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Journal of Sports Economics 2010 11: 243 originally published online 19 August 2009
DOI: 10.1177/1527002509340666

Journal of Sports Economics
11(3) 243-260

DOI: 10.1177/1527002509340666
http://jse.sagepub.com
SAGE

The Effect of Incentives on Sabotage: The Case of Spanish Football

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Abstract

A growing literature examines adverse behavior as unintended consequences of incentives. We test Lazear's hypothesis that states that if rewards were dependent solely on relative performance then an increase in rewards would induce agents to engage in sabotage activity to reduce rivals' output. We test this hypothesis using the natural experiment of a rule change in Spanish football, the increase in points for winning a league match from two to three. We find, consistent with Lazear's hypothesis, that teams in a winning position were more likely to commit offences punishable by dismissal of a player after this change.

Keywords

incentives, sabotage, rules, red cards, football

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Introduction

A growing literature examines unintended consequences of incentives that may be perverse in that the resulting behavior may have adverse effects. For example, teachers may cheat when schools are rewarded for high student test scores (Jacob & Levitt, 2003). Lazear (1989) developed a theoretical model where agents may respond to increased incentives by taking actions that reduce rivals' output. A key precondition for this result is that rewards depend solely on relative performance. Testing for sabotage in the workplace is extremely difficult. First, both employers and workers will understandably be reluctant to acknowledge that sabotage exists. Second, evidence of reduced performance may be consistent with a variety of explanations including mechanical failure and isolating the effects of sabotage will be difficult. Third, in standard work situations, natural experiments involving changes in incentives are hard to find. These difficulties have led several researchers to use sports leagues as useful settings in which to analyze changes in behavior following changes in incentives. Sports leagues are based on a set of fixtures (games) which are played under well-specified rules that are applied by a set of match officials (referees, umpires). The direct rewards of a game are points or wins that are accumulated as the fixture schedule unfolds during a season. Less directly, teams gain revenues from the games that they participate in and they may also gain revenues from the final league standings, especially if they win the Championship title. Rewards in sports matches are relative—if one team wins, the other loses—as required by Lazear's theory of sabotage.

We will assume that sabotage in football matches is related to actions beyond legal limits to avoid an opponent's objective. This mainly includes either unlawful or unfair behavior against opponents and wasting time. These are liable to be punished by the referee if he (or his assistants) witnesses an infraction and considers sanctions to be appropriate under the Laws of the Game. Punishments include yellow and red cards. A yellow card is a formal warning (caution) that will imply a sending-off (i.e., a red card) if a second yellow card is awarded. However, aggressive behavior, defined as either violent conduct or serious foul play, will be punished with a direct red card that implies a straight sending-off (dismissal of the player from the field of play). Obviously, players may try to commit these actions without being observed by the referee; hence, they can be labeled as sabotage actions.[1] The only observable signals of this kind of sabotage are either yellow or red cards. In doing so, we are assuming that there is a direct relationship between the total illegal actions (both observed and unobserved by the referees) and those which are actually punished by the referees. In line with Lazear's model, we analyze whether the change in the victory award rule has induced behavioral changes of the player concerning illegal actions.

One strand of the literature focuses on rules changes within sports and also the application of rules by match officials. In North American ice hockey (the National

Hockey League), Allen (2002), Levitt (2002), and Heckelman and Yates (2003) ask whether adding an extra referee in a random subset of games had an deterrent impact on number of infractions committed by players. It appears that increasing the number of referees did not induce players to commit fewer recorded fouls. In English football, Witt (2005) finds that the number of expulsions (red cards) of players did not increase following a rule change in 1998 to make a tackle from behind a player worthy of dismissal. Numbers of cautions (for less severe infractions) rose, however, suggesting that players substituted one type of illegal activity for another. Rickman and Witt (2008) find that discretionary time added on by referees in English football (for injuries, substitutions, and other disruptions) fell when home teams were behind in score following a change in referee compensation method toward full-time salary rather than payment per match officiated. Previously, Garicano, Palacios-Huerta, and Prendergast (2005) had shown that in Spanish football referees added disproportionately more discretionary time on for injuries and other disturbances in play for home teams that were behind in score in close games. This result was not found for games that are not close. Such results were described in the title of their paper as "favouritism under social pressure." Similar results were found by Sutter and Kocher (2004) using data from the German Bundesliga.

The National Hockey League instituted a new points regime in the 1999/2000 season. Concerned that a high ratio of tied games might be deterring audiences, in a continent where drawn games are rare (American Football) or impossible (Baseball and Basketball), the League decided to reward a team losing at the end of 5 min extra time (overtime) one point, as opposed to zero for a loss in regulation time. But Abrevaya (2004) reports that, although the incidence of tied games fell, the proportion of games going into overtime rose as an unintended effect of the change in incentives.

The focus of this article is the radical change in points incentive introduced in English football in 1981 and installed later, in 1995, in other European football leagues. We shall examine the case of the Spanish league. The winning team in a Spanish football match received two points up to the 1995/1996 season. From this point on, three league points were earned by the winning team. The rules of a single point for a tie and zero points for a defeat remained as before. The purpose behind this change was to encourage more attacking football that would be more attractive to fans. However, Brocas and Carrillo (2004) developed a game-theoretic model to show that if the value of a victory increases, then teams will rationally adopt a more offensive strategy to break a stalemate later in the match. But weaker teams will also adopt a more defensive strategy at the beginning of a match to avoid being led early (and to frustrate the supposedly superior opposition). This leaves the team the option of trying to break the tie later in the game when the opponent has little time left in which to retaliate. Therefore, the theory predicts that, on average, teams will play more defensively when the points per win rise from two to three. For Portugal, Correira-Guedes and Machado (2002) offer empirical evidence that, although teams favored to win (by the betting market) scored more goals after the rule change, underdog teams (usually the away side) defended to a greater extent than before and scored fewer goals. For England, Palacios-Huerta (2004) searched for structural breaks in a long time series for a set of team performance indicators. The points change in 1982 led to a structural break in variability of goals scored but with no change in mean goals per match. This is consistent with increased defensive effort offsetting any increase in attacking effort. For Germany, Dilger and Geyer (2009) find that, under the three points for win regime, winning teams adopt a more defensive strategy resulting in fewer shots on goal by both the winning and losing team. Finally, Haugen (2008) developed a theoretical model which implies that the three points reward induces lower competitive balance in a league and they tested this hypothesis using data from the United Kingdom, Norway, and Romania.

An increase in defensive effort could follow a change in points per win partly because the cost of going behind in a game is increased but also because teams that go one goal ahead may be more inclined to protect their lead rather than increase it. We predict that a rise in defensive effort will spill over to some extent into illegal activity and that, in turn, the likelihood of a team receiving at least one dismissal is raised. This argument has been advanced for Spanish football by Garicano & Palacios-Huerta (2006) but their analysis focuses on the more trivial cautionary (yellow card) offenses. In contrast, we analyze the effect of the three points rule on red cards. Red cards, by reducing number of players on the team, have a bigger impact on game outcomes than yellow cards.[2] Due to this larger impact on the results, red cards have a higher expected cost for the team. Hence, any significant increase in their number should be related with a rise of the expected benefits of those actions that raise the probability of being punished. As long as our data set captures an adequate natural experiment that keeping other thing unchanged but the relative incentives of a match victory, we are confident that the change in the average number of red cards per match is related with changes in the incentives, achieving new evidence in favor of Lazear's hypothesis.

The rest of the article is organized as follows. The next section describes the data and the empirical model. Section Empirical Results presents the empirical results. Section Conclusions concludes.

Data and Empirical Model

Our data are taken from the 1994/1995 and 1995/1996 seasons of the Spanish First Division. This comprised 20 teams in 1994/1995 and 22 in 1995/1996. Teams played each other twice during a season, once at home and once away. The choice of adjacent seasons needs some clarification. Garicano and Palacios-Huerta (2006) used data from the 1994/1995 and 1998/1999 seasons to test the effect of the points change in 1995 on fouls, cautions (yellow cards), and offensive effort. Their use of data from the 1998/1999 season is designed to allow for gradual adjustment of teams and players to the new points incentive. In contrast, we argue that behavior

Table 1. Sending-Offs Per Match

	1994/1995	1995/1996	Total
Loss	0.20	0.16	0.18
Draw	0.12	0.16	0.14
Win	0.07	0.13	0.10
Total	0.39	0.45	0.42

adjusts quickly as new information flows rapidly in football and a team offering a distinct strategy to deal with the new incentives would be quickly imitated. One advantage of using adjacent seasons is that similar teams (apart from promotion and relegation) and similar players appear in each season. This consistency in personnel would not be so apparent for seasons that are some time apart. In addition, the two seasons that we select did not have any other rule changes and hence we are confident that the points change is the major change in incentives at that time. In contrast, the 1998/1999 season saw the introduction of an International Federation of Association Football (FIFA) rule change to render the "tackle from behind" an offence worthy of dismissal (Witt, 2005). Use of data from this season would conflate the points incentive effect with a rule-of-game effect.

Our data come mainly from the referees' official postmatch reports, which can be viewed on the Spanish Professional Football League Web site (www.lfp.es). Specifically, the information include the name of the teams (i.e., home and away), the minute of sending-offs, the minute of each goal, and the referee's name. Moreover, we obtain public attendance of each match from García and Rodríguez (2002). The main advantage of our database is that we control for the score of the match so we are able to study the change in the behavior of players under different match scorelines. Some previous studies of biased behavior of referees and of impacts of rules changes on referee behavior have been limited by reliance on pregame covariates and a lack of controls for within-game events such as changes in score (see Buraimo, Forrest, & Simmons, IN PRESS; Simmons, 2008, for critical reviews).

The main purpose of the article is to test the sabotage hypothesis proposed by Lazear (1989) in a sports league setting. The hypothesis states that if teams face an increased relative value of winning, they will be more prone to commit sabotage. Table 1 presents the numbers of dismissals per match for a given team according to the different game states (winning, drawing, and losing) in each season and in total. It can be seen that the worse the state of the match for a team, the larger number of red cards in each season.[3] This could be explained by the fact that teams which are behind in score generate extra effort on scoring so as to negate the deficit and some of this extra effort will translate into illegal activity. However, the number of sending-offs per match that took place in the 1995/1996 season increased significantly from the 1994/1995 season. However, this change was not the same for the three feasible game states. Actually, there was a decrease in the number of red cards per match when teams were behind, but there was a slight increase for drawing and a large increase when teams were winning. Hence, teams which were ahead performed more punishable actions (in number and in scale of illegality) with a reward of three points compared to the two points reward. This is consistent with the conjecture that when teams are ahead they tend to place more effort into defensive actions so as to protect their lead in the three points reward than in two points. Some of this extra defensive effort spills over into illegal actions punishable by dismissal. Thus, we have obtained some preliminary descriptive evidence for our hypothesis. However, the results from Table 1 could be misleading because, for instance, the likelihood of a draw could be lower in the first season than in the second one. Also, we do not know whether dismissals affected game score or the reverse or indeed both. Thus, to identify effects of the incentive change in the next section, we are going to estimate probit models with appropriate control variables, including within-game covariates.

We define two different approaches by using two different units of observation. First, we define the observation as the period of time within a match in which the state of the match (win, draw, or loss) remains unchanged. We label this as the "constant state of match specification." Hence, for each period of time in which the result remains unchanged, there are two observations (i.e., one for the local team and other one for the away team). It is important to stress that we consider that the result is changed only if either a draw is converted into a winning or losing position or a win is converted into a draw. Therefore, because the period in which teams are ahead or behind is considered the same observation, it is unknown whether a team is winning or losing by only one goal or more goals. The observation does not change if a team goes from one goal ahead to two goals ahead and, thus, our unit of observation has varying time duration. This choice of time-varying unit of observation cannot be considered very restrictive in a low scoring game such as football. However, to avoid possible shortcomings, we also use the minute of a game as an alternative unit of observation, which we label as "minute by minute specification."[4] In particular, this measure allows us to control for the difference in goals between teams during a match. We expect that the greater the difference, the lower will be the number of sending-offs. Indeed, some evidence in support of this hypothesis is offered by Buraimo et al. (IN PRESS) in their probit model of dismissals in English Premier League and German Bundesliga that uses a minute of game unit of observation.

Our dependent variable takes value one when there is at least a sending-off for the team considered in the observation and zero otherwise. The empirical models include three types of variable: pregame control variables for team and game characteristics, time of observation, and within-game controls for state of the match.

The first set of variables controls for team and match features which could affect the importance of the match for both teams. Player behavior can be affected by such circumstances. We nominate a particular set of rivalrous games (RIVALRY) that include derby matches played between two teams close in distance to each other but extended to allow for matches that are known to be of high intensity (i.e., Real

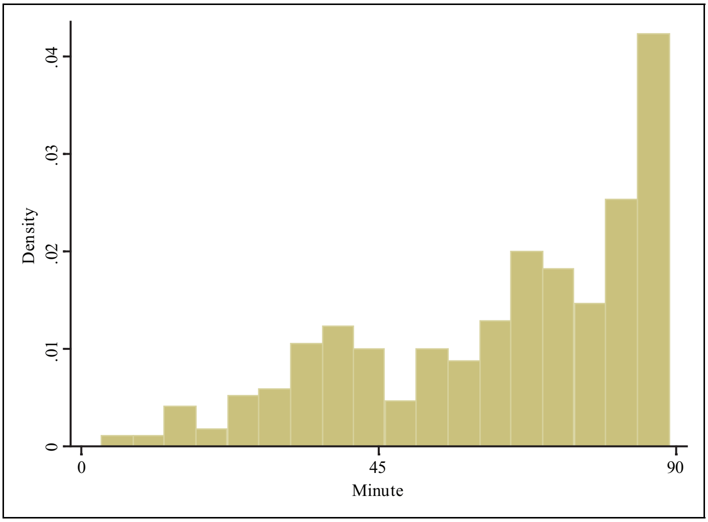

Figure 1. Histogram of player expulsions through time.

Madrid vs. F. C. Barcelona and F. C. Barcelona vs. Atlético de Madrid). We predict that these matches will have a higher probability of dismissal for each team.[5] Moreover, the extent of social pressure exerted by fans may be related to size of crowd. We proxy crowd intensity by match attendance (ATTENDANCE). We should note that Dawson, Dobson, Goddard, and Wilson (2007) and Buraimo et al. (IN PRESS) each tested the impact of gate attendance on disciplinary sanctions in English football and could not find a significant effect. In addition, we include a dummy variable for the home team (HOME). This variable could reflect referee bias but also could reflect the different playing strategies of home and away teams within a match. Hence, the coefficient of this variable must be interpreted cautiously.

The second set of variables controls for time and length of observation. Figure 1 shows the histogram of the minute in which the player dismissals took place.

We can see that the number of sending-offs increases with match time, and this should be taken into account in the empirical specification. There are several reasons that can explain the time pattern in Figure 1. First, an increasing function of probability of red card over time seems reasonable, because the majority of red cards are due to double yellow cards (56% in our sample). Moreover, it is likely that referees were more reluctant to expel players in the beginning of the match because this decision could have a larger impact on the match result (see Caliendo & Radic, 2006; Ridder, Cramer, & Hopstaken, 1994; Torgler, 2004).

Thus, we include several variables that are designed to control the timing of each observation. In particular, in the "constant state of match specification," we introduce the length of each observation measured in minutes (TIME) and its square

(TIME2). We expect a positive coefficient on the former variable. In addition, we control for the fact that the number of sending-offs increases along the match time, as shown in Figure 1. To do so, we include the minute in which the observation starts (PBEGIN). Furthermore, we also include a dummy variable that takes value one if the observation belongs to the last 10 min of the match (DMEND) and a dummy variable that takes value one if the observation belongs to the beginning of the match (DMBEGIN). Because the beginning of the match is always tied, the latter variable should be interpreted as the difference with the DRAWING variable at the beginning of the match. Moreover, we include an interactive term between DMEND with the dummy for the season 1995/1996 (D9596END) to test whether the number of expulsions is higher in the ending of the match in the second season as we expect. In the "minute by minute specification," besides DMEND and D9596END, we include dummies for the 45 (D45) and 90 (D90) minutes because those minutes are also reflecting the extra time added on by the referee on both halves of the match. Finally, we also include dummies for minute intervals of 15 min.

The final category of control variables refers to the different likelihood that a sending-off took place according to the state of the match. To establish suitable controls, we include a dummy variable if the team is winning (WIN) and another one if the team is losing (LOSS). Hence, the draw is the omitted variable. As explained above, we expect that there will be a decrease in size of the coefficients when the game state is better for a given team.

To test our primary hypothesis of increased sabotage activity as the reward to winning increased, we include the variables LOSS and WIN interacted with a dummy that takes the value of one for the season 1995/1996 (D9596LOSS, D9596WIN). These variables reflect the difference in the behavior of teams between the two seasons for each feasible result. We expect that the sign of D9596WIN would be positive because the winning teams are more encouraged to defend the result in the 1995/1996 season than in the previous one. Moreover, to control for the existence of an overall season effect regardless of the result, we also estimate another model including only a dummy variable for the season 1995/1996, D9596, instead of D9596LOSS and D9596WIN. Additionally, in the "minute by minute specification," we are able to control for the difference in score between teams in the previous minute. Hence, we include the variables RESWIN9596 and RESLOST9596 which are the interactions between the result defined as the difference in goals of the observation team and the opponent, the dummy for the second season and WIN and LOST, respectively. RESWIN9596 will take positive values for the leading teams at the 1995/1996 season and RESLOST9596 will take negative values for those teams losing in that season. We expect a negative coefficient for the former variable and a positive coefficient for the latter because the closer the match the more sending-offs are expected. However, in the "constant state of match specification," we know the result at the end of the match. Hence, we are able to control for the difference in goals between teams if the observation ending is the last minute of the match. Thus, we include several interactive terms combining the difference in

Table 2. Descriptive Statistics All Observations, $N = 4{,}258$

	Mean	Standard Deviation	Minimum	Maximum
SENDING-OFFS	0.08		0	1
TIME	36	27	1	90
LOSS	0.22		0	1
DRAW	0.56		0	1
WIN	0.22		0	1
RIVALRY	0.06		0	1
ATTENDANCE	22.97	16.94	1.58	99.27
D9596	0.57		0	1

goals at the end of the match, the season dummies, and the result dummies (DGDEND9495WIN, DGDEND9495LOSS, DGDEND9596WIN, DGDEND9596LOSS) as well as their squared counterparts (DGDEND9495WIN2, DGDEND9495LOSS2, DGDEND9596WIN2, DGDEND9596LOSS2). In the same way, we include the interaction between the draw result at the end of the match and the season dummies (DEND9495DRAW, DEND9596DRAW).

Finally, in the "minute by minute specification," we include a dummy variable that controls for the event of previous red cards in the match. This dummy variable takes the value one if there was at least one sending-off in the match previous to the minute under consideration. Likewise, we interacted this variable with the dummy for the season 1995/1996. We expect that the occurrence of previous red cards increased the likelihood of further sending-offs.

Table 2 shows some descriptive statistics for the entire sample while Tables 3 and 4 offer similar information for each season separately.

For convenience, we summarize our list of dependent and explanatory variables below (in alphabetical order):

SENDING-OFFS (dependent variable): dummy variable that takes value one if during the period there is a sending-off and zero otherwise.
ATTENDANCE: public attendance at the match measured in thousands.
D16-30: dummy variable that takes the value of one if the minute is equal between 16 and 30 and zero otherwise.
D31-45: dummy variable that takes the value of one if the minute is equal between 31 and 45 and zero otherwise.
D45: dummy variable that takes the value of one if the minute is equal to 45 and zero otherwise.
D46-60: dummy variable that takes the value of one if the minute is equal between 16 and 30 and zero otherwise.
D61-75: dummy variable that takes the value of one if the minute is equal between 61 and 75 and zero otherwise.

Table 3. Descriptive Statistics for 1994/1995, $N = 1,838$

	Mean	Standard Deviation	Minimum	Maximum
SENDING-OFFS	0.07		0	1
TIME	37	27	1	90
LOSS	0.22		0	1
DRAW	0.56		0	1
WIN	0.22		0	1
RIVALRY	0.06		0	1
ATTENDANCE	24.12	19.88	2.75	99.27

Table 4. Descriptive Statistics for 1995/1996, $N = 2,420$

	Mean	Standard Deviation	Minimum	Maximum
SENDING-OFFS	0.08		0	1
TIME	34	26	1	90
LOSS	0.22		0	1
DRAW	0.55		0	1
WIN	0.22		0	1
RIVALRY	0.06		0	1
ATTENDANCE	22.10	14.23	1.58	85.47

D76-90: dummy variable that takes the value of one if the minute is equal between 61 and 75 and zero otherwise.
D90: dummy variable that takes the value of one if the minute is equal to 90 and zero otherwise.
D9596: dummy variable that takes value one for the season 1995/1996 and zero otherwise.
D9596DRAW: interactive variable between D9596 and DRAW.
D9596LOSS: interactive variable between D9596 and LOSS.
D9596WIN: interactive variable between D9596 and WIN.
DEND9495DRAW: interactive variable between DMEND, D9495, and DRAW.
DEND9596DRAW: interactive variable between DMEND, D9596, and DRAW.
DGDEND9495LOSS: interactive variable between DMEND, D9495, LOSS, and the difference in goals at the end of the match.
DGDEND9495LOSS2: quadratic term of DGDEND9495LOSS.
DGDEND9495WIN: interactive variable between DMEND, D9495, WIN, and the difference in goals at the end of the match.
DGDEND9495WIN2: quadratic term of DGDEND9495WIN.
DGDEND9596LOSS: interactive variable between DMEND, D9596, LOSS, and the difference in goals at the end of the match.

DGDEND9596LOSS2: quadratic term of DGDEND9596LOSS.
DGDEND9596WIN: interactive variable between DMEND, D9596, WIN, and the difference in goals at the end of the match.
DGDEND9596WIN2: quadratic term of DGDEND9596WIN.
DMBEGIN: dummy variable that takes value one if the observation belongs to the beginning of the match.
DMEND: dummy variable that takes value one if the observation belongs to the last 10 min of the match.
DMEND9596: interactive variable between D9596 and DMEND.
DPRED: dummy variable that takes the value one if there was at least one sending-offs in the match previously the minute under consideration.
DPRED9596: interactive variable between DPRED and D9596.
DRAW: dummy variable that takes the value of one if the team is drawing and zero otherwise.
HOME: dummy variable that takes value one if the team is the home team and zero otherwise.
LOSS: dummy variable that takes the value of one if the team is losing and zero otherwise.
PBEGIN: minute which begins the period of the observation.
RESLOSS9596: interactive variable between LOSS, D9596, and the difference in goals.
RESWIN9596: interactive variable between WIN, D9596, and the difference in goals.
RIVALRY: dummy variable that takes value one for either a match which is played by geographical close teams or for a traditional match rivalry in the league (i.e., Real Madrid vs. F. C. Barcelona) and zero otherwise.[6]
TIME: minutes elapsed without a change in the result.
TIME2: TIME*TIME.
WIN: dummy variable that takes the value of one if the team is winning and zero otherwise.

Empirical Results

We use a probit model, in which we estimate the variance–covariance matrix of the estimators assuming that the observations are independent across seasons, but not necessarily within seasons. Table 5 presents the coefficients, marginal effects, and the standard deviation of the marginal effect from the ‘‘constant state of match specification.’’ Table 6 presents the results for the ‘‘minute by minute specification.’’ Apart from those variables discussed above, we have also included dummy variables for teams and referees.[7]

Looking first at pregame control variables, it is clear, from the significant and positive coefficient on RIVALRY, that derby and other intense matches generate

Table 5. Probit Results for Likelihood of a Player Dismissal (Constant State of Match Specification, $N = 4{,}258$)

	Model 1			Model 2			Model 3		
	Coefficient	ME	ME Standard Error	Coefficient	ME	ME Standard Error	Coefficient	ME	ME Standard Error
INTERCEPT	–2.8613***			–2.8072***			–2.8129***		
RIVALRY	0.2212***	0.0213	0.0033	0.2112***	0.0206	0.0036	0.2118***	0.0208	0.0033
ATTENDANCE	–0.0020	–0.0002	0.0002	–0.0018	–0.0001	0.0002	–0.0018	–0.0001	0.0002
HOME	–0.1628***	–0.0132	0.0019	–0.1865***	–0.0155	0.0029	–0.1969***	–0.0165	0.0028
TIME	0.0374***	0.0030	0.0003	0.0378***	0.0031	0.0003	0.0377***	0.0031	0.0003
TIME2	–0.0002***	–1.30E–05	4.33E-06	–0.0002***	–1.40E–05	4.75E-06	–0.0002***	–1.40E–05	4.48E-06
PBEGIN	0.0113***	0.0009	0.0001	0.0109***	0.0009	0.0002	0.0109***	0.0009	0.0002
DMEND	0.3344***	0.0281	0.0006	0.0879	0.0073	0.0055	0.0844	0.0071	0.0053
DMEND9596				0.0850***	0.0073	0.0007	0.0908***	0.0079	0.0014
DMBEGIN	–0.1355	–0.0107	0.0071	–0.1035	–0.0084	0.0087	–0.1037	–0.0085	0.0084
LOSS	0.1565***	0.0137	0.0051	0.3165***	0.0307	0.0105	0.2044***	0.0189	0.0017
WIN	–0.2747***	–0.0195	0.0060	–0.2917***	–0.0210	0.0063	–0.1225	–0.0096	0.0142
D9596LOSS	–0.2816***	–0.0189	0.0003	–0.2005***	–0.0145	0.0018			
D9596WIN	0.5044***	0.0570	0.0073	0.2671***	0.0263	0.0045			
D9596							–0.0135	–0.0011	0.0016
DEND9495DRAW	–0.3885***	–0.0231	0.0016						
DGDEND9495WIN	–0.2352***	–0.0190	0.0027						
DGDEND9495WIN2	0.0206***	0.0017	0.0005						
DGDEND9495LOSS	–0.1869***	–0.0151	0.0008						
DGDEND9495LOSS2	0.0481***	0.0039	0.0003						
DEND9596DRAW	–0.2934***	–0.0189	0.0016						
DGDEND9596WIN	–0.5164***	–0.0418	0.0023						
DGDEND9596WIN2	0.0746***	0.0060	0.0005						
DGDEND9596LOSS	0.0657	0.0053	0.0041						
DGDEND9596LOSS2	–0.0084	–0.0007	0.0009						
Log-likelihood		–934			–945			–948	

Notes: ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively. Models include team individual effects and referee individual effects. ME denotes marginal effect.

Table 6. Probit Results (Minute by Minute Specification, *N* = 151,200)

	Coefficient	ME	ME Standard Error
INTERCEPT	–3.84186***		
RIVALRY	0.09670***	0.00046	0.00002
ATTENDANCE	–0.00104	–4.38E–06	4.52E–06
HOME	–0.09187***	–0.00039	0.00001
DMEND	0.08702**	0.00040	0.00023
DMEND9596	0.14484***	0.00074	0.00001
D16-30	0.27797***	0.00158	0.00029
D31-45	0.58898***	0.00484	0.00130
D46-60	0.48573***	0.00352	0.00079
D61-75	0.74539***	0.00744	0.00129
D76-90	0.71818***	0.00693	0.00236
D45	0.27142***	0.00173	0.00061
D90	0.42719***	0.00348	0.00139
LOSS	0.21263***	0.00107	0.00006
WIN	–0.13329***	–0.00051	0.00001
D9596LOSS	–0.05704***	–0.00023	0.00001
D9596WIN	0.17142***	0.00088	0.00002
RESWIN9596	–0.03998***	–0.00017	4.45E-06
RESLOSS9596	0.05082***	0.00021	5.66E–06
DPRED	0.05030***	0.00022	0.00002
DPRED9596	–0.01330	–0.00006	0.00015
Log-likelihood		–2,301	

Notes: ***, **, and * denotes statistical significance at the 1%, 5%, and 10% levels, respectively. Models include team individual effects and referee individual effects.

increased probability of sending-offs in Spanish football thus reflecting that players play dirtier in these intense matches than in other matches. This result is similar to the findings of Witt (2005) for English Premier League and Buraimo et al. (IN PRESS), for English Premier League and Bundesliga. Here, we find that a RIVALRY match induces just over a 2% increase in probability of a sending-off. The negative coefficient of HOME in all the estimations could reflect a less severe attitude by the referees toward local teams and, hence, be the result of some positive discrimination or bias.[8] Attendance has no significant effect in line with Dawson et al. (2007) and Buraimo et al. (IN PRESS).

All the timing variables have the expected coefficients. TIME has a positive marginal effect, suggesting that the longer the period of the observation, the higher the probability that a sending-off takes place. However, this effect is positive at a decreasing rate as captured by the negative marginal effect on TIME2. The interval time dummies seem to show an increasing pattern. DMEND has a positive marginal effect that is only significant in Model 1 of both specifications. In the final minutes of the matches, there is a greater likelihood of a sending-off, 2.8% higher in the "constant state of match specification" and somewhat lower at 0.4% in the "minute by minute specification." Turning to our central hypothesis, the coefficient on D9596END is positive and significant in all models in which it was included. The likelihood of a red card at the end of game is higher still in the 1995/1996 season regardless of the state of the match. Marginal effects are between 0.7% and 0.8% in the "constant state of the match" specification and 0.07% for the "minute by minute specification," each higher than their 1994/1995 counterparts. Hence, higher relative incentives for each victory combined with a decreasing expected cost of punishable actions (as the end of the match approaches) leads to a significant rise in red cards at the end of 1995/1996 matches. Finally, the extended time effect captured by D45 and D90 dummies turns up in positive and significant marginal effects for both variables in the "minute by minute" specification with impacts of 0.17% and 0.35%, respectively. Time added on by the referee at the end of second half has a greater effect on probability of a sending-off than time added on at end of first half.

If we interact the season effect and the match status variables, we find in both specifications that the marginal effect on the D9596LOSS is significantly negative and that on D9596WIN is positive and significant in all the specifications. Hence, in 1995/1996 with increased rewards for victory, losing teams are less prone to perpetrate sabotage. The marginal effect of losing on probability of dismissal in the "minute by minute" model falls from 0.11% in 1994/1995 to 0.08% in 1995/1996. This effect is also significant at the 1% level and can reflect the relative decrease in the incentives for a draw in this season. In contrast, winning teams commit more offenses that are punishable by red card and hence dismissal of a player, when the three point system is introduced. The marginal effect of winning on probability of dismissal is –0.05% in 1994/1995 and becomes positive at 0.04% in 1995/1996. These results are in accord with Lazear's (1989) hypothesis that increased relative rewards are accompanied, in a contest environment, by sabotage. The sabotage in our context is illegal activity designed to prevent an opponent overturning the winning team's lead in a match. Furthermore, we see that the marginal effect on the dummy variable for the 1995/1996 season is not significantly different from zero if we do not control for results (Model 3). Although this suggests no change in likelihood of (at least one) player dismissal, controlling for pregame and within-game characteristics, we have seen that in fact this marginal effect hides an opposite effect for wining and losing teams that compensate each other.

In Model 1, in the "constant state of match specification," we also control for the goal difference if the observation belongs to the end of the match. All these interaction terms present the expected signs and are significant at 1% level, except the goal difference (and squared) for losing teams at 1995/1996 season. These results are in line with those of "minute by minute specification" captured by RESWIN9596 and RESLOSS9596. In general, the larger the goal difference, the lower the likelihood of a sending-off in both seasons. A final remark is that previous red cards in a match lead to increase the likelihood of additional red cards.

Conclusions

Lazear (1989) proposed that if rewards were dependent solely on relative performance then an increase in rewards would induce agents to engage in activity to reduce rivals' output. We have tested this hypothesis using the natural experiment of a rule change in Spanish football, the increase in points for winning a league match from two to three. We find the following key results that are consistent with Lazear's hypothesis: First, teams in a winning position were more likely to commit offences punishable by dismissal of a player (the red card issued by the referee) in the three points reward than in the two points. Second, there is a higher probability of red cards in 1995/1996 season as the end of the match approaches regardless the winning position of the team.

There were no other changes in rules of football over the time period that we investigate and also no reason to expect a change in application of the rules by referees. Hence, monitoring and detection activity can be regarded as constant. In addition, we have controlled for pregame and within-game influences on likelihood of dismissal. Given the lack of other external conditions surrounding player dismissals and given the presence of an appropriate set of control variables, we consider our results to be supportive of increased sabotage behavior following the increase in rewards for winning. The importance of relative rewards for winning for individual (legal) effort has been highlighted in a number of studies in individual sports including golf, marathon running, and motor racing (see Frick & Simmons, 2008, for a survey). Here, we find that increased rewards for winning spills over into increased illegal activity, as observed and punished by football referees. Actual punishment for actions deserving a red card consists of players dismissals and this may reduce audience enjoyment of games, either by making the contest more unequal or by making it less interesting as the team with reduced personnel operates a more defensive style of play. Therefore, the negative effects (sabotage actions) due to incentive changes can aggravate if punishment are inadequate. However, a different system of punishment to these sabotage actions could help to prevent or reduce them. For instance, rather than dismiss players, a red card could be punished with a penalty kick in spite of where the action has taken place. Alternatively, a "sin bin" could be introduced as in English Rugby League and the National Hockey League. The welfare consequences of alternative types of player sanctions merit attention in further research.

Notes

1. A well-known example due to its relevance is Materazzi's provocative behavior toward Zidane in the 2006 World Cup Final, which eventually led to Zidane to commit an act of aggression that was observed by the referee and punished with a red card. Therefore, for the Italian side, "sabotage" was successful and they were able to play against 10 men for the rest of the final.

2. Although football industry folklore claims that "10 men are harder to beat," a number of empirical studies find precisely the opposite (Caliendo and Radic, 2006; Ridder et al., 1994; Torgler, 2004). These studies show that teams with 11 players have a greater chance of winning against 10 players than 11. But obviously, the size of marginal effect of a red card depends on the timing of dismissal and hence how much time there is left for the full-strength team to exploit its advantage.
3. See Buraimo et al. (IN PRESS) for a similar finding for England and Germany.
4. In this case, because we are not able to control for the extra time, minutes 45 and 90 also capture the extra time added on by the referee at the end of the first and second half, respectively.
5. Buraimo et al. (IN PRESS), for England and Germany, and Witt (2005), for England, find that derby matches are associated with greater incidence of player dismissals.
6. The full list of designated RIVALRY matches is F. C. Barcelona vs. Atlético de Madrid, S. D. Compostela vs. Celta Vigo, Deportivo de la Coruña vs. Celta Vigo, Deportivo de la Coruña vs. S. D. Compostela, R. C. D. Español vs. F. C. Barcelona, Real Madrid vs. Atlético de Madrid, Real Madrid vs. F. C. Barcelona, Racing de Santander vs. Athletic de Bilbao, Racing de Santander vs. Real Oviedo, Rayo Vallecano vs. Atlético de Madrid, Rayo Vallecano vs. Real Madrid, Real Sociedad vs. Athletic de Bilbao, U. D. Salamanca vs. C. P. Mérida, Sevilla C. F. vs. Real Betis Balompié, Sporting de Gijón vs. Real Oviedo, and Sporting de Gijón vs. Racing de Santander.
7. These estimates are available on request.
8. However, it could also reveal less aggressive behavior of home teams, although in line with Garicano et al. (2005), we believe that this is a less likely explanation.

Authors' Note

The authors would like to thank Adrián Álvarez-Toyos and Fernando del Corral for their research assistance. The first author acknowledges the Spanish Ministry of Education and Culture for his F.P.U. fellowship. Any remaining errors are the sole responsibility of the authors. This article has been funded by the Spanish Ministry of Education and Science (Project SEJ2007-64700/ECON).

Declaration of Conflicting Interests

The authors declared that they had no conflicts of interests with respect to their authorship or the publication of this article.

Funding

This article has been funded by the Spanish Ministry of Education and Science (Project SEJ2007-64700/ECON).

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