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Player Dismissal and Full-Time Results in the UEFA Champions League and Europa League

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Abstract

This study is the first to estimate the effects of the sending-off of a player on the full-time results in international club soccer. To this end, we analyze data of more than 2,000 recent matches in the UEFA Champions League and UEFA Europa League. We find that, when home teams receive a red card, it harms their goal scoring and victory probabilities. By contrast, a red card for away teams can have a positive, negative, or neutral effect for them, depending on the timing of the player dismissal.

Keywords: soccer, red card, player dismissal, performance, fixed effects regressions

JEL codes: L83, J44, Z00

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Introduction

Soccer is by far the most popular sport in the world, with the number of fans estimated to be about four billion people (Sawe, 2018). This is particularly true in Europe, where the total revenue of the professional soccer market in the 2016/2017 season was estimated at about 26 billion euros (Deloitte, 2018). Clearly, soccer has become more than a sport game—it has become big business (Baert & Amez, 2018; Lowe, 2017). Given the economic dimension of this industry, the scientific literature on the determinants of soccer match outcomes has been growing. Investigated determinants comprise receiving a red card (Bar-Eli, Tenenbaum, & Geister, 2006; Caliendo & Radic, 2006; Červený, van Ours, & van Tuijl, 2016; Chowdhury, 2015; Mechtel, Stribeck, Brändle, & Vetter, 2011; Ridder, Cramer, & Hopstaken, 1994), home advantage (Carron, Loughead, & Bray, 2005; Garicano, Palacios-Huerta, & Pendergast, 2005; Torgler, 2004; Van Damme & Baert, 2019), referee bias (Buraimo, Forrest, & Simmons, 2010; Dohmen, 2008; Reilly & Witt, 2013; Albanese, Baert, & Verstraeten, in press), and even shirt color (Attril, Gresty, Hill, & Barton, 2008; Garcia-Rubio, Picazo-Tadeo, & Gonzalez-Gomez, 2011). This paper relates to the first group of studies and aims to better understand the consequences of receiving a red card during the final score of the match.

To ensure fair play, referees of soccer matches have the power to hand out yellow and red cards (Dunmore, 2011; FIFA, 2017). An unfair act by a player is called a foul, and as punishment, a free kick is given to the opposing team, which becomes a penalty kick if the foul occurred inside the team's own penalty area. For serious fouls, a yellow card (for caution) or a red card (for dismissing a player) can be issued. A player who gets a red card cannot be replaced; hence, red cards are potential game changers.

Although several studies have evaluated the effect of a red card on the final result of a soccer game, they have not converged on a single conclusion. On the one hand, based on data for the Dutch, German, and English national competitions, Ridder et al. (1994), Bar-Eli et al. (2006), and Chowdhury (2015) reported that, on average, a red card harms the full-time results for both home and away teams. The same pattern was found based on World Cup data by Caliendo and Radic (2006) as well as Červený et al. (2016). Thus, all these studies contrast with the famous 'ten do it better' soccer myth (Caliendo & Radic, 2006). On the other hand, Mechtel et al. (2011) found no overall effect of a red card for away teams in their large dataset comprised of matches from the German national league.

In this article, we are the first to estimate the effects of the sending-off of a player on the full-time results in international club soccer. To this end, we analyze data of more than 2,000 recent matches in the Union of European Football Associations (UEFA) Champions League and UEFA Europa League. Since we allow the effects of a red card to be heterogeneous by the home or away status of the team and by the moment of receiving the red card, we are able to answer the following research questions:

R1a. What is the effect of issuing of a red card for the home team on full-time results in European international club soccer?

R1b. What is the effect of the issuing of a red card for the away team on full-time results in European international club soccer?

R2a. Is the effect of a red card for the home team on full-time results in European international club soccer heterogeneous by the timing of this red card?

R2b. Is the effect of a red card for the away team on full-time results in European international club soccer heterogeneous by the timing of this red card?

In addition to its aforementioned substantive contribution, we explore heterogeneity in the effect of a red card by considering other observable match characteristics, such as phase of the tournament, type of competition, teams' relative strength, and nationality. Additionally, this study is innovative based on two methodological aspects. First, our dataset is substantially larger than those analyzed in most former studies in this literature, so we have more statistical power to distinguish between zero and significantly positive or negative effects. Second, the effects presented in former contributions might be biased because they do not control for the fact that when a team gets a red card, this event goes often hand-in-hand with a penalty for its opponent. We account for this in one of our several robustness checks.

Methods

Data

We analyzed data from recent soccer matches in the two most prestigious international club soccer competitions worldwide—measured by the prize and television money at stake (UEFA, 2017)—i.e., the UEFA Champions League and the UEFA Europa League. These two competitions are contested by top-division European club teams. Both the UEFA Champions League and the UEFA Europa League are comprised of two phases: the group phase and the knockout phase. The group phase is played by 32 teams in the UEFA Champions League and 48 teams in the UEFA Europa League. All groups comprise four teams. Each team meets the other teams of its group twice, once at home and once away. The group winners and runners-up proceed to the knockout phase of the competition. During the latter phase, teams meet each other in one home and one away game, after which the team with the positive goal difference over these two matches advances to the following round. In case the goal difference is zero, goals for away teams count twice. If no winner can be determined at the end of the regular time, the games continue for two extra-times and, if needed, penalty shoot-outs. This phase ends with a final match that is played at a neutral ground. To obtain additional insight into the complete structure of these championships, we refer to the official UEFA website (http://www.uefa.com).

Match reports of both competitions are publicly available on the official website of the UEFA (http://www.uefa.com). In one edition of the UEFA Champions League and UEFA Europa League, 125 and 205 official soccer matches, respectively, are played in the two phases of these competitions. Our analyses are based on the match reports for all 1,000 matches in the UEFA Champions League from season 2008–2009 until season 2015–2016 and 1,023 of the 1,025 matches in the

UEFA Europa League from season 2011–2012 until season 2015–2016. For two matches in the UEFA Europa League, the match reports were not available at the moment of our data processing. The match reports of the UEFA Europa League before soccer season 2011–2012 were not considered because the UEFA Europa League employed a different tournament structure before that season.

Table 1 describes the match characteristics used in our analyses conducted to answer R1a, R1b, R2a, and R2b. The dependent variables used in these analyses are presented in Panel A, the independent variables in Panel B, and the control variables in Panel C. We present summary statistics both at the level of the full dataset and at the level of two subsets of matches (i.e. matches with a red card for the home team and matches with a red card for the away team).

Table 1. Data: Summary Statistics

	All matches (*N* = 2,023)		**Matches with red card for home team (*N* = 132)**		**Matches with red card for away team (*N* = 243)**	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
A. Dependent variables						
Goal difference at full time	0.406	1.867	-0.333	1.790	0.869	1.732
Victory by home team	0.471	-	0.280	-	0.605	-
Victory by away team	0.288	-	0.462	-	0.181	-
Final number of goals by home team	1.549	1.326	1.201	1.215	1.790	1.366
Final number of goals by away team	1.142	1.147	1.538	1.201	0.922	0.991
B. Independent variables						
Red card home team	0.065	-	1.000	-	0.000	-
Red card home team × # minutes remaining	1.687	8.350	25.848	21.137	0.000	-
Red card home team × remaining time less than or equal to 20 minutes	0.029	-	0.447	-	0.000	-
Red card home team × remaining time more than 20 minutes	0.036	-	0.553	-	0.000	-
Red card home team × remaining time less than or equal to 10 minutes	0.018	-	0.280	-	0.000	-
Red card home team × remaining time between 10 and 30 minutes	0.023	-	0.348	-	0.000	-
Red card home team × remaining time more than 30 minutes	0.024	-	0.371	-	0.000	-
Red card away team	0.120	-	0.000	-	1.000	-
Red card away team × # minutes remaining	3.073	11.632	0.000	-	25.584	23.501
Red card away team × remaining time less than or equal to 20 minutes	0.063	-	0.000	-	0.527	-
Red card away team × remaining time more than 20 minutes	0.057	-	0.000	-	0.473	-
Red card away team × remaining time less than or equal to 10 minutes	0.043	-	0.000	-	0.358	-
Red card away team × remaining time between 10 and 30 minutes	0.034	-	0.000	-	0.280	-
Red card away team × remaining time more than 30 minutes	0.043	-	0.000	-	0.362	-
C. Control variables						
Match in UEFA Europa League	0.506	-	0.545	-	0.560	-
Match in group phase	0.735	-	0.742	-	0.667	-
Match in knockout phase: first leg	0.130	-	0.106	-	0.136	-
Match in knockout phase: second leg	0.130	-	0.152	-	0.198	-
Final game	0.006	-	0.000	-	0.000	-
Goal difference after first leg	-0.027	0.601	-0.129	0.452	-0.066	0.599
Relative strength home team	0.000	1.716	0.043	1.628	-0.006	1.719
Goal difference at issuing of red card between minute 1 and minute 30	0.000	0.070	-0.008	0.087	0.004	0.193
Goal difference at issuing of red card between minute 31 and half time	0.007	0.163	0.030	0.301	0.041	0.415
Goal difference at issuing of red card between half time and minute 60	0.012	0.237	0.091	0.647	0.049	0.487
Goal difference at issuing of red card between minute 61 and minute 75	-0.002	0.278	-0.061	0.639	0.016	0.649
Goal difference at issuing of red card between minute 76 and full time	0.023	0.412	-0.015	0.847	0.198	0.997

Notes: A definition of these variables can be found in the data discussion. No standard deviations are reported for binary variables. *Source*: Own data processing based on publicly available information on the official UEFA website (http://www.UEFA.com).

Our independent variables all relate to the issuing of red cards for the home and away teams. In 375 (18.5%) of the included 2,023 matches, at least one red card is issued. About 20% of the away teams and 31% of the home teams never received a red card. The top five nationalities that are more likely to receive a red card during a match are Moldova, Serbia, Russia, Slovenia, and Romania, whereas at the bottom we find Slovakia, Kazakhstan, Ireland, Finland, and Azerbaijan. In line with the literature, we consider the first red card only. So, in what follows, when we refer to 'a red card,' we actually refer to 'a first red card.' However, as a sensitivity analysis discussed on page 35, we test the robustness of our results after excluding the 47 matches in which more than one player is dismissed.

A (first) red card is issued to the home team in 132 (6.5%) of the analyzed matches and to the away team in 243 (12.0%) of these games. To answer R2a and R2b, we also included interactions between the issuing of a red card and the remaining time at that moment. First, an interaction with a continuous indicator is included. This continuous indicator is the number of minutes of remaining regular time, ranging from 0 (when the red card is issued in minute 90 or later) to 89 (when the red card is issued in minute 1). We truncate this variable by not including minutes during extra-times. Since only a minority of the matches in our dataset end in extra-time (1%), excluding these matches does not affect our estimates, as shown on page 35. Second, because the overall median remaining time at the issuing of a red card is approximately 20 minutes, we include interactions with indicator variables capturing whether a team has to play more than 20 minutes while one man down (versus 20 minutes or less). Third, interactions with three (instead of two) different time intervals with respect to the remaining time at the issuing of a red card were added: (i) less than or equal to 10 minutes, (ii) between 10 and 30 minutes, and (iii) more than 30 minutes—as can be seen from Table 1, the issuing of red cards is quite equally divided between these three time windows.

In line with Mechtel et al. (2011), Červený et al. (2016), and Baert and Amez (2018), we used the goal difference at full time as our benchmark dependent variable. This variable is defined as the difference at full time between the number of goals scored by the home team and the number of goals scored by the away team. The average value of this goal difference found in the full dataset is 0.406. This substantially positive number is consistent with the home advantage in soccer established in Carron et al. (2005), Garicano et al. (2005), Torgler (2004), and Van Damme and Baert (2019). The summary statistics for the other four dependent variables point in the same direction: The probability of victory for the home team equals 47.1%, whereas the probability of victory for the away team equals 28.8%. The final number of goals by the home team is on average 1.549, which is, again, substantially higher than the average number of goals by the away team at 1.142.

For the subdataset that contains only soccer matches in which the home team received a red card, we find a negative average goal difference at full time (-0.333). In addition, the probability of a victory by the home (away) team and the final number of goals by the home (away) team are substantially lower (higher) within this subdataset compared to the numbers for the total dataset. By contrast, for the subdataset containing only matches in which the away team got a red card, more favorable outcomes for the home team are found. These numbers are in line with most former contributions to the literature on the effects of red cards in soccer that found a negative impact for both home and away teams. However, this descriptive analysis does not consider the endogeneity of receiving a red card with respect to full-time results. That is, receiving a red card may correlate with other determinants of performance in soccer (e.g., relative ranking). The regression approach we discuss in the next subsection addresses this problem by controlling for a large set of match characteristics.

The majority of our control variables are predetermined before the start of the game. Most importantly, to be able to control for the relative strength of the home and away teams, we merged, by analogy with Baert and Amez (2018), the available match reports with information on the UEFA coefficient of the home and away teams (for our time window of seasons). The UEFA coefficient of a team is based on its participation and results in the five previous editions of the UEFA Champions League and the UEFA Europa League. The concrete proxy of the relative strength used in the present study was calculated by taking the natural logarithm of the quotient of the UEFA coefficient of the home team plus 1 and the UEFA coefficient of the away team plus 1 for the relevant season; 1 is added to the coefficients in the numerator and denominator to avoid division by 0. In addition, we created variables capturing the sort of match played: (i) an indicator of matches in the UEFA Europa League and (ii) four indicators of whether the soccer match was a match in the group phase, a first leg match in the knockout phase, a second leg match in the knockout phase, or a final game. The first of these four variables is used as a reference category in our regressions. A last control variable that is predetermined at the start of the match is the goal difference after the first leg knockout match in case the analyzed match is a second leg knockout match (and 0 otherwise).

The other variables in Panel C of Table 1 were added to our data to control for a particular concern with respect to the endogeneity of our independent variables. When a team is underperforming, this may, due to frustration or the need to commit a misconduct to brake the opponent's offensive actions, result in a red card for this team as well as in an unfavorable goal difference at the moment of that red card. Thus, it is important to control for this goal difference at the issuing of a red card. However, as mentioned in Mechtel et al. (2011), including this standing as one continuous number is not advisable, because it would impose the assumption that the goal difference at the issuing of a dismissal has the same impact on the game's outcomes at full time irrespective of whether this dismissal happened early or late in the game. Therefore, in line with Mechtel et al. (2011), we included five additional interaction variables to our dataset that equal 0 in case there was no red card (for the team under review) in the time interval and equal the goal difference in case the team got a red card in this interval: (i) goal difference at issuing of red card between minute 1 and minute 30, (ii) goal difference at issuing of red card between minute 31 and half time, (iii) goal difference at issuing of red card between half time and minute 60, (iv) goal difference at issuing of red card between minute 61 and minute 75, and (v) goal difference at issuing of red card between minute 76 and full time.

The Econometric Model

To answer R1a, R1b, R2a, and R2b, the data presented previously were analyzed by fixed effects regression models that can, by analogy with Baert and Amez (2018), be abstracted by using the following general equation:

$$Y_{ijn} = \alpha + \boldsymbol{\beta X_{ijn}} + \boldsymbol{\gamma Z_{ijn}} + \mu_i + \nu_j + \varepsilon_{ijn}$$

In this equation, Y_{ijn} represents the dependent variable: one of the full-time outcomes mentioned in Panel A of Table 1, with respect to the *n*th match between home team *i* and away team *j*. The vector of two or more independent variables is $\boldsymbol{X_{ijn}}$. These vectors are related to red cards for the home and away teams (as included in Panel B of Table 1), of which we want to know the impact with respect to the dependent variable. $\boldsymbol{Z_{ijn}}$ is a subset of the control variables mentioned in Panel C of Table 1. α is the intercept of the model, $\boldsymbol{\beta}$ is a vector of coefficients related to $\boldsymbol{X_{ijn}}$, and $\boldsymbol{\gamma}$ is a vector of coefficients associated with $\boldsymbol{Z_{ijn}}$. ε_{ijn} is the error term, which was White-corrected given the discrete distributions of our dependent variables.

Finally, μ_i (ν_j) is a home (away) team fixed effect. By introducing these fixed effects, we estimate the effect of receiving a red card on the results at full time within teams. As a result, all dimensions of unobserved, time-constant team heterogeneity that may determine the final outcomes of the analyzed soccer matches and that may correlate with receiving a red card are controlled. Nevertheless, the effect of a red card in these fixed effects models is exclusively identified based on the observation that, in at least one game, the team or its competitor received a red card as well as one match in which this was not the case. This results in a lower statistical power.

Results

Benchmark Model

Table 2 presents the results of regressing the goal difference at full time on indicators of receiving a red card as home or away team and various sets of control variables. In model (1), no control variables are included. Starting from model (2), all match characteristics mentioned in Section 2.1 are added except the relative strength of the teams, which is included from model (3) onward. Starting from model (4), the fixed effects for the home and away teams discussed previously are introduced. In model (5), which is our benchmark model, we include the variables capturing the goal difference at the issuing of a red card at different time windows.

We notice a highly significantly negative effect of receiving a red card by the home team on the goal difference at full time in model (1) to model (5). The magnitude of this effect is fairly stable across these models. The coefficient estimated in model (5) is -0.696 (p = 0.000), indicating that when a home team receives a red card during the game, the goal difference at full time is about seven-tenths of a goal lower. We return to the heterogeneity in this effect by the timing of the issuing of a red card.

By contrast, the effect of the away team receiving a red card on the same dependent variable is significantly positive—which implies an adverse effect from the perspective of the away team given the definition of the goal difference at full time—only for models (1) to (4). In model (4), the related coefficient is 0.370 (p = 0.002). Thus, without controlling for

Table 2. Results: Benchmark Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Red card home team	-0.731*** (0.162)	-0.728*** (0.163)	-0.742*** (0.156)	-0.637*** (0.154)	-0.696*** (0.125)	-0.660*** (0.135)
Red card away team	0.471*** (0.120)	0.449*** (0.119)	0.453*** (0.116)	0.370*** (0.121)	0.107 (0.100)	0.023 (0.102)
Match in UEFA Europa League	-	-0.038 (0.082)	-0.039 (0.079)	0.035 (0.134)	0.026 (0.128)	0.029 (0.129)
Match in knockout phase: first leg	-	-0.182 (0.113)	-0.116 (0.112)	-0.019 (0.124)	0.048 (0.119)	0.077 (0.122)
Match in knockout phase: second leg	-	0.417*** (0.123)	0.345*** (0.122)	0.146 (0.136)	0.109 (0.130)	0.108 (0.131)
Final game	-	-0.304 (0.495)	0.245 (0.463)	-0.708 (0.501)	-0.717 (0.494)	-0.711 (0.492)
Goal difference after first leg	-	0.187** (0.073)	0.151** (0.072)	0.058 (0.074)	0.063 (0.072)	0.065 (0.073)
Relative strength home team	-	-	0.303*** (0.024)	-0.026 (0.056)	-0.035 (0.053)	-0.053 (0.055)
Goal difference at issuing of red card between minute 1 and minute 30	-	-	-	-	1.203* (0.466)	0.974* (0.563)
Goal difference at issuing of red card between minute 31 and half time	-	-	-	-	1.205*** (0.206)	1.152*** (0.221)
Goal difference at issuing of red card between half time and minute 60	-	-	-	-	0.864*** (0.104)	0.882*** (0.107)
Goal difference at issuing of red card between minute 61 and minute 75	-	-	-	-	0.694*** (0.104)	0.656*** (0.119)
Goal difference at issuing of red card between minute 76 and full time	-	-	-	-	0.744*** (0.066)	0.767*** (0.070)
Constant	0.397*** (0.046)	0.396*** (0.069)	0.396*** (0.065)	0.749* (0.397)	0.764* (0.395)	0.723* (0.400)
Fixed effects home team	No	No	No	Yes	Yes	Yes
Fixed effects away team	No	No	No	Yes	Yes	Yes
Exclusion of matches in which red card is followed by penalty	No	No	No	No	No	Yes
Dependent variable: goal difference at full time	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.018	0.028	0.105	0.380	0.450	0.448
N	2,023	2,023	2,023	2,023	2,023	1,977

Notes: A definition of the included variables can be found in the data discussion. The presented statistics are linear regression model estimates with White-corrected standard errors in parentheses. The results for the independent variables are in bold. *** (**) ((*)) indicate significance at the 1% (5%) ((10%)) significance level.

the goal difference at the issuing of a red card, our coefficient estimate is in line with the aforementioned studies finding that, overall, red cards also harm away teams. However, when adding the controls for the standing at the issuing of a red card, this coefficient becomes insignificant both in economic and statistical terms, i.e., it decreases to 0.107 ($p = 0.288$). So, adding these controls turns out to be important.

As a first robustness check, in model (6) we reestimate model (5) after exclusion of the matches in which the red card is immediately followed by a penalty. As mentioned previously, this is done to rule out that the estimated effects of player dismissal are driven by red cards often going hand-in-hand with a penalty for the opponent. Indeed, in 46 of the 375 matches with a red card, the player dismissal is followed directly by a penalty. Excluding these matches from the sample results in a small decrease of the (magnitude of the) effect of a red card for the home team on the goal difference at full time (i.e., from -0.696 to -0.660). Still, however, this negative impact is highly significant ($p = 0.000$). In addition, after excluding these games, the effect of a red card for the away team is virtually zero (i.e., 0.023; $p = 0.820$).

Table 3 presents the results of regression analyses in which the alternative dependent variables discussed previously are used. For all the models in Table 3, the independent and control variables are the same as those included in model (5) of Table 2. The results confirm to a large extent the findings reported for our benchmark model. First, the harming effect of a red card for home teams is found for all models in Table 3. A red card for home teams decreases their probability to win the match by 18.8 percentage points ($p = 0.000$) and increases the corresponding probability for their opponents by 15.0 percentage points ($p = 0.000$). In addition, home teams that receive a red card score, on average, 0.298 goals less ($p = 0.002$) and concede, on average, 0.399 goals more ($p = 0.000$) than similar teams not being issued a red card. Second, in line with

Table 3. Results: Alternative Outcome Variables

	(1)	(2)	(3)	(4)
Red card home team	**-0.188*** (0.038)**	**0.150*** (0.040)**	**-0.298*** (0.098)**	**0.399*** (0.109)**
Red card away team	**0.058* (0.032)**	**-0.042 (0.028)**	**0.046 (0.084)**	**-0.060 (0.074)**
Match in UEFA Europa League	0.024 (0.039)	-0.002 (0.036)	0.132 (0.102)	0.106 (0.090)
Match in knockout phase: first leg	0.014 (0.036)	-0.039 (0.035)	-0.165* (0.085)	-0.213** (0.089)
Match in knockout phase: second leg	0.026 (0.038)	0.013 (0.032)	0.065 (0.102)	-0.043 (0.084)
Final game	-0.292** (0.135)	0.211 (0.147)	-0.321 (0.370)	0.396 (0.295)
Goal difference after first leg	0.017 (0.019)	-0.017 (0.016)	0.078 (0.059)	0.016 (0.042)
Relative strength home team	0.003 (0.017)	-0.013 (0.016)	-0.011 (0.042)	0.024 (0.038)
Goal difference at issuing of red card between minute 1 and minute 30	0.318*** (0.118)	-0.162 (0.140)	1.115*** (0.330)	-0.089 (0.379)
Goal difference at issuing of red card between minute 31 and half time	0.290*** (0.056)	-0.207*** (0.053)	0.655*** (0.179)	-0.550*** (0.131)
Goal difference at issuing of red card between half time and minute 60	0.157*** (0.048)	-0.127*** (0.040)	0.555*** (0.085)	-0.308*** (0.099)
Goal difference at issuing of red card between minute 61 and minute 75	0.147*** (0.025)	-0.144*** (0.030)	0.351*** (0.108)	-0.343*** (0.110)
Goal difference at issuing of red card between minute 76 and full time	0.196*** (0.022)	-0.177*** (0.022)	0.427*** (0.060)	-0.317*** (0.057)
Constant	0.529*** (0.093)	0.370*** (0.095)	2.206*** (0.292)	1.442*** (0.291)
Fixed effects home team	Yes	Yes	Yes	Yes
Fixed effects away team	Yes	Yes	Yes	Yes
Exclusion of matches in which red card is followed by penalty	No	No	No	No
Dependent variable: victory by home team	Yes	No	No	No
Dependent variable: victory by away team	No	Yes	No	No
Dependent variable: number of goals by home team at full time	No	No	Yes	No
Dependent variable: number of goals by away team at full time	No	No	No	Yes
R^2	0.358	0.327	0.380	0.301
N	2,023	2,023	2,023	2,023

Notes: A definition of the included variables can be found in the data discussion. The presented statistics are linear regression model estimates with White-corrected standard errors in parentheses. The results for the independent variables are in bold. *** (**) ((*)) indicate significance at the 1% (5%) ((10%)) significance level.

model (5) of Table 2, the effects of receiving a red card for the away team are insignificant in three of the four models, of which the results are presented in Table 3. Model 1 of Table 3 is an exception in this respect. Indeed, it is found that a red card for the away team has a weakly significantly positive impact on the probability of a victory by the home team (p = 0.075). However, as this exception to the overall pattern of overall insignificant effects of a red card for away teams does not remain when matches in which a red card is followed by a penalty are excluded—the corresponding coefficient is then 0.037 (p = 0.300)—we tend to interpret this finding as a statistical artifact.

In sum, we conclude with respect to R1a and R1b that red cards are seriously harming full-time results for home teams, whereas we do not find evidence for substantial effects of red cards received by away teams. Besides the possibly more defensive style, which may increase the risks of fouls and red cards, another reason for the higher probability of receiving a red card for away teams might be related to this heterogeneity in the effects. Indeed, away teams might anticipate the less detrimental effects of a red card and not "worry" as much as home teams about receiving one.

Table 4. Results: Extended Models

	(1)	(2)	(3)
Red card home team	-0.690*** (0.122)	-	-
Red card home team × # minutes remaining (normalized)	-0.017** (0.007)	-	-
Red card home team × remaining time less than or equal to 20 minutes	-	-0.352** (0.162)	-
Red card home team × remaining time more than 20 minutes	-	-0.967*** (0.173)	-
Red card home team × remaining time less than or equal to 10 minutes	-	-	-0.426** (0.189)
Red card home team × remaining time between 10 and 30 minutes	-	-	-0.516*** (0.201)
Red card home team × remaining time more than 30 minutes	-	-	-1.054*** (0.217)
Red card away team	0.106 (0.097)	-	-
Red card away team × # minutes remaining (normalized)	0.013*** (0.004)	-	-
Red card away team × remaining time less than or equal to 20 minutes	-	-0.128 (0.111)	-
Red card away team × remaining time more than 20 minutes	-	0.366** (0.156)	-
Red card away team × remaining time less than or equal to 10 minutes	-	-	-0.235* (0.123)
Red card away team × remaining time between 10 and 30 minutes	-	-	0.068 (0.171)
Red card away team × remaining time more than 30 minutes	-	-	0.466*** (0.178)
Match in UEFA Europa League	0.017 (0.128)	0.021 (0.128)	0.018 (0.128)
Match in knockout phase: first leg	0.041 (0.118)	0.042 (0.118)	0.041 (0.118)
Match in knockout phase: second leg	0.092 (0.129)	0.101 (0.129)	0.103 (0.130)
Final game	-0.724 (0.496)	-0.725 (0.496)	-0.718 (0.498)
Goal difference after first leg	0.066 (0.072)	0.062 (0.072)	0.064 (0.073)
Relative strength home team	-0.042 (0.053)	-0.045 (0.053)	-0.042 (0.053)
Goal difference at issuing of red card between minute 1 and minute 30	1.048** (0.447)	1.158*** (0.447)	1.146*** (0.444)
Goal difference at issuing of red card between minute 31 and half time	1.156*** (0.194)	1.161*** (0.198)	1.139*** (0.197)
Goal difference at issuing of red card between half time and minute 60	0.868*** (0.107)	0.860*** (0.110)	0.859*** (0.112)
Goal difference at issuing of red card between minute 61 and minute 75	0.696*** (0.103)	0.687*** (0.105)	0.702*** (0.107)
Goal difference at issuing of red card between minute 76 and full time	0.785*** (0.064)	0.777*** (0.064)	0.786*** (0.064)
Constant	0.773* (0.396)	0.766* (0.397)	0.767* (0.397)
F-test for equality of 'Red card home team × remaining time less than or equal to 20 minutes' and 'Red card home team × remaining time more than 20 minutes' (*p*-value)	-	0.008	-
F-test for equality of 'Red card home team × remaining time less than or equal to 10 minutes' and 'Red card home team × remaining time between 10 and 30 minutes' (*p*-value)	-	-	0.738
F-test for equality of 'Red card home team × remaining time less than or equal to 10 minutes' and 'Red card home team × remaining time more than 30 minutes' (*p*-value)	-	-	0.026
F-test for equality of 'Red card home team × remaining time between 10 and 30 minutes' and 'Red card home team × remaining time more than 30 minutes' (*p*-value)	-	-	0.067
F-test for equality of 'Red card away team × remaining time less than or equal to 20 minutes' and 'Red card away team × remaining time more than 20 minutes' (*p*-value)	-	0.007	-
F-test for equality of 'Red card away team × remaining time less than or equal to 10 minutes' and 'Red card away team × remaining time between 10 and 30 minutes' (*p*-value)	-	-	0.123
F-test for equality of 'Red card away team × remaining time less than or equal to 10 minutes' and 'Red card away team × remaining time more than 30 minutes' (*p*-value)	-	-	0.001
F-test for equality of 'Red card away team × remaining time between 10 and 30 minutes' and 'Red card away team × remaining time more than 30 minutes' (*p*-value)	-	-	0.099
Fixed effects home team	Yes	Yes	Yes
Fixed effects away team	Yes	Yes	Yes
Exclusion of matches in which red card is followed by penalty	No	No	No
Dependent variable: goal difference at full time	Yes	Yes	Yes
R^2	0.454	0.453	0.453
N	2,023	2,023	2,023

Notes: A definition of the included variables can be found in the data discussion. The variable '# minutes remaining' is normalized by subtracting its mean value in the relevant subdataset of matches with a red card. The presented statistics are linear regression model estimates with White-corrected standard errors in parentheses. The results for the independent variables are in bold. *** (**) ((*)) indicate significance at the 1% (5%) ((10%)) significance level.

Heterogeneity by the Timing of a Red Card

To answer R2a and R2b, we extend our benchmark model by adopting interactions between receiving a red card and the remaining regular time. More concretely, in model (1) of Table 4, interactions with the continuous indicator of remaining time are added. This indicator, when interacted with a red card for the home and away teams, is normalized by subtracting its mean value in the subdatasets of matches with a red card for home and away teams, respectively. This is done to ensure comparability of the overall effect of receiving a red card between model (1) of Table 4 and the results in Table 2. In models (2) and (3) the overall effect of a red card for home and away teams is broken down by the time interval in which it is received.

The results of model (1) of Table 4 show that red cards are more harming to full-time results when they are issued earlier in the game. The goal difference at full time decreases by 0.017 goals ($p = 0.002$) for each additional minute of regular time after a red card is issued to the home team, and it increases by 0.013 goals ($p = 0.002$) for each additional minute after a player of the away team is dismissed.

In addition, the results of model (2) and model (3) indicate that, irrespective of the time window in which a home team receives a red card, it always has a disadvantage in terms of the goal difference at full time for them. According to model (2), a red card for the home team decreases the goal difference at full time by 0.967 goals ($p = 0.000$) when this card is received before minute 71 and by 0.352 goals ($p = 0.030$) when it is received in minute 71 or later. As can be seen from the p-values noted in the lower rows of Table 4, these two coefficients are highly significantly different.

By contrast, a red card for the away team does not seem to harm this team's full-time results when this card is issued after minute 60. We even find a weakly significantly negative effect of a late red card issued to them on the goal difference. More concretely, when an away team receives a red card later than minute 80, the goal difference is 0.235 goals more to the advantage of that team ($p = 0.055$). On the other hand, when a red card is issued to the away team before minute 61, the goal difference is 0.466 goals more to their disadvantage ($p = 0.009$).

In sum, we conclude with respect to R2a and R2b that the effect of a red card in European international club soccer is, indeed, heterogeneous by the timing of this red card. For both home and away teams, player dismissal is less harming to their full-time results when it occurs later in the game. However, whereas a red card for home teams has a detrimental impact on their full-time results no matter in which period of the match the card is received, a red card for away teams can have a positive, negative, or neutral effect for them, depending on the timing of the player dismissal.

Further Heterogeneous Effects

In this subsection, we explore other possible sources of heterogeneous response to receiving a red card. For this exercise, we rely on specification (4) of our benchmark model (i.e., including team-fixed effect and all covariates) and interact the two independent variables with the variable of heterogeneity.

First, we consider the phase of the tournament: knockout phase, knockout 1st leg, and knockout 2nd leg. As reported in Table 5, no significant heterogeneity is found at 5% significance level, though we estimate a heterogeneous response at 10% significance level for away teams during the 1st phase of the game. For these away teams, the overall effect of receiving a red card is statistically insignificant ($0.464 - 0.689 = -0.225$; $p = 0.503$). This might be due to the away teams trying not to concede too much in the 1st phase of the game when there is still "everything to play for." Second, we estimate heterogeneous effects by relative team strength. No significant heterogeneous response is found. Third, we divide the sample between UEFA Champions League and Europa League matches since the teams participating in the two tournaments and the size of the stake are different. For example, in 2019/2020, the distribution of revenue to clubs for the UEFA Champions League was €2,032 million for the UEFA Champions League and "only" €510 million for the clubs participating in the UEFA Europa League (UEFA, 2019). Despite these differences, we do not estimate a significantly different response for the teams participating in the two tournaments. Finally, we test for heterogeneous effects depending on the nationality of the team. We divide the teams into two groups of nations according to the observed propensity of receiving a red card during a match. No significant heterogeneous effect is found for this dimension.

Further Robustness Checks

To further test the robustness of the results in the previous subsections, we conducted additional analyses, the results of which are available on request. First, we redid the analyses reported in Table 4 using the alternative dependent variables. This did not yield different answers with respect to R2a and R2b than those reported previously.

Table 5. Results: Further Heterogeneous Effects

		Knockout	Knockout 1st phase	Knockout 2nd phase	Relative team strength	Champions League	Nationality
Red home team	β	-0.512***	-0.547***	-0.623***	-0.638***	-0.522***	-0.672***
	SE	(0.183)	(0.164)	-0.170	(0.154)	(0.196)	0.239
Red home × heterogeneity	β	-0.453	-0.745*	-0.084	0.035	-0.236	0.063
	SE	(0.336)	(0.43)	(0.427)	(0.092)	(0.302)	0.315
Red away team	β	0.395***	0.464***	0.289**	0.369***	0.401**	0.333*
	SE	(0.141)	(0.129)	(0.131)	(0.121)	(0.172)	0.186
Red away team × heterogeneity	β	-0.083	-0.689*	0.400	-0.006	-0.062	0.068
	SE	(0.267)	(0.36)	(0.331)	(0.065)	(0.242)	0.245
	R^2	0.400	0.402	0.400	0.400	0.400	0.400
	N	2,023	2,023	2,023	2,023	2,023	2,023

Notes: Heterogeneous effects using model 4 from Table 2 and adding an interaction between the independent variables and the group heterogeneity reported in the column. The nationality group includes teams from nationalities that have a higher observed propensity to receive red cards: Moldova, Serbia, Russia, Slovenia, Romania, Israel, Poland, Sweden, Belarus, Portugal, Cyprus, Bulgaria, Switzerland, Ukraine, France, Scotland, Austria, Netherlands, and Hungary. The residual group includes Italy, Greece, Turkey, England, Germany, Czech Republic, Spain, Norway, Belgium, Denmark, Croatia, Azerbaijan, Finland, Ireland, Kazakhstan, and Slovakia. A definition of the included variables can be found in the data discussion. The presented statistics are linear regression model estimates with White-corrected standard errors in parentheses. *** (**) ((*)) indicate significance at the 1% (5%) ((10%)) significance level.

Second, not all of the 2,023 matches in our data had a substantial competitive value for both teams. Following Baert and Amez (2018), in a robustness test we exclude matches in the group phase where for one of the teams it is mathematically impossible to change its qualification status for the next round. This is the case if a team is sure it will finish within the group phase (i) as winner or runner-up (in the UEFA Champions League or UEFA Europa League), (ii) in third place in its group in the UEFA Champions League, (iii) in fourth place in its group in the UEFA Champions League, or (iv) in third or lower place in its group in the UEFA Europa League. After removing those matches, we ended up with a dataset consisting of 1,727 European soccer matches where the match stake is relevant for both teams. However, our answers to R1a, R1b, R2a, and R2b based on this restricted dataset were the same as those based on the full dataset. The same is true when we excluded the 47 matches in which more than one red card was issued.

Third, for all analyses discussed in this article, we also ran the corresponding (ordered) logistic regressions, yielding similar conclusions as those based on linear (probability) models. However, in the end, we opted to present linear models, given that (i) four of our five dependent variables are continuous, (ii) the good performance of the linear probability model with White-corrected standard errors for binary dependent variables (Angrist & Pischke, 2008; Baert & Amez, 2018), and (iii) the potential incidental parameters problem when combining logistic regression models with fixed effects (Greene, 2004).

Fourth, as referees might obtain specific instructions prior to the start of every single season on how to award red cards, we add season dummies in the set of control variables. As those instructions might differ for the two tournaments, in an additional specification we interact them with the Europa League dummy. Results are nearly identical.

Fifth, we exclude the matches that end in overtime or penalty shootouts. Results are virtually identical, as this restriction excludes only 1% of the matches.

Finally, as our identification strategy relies on the assumption that matches in which teams receive a red card are similar to the other matches, we test whether there are large differences in observable characteristics between these matches. We therefore implement a logistic regression of the probability that in the match a red card was awarded on our set of predetermined control variables. Small differences between matches are observed, as the Pseudo R2 of the model is only

0.0056. The explanatory power of the control variables in a within-team comparison (i.e., adding team fixed-effect) is also low, as the Pseudo R2 increases from 0.048 to 0.054.

Conclusion

We analyzed the effects of receiving a red card on full-time results in 2,023 recent matches in the UEFA Champions League and UEFA Europa League. We found that when a home team receives a red card, the goal difference at full time (in favor of this team) decreases by approximately 0.660 goals. In addition, receiving a red card for the home team lowers its probability of a victory by 18.8 percentage points. In contrast, as soon as we control for the goal difference at the issuing of a red card, the average effect of receiving a red card for away teams is close to zero. For both home and away teams, the effect of receiving a red card is more adverse when it is received early in the game. For an away team, the impact of receiving a red card can even be beneficial when it is received at the end of the game.

The heterogeneity in the effects of a red card by the timing of receiving the card is consistent with what Caliendo and Radic (2006) and Červený et al. (2016) reported based on World Cup data, in which there are no genuine home and away teams. Therefore, it is not surprising that they found a neutral effect of late red cards for teams at the World Cup, holding the middle between the adverse effect of receiving a late red card for home teams and its beneficial impact for away teams reported in our study.

Overall, our results are particularly in line with Mechtel et al. (2011) in the sense that theirs was the only study to date providing evidence for larger effects of receiving a red card for home teams (compared to away teams). This similarity in results might be explained by the fact that our sample size and statistical framework are more akin to each other than to the other studies not reporting evidence for this dimension of heterogeneity. The explanation for this greater adverse effect of receiving a red card for home teams in Mechtel et al. (2011) was that the tasks of home teams are more complex than those of away teams, given their usually more offensive playing style—this might be related to the expectations of their home audience, as discussed in Baert and Amez (2018). Due to this higher task complexity, the adjustment of the play to a player dismissal might be greater for home teams. In contrast, for away teams, a motivational aspect might be dominant. That is, in line with the soccer myth that 'ten do it better,' higher effort levels and better team spirit might be induced after receiving a red card (Caliendo & Radic, 2006; Mechtel et al., 2011). Whether these are indeed the mechanisms driving the estimated effects of receiving a red card in the UEFA Champions League and UEFA Europa League could be the subject of future qualitative research.

We end this study by acknowledging its main limitation. In several aspects, we took a step forward in measuring the unbiased effect of player dismissal on full-time results in European international club soccer. In particular, we had greater statistical power to reject zero effects than most former studies on the effects of red cards given the size of our dataset. Moreover, we showed that the presented effects of player dismissal are not driven by red cards being correlated with a penalty for the team of the dismissed player's opponent. Yet, the coefficient estimates in this article can only be given a causal interpretation under the assumption that the endogeneity problem discussed in this article is solved by our regression strategy. If receiving a red card is (i) correlated with match characteristics up to the issuing of the red card not being captured by the goal difference at the moment of the red card that (ii) affect the results at full time, this assumption does not hold. Therefore, we are in favor of future empirical work that exploits other statistical frameworks (e.g., the one presented in Caliendo [2006] or that used by Červený et al. [2016]) to further investigate how the effects of receiving a red card are heterogeneous by the home status of the team and by the remaining time at the issuing of the red card.

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