014) study the effect of football matches on crime and examine whether football matches in UK (around Wembley stadium) act as crime generators or crime attractors.[6] The authors, using an ecological approach to crime (focusing on patterns in space and time) found that, indeed, when Wembley stadium is used there is a significant increase of crime in the area that surrounds it. In a similar vein, although using aggregate Italian province level data, Campaniello (2011) founds a significant increase in crime (mainly property crimes) in those provinces that held the 1990 Football World Cup matches. Also analyzing the FIFA world cup tournament Kirby *et al*. (2013) show how football matches were associated with an increase in domestic violence in the United Kingdom.

Marie (2010, 2015) describes three main channels through which football matches may affect crime.[7] First, the concentration effect is the most straightforward of the effects to be considered. Simply put, an agglomeration of individuals in a particular place is likely to increase social interactions, which combined with high levels of

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[6] See the crime pattern theory (Brantingham and Brantingham, 1993) for a detailed explanation of offense patterns and the dynamics involved; and see Brantingham and Brantingham (1995) for an explanation of their classification of places as crime generators or crime attractors. In a nutshell, given the importance of places in the crime pattern theory football matches can be seen as both a crime attractor (they draw intending offenders because of known suitable targets) and as a crime generator (offenders are part of the population that frequent the match and take advantage of the unanticipated opportunities encountered).

[7] Spectator violence in stadiums has been a longstanding tradition and, as pointed out by Madensen and Eck (2008), documentation of such events is found in texts from ancient Greece and the Roman Empire. See Madensen and Eck (2008), and references therein, for a complete guide to address the problem of spectator violence in stadiums and other arena-type settings, discussing the factors that contribute to such incidents and reviewing the responses to the problem, and what is known about them from evaluative research and police practice.

alcohol intake may lead to interpersonal violence (clashes and fighting often referred as hooliganism) and property crimes (especially, theft and pick pocketing). In accordance with routine activity theory (Cohen and Felson, 1979), for a crime to occur, a suitable target, a motivated offender and the absence of a capable guardian must converge in time and space. A football match increases exponentially the number of potential targets, which in turn attract a certain number of motivated offenders (above all pick pockets given that the rewards should be high), while the agglomeration itself reduces the probability of apprehension (anonymity). If these elements all converge, then we would expect to observe an increase in the number of property crimes around a football stadium on match days.

Agglomerations, albeit at a smaller scale, may also occur in other parts of the city (and not only in the vicinity of the stadium), since supporters and football fans often gather in public places to watch the match or to celebrate (lament) a victory (a defeat). Therefore, a rise in thefts might be expected in other areas of the city on a match day. Additionally, when the team is playing away, while an impact around the stadium would not be expected, we might expect to see some effects in those places where matches can be watched (pubs and bars, etc.).

Second, the profiles (gender and age) of the average football fan and potential offender are not dissimilar, which may have a number of implications for crime rates. Specifically, our crime dataset including known offenders in Barcelona between 2007 and 2011 reveals that 79% were male; 76% were under the age of 40; and, 63% were under the age of 35, a profile that is, in general, very similar to that of football fans, as in the case of London, as captured by the FA Premier League Fan Survey 1994-1997. The coincidence of the two profiles might, on the one hand, point toward a potential increase in illegal activities, or, on the other, to a 'self-incapacitation effect', as a share of the population with a similar profile to those presenting a greater propensity to commit illegal activities will always be watching the match, resulting in a fall in the crime rate.[8]

The third effect, also cited in Marie (2010, 2015), is that of 'displacement', given the reassignment of police officers to points around the stadium on match days. This

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[8] Self-incapacitation due to attendance of an event by a part of the population with a greater propensity to commit crimes has been examined by Dahl and DellaVigna (2009) for the case of violent blockbuster movies. Here, we expect the incapacitation effect to be manifest during the ninety minutes of the game. However, after the final whistle, crime may increase as a result of both the incapacitation effect being lifted and the outcome of the match (Montolio and Planells-Struse, 2015).

represents an opportunity for criminals in areas in which levels of surveillance have been relaxed. The spatial analysis we perform here at the city level provides us with some insights as to whether this effect is evident for the city of Barcelona. Note, however, that if the number of police officers assigned to other areas of the city is not reduced on match days, this effect will not exist.

These three channels may not appear to increase crime when the data is examined on a daily basis; only an hourly analysis can reveal their presence. For instance, Montolio and Planells-Struse (2015) detect the incapacitation effect only during the football match itself, while the same authors report a substitution (displacement) effect with police officers apparently being reassigned from certain activities (driving- and drug-related offenses) to others in which their primary concern is guaranteeing citizen security and maintaining traffic flow.

Regarding the specific problem of hooliganism, and although our aim is not to unveil its determinants, there is a vast sociological, psychological and even anthropological literature analyzing such phenomenon.[9] In the economics literature the evidence is scarcer. Priks (2010) empirically tests the frustration-aggression hypothesis using hooligan data for Sweden, finding that, indeed, frustration (team's bad performance) increase unlawful supporter behavior. In this sense, this evidence points out how frustrated supporters can act violently even if in principle they do not belong to organized radical supporter groups that are those usually identified as hooligans and that sometime act more as street gangs being violent at random.[10] Moreover, Poutvaara and Priks (2009) and DiDomizio and Caruso (2014) present evidence of the impact of counter-hooliganism policies in Sweden and Italy, respectively.

The study reported in this paper – combining regression and spatial analyses – seeks to provide a precise characterization of the spatio-temporal patterns of crime and football in the city of Barcelona and aims at helping policy makers in their efforts to reduce sport-related illegal behaviors.

[9] See Russell (2004) for a social-psychological review on sports riots.

[10] Note that in Spain, some members of radical supporters organizations have been linked by police forces with all sort of criminal activities. Examples can be found, among other, for Real Madrid CF radical supporters (*Ultra Sur*); http://www.elmundo.es/madrid/2014/12/17/5491f6f7268e3e37598b457e.html?a=8191dfbf0bfaec17d197d61232f6a4c2&t=1418908926 (last accessed 10 April 2015).and for FCB; http://www.elmundo.es/elmundo/2012/09/12/barcelona/1347472104.html (last accessed 10 April 2015).

3. Data

3.1. Crime data

We use a non-public dataset for the city of Barcelona containing all crimes registered by the autonomous police agency in Catalonia (Spanish region in which Barcelona is located), the *Mossos d'Esquadra*, which is responsible for crime prevention, crime solving and specialized crime investigation in the Catalan region.[11] The dataset holds reports filed by both citizens and the *Mossos d'Esquadra*, as well as by the local police (the *Guardia Urbana*), responsible primarily for urban traffic and upholding municipal laws and ordinances.

The dataset records the time of the crime (when known), the location and the crime type. The dataset, which extends from 1 September 2007 to 31 December 2011,[12] was restricted so as to include only those months that correspond to the official football season (i.e., June, July and August have been removed). Of the remaining 635,065 observations, 98.74% (627,037 observations) were geocoded with a precision of within ten meters.[13]

Illegal activities were classified in accordance with the roughly 190 articles of the Spanish penal code. However, to reduce the number of categories without causing an aggregation bias that might reduce the effectiveness of our estimations (Cherry and List, 2002), we combined some of these articles, paying particular attention not to aggregate crimes with different offender motivations. For the main property crimes, we used the variable "*Thefts*", i.e., the misappropriation of the belongings of others without resorting to any type of violence, while for the main crimes involving interpersonal violence, we included the variable "*Assaults*", i.e., harmful, offensive contact perhaps resulting in injuries (which can be associated with hooliganism).

After eliminating all observations responding to other crime types, the final data subset comprised 359,711 geocoded observations. We aggregated all the crime data up to the census tract level. The city of Barcelona is made up of ten districts divided into

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[11] The *Mossos d'Esquadra* are responsible for virtually all police duties. The Spanish National Police (*Cuerpo Nacional de Policía*) and the military police (*Guardia Civil*) retain a number of administrative responsibilities (e.g., issuing of identity cards and passports) and undertake counter-terrorist and anti-mafia activities.

[12] The original dataset contained a total of 978,218 observations; with 953,257 observations that could be properly geocoded.

[13] The data coordinate type was UTM-31N, based on the European Datum 50 (ED 50) projection, although, for the sake of homogeneity with other layers of polygons, we re-projected the coordinates to ETRS89. The geocoding process was undertaken, in part, by the *Mossos d'Esquadra*, and completed using GIS techniques, with some 40,000 observations being geocoded by hand using Google Maps.

73 neighborhoods, which are in turn broken down into 1,061 census tracts according to the electoral population.[14] We opted to use this unit of analysis as it is the smallest available and, moreover, it can be directly linked to the districts, which are the primary spatial units employed by the police for their policing and strategy decisions. Additionally, as the census tracts are determined according to the population, we indirectly control for the population at risk in each spatial unit.

3.2. Football data

We merged the above crime dataset with that for the football matches played by FCB between 1 September 2007 and 31 December 2011 (again excluding the months of June, July and August).

This data set contains information about the day, time, result, number of spectators and the location of the match (i.e., played either at home or away). Table 1 reports the number of matches played and the corresponding attendance figures. The level of attendance was high for home matches with 75% being watched by more than 60,000 spectators and just seven being attended by fewer than 40,000 spectators.[15]

Table 1. FC Barcelona football matches 2007 - 2011.

Attendance	**# of matches**
> 80,000 spectators	36
> 60,000 and < 80,000 spectators	58
> 40,000 and < 60,000 spectators	24
< 40,000 spectators	7
Total number of home matches	125
Total number of away matches	130
Type of match	
Domestic League	169
King’s Cup	32
European Champions League	50
Spanish and International Super Cup	4

Note: In this period FC Barcelona played Real Madrid CF, their main rival, ten times (home and away).

[14] We use the census tracts for the 2011 municipal elections. One advantage of this spatial division is its homogeneity, with each containing a minimum of 500 and a maximum of 2,000 citizens.

[15] FC Barcelona’s stadium, the Camp Nou, is the fifth football largest stadium in the world with a capacity, at February 2013, of 99,354 spectators.

The dataset consists of a total of 125 home and 130 away matches. The majority of matches were played in the Spanish domestic league (169), followed by the King's Cup (32 matches played); however, the European Champions League matches (a total of 50) attracted by far the highest gates. Of the 255matches, ten were played against the historic rival, Real Madrid CF, the majority being Spanish domestic league games.

3.3. Matching process

Given the size of the dataset – comprising 255 days on which a football match was played (home and away), 960 days without a match, and 1,061 census tracts – we opted to undertake a matching process between days on which a game was played with highly similar days on which no match was organized. The main dataset was reduced in order to improve tractability and so as to be able to undertake the empirical estimations.

The matching of 'football days' with 'non-football days' was conducted taking into consideration the high variation in crime rates with time. Montolio and Planells-Struse (2015) show that the time of day, the day of the week and the month of the year, all appear to play a major role in accounting for crime. Weekends are, by far, the time of the week when crime levels are at their highest, while summer months, the first day of the month and bank holidays also record higher rates of crime. In order to capture this variability across time units and to form a dataset in which 'football days' can be compared to 'non-football' days, we employed the following matching process: we matched the days on which a game (home and away) was played (treatment) with a day without football (control) ensuring that these days corresponded in terms of the day of the week, the month and the year and that they corresponded to neither a bank holiday or the first day of a month. After applying these criteria, we were able to match 107 days in the case of home matches and 106 in the case of away matches. For the remaining matches we relaxed the month requirement. Hence, the remaining match days were matched with days that corresponded to the same day of the week in the same year (but not in the same month).[16] In this way, we matched a further 18 days on which home matches were played and a further 24 on which FCB played away.

Thus, we have two datasets: one comprising 125 days on which FCB played at home matched to 125 similar control days on which no football matches were played,

[16] The month fixed effect we introduce captures the heterogeneity across months.

and another comprising 130 days on which FCB played away matched to 130 similar control days on which no football matches were played.

To both datasets, we added a number of variables to control for weather conditions. These included rainfall per day, the number of sun hours per day, the average temperature per day, the average daily atmospheric pressure and the average daily wind speed. All these weather factors have been shown to be good explanatory variables for crime (Anderson, 2001; Jacob *et al.*, 2004). For instance, rainfall can reduce the potential number of targets in the streets as people prefer to stay at home, while the number of sun hours and higher temperatures can increase this number as people take to the streets and so the potential number of thefts also rises.

Table 2. Descriptive statistics for the whole city of Barcelona.

	Mean		**Std. Deviation**		**Min.**		**Max.**	
Home match days	Match days	Control days	Match days	Control days	Match days	Control days	Match days	Control days
Crime variables								
Thefts	302.048	284.69	59.54	57.09	188	178	485	433
Assaults	13.84	13.54	5.22	5.38	4	3	28	32
Control variables								
Rainfall	1.13	3.36	2.83	10.87	0.00	0.00	14.10	79.80
Sun hours	6.34	6.40	3.67	3.91	0.00	0.00	12.70	13.20
Temperature	13.02	12.95	4.71	5.47	2.70	0.00	25.50	25.50
Pressure	959.40	944.73	86.45	148.31	0.00	0.00	981.35	985.85
Wind Speed	14.81	15.10	5.89	6.54	2.88	3.96	36.00	39.96
Away match days								
Crime variables								
Thefts	298.13	294.18	61.88	54.95	126	182	451	433
Assaults	14.3	14.3	4.922	4.75	3	4	27	25
Control variables								
Rainfall	1.39	3.19	5.55	10.64	0.00	0.00	43.60	79.80
Sun hours	7.31	6.31	3.63	3.72	0.00	0.00	13.30	13.00
Temperature	12.96	13.16	5.30	5.84	0.00	0.00	25.90	25.60
Pressure	960.24	937.92	84.84	167.27	0.00	0.00	982.80	984.55
Wind Speed	14.30	14.32	5.59	5.42	2.88	3.96	36.00	28.08

Table 2 shows the main descriptive statistics for the days with home matches, the days with away matches and for the controls in both subsamples. It is evident that the statistics for the weather related variables are similar in the case of both treatment and control days. This shows that our matching process has been successful in matching 'football days' with 'non-football days' in terms of similar temperatures, number of sun hours, atmospheric pressure and wind speed. Therefore, our control sample, a priori, includes the same number of individuals on the streets and, hence, the same population at risk.

As for the main dependent variables, the number of thefts, or pick pocketing, is higher on days when FCB were playing both at home and away, although when the match was at home the difference was much greater. In contrast, in the case of assaults, no difference is observed between the number of assaults committed on match days and on control days. As such, we do not expect to find any impact of football matches on the number of assaults, at least, for the city of Barcelona as a whole.

4. Empirical approach: effects of football matches on crime

4.1. Regression approach

In order to estimate the overall effect of football matches on crime for the city of Barcelona, we omit, for the time being, the spatial variation of crime. In other words, we use the two datasets presented above with the crime counts by typology and the day of the year. We estimate a model of the following form:

$$Crime_t^m = \beta_1 Match_t + \beta_2 Away\_Match_t + \beta_3 X_t + \gamma + \varphi + \varepsilon_t \qquad (1)$$

where *t* represents the date and *m* the type of crime (theft or assault). Hence, $Crime^m_t$ represents the number of crimes of type *m* each day *t*. $Match_t$ is the variable capturing the fact of FCB playing at home or not. This variable takes different forms, including dummies for home match days, number of spectators, and different dummies to account for this level of attendance. Likewise, when FCB play away, we include the variable $Away\_Match_t$ in Eq. (1), which takes a value of 1 when FCB play away and 0 otherwise.

X is a vector containing potential predictors of thefts and assaults including averages of rainfall, number of sun hours, temperature, atmospheric pressure and wind speed as presented above. In Eq. (1) γ is a vector that contains time fixed effects to capture any potential heterogeneity across days, months or years. Specifically, it contains a day of the year fixed effect to account for specific dates across the year. Additionally, and with the same objective, we include a week of the year fixed effect to account for Easter or the spring break. To account for heterogeneity across months, we introduce a month fixed effect. We also include a day of the week fixed effect to capture the heterogeneity of crime counts across days of the week. In this sense, weekly crime patterns seem to increase from Wednesday to Sunday, with a marked weekend effect. We also include a year fixed effect to reflect the differences in crime across the five years of our data span and a season fixed effect to account for seasonal variations in crime.

Finally, φ in Eq. (1) represents a set of variables related to the football match being played. Specifically, it consists of dummy variables for the competitions being played and a dummy variable for special matches, such as those played between FCB and Real Madrid CF. Finally, ε_t represents the error term, which is assumed to be normally distributed with constant variance.

In order to estimate Eq. (1), we employ a basic Ordinary Least Squares (OLS) estimation with all the control variables presented above that account for variations in crime over time. We use robust errors to account for any potential problem arising from the errors.

As a robustness test we regress Eq. (1) also adding a dummy variable that takes value 1 for days following a match day, also distinguishing between home and away matches, and 0 otherwise. This robustness exercise is carried out since the effect of football matches on crime may persist during the following day after the match as shown in Montolio and Planells-Struse (2015). The authors find that some types of crime, such as thefts, are significantly increase even eight hours after the football match. Given that on average, the typical kick off and final whistle times for FCB football matches are between 20:00 and 22:00 the effect of the football matches on crime could be recorded the next day.

4.2. Spatial approach

After estimating the overall effects of football matches on crime, we are interested in analyzing changes in its spatial distribution when FCB play at home and away (treatment) and in comparing these outcomes with ‘non-football days’ (control). To do so, we undertake an Exploratory Spatial Data Analysis (ESDA, hereafter), which allows us to determine the presence of “hot spots” (areas where crime is more spatially concentrated) in the city of Barcelona employing kernel density functions and average nearest-neighbor statistics (Chainey *et al.*, 2008).[17] Additionally, we carry out a

[17] Using Local Indicators of Spatial Autocorrelation (LISA) would be a very useful tool to identify those census tracts with high/low values of crime surrounded by other census tracts with also high/low values of crime. However, for the case of Barcelona, its city centre distorts the analysis if applying this technique. Focusing only on the surroundings near the FCB stadium reduces the number of spatial units

confirmatory analysis by means of regressing crime occurrence as a function of a distance to the FCB stadium. More specifically, we carry out the following regression:

$$Crime_{it}^{m} = \sum_{k=300}^{1400} \xi_k dist_{ik} + \sum_{k=300}^{1400} \eta_k dist_{ik} Match_t + \beta_1 Match_t + \beta_2 Away\_match_t + \beta_3 X + \gamma + \varphi + \sigma + \varepsilon_{it} \quad (2)$$

where i denotes the census tract, σ denotes a vector containing neighborhood and district fixed effects, and all the other variables and parameters are as in Eq. (1) except for two new parameters and variables. The first of these, $\sum_{k=300}^{1400} \xi_k dist_k$, is a set of dummy variables that takes a value of 1 if the centroid of census tract i is within distance k (in meters) of the FCB stadium and 0 otherwise. This set of dummies captures the impact on crime of being within a certain distance of the stadium both on 'football days' and 'non-football days'. The second, $\sum_{k=300}^{1400} \eta_k dist_k Match_t$, represents the interaction term of the previous distance variable and a dummy indicating a match day at the stadium. As such, the parameters η_k capture the effect of being within a certain distance of the stadium when a football match is being held. We expect the number of crimes to rise as we get closer to the stadium, in part, due to the greater number of social interactions between supporters and, in part, due to the concentration effect that attracts offenders to crowded areas around a stadium.

We adopt two approaches to capture the distance decay effect. The first involves examining the way in which crime counts increase within cumulative rings of distance k (where k = 300, 400, ..., 1,400 meters). In other words, we construct cumulative rings that include crime counts in census tracts of increasing distances. In order to estimate this distance effect, we have to regress Eq. (2) k times with the k distance dummy, since the upper order rings are likely to be correlated to those of a lower order. The second approach involves estimating the non-cumulative rings. In other words, we focus on the way in which crime counts vary between census tracts at distance k and k-100 (in meters). In both cases we expect a distance decay pattern, as individuals are likely to be more spread out the further we move away from the stadium. It should be pointed out that the cumulative ring approach is more likely to show the effect of football matches

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and, hence, the use of LISA technique it is not a plausible solution since it is not recommended for datasets with few number of spatial units (Anselin, 1995).

on crime at greater distances since with this approach all rings include the census tracts that lie closest to the stadium, i.e., those that are most likely to show a significant increase in their crime counts.

With the inclusion of this new dimension (the census tracts), the non-trivial number of zeros and the positive skewed distribution of the crime counts, we cannot use OLS since our results could be biased. Moreover, the data present a problem of over-dispersion. In other words, the variance of the crime counts (both thefts and assaults) is larger than their mean. Therefore, we use a negative binomial approach that takes into account all the characteristics that differ from the standard assumptions underlying the OLS estimation.[18] It should be pointed out that the iteration process rarely converged when introducing census tract fixed effects. Consequently, we can only approximate the census tract fixed effects by means of district and neighborhood fixed effects.

5. Regression results

We estimate Eq. (1) using different definitions for the home matches.[19] We first present the results in Table 3 of the impact of an additional 10,000 spectators on the theft and assault counts. The first column represents a simple correlation with no control variables. Column 2 includes all time fixed effects except for the year fixed effects. Column 3 includes also the weather control variables. Finally, in column 4 we include the year fixed effects.

Results in Table 3 show that an additional 10,000 spectators increases the number of thefts by around seven; we are able to explain approximately 75% of the variation of thefts across the city of Barcelona. In the case of assaults an increase of 10,000 spectators does not have a significant impact. The average number of assaults (given by the constant) is much lower than the average number of thefts and, also, compared to the theft regressions, the models for assaults are only able to explain, as expected, around 36% of the variance in the number of assaults.

Table 4 shows the average effect of a football match being played at home on theft and assault counts. The four columns represent the same estimated model as in Table 3

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[18] Note that given that we estimate a negative binomial model, the coefficients reported in the corresponding tables are the incidence rate ratios that represent the increase or decrease in percentage of the number of counts of each crime type.

[19] For the sake of homogeneity throughout the paper we perform these initial regressions with the dataset containing ‘football days’ (home and away matches) and their respective controls as presented in section 3.3. Nevertheless, when using the full dataset (containing all available days), we obtain very similar results. The tables are not reported but are available upon request.

above. The estimated coefficients in column 4 show that, on average, there are 40 thefts more on those days when FCB play at home. In the case of assaults, there is no significant increase in the number of assaults committed in the city of Barcelona.

Table 3. OLS estimations. Effect of number of spectators on theft and assault counts.

VARIABLES	(1)	(2)	(3)	(4)
	Thefts	***Thefts***	***Thefts***	***Thefts***
Spectators/10,000	3.797***	7.818***	6.555***	7.079***
	(0.978)	(2.228)	(2.057)	(2.065)
Constant	279.9***	300.7***	262.4***	233.4***
	(4.986)	(14.87)	(18.67)	(16.42)
R-squared	0.059	0.686	0.735	0.750
	Assaults	***Assaults***	***Assaults***	***Assaults***
Spectators/10,000	0.0867	-0.126	-0.183	-0.213
	(0.0914)	(0.248)	(0.253)	(0.243)
Constant	13.38***	13.37***	11.73***	11.60***
	(0.465)	(1.705)	(2.170)	(2.180)
R-squared	0.004	0.344	0.356	0.365
Observations	250	250	250	250
Climate controls	NO	NO	YES	YES
Time controls	NO	YES	YES	YES
Year fixed effects	NO	NO	NO	YES
Seasonal controls	NO	YES	YES	YES
Derby dummy	NO	YES	YES	YES

Note: Climate controls include: average rainfall, average number of sun hours, average temperature, average pressure and average wind speed. Time controls include: day of the week, day of the year, week of the year, weekend and month. Seasonal controls include dummies for summer (mainly September) and winter. Robust standard errors are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4. OLS estimations. Effect of matches played at home on theft and assault counts.

VARIABLES	(1)	(2)	(3)	(4)
	Thefts	***Thefts***	***Thefts***	***Thefts***
Match	17.36**	40.70***	41.53***	40.56***
	(7.378)	(9.348)	(8.258)	(8.564)
Constant	284.7***	289.9***	241.9***	237.8***
	(5.107)	(13.41)	(18.01)	(16.98)
R-squared	0.022	0.669	0.723	0.737
	Assaults	***Assaults***	***Assaults***	***Assaults***
Match	0.304	0.321	0.374	0.406
	(0.671)	(1.057)	(1.072)	(1.065)
Constant	13.54***	12.03***	11.20***	11.47***
	(0.481)	(1.762)	(2.082)	(2.164)
R-squared	0.001	0.343	0.355	0.363
Observations	250	250	250	250
Climate controls	NO	NO	YES	YES
Time controls	NO	YES	YES	YES
Year fixed effects	NO	NO	NO	YES
Seasonal controls	NO	YES	YES	YES
Derby dummy	NO	YES	YES	YES

Note: see Table 3.

It might be the case that only the big matches, i.e., those with over 80,000 spectators, affect crime. In our sample, 36 matches can be considered as high risk or “hot” in terms of crime with attendances recorded at over 90% of the stadium’s capacity. The variance in the number of spectators might affect the way in which potential offenders perceive their opportunities for committing crimes and their potential rewards. Yet, if police deployment is greater during these “hot” matches, pickpockets may decide that their activities are only worthwhile on match days when police deployment is less intense. In the case of assaults, “hot” football matches may increase the number of potentially violent supporters or hooligans. In order to account for the effect of big matches, Table 5 includes a dummy variable that takes a value of 1 if the home match is played before more than 80,000 spectators.

Table 5 shows the impact of big home football matches on theft counts. In column 4, the most complete model, the estimated coefficients identify an increase of almost 23 thefts on such occasions. On days when match attendance does not reach 80,000, the increase is 18 for the whole city of Barcelona. In the case of assaults, the city of Barcelona does not, on average, suffer a significant increase in the number of assaults on big match days.

Table 5. OLS estimations. Effect of ‘big’ home matches on theft and assault counts.

VARIABLES	(1)	(2)	(3)	(4)
	Thefts	***Thefts***	***Thefts***	***Thefts***
> 80,000 spectators	43.63***	20.28***	19.59***	22.82***
	(11.41)	(7.364)	(7.096)	(6.823)
Match	4.795	30.19***	19.34**	18.37**
	(7.773)	(8.597)	(7.886)	(7.393)
Constant	284.7***	289.7***	242.0***	236.6***
	(5.117)	(13.29)	(17.64)	(16.01)
R-squared	0.078	0.679	0.733	0.749
	Assaults	***Assaults***	***Assaults***	***Assaults***
> 80,000 spectators	1.902*	1.480	1.465	1.324
	(1.114)	(1.065)	(1.074)	(1.066)
Match	-0.244	-0.445	-0.317	-0.238
	(0.702)	(1.088)	(0.949)	(0.936)
Constant	13.54***	12.01***	11.21***	11.40***
	(0.482)	(1.790)	(2.086)	(2.163)
R-squared	0.014	0.350	0.362	0.368
Observations	250	250	250	250
Climate controls	NO	NO	YES	YES
Time controls	NO	YES	YES	YES
Year fixed effects	NO	NO	NO	YES
Seasonal controls	NO	YES	YES	YES
Derby dummy	NO	YES	YES	YES

Note: See Table 3.

So far we have considered the overall impact of home football matches on theft and assault counts. However, as discussed above, away football matches might also increase criminal activity in the city given that people typically gather in the city’s pubs and bars to watch the game. This could generate similar crowding effects that might attract pickpockets or result in outbreaks of violence since alcohol is usually consumed while following the match. Table 6, however, shows that neither theft nor assault counts are significantly affected by FCB's away matches. Although the average number of pick pocketing is higher on those days when FCB play away, after controlling for weather conditions and time varying variables this increase is not statistically significant. In the case of assaults, we even find a negative effect, although here again it is not significant.[20]

Table 6. OLS estimations. Effect of away matches on theft and assault counts.

VARIABLES	(1)	(2)	(3)	(4)
	Thefts	***Thefts***	***Thefts***	***Thefts***
Away match	3.946	2.727	8.482	13.05
	(7.259)	(15.24)	(15.94)	(14.29)
Constant	294.2***	341.1***	280.6***	255.0***
	(4.820)	(14.49)	(21.32)	(19.00)
R-squared	0.001	0.715	0.739	0.768
	Assaults	***Assaults***	***Assaults***	***Assaults***
Away match	1.069*	-0.740	-0.396	-0.245
	(0.600)	(3.071)	(2.900)	(3.187)
Constant	13.24***	13.62***	12.68***	11.23***
	(0.417)	(2.498)	(2.999)	(2.870)
R-squared	0.012	0.376	0.393	0.410
Observations	260	260	260	260
Climate controls	NO	NO	YES	YES
Time controls	NO	YES	YES	YES
Year fixed effects	NO	NO	NO	YES
Seasonal controls	NO	YES	YES	YES
Derby dummy	NO	YES	YES	YES

Note: see Table 3.

6. Spatial results

6.1. Exploratory Spatial Data Analysis (ESDA)

After analyzing the overall effect of home and away football matches on theft and assault counts, we incorporate the spatial dimension by introducing the 1,061 census tracts of the city of Barcelona. We first present the descriptive statistics of the distribution of crime in the city of Barcelona and we carry out an ESDA analysis to

[20] Tables A1 (for attendance in home matches) and A2 (for away matches) in the appendix present the robustness exercise when considering the impacts on the day after the match. The results, obtained after including all the observations in the regressions (that is, the matching process was not applied), are very similar to the ones discussed in the main text. In general, the impact of football matches on crime, even if present for some hours after the match that belong to the following day, vanishes given that our time unit is the day and for the whole next day, as expected, we do not find any impact.

show the main crime patterns on days when FCB play at home, on days when FCB play away and on 'non-football days' (controls).

Columns 1 and 4 in Table 7 show the relative increase in theft and assault counts, respectively, in census tracts whose centroid is located at a distance of *k* meters from the center of the FCB stadium relative to the total increase for the whole city of Barcelona. Specifically, we show the results of the following formula:

$$\frac{\Delta Crime_i^{k}{}_{Home-control}}{\Delta Crime^{Barcelona}{}_{Home-control}} \tag{3}$$

where the numerator in Eq.(3) represents the increase in the variable $Crime^k_i$ (either thefts or assaults) in census tract *i* whose centroid is located within *k* meters of the center of the football stadium on days with no football (control) and on days when FCB play at home. The denominator simply represents the increase in the number of crimes in the whole of the city of Barcelona. Consequently, if the ratio is greater than 0, then the number of crimes within those census tracts located within a distance of *k* meters suffers a higher increase than the increase experienced by the city of Barcelona as a whole on the days when FCB play at home.

Table 7. Relative increase in the number of crimes.

	Thefts			***Assaults***		
	(1) Increase	(2) Control days	(3) Match days	(4) Increase	(5) Control days	(6) Match days
< 300	2.72%	0.05%	0.20%	13.16%	0.00%	0.29%
< 400	15.35%	0.50%	1.35%	31.58%	0.71%	1.39%
< 500	24.38%	0.75%	2.11%	50.00%	1.30%	2.37%
< 600	26.64%	0.83%	2.31%	60.53%	1.30%	2.60%
< 700	29.86%	0.99%	2.65%	55.26%	1.71%	2.89%
< 800	30.97%	1.14%	2.85%	57.89%	1.89%	3.12%
< 900	37.60%	1.70%	3.76%	65.79%	2.42%	3.82%
< 1,000	39.91%	2.07%	4.50%	73.68%	2.60%	4.16%
< 1,100	43.13%	2.54%	5.17%	84.21%	3.01%	4.80%
< 1,200	43.59%	3.03%	5.69%	65.79%	3.90%	5.26%
< 1,300	42.72%	3.44%	6.05%	44.74%	4.61%	5.49%
< 1,400	42.35%	3.84%	6.42%	42.11%	5.02%	5.84%

As can be seen in columns 1 and 4 of Table 7, the increase in theft and assault counts in the census tracts located within a certain distance of the stadium represents a sizeable share of the total increase for the whole city on days when there is a home football match. Specifically, in the case of thefts, the increase in census tracts within a radius of up to 1,200 meters represents 43.59% of the total increase. After this threshold, the share decreases, either because the numerator falls or because the denominator rises, or both. From the percentages presented in columns 2 and 3, which represent the share of thefts committed in census tracts located within a certain distance on ‘non-football days’ (controls) and on days when FCB play at home respectively, it can be seen that the number of thefts in the census tracts whose centroid is within 1,300 meters (or more) of the stadium increases more on the control days than on the days with home football matches. This means that the concentration effect seems to disappear after a certain distance.

In the case of the number of assaults, column 4 shows that the census tracts that are located within 1,100 meters of the stadium account for up to 84.21% of the total increase in the number of assaults across the whole of the city. This increase is not homogenous indicating that the increase in the number of assaults in these census tracts on match days is lower than it is on control days, thus reducing the representation of the total increase in the assault count. Columns 5 and 6 show the share of assaults committed in census tracts located within a certain distance with respect to the total number of assaults in Barcelona on ‘non-football days’ (controls) and on days when home football matches are played, respectively. Again, the share of assaults committed when FCB are playing at home is higher than the share on ‘non-football days’ for all distances.

After analyzing the main statistics and the concentration of thefts and assaults in the census tracts located in the vicinity of the FCB stadium, we are able to depict these results in cartographic form. We show the kernel density estimations in order to identify the places in the city of Barcelona where the risks of being a victim of theft or assault on certain days (‘football’ and ‘non-football’) are highest. Kernel density estimations simply provide a smooth estimate of the point process derived by means of a moving window (bandwidth) over the data. In this sense, the objective is to estimate how event levels vary continuously across a study area based on an observed point pattern for a sample of points (Bailey and Gatrell, 1995; Williamson *et al*., 1998). The estimated kernel values represent the predictive risk surface for each type of crime analyzed, in other words, the potential number of events per square km when taking into account potential contagious effects from other areas.

Delimiting the area in which to measure the risk of a certain crime, that is, the radius of the circle centered on each grid cell containing the points that contribute to the kernel density calculation, is known as the bandwidth decision problem. Large bandwidths result in over smoothing, with low density values and, therefore, an over generalized view, while small bandwidths result in maps that are spiky in appearance because of the jumps between spatial units (producing images similar to point patterns). Several rules of thumb have been suggested by Williamson *et al.* (2000) and Bailey *et al.* (1995) based mainly on the k-nearest neighbor mean distances, and dependent on the detail of analysis that the researcher wishes to obtain (city, county, neighborhood, street, parking lot, etc.). However, the bandwidth must also be theoretically justified since it reflects the contagious nature of a particular crime across space. For instance, thefts from vehicles may cluster in a specific parking lot because it has no surveillance cameras. It is reasonable to think that thefts from vehicles are likely to occur in the parking lot with the same degree of probability. If the lot extends over 250 meters, then a 250- or 300-meter bandwidth would capture the potential contagious effect. However, choosing a larger bandwidth will have the effect of extending the probability of thefts from vehicles to other areas where no cars are parked. Another example would be domestic violence, which tends to be highly focused on specific households. As such, the bandwidth of the kernel density estimation should be very small. In our case, we use a bandwidth of 300 meters for both thefts and assaults.[21]

In line with our matching process, we first calculate the kernel density functions for thefts and assaults on those days when FCB played at home (K_H) and for their respective controls (K_{CH}). We then compute the difference, K_H - K_{CH}, and plot it on a map. In Figure 1, Map 1A shows this difference for thefts and Map 1B for assaults. The areas shaded red present the largest increases in the number of thefts and assaults between days when FCB played at home and days without football (controls) while the areas shaded blue present the largest shifts in the other direction. The unshaded areas present no change in their theft or assault counts.

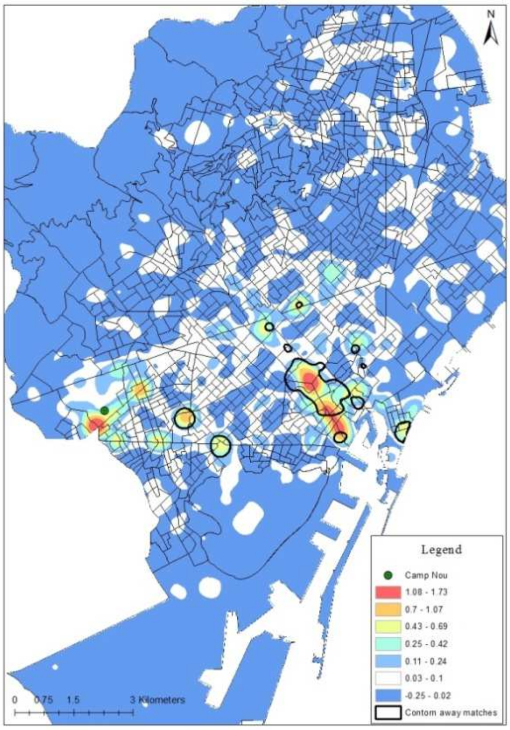
Map 1A shows that, in the case of thefts, there is an increase mainly in two areas of the city: first, in the city center where people gather in bars and pubs to watch the match and where victories are celebrated; and, second, in the vicinity of the stadium (identified

[21] Theoretically, the bandwidth for the assaults should be smaller since the contagious effect is lower; however, we opt to use the same bandwidth to make both maps comparable.

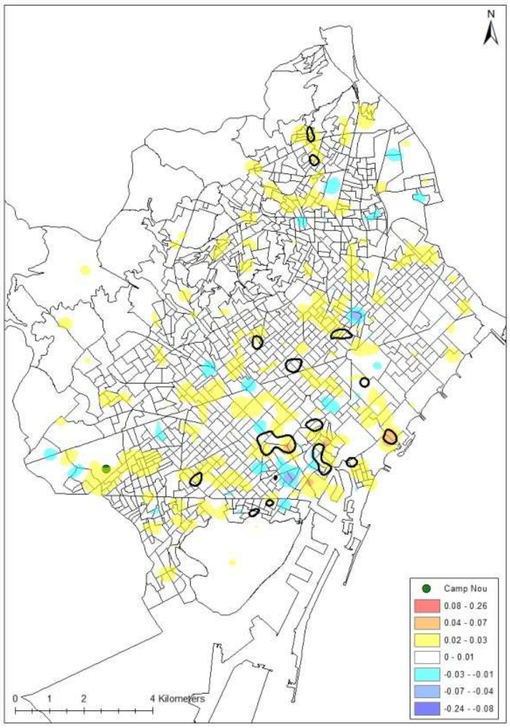
on the map with a green dot, see also Figure A1 in the appendix). A similar pattern is found in Map 1B for the number of assaults. An increase is observed especially in the city center, but also in areas surrounding the stadium.

Figure 1. Difference in kernel density values between days when FCB play at home and days with no football (control days).

Map 1A: ***Thefts***.



Map 1B. ***Assaults***.



Note: Quadratic kernel functions. The representation is the density function per square km using natural breaks so as to identify outliers clearly. Bandwidths are set at 300 meters for both thefts assaults. Cell size is set at 20 meters to show as much detail as possible.

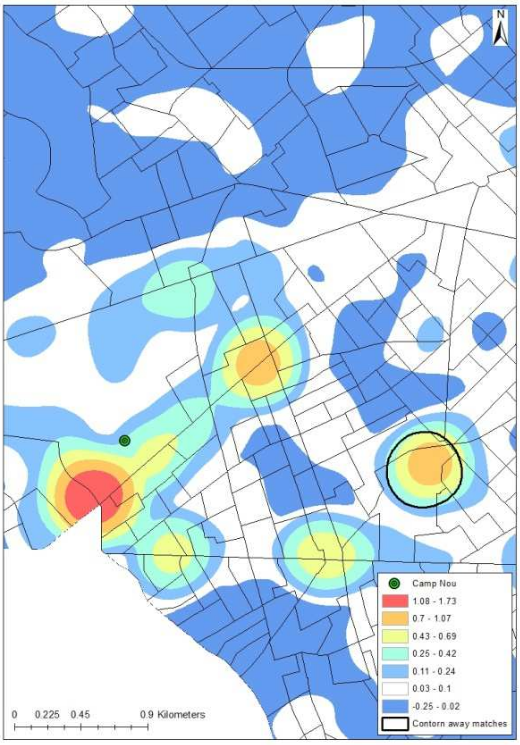
In Figure 1 the kernel density functions are the result of the difference between the kernel densities for the number of crimes committed on days when FCB play at home and those for the crimes committed on ‘non-football days’ (controls). The areas outlined in black on the two maps in Figure 1 denote “hot spots” corresponding to differences in densities on days when FCB play away and ‘non-football days’ (controls). As such, we plot on the same map increases attributable to both home and away matches. It is clear that these respective differences (i.e., home matches vs. controls and away matches vs. controls) do not coincide. On those days when FCB play away, there appear to be increases in theft and assault counts both in the center of the city and in certain areas where pubs and bars concentrate.

In order to focus our analysis on the vicinity of the FCB stadium, the maps in Figure 2 show only the crimes committed within a certain distance of the stadium. In this way we are able to understand more fully the fluctuations in crime counts around the football stadium.[22]

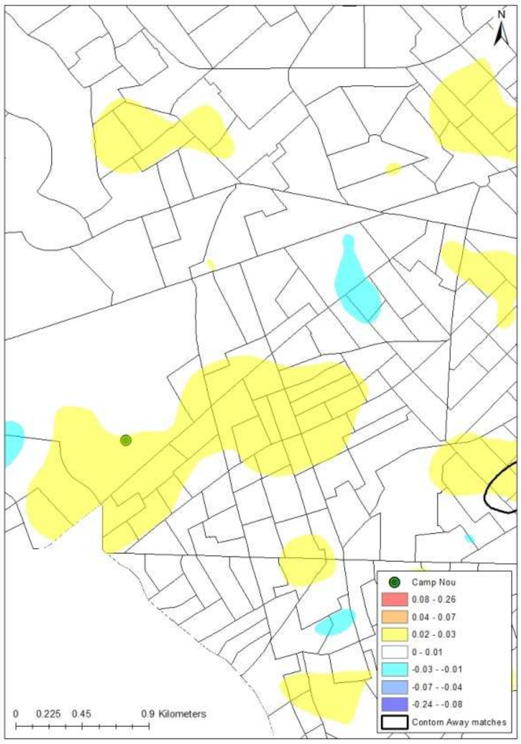
Map 2A shows that the number of thefts increases markedly when FCB play at home. This is particularly evident in the streets en route to the stadium from the main transport facilities. The circles outlined in black indicate the hot spots found when computing the difference in the kernel values when FCB play away and 'non-football days' (controls). Here, again the respective patterns (i.e., home matches vs. controls and away matches vs. controls) do not coincide. Map 2B shows similar results for the case of assaults. Although concentrated in smaller areas, there also appears to be a high concentration of assaults in the vicinity of the stadium.

Figure 2. Kernel density functions around FCB stadium for thefts and assaults when the club plays at home, away, and on days without a match.

Map 2A: ***Thefts***.



Map 2B. ***Assaults***.



Note: See Figure 1.

6.2. Confirmatory analysis

In order to confirm the crime concentration patterns around the FCB stadium when FCB play at home, we first estimate the effect of the distance to the stadium on the number of thefts and assaults. These results are presented in Table 8 where we also

[22] Figure A1 in the appendix shows exactly the area of the city presented in Figure 2.

include the square of the distance to account for possible non-linear relationships between crime and distance. Results show that the number of thefts in the census tracts is negatively affected by the distance to the stadium: the greater the distance, the lower the theft count. However, it is worth noticing that the square of the distance presents a coefficient greater than one, indicating a positive impact on the number of thefts. This non-linearity suggests that the effect of the distance on the number of thefts is convex, that is, the greater the distance, the smaller the effect on the number of thefts, with the reduction in this effect being higher. This reflects the potential presence of the concentration effect. In the case of assaults, Table 8 shows no effect of distance on the assault count.

Table 8. Distance decay effect. Distance and square distance. Negative binomial.

VARIABLES	***Thefts***	***Assaults***
Distance*Match	0.890***	0.968
	(0.0212)	(0.0605)
Distance^2*Match	1.009***	1.002
	(0.00244)	(0.00592)
Constant	3.223***	3.847***
	(0.0400)	(0.374)
Observations	265,250	265,250
Climate controls	YES	YES
Time controls	YES	YES
Year fixed effects	YES	YES
Seasonal controls	YES	YES
Derby dummy	YES	YES
District fixed effects	YES	YES
Neighborhood fixed effects	YES	YES

Note: see notes to Table 3. Each distance is estimated separately so as to avoid any correlation between rings at different distances. Coefficients reported as incidence rate ratios. Standard errors clustered at the district level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Next, we estimate Eq. (2) for both thefts and assaults using the cumulative and non-cumulative rings (or buffers); see Tables 9 and 10 respectively.[23] Table 9 shows the results for all home matches (columns 1 and 3) as well as for home matches with an attendance in excess of 80,000 (columns 2 and 4).

In the case of thefts, the results show a clear distance decay pattern as we move away from the stadium – being in a census tract whose centroid is less than 300 meters from the stadium when FCB are at home increases the number of thefts by an average of

[23] As explained in Section 4.2, each ring represents an increase of 100 meters from the stadium and includes all additional census tracts whose centroid falls within the ring. When using cumulative rings, all census tracts up to the distance ring are included. Figure A1 in the appendix maps the rings used, while Table A3 shows the number of census tracts included in each ring.

260% and by 400% on the day of a big match. This huge increase in pick pocketing during big matches in the same census tract as that of the stadium points to a clear concentration effect. Note that this impact is decreasing as we move away from the stadium.

Table 9. Cumulative rings. Negative binomial. Home and 'big' home matches.

VARIABLES	(1) Thefts	(2) Thefts (Big matches)	(3) Assaults	(4) Assaults (Big matches)
<300 m	2.604***	4.000***	5.011***	8.613**
	(0.652)	(1.068)	(2.059)	(7.003)
< 400 m	2.202***	2.684***	1.749**	1.870
	(0.368)	(0.368)	(0.461)	(0.749)
< 500 m	2.502***	2.745***	1.837**	2.247**
	(0.306)	(0.300)	(0.511)	(0.710)
< 600 m	2.534***	2.714***	2.020**	2.582***
	(0.279)	(0.273)	(0.555)	(0.760)
< 700 m	2.555***	2.769***	1.695**	2.309***
	(0.267)	(0.259)	(0.420)	(0.632)
< 800 m	2.339***	2.546***	1.661**	2.455***
	(0.232)	(0.217)	(0.394)	(0.636)
< 900 m	2.257***	2.306***	1.589**	2.414***
	(0.199)	(0.174)	(0.341)	(0.558)
< 1,000 m	2.129***	2.129***	1.619**	1.619**
	(0.144)	(0.144)	(0.333)	(0.333)
< 1,100 m	1.935***	1.982***	1.613**	2.317***
	(0.146)	(0.119)	(0.307)	(0.473)
< 1,200 m	1.812***	1.810***	1.364*	1.993***
	(0.126)	(0.0979)	(0.238)	(0.388)
< 1,300 m	1.752***	1.697***	1.195	1.923***
	(0.116)	(0.0865)	(0.197)	(0.358)
< 1,400 m	1.700***	1.611***	1.166	1.910***
	(0.108)	(0.0778)	(0.185)	(0.342)
Observations	265,250	265,250	265,250	265,250
Climate controls	YES	YES	YES	YES
Time controls	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Seasonal controls	YES	YES	YES	YES
Derby dummy	YES	YES	YES	YES
District fixed effects	YES	YES	YES	YES
Neighborhood fixed effects	YES	YES	YES	YES

Note: see notes to Table 3. Each distance is estimated separately so as to avoid any correlation between rings at different distances. Coefficients reported as incidence rate ratios. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

The distance decay pattern for assaults appears to be very similar to that observed for thefts. Here again there is a sharp decrease in crimes between census tracts located within 300 meters of the stadium and those located within a radius of 400 meters. The marked increase in assaults in the census tracts closest to the stadium are presumably attributable, as previously explained, to the fact that a greater number of social interactions, and possible rivalries between opposing football fans, can lead to clashes and fighting. In the case of big football matches there appears to be a greater impact on crime at all distances computed from the stadium.

Table 10 presents our analysis of effects on crime counts at specific distances from the stadium, without taking into account census tracts that lie closer to the football ground. These non-cumulative distance rings show the impact of home football matches in census tracts located 100 meters apart.

Table 10. Non-cumulative rings. Negative binomial. All matches and 'big' matches.

VARIABLES	(1) *Thefts*	(2) *Thefts* (Big matches)	(3) *Assaults*	(4) *Assaults* (Big matches)
<300 m	2.661***	4.141***	5.483***	8.633**
	(0.667)	(1.105)	(2.479)	(7.893)
>300 and < 400 m	2.177***	2.598***	1.554	1.358
	(0.412)	(0.389)	(0.626)	(0.634)
>400 and < 500 m	3.132***	2.936***	1.666	2.824**
	(0.556)	(0.535)	(0.712)	(1.364)
>500 and < 600 m	2.957***	2.553***	2.135***	17.84**
	(0.644)	(0.629)	(1.056)	(20.59)
>600 and < 700 m	2.372***	2.655***	0.701	1.142
	(0.645)	(0.561)	(0.407)	(0.890)
>700 and < 800 m	1.044	1.474*	1.309	4.377*
	(0.337)	(0.312)	(1.000)	(3.431)
>800 and < 900 m	1.993***	1.774***	1.324	2.236
	(0.357)	(0.257)	(0.642)	(1.118)
>900 and < 1,000 m	1.109	1.315**	1.977	0.701
	(0.225)	(0.178)	(1.395)	(0.738)
>1,000 and < 1,100 m	1.229	1.365***	1.542	2.782**
	(0.184)	(0.159)	(0.744)	(1.361)
>1,100 and < 1,200 m	1.178	1.059	0.523	0.546
	(0.182)	(0.127)	(0.233)	(0.406)
>1,200 and < 1,300 m	1.151	0.860	0.324*	1.306
	(0.199)	(0.113)	(0.187)	(0.836)
>1,300 and < 1,400 m	1.102	0.875	0.850	1.729
	(0.216)	(0.116)	(0.470)	(1.143)
Constant	3.088***	3.084***	9.202***	4.039***
	(0.0373)	(0.0373)	(0.740)	(0.376)
Observations	265,250	265,250	265,250	265,250
Climate controls	YES	YES	YES	YES
Time controls	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Seasonal controls	YES	YES	YES	YES
Derby dummy	YES	YES	YES	YES
District fixed effects	NO	YES	NO	YES
Neighborhood fixed effects	NO	YES	NO	YES

Note: see Table 9.

Our results provide a clearer indication of the distance at which the impact of football on crime disappears. In the case of thefts, distance decay is clear, although not homogeneous as there are specific rings that present higher levels of thefts than rings that are closer to the stadium. This presumably reflects the fact that certain circumstances of an area are likely to increase the number of thefts. For instance, the ring of census tracts located at a distance of between 700 and 800 meters from the stadium presents almost no impact on the number of thefts. The effect of football matches on the number of thefts seems to disappear in census tracts located at an average distance of 900 meters from the stadium and in those located at 1,100 meters when FCB is playing a big match.

The largest increase in the number of assaults during home football matches occurs, as previously found, in census tracts located within 300 meters of the stadium. Indeed, it is probable that the majority of these incidents occur in the same census tract as that in which the stadium is located. The effect seems to disappear in census tracts located 600 meters from the stadium; however, it reappears in census tracts located between 800 and 1,000 meters from the ground. Again, the presence of specific places (bars, pubs, parking areas, etc.) could explain the spatial patterns observed.

6.3. Placebo test

We conduct a final exercise to verify the robustness of the above results by estimating the following equation:

$$Crime_{it}^{m} = \sum_{k=300}^{1400} \xi_k dist_k + \sum_{k=300}^{1400} \eta_k dist_k Awaymatch_t + \beta_1 Match_t + \beta_2 Away\_match_t + \beta_3 X + \gamma + \varphi + \sigma + \varepsilon_{it} \quad (4)$$

where the only difference with respect to Eq. (2) is that here we estimate the impact of being in a census tract at a certain distance from the stadium on a day when FCB play away. The results (see Table 11) indicate that, in general and as expected, when FCB play away the crime counts (both for thefts and assaults) are significantly lower in areas close to the stadium. Note that the only ring that shows an increase in the number of thefts and assaults during away football matches is the one located between 300 and 400 meters from the stadium. This result may be identifying a specific location (concentration of bars or pubs) in which people gather to watch the (away) match.

7. Conclusions

This paper has analyzed the overall effects and the spatial displacement/concentration effects of football matches on thefts (mainly pick pocketing) and assaults (related to hooliganism in the present set up) in an urban context. Using an OLS regression approach we first estimated the impact on crime across the city of Barcelona of Football Club Barcelona playing at home and away. The results show clear evidence of an increase in thefts when FCB play at home; however, this trend is not present for assaults or when FCB play away.

Table 12. Placebo test (non-cumulative rings).

Variables	*Thefts*	*Assaults*
<300 m	0.269***	1.70e-08***
	(0.0229)	(1.77e-08)
>300 and < 400 m	1.704***	1.475***
	(0.144)	(0.0448)
>400 and < 500 m	0.924	0.866
	(0.166)	(0.155)
>500 and < 600 m	0.394***	0.545
	(0.135)	(0.474)
>600 and < 700 m	0.361***	0.703***
	(0.0205)	(0.0302)
>700 and < 800 m	0.162***	0.186***
	(0.0368)	(0.111)
>800 and < 900 m	0.927	0.386**
	(0.813)	(0.184)
>900 and < 1,000 m	0.446***	0.600***
	(0.0561)	(0.0995)
>1,000 and < 1,100 m	0.389***	0.528***
	(0.0722)	(0.121)
>1,100 and < 1,200 m	0.575	0.813*
	(0.368)	(0.0982)
>1,200 and < 1,300 m	0.334***	0.824
	(0.0550)	(0.117)
>1,300 and < 1,400 m	0.458***	0.597*
	(0.138)	(0.171)
Observations	275,860	275,860
Climate controls	YES	YES
Time controls	YES	YES
Year fixed effects	YES	YES
Seasonal controls	YES	YES
Derby dummy	YES	YES
District fixed effects	NO	YES
Neighborhood fixed effects	NO	YES

Note: see Table 9.

In order to analyze in depth how large crowds attending football matches can impact criminal behavior, we analyzed crime patterns around the FCB stadium and found that both the number of thefts and assaults increased significantly. This pattern was confirmed using an ESDA and by undertaking a regression analysis. Specifically, we found that the number of thefts increased significantly in census tracts located within a 900-meter radius (1,100 meters on big match days) of the stadium, while the increase recorded in assaults was limited more specifically to areas located in the vicinity of the stadium entrances, that is, in census tracts located within a 600-meter radius (700 meters on big match days) of the stadium.

These results – the overall effects and the spatial crime patterns – point to two different crime generating processes. First, the spatial patterns indicate a clear concentration effect for both types of crime. In the case of thefts, large crowds attract pickpockets that perceive (in terms of the Routine Activity Theory) that their rewards will be higher and their probability of being apprehended lower, despite the increase in police presence around the stadium. The attractiveness of the targets may also drive part of this effect; the presence of spectators carrying cameras and cash, in addition to a large number of inattentive tourists, serve as magnets for pickpockets.

In the case of assaults, the spatial patterns also point to a concentration effect around the stadium when FCB play at home pointing out to the presence of interpersonal violence or hooliganism. Indeed, in the census tracts closest to the stadium (and in the census tract in which the stadium is located) the number of assaults increases significantly. However, the absence of any effects for the city as a whole (whether FCB are at playing home or away) suggests a second effect, that of displacement from other areas of the city to the stadium on match days. A possible explanation for this might be the similar profiles shared by football fans and potential offenders. The results reported in this study, however, do not control for the extra policing provided on match days, as no data are available. Yet, we have been able to show the significant increase in the number of thefts across the city of Barcelona even though there is a greater presence of police officers when FCB play at home.

Thus, in addition to shedding light on the effects of football matches on crime in an urban context, this paper may also be used for the effective allocation of police patrols in the city of Barcelona. As the ESDA and kernel density function analyses show, not only does the number of thefts in the vicinity of the stadium increase, there is also a rise in such crimes in the center of the city and in and around large transport hubs, including metro and railway stations. This indicates that additional police officers should be assigned to the area around the stadium and to certain parts of the city, including the city center, which suffers (approximately) half of the overall increase in the number of thefts.

The policy implications of our results are multiple. For instance, we have presented strong evidence of the increase in certain types of crime throughout the city of Barcelona when football matches are played, above all around the FCB stadium. An increase in illegal activities is recorded in relation to the celebration of a private leisure activity such as football and, hence, additional public resources must be devoted to control for these negative externalities.

While it is true that private institutions already contribute to public budgets via regular tax payments, the extra costs society has to face as a result of their activities need to be taken into consideration. In this regard, we still have much to learn about adapting taxation to the real costs attributable to the impact of football on illegal behavior. For instance, the real costs would have to take into account not only the need for extra police officers on match days around the stadium but also the need for additional policing in other crowed places in the city where, on match days, increases in thefts are recorded. Additionally, the police should not only monitor crowds at the entrance to the stadium, as they do now. As we have shown, the impact of football matches extends over a radius of more than 1 km in the case of thefts and around 500 meters in the case of assaults. In sum, any tax levied should take into account the direct costs of assigning extra police patrols within a radius around the stadium in which football is known to have a significant impact on crime.

References

Allmers, S., and Maennig, W. (2009). “Economic impacts of the FIFA Soccer World Cups in France 1998, Germany 2006, and outlook for South Africa 2010”. *Eastern Economic Journal*, 35(4), 500-519.

Anderson, C.A. (2001). “Heat and Violence”. *Current Directions in Psychological Science*: 33-38.

Anselin, L. (1995). “Local indicators of spatial association – LISA”. *Geographical Analysis*, 27, 93-115.

Bailey, T.C. and Gatrell, A.C. (1995). *Interactive Spatial Data Analysis*. Harlow: Longman.

Brantingham, P.L., and Brantingham, P.J. (1993). Environment, Routine, and Situation: Toward a Pattern Theory of Crime. In *Routine Activity and Rational Choice,* edited by Ronals V. G. Clarke and Marcus Felson. New Brunswick, NJ: Transaction. 259-294.

Brantingham, P.L., and Brantingham, P.J. (1995). Criminality of Place: Crime Generators and Crime Attractors. *European Journal on Criminal. Policy and Research*, 3, 1-26.

Campaniello, N. (2011). “Mega Events in Sports and Crime: Evidence From the 1990 Football World Cup”, *Journal of Sports Economics*, 1-23.

Card, D., and Dahl, G.B. (2011). “Family Violence and Football: The Effect of Unexpected Emotional Cues on Violent Behavior”. *The Quarterly Journal of Economics*, 126(1), 103-143.

Cherry, T. and List, J. (2002). “Aggregation bias in the economic model of crime”. *Economic Letters*, 81-86.

Chainey, S.P., Tompson, L., and Uhlig, S. (2008). “The utility of hotspot mapping for predicting spatial patterns of crime”. *Security Journal*, 21, 4-28.

Cohen, L.E., and Felson, M. (1979). “Social change and crime rate trends: A routine activity approach”. *American Sociological Review*, 588-608.

Dahl, G. and DellaVigna, S. (2009). “Does Movie Violence Increase Violent Crime?”. *Quarterly Journal of Economics*, 124, 677-734.

DiDomizio, M., and Caruso, R. (2014). “Hooliganism and demand for football in Italy: Attendance and counter-violence policy evaluation”. *German Economic Review*, 16(2), 123-137.

Dohmen, T., Falk, A., Huffman, D., and Sunde, U. (2006). “Seemingly Irrelevant Events Affect Perceptions and Expectations-The FIFA World Cup 2006 as a Natural Experiment”. *IZA Discussion Paper* No. 2275.

Hagn, F., and Maennig, W. (2008). "Employment effects of the Football World Cup 1974 in Germany". *Labour Economics*, 15(5), 1062-1075.

Home Affairs Committee (2009) *The cost of policing football matches*, (Tenth Report). HC676. Avaliable at: http://www.publications.parliament.uk/pa/cm200809/cmselect/cmhaff/676/67602.htm

Jacob, B., Lefgren, L., and Moretti, E. (2004). "The dynamics of criminal behavior: evidence from weather shocks". *Journal of Human Resources*, 42.

Kirby, S., Francis, B. and O'Flaherty, R. (2013). "Can the FIFA World Cup Football (Soccer) Tournament Be Associated with an Increase in Domestic Abuse?", *Journal of Research in Crime and Delinquency*, 1-18.

Kurland, J., Johnson, S. D., and Tilley, N. (2014). "Offenses around stadiums: A natural experiment on crime attraction and generation". *Journal of research in crime and delinquency*, 51(1), *5-28.*

Madensen, T.D. and Eck, J.E. (2008). *Spectator Violence in Stadiums*, Problem-oriented Guides for Police. Problem-Specific Guides Series No 54. Community Oriented Policing Services (COPS). US Department of Justice.

Marie, O. (2010). "Football Matches: the Effects on Crime". Centre for Economic Performance LSE *Discussion Paper* No 348.

Marie, O. (2015). "Police and thieves in the stadium: measuring the (multiple) effects of football matches on crime". *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, Forthcoming.

Matheson, V.A. and Baade, R.A. (2004). "Mega-Sporting Events in Developing Nations: Playing the Way to Prosperity?". *South African Journal of Economics*, 72(5), 1085-1096.

Montolio, D. and Planells-Struse, S. (2015). "How time shapes crime: the displacement effects of football matches in the city of Barcelona". *Working paper 2015/10 Instituto de Economía de Barcelona* (IEB). Available at: http://www.ieb.ub.edu/2012022157/ieb/ultimes-publicacions

Poutvaara, P. and Priks, M. (2009). "The effect of police intelligence on group violence: Evidence from reassignments in Sweden". *Journal of Public Economics*, 93(3), 403-411.

Priks, M. (2010). "Does frustration lead to violence? Evidence from the Swedish hooligan scene". *Kyklos*, 63(3), 450-460.

Russell, G.W. (2004). "Sport riots: A social–psychological review". *Aggression and violent behavior*, 9(4), 353-378.

Süssmuth, B., Heyne, M., and Maennig, W. (2010). "Induced Civic Pride and Integration." *Oxford Bulletin of Economics and Statistics*, 72(2), 202-220.

Williamson, D., McLafferty, S., Goldsmith, V., Mollenkpf, J. and McGuire, P. (1998). "Smoothing crime incident data: New methods for determining the bandwidth in Kernel estimation". Working paper presented at the Environmental Systems Research Institute International User Conference, 27-31 July.

Appendix

Table A1. OLS estimations. Effect of home matches on theft and assault counts. Day after the match.

VARIABLES	(1)	(2)	(3)	(4)
	Thefts	***Thefts***	***Thefts***	***Thefts***
Spectators/10,000	3.787***	8.249***	7.300***	7.800***
	(0.746)	(2.171)	(2.068)	(2.110)
Day after	-2.091***	0.166	0.0759	0.183
	(0.612)	(0.432)	(0.418)	(0.411)
Constant	280.0***	300.1***	286.0***	266.0***
	(1.742)	(4.682)	(8.013)	(7.902)
R-squared	0.042	0.563	0.607	0.640
	Assaults	***Assaults***	***Assaults***	***Assaults***
Spectators/10,000	0.208***	-0.174	-0.233	-0.210
	(0.0693)	(0.230)	(0.237)	(0.237)
Day after	0.0726	0.0269	0.0235	0.0253
	(0.0617)	(0.0544)	(0.0530)	(0.0531)
Constant	12.47***	11.12***	10.49***	10.20***
	(0.162)	(0.509)	(0.874)	(0.916)
R-squared	0.011	0.251	0.271	0.272
Observations	1,084	1,084	1,084	1,084
Climate controls	NO	NO	YES	YES
Time controls	NO	YES	YES	YES
Year fixed effects	NO	NO	NO	YES
Seasonal controls	NO	YES	YES	YES
Derby dummy	NO	YES	YES	YES

Note: Climate controls include: average rainfall, average number of sun hours, average temperature, average pressure and average wind speed. Time controls include: day of the week, day of the year, week of the year, weekend and month. Seasonal controls include dummies for summer (mainly September) and winter. Robust standard errors are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A2. OLS estimations. Effect of away matches on theft and assault counts. Day after the match.

VARIABLES	(1)	(2)	(3)	(4)
	Thefts	***Thefts***	***Thefts***	***Thefts***
Away match	17.43***	6.646	8.398	12.20
	(5.691)	(8.549)	(10.26)	(9.362)
Day after	-15.19***	0.754	2.082	2.350
	(4.514)	(3.569)	(3.396)	(3.222)
Constant	280.7***	284.6***	272.8***	254.1***
	(1.754)	(4.548)	(8.029)	(7.962)
R-squared	0.023	0.569	0.611	0.643
	Assaults	***Assaults***	***Assaults***	***Assaults***
Away match	1.882***	-1.091	-0.944	-0.784
	(0.460)	(2.646)	(2.530)	(2.624)
Day after	0.936*	0.181	0.265	0.284
	(0.478)	(0.422)	(0.424)	(0.425)
Constant	12.47***	11.12***	10.49***	10.20***
	(0.162)	(0.509)	(0.874)	(0.916)
R-squared	0.018	0.261	0.280	0.283
Observations	1,089	1,089	1,089	1,089
Climate controls	NO	NO	YES	YES
Time controls	NO	YES	YES	YES
Year fixed effects	NO	NO	NO	YES
Seasonal controls	NO	YES	YES	YES
Derby dummy	NO	YES	YES	YES

Note: See Table A1.

Table A3. Buffers from the FCB stadium. Census tracts included in each ring.

Distance from FC Barcelona stadium	# of census tracts
<300 m	2
>300 m and <400 m	4
>400 m and <500 m	6
>500 m and <600 m	4
>600 m and <700 m	4
>700 m and <800 m	7
>800 m and <900 m	9
>900 m and <1,000 m	7
>1,000 m and <1,100 m	10
>1,100 m and <1,200 m	10
>1,200 m and <1,300 m	8
>1,300 m and <1,400 m	7

Figure A1.

Area depicted in Figure 2.

Cumulative rings (buffers) around FCB's stadium

Camp Nou Location, Barcelona

2011

2011/1, Oppedisano, V; Turati, G.: "What are the causes of educational inequalities and of their evolution over time in Europe? Evidence from PISA"
2011/2, Dahlberg, M; Edmark, K; Lundqvist, H.: "Ethnic diversity and preferences for redistribution"
2011/3, Canova, L.; Vaglio, A.: "Why do educated mothers matter? A model of parental help"
2011/4, Delgado, F.J.; Lago-Peñas, S.; Mayor, M.: "On the determinants of local tax rates: new evidence from Spain"
2011/5, Piolatto, A.; Schuett, F.: "A model of music piracy with popularity-dependent copying costs"
2011/6, Duch, N.; García-Estévez, J.; Parellada, M.: "Universities and regional economic growth in Spanish regions"
2011/7, Duch, N.; García-Estévez, J.: "Do universities affect firms' location decisions? Evidence from Spain"
2011/8, Dahlberg, M.; Mörk, E.: "Is there an election cycle in public employment? Separating time effects from election year effects"
2011/9, Costas-Pérez, E.; Solé-Ollé, A.; Sorribas-Navarro, P.: "Corruption scandals, press reporting, and accountability. Evidence from Spanish mayors"
2011/10, Choi, A.; Calero, J.; Escardíbul, J.O.: "Hell to touch the sky? Private tutoring and academic achievement in Korea"
2011/11, Mira Godinho, M.; Cartaxo, R.: "University patenting, licensing and technology transfer: how organizational context and available resources determine performance"
2011/12, Duch-Brown, N.; García-Quevedo, J.; Montolio, D.: "The link between public support and private R&D effort: What is the optimal subsidy?"
2011/13, Breuillé, M.L.; Duran-Vigneron, P.; Samson, A.L.: "To assemble to resemble? A study of tax disparities among French municipalities"
2011/14, McCann, P.; Ortega-Argilés, R.: "Smart specialisation, regional growth and applications to EU cohesion policy"
2011/15, Montolio, D.; Trillas, F.: "Regulatory federalism and industrial policy in broadband telecommunications"
2011/16, Pelegrín, A.; Bolancé, C.: "Offshoring and company characteristics: some evidence from the analysis of Spanish firm data"
2011/17, Lin, C.: "Give me your wired and your highly skilled: measuring the impact of immigration policy on employers and shareholders"
2011/18, Bianchini, L.; Revelli, F.: "Green polities: urban environmental performance and government popularity"
2011/19, López Real, J.: "Family reunification or point-based immigration system? The case of the U.S. and Mexico"
2011/20, Bogliacino, F.; Piva, M.; Vivarelli, M.: "The impact of R&D on employment in Europe: a firm-level analysis"
2011/21, Tonello, M.: "Mechanisms of peer interactions between native and non-native students: rejection or integration?"
2011/22, García-Quevedo, J.; Mas-Verdú, F.; Montolio, D.: "What type of innovative firms acquire knowledge intensive services and from which suppliers?"
2011/23, Banal-Estañol, A.; Macho-Stadler, I.; Pérez-Castrillo, D.: "Research output from university-industry collaborative projects"
2011/24, Ligthart, J.E.; Van Oudheusden, P.: "In government we trust: the role of fiscal decentralization"
2011/25, Mongrain, S.; Wilson, J.D.: "Tax competition with heterogeneous capital mobility"
2011/26, Caruso, R.; Costa, J.; Ricciuti, R.: "The probability of military rule in Africa, 1970-2007"
2011/27, Solé-Ollé, A.; Viladecans-Marsal, E.: "Local spending and the housing boom"
2011/28, Simón, H.; Ramos, R.; Sanromá, E.: "Occupational mobility of immigrants in a low skilled economy. The Spanish case"
2011/29, Piolatto, A.; Trotin, G.: "Optimal tax enforcement under prospect theory"
2011/30, Montolio, D; Piolatto, A.: "Financing public education when altruistic agents have retirement concerns"
2011/31, García-Quevedo, J.; Pellegrino, G.; Vivarelli, M.: "The determinants of YICs' R&D activity"
2011/32, Goodspeed, T.J.: "Corruption, accountability, and decentralization: theory and evidence from Mexico"
2011/33, Pedraja, F.; Cordero, J.M.: "Analysis of alternative proposals to reform the Spanish intergovernmental transfer system for municipalities"
2011/34, Jofre-Monseny, J.; Sorribas-Navarro, P.; Vázquez-Grenno, J.: "Welfare spending and ethnic heterogeneity: evidence from a massive immigration wave"
2011/35, Lyytikäinen, T.: "Tax competition among local governments: evidence from a property tax reform in Finland"
2011/36, Brülhart, M.; Schmidheiny, K.: "Estimating the Rivalness of State-Level Inward FDI"
2011/37, García-Pérez, J.I.; Hidalgo-Hidalgo, M.; Robles-Zurita, J.A.: "Does grade retention affect achievement? Some evidence from Pisa"
2011/38, Boffa, f.; Panzar. J.: "Bottleneck co-ownership as a regulatory alternative"

2011/39, González-Val, R.; Olmo, J.: "Growth in a cross-section of cities: location, increasing returns or random growth?"
2011/40, Anesi, V.; De Donder, P.: "Voting under the threat of secession: accommodation vs. repression"
2011/41, Di Pietro, G.; Mora, T.: "The effect of the l'Aquila earthquake on labour market outcomes"
2011/42, Brueckner, J.K.; Neumark, D.: "Beaches, sunshine, and public-sector pay: theory and evidence on amenities and rent extraction by government workers"
2011/43, Cortés, D.: "Decentralization of government and contracting with the private sector"
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