Favoritism of agents – The case of referees' home bias*

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Abstract: We study the behavior of football (soccer) referees in the German Bundesliga. Referees are requested to act as impartial agents. However, they may be tempted to allocate benefits and rewards in a biased way. Agency theory has long neglected this form of malfeasance of economic agents, but has rather concentrated on agents exerting suboptimal effort levels. Favoritism or biased behavior of referees can be investigated by examining their decisions on awarding penalties or extra time at the end of a football match. We can confirm a systematic home bias of referees.

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1 Introduction

In the season 2000/1 the German football (soccer) championship was decided in the very final round. After 90 minutes in the 34th game of the season, Schalke 04 was leader – and would have been the champion *if* a referee of a parallel match had not awarded three minutes of extra time in which Bayern München scored against Hamburger SV, making Bayern München the German football champion for the third time in a row.

Even though referees are employed to interpret the rules of football in an impartial way, they can exert considerable discretionary power, in particular when adding extra time, awarding penalties, allocating yellow or red cards and deciding on free-kicks or offside. As a consequence, referees can have a very important influence on the final result of a football match.

Economically speaking, referees act as agents. Typically, agency theory is concerned with agents exerting (more or less) effort depending on incentives (see Prendergast, 1999; Laffont and Martimort, 2002). The problem of agents, like referees, making biased or impartial decisions in the sense that they show favoritism has not been thoroughly explored so far in the economics literature. Prendergast and Topel (1996) are, however, a noteworthy exception. In a theoretical model they discuss the consequences of favoritism in organizations and show that favoritism is not necessarily costly to organizations even though it may create arbitrary rewards.

There is a growing body of empirical assessments of agent bias and favoritism. In particular, behavior of agents in sports tournaments has attracted quite some attention in recent years.[1] Garicano, Palacios and Prendergast (2001) investigate the behavior of referees

[1] Knowles, Persico and Todd (2001) are a prominent example of addressing agent bias outside the world of sports. They examine behavior of police officers searching vehicles of African-American or white motorists for illegal drugs. Their evidence is not indicative of 'racial profiling' of the police, which would mean that police officers use race as a criterion whether to search cars.

in the Spanish football league, *Primera Division*, under the social pressure exerted by the spectators of matches. In particular, they examine the amount of extra time a referee adds after 90 minutes, depending upon the score of the game and the composition of the crowd watching the game. Garicano et al. (2001) provide clear evidence for a distinct home bias of referees. Controlling for 'objective reasons' to add extra time, like the number of yellow or red cards or the number of player substitutions, referees still add significantly more extra time in case the home team is behind by one goal than if it is ahead by one goal after 90 minutes.

Nevill, Balmer and Williams (2002) report another possible manifestation of home bias of referees. They showed a video-tape of 47 tackles from an English Premier League match to 40 qualified referees who were asked to classify a tackle as regular or irregular. Referees were informed about the colors of the home team and visiting team, respectively.[2] Then referees were split in two groups, with one group hearing the noise of the crowd's reaction, while the other watched the tackles silently. As a result, the group of referees who heard the sound was markedly more reluctant (by about 15%) to classify tackles of home teams as irregular and was more often uncertain in their decision. It is noteworthy that the decisions made by the group of referees who heard the noise were significantly more in line with those made by the original match referee than the decisions made by the group which watched the tackles silently.[3]

[2] Nevill et al. (2002) have chosen tackles from the match 'Liverpool vs. Leicester City'. From a methodological point of view it would have been desirable if the authors had also considered tackles from the return match 'Leicester City vs. Liverpool' in order to show that the bias of qualified referees was a home bias rather than a Liverpool-bias.

[3] Interestingly, the effect of the crowd noise on assessing home fouls is not dependent upon refereeing experience, as has been shown by Nevill et al. (2002) by controlling for years of refereeing experience.

Hence, we have quite robust evidence of favoritism in football. Even though there are other possible factors which might account for the home advantage in team sports[4] like football, only the crowd factor and the social pressure exerted by the crowd have been shown to be of major importance. The channels through which the crowd factor becomes effective are manyfold: First, crowds can stimulate the home team to perform better. Even though the literature is not conclusive on the latter aspect, a recent study by Neave and Wolfson (2002) has been able to link crowd composition to physiological factors by showing that players have a significantly higher testosterone level in home matches than when playing away, which might be caused by the desire to defend the 'own' territory.

Second, crowds can influence the referee to favor the home team. It has long been acknowledged in the literature on endogenous preference formation (see, for instance, Bernheim, 1994; Becker and Murphy, 2000) that the social environment can influence individual behavior. Regarding football matches, crowds vent their anger with large volume and rather quickly at referees for decisions that do not favor their preferred team. As a consequence, referees might be tempted to make decisions which are socially desirable in the very situation, thereby pleasing the crowd. This kind of behavior can also be rationalized as a form of coping strategy in response to stressful events, as has been shown to exist with respect to basketball referees (see Anshel and Weinberg, 1999).

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[4] Courneya and Carron (1992, p. 13) defined the home advantage in team games as 'the consistent finding that home teams in sports competitions win over 50% of the games played under a balanced home and away schedule'. Nevill and Holder (1999) discuss four major factors which might explain the home advantage: rules, learning/familiarity, travel factors and crowd factors. With the exception of the crowd factors, none seems to have an important impact on the widely observed home advantage in team sports. Interestingly, in individual sports like golf or tennis, home advantage seems to be (almost) non-existent, which may reflect the relatively objective nature of scoring systems in golf or tennis, compared to the much more subjective decisions of referees in team sports like football, basketball or ice hockey (see Holder and Nevill, 1997, or Nevill, Holder, Bardsley, Calvert and Jones, 1997).

The influence of the crowd on referee decisions might, however, be even more subtle. Referee decisions have to be made instantaneously, implying a lot of time pressure on the referee. Wallsten and Barton (1982) have shown that under time pressure people have a tendency to focus on the most salient cues to make a decision. The crowd noise caused by a tackle may serve as a salient, yet potentially (and probably) biased cue for the referee's decision (see also Wickens and Holland, 2000, or Nevill et al., 2002). As a consequence, when facing a contentious decision, the salient cue of crowd noise (remaining rather silent when a home team player makes a tackle, but booing when a visitor tackles) may cause a difference in assessing fouls of home players or visiting players.

Another subtle form of crowd noise influencing referees may stem from the use of heuristics in decision making. Even though heuristics frequently result in systematic errors (Tversky and Kahneman, 1974), they are often used as rules of thumb to reduce complexity in judgment. If a referee is uncertain whether a tackle was regular or irregular, he might, therefore, place equal weight on the biased auditory information from the crowd and on the visual information from the tackle.[5]

Of course, we do not claim that referees simply give in to the crowd's wishes. Rather, we may assume that the preferences of referees depend on two distinct factors. First, referees want to be reappointed and step up the professional ladder, which requires appearing impartial and unbiased in the eyes of the principal, the German Football Federation. Second, they try to satisfy the crowd in the stadium, and their actions depend on the size and the composition of the crowd.[6] Given these preferences, the home bias of referees depends on the probability of being replaced because of biased decisions, the referee's valuation of the crowd's satisfaction,

[5] The use of heuristics and the consideration of other information as if it were of equal importance as the clinical information has, for instance, been documented for nurses (see Rossi and Madden, 1979).

[6] Note that we do not assume referees to be in favor of or biased to individual football teams. Since referees are randomly assigned to matches, the favored teams change every time.

and the size and the composition of the crowd in the stadium.[7] As a consequence, it is possible to formulate hypotheses on the favoritism of referees – as is done at the end of this section – which can be put to a test by the use of field data. The purpose of this paper is to provide such a test. As opposed to many other empirical environments, football referee behavior provides a great opportunity to analyze favoritism, because social pressure is exerted by the fanatic supporters of a football team during the match and data are available that allow to distinguish between fair and biased decisions. Specifically, we are interested in two different aspects of referee behavior in the German *Bundesliga* in the season 2000/1.

First, we analyze the amount of extra time added by the referee at the end of a match. [8] This approach has been motivated by the paper of Garicano et al. (2001). In particular, we consider close matches where the score difference between the home team and the visiting team ranges from +1 (home team ahead by one goal) to –1 (home team behind by one goal).[9] In close matches extra time can have an impact on the final result of the match. Our results from this approach may serve as further evidence for another major football league in Europe, substantiating the explanation that social pressure leads to favoritism in referee behavior when awarding extra time.

Second, we are going to examine referee decisions on penalties.[10] Adding extra time in a biased way is, without doubt, a sign of favoritism, but – as has been shown by Garciano et al. (2001) and will be shown in this paper – it is of rather minor importance.[11] It is a matter of

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[7] For a formal model of referee behavior, which takes into account these preferences, see Garicano et al. (2001).

[8] Football referees have a considerable degree of discretion in setting extra time, although the official Laws of the Game (FIFA, 2000) give some guidance. We present the most important according regulations in the result section.

[9] Note that since 1996 the losing team receives zero points and the winning team three points. In case of a draw both teams are awarded one point.

[10] A penalty is a special form of free-kick, eleven meters in front of the goal. The football laws list several reasons for penalties, among which foul play in the penalty area in front of the goal and hands within this area are the most important.

[11] In a sense it is a sign that pleases the crowd, but does not offend the principal too much in general.

fact that only a few goals are scored in extra time in pivotal situations and that the distribution of these goals among the home team and the visiting team is fairly even. Penalties, however, are typically a rather safe bet for scoring a goal. In the German Bundesliga about 80% to 85% of penalties are successful. Therefore, awarding, but also refusing, penalties can have a considerable impact on the result of a match. We examine decisions on penalties by checking whether there is a difference in the frequencies of awarding or refusing penalties between the home team and the visiting team.[12] If penalties are awarded or refused in a biased way between home teams and visiting teams this would be a very strong form of favoritism in the sense that it may likely have a decisive impact on the final result of a match. This is a new and complementary approach to measure agent-bias in professional football.

Given our discussion about the influence of the crowd on referees, we are going to test specifically the following hypotheses:

- **Hypothesis 1**: Extra time in the second half depends on the score margin. There should be more extra time in close matches where a goal in the extra time can have an impact on win, draw or loss.
- **Hypothesis 2**: In close matches, extra time will be longer if the home team is behind by one goal than in case of a draw or the home team being ahead by one goal.
- **Hypothesis 3**: Referees will add more extra time as the number of spectators increases.
- **Hypothesis 4**: Decisions on penalties are biased in favor of home teams. Compared to actually awarded penalties, referees are relatively more likely to refuse the visiting team a justified penalty than the home team.

[12] Ex post it is rather easy to judge whether a penalty was regular or not and whether refusing a penalty was the correct decision or not. We did not evaluate penalties as 'regular' or 'irregular' ourselves, but relied on reports judging a referee's performance. Details are explained in section 2.

The rest of the paper is organized in the following way. Section 2 introduces our data set to test our hypotheses. Section 3 reports the results, and Section 4 discusses the implications of the results and concludes.

2 Data and basic statistics

Our data base has been constructed from the web-site of *Kicker Sportmagazin,* the most important magazine for German football (see www.kicker.de). The web-site offers a live-ticker for each match, indicating among others by the minute the kick-off, goals, penalties, yellow or red cards, substitutions, and the final whistle of each half. In addition, there is a report on the match referee's performance, which comments especially on whether awarded penalties have been regular according to the rules of the game and on whether a referee has refused to award a regular penalty. We take into account these assessments on (awarded or refused) penalties for testing our hypothesis on penalties in section 3.2 below. Descriptive data for the season 2000/1 with its 306 matches are displayed in Table 1.

[Table 1 here]

Home teams score on average 0.62 goals more than the visiting team, and we observe a total of 2.93 goals per match on average. 161 matches are won by the home teams, but only 76 by the visiting teams. The other 69 matches ended with a draw. Excluding draw matches, home teams win 67.9% of matches, visiting teams only 32.1%.[13]

In total, 76 penalties have been awarded, 55 for the home teams, respectively 21 for the visiting teams. Goals in extra time have only been scored in 11 out of 306 matches. Average

[13] Home advantage in the English Premier League is slightly lower (about 65%; see Nevill et al., 1996), whereas it is considerably higher in Italy or Spain (with about 75%; see Stefani, 1983).

extra time in the second half is 1.88 minutes, whereas it is significantly smaller in the first half (1.11 minutes; $p < 0.001$; t-test). Home teams are significantly less often penalized by yellow cards and sending-offs through red cards, respectively ($p < 0.001$; t-test).[14] Substitutions are 2.65 per team on average (the maximum allowed being 3 players) and do not differ between home and visiting teams. Note that on average only 0.3 players are substituted in the first half, whereas 5.0 players are substituted in the second half. Average attendance is 30,900, filling on average 75% of stadium capacity.

3 Results

3.1 Home bias in extra time

Figure 1 presents average extra time in the second half, depending upon the score margin after 90 minutes. A positive score margin indicates that the home team is leading when extra time starts. The most extra time is awarded in case the home team is one goal behind (–1). The general impression is that extra time gets smaller the larger the absolute score margin. I.e., referees award less extra time if it is already clear which team is going to win, respectively lose. A simple OLS-regression supports the general impression and, thus, our Hypothesis 1. Table 2 reports the impact of the score difference (score margin) on extra time added after 90 minutes. Even when controlling for the number of yellow or red cards and the number of player substitutions [see model (2) in Table 2][15], the absolute value of the score

[14] Nevill et al. (1996) report that home teams also face significantly less sending-offs (red cards) than visiting teams in the English and Scottish football leagues. They take this as a sign of home advantage and of referee bias. We deem their results as indirect evidence at best. A clean test of referee bias would have to take into account the frequency of not allocating a red card as well, both for home and visiting teams. Such a test is provided for penalties in this paper.

[15] Yellow and red cards are often connected with injuries, which tend to be time consuming. As opposed to most US team sports, in (European) football the 90 minutes of a match are in gross terms. Hence, the clock is never stopped during the match (with the exception of the half-time break of course). Referees are requested

difference remains significant such that each unit increase in the score difference yields about a quarter of a minute less extra time.

[Figure 1 here]

[Table 2 here]

In our further analysis, we will concentrate on matches with a close score margin, ranging from –1 to +1, since in these matches the discretionary power of the referee to decide on extra time can have the most weight. Note first that extra time is significantly longer when the home team is one goal behind ($N = 41$) than when it is one goal ahead ($N = 68$) or when there is a draw ($N = 71$) after 90 minutes ($p < 0.05$; t-tests). The duration of extra time appears to benefit the home team, because there is systematically more extra time in case the home team is one goal behind than if it is one goal ahead. Hence, the amount of extra time, depending upon the score margin, is our measure of favoritism in the following. Of course, this preliminary evidence for bias in referee decisions does not take into account possible factors influencing extra time, like player substitutions or yellow and red cards. Hence, we have tested several models where we account for objective factors possibly affecting the 'correct' extra time.

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to consider injury treatment time and substitutions when they decide on extra time. According to Law 7 in the official Laws of the Game, "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" (see FIFA, 2000, pp. 37-39).

3.1.1 The influence of the score margin

Results on the influence of the score margin on extra time are presented in Table 3 (for score margins –1 and +1, respectively) and Table 4 (for score margins –1 and 0, respectively). The influence of the score margin in close matches on the minutes of extra time in the second half is significantly negative in any of the models presented in Tables 3 and 4, meaning that there is more extra time when the home team is behind by one goal.[16] This is strong evidence in favor of our Hypothesis 2.

[Table 3 here]

With score margins either +1 or –1 at the end of the regular 90 minutes (Table 3), extra time is about half a minute longer if the home team is behind by one goal than when it is ahead by one goal. The total number of yellow cards has a significantly positive influence on extra time in any model. Red cards and the number of player substitutions have no significant impact on extra time [see model (2) in Table 3].[17]

In models (3) and (4) of Table 3 we control for the influence of the identities of the teams involved in a match. True stoppage of a game may depend on the relative strength of the home team versus the visiting team. We measure strength both in terms of a team's budget

[16] The argument that visiting teams being ahead waste more time, which might justify a longer extra time, is unsuitable to account for our results. Using data from Italian, English and Spanish professional top leagues, Palomino, Rigotti and Rustichini (2000) provide evidence, supported by a game theoretic analysis of soccer, that home teams being ahead resort to the same strategy of defending and wasting time as visiting teams being ahead.

[17] The insignificance of player substitutions may seem surprising at first sight. However, there is only very little variation in player substitutions in the second half. In all 306 matches, there are on average 5.03 substitutions in the second half with a standard deviation of 0.96. 77% of all matches have 5 or 6 (the maximum number) substitutions in the second half. Another 15% have 4 substitutions.

for the respective season as well as a team's rank in the table of the previous round.[18] Our regression results imply that the identities of teams have no significant effect on extra time. Hence, we may conclude that referee decisions on the amount of extra time do not systematically depend on the identity of a given team. Even though there is sometimes speculation in newspapers that referees favor the big teams like Bayern München or Borussia Dortmund, we find no statistical evidence for it.[19] Rather, it is the home teams which are favored by referees, since they get significantly more extra time if they are behind by one goal than if they are ahead by one goal. This latter finding is perfectly in line with our assumptions on the preferences of referees and on the deducted expectations on referee behavior under social pressure.

Finally, model (5) in Table 3 analyzes the influence of the stage of the season (game number). Since matches in the later stage of the season are relatively more important in the sense that the decisions on the champion, on the teams that qualify for international competitions and on teams that are relegated to a lower league are imminent, one may suspect that matches become more intense in the later stage of the season, raising the social pressure exerted by the crowd, and referees may react to that by adding more extra time. Even though the coefficient on *game number* is positive, it is far from being significant. Since budgets and ranks of teams as well as the stage of the season exert no significant influence on extra time,

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[18] Garicano et al. (2001) use the position of the team in the standings at the end of the *current* season. We deem it more appropriate to either use the standings in the previous round (as we did and report in the paper) or the standing at the end of the *previous* season (which we did in order to control for the sensitivity of the results in Tables 3 and 4; results remained unchanged), because the reputation of a team is built on past achievements and not on the future standings at the end of the season.

[19] Clarke and Norman (1995) have investigated the question of whether there exists a team specific home advantage in English football leagues. Although they can estimate a home advantage of single teams, a serious drawback of their study is the lack of consistency of home advantage parameters of teams from one year to the next. Consequently, individual team home advantage is a relatively transient or random phenomenon. Our results of models (3) and (4) in Table 3 point in the latter direction, too.

we will abstain in the following tables from reporting model specifications which include these variables.

[Table 4 here]

Results in Table 4 confirm referees' home bias for matches where there is a draw after 90 minutes or where the home team is behind by one goal. Again, extra time is significantly smaller (almost one minute) if the score is relatively more advantageous for the home team, i.e. if there is a draw. Model (2) in Table 4 shows that the number of yellow cards has again a positive impact on extra time. Also the number of red cards enters significantly here. The coefficient for player substitutions is not significant, even though it has the expected positive sign.

[Table 5 here]

Table 5 reports the effects of the score difference on extra time added in the *first* half. Given that we predict referees to favor home teams by adding an amount of extra time which is in the interest of the home team and its supporters, there is no reason why referees should add more extra time when the home team is behind by one goal after 45 minutes, because at least 45 minutes remain to change the result. Rather, referees might be tempted to add less extra time if the home team is behind by one goal in the first half in order to prevent more damage (by the visiting team scoring once more) and to give the home team the opportunity to regroup in the break as soon as possible. Therefore, if anything, we would expect a *positive* sign of the variable score margin on extra time in the *first* half of a match.

Table 5 supports our expectation by showing that referees add about half a minute more extra time if the home team is ahead by one goal than if it is behind by one goal. Model (2) in

Table 5 adds yellow and red cards as well as player substitutions as control variables. In contrast to the second half, where yellow cards extend extra time significantly, they have no significant effect in the first half. The same holds true for red cards. The number of player substitutions turns out to be significant for extra time in the first half. The reason for this is most likely the fact that the few substitutions in the first half – with an average of 0.28 substitutions in the first half and only 24% of matches having one or two substitutions – are in most cases caused by a player's injury which needs some treatment on the field.[20]

3.1.2 The influence of the crowd size

If we assume that referees have a preference to please home team supporters, one may expect more extra time in close matches with a relatively larger audience. Typically, attendance is higher when the visiting team is very popular or when the geographical distance between home team and visiting team is relatively small.[21]

[Table 6 here]

[20] On the contrary, most substitutions in the second half are not caused by major injuries, but by a the desire of the coach to bring in 'fresh' players.

[21] We tested for this in a regression where the deviation of the ratio of attendance to capacity from its mean was the dependent variable and distance between home and visiting team as well as dummies for visiting teams were independent variables. Indeed, distance enters significantly negative and the probably most popular teams in the German Bundesliga (Bayern München, Borussia Dortmund, Schalke 04, Hertha BSC, Hamburger SV and 1. FC Kaiserslautern) enter significantly positive, whereas all other teams enter significantly negative. Regression results are available upon request.

Table 6 presents our regression results where we include either the absolute attendance or the ratio of attendance to stadium capacity as explanatory variables.[22] As can be seen, both variants of controlling for the impact of the crowd size on favoritism yield a significantly positive coefficient, which has been expected from our Hypothesis 3. However, the positive influence of attendance (which is typically higher if the number of away fans is relatively higher) on extra time does not remove the general home bias of referees, as indicated by the significantly negative influence of the score margin on extra time.

3.2 Home bias in awarding penalties

Our Hypothesis 4 claims that decisions on penalties are biased in favor of home teams. Actually, home teams are awarded a total of 55 penalties, 17 of which are awarded in the first half, 38 in the second half. Visiting teams, on the contrary, receive only 21 penalties, 11 in the first, and 10 in the second half. In each half, penalties are more or less evenly distributed across the three quarters of an hour, as can be seen from Table 7.

[Table 7 here]

Of course, we have no reason to assume that it is equally likely that the home team or the visiting team is awarded a penalty. Given that home teams, typically, take the offensive more often than visiting teams, home teams are more likely to get into the penalty area which, in turn, might be responsible for the higher number of penalties for home teams. Yet, it does not seem unreasonable to us to assume that the relation of the number of total goals to the number of awarded penalties should be more or less the same for home and visiting teams.

[22] The ratio of attendance to stadium capacity is employed as an explanatory variable to account for the fact that attendance and identity variables may be highly correlated, which makes it difficult to distinguish between

Yet, whereas home teams get 55 penalties and score 543 times in total, visiting teams get only 21 penalties and score 354 times. Applying a χ^2-test, the distribution of frequencies is significantly different between home teams and visiting teams ($\chi^2 = 4.1$; $df = 1$; $p < 0.05$). Still, we do not want to oversell this distributional difference as an unmistakable sign of a possible home bias of referees.

For a more precise test, we have gone through the reports on whether or not a penalty has been regular according to the rules of the game and whether a referee has refused to award a regular penalty. To qualify a referee's decision as 'refuse' we have considered only those cases where the report on the referee states that the 'referee would have been obliged by the rules to award a regular penalty, but refused to do so'. Clearly, if referees were neutral arbitrators, the relation of regular and awarded penalties to regular, but refused penalties should be the same for home and visiting teams.

Of the 55 penalties for home teams only 5 were classified as irregular, leaving us with 50 regular penalties for home teams. In the reports it was indicated that in another 12 cases the referee would have been obliged to award a regular penalty to the home team. For the visiting teams, only 1 out of 21 penalties was classified as irregular[23], yielding 20 regularly awarded penalties. Yet, in 19 cases referees were reported to have refused to award a regular penalty to the visiting team even though that would have been the only correct decision. Hence, whereas in 50 out of 62 cases (81%) the home team is awarded a penalty which is regular, visiting teams are awarded a regular penalty only in 20 out of 39 cases (51%). The difference is highly significant ($\chi^2 = 9.7$; $df = 1$; $p < 0.01$), indicating a clear home bias of referees with regard to awarding penalties. This result constitutes strong support for our Hypothesis 4.

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the two explanations as predictors for the amount of extra time.

[23] With respect to irregular, but awarded penalties out of the total number of penalties there is no significant difference between home teams and visiting teams.

4 Conclusion

In this paper we have addressed two different forms of agent bias in professional football. By studying decisions on penalties and on extra time, we have provided an empirical test of favoritism of agents, i.e. of referees, which is a hitherto understudied aspect of agency theory. The home bias of football referees is assumed to be caused by the influence of the crowd by (sometimes possibly subconsciously) influencing referee decisions. Favoritism of referees is rewarded non-monetarily in the form of pleasing the crowd which supports the home team. The amount of favoritism established by our empirical analysis should be viewed as a lower bound of favoritism exerted by referees. Other important decisions possibly affecting the result of a match – like assigning red cards to players or deciding on a free kick near the penalty area and on off-sides– have been disregarded in this paper.

Our analysis of data from the season 2000/1 of the German Bundesliga has shown that referees are much more likely to award penalties, which were regular according to the rules of the game, to the home team than to the visiting team. I.e. visiting teams are refused a regular penalty significantly more often. This result adds a further piece to the puzzle of the home advantage of football teams. One explanation for our results stems from the recent findings of Nevill et al. (2002), who have shown that referees tend to penalize home teams less often for the same type of tackles than they do visiting teams. Given this is true, one can readily infer that visiting teams will be awarded less often a (regular) penalty, because referees penalize tackles of the home teams (in the penalty area) less often.

By concentrating on both awarded as well as refused penalties, our analysis is much more suitable to address home bias of referees than the mere counting of awarded penalties,

as has been done by Nevill et al. (1996), for instance.[24] Making an inference from the number of awarded penalties on home bias of referees would necessarily imply the assumption of an equal probability of the home team and the visiting team being awarded a penalty. This assumption seems unreasonable to us, and it is unnecessary for our approach of considering awarded and refused penalties.

Penalties can be crucial for the result of a match. For a rough assessment of the consequences of refusing a penalty, let us simply assume that refused penalties would have been awarded as well as successfully shot and that all other events in a game would have remained constant. Then, 15 results in our data set – equivalent to about 5% of games – would have been changed, 4 in favor of the home teams, and 11 in favor of the visiting teams.

With respect to extra time, we can confirm the results of Garicano et al. (2001) that referees add significantly more extra time when the home team is behind by one goal than when it is ahead by one goal or when there is a draw after 90 minutes. This result holds also true when controlling for 'objective' reasons for extra time such as player substitutions or yellow and red cards. Compared to the results for the *Primera Division*, our results for the *German Bundesliga* indicate that the extent of home bias, even though significant, is much less pronounced in Germany. Whereas in Spain referees add almost 2 minutes more extra time in case the home team is behind than when it is ahead by one goal, the difference is only slightly more than half a minute in Germany. Still, goals scored in extra time changed the results of 4 matches – or about 1% of matches – in the entire season. In three times, the beneficiary was the home team, the only case where the visiting team benefited was Bayern München in the final seconds of the season 2000/1.

[24] A noteworthy feature of the results of Nevill et al. (1996) is the fact that the home bias in awarding penalties depends crucially on the size of the crowd, since the observed imbalance in awarding penalties increases in leagues with a larger number of spectators. This result is another indication for the crucial role of the crowd for the home advantage in football.

It can be concluded that favoritism seems to play an important role in referee decisions and that our assumptions about preferences of referees are reasonable. We believe that our findings of biases in penalty decisions are more important than those on extra time, because decisions on penalties are typically much more influential than adding half a minute of extra time. Much more match results would have been changed if penalties had been awarded in an impartial way than if extra time had been assigned without a bias. Of course, the ceteris paribus assumption is much more heroic in the penalty case – on average there is much more time left to react to an (awarded or refused) penalty in the course of the game – than in the extra time case. Still, referee decisions on penalties have been proven to be a considerable source of favoritism of agents. Note finally that there are quite a few economically relevant situations in which agents have to decide under social pressure, and the according decisions may, therefore, be biased and, probably, inefficient. The behavior of football referees that we studied here serves only as a possible example of favoritism which may, in fact, also be widespread in environments that are of higher relevance for economics.

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Table 1. Descriptive statistics (N = 306)

Variable	average	standard deviation	minimum	maximum
Score difference	0.62	1.89	-4	6
Score home	1.77	1.45	0	6
Score visitor	1.16	1.13	0	5
Penalties home	0.18	0.43	0	2
Penalties visitor	0.07	0.25	0	1
Goals in extra time home	0.02	0.13	0	1
Goals in extra time visitor	0.02	0.14	0	1
Minutes extra time 2nd half*	1.88	1.40	-1	7
Minutes extra time 1st half*	1.11	0.97	-1	6
Yellow cards home	1.98	1.20	0	5
Yellow cards visitor	2.41	1.38	0	10
Red cards home	0.10	0.30	0	1
Red cards visitor	0.20	0.45	0	3
Player substitutions 1st half	0.28	0.53	0	2
Player substitutions 2nd half	5.03	0.96	2	6
Attendance (in 1000s)	30.92	15.38	6	69
Attendance/Capacity	0.75	0.21	0.29	1
Distance home – visitor (in 100 kms)	4.46	2.15	0	9.39

* The minimum value of '-1' (with 5 observations) indicates that the final whistle was blown *within* the 45th minute of the respective half. A value of '0' would indicate that the game ended within the 46th minute.

Table 2. Absolute score margin and extra time in 2nd half

model (dependent variable: extra time in 2nd half)	(1)	(2)
absolute value of score margin#	-0.27**	-0.26**
	(0.06)	(0.06)
yellow cards 2nd half		0.18**
		(0.04)
red cards 2nd half		0.04
		(0.13)
player substitution 2nd half		0.14
		(0.08)
constant	2.27**	0.79
	(0.12)	(0.45)
adj. R^2	0.06	0.14

$N = 306$. Standard errors in parenthesis.

** significant at 1%-level.

The score margin is positive (negative) if the home team is ahead (behind).

Table 3. Minutes of extra time in 2nd half (score margin +1/–1)

model (dependent variable: extra time in 2nd half)	(1)	(2)	(3)	(4)	(5)
score margin#	-0.52*	-0.53*	-0.51*	-0.53*	-0.54*
	(0.26)	(0.25)	(0.25)	(0.26)	(0.26)
yellow cards 2nd half		0.15*	0.16*	0.16*	0.16*
		(0.06)	(0.06)	(0.06)	(0.06)
red cards 2nd half		0.01	0.04	0.04	0.02
		(0.20)	(0.20)	(0.20)	(0.20)
player substitution 2nd half		0.14	0.13	0.12	0.13
		(0.12)	(0.12)	(0.12)	(0.12)
budget home (in Mio. DM)			0.003	0.003	0.003
			(0.002)	(0.003)	(0.003)
budget visitor (in Mio. DM)			0.003	0.003	0.003
			(0.002)	(0.003)	(0.003)
rank home+				0.02	0.02
				(0.05)	(0.05)
rank difference visitor – home+				0.01	0.01
				(0.03)	(0.04)
game number					0.01
					(0.01)
Constant	2.68**	1.29*	0.80	0.57	0.33
	(0.20)	(0.66)	(0.69)	(0.93)	(1.03)
adj. R^2	0.04	0.11	0.15	0.15	0.15

N = 109. Standard errors in parenthesis.

* (**) significant at 5% (1%) level.

Score margin is coded 1 if home team is ahead by one goal, 0 if home team is behind by one goal.

+ rank of home (visiting) team in previous round.

Table 4. Minutes of extra time in 2nd half (score margin 0/–1)

model (dependent variable: extra time in 2nd half)	(1)	(2)
score margin#	-0.88**	-0.86**
	(0.29)	(0.28)
yellow cards 2nd half		0.16*
		(0.07)
red cards 2nd half		0.45*
		(0.22)
player substitution 2nd half		0.01
		(0.13)
constant	1.80**	0.87
	(0.18)	(0.69)
adj. R^2	0.08	0.19

N = 112. Standard errors in parenthesis.

* (**) significant at 5% (1%) level.

Score margin is coded 1 in case of a draw, 0 if home team is behind by one goal.

Table 5. Minutes of extra time in 1st half (score margin +1/–1)

model (dependent variable: extra time in 2nd half)	(1)	(2)
score margin#	0.45*	0.33~
	(0.18)	(0.17)
yellow cards 1st half		0.04
		(0.07)
red cards 1st half		0.43
		(0.33)
player substitutions 1st half		0.41**
		(0.16)
constant	0.98**	0.77**
	(0.13)	(0.20)
adj. R^2	0.04	0.11

N = 134. Standard errors in parenthesis.

~ (*) [**] significant at 6% (5%) [1%] level.

Score margin is coded 1 if home team is ahead by one goal, 0 if home team is behind by one goal after 45 minutes.

Table 6. Attendance and minutes of extra in 2nd half

(score margin +1/–1)

model (dependent variable: extra time in 2nd half)	(1)	(2)	(3)
score margin#	-0.53*	-0.53*	-0.53*
	(0.25)	(0.25)	(0.25)
yellow cards 2nd half		0.15*	0.15*
		(0.06)	(0.06)
red cards 2nd half		0.01	0.03
		(0.20)	(0.20)
player substitutions 2nd half		0.13	0.13
		(0.12)	(0.12)
attendance (in 1000s)	0.02*	0.02*	
	(0.01)	(0.01)	
attendance/capacity			1.00~
			(0.53)
constant	2.14**	0.80	0.62
	(0.31)	(0.68)	(0.74)
adj. R^2	0.08	0.15	0.14

N = 109. Standard errors in parenthesis.

~ (*) [**] significant at 6% (5%) [1%] level.

Score margin is coded 1 if home team is ahead by one goal, 0 if home team is behind by one goal.

Table 7. Penalties

	first half			second half		
number of penalties for	1' – 15'	16' – 30'	31' – 45'	46' – 60'	61' – 75'	76' – 90'
home team	4	6	7	12	15	11
visiting team	4	3	4	2	4	4

Fig. 1 - Extra time by score margin (after 90')