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Ivan Trestcov

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Compliance Behavior Under Surveillance: Introduction of the Video Assistant Referee to European Football *

Ivan Trestcov†

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Abstract

This paper analyzes the effect of introducing the Video Assistant Referee (VAR) to European football. First, the setting allows for decomposition of the deterrence and monitoring effects in Becker's (1968) model of crime. Second, I estimate the deterrence effect's spillover outside the surveillance environment. Third, I find evidence of a much under-studied learning-by-punishment effect. This paper applies the difference-in-difference strategy to show that the introduction of VAR causes a significant decrease in the number of fouls in two German football leagues. VAR had an immediate impact on severe fouls, while the effect on penalty fouls is apparent after a 12 week adjustment period. Punishment intensifies the deterrence effect as punished players commit even fewer fouls than unpunished players. Moreover, the deterrence effect persists outside of the surveillance environment, i.e., there is a spillover effect on international competitions. I show that players from countries with VAR commit fewer fouls in international competitions than other players.

Keywords: Becker Model, Video Assistant Referee, Deterrence, European Football, Spillover, Learning-by-Punishment

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†CERGE-EI, a joint workplace of Charles University and the Economics Institute of the Czech Academy of Sciences, Politickych veznu 7, 111 21 Prague, Czech Republic, Ivan.Trestcov@cerge-ei.cz

1 Introduction

Governments and businesses spend billions on surveillance cameras to lower crime rates, and the number of surveillance cameras worldwide climbed above 1 billion in 2021[1]. The existing literature finds strong evidence of general deterrence caused by surveillance (Munyo Rossi, 2019; Priks, 2015). However, the evidence is scarce when it comes to understanding various dimensions of the link between surveillance and criminal behavior, including the mechanism of learning the increased probability of detection, rate of recidivism, and spillover effect to unmonitored areas.

This paper addresses several under-studied aspects of the relationship between surveillance and crime using a novel setting of the introduction of a video assistant referee (VAR) to European football. The paper builds on McCormick and Tollison (1984), who propose testing the Becker's (1968) model of crime using sports data. They treat referees as "police" and players as potential lawbreakers and find that the number of fouls in college basketball decreases by 30 percent after the number of referees changes from 2 to 3.

Several studies have applied this idea to different sports (Levitt, 2002; Heckelman and Yates, 2003; Kitchens, 2014; Janhuba, 2018). In the setting of this paper, the source of the increased probability of detection arises not from the additional referee but the surveillance technology. VAR is a video footage technology in football that helps game officials to review decisions made by the head referee. Dozens of major football leagues have introduced it to increase the accuracy of officiating in matches.

First, I contribute to the literature by estimating the long-lasting change in criminal behavior outside the surveillance environment after being monitored. I use player-level data from two international competitions and apply the difference-in-difference estimation strategy to compare the changes in the number of fouls committed by players from leagues with and without VAR. Two international competitions - the Champions League and the Europa League - introduced VAR later than some domestic leagues. This timing opens a window for estimation of the spillover effect. I test the hypothesis that the general deterrence causing from use of VAR continues to affect players in games without the

[1]See IHS Markit: Video surveillance: How technology and the cloud is disrupting the market

surveillance technology. I find that players from three domestic leagues start to commit 15-20 % fewer fouls immediately after the introduction of VAR. The effect strengthens with the number of games played under surveillance.

Second, this paper contributes to the literature on specific deterrence - the deterrence caused by experience of law enforcement experience[2]. It is an empirical challenge to isolate the learning-by-punishment channel. One reason is that the expectation of punishment often increases with prior convictions and implies a general deterrence effect. Moreover, punishment usually has a treatment effect that is simultaneous with incapacitation and aging (Ganong, 2012; Barbarino and Mastrobuoni, 2014), criminogenic peer effects (Bayer et al., 2009), diverging labor market consequences (Mueller-Smith, 2015; Bhuller et al., 2019), and non-trivial income effects (Kolm, 1973). This paper avoids these pitfalls by considering regular, constant, and non-severe punishments. I use the data on fouls detected by VAR to investigate whether the players' experience with law enforcement may accelerate their learning about the increased probability of detection and intensify the general deterrence. I find that after experiencing punishment, players start to commit significantly fewer penalty-kick and severe fouls, over and above the general deterrence. Moreover, I show weak evidence that players learn not only from their own mistakes but also if they witness VAR punishing other players.

Third, this paper contributes to the general deterrence literature by providing a clear link between monitoring and deterrence effects. The police literature offers estimates of the crime-police elasticity (Levitt, 1997; Di Tella and Schargrodsky, 2004; Draca and Witt, 2011). The surveillance cameras literature exploits the fact that police rarely use CCTV cameras for crime detection; hence only the deterrence effect is present (Armitage et al., 1999; Blixt, 2003; Brown, 1995; Caplan et al., 2011; Ditton and Short, 1999; Gill and Spriggs, 2005; Munyo and Rossi, 2019; Priks, 2015). However, it is complicated to estimate the monitoring effect of additional police or cameras on the number of arrests due to the simultaneous nature of monitoring and deterrence, or the long time between a crime and its prosecution. This paper exploits the special timing of VAR decision-

[2]The concept of specific deterrence proposes that punished criminals avoid future criminal activity. General deterrence suggests that punishment awareness prevents individuals from committing crimes.

making to better distinguish between the monitoring and deterrence effects. The head referee always makes the initial decision regarding the game event, and only then may VAR interfere with the game and change the decision. Observing both initial and final decisions I estimate the effect of VAR on the number of fouls for two alternative datasets. A 37 percent increase in the number of fouls detected due to surveillance (the monitoring effect) leads to a 32 percent decrease in the number of fouls committed (the deterrence effect).

The rest of the paper has the following structure. Section 2 describes the introduction of the Video Assistant Referee to European football. Section 3 summarises the data and justifies the empirical strategy of the paper. Section 4 presents the results of the analysis. Section 5 concludes.

2 The Video Assistant Referee

VAR is a surveillance technology in football that helps head and assistant referees to officiate the game with greater accuracy. It is gradually spreading across all major football leagues in the world. In Europe, the German Bundesliga, Italian Serie-A, and Portuguese Primeira were the first three leagues to introduce the new technology, in all games for the 2017-2018 season. The International Federation of Association Football (FIFA) officially included VAR in the laws of the game in 2018. In the 2018-2019 season, four more European leagues incorporated the technology. Currently, approximately 40 countries use VAR in their top leagues.

The primary purpose of VAR is to increase the accuracy of referee decisions by correcting clear and obvious mistakes for possibly match-changing events, including goals, penalties, red cards, and mistaken identity. VAR can intervene when the head or assistant referee mistakenly calls, or overlooks one of these events.

KU Leuven's independent research (Spitz, 2020) on the data from the experimental phase of VAR introduction reports that 57 percent of checks were for penalty or goal incidents. VAR initiates approximately five inspections per match with a median check

time of 20 seconds. On average, VAR detects one clear and obvious mistake every three games. The research estimates that the technology improved accuracy in decision-making from 93 to 98.9 percent.

According to the laws of the game, the VAR, supported by the VAR operator, reviews all video replays of game-changing events. If a review reveals that the head or assistant referee made an obvious mistake, the VAR suggests that the referee checks the preliminary decision. The head referee can overturn an initial decision based only on the information from the VAR. For subjective conclusions such as sending a player off, the head referee can review the footage on a monitor near the field before making a final decision. Another essential protocol rule is that the head referee must always make an initial decision as if there was no VAR, and he is not permitted to give 'no decision.'

3 Data and Empirical Strategy

I use player-level match statistics and VAR-decisions data from several open sources: fbref.com, whoscorred.com, and goal.com. The data cover three years starting from the 2015/2016 season. First, I focus on two major German leagues: the Bundesliga and 2. Bundesliga. The Bundesliga introduced VAR in the 2017/2018 season, while 2. Bundesliga incorporated the technology in the 2019/2020 season, and acts as a control group in this study. Second, I use statistics from two leading international competitions: the Champions League and the Europa League, neither of which incorporated VAR in the period covered by this analysis.

Table 1 presents summary statistics of the main variables of interest and outcome variables for two major German football leagues analyzed in this paper. The Bundesliga and 2. Bundesliga are the first and second tier leagues of the German football league system. I use several types of fouls as outcome variables. Penalty-kick fouls are committed close to the goal of an offender (inside the penalty area). A head referee shows the offender a yellow card if he commits a severe foul (e.g., persistent infringement of the Laws of the Game). If a player commits a second severe foul or an exceptionally severe foul (e.g.,

foul committed using excessive force), the head referee shows a red card to signify that a player must be sent off. The number of games played with VAR by a player is the variable of interest.

As player-level penalty data is unavailable for 2. Bundesliga, I use team-level statistics and assign penalty kick fouls to one if the player's team committed such fouls in the game. A penalty kick happens once in two games. A yellow card is more frequent: every 7th player receives one in a game. The rarest event is a red card, which is shown once in 5-6 games. There are no players with VAR experience in 2. Bundesliga since it had not implemented VAR before 2019. In contrast, I observe players with experience of up to 34 games using VAR in the Bundesliga as it introduced VAR in the last season analyzed.

Table 1: Summary Statistics, Germany 2015-2018 by Competition

	Mean	SD	Min	Max	N
Panel A: 2.Bundesliga					
Penalty Kick Fouls (Team)	0.24	0.49	0.00	3.00	24,525
Yellow Cards	0.16	0.37	0.00	2.00	24,525
Red Cards	0.01	0.08	0.00	1.00	24,525
Games with VAR before	0.00	0.00	0.00	0.00	24,525
Panel B: Bundesliga					
Penalty Kick Fouls (Team)	0.30	0.53	0.00	3.00	24,972
Yellow Cards	0.14	0.35	0.00	2.00	24,972
Red Cards	0.01	0.07	0.00	1.00	24,972
Games with VAR before	4.21	7.57	0.00	34.00	24,972
Punished by VAR before	0.01	0.11	0.00	1.00	24,972

Notes: All statistics were obtained from player-match level samples with 24 525 observations in 2. Bundesliga and 24 972 observations in the Bundesliga. Penalty Kick Fouls are assigned based on team-level statistics. "Games with VAR before" correspond to the number of games officiated with VAR which players had participated in before a current game. "Punished by VAR before" correspond to the number of times a player was caught and punished by VAR before a current game.

I estimate a difference-in-difference model of the following form:

$$Y_{imt} = \alpha_t + \lambda_c + \theta_i + \gamma_{mt} + \beta VAR_{ct} + \beta_e E_{imt} + \beta_x X_{mt} + \epsilon_{imt} \tag{1}$$

Y_{imt} is a number of fouls committed by player i, in the matchup (pair of competing teams) m, competition c, and year t. I use three types of fouls committed: severe foul,

penalty-kick foul, and common foul. The head referee shows a yellow or red card if a player commits a severe foul. A penalty kick foul is any foul committed inside the penalty area adjacent to the goal. I include fixed effects of the competition λ_c , game week α_t , player θ_i. γ_{mt} are the matchup level fixed effects: pair of teams and referee. I also include a variety of controls at the game level including shots, ball possession, and the difference in the final score etc. The treatment variable VAR_{ct} for the analysis of German leagues is a dummy which takes the value of one if it is a game officiated with VAR. For the analysis of the international competitions, VAR_{it} is a dummy which takes the value of one if player i participated in the match with VAR before time t. E_{imt} reflects the learning-by-punishment effect. It takes the value of one if at a time t player i has been caught by VAR at least once. β_e captures the additional deterrence effect of personal experience of the punishment.

To test the spillover hypothesis, I use international data. Mainly, I investigate players' compliance behavior in the Champions League and Europa League after being exposed to treatment. I compare the number of fouls committed by players from domestic championships with VAR versus players from championships without VAR. The evidence for the spillover effect would be a significant and negative β. One possible explanation of the spillover effect is a significant cost of switching over two regimes: "soft" (law-abiding) and "aggressive" (criminal). If a player anticipates treatment in future games, it might be optimal to stick to one "regime" to eliminate switching costs. Another explanation is a long adjustment period to a new environment; hence one game is merely insufficient time.

Another part of the analysis is an investigation of the link between monitoring and deterrence effects in the framework of Becker (1968). I use the German leagues' data and analyze two alternative datasets: initial and final head referee decisions. Assuming no changes in referees' behavior after the introduction of VAR, one can estimate the monitoring effect as a simple fraction of additional fouls caused by VAR to the number of fouls initially called by the head referee. I use DiD for the initial decisions dataset to estimate the deterrence effect. If VAR does not affect referees, then a possible drop

in the number of fouls after the introduction of the surveillance can be explained by the deterrence of players.

The main concern for this analysis is the assumption of the unchanged referee behavior after the introduction of VAR. One argument supporting this assumption is the protocol rule which explicitly states that the referee must provide an initial decision as if there is no VAR. Moreover, he can not give a "no decision" call. To give a formal argument, I apply a similar specification as in Equation 1 to the data of Bundesliga 2 only. The league did not introduce VAR in 2017/2018; however, some referees officiating games in this season had already experienced VAR in the first Bundesliga. I change the variable of interest in Equation 1 to VAR_{rt} - a dummy that takes one if the referee r officiated at least one game with VAR before t. I find no significant changes in the number of fouls (severe and penalty kicks) called by referees with VAR experience (Table 2). I use the same fixed effects as in the main specification: time, players, and team pairs.

Table 2: The effect of VAR on referees in Bundesliga 2

	(1) Penalty Kicks	(2) Severe Fouls
VAR	0.040	-0.016
	(0.177)	(0.021)
Observations	468	468
Time FE	Yes	Yes
Player FE	Yes	Yes
Teams FE	Yes	Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

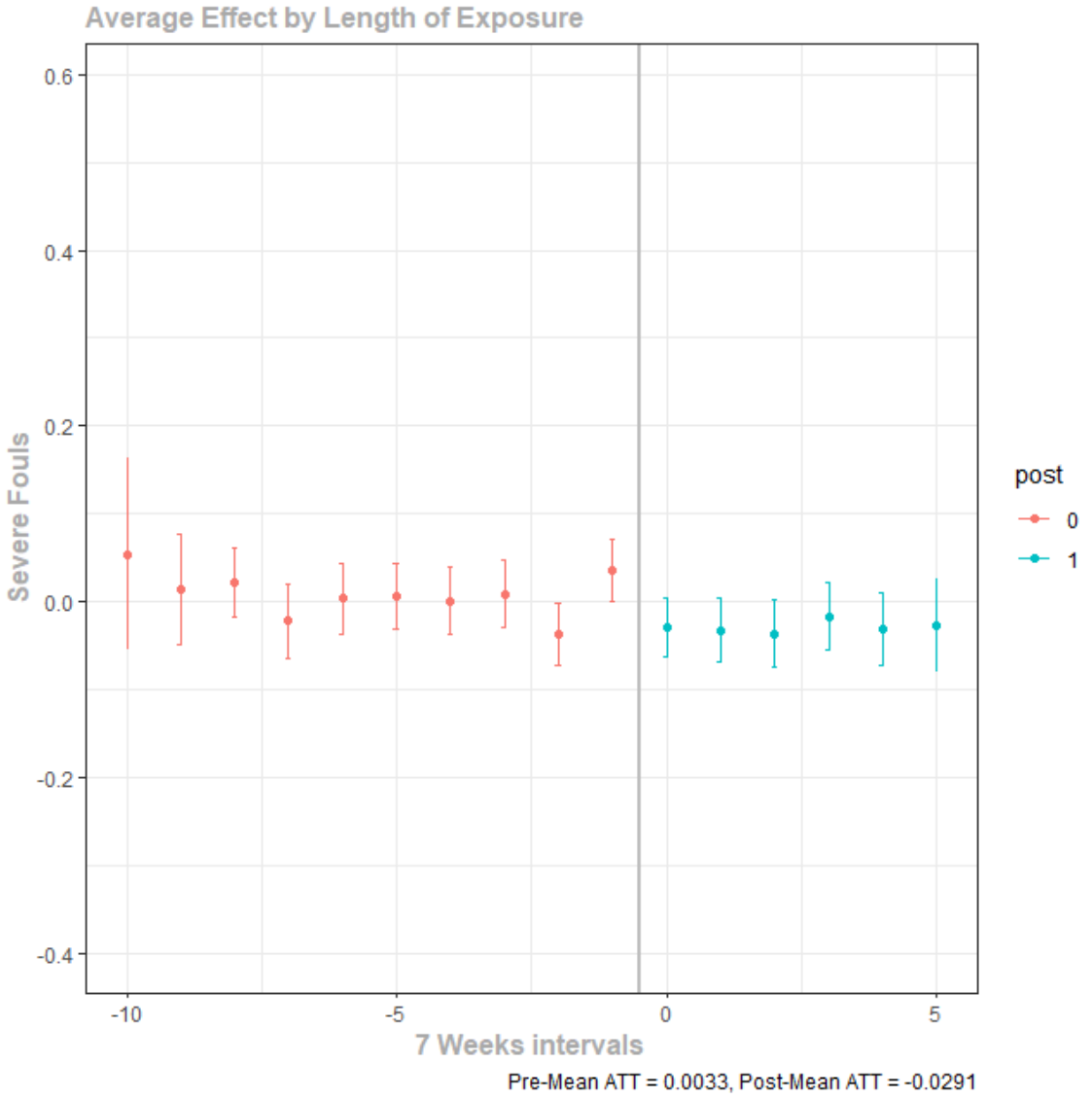
Notes: VAR indicates whether a referee officiated games with VAR in the past. Teams fixed effects control for a pair of two competing teams. I used data of all games in 2.Bundesliga for 2017-2018. Referee-clustered robust standard errors in parentheses.

Parallel trends are the underlying assumption for using the difference-in-difference estimation procedure. To justify the parallel pre-trends, I provide event study graphs for the following specification:

$$Y_{igct} = \alpha_t + \theta_i + \sum \beta_t VAR_c + \epsilon_{igct} \tag{2}$$

Figure 1 shows β_t coefficients (average treatment effects of VAR on Severe Fouls) for the data aggregated to 7-week intervals. While pre-treatment ATTs float around zero (parallel pre-trends) with $\sum_{t=-10}^{-1} \hat{\beta}_t = 0.0033$, post-treatment coefficients are consistently below zero with $\sum_{t=0}^{5} \hat{\beta}_t$ = -0.0291. This pattern signifies the general deterrence effect kicking off immediately after VAR's introduction.

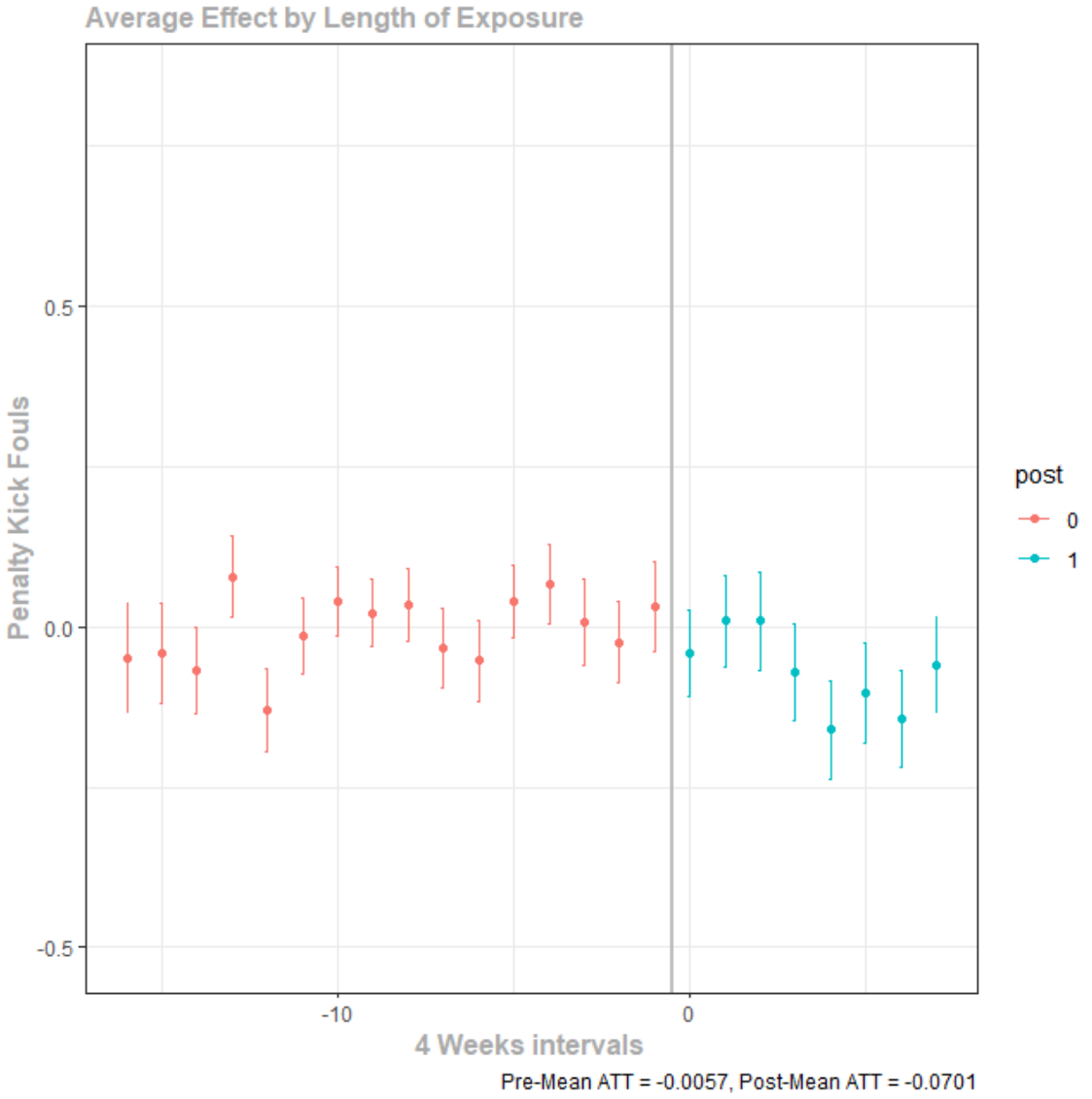
Figure 1: Parallel Pre-Trends: Severe Fouls



Notes: The vertical grey line corresponds to the introduction of VAR in the 2017-2018 Bundesliga season. Each point with confidence intervals refers to a 7-week period. A week here is a game-week as teams, mostly, play one game weekly

Figure 2 plots the same ATTs but for penalty kick fouls as an outcome variable. The data for penalty-kicks is more volatile as it is a less frequent event. Nevertheless, the average pre-treatment effect is again close to zero (-0.0057), and the average post-treatment diverges significantly (-0.0701). Interestingly, the deterrence effect does not begin immediately as it does for severe fouls. It is close to zero for the first 12 weeks and only then drops below zero and consistently remains negative.

Figure 2: Parallel Pre-Trends: Penalties



Notes: The vertical grey line corresponds to the introduction of VAR in the 2017-2018 Bundesliga season. Each point with confidence intervals refers to a 4 game (weeks) period. I show four-week intervals as the deterrence pattern becomes noticeable after the 12th game in the season

4 Results

First, I investigate the link between the monitoring and deterrence effects of introducing VAR into the German major football league. I use two alternative datasets: initial (before VAR intervention) and final (after VAR intervention) referee decisions. The number of fouls detected by referees and VAR can be compared to assess the monitoring effect. Table 3 shows the direct impact of VAR on the number of penalty and severe fouls in the Bundesliga's 2017/2018 season. VAR intervened in the game to overturn a penalty decision five times more than it did for a red card decision. Moreover, there is a substantial imbalance in the type of errors in penalty kick decisions that head referees make. A referee overlooks penalty fouls three times more often than he falsely calls for a penalty. The monitoring effect for penalty-kick fouls (37%) is three times stronger than for severe fouls (13%).

Table 3: VAR Overturns, Bundesliga 2017/2018

	Initial	Final	Overturns	Overturned to foul	Overturned to no foul	% Change in true fouls
Penalty Fouls	77	93	34	25	9	37 %
Severe Fouls	42	43	9	5	4	13 %

Notes: Severe fouls include yellow and red card fouls. The "Initial" column shows the decisions made by the head referee before VAR intervention. The "Final" column shows the decisions of the head referee after he consulted with the VAR assistant or reviewed the video replay himself. "Overturns" is the number of overturned decisions, which can be of two types: "Overturned to foul" and "Overturned to no foul." "% Change in true fouls" assumes a perfect accuracy of the decisions made with the help of VAR and calculates the percentage change as $\frac{OverturnedToFoul}{Initial-OverturnedToNoFoul}$.

Table 4 shows the results for the final referee decisions. The estimates reflect the overall VAR effect - monitoring and deterrence. The monitoring effect dominates over the deterrence effect for the penalty kick fouls due to a drastic increase in the number of penalties detected. Meanwhile, the deterrence effect prevails for severe fouls. To support evidence from the event study, I add a specification in which the treatment is a dummy that takes the value of one if a player participated in at least in 12 games with VAR. The model confirms the findings: following the adjustment period of 12 games, the deterrence effect rises and becomes dominant. This result supports the idea of gradual

learning; players update their beliefs game after game. The introduction of VAR had an immediate and negative effect on the number of severe fouls.

Table 4: Germany, Final Referee Decisions

	Penalty Kicks			Severe Fouls
	(1)	(2)	(3)	(4)
VAR	0.039***		0.062***	-0.026***
	(0.013)		(0.014)	(0.010)
12 Games with VAR		-0.031***	-0.051***	
		(0.010)	(0.012)	
Observations	49379	49379	49379	49379
Time FE	Yes	Yes	Yes	Yes
Player FE	Yes	Yes	Yes	Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The player-level data covers all games in 2016-2018 for the Bundesliga and 2.Bundesliga. *VAR* indicates if the game is officiated with VAR. *12 Games with VAR* takes the value of 1 if player participated in at least 12 games with VAR before the current game. I include fixed effects of year, player, referee, opposing team, and position of the player. Player clustered standard errors in parentheses.

Table 5 shows results for the alternative dataset with the initial referee decisions. The introduction VAR induces significant general deterrence for severe fouls and penalty-kick fouls. The monitoring effect of the 37 % increase in the number of fouls detected leads to a deterrence effect of a 32 % decrease in the number of penalty-kick fouls. For severe fouls the 13 % monitoring effect leads to a 28 % deterrence effect. The effect is immediate for severe fouls and begins after a 12 game adjustment period for penalty-kick fouls. The results are supported by the event-study analysis.

There are several possible explanations for the difference in adjustment periods for the two types of fouls. First, it might be more obvious for players that VAR can detect severe fouls (e.g., violent conduct, denying a goal with a handball) than penalty-kick fouls. A soft holding may remain undetected even after a video review. Second, refraining from serious violations requires less effort than compliance with the rules in intense situations close to the goals.

Secondly, I test the "learning-by-punishment" hypothesis. I analyze several variations of the variable E_{igct} from equation (1), which is a dummy that takes one if the

Table 5: Germany, Initial Referee Decisions

	Penalty Kicks			Severe Fouls
	(1)	(2)	(3)	(4)
VAR	-0.004		0.011	-0.031***
	(0.013)		(0.014)	(0.010)
12 Games with VAR		-0.031***	-0.034***	
		(0.010)	(0.011)	
Observations	49224	49224	49224	49224
Time FE	Yes	Yes	Yes	Yes
Player FE	Yes	Yes	Yes	Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The player-level data covers all games in 2016-2018 for the Bundesliga and 2.Bundesliga. *VAR* indicates if the game is officiated with VAR. *12 Games with VAR* takes the value of 1 if a player participated in at least 12 games with VAR before the current game. I include fixed effects of year, player, referee, opposing team, and position of the player. Player clustered standard errors in parentheses.

Player/Teammate/Opponent was punished at least once before the t. The second and fourth columns in Table 6 show the estimation results using only for the Bundesliga, because player-level penalty kicks data is not available for 2. Bundesliga. The evidence of specific deterrence is robust and present in all specifications. After experiencing punishment, players commit fewer penalty kicks and severe fouls, over and above the general deterrence. Interestingly, there is weak evidence of players learning from the punishment of other players. Players commit fewer penalty fouls after witnessing VAR detection and punishment during the game (Column 3).

Lastly, I test whether deterred players remain compliant outside the surveillance environment. Table 7 shows the effects of VAR introduction on two international competitions: Champions League and Europa League. Three countries experienced VAR introduction in the 2017/2018 season: Germany, Italy, and Portugal. Players from these three domestic leagues begin to commit significantly fewer fouls immediately after the introduction of VAR. Moreover, there is evidence of a spillover effect for penalty-kick fouls for players who played more than 20 games with VAR. The results have a striking resemblance to those in Tables 4 and 5 and the event study analysis.

Table 6: Germany, Specific Deterrence Effect

	Severe Fouls		Penalty	
	(1)	(2)	(3)	(4)
VAR	-0.022**		0.071***	
	(0.010)		(0.016)	
Player Punished by Red Card	-0.112**	-0.134**		
	(0.056)	(0.056)		
Teammates of Player Punished by Red Card	-0.001	-0.001		
	(0.015)	(0.016)		
Witness to Red Card Punishment	-0.015	-0.016		
	(0.012)	(0.015)		
12 games with VAR			-0.045***	
			(0.013)	
Team Punished by Penalty			0.008	
			(0.014)	
Witness to Penalty Punishment			-0.032**	-0.004
			(0.014)	(0.003)
Player Punished by Penalty				-0.052***
				(0.008)
Teammates of Player Punished by Penalty				-0.001
				(0.003)
Observations	49379	16754	49379	16754
Time FE	Yes		Yes	Yes
Player FE	Yes		Yes	Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: In columns (1) and (3) the player-level data covers all games in 2016-2018 for the Bundesliga and 2.Bundesliga. Columns (2) and (4) show results for the Bundesliga only. *VAR* indicates if the game is officiated with VAR. *Player Punished by Red Card/Penalty* takes the value of 1 if VAR overturned a no-call to a red card/penalty for the player at least once before the current game. *Teammates of Player Punished by Red Card/Penalty* takes the value of 1 if the player witnessed VAR overturning a no-call to a red card/penalty to his teammate at least once in a game in which he participated before the current game. *Witness to Red Card/Penalty Punishment* takes the value of 1 if the player witnessed VAR overturning a no-call to a red card/penalty at least once in a game in which he participated before the current game. *12 Games with VAR* takes the value of 1 if a player participated at least 12 games with VAR before the current game. *Team Punished by Penalty* takes the value of 1 if VAR overturned a no-call to a penalty for a team at least once before the current game. I include fixed effects of year, player, referee, opponent team, and position of the player. Player clustered standard errors in parentheses.

Table 7: International Competitions, 2015-2018

	Penalty Kicks			Fouls		
	(1)	(2)	(3)	(4)	(5)	(6)
VAR	0.002			-0.128**		
	(0.007)			(0.065)		
20 games with VAR			-0.010**			-0.209**
			(0.005)			(0.093)
Observations	6282	6282	6288	6282	6282	6282
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Player FE	Yes	Yes	Yes	Yes	Yes	Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: The player-level data covers all games in 2015-2018 for the Champions League and the Europa League *VAR* indicates if the player participated in a game with VAR at least once before the current game. *20 Games with VAR* takes the value of 1 if a player participated in at least 20 games with VAR before the current game. I include fixed effects of year, player, competition, opposing team, position of the player, and stage of the tournament. Player clustered standard errors in parentheses.

5 Conclusion

This paper argues that the analysis of the introduction of a video assistant referee to European football is a valuable setting for studying compliance behavior. It provides several unique features that can improve our understanding of behavior under surveillance. The setting allows me to observe the pure monitoring effect and consequently estimate the deterrence effect with higher precision. I can observe the behavior of treated players in unmonitored areas, which yields the estimates for the spillover effect. I can estimate the learning-by-punishment effect and its persistence. I use the difference-in-difference estimation procedure at the national and international levels to study the effects. The results show that the introduction of VAR at the national level leads to a significant decrease in severe fouls and penalty-kick fouls. The extraction of the pure monitoring effect using the data on initial referee decisions uncovers the deterrence effect for penalties. Moreover, the existence of the spillover effect is confirmed by analysis of international data. In particular, teams in games with VAR in domestic championships commit fewer fouls than teams in games without VAR. Law (of the game) enforcement plays a significant

role in the process of behavioral adjustment after the introduction of surveillance. After experiencing punishment, players commit fewer penalty kicks and severe fouls, over and above the general deterrence. Moreover, players not only learn from their own mistakes but also the mistakes of other players.

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Abstrakt

V tomto článku zkoumám vliv zavedení video asistenta rozhodčího (VAR) do evropského fotbalu. Zkoumaný fenomén umožňuje s využitím Beckerova modelu kriminality rozložit celkový vliv na efekt odrazení a dohledu. Dále zkoumám efekt přelévání dopadu zavedení VAR mimo soutěže, kde byl VAR zaveden. Nacházím důkazy o málo prozkoumaném efektu učení se trestem. Využívám odhad difference-in-difference a ukazuji, že zavedení VAR způsobuje významné snížení počtu faulů ve dvou německých fotbalových ligách. VAR má okamžitý dopad na vážné fauly, zatímco dopad na fauly potrestané v pokutovém území se projevuje až po 12týdenním přizpůsobovacím období. Trest posiluje efekt odrazení, jelikož potrestaní hráči faulují méně než nepotrestaní hráči. Vliv odrazení navíc přetrvává mimo sledované prostředí a přelévá se i do mezinárodních soutěží. Ukazuji, že hráči ze zemí s VAR v mezinárodních soutěžích faulují méně než ostatní hráči.

Klíčová slova: Beckerův model, video asistent rozhodčího, odrazení, evropský fotbal, efekt přelévání, učení se trestem

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