Red Cards: Not Such Bad News For Penalized Guest Teams

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Abstract

A popular soccer myth states that teams affected by a sending-off perform better than they would have performed without the penalty. Based on economic theory, we analyze the course of soccer matches using data from the German Bundesliga from 1999 to 2009. The results show that sending-offs affecting home teams have a negative impact on their performance. However, for guest teams the impact of a sending-off on their performance depends on the time remaining after the sending-off. Thus, the "ten do it better" myth seems to hold for guest teams to a certain extent.

Keywords: soccer, team performance, red card, sending-off, Bundesliga
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1 Introduction And Related Literature

In soccer, as in most team sports, penalties exist to ensure fair play by punishing the player (and the team) for using illegitimate measures to influence the game. For example, someone preventing a scoring chance by committing a foul is sanctioned with a red card.[1] The rules of the International Football Association (Fédération Internationale de Football Association, FIFA) contain several reasons for excluding a player.[2] Contrary to e.g. hockey or handball, the team must not be backfilled after some minutes of short-handedness: it has to play with one less player until the end of the match. However, it remains unclear whether a sending-off actually turns out to be a punishment for the penalized team, or if - like a popular soccer myth states - penalized teams perform better than they would otherwise have performed, had they not received a sending-off.[3]

In light of this ambiguity, we look more closely at the effects a red card might have on a match's process. As theoretical basis, we use team role theory (Belbin, 2004), social impact theory (Latané, 1973), process analysis (Steiner, 1972), and a team development model by Morgan et al. (1994) to derive hypotheses regarding the effect of a red card on the performance of the competing teams, i.e. on the match's outcome. We place a particular emphasis on the moderating role of the complexity of the team task. To test our theoretical predictions empirically, we use data from the German Premiership (Bundesliga) for the seasons 1999/2000 to 2008/2009.

There have been some attempts to estimate the effects of red cards in soccer in the economic literature. Ridder et al. (1994) analyze matches of the first and second division of the Dutch professional soccer league from 1989 to 1992. Using the 140 matches with at least one sending-off, they find that red cards have a negative impact on team performance. Carmichael and Thomas (2005) use data from the 1997/1998 season of the English Premier League to explore home advantages. Additionally, they analyze the effects of sending-offs and find that the expulsion of a player is less costly to guest teams than to home teams. They argue that guest teams who - in many cases - play more defensively are better able

[1]Within this article, we use "sending-off" and "red card" as synonyms, irrespective of whether the sending-off in a particular match was a red card or a second yellow ("yellow-red") card because they both result in an exclusion of the player from the match.

[2]Namely: serious foul play, violent conduct, spitting at an opponent or any other person, denying the opposing team a goal or an obvious goal-scoring opportunity by deliberately handling the ball (this does not apply to a goalkeeper within his own penalty area), denying an obvious goal-scoring opportunity to an opponent moving towards the player's goal by an offence punishable by a free kick or a penalty kick, using offensive, insulting or abusive language and/or gestures, or receiving a second warning in the same match (Fifa, 2009).

[3]In recent years, there have been a lot of examples for that myth. For instance, Barcelona FC was able to equalize in the 2009 UEFA Champions League semi-final against Chelsea FC being short-handed after Eric Abidal received a red card. The equalizer was the decisive goal, implicating Barcelona reaching the final. Another example was the match between Bolton Wanderers and Arsenal FC in the 2008/2009 English Premier League Season. Arsenal midfielder Abou Diaby received a red card - and Arsenal was able to win the match with 3-2 while being short-handed after a 0-2 deficit.

to accommodate to the disadvantage of having one less player. However, the effects of sending-offs have a low statistical significance (for guest teams) and no significance for home teams.

Caliendo and Radic (2006) focus on the Fifa World Cup matches from 1930 to 2002. Their results show no support for the "ten do it better" myth. However, they show that if the sending-off takes place in the second half of the match, the ten players are at least not worse off.

Bar-Eli et al. (2006) are the first to analyze sending-off effects for the German Bundesliga. Using a dataset that contains the Bundesliga matches with one or more red card(s) between 1963 and 2004, they show that an expulsion weakens the team and that its scoring and winning chances decrease. However, they do not account for individual team strength. Additionally, there are no counterfactual observations in their sample. For example, they show that home teams are more likely to score the first goal after a sending-off. As the literature (e.g. Carmichael and Thomas, 2005) suggests, home teams are in general more likely to win matches, Therefore, Bar-Eli et al.'s finding does not necessarily indicate an effect of red cards. Thus, to ascertain the effect of a sending-off on the course of a match, matches without a sending-off should also be taken into account to control for a selection bias.

Our empirical analysis is based on the literature discussed above. We contribute to the literature as follows. First, we introduce a broad dataset for the last ten seasons of the German Bundesliga, which includes both matches with and without sending-offs. In doing so, we are able to test whether a sending-off has a causal effect on the final scoreboard, which is not necessarily the case if, for example, a penalized team would have lost the game anyway. Second, both Caliendo and Radic (2006) and Carmichael and Thomas (2005) control for team strength using information on the number of scoring chances and the number of goals within each match. However, as a team's performance depends not only on its form on the day of the match, but also on its general ability, we control for team strength by additionally taking into account the team performance throughout the whole season. Third, we explicitly take into account a team's home strength. Neither Bar-Eli et al. (2006) nor Ridder et al. (1994) include this variable. Moreover, Caliendo and Radic (2006) include only home team dummies as there is only one home team taking part in each World Cup.[4] However, in league matches, there is always one home team in every match, thus the individual home advantage should be considered.

We find that the key factors explaining the course of a match following a sending-off are the strength of each team, the remaining time to go, and whether the penalized team is playing a home game. A sending-off only affects a guest team negatively when it occurs before minute 70, while a red card always has a negative impact on a home team's performance. Furthermore, we find highly significant negative effects on a match's outcome from the home team's perspective whenever the guest team loses a player after the 70th minute. Hence, our

[4]The 2002 World Cup which took place in Japan and South Korea was an exception.

results support the "ten do it better" myth for guest teams that are not penalized too early in the match.

The article is organized as follows. Section 2 establishes our hypotheses. In section 3, we present our data, econometric model, and empirical results. Section 4 concludes the analysis.

2 Theoretical Predictions

A soccer team is (like any kind of team) composed of different team members having to cooperate to achieve their common target - in this case to win the match. The match itself can be equated with the team task. Within a team, each player has a specific functional role according to his special abilities (Belbin, 2004): in soccer, one can either be a goalkeeper, defender, midfielder, or striker - with several differences within these four "basic" positions, such as center-forward, outside left, outside right, etc. We assume that the team manager composes the team with the optimal combination of players and functional roles at the beginning of the match and constantly optimizes the team's composition regarding players' abilities and roles. Consequently, a sending-off will lead to a suboptimal composition of the team (Belbin, 2004), which in turn will result in a lower ability to perform (Lazear, 1999; Ancona and Caldwell, 1992). The remaining ten players have to cope with the situation by compensating for the missing player. Thus, all, or at least some players have to fulfill not only their own functional role, but also parts or all of the role of the penalized player. Given this reasoning, we pose the following hypothesis:

Hypothesis 1: *The sending-off affects the performance of the penalized team negatively.*

However, motivational aspects of a sending-off could also be important. The theory of social impact proposes that group size is negatively correlated with the outside pressure felt by group members (Latané, 1973). The larger a group becomes, the more the perceived pressure decreases. The reduced pressure allows group members to cut their effort, which is known as "social loafing" (Latané et al., 1979). A sending-off reduces the size of the penalized team externally. Thus, according to the social impact theory, the sending-off increases the perceived pressure on the remaining players, inducing higher effort levels. As performance should be positively affected by player effort, we expect a positive effect on the performance of the reduced team.

Furthermore, team members have to communicate and coordinate themselves to organize their resources in an optimal way to accomplish their goals. Given that smaller teams have lower communication and coordination costs (Lazear, 1999; Steiner, 1972), the reduction of the team size due to a sending-off could allow for a higher team output. Keeping this argument in mind, a team's ability to perform could actually increase when the team is penalized. Given these motivational aspects as well as efficiency gains in the process, we can make a case for the common myth that ten players perform better than eleven. We propose:

Hypothesis 2: *The sending-off affects the performance of the penalized team positively.*

So far, the theories presented propose an impact on the penalized team's performance only. However, we argue that a penalty also has an effect on the opposing team because the constellation of the match changes after the sending-off. Both teams are therefore required to adapt to the changed circumstances. This adaption process could affect both teams' performance. We follow this particular line of thought by applying a model of team development to the context of teams in a soccer match.

Team development models (see Morgan et al., 2001 for an overview) generally propose that while working on a task, teams undergo a series of different stages. This dynamic process is characterized by an increase in the performance of the team. Accordingly, Morgan et al. (2001) state that "teams develop generally from initial ineptness and exploratory interactions to the final levels of skilled performance that are manifested as team members learn to cooperate and coordinate their efforts effectively". In soccer, one can assume that both teams are already in the advanced stages of team development at the beginning of the match. The training sessions and the interventions by the team manager should have allowed the team members to get to know each other and to find their roles within the team. Each team might only have to make small adjustments to the opposing team's play. However, these adjustments usually do not take long because each team has a characteristic way of playing and has prepared for the match by studying the characteristics of the opposing team's strategy in advance. Still, Morgan et al. (2001: 282) state: "The development of a team might be recycled from any of the final stages to an earlier stage if necessitated by a failure to achieve satisfactory performance or if adjustments to environmental demands are required or if problematic team interactions develop."

When a sending-off occurs, both teams face a different environment and have to regain their former performance potential through adaptation. Specifically, the sending-off is equal to an internal shock for the penalized team: the remaining players have to adjust to the smaller team size. Consequently, they are recycled to an earlier stage. However, at the same time, the environment for the opposing team changes as well. Hence, while the reduced team has to adjust its team processes to the altered team composition, the rival team is forced to adapt its processes to a change in the penalized team's composition.

Adapting to changed circumstances (e.g., Allen et al., 2001) takes time and energy away from the original task and thus leads to a poorer team performance. Given that both teams need to adapt to changed circumstances, it is not clear how the red card affects the outcome of the match. However, we argue that some tasks require more attention than others. In this case, if a shock in the form of a sending-off occurs and both teams refocus their energy on adjusting to this shock, the performance of the team with the more difficult task suffers more.

In soccer, the two competing teams can be classified as either the home or the guest team. Empirically, the tasks of the home and guest teams are different, though of course both teams have to concur with the rules of soccer and share the goal of winning the match. Home teams usually choose a more offensive strategy than guest teams.[5] The guest teams' defensive strategy might be conceived as less complex than the home teams' offensive strategy because the latter represents a constant struggle for a balance between scoring and not letting the other team counterattack. Given this reasoning, we argue that the home team is confronted with a more complex task and therefore the performance of the home team will suffer more from a sending-off. Thus, we pose the following hypothesis:

Hypothesis 3: *The sending-off affects the performance of the home team worse.*

3 Empirical Analysis

3.1 Data and Descriptive Statistics

To test our hypotheses, we use data from the German Bundesliga for the seasons 1999/2000 to 2008/2009. All data are obtained from the website of the leading German soccer magazine *Kicker Sportmagazin*. Using the online database on kicker.de, we gathered information on 3060 matches. For each match, we have information on the minute of an exclusion, the name of the player being excluded, and the score at the time of exclusion. In addition, we know the exact time of every goal, the final score, the number of attempts, corners, yellow cards, and the attendance.

Within the ten years covered in our data set, 672 players are excluded from matches. Descriptive statistics show that the number of sending-offs per season varies over time with a maximum of 89 in 2000/01 and a minimum of 49 in 2007/08. The mean is 67.2. Many fans in Germany assume that strong teams such as Bayern Munich or Werder Bremen receive significantly less sending-offs than weak teams such as Energie Cottbus or MSV Duisburg. However, the correlation coefficient between a team's position in the final league table and the number of sending-offs received is not significant, with a value of 0.1099. The correlation coefficient between strength and number of sending-offs against the respective opponent team is -0.1158 and is also not significant.

Controlling for the time a team has been affiliated with the German Bundesliga, the data show that Karlsruher SC (1.5 sending-offs per season), Mainz 05 (1.67), and Arminia Bielefeld (1.71) are the teams that play most fairly. On the other hand, SSV Ulm (7), TSG Hoffenheim (6), and MSV Duisburg (5.67) are sent off the most per season. From an opponent's point of view, teams should be careful when playing Hoffenheim, FC St. Pauli, 1860 Munich, or Schalke 04. These teams' opponents receive 9, 7, 5.2, and 5.1 sending-offs per season respectively. In contrast, teams playing against Mainz 05 (2), Hannover 96 (2.3), and

[5]Empirical evidence for tactical differences depending on the venue which is in a similar vein to our suggestion here is provided by Carmichael and Thomas, 2005.

Unterhaching (2.7) are punished the least. Table 1 reports data on sending-offs for all teams.

Table 1 about here

The majority, about 39 percent, of all sending-offs occurred within the last 15 minutes of the games. Of the remaining, 10 percent prolapsed within the first 30 minutes and 25 percent within the first half.

Table 2 about here

According to public opinion and fans' perceptions, matches between teams from the same or neighboring cities have a special character. Matches such as Borussia Dortmund vs. Schalke 04, 1. FC Köln vs. Bayer Leverkusen, or Hamburger SV vs. Werder Bremen gain significantly more public attention than other matches. We define matches between teams from neighboring cities as derbies. A list of all derbies can be found in the appendix.

The descriptive data (table 3) show that derbies are associated with slightly more sending-offs (0.25 sending-offs per derby and 0.22 sending-offs per match in the total sample) and also slightly more multiple sending-offs (0.05 per derby and 0.03 per match in the total sample). However, the correlation coefficients between the derby dummy variable and the total number of sending-offs in a match, the number of sending-offs of home team players, and the number of sending-offs of guest team players are insignificant.

Table 3 about here

3.2 Econometric analysis

Our total sample includes 98 matches (3.20%) with more than 1 sending-off. Such multiple sending-offs can lead to problems in our econometric analysis: (a) each sending-off could have effects on the final score, (b) there might be multiple interaction effects, and (c) a second (or third etc.) sending-off could be correlated with the prior sending-off(s). Thus, in the following, we exclude all matches with more than one sending-off. To estimate which factors influence the outcome (score) of a match, we start with the following basic model:

$$\text{score90}_{is} = \alpha_0 + \alpha_1 \text{SOhome}_{is} + \alpha_2 \text{SOguest}_{is} + \epsilon_{is},$$

where score90_{is} denotes the final score of match i in season s. We measure the score as the difference between the number of goals of the home team and the number of goals of the guest team. For example, a $4-2$ victory for the home team would yield a score90_{is} equal to $+2$, as would a $2-0$ or $3-1$, etc. SOhome_{is} (SOguest_{is}) is a dummy variable taking the value of one if a player of the home (guest) team is sent off during the game and zero otherwise. Estimating the model using an OLS estimator with heteroscedasticity robust standard errors (White, 1980), we find highly significant coefficients for both dummies, with the SOhome_{is} dummy having a larger impact in absolute terms. Column 1 of table 4 shows the results. We find that a red card for the home team leads to a score that is .99 goals worse within that match. A red card for the guest team worsens the result from the guest team's point of view by .78 goals.

Table 4 about here

However, one might argue that an important explanation for a soccer match's result is the strength of each team. In a second step, we therefore control for each team's strength. We interpret team strength not as the performance of the team on the day, but as the overall strength during the season. As a proxy for the strength of a team in season s, we take the team's number of points in the final table.[6] Of course, the outcome of each match that we analyze influences this number. However, given that we have a maximum number of points in a season of 102 and a maximum number of points in one game of 3, we feel justified in ignoring the bias of our estimates due to endogeneity.

The extended model including controls for team strength is:

$$\text{score90}_{is} = \alpha_0 + \alpha_1 \text{SOhome}_{is} + \alpha_2 \text{SOguest}_{is} + \alpha_3 \text{STRhome}_s + \alpha_4 \text{STRguest}_s + \epsilon_{is},$$

with STRhome_s (STRguest_s) being the home (guest) team's number of points in the final table of season s. Column 2 of table 4 displays the associated results. We find that the coefficients of both sending-off dummy variables remain significant at the 1%-level. However, their impact becomes slightly smaller. Furthermore, we find highly significant coefficients for the team strength control variables. One additional point in the season's final table leads to a .039 better score for the home team. Exactly the same holds for the guest team. The high significance level of these coefficients suggests that the corresponding variables are crucial for determining a match's outcome.

Looking at our results so far, it could be argued that we have an endogeneity problem. The descriptive statistics show that the occurrence of a sending-off is correlated with the score at the minute of occurrence. Thus, our results do not necessarily mean that the sending-off leads to a worse score at the end of the match: maybe the team receives a penalty because of the worse score.

To account for this reverse causality effect, namely that the score has a significant effect on the probability that a sending-off occurs, we include a battery of control variables. For each minute of each match, we create one dummy variable taking on the value of one whenever there has been a sending-off in this minute, and zero otherwise. We then interact each minute's sending-off dummy variable with the score at the end of this minute. This results in a set of interaction terms that are zero in minutes without a sending-off, and which take on the value of the score of the match in minutes when a sending-off occurs. Including these

[6] We explicitly do not use a team's position in the table of the previous matchday as this bears two problems. First, experts argue that the table has only limited validity within the first, say, ten matchdays of a season. Second, it would be unclear how to proceed at each season's first matchday.

interaction terms in our empirical model, we control for the score before every sending-off and, thereby, switch off the reverse causality effect. For the rest of this article, our model thus takes the following form:

$$\text{score90}_{is} = \alpha_0 + \alpha_1 \text{SOhome}_{is} + \alpha_2 \text{SOguest}_{is} + \alpha_3 \text{STRhome}_s + \alpha_4 \text{STRguest}_s + \beta \text{controls} + \epsilon_{is},$$

where *controls* is a vector of additional control variables that we include step-by-step. It contains the variables that allow us to control for the score at the point where the sending-off occurred, as well as additional factors such as home advantage or attendance.

Table 5 about here

We estimate our empirical model using an OLS estimator that includes heteroscedasticity robust standard errors. Column 1 of table 5 shows the result of the basic regression. With respect to the impact of team strength, we hardly observe any difference compared to our previous regression results. However, we find substantial changes in the effects of a sending-off. The negative effect for the home team is still significant at the 1%-level, but the coefficient becomes smaller. Looking at the dummy variable for a sending-off imposed against the guest team, we find that it not only becomes much smaller, but that it is also only significant at the 10%-level. This leads us to the conjecture that we cannot reject hypotheses 1 and 3: a red card weakens the affected team, but the effect is worse for a penalized home team than for a penalized guest team. As we control for the possible reverse causality effect of a score leading to the occurrence of a sending-off, we can interpret these effects as causal effects of sending-offs on the final score of a match.

One particularly important factor in soccer is the existence of a home advantage. Within our sample, home teams won about 48% of the matches, but guest teams only won 27%. 25% of the matches resulted in a draw. However, for our analysis, the very existence of a home advantage is not that important. Instead, it is more important whether the home advantage differs between teams. One might think about a loud crowd on the standing terraces or a historical playground, irritating guest players. An example for the latter would be the famous Anfield Road Stadium in Liverpool. Just before entering the stadium, the players pass a red sign that reads, "This is Anfield.", which is touched by each player of Liverpool FC and is intended to impress the other team's players. Clarke and Norman (1995) describe a measure for calculating the home advantage of a certain team in a particular season. They compare each team's goal difference at home and the goal difference away with the average home team's goal difference and use this information to calculate each team's home advantage. We apply their method and obtain a specific home advantage measure for each team in each season. Implementing this control variable for the home advantage in our regression (column 2 of table 5), we hardly find any changes in the results with respect to the impact of a home sending-off, guest sending-off, or each team's strength. However, the positive coefficient for the home advantage turns out to be highly significant (at the 1%-level). Hence, the larger the home advantage of a team in a season, the better the result of the particular match.

Attending a soccer match in a stadium or watching it on TV, one can in most cases hear both teams' supporters chanting. As the supporters want to help their team and intimidate the opponent team, it would be useful to test whether there is a "supporters effect" on the outcome of a match. Unfortunately, we have no objective measure to account for the supporters. Thus, as a first step, we simply include the attendance in our estimation. However, column 3 of table 5 shows that attendance does not have a significant impact on the final outcome of a match. To check whether relative attendance plays a role, we calculate the ratio of attendance to stadium capacity and include this control variable in the estimation (column 7 in table 5). In doing so, none of the results change.

As discussed in our descriptive statistics section, one might argue that derbies are different to other matches. With respect to our supporters argument, derbies may lead to different results as the share of fans of the guest team is usually higher in derbies than in other matches, due to the shorter journey and the higher public relevance of the match. Thus, we add a derby dummy into our regression. The coefficient has the expected negative sign, but remains statistically insignificant (see column 4 of table 5). Interacting the derby dummy with attendance does not lead to any different results.

Caliendo and Radic (2006) examine another important factor for the effect of a sending-off: the time to go until the end of the match. To control for this time aspect, we implement two additional variables, where we interact the sending-off dummy variables for the home and the guest team with the remaining time in the match when the sending-off occurs. Column 5 of table 5 shows the results of the OLS estimation, including the information on the time to go. Compared to the previous results, the picture changes dramatically. The coefficient of the home sending-off dummy, which is $-.4987$, remains negative and significant at the 1%-level. However, the sign of the guest sending-off coefficient changes. We find that a red card for the guest team leads to a score that is worse .4937 goals for the home team. The coefficient is significant at the 1%-level. Looking at the coefficients for the time control variables, we can explain this astonishing result: for a home sending-off, remaining time does not play any role. In contrast, for a guest sending-off, we find that one more minute to go after the sending-off leads to a .02585 better final score for the home team. Combining the negative "level effect" of the guest sending-off on the final score (from the home team's perspective) with the "time effect", we find that the positive "time effect" overcompensates the negative "level effect" whenever the sending-off occurs more than 19 minutes before the end of the match. The same holds when instead of using the minutes to go until the end of the match we use their *log* (column 6).

The inclusion of further control variables (table 5, columns 8 and 9) does not change the results that are of central interest to us. We still have a highly significant (1%-level) negative home team effect whenever the home team is penalized, and a significant positive, but smaller, effect for the home team whenever the guest is penalized. The team strengths coefficients remain unchanged.

As we use the team strength variables to control for strength within the season, one might argue that we should also control for each team's strength within the particular game. Given the data available in public databases, one possible proxy could be the number of scoring chances for each team during each match.[7] However, we do not know the exact quantity of attempts before and after the sending-off, but only the sum of each team's scoring chances for the whole match. If we include control variables for both teams' scoring chances, both turn out highly significant and have the expected sign. All other coefficients of central interest remain unchanged. The same holds when we include the number of corners for each team in a particular match. Interestingly, the coefficients of the corner control variables for both teams do not have the expected sign: the more corners a team has, the worse is its final score. This result seems somewhat surprising at a first glance. However, the fraction of goals after corners is extremely low - as only about 2 out of 100 corners actually lead to a goal (Biermann, 2009). Additionally, corners pose a severe threat of being counterattacked, particularly if some of the (usually tall) defence players join in on a header.

With respect to the hypotheses we developed at the beginning, we can draw several conclusions. First, we cannot reject hypothesis 1 ("The sending-off affects the performance of the penalized team negatively"). For penalized home teams we find a highly significant negative effect in all specifications of our empirical model. Assuming that the team is composed optimally at the beginning of the match (and within the match via substitutions), a sending-off weakens the team, as a player who is specialized in a certain position is excluded from the match. Second, we can partly, but not wholly reject hypothesis 2 ("The sending-off affects the performance of the penalized team positively"). On the one hand, we find a positive "level effect" of a sending-off for the guest team, but, on the other hand, the negative time effect compensates this effect whenever the sending-off occurs earlier than in minute 70. The motivation effect discussed in the argumentation for hypothesis 2, therefore, appears to (over)compensate for the optimal team composition effect, at least for some time. Third, hypothesis 3 ("The sending-off affects the performance of the home team worse") can also not be be rejected as we consistently find highly significant negative effects of a sending-off imposed against the home team on its performance, while we only partly find negative effects for the guest team.

Thus, we conclude that the famous "ten do it better" myth may hold for guest teams - if they are penalized not too early in the game. In contrast, red cards are always bad for penalized home teams, no matter when they are penalized.

3.3 Robustness checks

To control the robustness of our results, we first apply two alternative measures of a team's strength: a team's position in each season's final table and a team's goal difference in each season's final table. As can be seen in columns 2 and 3 of table 6, the coefficients of our variables of interest are robust and stay almost the same. In interpreting the team strength coefficients, one should note that the coefficients of the strength measure "position in final table" have reverse signs in comparison to our standard measure for a team's strength,

[7] This is exactly what Carmichael and Thomas (2005) also do in their analysis.

namely its number of points in the final table of a season. This is due to the fact that a higher number of points represents a better team performance - corresponding to a better position in the final table which is denoted by a smaller number. Hence, our standard measure for a team's strength increases with the team's strength, whereas this robustness check measure decreases with the team's strength, leading to different signs of the coefficients.

Table 6 about here

Due to the (small) endogeneity of our standard team strength measure which we discuss above, we apply a third alternative measure for team strength, namely a team's average position in the final tables of the three preceding seasons. This measure is clearly exogenous when analyzing matches of subsequent seasons. For those teams which have not been members of the Bundesliga within all of the last three seasons at any point of time, we use their positions in the final table of the second division (Zweite Liga) or third division (Regionalliga/Dritte Liga), respectively. For example, a team which has been on positions 14 and 17 in the Bundesliga and position 2 (equivalent to $18 + 2$) in the Zweite Liga during the last three seasons would end up with rank $(14 + 17 + 20)/3 = 17$. From column 4 of table 6, we can see that our results are robust.

As a further check for robustness, we estimate our empirical model using an ordered logit estimator as one may perhaps argue that scoring one additional goal is more important in case of a tight score. Employing our four different measures for team strength, columns 5 to 8 of table 6 show that the coefficients have the identical signs and significance levels as in the OLS regressions. The marginal effects are consistent with our OLS results for final outcomes between 5-goals victories of the guest team and 6-goals victories of the home team (which are 99.75% of all matches).

Tables 7 and 8 about here

So far, we analyze whether the number of goals scored by each team depends on a sending-off. As a last check for robustness, we do not look at the number of goals, but at the score measured by home victory, guest victory, or draw. Tables 7 and 8 show that results in terms of victory, draw, defeat remain largely the same. For instance, home (guest) teams which are in the lead when receiving a red card nonetheless win 70% (62%) percent of these games. However, in 30% of the matches with a sending-off, the final score in terms of victory, draw, defeat deviates from the score at the minute of the sending-off. Using a new dependent variable indicating home victory, draw, or guest victory in our regression model (employing adjusted measures for the score at the minute of the sending-off), our OLS estimates show the same picture as described above. None of the coefficients relevant for testing our hypotheses changes with respect to magnitude or significance.

4 Conclusion

A popular soccer myth states "ten do it better", meaning that a team penalized by a sending-off performs better than it would have done, had it not been penalized. Using team role theory, social impact theory, process analysis, and team development theory, we derive hypotheses about the course of a soccer match after a sending-off.

To test our hypotheses, we use data from the German Bundesliga from seasons 1999/2000 to 2008/2009. The econometric analysis shows that performance effects contingent on sending-offs exist. Controlling for each team's strength and possible reverse causality effects as well as other factors such as the home team's home strength, attendance, and whether a particular match was a derby, we derive the following results. First, a sending-off imposed against the home team worsens the final score (from the home team's perspective). Second, a sending-off imposed against the guest team does not lead to such clear results. Whenever the sending-off is given more than 20 minutes before the end of the game, it has a negative impact on the score (from the guest team's perspective). However, a guest team sending-off given later than in minute 70 leads to a worse score from the home team's perspective.

All these effects are highly significant and robust. Employing different measures for team strength, as well as additional control variables such as the number of scoring chances or corners, the results still stay the same and significant. With respect to our hypotheses, we can thus conclude that we cannot reject the hypothesis derived from the team development theory: the home team is more affected by a sending-off than the guest team. Team role theory would suggest a team becomes weaker after a sending off - and this is exactly what we find for home teams. However, social impact theory and process analysis suggest some counteracting effects, e.g. motivational effects, that lead to a better performance for the penalized team. As we find that a guest team sending-off given in a later stage of the match betters the result (from the guest team's perspective), these motivational effects seem to be important (in the case of a sending-off imposed against the guest team) and seem to be able to overcompensate for the negative effects derived from team role theory. However, as we find that a guest team sending-off given early in the match harms the guest team's chances, we conclude that this motivational effect is not large enough to overcompensate for being short-handed for a long time.

5 Appendix

Team	Seasons of affiliation to Bundesliga	Sending-offs imposed against team (total)	Sending-offs imposed against opponent (total)	Sending-offs imposed against team (av. per season)	Sending-offs imposed against opponent (av. per season)
Alemannia Aachen	1	4	3	4.0	3.0
Hertha BSC Berlin	10	41	31	4.1	3.1
VfL Bochum	7	25	27	3.6	3.9
SV Werder Bremen	10	40	29	4.0	2.9
DSC Arminia Bielefeld	7	12	26	1.5	3.7
FC Energie Cottbus	6	22	17	3.7	2.8
BV Borussia 09 Dortmund	10	38	35	3.8	3.5
MSV Duisburg	3	17	10	5.7	3.3
SG Eintracht Frankfurt	7	24	24	3.4	3.4
SC Freiburg	5	17	18	3.4	3.6
Hamburger SV	10	40	50	4.0	5.0
Hannover 96	7	24	16	3.4	2.3
1.FC Kaiserslautern	7	25	27	3.6	3.9
Karlsruher SC	2	3	7	1.5	3.5
1.FC Köln	5	25	20	5.0	4.0
Bayer 04 Leverkusen	10	47	41	4.7	4.1
FSV Mainz 05	3	5	6	1.7	2.0
Bayern Munich	10	26	35	2.6	3.5
TSV 1860 Munich	5	25	26	5.0	5.2
Borussia Mönchengladbach	7	21	20	3.0	2.9
1.FC Nürnberg	6	21	22	3.5	3.7
FC St. Pauli	1	5	7	5.0	7.0
FC Hansa Rostock	7	34	33	4.9	4.7
FC Schalke 04	10	38	51	3.8	5.1
VfB Stuttgart	10	39	42	3.9	4.2
SSV Ulm 1846	1	7	5	7.0	5.0
SpVgg Unterhaching	2	8	5	4.0	2.5
VfL Wolfsburg	10	33	30	3.3	3.0

Table 1: Descriptive Statistics. Sending-offs per team.

Minute	Total	Percent	Cumulated
1-15	10	1.49	1.49
16-30	48	7.14	8.63
31-45	94	13.99	22.62
46-60	118	17.56	40.18
61-75	135	20.09	60.27
76-90	267	39.73	100.00

Table 2: Descriptive Statistics. Time structure of sending-offs.

List of derbies (Average numbers of sending-offs per match in brackets)
VfL Bochum - FC Schalke 04 (0.21), VfL Bochum - Borussia Dortmund (0.14), VfL Bochum - MSV Duisburg (0), Werder Bremen - Hannover 96 (0.25), Werder Bremen - FC St. Pauli (0.5), Borussia Dortmund - FC Schalke 04 (0.5), Borussia Dortmund - MSV Duisburg (0.16), Eintracht Frankfurt - FSV Mainz 05 (0.5), Hamburger SV - Werder Bremen (0.15), Hamburger SV - Hannover 96 (0.08), Hamburger SV - FC St. Pauli (0), 1. FC Kaiserslautern - FSV Mainz 05 (0.25), 1.FC Köln - Bayer Leverkusen (0.5), 1.FC Köln - Borussia Mönchengladbach (0.25), Bayer Leverkusen - Borussia Mönchengladbach (0.21), Bayer Leverkusen - Alemannia Aachen (1), Borussia Mönchengladbach - Alemannia Aachen (0), Bayern Munich - 1.FC Nürnberg (0.25), Bayern Munich - 1860 Munich (0.3), Bayern Munich - SpVgg Unterhaching (0), 1.FC Nürnberg - 1860 Munich (0), FC Schalke 04 - MSV Duisburg (0), VfB Stuttgart - SC Freiburg (0.3), VfB Stuttgart - Karlsruher SC (0), SpVgg Unterhaching - 1860 Munich (0.5)

	Full sample	Derbies
Number of sending-offs / All matches	21.96%	25.00%
Number of sending-offs imposed against home team / All matches	7.32%	10.00%
Number of sending-offs imposed against guest team / All matches	14.64%	15.00%
Matches with multiple sending-offs / All matches	3.20%	5.00%
Number of red cards / All sending-offs	46.00%	50.00%
Number of second yellow cards / All sending-offs	54.00%	50.00%

Table 3: Descriptive Statistics.

List of variables in regression result tables:

- **SOhome (SOguest)**: Dummy variable, 1 if sending-off imposed against home (guest) team, 0 otherwise
- **Str h po (Str g po)**: Strength of home (guest) team: points in respective season's final table
- **Str h pl (Str g pl)**: Strength of home (guest) team: rank in respective season's final table
- **Str h goals (Str g goals)**: Strength of home (guest) team: goal difference in respective season's final table
- **Str h av (Str g av)**: Strength of home (guest) team: average rank in the 3 preceding season's final table
- **Homeadv**: Homeadvantage/homestrength: measure developed by Clarke and Norman (1995)
- **Attendance**: Absolute number of spectators
- **Derby**: Dummy variable, 1 if match was classified as derby, 0 otherwise
- **Rel. Attendance**: Absolute number of spectators as ratio of stadium capacity
- **SOhome mintogo (SOguest mintogo)**: Interaction between SOhome (SOguest) dummy and minutes to go after sending-off
- **SOhome log mintogo (SOguest log mintogo)**: Interaction between SOhome (SOguest) dummy and log of minutes to go after sending-off
- **h attempts (g attempts)**: Absolute number of scoring chances for the home (guest) team during the match
- **h corners (g corners)**: Absolute number of home (guest) team corners during the match
- **dPV min**: Controls for score at the minute of sending-off

	(1)	(2)
SOhome	-.9919***	-.8461***
	(7.17)	(6.70)
SOguest	.7759***	.7363***
	(7.90)	(7.84)
Str h po		.0389***
		(17.20)
Str g po		-.0390***
		(16.90)
Constant	.4572***	.4548***
	(12.76)	(2.89)
Observations	2970	2970
R-Squared	0.04	0.20
Control for dPV min	no	no

Notes: Absolute value of t-statistics in brackets.
* significant at 10%, ** significant at 5%, *** significant at 1%.

Table 4: Regression Results. Dependent Variable: goals scored by home team minus goals scored by guest team after 90 minutes. Robust standard errors.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SOhome	-0.6048***	-0.5651***	-0.5631***	-0.5620***	-0.4987***	-0.5548***	-0.4986***	-0.4413***	-0.4251***
	(5.25)	(4.73)	(4.73)	(4.70)	(3.68)	(3.06)	(3.67)	(3.05)	(2.98)
SOguest	0.1556*	0.1797*	0.1801*	0.1798*	-0.4937***	-0.8333***	-0.4946***	-0.4545***	-0.4423***
	(1.68)	(1.94)	(1.94)	(1.94)	(4.99)	(5.23)	(4.99)	(4.62)	(4.31)
Str h po	0.03739***	0.03794***	0.03891***	0.03886***	0.03865***	0.03872***	0.03801***	0.01778***	0.04064***
	(16.30)	(16.65)	(15.14)	(15.10)	(15.11)	(15.12)	(16.44)	(7.84)	(17.69)
Str g po	-0.03923***	-0.03940***	-0.03917***	-0.03917***	-0.03891***	-0.03900***	-0.03896***	-0.01868***	-0.04301***
	(16.66)	(16.89)	(16.57)	(16.57)	(16.53)	(16.55)	(16.43)	(8.52)	(18.30)
Homeadv		0.4136***	0.4108***	0.4101***	0.4112***	0.4119***	0.4137***	0.3567***	0.3932***
		(8.43)	(8.35)	(8.34)	(8.40)	(8.40)	(8.46)	(8.30)	(8.16)
Attendance			$-1.65\text{x}10^{-6}$	$1.53\text{x}10^{-6}$	$1.3\text{x}10^{-6}$	$1.23\text{x}10^{-6}$			
			(0.86)	(0.79)	(0.68)	(0.64)			
Derby				-0.05007	-0.06123	-0.05634	-0.06837	0.0004132	-0.07090
				(0.40)	(0.49)	(0.45)	(0.55)	(0.00)	(0.57)
Rel. Attendance							-0.03823	-0.02039	-0.07468
							(0.23)	(0.14)	(0.45)
SOhome mintogo					-0.003064		-0.003149	0.002407	-0.005783
					(0.50)		(0.52)	(0.42)	(0.95)
SOguest mintogo					0.02585***		0.02589***	0.01614***	0.02617***
					(7.03)		(7.04)	(4.94)	(7.19)
SOhome log mintogo						-0.003343			
						(0.04)			
SOguest log mintogo						0.3692***			
						(5.88)			
h attempts								0.1940***	
								(17.85)	
g attempts								-0.2144***	
								(16.22)	
h corners									-0.08047***
									(8.25)
g corners									0.04544***
									(3.74)
Constant	0.5368***	0.3161**	0.3224**	0.3238**	0.3131**	0.3111*	0.3292*	0.07114	0.7208***
	(3.37)	(1.98)	(2.02)	(2.03)	(1.97)	(1.96)	(1.78)	(0.38)	(3.52)
Observations	2971	2971	2971	2971	2971	2971	2971	2971	2971
R-Squared	0.27	0.29	0.29	0.29	0.30	0.30	0.30	0.44	0.32
Control for dPV min	yes	yes	yes	yes	yes	yes	yes	yes	yes

Notes: Absolute value of t-statistics in brackets. * significant at 10%, ** significant at 5%, *** significant at 1%

Table 5: OLS Regression Results. Dependent Variable: goals scored by home team minus goals scored by guest team after 90 minutes. Robust standard errors.

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) o logit	(6) o logit	(7) o logit	(8) o logit
SOhome	-0.4987***	-0.4943***	-0.4415***	-0.5414***	-0.6101***	-0.6032***	-0.5486***	-0.6080***
	(3.68)	(3.65)	(3.09)	(4.03)	(3.71)	(3.70)	(3.12)	(3.91)
SOguest	-0.4937***	-0.5074***	-0.4320***	-0.4932***	-0.5769***	-0.5937***	-0.5302***	-0.5426***
	(4.99)	(5.10)	(4.30)	(5.09)	(4.96)	(5.09)	(4.42)	(5.01)
Str h po	0.03865***				0.04602***			
	(15.11)				(15.29)			
Str g po	-0.03891***				-0.04474***			
	(16.53)				(16.05)			
Str h pl		-0.09498***				-0.1130***		
		(14.78)				(14.89)		
Str g pl		0.09489***				0.1089***		
		(16.30)				(15.87)		
Str h goals			0.02696***				0.03161***	
			(16.46)				(16.07)	
Str g goals			-0.02680***				-0.03051***	
			(17.56)				(16.57)	
Str h av				-0.04833***				-0.05293***
				(8.51)				(8.38)
Str g av				0.05041***				0.05444***
				(10.60)				(10.28)
Homeadv	0.4112***	0.4214***	0.4376***	0.4084***	0.4880***	0.4978***	0.5335***	0.4491***
	(8.39)	(8.55)	(9.06)	(7.80)	(8.49)	(8.68)	(9.10)	(7.83)
Attendance	$-1.3\text{x}10^{-6}$	$1.58\text{x}10^{-6}$	$-8.20\text{x}10^{-7}$	$-1.37\text{x}10^{-6}$	$-1.81\text{x}10^{-6}$	$-2.41\text{x}10^{-6}$	$-1.01\text{x}10^{-6}$	$1.17\text{x}10^{-6}$
	(0.68)	(0.82)	(0.44)	(0.64)	(0.81)	(1.07)	(0.45)	(0.50)
Derby	-0.06123	-0.05033	-0.06106	-0.06990	-0.07925	-0.05897	-0.06962	-0.08794
	(0.49)	(0.40)	(0.51)	(0.52)	(0.57)	(0.43)	(0.50)	(0.65)
SOhome mintogo	-0.003064	-0.004222	-0.004181	-0.009526*	-0.002166	-0.003409	-0.004263	-0.009671
	(0.50)	(0.68)	(0.69)	(1.71)	(0.30)	(0.46)	(0.57)	(1.49)
SOguest mintogo	0.02585***	0.02646***	0.02373***	0.02790***	0.02981***	0.03050***	0.02821***	0.03050***
	(7.03)	(7.20)	(6.82)	(6.82)	(6.51)	(6.63)	(6.32)	(5.98)
Constant	0.3131**	0.3046**	0.2669***	0.1806				
	(1.97)	(2.13)	(3.27)	(1.20)				
Observations	2971	2971	2971	2971	2971	2971	2971	2971
R-Squared	0.30	0.29	0.32	0.21				
Pseudo-R-Squared					0.09	0.09	0.10	0.06
Control for dPV min	yes	yes	yes	yes	yes	yes	yes	yes

Notes: Absolute value of t-statistics (z-statistics) in brackets. * significant at 10%, ** significant at 5%, *** significant at 1%

Table 6: Robustness Checks. Dependent Variable: goals scored by home team minus goals scored by guest team after 90 minutes. Robust standard errors.

		score at minute of sending-off		
		home team leads	draw	guest team leads
final score	home team leads	33	13	3
	draw	11	37	3
	guest team leads	3	18	59
	sum	47	68	65

Table 7: Sending-offs against the home team: score at the minute of the sending-off and at the end of the match.

		score at minute of sending-off		
		home team leads	draw	guest team leads
final score	home team leads	180	56	8
	draw	15	60	15
	guest team leads	6	14	37
	sum	201	130	60

Table 8: Sending-offs against the guest team: score at the minute of the sending-off and at the end of the match.

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