10-2022

The effect of monitoring and crowds on crime and law enforcement: A natural experiment from European football

Brad R. Humphreys

Alexander Marsella

Levi Perez

The effect of monitoring and crowds on crime and law enforcement: A natural experiment from European football

Brad R. Humphreys
West Virginia University

Alexander Marsella
West Virginia University

Levi Perez
University of Oviedo

October 17, 2022

Abstract

Technological advancements like the presence of smart phones and body cameras have led to increased monitoring of police, but little evidence exists on their impact. We address these problems using data on fouls from football matches in five European football leagues over six seasons. This period contains exogenous changes in monitoring rule enforcers through introduction of Video Assistant Referee review and limited "bystanders" from Covid-19 restrictions. Results from difference-in-differences models estimated separately for each league indicate that both events influenced the number of fouls called with substantial heterogeneity across leagues and home/away teams. (Word count: 4776, 18 tables.)

JEL Codes: H41 (Public Goods), K42 (Illegal Behavior and the Enforcement of Law), Z20 (General Sports Economics)

Keywords: crime, police monitoring, football fouls

Introduction

Crime represents an important societal problem around the world and a large literature in economics analyzes the complex relationship between crime and policing. The seminal paper by Becker (1968) emphasized the importance of decisions made by criminals and

police officers, the interaction between their actions, and the role that the presence of other people nearby play in the commission of crime and apprehension of criminals. For example, Becker's model focuses on individual's utility maximizing decisions about committing or not committing crimes based on her constraints and preferences, what actions she expects the police to take, and what consequences she faces if caught. The presence or absence of others nearby also affect the expected benefit from committing a crime, the expected likelihood of detection, the actions taken by police, and the likelihood a crime is committed.

Owens and Ba (2021) summarized the recent literature on monitoring of police officers, the interaction between police and the general public, and systematic bias in policing. This paper documented dramatic recent changes in monitoring police and how the public interacts with police due to technological changes in smart phone use, CCTV cameras, and police body cameras. However, little empirical evidence on the impact of the presence or absence of nearby people on the commission and detection of crime exists, probably due to lack of appropriate data.

The empirical economics of crime literature contains a long, rich tradition of using data from sports to assess the effectiveness of policing (Pope et al., 2018; Kitchens et al., 2019). This paper uses data from games played in European professional football leagues and a natural experiment to assess the impact of direct monitoring of law enforcement and interaction between law enforcement and the general public on a form of petty crime, fouls called in football matches. We exploit two sources of exogenous variation in factors affecting referees, players, and fouls in football matches: the introduction of Video Assistant Referee (VAR) oversight of officiating decisions made in football matches and the full or partial elimination of fans in stadiums due to Covid-19 pandemic restrictions. Both events should be plausibly exogenous to unobservable factors affecting policing and the commission of crime in this setting. Cohen et al. (2021) take a similar approach, but focus only on football matches in Germany.

We analyze outcomes in 10,818 matches played in the top professional football leagues in England, France, Italy, Germany, and Spain over the 2015/16 to 2020/21 domestic league competitions. We estimate separate regression models for each league to account for league and country specific heterogeneity. Our difference-in-differences model results exploiting the introduction of VAR and prohibition on fan attendance find significant, but heterogeneous impacts of these changes on fouls called. The introduction of VAR monitoring reduced fouls in Germany, Spain, and Italy but not in England or France. Elimination or reduction of fans attending games reduced fouls committed by visiting teams in Germany and France, both home and visiting teams in Italy, and by home teams in England. These results are robust to the inclusion of game-level control variables that proxy for game importance and

intensity of play. Both monitoring of police and the presence of people nearby affect the the commission of crime and law enforcement.

Context

The presence or absence of people can affect both potential criminals and law enforcement. Some criminal acts are more likely to occur in crowded areas such as shopping districts, bus stops, and on public transportation. Other criminal acts are more likely to occur in isolated settings. For example, petty crimes like pickpocketing and shoplifting are more likely to go unnoticed in crowded environments in which criminals tend to target victims or property based on an appearance of inattention. Evidence also suggests that law enforcement personnel are not impartial enforcers of laws, but sometimes exhibit biased behavior depending on the setting (Pope et al., 2018).

The fact that empirical researchers typically only observe outcomes where an individual was arrested for a crime, and not the actions taken by the person arrested, the officer making the arrest, their interactions prior to the arrest, and the presence or absence of observers complicates empirical analysis of outcomes in these markets. Lack of information about the setting in which arrests take place also complicates empirical analysis. Sporting events represent a useful setting for empirical research on crime. Play in team sports reflects clear rules governing conduct, law enforcers in the form of referees, and varying costs and benefits associated with committing an offense. It also features interaction between law enforcers, players and the general public (fans).

The analogy between full stadiums and crowded public spaces can be explained in terms of the atmosphere, namely the noise fans produce in stadiums. The crowd's cheering, chanting and shouting for their teams can improve the performance of the home players and at the same time adversely affect the performance of players on the visiting team. In addition, there is another mechanism at work in football stadiums: the home crowd clearly attempts to put pressure on the referees to make decisions favorable to their team. In such a setting, some players' fouls and misconduct may go unnoticed (like pickpockets in crowded public spaces). Additionally, in terms of referees' behavior, fan pressure could distract referees or make them more rash (prone to erroneous decisions, again, similar to what police experience in crowded spaces).

We posit that referees and players can be influenced by the atmosphere in the stands. One of the seminal papers on this topic, Garicano et al. (2005), showed that because referees have discretion over the amount of extra time awarded in matches to compensate for stoppages in play, referees systematically reduce time awarded when the home team is winning; in

matches with a greater payoff for winning they modify their behaviour even more. In fact, the authors argue that these results occur because of referees' desire to satisfy the crowd of home team fans in the stands. And the more fans in attendance, the larger the referee response. Other research confirms this result in other settings, and similar results for the enforcement of other football rule infractions like fouls and red/yellow cards.

The Covid-19 pandemic represents an opportunity to study crime and policing using a unique natural experiment. The 2019/20 football season in Europe was interrupted in mid-March 2020 by coronavirus spread and the Covid-19 disease. The seasons resumed in June 2020 in the "Big-Five" professional football leagues in Europe, except for French Ligue 1 which terminated its season in April 2020. All remaining matches were played behind closed doors under governments' plans to combat coronavirus spread. With some minor exceptions, European leagues started the next season (2020/21) in empty stadiums.

A number of recent studies discussed below also exploit the Covid-19 attendance bans to understand the impact of fans on decisions made by players and referees. These papers analyzed data from many different competitions over different sample periods using a umber of different match outcomes. Some focus on football results and performance variables like wins and goals; others analyzed crime related outcomes like Red Cards, Yellow cards, and fouls. Nearly all allow for effect heterogeneity by estimating separate regression models for home team and away team outcomes. The general approach used posits that the banning of fans from matches represents a strong difference-in-differences natural experiment.

Reade et al. (2020) estimated the effects of the absence of fans in men's football competitions in Europe beginning in the 2002/03 season, a relatively long pre-treatment period. Competitions analyzed include a pooled sample of matches played in the UEFA Champions League, the UEFA Europa League, French Ligue 1, Italian Serie A, B and C, and the Coppa d'Italia. The authors found a significant effect absence of fans on the severity of referee penalties given to visiting teams only. Visiting teams got fewer yellow cards.

Like Reade et al. (2020), Cueva (2020) analysed match outcomes and referee decisions in matches played in 41 football leagues in 30 different countries beginning in 1993. The pooled analysis sample contained more than 230,000 matches with 2,749 matches played with no fans, again a long pre-treatment period. The results indicated that home teams received more red and yellow cards and were penalized with more fouls after the pandemic began. Away team treatment in the pandemic was no different than before.

Dilger and Vischer (2020) analyzed changes in home advantage in terms of the likelihood the home team won matches, as well as Yellow cards and Red cards issued with and without fans attending matches in Germany's Bundesliga 1 in the 2019/20 season. Dilger and Vischer (2020) reported significantly fewer Yellow and Red cards for the away team, but no change

in home advantage.

Endrich and Gesche (2020) also focused on the effects of missing fans on referees' behavior and decision-making using an analysis sample of 1224 matches played in Germany's Bundesliga 1 and 2, the top two professional football leagues in Germany in the 2019/20 season. The results indicated that significantly more fouls and yellow cards were called on home teams when no fans were present relative to when fans were allowed to attend matches.

Ferraresi and Gucciardi (2020) analyzed match outcomes in the top league in France, Germany, Italy, Spain, and the United Kingdom in 2019/20 season in a pooled sample, focusing only on points earned by teams. They found home team performance deteriorated during the pandemic, but away team performance did not.

McCarrick et al. (2020) analyzed team success, goals scored, Yellow cards, and Red cards in a pooled sample of matches played in 15 different leagues in 11 different European countries in the 2019/20 season. The results found a negative impact of the pandemic on home team performance and a negative impact on away team Yellow cards.

Bryson et al. (2021) analyzed match outcomes in a pooled sample of 23 professional football leagues in the 2019/20 season, including matches played by 369 football teams and officiated by 472 referees. Their data set included 6481 football matches played in the 2019/20 season in 17 countries before and after the mid-season shutdown. The sample contained data from 1498 matches, 23% of the sample, played without spectators. The absence of fans reduced yellow cards called on visiting teams by 33%.

Cohen et al. (2021) analyzed the impact of missing fans and the introduction of external Video Assistant Referee (VAR) review of in-game referee decisions matches played in Germany's Bundesliga 1 and 2. The Bundesliga 1 sample started with the 2009/10 season and the Budesliga 2 sample with the 2013/14 season. Cohen et al. (2021) analyzed three different periods in the sample: the period before the introduction of VAR review of referee decisions, the period between the introduction of VAR and the beginning of the pandemic, and the period with both VAR review and no fan attendance. The paper focused on the impact of mistakes made be referees, as identified by decisions subject to VAR review that were overturned, on subsequent referee decisions in each match. The results showed that referees called fewer Yellow cards on home teams following a call ruled incorrect by VAR review. They also found that VAR oversight reduced the number of referee errors, but had no effect on the number of Yellow cards or the number of goals scored.

Scoppa (2021) analyzed differences in team wins and goals, all cards, and penalties called in a pooled sample of matches played in first and second division leagues in Germany, Spain, England, Italy, and Portugal from the 2010/11 until the 2019/20 season. Again, this paper used a long pre-treatment sample period. The paper reported evidence that more fouls were

called on both home and away teams in the pandemic period with fans absent.

Fischer and Haucap (2021) analyzed changes in home advantage, Yellow cards, and fouls in matches played in the top three divisions in Germany (Bundesligas 1, 2, and 3) over the 2017/18 to 2019/20 seasons using separate regression models for each division. Results found reduced home advantage in the pandemic period in the top division only. Fewer Yellow cards were given to away teams and more to home teams. More fouls were called against home teams.

Morita and Araki (2022) analyzed match outcomes, Yellow cards, and fouls in the top two football leagues in Japan, JL1 and JL2, in the 2019/2020 season. The results: fewer fouls called on home teams but no change in fouls called on away teams.

Several patterns emerge in this growing literature. First, a clear presence of heterogeneous effects of the pandemic on all outcomes throughout the literature, along with heterogeneous outcomes for home and away teams. Second, most of the studies using matches played in a large number of different leagues use pooled samples, implicitly assuming homogeneous effects of the lack of fans in the leagues analyzed. Third, even the research focused on outcomes in one country, Germany, tend to report heterogeneous effects of missing fans on different outcomes. Fourth, many pooled studies contain relatively long pre-pandemic periods. Finally, nearly all of the studies adopt a "kitchen sink" approach analyzing a large number of outcomes.

These patterns appear related. Pooled samples across countries and leagues will not account for underlying heterogeneity in individual leagues, and the results will reflect idiosyncratic features of the sample. Also, the use of long pre-treatment periods will tend to attenuate estimates of the effect of the pandemic on outcomes, and these studies also tend to ignore the effect of the introduction of VAR referee oversight in the seasons before the pandemic. Our research design addresses these limitations by using a relatively short pre-treatment sample period beginning in the 2015/16 season, accounting for the introduction of VAR oversight, and estimating separate models for each league. It also focuses on a single outcome, fouls called in matches, which we posit represents a good proxy for petty crimes, unlike more serious offenses like Yellow cards, Red cards, and penalties.

Research Questions

This paper tests whether playing behind closed doors with no fans in attendance affected the number of fouls called by referees, a proxy for the commission of petty crimes in settings outside football matches. Without fans, pressure fouls and player misconduct will receive more notice and a greater number of fouls might be called. On the other hand, in this

setting there may be less incentive for players to engage in misconduct or commit fouls since they may not feel "protected" by a noisy environment (the likelihood of misconduct going unnoticed is lower), so fewer fouls might be expected to be committed, and thus called. Furthermore, in empty stadiums, the referee might be more attentive to play because of reduced distractions.

Second, this paper examines the impact of Video Assistant Referee (VAR) monitoring on the number of fouls called in matches, relative to matches with no VAR oversight. VAR review of play was implemented in the "Big-Five" European football leagues beginning in the 2017/18 season. Note that VAR review applies only to "clear and obvious errors" or "serious missed incidents" occurring in four match-changing situations: goals, penalty decisions, direct red-card incidents, and cases of mistaken player identity. If the VAR monitor believes the referee committed a clear and obvious error by only cautioning a player, rather than sending him off, they can advise the referee to watch the incident again on video in the Referee Review Area.

If the VAR review identifies an error in any of these four situations they will intervene in play, regardless of how marginal the decision was. In terms of subjective decisions, either the referee informs the VAR official that a decision should be reviewed or the VAR official identifies a "clear and obvious error" in one of the four match-changing situations and communicates this to the referee. However, there is no consensus about what qualifies as a "clear and obvious error".

In any event, knowledge that the game is under surveillance by an independent monitor should affect players' behavior, including the likelihood of engaging in behavior that could result in a foul and other forms of misconduct that could be reviewed. Referee behavior should also change in light of VAR adoption. This could affect many referee decisions including the decision to call or not call a foul and the choice between issuing a caution or sending a player off. Previous research by Lago-Peñas et al. (2019) and Han et al. (2020) found that VAR monitoring reduced off sides calls, Yellow cards, and overall foul calls by referees after implementation.

This increased monitoring is expected to affect players' behavior regarding fouls and misconduct (petty crimes are less likely to occur when police presence is felt) as well as referee (police) behavior, much like body cameras affect police actions. Jennings et al. (2015) and Ariel et al. (2017) find that the implementation of body-worn cameras (BWCs) in police precincts reduced complaints against officers substantially, but Ariel et al. (2017) goes further and found evidence of a "contagion" effect where officers in the control group in the experiment (those working on shifts in the same department at the same time but not wearing body cameras) were almost identically affected. Ready and Young (2015) found

that BWCs reduced arrests made by officers but increased the number of citations issued.

Empirical Analysis

We estimate reduced form empirical models explaining observed variation in fouls committed by players and called by referees in football matches. The model takes the form

$$Fouls_{mijt} = \alpha_i + \gamma_t + \beta_1 VAR_{mt} + \beta_2 LimFans_{mt} + \beta_3 NoFans_{mt} + \beta_4 A_{mijt} + \varepsilon_{mijt} \quad (1)$$

where $Fouls_{ijt}$ represents fouls committed by either home team i or away team j playing in match m in season t. VAR_{mt} is a binary variable equal to 1 when match m used Video Assistant Referee monitoring at time t. $LimFans_{mt}$ is a binary variable equal to 1 for match m at time t where attendance in the stadium was limited but not zero due to Covid-19 restrictions. $NoFans_{mt}$ is a binary variable equal to 1 for match m at time t where no fans were allowed to attend due to Covid-19. The parameters on these three variables represent the parameters of interest.

A_{mijt} contains a vector of observable characteristics of matches. We include variables that might affect the nature of play in matches, including the ratio of the implied home win and away win probability from betting odds on each match, the total number of shots by the home and away teams in each match, total home and away team shots on target, and total home and away team corner kicks. We estimate alternative models that exclude and include A_{mijt} to show robustness of the results to inclusion of match-level variables.

α_i is a home team fixed effect capturing unobservable team-level heterogeneity. γ_t is a vector of day-of-week and season indicator variables. ε_{mijt} is a mean zero, heteroskedastic equation error term capturing other factors that affect fouls in football matches.

Some previous research suggests that the number of fans attending games and their proximity to the field can affect referee and player behavior. To investigate this idea, we also estimate empirical models of the form

$$\begin{aligned} Fouls_{mijt} = \alpha_i + \gamma_t + \beta_1 VAR_{mt} + \beta_2 attendance_{mt} + \beta_3 lockdown_{mt} \\ + \beta_4 A_{mijt} + \beta_5 attendance \times lockdown \varepsilon_{mijt} \end{aligned} \quad (2)$$

where $Fouls_{ijt}$ again represents fouls committed by either home team i or away team j playing in match m in season t and VAR_{mt} again is a binary variable equal to 1 when match m used Video Assistant Referee monitoring at time t. $attendance_{mt}$ is an indicator variable identifying matches played after the pandemic lockdown affected each league in the

2019/20 season. *attendance* × *lockdown* is the interaction between match attendance and the lockdown indicator. This indicator variable allows for the impact of fans on fouls to vary with match attendance.

Finally, to assess the relationship between fouls in football matches and the actual commission of petty crimes, we estimate models that add variables reflecting the actual number of petty crimes (assaults and thefts) committed in each country to Equation (1). This represents an assessment of the external validity of our regression results. The number of these petty crimes committed varies only by country and year, not by match.

Data and descriptive analysis

Data on 10,818 matches played in the "Big-Five" European leagues were collected for seasons 2015/16 to 2020/21. Table 1 contains summary statistics on fouls called by league and other important match characteristics for the full sample pooled over all five leagues.

Data for our match-level statistics, which include home/away fouls, home/away shots, home/away shots on target, home/away corners, and odds ratios were taken from `www.football-data.co.uk`. Odds ratios were calculated using betting odds from William Hill Limited, as reported on `football-data.co.uk`. Attendance numbers were obtained from `www.soccerstats.com`.

Table 1: Summary Statistics

Statistic	Mean	St. Dev.	Min	Max
Home Fouls	12.6	4.1	0	29
Away Fouls	12.9	4.1	0	32
VAR Matches	0.53	—	0	1
Matches With No Fans	0.222	—	0	1
Match Attendance (000)	25.24	19.49	0	81.2
Betting Odds Ratio	2.92	4.24	0.05	49.0
Home Shots	13.3	5.2	0	37
Away Shots	10.9	4.6	0	32
Home Shots on Target	4.8	2.6	0	18
Away Shots on Target	4.0	2.3	0	15
Home Corners	5.5	3.0	0	20
Away Corners	4.5	2.6	0	19

On average, slightly more fouls were called on visiting team players (12.9 per match) than on home team players (12.6) in the sample. More than half the matches in the sample featured VAR monitoring. About 20% were played with no fans in attendance.

The betting odds ratio reflects the difference between the implied probability that the home team will win each match relative to the implied probability that the visiting team will win the match based on the final betting odds offered on each match after accounting for bookmaker over round. Betting odds based win probabilities have been used extensively in the literature (Vandenbruaene et al., 2022). On average, betting odds implied that the home team was 3 times more likely to win a match than the visiting team. Home teams took more shots, more shots on target, and more penalty kicks than visiting teams.

Regression Results

Regression models explaining variation in the total number of fouls called per match were estimated separately for each of the five top European football leagues. These difference-in-differences models included indicator variables for the period when fans were barred from matches ("Lockdown" matches) and also indicator variables for the period when VAR referee oversight was in place in each league. The ratio of the home team probability to the away team win betting probability based on betting odds for each match were included in some models to control for expected match outcomes and intensity of play and referee oversight. Other match level variables, including home and away team shots, shots on target, and corner kicks, are included in some models to further control for intensity of play in matches and to assess robustness of the results to inclusion of match-level variables.

The results from a baseline model containing only difference-in-differences indicator variables for the introduction of VAR monitoring and the banning of fan attendance or limiting of fan attendance are shown on the left panel of Table 5 for England, Table 6 for France, Table 2 for Germany, Table 4 for Italy, and Table 3 for Spain. These results come from models omitting the vector of match characteristics (A_{mijt}) from Equation (1). In keeping with the practice in the literature, we estimate all models using three different dependent variables: home team fouls, visiting team fouls, and total fouls. All estimated standard errors are cluster corrected at the season level.

We find that the effect of Lockdown measures and VAR oversight vary greatly depending on the country and league. Fouls called in England's Premier League and France's Ligue 1 were completely unaffected by VAR Oversight. Italy's Serie A and Germany's Bundesliga 1 experienced a substantial impact from VAR oversight, reducing fouls by approximately 3 per match for Italy and 4 per match in the Bundesliga, roughly 15% reductions.

Based on the coefficient estimates, it is not clear that either team was necessarily favored after the imposition of VAR oversight. Spain's La Liga experienced a much more modest effect from VAR, with the negative effect on fouls called only being significant for the home

team.[1]

The effect of lockdown measures and the lack of fans was substantially more heterogeneous across the leagues than the effect of VAR oversight, which either reduced fouls or did nothing at all. Leagues in Italy and England saw substantial increases on fouls called when no fans were present. In general, this effect is more often significant for the home team, especially in England.

The fact that the effect is more salient for the home team has an intuitive explanation: there is an extra cost associated with calling fouls on a home team since the referee then faces thousands of booing fans assailing him for several moments. The intuition for why limited attendance would not have this same effect on home fouls is simple as well: reducing boos from a 50,000 person audience to a 2,000 person audience still leaves thousands of booing voices in the crowd, whereas an empty stadium removes them completely.

The effect of removing fans from matches in France differed from other leagues in that it resulted in almost two fewer fouls to be called on the away team, but had no effect on the home team or the total number of fouls called. Since away fouls are part of total fouls, this is more difficult to explain. [2]

That being said, a lack of fans in French football games may cause referees to be more lenient with the away team. This could be an inverse effect from the aforementioned booing fans. When a referee calls a foul on the opposing team, he is met with cheers from thousands of home-team fans. This may increase the benefit to the referee of calling a foul on the away team, making them marginally more likely to call them when there are fans in the stadium. Without fans, that effect is gone, and referees have a marginally reduced incentive to call fouls on the away team.

As for the interaction models, the results are generally consistent with those of the baseline models. For teams where "No Fans" was significant, the "Lockdown" variable was usually significant. However, in the case of Italy's Serie A, the lockdown effect was insignificant despite the "No Fans" effect being significant. Instead, the attendance and lockdown interaction term is significant. When limited fans were allowed, every additional thousand of them increased total fouls called in Italian games by approximately 0.06.

The results including the actual annual number of assaults and thefts committed in each country are shown on Table 12 for Germany, Table 13 for Spain, Table 14 for Italy, Table 15 for England, and on Table 16 for France. Adding these variables makes little difference to the parameter estimates of interest in Equation 1, except in the case of Germany, where

[1]Note that in Table 3, there is no Limited Attendance variable. This is because Spain only adopted full attendance restrictions during Covid-19.

[2]The sign is the same and the magnitude of the effect is similar for total fouls, it is just a matter of the estimated standard error preventing significance at a bare minimum 5% level.

the impact of VAR introduction loses significance when thefts are included. The parameter estimate on the actual thefts variable are also positive in Germany, suggesting that crime in football matches are associated with petty crime commission in the country. In Spain, however, annual assaults are significant and positively associated with total fouls called. Table 17 shows simple correlations between total football fouls and total petty crimes by country. The positive correlation exists in the unconditional correlations in Germany as well, and to a lesser extent in Italy between thefts and football fouls only.

Conclusions

The results clearly show that VAR and crowd presence have a significant effect on the way referees and players act in football matches. Perhaps even more intriguing, it appears that the effects differ across countries, which could reflect some sort of cultural mechanism through which rule changes affect both individuals and law enforcers. The literature on policing has long recognized that cultural norms can affect the behavior of law enforcers (Brehm and Gates, 1993). Our results contribute to this literature by developing evidence from a novel setting containing two natural experiments that should be plausibly exogenous to other unobservable factors affecting policing outcomes.

If we assume that the heterogeneity in VAR and Crowd-Size effects across European Football fans in several different countries can be extrapolated to overarching cultural factors, then we can draw some interesting conclusions. For example, we have established that VAR, which allows third-party analysis of sanctions on players, substantially reduces the number of sanctions given in German and Italian football games. This might imply that body-worn cameras for police in Germany and Italy will significantly reduce the number of sanctions they levy on citizens. In countries where the VAR effect is absent, such as England and France, body-worn cameras may have no effect on police sanctions due to some cultural mechanism specific to those countries, reflected in referee behavior.

In summary, two major conclusions can be drawn from the results. First, public pressure, proxied by the presence of noisy crowds and reflecting interaction on social media, newspapers, and gatherings of protesters, impact law enforcement, proxied by referees representing police officers, "enforcing the rules." Second, third-party visual monitoring, proxied by VAR and representing BWCs also affect the behavior of law enforcement officials.

Table 2: Regression Results - Bundesliga 1 (Germany)

	Dependent variable: Fouls by Team					
	Home	Away	Total	Home	Away	Total
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	−2.109**	−2.323**	−4.433**	−2.026**	−2.299**	−4.326**
	(0.591)	(0.799)	(1.370)	(0.578)	(0.784)	(1.340)
Limited Att.	0.569	0.213	0.782	0.445	0.210	0.655
	(0.477)	(0.718)	(1.185)	(0.475)	(0.722)	(1.191)
No Fans	0.778	0.618	1.395	0.673	0.648	1.321
	(0.679)	(0.706)	(1.342)	(0.707)	(0.693)	(1.348)
Odds Ratio				0.020	−0.036	−0.016
				(0.042)	(0.057)	(0.069)
Home Shots				−0.067	0.065	−0.002
				(0.054)	(0.041)	(0.080)
Away Shots				0.004	−0.076	−0.073
				(0.039)	(0.040)	(0.052)
Home Shots on Target				0.046	−0.096	−0.050
				(0.045)	(0.055)	(0.087)
Away Shots on Target				−0.066	−0.073	−0.139*
				(0.053)	(0.060)	(0.059)
Home Corners				−0.078	−0.066	−0.144*
				(0.045)	(0.039)	(0.059)
Away Corners				−0.091**	−0.001	−0.092
				(0.032)	(0.043)	(0.049)
Observations	1,768	1,768	1,768	1,767	1,767	1,767
R^2	0.202	0.140	0.222	0.213	0.155	0.234

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 3: Regression Results - La Liga (Spain)

	Dependent variable: Fouls by Team					
	Home	Away	Total	Home	Away	Total
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	−0.489***	−0.266	−0.755***	−0.622***	−0.287	−0.909***
	(0.166)	(0.192)	(0.237)	(0.177)	(0.176)	(0.179)
No Fans	0.050	−0.246	−0.196	−0.307	−0.500**	−0.806**
	(0.178)	(0.193)	(0.259)	(0.263)	(0.210)	(0.340)
Odds Ratio				−0.115***	0.045	−0.070
				(0.027)	(0.038)	(0.051)
Home Shots				−0.090***	−0.025	−0.115**
				(0.029)	(0.037)	(0.056)
Away Shots				−0.025	−0.148***	−0.173***
				(0.025)	(0.041)	(0.038)
Home Shots on Target				−0.013	−0.111***	−0.124**
				(0.051)	(0.032)	(0.059)
Away Shots on Target				−0.071	−0.070	−0.141**
				(0.062)	(0.076)	(0.067)
Home Corners				−0.116***	−0.071***	−0.187***
				(0.041)	(0.026)	(0.058)
Away Corners				−0.085***	−0.110**	−0.195***
				(0.031)	(0.043)	(0.051)
Observations	2,280	2,280	2,280	2,280	2,280	2,280
R^2	0.130	0.080	0.100	0.159	0.124	0.151

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 4: Regression Results - Serie A (Italy)

	Dependent variable: Fouls by Team					
	Home	Away	Total	Home	Away	Total
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	-1.459^{***}	-1.382^{**}	-2.841^{***}	-1.717^{***}	-1.611^{***}	-3.328^{***}
	(0.491)	(0.553)	(1.038)	(0.381)	(0.418)	(0.779)
Limited Att.	0.209	0.375	0.584	0.165	0.325	0.490
	(0.259)	(0.420)	(0.615)	(0.335)	(0.424)	(0.661)
No Fans	0.669^{**}	0.578	1.248^{**}	0.542^{**}	0.512	1.054^{**}
	(0.261)	(0.382)	(0.576)	(0.248)	(0.356)	(0.537)
Odds Ratio				−0.024	-0.050^{**}	-0.074^{***}
				(0.020)	(0.024)	(0.007)
Home Shots				-0.120^{***}	-0.062^{*}	-0.182^{***}
				(0.018)	(0.037)	(0.044)
Away Shots				−0.028	-0.104^{***}	-0.133^{***}
				(0.033)	(0.008)	(0.039)
Home Shots on Target				0.022	0.001	0.023
				(0.042)	(0.060)	(0.089)
Away Shots on Target				−0.045	−0.082	−0.127
				(0.068)	(0.069)	(0.107)
Home Corners				0.008	-0.060^{**}	−0.052
				(0.014)	(0.026)	(0.037)
Away Corners				-0.160^{***}	-0.108^{***}	-0.268^{***}
				(0.023)	(0.029)	(0.041)
Observations	2,261	2,261	2,261	2,260	2,260	2,260
R^2	0.128	0.111	0.153	0.153	0.141	0.195

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 5: Regression Results - Premier League (England)

	Dependent variable: Fouls by Team					
	Home	Away	Total	Home	Away	Total
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	−0.218	0.059	−0.158	−0.171	0.130	−0.041
	(0.207)	(0.271)	(0.429)	(0.210)	(0.247)	(0.396)
Limited Att.	0.563**	−0.562*	0.001	0.353*	−0.758**	−0.405
	(0.247)	(0.314)	(0.281)	(0.187)	(0.345)	(0.295)
No Fans	1.275***	0.107	1.382***	1.145***	0.023	1.168***
	(0.136)	(0.178)	(0.278)	(0.162)	(0.187)	(0.311)
Odds Ratio				−0.137***	−0.091***	−0.228***
				(0.039)	(0.032)	(0.050)
Home Shots				−0.021	0.018	−0.003
				(0.024)	(0.023)	(0.022)
Away Shots				0.016	−0.049**	−0.033
				(0.011)	(0.023)	(0.031)
Home Shots on Target				0.083**	−0.051*	0.032
				(0.034)	(0.031)	(0.038)
Away Shots on Target				−0.001	0.001	0.0004
				(0.015)	(0.032)	(0.032)
Home Corners				−0.036	−0.026	−0.062
				(0.048)	(0.038)	(0.065)
Away Corners				−0.073**	−0.071	−0.144**
				(0.033)	(0.046)	(0.057)
Observations	2,330	2,330	2,330	2,330	2,330	2,330
R^2	0.090	0.107	0.106	0.110	0.121	0.129

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 6: Regression Results - Ligue 1 (France)

	Dependent variable: Fouls by Team					
	Home	Away	Total	Home	Away	Total
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	0.048	−0.096	−0.047	0.101	−0.051	0.050
	(0.160)	(0.376)	(0.525)	(0.155)	(0.366)	(0.507)
Limited Att.	0.290***	−0.341**	−0.051	0.138**	−0.442**	−0.304*
	(0.049)	(0.159)	(0.135)	(0.054)	(0.172)	(0.166)
No Fans	0.111	−1.677***	−1.566***	0.094	−1.738***	−1.645***
	(0.378)	(0.280)	(0.332)	(0.395)	(0.272)	(0.327)
Odds Ratio				−0.080***	−0.003	−0.083
				(0.031)	(0.065)	(0.056)
Home Shots				−0.087***	−0.038***	−0.125***
				(0.031)	(0.014)	(0.039)
Away Shots				−0.002	−0.115***	−0.117***
				(0.025)	(0.032)	(0.034)
Home Shots on Target				0.025	−0.011	0.014
				(0.048)	(0.049)	(0.054)
Away Shots on Target				−0.032	−0.065	−0.097
				(0.041)	(0.066)	(0.096)
Home Corners				−0.056***	−0.095***	−0.151***
				(0.021)	(0.033)	(0.050)
Away Corners				−0.109***	−0.042	−0.151***
				(0.032)	(0.027)	(0.053)
Observations	2,178	2,178	2,178	2,176	2,176	2,176
R^2	0.064	0.080	0.083	0.084	0.105	0.114

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 7: Regression Results, Interaction Model - Bundesliga 1 (Germany)

	Dependent variable: Fouls by Team					
	Home	Away	Total	Home	Away	Total
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	-2.106^{***}	-2.327^{***}	-4.433^{***}	-2.025^{***}	-2.304^{***}	-4.330^{***}
	(0.602)	(0.792)	(1.375)	(0.586)	(0.777)	(1.341)
Limited Att.	0.007	−0.009	−0.002	0.005	−0.011	−0.006
	(0.012)	(0.016)	(0.012)	(0.009)	(0.018)	(0.016)
No Fans	0.720	0.085	0.805	0.556^{**}	−0.001	0.555
	(0.447)	(1.242)	(1.206)	(0.269)	(1.324)	(1.423)
Odds Ratio				0.013	−0.034	−0.021
				(0.042)	(0.060)	(0.072)
Home Shots				−0.067	0.064	−0.002
				(0.054)	(0.040)	(0.080)
Away Shots				0.005	-0.078^{*}	−0.073
				(0.037)	(0.040)	(0.052)
Home Shots on Target				0.048	-0.098^{*}	−0.050
				(0.045)	(0.056)	(0.088)
Away Shots on Target				−0.066	−0.072	-0.138^{**}
				(0.053)	(0.060)	(0.058)
Home Corners				-0.078^{*}	-0.065^{*}	-0.143^{**}
				(0.046)	(0.038)	(0.059)
Away Corners				-0.091^{***}	−0.0002	-0.091^{*}
				(0.031)	(0.043)	(0.049)
Attendance x Lockdown	0.017	0.005	0.022^{**}	0.018^{***}	0.007	0.024
	(0.011)	(0.020)	(0.011)	(0.006)	(0.021)	(0.016)
Observations	1,768	1,768	1,768	1,767	1,767	1,767
R^2	0.204	0.140	0.222	0.215	0.155	0.234

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 8: Regression Results, Interaction Model - La Liga (Spain)

	Dependent variable: Fouls by Team					
	Home	Away	Total	Home	Away	Total
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	-0.503^{***}	-0.288^{*}	-0.791^{***}	-0.655^{***}	-0.314^{**}	-0.968^{***}
	(0.167)	(0.168)	(0.211)	(0.188)	(0.153)	(0.162)
Limited Att.	0.012	0.018^{**}	0.030^{**}	0.024^{***}	0.012	0.036^{**}
	(0.008)	(0.009)	(0.014)	(0.008)	(0.008)	(0.014)
No Fans	0.338	0.158	0.495	0.299	−0.249	0.050
	(0.255)	(0.306)	(0.324)	(0.307)	(0.224)	(0.351)
Odds Ratio				-0.130^{***}	0.036	-0.094^{*}
				(0.024)	(0.040)	(0.054)
Home Shots				-0.088^{***}	−0.024	-0.112^{**}
				(0.030)	(0.036)	(0.056)
Away Shots				−0.026	-0.149^{***}	-0.175^{***}
				(0.024)	(0.041)	(0.039)
Home Shots on Target				−0.015	-0.110^{***}	-0.125^{**}
				(0.051)	(0.032)	(0.060)
Away Shots on Target				−0.072	−0.070	-0.143^{**}
				(0.062)	(0.076)	(0.067)
Home Corners				-0.114^{***}	-0.070^{***}	-0.184^{***}
				(0.040)	(0.026)	(0.057)
Away Corners				-0.083^{***}	-0.108^{***}	-0.191^{***}
				(0.032)	(0.041)	(0.049)
Attendance x Lockdown	−0.001	0.002	0.001	−0.011	0.006	−0.005
	(0.006)	(0.008)	(0.014)	(0.008)	(0.008)	(0.013)
Observations	2,280	2,280	2,280	2,280	2,280	2,280
R^2	0.131	0.082	0.102	0.161	0.125	0.153

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 9: Regression Results, Interaction Model - Serie A (Italy)

	Dependent variable: Fouls by Team					
	Home	Away	Total	Home	Away	Total
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	-1.396^{***}	-1.362^{**}	-2.758^{***}	-1.641^{***}	-1.594^{***}	-3.235^{***}
	(0.500)	(0.564)	(1.060)	(0.391)	(0.427)	(0.802)
Limited Att.	-0.023^{**}	-0.005	-0.028	-0.024^{*}	-0.005	-0.029
	(0.010)	(0.015)	(0.023)	(0.013)	(0.016)	(0.027)
No Fans	-0.226	0.389	0.163	-0.364	0.343	-0.021
	(0.470)	(0.705)	(1.150)	(0.523)	(0.675)	(1.168)
Odds Ratio				-0.021	-0.050^{**}	-0.072^{***}
				(0.020)	(0.025)	(0.013)
Home Shots				-0.119^{***}	-0.063^{*}	-0.182^{***}
				(0.017)	(0.037)	(0.043)
Away Shots				-0.025	-0.105^{***}	-0.130^{***}
				(0.032)	(0.010)	(0.042)
Home Shots on Target				0.018	0.002	0.020
				(0.037)	(0.060)	(0.085)
Away Shots on Target				-0.046	-0.082	-0.127
				(0.069)	(0.070)	(0.110)
Home Corners				0.010	-0.059^{**}	-0.049
				(0.014)	(0.026)	(0.037)
Away Corners				-0.164^{***}	-0.108^{***}	-0.272^{***}
				(0.024)	(0.030)	(0.044)
Attendance x Lockdown	0.053^{***}	0.005	0.058^{*}	0.053^{***}	0.003	0.056^{*}
	(0.012)	(0.021)	(0.032)	(0.014)	(0.020)	(0.033)
Observations	2,261	2,261	2,261	2,260	2,260	2,260
R^2	0.131	0.111	0.155	0.156	0.141	0.196

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 10: Regression Results, Interaction Model - Premier League (England)

	Dependent variable: Fouls by Team					
	Home	Away	Total	Home	Away	Total
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	−0.239	0.025	−0.214	−0.200	0.091	−0.110
	(0.210)	(0.275)	(0.435)	(0.213)	(0.251)	(0.401)
Limited Att.	−0.0001	0.014	0.014	0.006	0.016	0.022
	(0.007)	(0.013)	(0.017)	(0.005)	(0.012)	(0.015)
No Fans	1.054***	0.443	1.497**	1.129***	0.432	1.561***
	(0.291)	(0.503)	(0.665)	(0.202)	(0.478)	(0.597)
Odds Ratio				−0.138***	−0.094***	−0.232***
				(0.039)	(0.032)	(0.051)
Home Shots				−0.020	0.020	−0.0001
				(0.024)	(0.024)	(0.023)
Away Shots				0.016	−0.048**	−0.032
				(0.011)	(0.023)	(0.031)
Home Shots on Target				0.088***	−0.046	0.042
				(0.032)	(0.031)	(0.034)
Away Shots on Target				0.001	0.001	0.002
				(0.016)	(0.031)	(0.030)
Home Corners				−0.035	−0.025	−0.060
				(0.049)	(0.037)	(0.064)
Away Corners				−0.072**	−0.070	−0.142**
				(0.034)	(0.046)	(0.058)
Attendance x Lockdown	0.010	−0.001	0.009	0.007	−0.002	0.005
	(0.009)	(0.011)	(0.016)	(0.007)	(0.011)	(0.013)
Observations	2,330	2,330	2,330	2,330	2,330	2,330
R^2	0.089	0.108	0.105	0.109	0.121	0.128

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 11: Regression Results, Interaction Model - Ligue 1 (France)

	Dependent variable: Fouls					
	Home	Away	Total	Home	Away	Total
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	0.057	−0.084	−0.028	0.108	−0.037	0.071
	(0.162)	(0.373)	(0.526)	(0.158)	(0.365)	(0.510)
Limited Att.	−0.016	−0.013	−0.029	−0.015	−0.018	−0.033*
	(0.011)	(0.014)	(0.019)	(0.010)	(0.015)	(0.018)
No Fans	−0.507**	−1.615***	−2.122***	−0.625***	−1.863***	−2.487***
	(0.204)	(0.476)	(0.606)	(0.139)	(0.480)	(0.563)
Odds Ratio				−0.079**	−0.002	−0.080
				(0.032)	(0.065)	(0.053)
Home Shots				−0.087***	−0.040***	−0.127***
				(0.030)	(0.014)	(0.038)
Away Shots				−0.004	−0.116***	−0.119***
				(0.025)	(0.032)	(0.033)
Home Shots on Target				0.025	−0.010	0.015
				(0.048)	(0.048)	(0.053)
Away Shots on Target				−0.030	−0.065	−0.095
				(0.040)	(0.065)	(0.095)
Home Corners				−0.056***	−0.096***	−0.152***
				(0.021)	(0.033)	(0.050)
Away Corners				−0.108***	−0.042	−0.150***
				(0.032)	(0.027)	(0.053)
Attendance x Lockdown	0.131***	0.248***	0.380***	0.132***	0.266***	0.398***
	(0.032)	(0.043)	(0.054)	(0.032)	(0.043)	(0.045)
Observations	2,178	2,178	2,178	2,176	2,176	2,176
R^2	0.065	0.079	0.083	0.084	0.105	0.114

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 12: Regression Results Including Actual Crimes - Bundesliga (Germany)

	Dependent variable:			
	Total Fouls			
	(1)	(2)	(3)	(4)
VAR	-4.170^{***}	-4.316^{***}	-3.766^{**}	-0.983
	(1.257)	(1.379)	(1.490)	(2.328)
No Fans		1.798^{*}		
		(0.992)		
Assaults			0.084	
			(0.080)	
Thefts				0.012^{*}
				(0.007)
Home Team FE?	X	X	X	X
Week of Season FE?	X	X	X	X
Day of Week FE?	X	X	X	X
Observations	1,461	1,461	1,317	1,317
R^2	0.244	0.246	0.238	0.248
Adjusted R^2	0.207	0.209	0.196	0.206
Note:				*p<0.1; **p<0.05; ***p<0.01
				Season-level SE. Controls included.

Table 13: Regression Results Including Actual Crimes - La Liga (Spain)

	Dependent variable:			
	TF			
	(1)	(2)	(3)	(4)
VAR	-0.851^{***}	-0.885^{***}	-1.085^{***}	-1.127^{***}
	(0.178)	(0.176)	(0.138)	(0.121)
No Fans		0.239		
		(0.530)		
Assaults			0.029^{**}	
			(0.012)	
Thefts				0.006
				(0.004)
Home Team FE?	X	X	X	X
Week of Season FE?	X	X	X	X
Day of Week FE?	X	X	X	X
Observations	1,900	1,900	1,700	1,700
R^2	0.148	0.148	0.153	0.152
Adjusted R^2	0.112	0.111	0.112	0.112
Note:				*p<0.1; **p<0.05; ***p<0.01
				Season-level SE. Controls included.

Table 14: Regression Results Including Actual Crimes - Serie A (Italy)

	Dependent variable:			
	TF			
	(1)	(2)	(3)	(4)
VAR	-3.220^{***}	-3.295^{***}	-2.404^{***}	-3.483^{**}
	(0.794)	(0.762)	(0.806)	(1.466)
No Fans		1.238^{***}		
		(0.313)		
Assaults			-0.326^{*}	
			(0.184)	
Thefts				-0.001
				(0.005)
Home Team FE?	X	X	X	X
Week of Season FE?	X	X	X	X
Day of Week FE?	X	X	X	X
Observations	1,881	1,881	1,681	1,681
R^2	0.218	0.220	0.231	0.230
Adjusted R^2	0.185	0.186	0.194	0.192
Note:				*p<0.1; **p<0.05; ***p<0.01
				Season-level SE. Controls included.

Table 15: Regression Results Including Actual Crimes - Premier League (England)

	Dependent variable:			
	TF			
	(1)	(2)	(3)	(4)
VAR	0.489	−0.033		
	(0.432)	(0.391)		
No Fans		2.268***		
		(0.345)		
Assaults			−0.004	
			(0.004)	
Thefts				−0.001
				(0.002)
Home Team FE?	X	X	X	X
Week of Season FE?	X	X	X	X
Day of Week FE?	X	X	X	X
Observations	1,881	1,881	1,321	1,321
R^2	0.134	0.139	0.149	0.148
Adjusted R^2	0.096	0.101	0.097	0.095

Note: *p<0.1; **p<0.05; ***p<0.01
Season-level SE. Controls included.
2019 Crime data missing.

Table 16: Regression Results Including Actual Crimes - Ligue 1 (France)

	Dependent variable:		
	TF		
	(1)	(2)	(3)
VAR	−0.016	0.402	0.211
	(0.520)	(0.691)	(0.566)
Assaults		−0.006	
		(0.012)	
Thefts			0.001
			(0.001)
Home Team FE?	X	X	X
Week of Season FE?	X	X	X
Day of Week FE?	X	X	X
Observations	1,797	1,705	1,705
R^2	0.129	0.125	0.126
Adjusted R^2	0.090	0.083	0.084
Note:			*p<0.1; **p<0.05; ***p<0.01
			Season-level SE. Controls included.
			2019 Crime data missing.

Table 17: Within Country Correlation Coefficients - Crimes and Football Fouls

League	Cor(Assaults,Total Fouls)	Cor(Thefts, Total Fouls)
Germany	0.14	0.35
Spain	0.04	0.03
Italy	-0.21	0.18
England	-0.08	-0.06
France	-0.02	0.06

References

Ariel, B., Sutherland, A., Henstock, D., Young, J., Drover, P., Sykes, J., Megicks, S., and Henderson, R. (2017). "contagious accountability": A global multisite randomized controlled trial on the effect of police body-worn cameras on citizens' complaints against the police. *Criminal Justice and Behavior*, 44(2):293–316.

Becker, G. S. (1968). Crime and punishment: An economic approach. *Journal of Political Economy*, 76(2):169–217.

Brehm, J. and Gates, S. (1993). Donut shops and speed traps: Evaluating models of supervision on police behavior. *American Journal of Political Science*, pages 555–581.

Bryson, A., Dolton, P., Reade, J. J., Schreyer, D., and Singleton, C. (2021). Causal effects of an absent crowd on performances and refereeing decisions during covid-19. *Economics Letters*, 198:1–5.

Cohen, A., Neeman, Z., and Auferoth, F. (2021). Judging under public pressure. Working paper, National Bureau of Economic Research.

Cueva, C. (2020). Animal spirits in the beautiful game. testing social pressure in professional football during the covid-19 lockdown. Working paper, OSF Preprints.

Dilger, A. and Vischer, L. (2020). No home bias in ghost games. Discussion paper, Institute for Organisational Economics.

Endrich, M. and Gesche, T. (2020). Home-bias in referee decisions: Evidence from "ghost matches" during the covid19-pandemic. *Economics Letters*, 197:1–4.

Ferraresi, M. and Gucciardi, G. (2020). Team performance and audience: experimental evidence from the football sector. Working paper, Società italiana di economia pubblica.

Fischer, K. and Haucap, J. (2021). Does crowd support drive the home advantage in professional football? evidence from german ghost games during the covid-19 pandemic. *Journal of Sports Economics*, 22(8):982–1008.

Garicano, L., Palacios-Huerta, I., and Prendergast, C. (2005). Favoritism under social pressure. *Review of Economics and Statistics*, 87(2):208–216.

Han, B., Chen, Q., Lago-Peñas, C., Wang, C., and Liu, T. (2020). The influence of the video assistant referee on the chinese super league. *International Journal of Sports Science & Coaching*, 15(5-6):662–668.

Jennings, W. G., Lynch, M. D., and Fridell, L. A. (2015). Evaluating the impact of police officer body-worn cameras (bwcs) on response-to-resistance and serious external complaints: Evidence from the orlando police department (opd) experience utilizing a randomized controlled experiment. *Journal of Criminal Justice*, 43(6):480–486.

Kitchens, C., Makofske, M. P., and Wang, L. (2019). "Crime" on the field. *Southern Economic Journal*, 85(3):821–864.

Lago-Peñas, C., Rey, E., and Kalén, A. (2019). How does video assistant referee (VAR) modify the game in elite soccer? *International Journal of Performance Analysis in Sport*, 19(4):646–653.

McCarrick, D., Bilalic, M., Neave, N., and Wolfson, S. (2020). Home advantage during the covid-19 pandemic in european football. Working paper, PsyArXiv.

Morita, H. and Araki, S. (2022). Social pressure in football matches: an event study of 'remote matches' in japan. *Applied Economics Letters*, pages 1–4.

Owens, E. and Ba, B. (2021). The economics of policing and public safety. *Journal of Economic Perspectives*, 35(4):3–28.

Pope, D. G., Price, J., and Wolfers, J. (2018). Awareness reduces racial bias. *Management Science*, 64(11):4988–4995.

Reade, J., Schreyer, D., and Singleton, C. (2020). Eliminating supportive crowds reduces referee bias. Working paper 3743972, SSRN.

Ready, J. and Young, J. T. N. (2015). The impact of on-officer video cameras on police–citizen contacts: findings from a controlled experiment in Mesa, AZ. *Journal of Experimental Criminology*, 11:445–458.

Scoppa, V. (2021). Social pressure in the stadiums: Do agents change behavior without crowd support? *Journal of Economic Psychology*, 82:102344.

Vandenbruaene, J., Ceuster, M. D., and Annaert, J. (2022). Efficient spread betting markets: A literature review. *Journal of Sports Economics*, pages 1–43.

Appendix: Robustness Checks (Removal of 2020/21 season data.)

Table 18: Regression Results - Bundesliga 1 (Germany) - 2020/21 Season Excluded

	Dependent variable: Fouls by Team					
	Home	Away	Total	Home	Away	Total
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	−2.119***	−2.295***	−4.414***	−2.056***	−2.260***	−4.316***
	(0.611)	(0.818)	(1.413)	(0.597)	(0.797)	(1.379)
No Fans	1.340***	0.523	1.863*	1.299***	0.499	1.798*
	(0.390)	(0.720)	(1.042)	(0.392)	(0.679)	(0.992)
Odds Ratio				−0.015	−0.036	−0.051
				(0.043)	(0.071)	(0.079)
Home Shots				−0.070	0.054	−0.016
				(0.066)	(0.048)	(0.094)
Away Shots				0.033	−0.089*	−0.056
				(0.029)	(0.047)	(0.060)
Home Shots on Target				0.041	−0.110*	−0.069
				(0.056)	(0.061)	(0.097)
Away Shots on Target				−0.087*	−0.094	−0.181***
				(0.050)	(0.071)	(0.042)
Home Corners				−0.040	−0.052	−0.092**
				(0.036)	(0.045)	(0.041)
Away Corners				−0.096**	−0.003	−0.099*
				(0.044)	(0.055)	(0.059)
Observations	1,462	1,462	1,462	1,461	1,461	1,461
R^2	0.220	0.146	0.235	0.230	0.164	0.246
Adjusted R^2	0.186	0.108	0.201	0.191	0.123	0.209
Residual Std. Error	3.775	4.092	6.051	3.759	4.058	6.016

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 19: Regression Results - La Liga (Spain) - 2020/21 Season Excluded

	Dependent variable:					
	Home	Away	Total	Home	Away	Total
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	−0.515***	−0.221	−0.735***	−0.653***	−0.232	−0.885***
	(0.170)	(0.176)	(0.236)	(0.184)	(0.155)	(0.176)
No Fans	0.547**	0.185	0.732*	0.273	−0.034	0.239
	(0.277)	(0.293)	(0.417)	(0.333)	(0.370)	(0.530)
Odds Ratio				−0.127***	0.060*	−0.066
				(0.029)	(0.036)	(0.054)
Home Shots				−0.094***	−0.024	−0.118*
				(0.033)	(0.043)	(0.068)
Away Shots				−0.039	−0.134***	−0.174***
				(0.024)	(0.043)	(0.045)
Home Shots on Target				0.006	−0.111***	−0.105
				(0.052)	(0.040)	(0.066)
Away Shots on Target				−0.033	−0.126**	−0.159**
				(0.055)	(0.056)	(0.073)
Home Corners				−0.105**	−0.065**	−0.170***
				(0.048)	(0.027)	(0.060)
Away Corners				−0.097***	−0.087**	−0.184***
				(0.037)	(0.040)	(0.053)
Observations	1,900	1,900	1,900	1,900	1,900	1,900
R^2	0.142	0.087	0.097	0.171	0.133	0.148
Adjusted R^2	0.108	0.051	0.062	0.136	0.096	0.111
Residual Std. Error	4.015	4.016	5.745	3.953	3.921	5.591

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 20: Regression Results - Serie A (Italy) - 2020/21 Season Excluded

	Dependent variable:					
	Home	Away	Total	Home	Away	Total
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	-1.447^{***}	-1.313^{**}	-2.760^{***}	-1.751^{***}	-1.544^{***}	-3.295^{***}
	(0.522)	(0.541)	(1.058)	(0.398)	(0.386)	(0.762)
No Fans	1.132^{***}	0.178	1.311^{***}	1.025^{***}	0.213	1.238^{***}
	(0.192)	(0.371)	(0.466)	(0.211)	(0.275)	(0.313)
Odds Ratio				−0.028	−0.044	-0.071^{***}
				(0.023)	(0.027)	(0.007)
Home Shots				-0.119^{***}	−0.063	-0.182^{***}
				(0.020)	(0.046)	(0.053)
Away Shots				-0.052^{**}	-0.111^{***}	-0.163^{***}
				(0.022)	(0.004)	(0.022)
Home Shots on Target				−0.005	−0.002	−0.008
				(0.043)	(0.071)	(0.095)
Away Shots on Target				−0.014	−0.120	−0.134
				(0.069)	(0.077)	(0.132)
Home Corners				0.016	-0.063^{**}	−0.046
				(0.011)	(0.027)	(0.036)
Away Corners				-0.163^{***}	-0.123^{***}	-0.286^{***}
				(0.030)	(0.034)	(0.053)
Observations	1,881	1,881	1,881	1,881	1,881	1,881
R^2	0.140	0.133	0.174	0.167	0.168	0.220
Adjusted R^2	0.106	0.099	0.141	0.131	0.132	0.186
Residual Std. Error	3.974	4.164	6.187	3.918	4.087	6.023

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 21: Regression Results - Premier League (England) - 2020/21 Season Excluded

	Dependent variable:					
	Home	Away	Total	Home	Away	Total
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	−0.170	0.017	−0.153	−0.126	0.094	−0.033
	(0.209)	(0.287)	(0.419)	(0.219)	(0.264)	(0.391)
No Fans	1.571***	0.837***	2.409***	1.488***	0.779***	2.268***
	(0.314)	(0.144)	(0.323)	(0.327)	(0.187)	(0.345)
Odds Ratio				−0.111***	−0.104***	−0.215***
				(0.033)	(0.034)	(0.054)
Home Shots				−0.041**	0.020	−0.021
				(0.017)	(0.025)	(0.018)
Away Shots				0.018	−0.055**	−0.037
				(0.015)	(0.022)	(0.034)
Home Shots on Target				0.111***	−0.054	0.058
				(0.020)	(0.040)	(0.043)
Away Shots on Target				−0.001	−0.010	−0.011
				(0.017)	(0.043)	(0.039)
Home Corners				−0.046	−0.029	−0.074
				(0.060)	(0.046)	(0.080)
Away Corners				−0.088**	−0.055	−0.143**
				(0.038)	(0.051)	(0.069)
Observations	1,881	1,881	1,881	1,881	1,881	1,881
R^2	0.096	0.107	0.115	0.117	0.123	0.139

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 22: Regression Results - Ligue 1 (France) - 2020/21 Season Excluded

	Dependent variable:					
	HF	AF	TF	HF	AF	TF
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	−0.015	−0.126	−0.141	0.049	−0.065	−0.016
	(0.151)	(0.390)	(0.530)	(0.153)	(0.386)	(0.520)
Odds Ratio				−0.099***	0.021	−0.078
				(0.024)	(0.083)	(0.078)
Home Shots				−0.108***	−0.040**	−0.149***
				(0.029)	(0.017)	(0.040)
Away Shots				−0.008	−0.134***	−0.142***
				(0.029)	(0.032)	(0.029)
Home Shots on Target				0.053	−0.009	0.044
				(0.050)	(0.060)	(0.054)
Away Shots on Target				−0.0001	−0.060	−0.060
				(0.031)	(0.079)	(0.103)
Home Corners				−0.064***	−0.083**	−0.147**
				(0.022)	(0.041)	(0.063)
Away Corners				−0.123***	−0.037	−0.161**
				(0.034)	(0.038)	(0.066)
Home Team FE?	X	X	X	X	X	X
Week of Season FE?	X	X	X	X	X	X
Day of Week FE?	X	X	X	X	X	X
Observations	1,798	1,798	1,798	1,797	1,797	1,797
R^2	0.073	0.085	0.097	0.098	0.113	0.129
Adjusted R^2	0.036	0.048	0.060	0.058	0.073	0.090
Residual Std. Error	3.769	3.926	5.773	3.725	3.873	5.680

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 23: Regression Results, Interaction Model - Bundesliga 1 (Germany) - 2020/21 Season Excluded

	Dependent variable:					
	HF	AF	TF	HF	AF	TF
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	-2.105^{***}	-2.374^{***}	-4.479^{***}	-2.054^{***}	-2.342^{***}	-4.397^{***}
	(0.639)	(0.852)	(1.476)	(0.625)	(0.816)	(1.425)
Attendance	0.032	-0.131^{*}	-0.099	0.014	-0.142^{**}	-0.128
	(0.053)	(0.077)	(0.128)	(0.045)	(0.063)	(0.107)
Lockdown	-0.111	2.263^{**}	2.152^{**}	0.090	2.360^{***}	2.450^{***}
	(0.159)	(0.914)	(0.968)	(0.244)	(0.901)	(0.918)
Odds Ratio				-0.015	-0.034	-0.049
				(0.044)	(0.071)	(0.081)
Home Shots				-0.070	0.054	-0.017
				(0.066)	(0.048)	(0.093)
Away Shots				0.032	-0.087^{*}	-0.054
				(0.029)	(0.046)	(0.061)
Home Shots on Target				0.041	-0.108^{*}	-0.067
				(0.055)	(0.060)	(0.095)
Away Shots on Target				-0.086^{*}	-0.101	-0.186^{***}
				(0.050)	(0.069)	(0.044)
Home Corners				-0.037	-0.058	-0.095^{**}
				(0.034)	(0.044)	(0.041)
Away Corners				-0.093^{**}	-0.009	-0.103^{*}
				(0.043)	(0.056)	(0.061)
Attendance x Lockdown	0.034^{***}	-0.040^{***}	-0.006	0.028^{***}	-0.042^{***}	-0.014
	(0.008)	(0.008)	(0.014)	(0.009)	(0.009)	(0.015)
Observations	1,462	1,462	1,462	1,461	1,461	1,461
R^2	0.222	0.149	0.235	0.230	0.167	0.247
Adjusted R^2	0.186	0.110	0.200	0.191	0.124	0.208
Residual Std. Error	3.775	4.089	6.054	3.760	4.054	6.019

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 24: Regression Results, Linear Interaction - Serie A (Italy) - 2020/21 Season Excluded

	Dependent variable:					
	HF	AF	TF	HF	AF	TF
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	-1.326^{**}	-1.252^{**}	-2.579^{**}	-1.603^{***}	-1.451^{***}	-3.054^{***}
	(0.554)	(0.578)	(1.130)	(0.435)	(0.443)	(0.864)
Attendance	-0.040^{***}	-0.021	-0.061^{*}	-0.052^{***}	-0.032	-0.084^{***}
	(0.014)	(0.023)	(0.033)	(0.014)	(0.023)	(0.033)
Lockdown	-0.926^{***}	-1.166^{**}	-2.093^{***}	-1.061^{***}	-0.964^{**}	-2.025^{***}
	(0.228)	(0.484)	(0.533)	(0.241)	(0.426)	(0.358)
Odds Ratio				-0.021	-0.040	-0.061^{***}
				(0.025)	(0.025)	(0.006)
Home Shots				-0.123^{***}	-0.066	-0.188^{***}
				(0.021)	(0.048)	(0.056)
Away Shots				-0.051^{**}	-0.111^{***}	-0.162^{***}
				(0.021)	(0.004)	(0.021)
Home Shots on Target				-0.002	-0.00001	-0.002
				(0.041)	(0.071)	(0.095)
Away Shots on Target				-0.010	-0.117	-0.127
				(0.074)	(0.079)	(0.138)
Home Corners				0.017	-0.063^{**}	-0.046
				(0.011)	(0.028)	(0.036)
Away Corners				-0.168^{***}	-0.126^{***}	-0.294^{***}
				(0.032)	(0.036)	(0.058)
Attendance:lockdown	0.076^{***}	0.049^{***}	0.125^{***}	0.077^{***}	0.044^{***}	0.120^{***}
	(0.006)	(0.008)	(0.008)	(0.005)	(0.006)	(0.005)
Observations	1,881	1,881	1,881	1,881	1,881	1,881
R^2	0.144	0.135	0.178	0.172	0.169	0.224

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 25: Regression Results, Linear Interaction - Premier League (England) - 2020/21 Season Excluded

	Dependent variable:					
	HF	AF	TF	HF	AF	TF
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	−0.145	0.109	−0.036	−0.108	0.175	0.067
	(0.211)	(0.257)	(0.393)	(0.218)	(0.243)	(0.371)
Attendance	−0.022	−0.063***	−0.085***	−0.016	−0.058**	−0.074**
	(0.015)	(0.020)	(0.024)	(0.012)	(0.024)	(0.029)
Lockdown	1.343***	2.663***	4.006***	1.477***	2.491***	3.967***
	(0.249)	(0.279)	(0.200)	(0.246)	(0.358)	(0.328)
Odds Ratio				−0.109***	−0.096***	−0.205***
				(0.032)	(0.032)	(0.052)
Home Shots				−0.042**	0.015	−0.027*
				(0.017)	(0.024)	(0.016)
Away Shots				0.018	−0.054***	−0.036
				(0.014)	(0.020)	(0.031)
Home Shots on Target				0.110***	−0.055	0.055
				(0.019)	(0.039)	(0.041)
Away Shots on Target				0.0004	−0.008	−0.007
				(0.018)	(0.040)	(0.037)
Home Corners				−0.046	−0.029	−0.075
				(0.060)	(0.046)	(0.080)
Away Corners				−0.089**	−0.059	−0.148**
				(0.039)	(0.051)	(0.067)
Attendance:lockdown	0.006	−0.046***	−0.040***	0.0003	−0.043***	−0.043***
	(0.006)	(0.004)	(0.006)	(0.005)	(0.005)	(0.007)
Observations	1,881	1,881	1,881	1,881	1,881	1,881
R^2	0.097	0.114	0.120	0.117	0.129	0.143

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level

Table 26: Regression Results, Interaction Model - La Liga (Spain) - Season 6 Excluded

	Dependent variable:					
	HF	AF	TF	HF	AF	TF
	(1)	(2)	(3)	(4)	(5)	(6)
VAR Oversight	−0.390***	−0.161	−0.551**	−0.553***	−0.145	−0.699***
	(0.138)	(0.190)	(0.261)	(0.146)	(0.167)	(0.199)
Attendance	−0.082**	−0.041	−0.123***	−0.060	−0.056**	−0.116***
	(0.039)	(0.026)	(0.021)	(0.040)	(0.027)	(0.025)
Lockdown	1.066***	0.165	1.231**	1.083***	−0.098	0.985*
	(0.250)	(0.404)	(0.550)	(0.339)	(0.356)	(0.591)
Odds Ratio				−0.122***	0.067*	−0.055
				(0.027)	(0.036)	(0.055)
Home Shots				−0.095***	−0.025	−0.120*
				(0.033)	(0.042)	(0.067)
Away Shots				−0.040*	−0.136***	−0.176***
				(0.021)	(0.045)	(0.045)
Home Shots on Target				0.006	−0.108***	−0.102
				(0.049)	(0.040)	(0.062)
Away Shots on Target				−0.033	−0.124**	−0.157**
				(0.053)	(0.056)	(0.071)
Home Corners				−0.106**	−0.065**	−0.172***
				(0.048)	(0.027)	(0.060)
Away Corners				−0.096***	−0.084**	−0.180***
				(0.036)	(0.041)	(0.053)
Attendance:lockdown	−0.016***	0.002	−0.014	−0.027***	0.004	−0.023*
	(0.006)	(0.008)	(0.013)	(0.009)	(0.009)	(0.013)
Observations	1,900	1,900	1,900	1,900	1,900	1,900
R^2	0.144	0.088	0.099	0.173	0.134	0.150
Adjusted R^2	0.110	0.051	0.063	0.137	0.096	0.113
Residual Std. Error	4.011	4.017	5.740	3.950	3.921	5.586

Notes: **p<0.05; ***p<0.01. All models contain home team, week of season, and day of week fixed effects. Std. Errors Clustered at Season Level