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ABSTRACT

This paper provides empirical evidence of favoritism by agents, where that favoritism is generated by social pressure. To do so, we explore the behavior of professional soccer referees. Referees have discretion over the addition of extra time at the end of a soccer game (called injury time), to compensate for lost time due to unusual stoppages. We test for systematic bias shown by Spanish referees in favor of home teams. We show that referees systematically favor home teams by shortening close games where the home team is ahead, and lengthening close games where the home team is behind. They show no such bias for games that are not close. We further show that when the rewards for winning games increase, referees change their bias accordingly. We also identify that the mechanism through which bias operates is the referees' desire to satisfy the crowd, by documenting how the size and composition of the crowd affect referee favoritism.

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1 Introduction

This paper provides empirical evidence of favoritism by agents, by addressing the discretionary behavior of professional soccer referees. Referees have discretion to add injury time to the end of a soccer game. This is meant to compensate for lost time due to unusual stoppages, such as injuries and time wasting. We test for systematic bias shown by referees in favor of home teams, by showing how the identity of the team leading in close games affects the amount of injury time added. We also show that when the rewards for winning increase, referees become more biased. We further identify the mechanism through which bias operates: the referees' desire to satisfy the crowd in the stadium.

The possibility of malfeasance by economic actors is the concern of agency theory. Such malfeasance can come in many forms, yet most theoretical and empirical work in this field has addressed incentives to "exert effort" (see Prendergast (1999) for a review). Yet in many instances, a more important form of malfeasance is agents' allocation of benefits and resources in a biased way, possibly based on personal preferences.[1] Agency theory has largely ignored situations where the concern is that agents show favoritism rather than act in a lazy fashion. Theoretical work is rare (an exception is Prendergast and Topel (1996)), as is empirical work documenting its importance.[2] The primary reason for this paucity is that it is difficult to convincingly distinguish between favoritism and efficient decision making in most empirical

[1]For example, there is considerable evidence within organizations that personal preferences towards employees affect their likelihood of promotion and career advancement: indeed, managers often admit such favoritism in their decisions (e.g., Cardy and Dobbins (1986), Bjerke et al. (1987) and Varma *et al.* (1996)). Other examples where the dimension of malfeasance is bias include possible 'racial profiling' by police officers, politicians favoring those who give electoral contributions, or figure skating judges giving higher marks to participants from certain countries (the 'East German' judge problem), or customs officials disproportionately stopping and searching people of particular nationalities (New York Times, 2000).

[2]Exceptions are Knowles, Persico and Todd (2001) and Goldin and Rouse (2000).

settings. For example, while superiors admit promoting those that they like, it may be argued that good interpersonal relations enhance productivity, and so it could be an efficient way of allocating those resources.[3]

In this paper we provide an empirical analysis of agent favoritism which we believe overcomes these difficulties. We exploit a unique dataset on a subjective decision made by referees in professional soccer games in Spain, namely how much 'injury time' they add to a game. As mentioned above, referees have discretion over the duration of a soccer match, by adding what is called injury time at the end of the two halves of play. The amount of time added is subjectively chosen by the referee, though are guided by the official LAWS OF THE GAME (FIFA, 2000) which prescribe the reasons for such extra time. The subject of our paper is that instead of choosing this additional time in an impartial way, referees may exercise favoritism in the face of the *social pressure* imposed by the fans in the stadium. To put it simply, referees internalize the preferences of the crowd in their decisions by systematically favoring the home team in its decisions.

That social environments can affect individual behavior has long been the focus of a literature on endogenous preference formation (e.g., Akerlof (1980), Bernheim (1994), Becker and Murphy (2000)). The pursuit of social approval has been offered as an explanation for consumption patterns, social customs, cultural practices, parental influences on children's tastes, and a variety of other forms of socioeconomic behavior. Despite this, convincing empirical tests of social pressure are hard to find. Our empirical analysis allows us to address how the social environment, in the form of the size and composition of the crowd, plays a fundamental role in shaping individual choices by showing how social pressures on a referee can make his behavior change from game to game. The games that we study here can be attended by up to 100,000 spectators (their average is 28,000), often overwhelmingly

[3]Equally, the 'East German' judge typically claimed that the figure skater from the Eastern Bloc was just better.

supporting the home team, and it is this pressure which we expect to affect agent performance.[4]

The empirical analysis proceeds in three steps. First, we document the existence and importance of referee favoritism. The premise of the paper is that the amount of additional time added should not systematically depend on the identity of the team that is leading at the end of each of the two periods of play in a game. Yet empirically we find that it does, but only for close contests. On average, allowance for time lost is about three minutes. However, this number is 35% higher if the home team is behind by one goal at the end of regulation, and 29% lower if the home team is ahead by one goal. Such differences only arise when the game is close: when either side is ahead by two goals or more, there is no change from the average. Thus, we argue, referees use their discretionary power to favor home teams, but only in close games, where the time added can affect the ultimate outcome. Controlling for factors that directly predict the intensity of the game (such as disciplinary actions by the referee, player substutitions, or the position and strength of the teams involved in the contest) makes no difference to this result. This is our primary evidence of agent bias.

We then address another way in which referees can exert favoritism by noting they can choose the length of the game based on what happens *during* injury time. Accordingly, we test for home bias by referees when one team scores during injury time, to determine whether the identity of the scoring team affects additional time. We show that when visitors score, injury time is 15% longer than if the home team scores. In other words, the referees are more speedy in 'blowing up' for the end of the game if the home team scores, thus giving the visitors less time to respond, than if the visitors score.

[4] A note for the reader unfamiliar with soccer. The crowd generally makes its preferences at this stage extremely clear. Soccer spectators furiously shout for an early end of the match when their team is ahead, and complain as loudly when they find the end is called early in a match in which their team is behind.

Much of agency theory is premised on the idea that agents are more likely to exhibit malfeasance when the returns from doing so are larger. Accordingly, our second exercise is to show that when the returns to satisfying the crowd increase, referees change the extent of their favoritism accordingly. If referees are biased in favor of home teams, they are more likely to do so when the relative benefits are larger for that team. Showing that referees only show bias for close games is one way of doing this. In addition, we exploit an exogenous change in the reward spread between winning and losing. Before 1995, two points were awarded per win in league games, one per tie, and zero per loss. After 1995, the points per win were increased to three. The implications of this exogenous change on favoritism are as predicted: specifically, after 1995, they become more biased where the home team was ahead by a goal compared to when it was behind by a goal. A final test considers how the bias exercised by the referee depends on the stage of the football season, where games tend to be more important than at the beginning. We find evidence that the favoritism exercised by referees is indeed more pronounced at the end of the season than at the beginning. From the beginning to the end of the season, the referee's bias increases by almost 40%.

Third, our hypothesis is that crowd size imposes pressure on referees: although millions of people may care about the outcome of the game, it is the (on average) 28,000 in the crowd who are influential. To test for this, we examine the connection between referee bias and crowd size or composition. We find, first, that when crowds are larger, referees add more injury team when the home team is behind in the score and less when it is ahead: a one standard deviation increase in crowd size increases the home bias by 20%. But crowds do not only support the home team. Our second test of social pressure examines the relation between the composition of the crowd and the bias. We show that in cases where the crowd is made up of a substantial number of fans supporting the visiting team, the bias in favor of home teams is mitigated: by reacting to the preferences of the representative supporter

in the crowd, they become more impartial.

In summary, we address agent favoritism, an understudied aspect of agency theory, and the role of social forces in shaping individual behavior. Our objective is both to show that agents both have incentives for malfeasance, and that the exercise of that malfeasance depends on rewards and incentives. A further objective is to show how the (immediate) social environment plays an important role in shaping individual choices. Our referees change their behavior from game to game based on the nature of the crowd: we see this as strong evidence that their immediate environment affects their behavior. We conclude from this that models that allow for the agents preferences to conform in the presence of social pressure hold promise for enhancing our understanding of both agency theory problems and the social determinants of behavior.

2 Theory

Referees are employed to interpret the rules of soccer in an impartial way. One component of this is to identify the amount of time that they should add at the end of the game to compensate for time lost. Their incentives to do so are provided by the likelihood that they are retained as professional referees. The model offered below trades off this incentive to be retained with their desires to satisfy the crowd. To do so, we offer a model where the principal, the Football Federation, replaces referees who it believes are biased (similar results would arise if the league were replacing those it believed to be less able).

To model these issues, assume that the referee observes that true injury time is given by I, which he observes perfectly, and on the basis of this observation, chooses injury time of $\tilde{I}$.[5] There are two types of referees: unbiased and biased. The Football Federation seeks unbiased referees, and reappoints

[5]It is not important that the referees observe the truth without error.

them based on perceptions of how unbiased they are. It observes $\hat{I} = I + \epsilon$, where $\epsilon \sim \mathcal{N}(0, \sigma^2)$. This observation derives from viewing videos of the games, listening to team complaints, and so on. The referee does not know the Federation's observation when it makes its decisions. The Federation makes inferences about the bias of its referees and, for simplicity, replaces them with probability p, where p is the probability that a referee is biased.

The preferences of referees depend on two factors: (i) being reappointed, and (ii) satisfying the fans in the stadium. Unbiased referees do not value the approval of the fans in the stadium, and seek only to maximize the probability of being reappointed. Biased referees care about the preferences of the fans. Let the preferences of the fans in the stadium over injury time be given by $F(\tilde{I}; S)$, where S is the score difference between the home team and the away team. We assume that the preferences of the biased referee are given by

$$V = -E_{\hat{I}} p(\tilde{I}, \hat{I}) + \eta F(\tilde{I}; S). \tag{1}$$

Unbiased referees always allow the true amount of injury time, I.

Next consider the desires of the fans in the stadium, F. Assume that N_h fans support the home team and N_a support the away team. Fans care about the number of points obtained by their team. We assume that F is constant returns to scale in the number of fans so that the value of injury time to a fan is the probability that his team scores times its marginal return minus the probability that the other team scores times its marginal return to that fan.[6] For simplicity, assume that the instantaneous probability of either team scoring in injury time is identical and given by β (where the probability of both scoring is ignored). Let the notation +1 refer to the home team scoring in injury time and -1 refer to the away team scoring, and let R_i^x be the increment in the number of points earned by team i, $i = \{h, l\}$, if the change in the scoreline is x.

[6] We ignore the case where more than one goal is scored in injury time. This occurs in only 3 of 760 games.

Throughout our sample, teams earned 0 points for losing and 1 point for a tie. Before 1995-96, they earned 2 points for a victory while starting in 1996, wining was worth 3 points. Then for example, if the score in favor of the home team is 1 - 0, $R_h^{+1} = 0$ and $R_h^{-1} = -1$ before 1995-96 and $R_h^{-1} = -2$ after 1995-96. Then

$$F(\tilde{I}; S) = \beta \tilde{I}[N_h R_h^{+1} + N_a R_a^{+1} + N_h R_h^{-1} + N_a R_a^{-1}]. \tag{2}$$

Let the bias chosen by the biased referee be given by $\tilde{b}(.)$, where $\tilde{b}$ can depend on the score, the crowd, and so on. To make an inference on the bias of the referee, the Federation assumes that bias is given by $b(.)$: in equilibrium, $b(.) = \tilde{b}$. Upon observing injury time of $\tilde{I}$ and also observing the signal of $\hat{I}$, the posterior probability of the referee being biased is given by

$$p(\tilde{I}, \hat{I}, b(.)) = \frac{\phi(\hat{I} - \tilde{b}(.) - \tilde{I})}{\phi(\hat{I} - \tilde{I}) + \phi(\hat{I} + \tilde{b}(.) - \tilde{I})}, \tag{3}$$

where ϕ is the density of a normal distribution with mean 0 and variance σ^2. In equilibrium, this is given by

$$p(\tilde{I}, \hat{I}, b(.)) = \frac{\phi(\epsilon - b(.))}{\phi(\epsilon) + \phi(\epsilon - b(.))}. \tag{4}$$

In the absence of bias (where $\eta = 0$) the referees choose $\tilde{I} = I$, as this maximizes the probability of being reappointed. However, more generally, the choice of injury time by the biased referee is given by

$$E_\epsilon \frac{dp}{db} + \eta\beta[N_h R_h^{+1} + N_a R_a^{+1} + N_h R_h^{-1} + N_a R_a^{-1}] = 0. \tag{5}$$

This determines $b(.)$. This outcome is unique for η small, as we assume and hence this updating rule can used to infer the type of the referee. Therefore, the referees bias their decisions based on (i) how the likelihood of being replaced varies with bias, (ii) how much they wish to satisfy the fans, and (ii) the desires of the fans in the stadium.

This simple model offers the following testable hypotheses. First, referees reduce injury time when the team with most fans is ahead by a goal, but not when ahead by more than one goal (in which case, $R_i^x = 0$, as teams never score more than once in injury time in our sample). By contrast, referees increase injury time when the team with most fans is behind by a goal, but not when behind by more than one goal. In general, the home team has more fans. Second, referees should only exhibit bias for injury time in the second half of play. At the end of the first half, the marginal effect of injury time on the ultimate outcome is lower than in the second half, as there is a further 45 minutes of second half play to occur. Third, changes in the returns to winning should affect the bias exhibited by referees. Remember that the rewards for losing a game have always been 0 points, and the return for drawing 1 point while before the 1995-6 season, the reward for winning a game was 2 points, while after this season the return was 3 points. This implies that referees show more bias when the home team is ahead relative to behind after 1995 than before, as the marginal return for avoiding defeat has increased relative to drawing. As a test of social pressure, the model implies more bias as the crowd size increases, holding fixed the composition of home and away fans in the stadium. Equally, as the fraction of home fans rises, bias increases while and less bias occurs as the number of away fans increases. We test each of these issues below.

3 Data and Descriptive Statistics

The data in this paper come from the main professional soccer league in Spain (Primera Division). In this competition, 20 teams play each other twice during the season, once as a home team and once as a visitor. A season lasts for about 9 months (September through May) and teams typically play one game per week. The games have two 45-minute halves at the end of which the referee may, at his discretion, award injury time to make up for

the time lost during the game. Time awarded ranges, in our sample, between 0 and 7 minutes.

The incentives of the teams engaged in a soccer match are determined by the points they are awarded for the results they obtain. There are three possible outcomes in a soccer match: a win, a draw (or tie) and a loss. Until 1995, these three outcomes yielded 2, 1, and 0 points respectively. After 1995, the point structure was changed so that a win yields 3 points rather than 2, thus increasing the return to winning. As one of our intentions is to explore the effects of a change in incentives on referee behavior we use data from both the 1994-95 season (380 games), the last one with the 2-1-0 reward scheme, and from the 1998-99 full season (380 games) with the new 3-1-0 reward scheme.[7] Some descriptive statistics are given in Table 1.

[Table 1 here]

As can be seen in this table, there are on average 2.57 goals per game, with the home team scoring about a half a goal more than the away team. Attendance on average is 28,000 but is as high as 98,000. Referees can discipline players for foul play in two easily observable ways: yellow cards, which allow the person to stay on the field unless he gets another one, and red cards, which result is the player being expelled. On average 5 yellow cards are awarded per game (2.6 of these to the away team), and .17 red cards.[8] As for the issue of direct interest to us, referees add on average 2.93 minutes of injury time in the second half of the game, but only 0.8 minutes in the first half. In total, 56 goals were scored in injury time, and there is no statistical difference in the likelihood of a goal in injury time compared to normal time.

The discretion that referees have over the amount of injury time varies in our sample. Until the World Cup of 1996, referees simply added on as

[7] See the Appendix for the data sources.

[8] These disciplinary sanctions are described in the Appendix.

much injury time as they saw fit, and notified nobody about their amount they intended to add on at the end of normal play. After 1996, referees must announce at the end of normal play how long they expect injury time to last. In effect, they now commit to injury time in a way that was not true before 1996. We exploit this distinction below.

4 Evidence of Favoritism

Our initial evidence of bias is given in Figure 1, where we plot average injury time played by the scoreline.

[Figure 1 here]

As mentioned above, injury time in the second half averages 2.93 minutes. For games which are decided by 2 or more goals, the referee adds roughly this amount of time. Moreover, how much they add seems to be independent of which team is ahead in the score. However, when the home team is ahead by one goal (+1 in the Figure), the referee reduces additional time by almost 30%. This is comfortably the shortest period of injury time across scorelines. On the other hand, if the home team is behind by a goal, the referee adds 35% more time. Again, this is considerably longer than the injury time for any other scoreline. Both levels are significantly different from the average.

This is *prima facie* evidence of favoritism on the part of the referee. Injury time appears to systematically benefit the home team, but only in cases where the ultimate result can be changed, with opposite effects depending on who is leading. These observations lead us to suspect that referees systematically favor teams simply because they play at home. The remainder of the paper is to address the robustness of this initial result, to test for different ways in which the bias may operate, and to identify as best we can the mechanisms through which this happens. We find little to change this initial impression, but show that favoritism takes other forms in addition and is directly affected by the crowd attending the game.

We are primarily interested in how referees act when the home team is ahead by a goal compared to behind by a goal. This succinctly measures the way that the scoreline affects referee behavior, and is more parsimonious that a complete non-parametric estimation. Accordingly, in our regression analysis, we restrict attention to games where the home team is ahead by one goal or when the home team is behind by a goal. This restricts our sample to 268 observations.

We attribute differences in injury time in close games when ahead compared to behind as referee favoritism. However, an alternative hypothesis to favoritism that could explain the data is that 'true' injury time is correlated with the identity of the team leading, but only in close games. Law 7 in the official Laws of the Game (FIFA, 2000, pp. 37-39) states that "allowance is made in either period of play for all time lost through substitutions, assessment of injury to players, removal of injured players for treatment, wasting time or any other cause." Tables 2 and 3 test whether the inclusion of variables correlated with such issues affect our results. To do so, Table 2 estimates how our measure of bias is affected by controlling for (i) the effect of yellow and red cards, which are awarded to players that cause injuries, and (ii) the number of player substitutions. To better isolate the effects of the scoreline on referee behavior, we also control for year effects, the importance of each team (as measured by its annual budget), and team fixed effects. Our results are given in Table 2.

[Table 2 here]

Favoritism is estimated in Table 2 by the coefficient on the *Score Difference Dummy*, which equals 1 if the home team is ahead by one goal, and 0 if the home team is behind by one goal. The univariate regression shows a difference of -1.88 minutes between matches with these results: on average, injury time is shorter by 1.88 minutes when the home team is ahead by a goal. The second specification includes controls for yellow, red cards and

number of team players replaced. Injury time, not surprisingly, is likely to be affected by the intensity of the game. Table 2 shows positive and significant effects of yellow cards on the amount of injury time. The number of player substitutions also affects the amount of injury time. We also include controls for year effects (1998-99 = 1), which enters positively and significantly. The effect of the *Score Difference* is, however, unchanged by the inclusion of any of these variables. As a result, we are confident that the amount of true injury time is not correlated with game intensity affected by the scoreline.[9]

The next specifications attempt to account for the possibility that the identity of the teams is indicative of the true amount of stoppage. We do this by controlling for the relative strength of home team and the visitor team, as given by their rank, their budgets, and the difference in ranks between home and visitor team in absolute values, and finally by introducing team fixed-effects.[10] These regressions show that when the intensity of the match increases, more stoppage time is added. In particular, when the visitor team is stronger (as determined by a higher budget visitor) and when the difference in rank between visitor and home team is smaller, the injury time added is larger. Finally, we control for the stage of the season (*Game Number)* which may also predict the intensity of the play. Interestingly enough, while the percentage in the variation of injury time explained by our regression increases substantially (from 49% explained simply by the difference in score at the end of the match to 60% in the most complete specification), the regression coefficient is not affected in any empirically significant way. Neither the size nor the significance of the effect of the score difference changes when these controls are introduced, strengthening our initial impression of referee bias.

The referee also has the discretion to add injury time at the end of the first half of play. But since there are another 45 minutes to play in the second

[9]Referees are randomly assigned to games, so that we do not have to worry about alternative hypotheses where referees are selectively allocated based on expected score.

[10]The rank is given by the position of the team in the standings at the end of the season.

half, the marginal effect of adding an extra minute or two on the ultimate result is likely to be low in the first half. If this is true, we expect to see little evidence on injury time in the first half depending on the scoreline, as there is a full 45 minutes to be played in the second half, and the marginal effect of changing injury time on the ultimate winner is much lower. Accordingly, in Table 3 we carry out similar regressions to those in Table 2, where we predict injury time in the first half of play by the scoreline at that time.

[Table 3 here]

As can be seen, the sign of the first half *Score Difference* variable is positive (so injury time is lower when the home team is behind), though of much smaller magnitude and statistically insignificant. Again, the evidence in this table confirms the idea that the form of favoritism described above seems not to be caused by true stoppages but instead is dependent on the identity of the leading team at the end of the match.

4.1 The Marginal Effect of Incentives

Agency theory is predicated on the assumption not only that agent have incentives for malfeasance but also that these incentives are affected by the rewards that they face. In this context, this would imply that in cases where the returns to satisfying the crowd increase, referees will change their bias accordingly. We test for this in two ways.

4.1.1 Changes in the Rewards for Winning

As mentioned above, starting in the 1995-6 season, professional leagues changed the reward schedule so that a win would give the winner 3 points, whereas previously a win was worth 2 points. First, consider the case where the home team is behind by one goal. If the home team scores, it gains one point under both regimes. But if the home team is ahead by one goal, the marginal return to finishing the game to the home team increases from 1 point to 2

points (if they concede a goal, they previously went from 2 points to 1; now they go from 3 points to 1). As a result, an implication of the theory is that the effect of being ahead relative to being behind in the score should be higher in the 1998-9 season than in the 1994-5 season. Table 4 tests for this by including interaction terms between the year of observation and the score difference dummy.

[Table 4 here]

As can be seen, the interaction is negative and significant, implying that the bias was *stronger* after the increase in the rewards for winning than before. In numerical terms, the 1994-5 season saw a difference of one minute and thirty seconds, which increased to almost 2 minutes by the 1998-9 season.

4.1.2 Stage of the Season

Games at the end of the season are considered generally more important than those at the beginning of the year, as the marginal return to winning becomes both more imminent and more informed.[11] As a result, fans are more likely to be vocal in their support as the ultimate prizes of winning competitions or not being relegated get nearer. To test for this, we include in Table 4, in both Panel A and B, a fourth specification in which we study how the exercise of bias depends on the *Game Number*, which runs from game 1 to game 38, the final game of the season. First, games later in the season tend to have a more injury time, one measure of the more intense competition at the end of the season. The difference between the first and last game is approximately one minute, or 35% of the average injury time. Second, and

[11] The effect is not unambiguous, however, as teams on the middle positions in the standings may have fewer incentives because they have little at stake. In Primera Division, the bottom four teams are relegated to the lower Segunda Division, while the top six or seven teams qualify to play various European competitions next season. During the 1994-95 and 1998-99 seasons basically all 20 teams in the league had much at stake in the later part of the season, especially in the last few games, and for the majority of teams even in the last game.

more directly related to our objective, referee favoritism, both as measured in the difference in injury time between +1 and -1 scorelines, and as measured by the difference between -1 and 0 scorelines, is significantly greater later in the year. From the beginning to the end of the season, referee bias increases by almost 40 seconds in -1 relative to +1 matches, again illustrating the response of these agents to changes in the incentives that they face.

4.2 Another Form of Favoritism

Apart from delaying games in the hope that the home team scores, referees may also show bias by responding to goals in extra time in different ways depending on who scores. For example, consider a game which is a draw. If the home team scores, the model above would suggest that the referee should signal an end to the game quickly. By contrast, if the away team scores, the referee should prolong the game in the hope that the home team can respond. To analyze this, we restrict attention to those games where a goal was scored in injury time, and identify whether the total amount of injury time depends on who scored.[12] In total, there were 53 games where one or other team scored. Our identification strategy here is simply that conditional on one team scoring, injury time added should not depend on who scored. Yet it does, as illustrated in Table 5. Given the small number of observations, we only control for the most important variables that appear to enter in the specification of injury time according to the regressions in Table 2.

[Table 5 here]

When the scorer is the visiting team rather than the home team the amount of injury time awarded is significantly greater, and equal to about

[12]We restrict attention to those games where at least one team scored because otherwise there is a bias that otherwise arises. For instance, suppose that we analyzed all games and found that scoring in injury time resulted in more time being added. This would likely be caused by the reverse causation that when more injury time is added, it gives teams more opportunities for scoring, rather than reflecting anything to do with the bias of the referee.

20% of the average injury time. Thus referees appear to signal the end more quickly when the home team scores.

But remember that in our later data period, 1998-9, referees must commit ex ante to the amount of injury time that they expect to add. If this commitment is binding, this would suggest that referees no longer can react to goals in injury time by changing their minds at that stage as to the amount of time they add. Accordingly, in Table 6, we estimate separate regressions for both time periods.

[Table 6 here]

We find that only in the 1994-5 does the identity of the scorer matter for injury time, which we interpret as the referees using their discretion to change injury time based on a score. There is no such relationship in 1998-9, illustrating their reduced discretion, though care must be take here as our sample sizes are too small to allow us to say that the effects are statistically significantly different.

4.3 Social Pressure by Crowds

We believe that the incentive to favor the home team likely arises from the crowd supporting that team. Anyone who has attended a sports event with a large crowd can attest to the volume that may be created. Crowds in professional soccer games in Europe are not slow to vent their anger at referees for decisions that do not favor their preferred team. In order to test for the direct effect of the crowd on the behavior of the referee, we carry out two exercises. First, we consider how higher attendance affects the referees' behavior. Second, we address how changing the mix between home and away fans affects the bias exercised by the referee. In particular, when the fraction of away fans increases, the extent of favoritism should fall if the crowd is the mechanism by which referees are affected. We test for this in Table 7, where

we show how injury time added in the second half is affected by two crowd measures.

[Table 7 here]

First, we study how attendance affects injury time. On average, attendance does not significantly affect injury time: instead, the only effect is the interaction between attendance and the scoreline. Specifically, when attendance rises the bias shown by the referee, as measured by the difference between the +1 and -1 scorelines, also increases. A one standard deviation increase in attendance increases bias by approximately 20 seconds or 20%.

This effect is predominantly caused by the larger stadiums in which the more popular teams play.[13] One reflection of this is that econometrically we cannot distinguish between attendance and home team fixed effects. But another test of the effect of attendance games is to consider the effect of unusually large attendance on the bias shown by the referee. To do so, we compute the ratio of attendance to stadium capacity. Crowds tend to be high relative to capacity when either popular visiting teams play and when the teams tend to be geographically close. To see this, consider Table 8, where we predict the variation in this ratio away from the team mean by (i) visiting team dummies, and (ii) the distance traveled by the visiting team.

[Table 8 here]

The visitor team dummies that significantly predict unusually high attendance are those which have the greatest support all over Spain (Barcelona

[13] One way of seeing this is to run these regressions not on attendance at the game, but instead controlling for the popularity of the teams by using the budgets spent by the teams. When we run this regression, the significance of the attendance variable interacted with the score disappears. However, as we argue below, the effect of attendance to capacity remains significant and positive, illustrating the reduced favoritism when attendance is unusually high.

and Real Madrid), while teams separated by small distances have high attendance as well.[14] In either case, these scenarios reflect a greater fraction of the crowd supporting the away team. The theoretical impact of this is that referees are likely to be less biased in favor of the home team when attendance is unusually high, as the crowd is less biased towards the home team. This is considered in the last specification in Table 7, where we find that unusually high attendance (as given by a high ratio of attendance to capacity) results in less bias, as predicted.

5 Conclusion

This paper addresses agent bias, an understudied aspect of agency theory. We have documented that, as a result of the pressure exercised by the crowd, referees reduce injury time when the home team is ahead, and increase it when it is behind. We controlled for direct measures of substitutions and injury, and our results were unchanged. We also showed that these agents appear to respond to incentives on the margin, by biasing more when the returns to winning increased from 2 points to 3 points, and by showing more favoritism later in the season. We further showed that referee exercise favoritism not only when no team scores in injury time, but also they finish the game more quickly when the home team scores than when the visiting team scores. As such, we believe that this work complements the previous literature on empirical tests of agency theory by showing that agents both have incentives for malfeasance (though here on another dimension) and that the exercise of that malfeasance depends on the rewards faced by all the parties.

It is important that we address some alternative hypotheses. As mentioned above, we find it unlikely that the effects are generated by true stoppage time being correlated with the identity of the team leading, but only for close games. We tested for this by including variables such as substi-

[14] In fact, Barcelona and Real Madrid are the only teams in the league with official clubs of supporters (so called Peñas) in *every* province in Spain.

tutions, disciplinary cards, and so on, which (though correlated with total injury time) are uncorrelated with our bias measure, and so left our results unchanged. An alternative hypothesis is not that social pressure generates the referee's incentives, but instead that they take bribes. Again, we are unconvinced by this hypothesis because there is no reason to believe that the ability to bribe depends on whether a team is playing at home or away. If teams have connections with referees and can bribe them, we think that they are as likely to do so for a home game as an away game. Since our result only arise for outcome when teams play at home relative to away, we do not find the bribery hypothesis persuasive.

Finally, we cannot rule out that these behaviors are approved by the football authorities. All that we can show is that referees show favoritism, not that such favoritism does not correlate with the objectives of the principal. Yet we suspect that it is not their objective to satisfy home crowds: perhaps the Federation benefits certain clubs, but we see little reason to think that they systematically favor home versus away teams, as all teams play an equal number of home and away games. One could alternatively imagine that they would like close games to continue longer, as these are most exciting, but why then is injury time shorter than average when the home team is ahead in close games? Perhaps more relevantly, we should note that FIFA has constrained the behavior of referees in injury time, by changing the rules in 1996 to make them commit ex ante to the amount of injury time. We suspect that this change was induced by a suspicion of inefficient behavior by the referees.

We should note in conclusion that the number of matches whose results were affected by this component of the referee's bias is small, even though the baying crowd in injury time would give an alternative impression. Our estimates suggest that this bias changed the result of about 7 games, or 2.4% of all the games in our sample.[15] But it is important to point out

[15]When the home team is behind by a goal, the referee adds one minute too long. Home teams score with probability .015 per minute of extra time, which translates to 4.25 results which were changed from the 284 close games in our sample. Similar analysis

that this is highly unlikely to be the only form of bias exercised by referees: this is the only form that we can verify. Referees may also show favoritism when awarding fouls, offsides etc. As a result, we see the estimates we have obtained as a lower bound on the favoritism shown by referees.

One feature that differentiates this work from its predecessors is that rewards here are not monetary: few would claim that referees take bribes to change their behavior. Instead, our 'rewards' mechanism is to satisfy crowds, where we have linked the extent of agent malfeasance to the social pressure that he faces, both in terms of the size of the crowd and its determinants. Convincing empirical tests of social pressure are hard to find in the literature on the effects of the social determinants of behavior, and empirical work documenting the importance of favoritism and providing testable implications is, to our knowledge, non-existent in the agency theory literature. We consider that these are the main contributions of the analysis.

shows that when the home team is in front, the referee shortens the game by 0.82 minutes. Away teams score with probability 0.01 per minute of injury time, which translates to an additional 2.33 games which would have changed results had the referee not shown favoritism.

APPENDIX. Data Sources

We collected the data from the records of Marca, the best selling newspaper in Spain, and *www.sportec.es*. It includes information on the name of the teams, the number of goals scored by each team, the time of the goals, whether the team plays at home or as a visitor, attendance to the games, stadiums capacity, the operating budgets of the teams, and the sanctions in the form of yellow and red cards received by the players.[16] We also have data on the geographical distance between the cities associated with each of the teams.

Data on the names of the referees, and the extra time added in the first and second halves by the referees were obtained from Marca and from the Spanish Association of Soccer Referees (SASR) which collects the referees' records of the games. Twenty two referees are selected at the beginning of the season by the SASR. Typically the set consists of the referees they selected the previous season except those who, according to the Association, performed worst during the past season. The number of referees being replaced varies but it is typically never more than four. They are replaced by the top referees in Segunda Division, a lower quality professional division, who are promoted to the top division.[17] A referee on average is involved in about 18 games every season, ranging from 16 to 19 games. Nine of the referees in the 1994-95 season remained in the 1998-99 season.

[16] Referees award either a yellow or a red card to a player who commits an unnecessarily rough foul. A red card is awarded for especially rough fouls and for behavior considered to be clearly beyond the bounds of the game. A red card has as a consequence that the player is expelled from the game. Players with one yellow card may continue playing the game. If a second yellow card is awarded to a given player he is then expelled from the game. Empirically red cards are extremely rare. Around 0.07-0.09 are awarded per team per game, whereas on average 2.15-2.90 yellow cards are given per team per game.

[17] The referee's performance is evaluated by the SASR at every game. These evalutions are not known by the referees.

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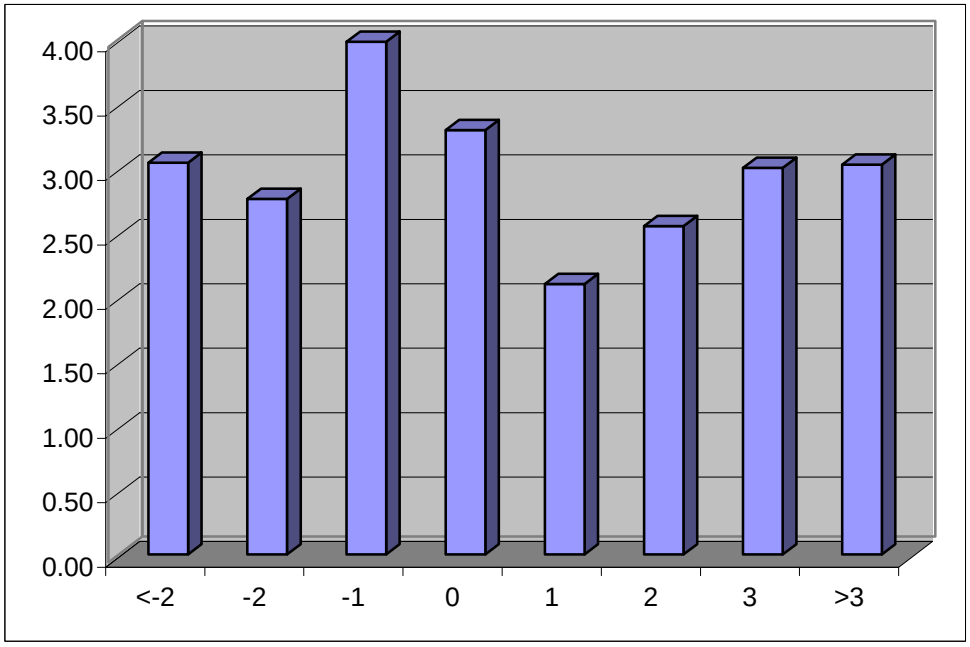
FIGRE 1.
INJURY TIME AWARDED BY SCORE MARGIN

Number of minutes awarded by referees as a function of the margin in favor of the home team at the end of the match (goals scored by home team - goals scored by visitors).



Note: 3.3% of the matches ended with score differences smaller than -2. 5.2% of the matches ended with score differences larger than 3.

TABLE 1.
DESCRIPTIVE STATISTICS

Variable	Obs.	Mean	Standard Deviation	Min	Max
Score Difference	750	0.58	1.71	-5	6
Score Home	750	1.57	1.32	0	7
Score Visitor	750	1.00	1.08	0	7
Goals in Extra Time Home	750	0.04	0.21	0	1
Goals in Extra Time Visitor	750	0.03	0.17	0	1
Minutes Extra Time 2nd Half	750	2.93	1.11	0	7
Minutes Extra Time 1st Half	750	0.79	0.73	0	3
Yellow Cards Home	750	2.23	1.37	0	7
Yellow Cards Visitor	750	2.55	1.39	0	8
Red Cards Home	750	0.09	0.30	0	2
Red Cards Visitor	750	0.08	0.31	0	3
Total Player Substitutions	750	4.496	1.06	0	6
Attendance	750	27.84	17.78	5	98
Attendance/Capacity	750	0.74	0.17	0.19	1
Distance Home - Visitor (1000 KM)	750	0. 73	0.60	0	2.70

TABLE 2.
MINUTES OF INJURY TIME AT END OF MATCH IN CLOSE MATCHES

The dependent variable is the length of injury time in matches that ended with a 1 goal difference. Controls are included for variables that may affect 'true' stoppages in the match. Score difference is 1 if home team finished ahead by 1 goal, 0 if home team finished behind by 1 goal.

	Score Difference	Yellow Cards	Red Cards	Player Substitutions	Year Effect	Budget Home	Budget Visitor	Rank Home	Difference in Rank[+] (home-vis)	Team Fixed Eff.	Constant	R Sq (N)
(1)	**-1.88****										3.98**	0.4852
	(0.12)										(0.09)	(268)
(2)	**-1.86****	0.08**	-0.2	0.14**							2.94**	0.5221
	(0.11)	(0.02)	(0.13)	(0.05)								(268)
(3)	**-1.86****	0.07**	-0.2	0.03	0.37*						3.28**	0.5328
	(0.11)	(0.02)	(0.13)	(0.07)	(0.15)						(0.31)	(268)
(4)	**-1.8****	0.06**	-0.19	0.04	0.29	-0.03	0.05*				3.21**	0.5492
	(0.11)	(0.02)	(0.13)	(0.07)	(0.17)	(0.02)	(0.02)				(0.31)	(268)
(5)	**-1.78****	0.06*	-0.19	0.04	0.11	0	0.05**	0.02	-0.03*		3.23**	0.5637
	(0.11)	(0.02)	(0.12)	(0.07)	(0.19)	(0.02)	(0.02)	(0.01)	(0.01)		(0.33)	(268)
(6)	**-1.77****	0.05*	-0.17	0.04	-0.09	0.06	0.05**	0.01	-0.03**	yes	3.28**	0.6025
	(0.12)	(0.03)	(0.13)	(0.07)	(0.37)	(0.1)	(0.02)	(0.03)	(0.01)	home	(0.6)	(268)
(7)	**-1.76****	0.06*	-0.16	0.02	0.52	-0.01	-0.02	0.02	-0.02*	yes	3.01**	0.6063
	(0.12)	(0.03)	(0.13)	(0.07)	(0.37)	(0.02)	(0.08)	(0.01)	(0.01)	visitor	(0.44)	(268)

Standard Errors In parenthesis * Significant at 5% level; ** Significant at 1% level; + Rank Difference: Absolute value of Rank Home- Rank Visitor.

TABLE 3.
MINUTES OF INJURY TIME AT END OF FIRST HALF WHEN RESULT AT END OF HALF IS CLOSE

The dependent variable is the length of first half injury time in matches in which the first half ended with a 1 goal difference. Controls for variables that may affect 'true' stoppages in the match are included. Score difference is 1 if home team finished half ahead by 1 goal, 0 if home team finished half behind by 1 goal.

	Score Difference at Half	Yellow Cards first half	Red Cards first half	Player Substit. first half	Year Effect	Budget Home	Budget Visitor	Rank Home	Difference in Rank+ (home-vis)	Team Fixed Eff.	Constant	R Sq. (N)
(1)	0.13										0.7**	0.01
	(0.08)										(0.06)	(332)
(2)	0.10	-0.06*	-0.26	0.12							0.81**	0.03
	(0.09)	(0.03)	(0.26)	(0.08)							(0.09)	(290)
(3)	0.10	-0.06*	-0.26	0.12	0.04						0.79**	0.03
	(0.09)	(0.03)	(0.26)	(0.08)	(0.08)						(0.1)	(290)
(4)	0.10	-0.06*	-0.24	0.12	-0.02	0.01	0.01				0.76**	0.03
	(0.09)	(0.03)	(0.26)	(0.08)	(0.1)	(0.01)	(0.01)				(0.01)	(290)
(5)	0.11	-0.06*	-0.24	0.12	-0.02	0.01	0.01	0.00	0.00		0.78**	0.03
	(0.09)	(0.03)	(0.26)	(0.08)	(0.12)	(0.02)	(0.01)	(0.01)	(0.01)		(0.13)	(290)
(6)	0.08	-0.05	-0.18	0.13	0.17	-0.07	0.01	-0.03	0.00	yes	1.42**	0.10
	(0.09)	(0.03)	(0.27)	(0.08)	(0.25)	(0.07)	(0.01)	(0.03)	(0.01)	home	(0.45)	(290)
(7)	0.09	-0.05	-0.17	0.08	0.46	0.00	-0.11	0.00	-0.01	yes	0.59*	0.19
	(0.09)	(0.03)	(0.26)	(0.08)	(0.24)	(0.02)	(0.06)	(0.01)	(0.01)	visitor	(0.28)	(290)

Standard Errors In parenthesis * Significant at 5% level; ** Significant at 1% level; + Rank Difference: Absolute value of Rank Home- Rank Visitor

TABLE 4.
MARGINAL EFFECT OF INCENTIVES ON INJURY TIME ADDED AT THE END OF MATCH

The table analyzes the effect of the *change* in points awarded per win on the minutes of second half injury time added by the referee in which that ended by 1 goal of difference, and controls for variables that may affect 'true' stoppages in the match. Year* Difference is the interaction between the dummy variable Score Difference and the Year (0 if pre-change, 1 if after change).

	Score Difference (-1; 1)	Year Effect	**Year * Socore Difference**	Yellow Cards	Red Cards	Player Changes	Budget Home	Budget Visitor	Rank Home	Difference in Rank^{+} (home-vis)	Game Number	**Game Number* Score Difference**	Constant	R Sq. (N)
(1)	**-1.53****	0.81**	**-0.58***										3.5**	0.5263
	(0.18)	(0.18)	**(0.23)**										(0.14)	(268)
(2)	**-1.56****	0.7**	**-0.52***	0.07**	-0.20	0.03							3.11**	0.5415
	(0.18)	(0.21)	**(0.23)**	(0.02)	(0.13)	(0.07)							(0.32)	(268)
(3)	**-1.47****	0.49	**-0.51***	0.06*	-0.19	0.05	-0.01	0.05**	0.01	-0.03**	0.01		2.93**	0.5773
	(0.17)	(0.25)	**(0.23)**	(0.02)	(0.12)	(0.07)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)		(0.34)	(268)
(4)	**-0.64***	0.55*	**-0.55***	0.06*	-0.09	0.04	-0.02	0.04*	0.01	-0.04**	0.02**	**-0.02****	2.42**	0.5989
	(0.28)	(0.27)	**(0.23)**	(0.02)	(0.12)	(0.07)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	**(0.01)**	(0.39)	255

Standard Errors In parenthesis * Significant at 5% level; ** Significant at 1% level; + Rank Difference: Absolute value of Rank Home- Rank Visitor

TABLE 5.
EFFECT OF THE IDENTITY OF THE SCORER ON INJURY TIME ADDED AT THE END OF MATCH

The table analyzes the impact of the identify of the scorer on the number of minutes of extra time added at the end of the match. To do this, it compares matches where the home team scored with those in which the visitor scored during extra time. It controls for the most important variables affecting extra time (see table 2)

	Scorer is Visitor Team	Year Effect	Yellow Cards	Difference in Rank+ (home-vis)	Intercept	R Sq (N)
(1)	0.57*	0.81*	-0.05		2.55**	0.16
	(0.28)	(0.33)	(0.06)		(0.38)	53
(2)	0.56*	0.81*	-0.04	0.01	2.48**	0.16
	(0.28)	(0.33)	(0.06)	0.03	(0.44)	53

Standard Errors In parenthesis * Significant at 5% level; ** Significant at 1% level; + Rank Difference: Absolute value of Rank Home- Rank Visitor

TABLE 6.
EFFECT OF THE IDENTITY OF THE SCORER ON INJURY TIME ADDED AT THE END OF MATCH

The table analyzes the impact of the identify of the scorer on the number of minutes of extra time added at the end of the match with and without referee commitment (see text). To do this, it compares matches where the home team scored with those in which the visitor scored during extra time in the first year of our sample (referee can decide on the spot) and in the second (referee has to commit). It controls for the most important variables affecting extra time (see table 2)

Panel A: No referee Commitment (year 1994-95)

	Scorer is Visitor Team	Yellow Cards	Difference in Rank+ (home-vis)	Intercept	R Sq (N)
(1)	1.14*	0.33**		0.62	0.51
	(0.46)	(0.12)		(0.63)	(15)
(2)	1.13*	0.34**	0.00	0.61	0.51
	(0.5)	(0.13)	(0.03)	(0.66)	(15)

Standard Errors In parenthesis * Significant at 5% level;
** Significant at 1% level; + Rank Difference: Absolute value of Rank Home- Rank Visitor

Panel B: No referee Commitment (year 1998-99)

	Scorer is Visitor Team	Yellow Cards	Difference in Rank+ (home-vis)	Intercept	R Sq (N)
(1)	0.43	-0.12*		3.87**	0.14
	(0.31)	(0.06)		(0.39)	(38)
(2)	0.44	-0.12*	0.00	3.86**	0.14
	(0.32)	(0.06)	(0.02)	(0.42)	(38)

Standard Errors In parenthesis * Significant at 5% level;
** Significant at 1% level; + Rank Difference: Absolute value of Rank Home- Rank Visitor

TABLE 7.
EFFECT OF THE SIZE AND COMPOSITION OF THE CROWD ON REFEREE BIAS AS GIVEN BY INJURY TIME AT END OF CLOSE MATCH ES

The dependent variable is the extra time granted in the 2nd Half by the Referee. The impact of the crowd on bias is given by the interaction between attendance and score difference and by the interaction between the ratio of attendance to capacity and difference.

	Score Difference (1; -1)	Year Effect	Attendance	**Attendance* Score Difference**	Yellow Cards	Budget Home	Budget Visitor	Rank Home	Difference in Rank+ (home-vis)	Game Number	Ratio of Attendance to Capacity	**Ratio * Difference**	Constant	R Sq. (N)
(1)	**-0.93****	0.36**	0.00	**-0.02****									3.23**	0.5676
	(0.2)	(0.11)	(0)	**(0)**									(0.18)	(255)
(2)	**-0.96****	0.33**	0.00	**-0.02****	0.07**								2.94**	0.5802
	(0.2)	(0.11)	(0)	**(0)**	(0.02)								(0.2)	(255)
(3)	**-0.88****	0.12	0.01	**-0.02****	0.05*	0.00	0.05*	0.02*	-0.03*	0.01			2.65**	0.6107
	(0.2)	(0.18)	(0.01)	**(0)**	(0.02)	(0.04)	(0.02)	(0.01)	(0.01)	(0.00)			(0.26)	(255)
(4)	**-2.92****	0.12	0.01	**-0.02****	0.05*	0.00	0.05**	0.02	-0.02	0.01	-0.51	**1.51****	4.09**	0.6436
	(0.47)	(0.18)	(0.01)	**(0)**	(0.02)	(0.04)	(0.02)	(0.01)	(0.01)	(0.00)	(0.37)	**(0.32)**	(0.44)	(255)

Standard Errors In parenthesis * Significant at 5% level; ** Significant at 1% level; + Rank Difference: Absolute value of Rank Home- Rank Visitor

TABLE 8.
EFFECT OF THE DISTANCE AND VISITOR TEAM ON OCCUPATION OF STADIUM

The dependent variable is the deviation of the ratio of attendance to capacity from its mean.

Independent Variable	Coefficient	Standard Error
ALB	-0.05	(0.03)
ALA	-0.16**	(0.03)
AMA	0.01	(0.02)
BAR	0.16**	(0.02)
CEL	-0.02	(0.02)
COM	-0.07*	(0.03)
DEP	0.03	(0.02)
ESP	-0.08**	(0.02)
EXT	-0.04	(0.03)
LOG	-0.11**	(0.03)
MAL	-0.06*	(0.03)
OVI	-0.09**	(0.02)
RAC	-0.04	(0.02)
RBE	-0.05*	(0.02)
RMA	0.16**	(0.02)
RSO	-0.02	(0.02)
SAL	-0.09**	(0.03)
SEV	-0.02	(0.03)
SPO	-0.06*	(0.03)
TEN	-0.03	(0.03)
VAL	-0.06**	(0.02)
VCF	-0.01	(0.03)
VIL	-0.1**	(0.03)
VLN	0.04	(0.03)
ZAR	-0.08**	(0.02)
Distance	-0.02**	(0.01)
Constant	0.04*	(0.02)
R Sq. (N)	0.3644	750