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ABSTRACT

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This paper surveys the empirical literature on the behavior of referees in professional football and other sports. Referees are typically appointed by a principal to be impartial, especially when unbiased referee judgment is vital for the accomplishment of the principal's objective. Answering whether referees make biased decisions and understanding the causes that lead referees to digress from their principal duty of impartiality is therefore fundamental from a theoretical point of view. At the same time, assessing the prevalence and origin of referee bias is germane to various domains of life. Referee bias is particularly relevant in sports, where partial decision-making can determine competition outcomes, which can have strong repercussions on athletes' careers and supporters' well-being.

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1 Introduction

This paper surveys the empirical literature on referee bias in professional football and other sports. Referees are typically appointed by a principal to be impartial, especially when unbiased referee judgment is vital for the accomplishment of the principal's objective. In these cases, subjective evaluation or interpretation of facts is often inevitable. Such situations are prevalent in virtually all domains of life, be it in jurisdiction, where unbiased judgment is crucial to ensure the state's objective of just law enforcement, in labor relations, where non-discriminatory performance evaluations are essential for a fair treatment of workers and to guarantee optimal assignment and promotion decisions, in the scientific production process, where an efficient allocation of research funds depends on impartial referee decisions, and, of course in sports, where favoritism of referees can be detrimental. In order to ensure that referees act in the interest of the principal who appoints them, agency theory offers as simple recipe, namely to align the incentives of the agent and the principal (Baker, 1992).

Taking this formula at face value, economists might jump to the conclusion that it would suffice to pay referees for being impartial, or to punish them for being biased. Such material incentives would, in fact, be more effective if they were the only driver of agents' behavior. However, sociologists and social psychologists postulate that individuals' decisions are not solely determined by material rewards, but are also governed by non-material payoffs that arise in the decision-makers' social environment, in the form of social approval or social sanctions (see Asch, 1951 or Coleman, 1990). Building on this idea, several economists have incorporated social payoffs as an argument in an individual's utility function and developed models in which the quest for social rewards or the avoidance of social sanctions affects individual decision-making (see, e.g., Akerlof, 1980, Bernheim, 1994, Becker and Murphy, 2000). If agents are influenced by social forces, referees might make biased decisions even if such behavior jeopardizes material payoffs. When social stimuli are not aligned with the principal's objectives and out of the prin-

cipal's control, providing the right incentives for unbiased refereeing becomes a baffling task.

Answering whether referees make biased decisions and understanding the causes that lead referees to digress from their principal duty of impartiality is therefore fundamental. At the same time, assessing the prevalence and origin of referee bias is germane to various domains of life. Referee bias is relevant in sports, where partial decision-making can determine competition outcomes, which can have strong repercussions on athletes' careers and supporters' well-being. Referee bias potentially contributes to the home advantage that is observed in many team sports like football, basketball, baseball, and ice hockey.[1] A prominent explanation in the literature on home advantage entails that social support generated by the crowd boosts the home team's performance (e.g., Schwartz and Barsky, 1977, Mizruchi, 1985, Clarke and Norman, 1995), but psychologists question the assumption that supportive crowds directly provoke performance increases across-the-board (see Guerin and Innes, 1993).[2] An alternative mechanism through which a supportive crowd can be conducive to a home advantage works through the crowds' influence on referees to favor the home team (Nevill, Newell, and Gale, 1996; Unkelbach and Memmert, 2010). This mechanism is plausible if social pressure can cause referees to make decisions that accommodate the preferences of a social group even if they are not in accordance with their own material interest.

In this survey, we review the evidence of referee bias in sports. Our initial focus in Section 2 is on studies that assess referee bias in football. These studies constitute an important strand in the literature that focuses on social forces as drivers of biased

[1] Page and Page (2007) survey the literature on home advantage in sports. Several factors and mechanisms that might lead to a superior performance in home games have been put forward, including familiarity with the home stadium, travel factors (Oberhofer, Philippovich, and Winner, 2009), increased levels of testosterone (Neave and Wolfson, 2003), or shirking of the visiting team (Koyama and Reade, 2009).

[2] The social support hypothesis is based on the assumption that individuals provide more effort than is privately optimal for them in the presence of social support (Coleman, 1988). Critics of the social support hypothesis argue that the mere presence of others might also create pressure (either through interaction with other pressure variables or as an autonomous source) and induce individuals perform worse (Zajonc, 1965). Zajonc, Heingartner, and Herman (1969) provide evidence for both views. Findings by Butler and Baumeister (1998) and Cottrell, Wack, Sekerak, and Rittle (1968) underscore that the presence of others can have ambivalent effects on performance.

decision making. Social forces might operate, similar to material incentives, by directly affecting the rewards of referees. An extreme example is bribing, which typically involves material incentives.[3] We do not review studies in this spirit (see e.g. Levitt and Duggan, 2002), but rather focus on studies that entertain the idea that referees are influenced by nonmaterial social payoffs that arise in the decision maker's social environment, e.g. in the form of social approval or social sanctions. Resulting social pressure might not only shape referee behavior by affecting their perceived rewards, but it might also trigger cues to which referees succumb subconsciously, which leads to perceptive bias. For example, if football supporters voice that a player was fouled in the penalty box, the referee might misinterpret the biased opinion of the supporters as signals that the player was actually fouled. Note, however, that we do not survey studies that discuss other forms of cognitive and perceptive biases.[4]

We organize our review in Section 2 by first discussing the evidence of bias in stoppage time decisions. We then turn to the evidence of bias in other referee decisions, such as awarding penalties and goals or sanctioning players by red and yellow carding. Section 3 shifts attention to the determinants of referee bias by considering the impact of social forces and material payoffs. We then review the evidence for referee bias in other sports in Section 4. These studies also highlight the role of preferences for discrimination as a source of bias. Such intrinsic incentives might induce referees to favor particular teams or players based on nationality, ethnicity or gender. Section 5 summarizes and concludes.

[3]There are other forms of misaligned incentives that might arise due to the existence of social forces. For example, officials of sporting bodies might accept home-biased refereeing if this would boost gate revenues as home team supporters are more likely to attend matches when the home team is more likely to win. Such a policy might be optimal even if the sporting body has a strong preference for unbiased competition. For example, in the case of most soccer leagues in which teams typically play each other twice during a season - once as the home team and once as the visiting team - the home bias should be cancelled out over a season (see discussion in Garicano, Palacios-Huerta, and Prendergast, 2005).

[4]Various studies have documented the existence of cognitive and perceptive biases. An interesting example in the context of football is the study by Helsen, Gilis, and Weston (2006), who show that calls for offside position depend on the position of the referee relative to that of the attacker and defender. Frank and Gilovich (1988) show that shirt color induces cognitive biases amongst players. Page and Page (2007) provide evidence that teams have a higher chance to qualify for the next round when they play the second leg at home.

2 Evidence for referee bias in football

For several reasons, referees in professional sports are a perfect object for studying the existence and drivers of referee bias empirically: First, data on referees' decisions are recorded, and it is possible to assess their correctness either by observing objective information or by using statistical methods to detect bias. Second, the incentive structure that referees face, is known. Professional referees are paid to be impartial and their performance is generally monitored. These material payoffs need not be complementary, as there might be a tension between referees' vested interest to be impartial and the preferences of fans in each camp who derive utility from their team's success. Referees' material incentives stem from reappointment probabilities and wage contracts that are usually public. Importantly, there is variation in material payoffs, be it across countries, leagues, or over time, which allows for assessing their role in preventing referee bias. We also observe referees in different social environments, in which distinct social groups have different, well-defined, and potentially conflicting interests. Consequently, there is variation in social payoffs, which become manifest in the form of approval or social sanctions. Variation in material and social payoffs allows researchers to assess their relative importance.

2.1 Referee bias in allowance for time lost

The literature on the behavior of football referees originates in a study by Garicano, Palacios-Huerta, and Prendergast (2001, 2005), which assesses whether referees make biased decisions in the allowance for time lost, or stoppage time.[5] In football games, which consist of two periods that last for 45 minutes each, an "[a]llowance is made in either period for all time lost through: substitution(s), assessment of injury to players, removal of injured players from the field of play for treatment, wasting time, any other cause." (FIFA, 2008, p. 26). According to the official laws of the game "[t]he allowance for time lost is at the discretion of the referee" (FIFA, 2008, p. 26); the referee "has full

[5]Stoppage time and injury time are used as synonyms for the allowance for time lost.

authority to enforce the laws of the game" (p. 21). Garicano et al. (2005) argue that referee bias in stoppage time decisions stems from incentives to satisfy the supporters in the stadium, or – put differently – from referees' quest for social approval. They conjecture that referees favor the home team by allowing for more stoppage time when the home team is behind at the end of regular time, in order to grant the home team the opportunity to turn the score. The expected payoffs for the home crowd are clearly highest when the home team is trailing by only one goal. In this situation, just one goal scored by the home team during stoppage time prevents it from a defeat. The home crowd faces the highest expected costs, in contrast, when the home team leads by one goal and is threatened that the visiting team levels the score during stoppage time.

Garicano et al. (2005) compare referee behavior in 268 close games out of all 750 that were played during the 1994/1995 and 1998/1999 seasons of the Spanish Primera Division. They find significant evidence for home biased refereeing: Stoppage time is about 113 seconds longer when the home team is behind by one goal compared to the situation in which the home team is ahead by one goal. Even when controlling for other potentially confounding factors such as the number of yellow and red cards awarded, and the number of substitutions, this stoppage time differential never drops below 105 seconds. Interestingly, referees apparently adapt their decisions to changing objectives of the home crowd, by shortening the remaining stoppage time once the home team scores during stoppage time.

Referees also have to decide on stoppage time at the end of the first 45 minutes. As fans of the team that is behind are probably less concerned at halftime as their team has another 45 minutes to turn the score, supporters are not expected to put pressure on referees. Indeed, Garicano et al. (2005) find no significant difference in stoppage time decisions at the end of the first half. This finding suggests that referees weigh material and social benefits: When the crowd's marginal benefit of an additional second of stoppage time is (sufficiently) small as is the case at half-time, social rewards are arguably not large enough to induce the referee to make biased decisions.

The work by Garicano et al. (2005) inspired several studies, listed in Table 1, that replicated their results using data from other countries. Using data for the 109 close games of the 2000/01 season that the sports magazine kicker publishes on its website, Sutter and Kocher (2004) find a stoppage time differential of 0.53 minutes (i.e., 32 seconds) when they control for number of player substitutions and cards awarded. This differential is substantially smaller than in the Spanish data but still significant.

Dohmen (2008) analyzes data from 12 seasons of the German premier football league (1. Bundesliga) that were collected by the company that maintains the official football database of the DFL Deutsche Fuball Liga GmbH, the German football league association. Controlling for yellow and red cards, player substitutions, and fouls, he finds an average stoppage time differential of about 22 seconds in the 1,166 close games (i.e. games, in which the home team is either ahead or behind by one goal).[6] As in Spain, referee bias in first-half stoppage time decisions is much smaller, compared to the stoppage time in the second half (amounting to 7 seconds only). There is also no evidence of referee bias in games in which either team is ahead by more than one goal.[7] Remarkably, a re-analysis of an extended data set covering 14 seasons from 1992/93 to 2005/06 reveals that games in which the home team is behind by one goal at the end of regular playing time last on average longer than games in which the home team is ahead in all but two seasons (1992/93 and 1995/96). In the latter seasons games last 8-9 seconds longer when the home team is ahead, but this effect is statistically not significant. In all other 12 seasons,

[6]The data that Dohmen (2008) analyzes records the timing of the events that should determine the length of stoppage time according to Law 7 of the laws of the game. This allows to distinguish events that occur in the second half and therefore should affect second half stoppage time from events that happen in the first half. In addition, these data also record the number of interruptions due to injury treatment. Controlling for these events is important as Law 7 of the Game lists "assessment of injury to players" and "removal of injured players from the field of play for treatment" as reasons for granting stoppage time.

[7]One difference between Spain and Germany relates to the length of stoppage time in tied games. While in Spain less stoppage time is granted in games in which the home team is ahead by one goal than in tied games, these games last longer than tied games in Germany (see Dohmen, 2005), and Italy (see Scoppa, 2008; Lucey and Power, 2005) and the U.S. (Lucey and Power, 2005). Importantly, key patterns of stoppage time distributions conditional on the score difference are, however, similar in all countries: (1) most allowance for time lost is made in games in which the home team is one goal behind, and (2) stoppage time distributions in which the absolute score difference exceeds one goal do not depend on whether the home team is ahead or behind.

referee bias ranges from 8 to 43 seconds and is statistically significant at the 5% level in eight cases.

Referee bias in stoppage time decisions is of the same order of magnitude in English and Italian professional football as it is in German professional football. Analyzing data from the 1999/2000 and 2002/03 season of the English Premiere League, Rickman and Witt (2008) find that close games last about 32 seconds longer when the home team is behind at the end of the regular 90 minutes. Likewise, Scoppa (2008) shows that the home bias in stoppage time decisions amounts to half a minute in two seasons (2003/04 and 2004/05) of the Italian Serie A. Lucey and Power (2005) provide evidence for biased stoppage time decisions in 2003 US Major League Soccer and find that matches in which the home team is one goal behind at the end of regular time last 31 seconds longer than matches in which the home team is trailing by one goal.[8] Two studies for South American leagues suggest that referee bias in stoppage time is fairly small. For the Brazilian Football Championship (Campeonato Brasileiro) 2004 to 2008, Rocha, Sanches, Souza, and Carlos Domingos da Silva (2013) find that the stoppage time in close games is only 11.3 seconds longer when the home team is behind by one goal. For games in the Colombian Professional League (DIMAYOR) between 2005 and 2010, Mendoza and Rosas (2013) find similar differences: If the home team is trailing by one goal, the stoppage time is 11 seconds longer, compared to other close games.

In sum, these studies show that there is evidence for systematic referee bias in second half stoppage time decisions; it is present in all major professional European football leagues, in U.S. soccer, and in two South American football leagues. In all countries, the intensity of home biased refereeing depends on the score margin: It is strongest when the home team is one goal behind before stoppage time starts. In these situations, the home crowd has unambiguously strong preferences for an extension of the game, because the payoffs are high if the home team levels the score while the costs of an additional

[8]This result, however, is significant at the 10% significance level only. For the Italian Serie A, Lucey and Power (2005) do not find significant differences for the 2002/2003 season. The results are, however, not directly comparable to the previous studies because they consider all games in their empirical analysis, and not only close games as in other studies.

goal scored by the visiting team are comparably low. These findings suggest that social payoffs influence the referee's decision who seeks social approval and tries to avoid social sanctioning by the crowd. The impact of social forces might be one of the explanations why we observe differences in the absolute magnitude of the bias across countries: Home bias in stoppage time decisions is, for example, found to be larger in Spain, where average travel distance is longer than 700 kilometers (see Garicano et al., 2005) as opposed to Germany, where average travel distance is shorter than 400 kilometers.[9] To the extent that travel distance is related to the number of away team supporters, this result hints at the role of countervailing social forces that are determined by crowd composition, an issue that we discuss in more detail in Section 3.

A second reason for the differences between the seminal study of Garicano et al. (2005) and other studies is likely to be a change in the Rules of the Game: Just before the end of the regular 90 minutes, the fourth official would then uphold a board displaying the stoppage time visible to everyone. Though the stoppage time is still at the referee's discretion, it may reduce referee bias as the referee's decision is publicly revealed.[10]

2.2 Referee bias in other decisions

Before the introduction of official stoppage time announcements, referees had quite a bit of discretionary power in setting stoppage time and referee bias is relatively difficult to prove for the casual observer because it is typically hard to track how much stoppage time exactly should be awarded. This is because stoppage time is the cumulated allowance for time lost due to a host of events that lead to shorter or longer interruptions. Moreover, observers might be less concerned with monitoring stoppage time decisions as an increase in stoppage time does not have an immediate impact on the game outcome; it merely

[9] See, e.g., http://beta.vereinswappen.de/liga/890022/view/entfernung.

[10] The indication of stoppage time by the fourth official was introduced during the FIFA World Cup in 1998. Several national football leagues introduced this practice in the subsequent years. The English Premier League and the Spanish Primera Division introduced it with the start of the 1998/1999, while the German Bundesliga only adopted the policy in January 2003. Since 2007/2008 edition (FIFA, 2008), the practice is mandated by the Rules of the Game.

provides the team that is behind in score the opportunity to attain a better match result. Other referee decisions such as awarding goals or penalty kicks have a much more immediate impact on the outcome of a game, and these decisions are thus more likely to be scrutinized. Since these decisions also relate to specific events, their correctness is arguably also easier to judge. It is therefore plausible to conjecture that referees are more cautious in these situations and less likely to make obviously wrong decisions in favor of a particular team. On the other hand, the payoff to the crowd is much higher, so that social pressure might be concentrated and high. Table 2 provides an overview of studies that have investigated whether referees are biased with respect to other important decisions in the match, such as penalty kicks, awarding goals, free kicks, red and yellow cards.

2.2.1 Goals

Boyko, Boyko, and Boyko (2007) analyze 5344 of the 5566 English Premier League matches played between August 1992 and June 2006. They estimate the effect of referee-fixed effects on the goal difference, the number of goals for the home team, and the number of goals for the away team, while controlling for other potentially confounding effects, such as crowd size and crowd density. They interpret the significance of the referee-fixed effects as evidence for home-team biased referee behavior. Using a similar approach, but a smaller sample, Johnston (2008) could not replicate this result. In a similar analysis using large data from several UK leagues and competitions, Page and Page (2010a) find that these referee-specific effects are moderated by social pressure. This result suggests that the referees might react differently to social pressure.

Using regression analysis to predict the number of goals for the home and visiting team to make inferences about referee bias based on the difference between actual and predicted outcomes has the obvious drawback that the approach is indirect and hinges on the correct specification of the prediction model. An alternative approach is to directly assess the correctness of decisions to award goals. Dohmen (2008) evaluates expert judgements on the correctness of referee decisions and finds that goals awarded to the home

team were significantly less likely awarded correctly. Moreover, an analysis of all situations in which a goal was scored, reveals tentative evidence that referees grant the visiting team fewer disputable goals, and significant evidence that the home side is granted more illegitimate goals than the visiting side. However, there is no evidence that referees award the visitor fewer legitimate goals than the home team.

2.2.2 Penalty kicks

Evidence of home biased refereeing with respect to penalty kick decisions is more clear cut. Dohmen (2008) finds that a larger fraction of awarded penalty kicks is either wrongly awarded or disputable when the home team is one goal behind. Evaluating all critical situations in the penalty kick area, he also finds that home teams are significantly more likely to be awarded a penalty kick in situations that are rated as disputable by experts who assess the correctness of these decisions after each match based on video recordings.[11] Similarly, Sutter and Kocher (2004), who use journalists' reports on referees' performance, find that during the 2000/01-Bundesliga season home teams were awarded 81 percent of all penalty kicks that should have been legitimately awarded, while visiting teams are awarded only 51 percent of all penalties that should have been awarded. This differential referee treatment is statistically significant. Corroborating suggestive evidence on biased penalty kick decisions is also provided by Boyko et al. (2007) who show that home teams in the English Premier League receive significantly more penalties than their model predicts. Using the same approach that they used to judge referee bias in awarding goals, they find significant referee fixed-effects, which suggests that referees are biased in awarding penalty kicks.

[11] Dohmen (2005) documents that home teams are significantly more likely to receive a penalty kick when it should be awarded and when a penalty call is disputable according to the experts.

2.2.3 Yellow and red cards

Various studies find that referees are biased towards the home team when awarding yellow and red cards. Dawson, Dobson, Goddard, and Wilson (2007), Buraimo, Forrest, and Simmons (2010), Dawson and Dobson (2010), and Buraimo, Simmons, and Maciaszczyk (2012) confirm the indicative evidence for home team favoritism in yellow carding. As yellow and red cards will, however, also be influenced by the player's behavior, these studies attempt to control more precisely for the effect of playing style. Dawson et al. (2007) use pre-match winning probabilities for the opponents from a forecasting model to account for underdog status of teams and the extent to which relative team strength differ. They also control for stakes by distinguishing end-of-season outcomes and including crowd size as an explanatory variable. Buraimo et al. (2010) and Buraimo et al. (2012) refine the approach of controlling for playing style by including within-match information. This is important as playing style and tactics do not only depend on pre-match expectations but also unfold during the game.

Boyko et al. (2007) also analyze decisions to caution or dismiss players and find mixed results. Referees do on average caution players of the visiting team more often than their econometric model, which controls for relative team strengths, predicts, but there is no statistically significant evidence that home team players are less likely to be dismissed due to biased refereeing. In contrast to the findings of Boyko et al. (2007), Johnston (2008) (English Premier League, Season 2006/07) and Reilly and Witt (2013) (English Premier League, Seasons 2003/04 to 2007/08) do not find statistically significant evidence for referee bias in awarding yellow and red cards using a similar sample. Using data from the English FA Cup, Downward and Jones (2007) find that crowd size decreases the probability of a home team player being awarded with a yellow card. While there is a clear effect of crowd size, it is offset by the largest games. In a study using data from the Union of European Football Associations (UEFA)'s Champions League and Europa League, Goumas (2014) finds evidence for referee bias in awarding yellow cards. He documents that crowd density, as opposed to crowd size, significantly affects referee

bias in these European contests. These results suggest that it remains difficult to find conclusive evidence on the how the crowd affects referees.

Pettersson-Lidbom and Priks (2010) exploit a unique situation in Italy in order to identify the effect of the crowd on referee behavior: due to hooligan violence in the Italian Serie A and Serie B, spectators were banned from a substantial number of games of the 2006/2007 season. Pettersson-Lidbom and Priks (2010) find that referees favor the home team by punishing their players less and those of the visiting team more strongly when the game is attended by spectators, compared to games in which spectators were excluded. In order to address the concern that this result is driven by a direct effect of social pressure on the players' behavior, they show that the playing style is not affected by the presence or absence of spectators.

3 Determinants of referee bias in football

Referees are paid for being impartial. If social payoffs are strong, however, financial rewards and career concerns can be jeopardized. Individuals' decisions are affected by both, social as well as material payoffs. In this section, we review the evidence for determinants of referees' biased behavior.

3.1 The role of social payoffs

3.1.1 Stake size

Garicano et al. (2005) analyze a change in the reward system for teams: rewards for winning a game increased from 2 to 3 points.[12] Estimated referee bias in awarding stoppage time in close games is higher in the season after the change, i.e. when relative rewards for winning are higher, than before the change, suggesting that stake size affects referee bias.

[12]Rewards for draws (1 points) and losses (0 points) remained unchanged.

Since supporters have stronger incentives to affect referees' decisions when more is at stake, Garicano et al. (2005) assess whether the size of the bias in stoppage time decisions is higher towards the end of a season. The fewer games remain to be played, the higher are typically the stakes for teams as there is less scope to compensate for points not gained in the current game by increased performance in future games. There are substantial financial incentives (and sportive motives) to finish high in the ranking.[13] Indeed, Garicano et al. (2005) find that referees favor home teams more as the season advances.

3.1.2 Attendance and composition

If referee bias is mainly determined by social pressure, referees should be more biased in games with a large overall attendance compared to games with lower attendance. Garicano et al. (2005) show that an increase in attendance of one standard deviation increases the referee bias by 20%. This result is in line with other results from the literature of home advantage.

The effect of attendance on score difference could, however, be driven by home teams with relatively large attendances. Garicano et al. (2005) propose to use the ratio of attendance to stadium capacity, arguing that crowds are usually large relative to capacity when teams are geographically close to each other, or if the visiting team is very popular. In both scenarios, the share of supporters for the visiting team should be relatively high. Referee bias should thus be smaller since crowds of both teams have similar pressure on the referees. Adding an interaction effect of the ratio of attendance relative to capacity and score difference leads indeed to less bias.

Dohmen (2008) measures relative popularity by a team's attendance-to-capacity ratio in previous away games, since more popular clubs should have more fans nationwide and thus higher attendance-to-capacity ratio even in away games. He finds that referee bias

[13]The highest ranked team wins the championship, but the subsequent ranks are also important, since these ranks determines participation in international competitions, and, for the lowest-ranked clubs, relegation.

towards the home team does not appear if teams are geographically close, unless the visiting team is relative popular. If teams are based further than 150 kilometers apart, referee bias is significant, independent of relative popularity. This is consistent with the idea that social approval and social sanctions have countervailing effects on net social rewards. We expect supporters of each side, who have the common interest that their preferred team achieves success, to work towards this common goal by acclaiming favorable decisions of the referee and by expressing dissatisfaction with unfavorable referee decisions. Referees' decisions hence evoke social approval from supporters of the favored team and social sanctions from the opponent side. A referee who is not inherently biased, i.e. who does not derive intrinsic utility from a particular match outcome and values social payoffs, is expected to weight social costs and benefits.

Exploiting the exclusion of spectators in the Italian Serie A and Serie B in the 2006/2007 season, Pettersson-Lidbom and Priks (2010) find that if referees are exposed to crowd noise, they award significantly less yellow cards and fouls, respectively, to the home team. Their findings confirm the results from a laboratory study by Nevill, Balmer, and Williams (2002) who showed in a controlled experiment that referees assess tackles and challenges differently when they are exposed to crowd noise.

3.1.3 Distance to the field

A third hypothesis regarding the effect of the crowd on the referee's behavior is whether supporters are physically close to the referees or not. If supporters are physically closer to referees, it should be easier to put pressure on referees. Dohmen (2008) distinguishes between stadiums with running tracks and stadiums without running tracks. The estimate of score difference is, controlling for overall attendance and popularity of the visiting team, much weaker and statistically not significant in regressions with games which take place in stadiums without a track. Furthermore, referees tend to award fewer disputable and unjustified penalty kicks when the crowd is separated from the field by an athletics track.

For the Italian Serie A, Scoppa (2008) finds that referee bias is weaker in games with a running track.

Using data from European competitions, Dawson and Dobson (2010) find that referees award more disciplinary points to the home team in stadiums with a running track, suggesting that home supporters have less possibilities to exert pressure on the referee. Buraimo et al. (2010) and Buraimo et al. (2012) confirm this result for the German Bundesliga and the Spanish Primera Division, respectively.

3.2 Material Payoffs

While there is substantial evidence that social payoffs affect (im)partiality of referees, the question remains whether partiality can (partly) be offset by the choice of material payoffs. In the presence of referee bias, football associations could improve their incentive system to elicit more partial behavior. Since football associations can monitor their referees only imperfectly, financial incentives can be used to elicit more partial behavior.

An important determinant of referee bias are wage and career related incentives. For England, Rickman and Witt (2008) use the introduction of professional referees in the Premier League to study the effect of financial rewards for referees on estimated referee bias. The bias is offset in the period after the introduction of financial incentives for referees. Though this result could also be due to selection of high-quality referees into professional contracts or due to an overall decreasing trend in referee bias, the results suggest that financial incentives work for referees.

Besides official financial incentives set by the association, there may also be a separate source of referee bias: bribing. Boeri and Severgnini (2011) analyze rigged matches in the 2004/2005 championship where career incentives, media, and rigging plays an important role. Positive evaluations determined the referee's career prospects. Corrupting managers used media power to put pressure on referees to get favorable referee decisions. Interestingly, not only games at high stakes were influenced, but also games *before* important games, for instance in order to block a top-player for the following game. Though

the case of rigging reported by Boeri and Severgnini (2011) is an extreme (and conscious) form of biased referee behavior, it shows that also games with seemingly lower stakes can have high returns to social pressure.

3.3 Referee-specific effects

Besides the effect of material incentives set by the principal on the bias in refereeing, several studies pointed out that individual-specific characteristics matter for how referees cope with pressure from the crowd. Folkesson, Nyberg, Archer, and Norlander (2002) provide suggestive evidence that age matters for how referees can deal with social pressure, using data from a survey among Australian football referees. A number of studies have tried to provide evidence for individual-specific effects in game outcomes. Boyko et al. (2007) and Dawson et al. (2007) find that referees in the English Premier League differ significantly with respect to the extent of biased decision-making. Dohmen (2005) reports differences in point estimates for individual referee bias, which are statistically not significant, however.[14]

An explanation for differences between referees that was put forward is experience in umpiring games. Boyko et al. (2007) find that more experienced referees call fewer red cards for the away teams. Dawson (2012), however, casts doubt on the argument that more experienced referees can better cope with social pressure from supporters. Although more experienced referees are less likely to be biased towards the home team, the effect of crowd size does not depend on the referee's experience. Overall, the evidence on the importance of refereeing experience in coping with social pressure is not conclusive.[15]

[14]While this may imply that controlling for referee fixed effects should be considered, the estimate of score difference in Garicano et al. (2005), Dohmen (2008) and Rickman and Witt (2008) is only slightly affected by including referee fixed effects.

[15]In international settings, nationality and player might also matter. For international contests, Torgler (2004) and Dawson and Dobson (2010) provide evidence that referees tend to favor teams that are closer to them in terms of nationality.

4 Favoritism in other sports

With regard to the discussion of favoritism in sports, we have so far focussed on football, but referee bias seems also to be prevalent in other sports. Pollard and Pollard (2005) analyze home advantage in team sports in England and North America. While they do not provide evidence for biased behavior of referees towards the home team, they show that home advantage can also be found in baseball, basketball, ice hockey, and American football. For baseball and ice hockey, Pollard and Pollard (2005) find a decline of home advantage over time. While it remains difficult to assess the reasons for this decline, Kalist and Spurr (2006) suggest that technical progress, rule changes, and environmental factors such as lighting affect home advantage in baseball. In contrast to the findings of Garicano et al. (2005), Kalist and Spurr (2006) find that increasing stakes for players did not increase home advantage in US-American baseball, most probably due to actions taken to mitigate home team bias among referees. Using batting information from US-American baseball, Mills (2014) finds that catchers who were close to the umpire get more favorable decisions, similar to more experienced and higher-status players. Balmer, Nevill, and Lane (2005) find different degrees of home bias in judging decisions in boxing and find that home bias is strongest in decisions with most discretionary freedom (point decisions), as compared to knockouts, and attribute this to biased behavior of judges.

A different source of biased behavior among referees is discrimination. Several studies provide evidence that referees discriminate against individual players, mostly due to ethnicity. In a study on racial discrimination in basketball, Price and Wolfers (2010) find that players get more points awarded when the ethnicity of the player is the same as of the refereeing crew. At the same time, they get fewer fouls awarded. For US-baseball, Parsons, Sulaeman, Yates, and Hamermesh (2011) show that a match of the ethnicity of umpire and batter decreases the probability of a pitch being called a strike. Interestingly, this effect can only be found in games where umpires decisions are not electronically monitored. This suggests that referees adapt their behavior consciously if there are monitoring systems. Their evidence also shows that the referee bias also causes changes in the

players' behavior: Pitchers anticipate referee bias and alter their behavior in situations where they are potentially discriminated against.

A related source of biased referee behavior can be observed in national and international competitions. Though referees or judges are often selected to avoid nationalism, there is evidence for nationalism in contests. In Australian football, Mohr and Larsen (1998) find favoritism by referees from the same state: Referees award more free kicks to teams that are from the same state. Similar favoritism is found by Page and Page (2010b) in Rugby competitions where referees in international leagues are often from the same countries as participating teams. In a study on biased behavior of judges in ski jumping and figure skating, Zitzewitz (2006) found evidence for partial behavior. He points out, however, that this behavior is not always the result of favoritism for certain nationalities. Partial behavior can also be the result of "compensating" for nationalism/favoritism of other panel members. He also finds evidence for vote trading within panel juries and bloc judging.[16]

Another argument for inconsistency in referees' decisions is the quality of his decisions. Though, inconsistent behavior in decision does not necessarily has to be biased towards one team. For US-basketball, McCormick and Tollison (1984) show that the increase of the number of referees from 2 to 3 reduces arrests by 34%. Furthermore, their results suggest that the referees decisions became more competent. Evaluating a similar change in ice hockey, Levitt (2002) does only find little effects.

5 Conclusions

This paper reviewed the literature on referee bias. For football, a number of studies have shown that referees favor the home team. Favoritism of football referees can be shown using different measures, such as stoppage time in close games, awarding goals, penalty kicks, and awarding cards to players. Though there are differences in magnitude, the

[16] Zitzewitz (2012) reports that the introduction of anonymous voting to reduce vote trading in Figure Skating did not decrease bias.

results are consistent across different time periods as well as across countries. Referee bias, however, is not unique to football, but can also be observed in other sports, such as basketball or baseball. While most literature on referee bias in US-American sports focused on biased behavior with respect to players' race, the literature on referee bias put forward a different mechanism to explain biased behavior: social forces.

Determinants of referee bias can be summarized in two groups: social payoffs and material payoffs. Referees' social payoffs are affected by size and composition of the supporting crowd, distance of the crowd from the referee, as well as the returns from a win. Research has also shown, however, that principals can at least partly offset social forces by setting incentives, such as increasing wages for referees, or monitoring of referee's decisions. The possibility of appeals, for instance through video proofs, might raise awareness of referees to being monitored. Due to referees' career concerns, they might be induced to reduce biased refereeing. Another potential channel is that increased awareness inhibits subconscious decision making such that referees are less susceptive to succumb to social pressure. Parsons et al. (2011) have shown that the introduction of electronic monitoring systems can reduce referee bias in U.S. baseball. In football, the introduction of video technology to correct wrong referee decisions is currently discussed.

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Table 1: Effect of referee bias on stoppage time*

Observations[a]	Referee bias[b]	Controls used
Garicano et al. (2005): Primera Division, Spain (1994/95 and 1998/99)		
$N = 268$ (750)	112.8 seconds	no controls
	108.0 seconds	controls: yellow and red cards; player substitutions; year dummy; team budgets: rank; difference in rank; team and referee fixed effects further controls used: game number; attendance; ratio of attendance to capacity
Sutter and Kocher (2004): Bundesliga, Germany (2000/01)		
$N = 109$ (306)	31.8 seconds	controls used: yellow and red cards; substitutions
Dohmen (2008): Bundesliga, Germany (1992/93–2003)		
$N = 1{,}166$ (3,519)	22.1 seconds	controls: yellow cards (2nd half and in total); red cards; substitutions; fouls; treatments
	21.7 seconds	additional controls used: season dummies; relative team strength; home team, visiting team, and referee fixed effects further controls used: distance; attraction; attendance; ratio of attendance to capacity
Rickman and Witt (2008): Premier League, England (1999/00 and 2002/03)		
$N = 311$ (760)	18.0 seconds	no controls
	31.9 seconds	controls: yellow and red cards; substitutions; turnover of clubs; team ranking; attendance; ratio attendance to capacity; difference in rank; team and referee fixed effects; also controls for the effect of introducing professional referees
Scoppa (2008): Serie A and B, Italy (2003/04–2004/05)		
$N = 264$ (686)	30.2 seconds	no controls
	26.3 seconds	controls used: yellow cards; red cards (2nd half); substitutions (2nd half); penalties (2nd half)
	40.5 seconds	additional controls used: stadiums with track further controls used: rigged games; team success
Lucey and Power (2005): Serie A, Italy (2002/03)		
$N = 283$	30.0 seconds	no controls
	5.4 seconds (not significant)	controls used: yellow cards (2nd half); red cards (2nd half); goal difference; home/visiting team scoring during extra time; attendance and capacity; ranking variables
Lucey and Power (2005): Major League Soccer, USA (2003)		
$N = 159$	30.6 seconds	no controls
	30.4 seconds	controls used: yellow cards (2nd half); red cards (2nd half); goal difference; home/visiting team scoring during extra time; attendance and capacity; ranking variables
Rocha et al. (2013): Brazilian Football Championship (2004–2008)		
$N = 1413$	11.3 seconds	with controls
Mendoza and Rosas (2013): Colombian Professional League (DIMAYOR) (2005–2010)		
$N = 720$	12 seconds	compared to all other games

Notes:

* Studies are sorted in order of their appearance in the text.

[a] Number of games with a score difference of one after 90 minutes; all games in parentheses.

[b] Measured at the end of the second half of close games using a dummy variable which is 1 if the home team is one goal ahead, and zero if the home team is one goal behind.

Table 2: Effect of referee bias in other decisions*

Boyko et al. (2007): Premier League, England (1992/93–2006/07)	
Goals	1.51 (1.10) goals for the home (visiting) team; significant effect of referee fixed-effect on goal differential and goals of home team;
Penalties	.10 (.06) penalties for the home (visiting) team; significant effect of referee fixed-effect on penalty differential, penalties for home and visiting team
Red cards	.06 (.09) red cards for the home (visiting) team; significant effect of referee fixed-effects for home and visiting team
Yellow cards	1.17 (1.62) yellow cards for the home (visiting) team; significant effect of referee fixed-effects for home and visiting team
	Note: yellow card and penalty differential can partly be explained by referee fixed effects; they note that results are not consistent over time; crowd size affects outcome significantly in most cases, crowd density does not
Johnston (2008): Premier League, England (2006/07)	
Goals	No effect of variation in attendance in explaining goal differential; no effect of referees on goal difference;
Page and Page (2010a): English competitions (1994–2007)	
Goals	Controlling for attendance and difference in team quality, their results suggest that there are still large difference in home bias between referees
Dohmen (2008): Bundesliga, Germany (1992/93–2003)	
Goals	95.05% (95.99%) of home (visiting) team goals are correctly granted
Penalties	65.20% (72.57%) of home (visiting) team penalties are correctly awarded
Sutter and Kocher (2004): Bundesliga, Germany (2000/01)	
Penalties	81% (51%) of home (visiting) team penalties found to legitimate
Dawson et al. (2007): English Premier League (1996–2003)	
Yellow/red cards	More disciplinary actions towards underdogs than to favorites; more sanctions in balanced games and games at the end of the season; evidence for variation of home team bias between referees
Buraimo, Forrest, and Simmons (2010): Premier League, England (2000/01–2005/06)	
Yellow/red cards	Underdog teams playing at home have a lower probability of receiving yellow and red cards
Buraimo, Forrest, and Simmons (2010): Bundesliga, Germany (2000/01–2005/06)	
Yellow/red cards	Underdog teams playing at home have a lower probability of receiving yellow and red cards; in games with tracks, home teams have an increased probability of being awarded with a yellow card
Dawson and Dobson (2010): UEFA^a-tournaments, Europe (2002/03–2006/07)	
Yellow/red cards	More yellow/red cards awarded for visiting team; stadiums with track and referee's nationality affects referee's behavior
Buraimo et al. (2012): Primera Division, Spain (2003/04 and 2006/07)	
Yellow/red cards	Crowd effects larger in stadiums with running track; greater crowd size is related to stronger home bias
Buraimo et al. (2012): UEFA's Champions League (2003/04 and 2006/07)	
Yellow/red cards	Crowd effects larger in stadiums with running track
Downward and Jones (2007): FA Cup, England (1996/97-2001/02)	
Yellow cards	Crowd size affects the probability of home team being awarded; effect is attenuated by games with largest crowds
Reilly and Witt (2013): English Premiership League (2003/04–2007/08)	
Red Cards	No evidence for social pressure effects
Goumas (2014): Champions League and Europa League (2009/10-2010/11)	
Yellow cards	Crowd density, not crowd size affects referee bias
Pettersson-Lidbom and Priks (2010): Serie A and B, Italy (2006/07)	
Yellow cards	.61–.68 fewer yellow cards for home teams in games with spectators

Continued on next page

Table 2 – continued from previous page

Red cards	.07–.08 fewer red cards for home teams (hardly significant)
Fouls	4.36–4.56 fewer fouls for home teams
	Note: Comparing games with and games without spectators
Nevill et al. (2002): laboratory study	
Fouls	15.5% fewer fouls awarded to home team with crowd noise
	Note: they analyse tackling scenes from the game between Liverpool (home) and Leicester City (visiting) (1998/99); referee experience matters for awarding fouls
Boeri and Severgnini (2011): Serie A, Italy (2004/05)	
Game outcomes	Use information on match rigging to detect rigging in previous seasons; rigging is also apparent in balanced matches
Torgler (2004): FIFA Football Worldcup (2002)	
Game outcome	Having a referee from the same region increases probability of winning; language does not have an effect

Notes:

* Studies are sorted in order of their appearance in the text.

[a] UEFA: Union of European Football Associations

Table 3: Referee bias in other sports*

Pollard and Pollard (2005): Baseball, ice hockey, American football (1876–2002)	
Baseball	declining home advantage
Ice hockey	declining home advantage
American football	more annual variability in home advantage; no evidence for decline
Basketball	up- and downward trends in home advantage
Kalist and Spurr (2006): Major League Baseball, USA (1886–2004)	
Errors	evidence for home team bias (decline over time); evidence for environmental factors
Mills (2014): Major League Baseball (2007–2010)	
Pitches	Catchers get more favorable decisions when batting; more favorable decisions toward more experienced and higher-status players
Balmer et al. (2005): European championship boxing (1910–1969)	
Knockouts, technical knockouts, point decisions	Probability of home wins is significantly larger when bout ends in point decisions, compared to knockouts
Price and Wolfers (2010): National Basketball Association, USA (1991/92–2003/04)	
Points	2.5% more points if player race is the same as refereeing crew race
Foul rate	4% fewer fouls if player race is the same as refereeing crew race
Parsons et al. (2011): Major League Baseball, USA (2004–2006)	
Pitches	same ethnicity/race of umpire and batter decrease the probability of being called a strike; effect is only observable in games without monitoring umpires' decisions
Mohr and Larsen (1998): Australian Football League (1992–1995)	
Free kicks	Teams from the same state as the referee get more free kicks
Page and Page (2010b): European Super League (Rugby League), Super 14 (Rugby Union) (2006–2009)	
Game outcomes, penalties, tries	Evidence for favoritism in tournaments with referees of the same nationality as one of the teams
Zitzewitz (2006): judging in winter sports	
Ski jumping	evidence suggesting that judges compensate for other panel members nationalism
Figure skating	evidence for vote trading and bloc judging
Zitzewitz (2012): Figure skating	
Votes	Anonymity of voting did not decrease bias (for vote trading)
McCormick and Tollison (1984): Atlantic Coast Conference basketball, USA (1954–83)	
Arrests	Increasing the number of referees from 2 to 3 reduces arrests by .34; results suggest that referees decisions were more competent
Levitt (2002): National Hockey League, USA (1998/99)	
Minor penalties	evidence for more penalties with two instead of one referee; no effect on other outcomes

Notes:

* Studies are sorted in order of their appearance in the text.