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Does the Home Advantage Depend on Crowd Support? Evidence From Same-Stadium Derbies

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Abstract

We investigate to what extent crowd support contributes to the home advantage in soccer, disentangling this effect from other mechanisms such as players' familiarity with the stadium and travel fatigue. To evaluate the relevance of crowd support in determining home advantage, we analyze same-stadium derbies (matches among teams that share the same stadium), in which teams enjoy different levels of support from the crowd—the home team has many more supporters mainly because of season ticket holders—while teams do not differ in terms of travel fatigue or familiarity with the stadium. Our estimation results suggest the existence of a sizable crowd support's effect on the home advantage generated through the encouragement of players' performance. Furthermore, we find consistent evidence that the support of the crowd tends to bias referee's decisions (in terms of penalties, red cards, and yellow cards) in favor of the home team.

Keywords

soccer, home advantage, crowd support, social pressure, team performance, attendance, travel fatigue, stadium familiarity, referee home bias

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Home advantage—the tendency for the home team to win more often than the visiting team—is one of the best documented phenomena in soccer and in sports in general (for surveys, see Courneya & Carron, 1992; Nevill & Holder, 1999; Pollard & Pollard, 2005). However, the determinants of the home advantage have been difficult to identify. Three main factors have been recognized and empirically analyzed in the literature: crowd support, familiarity with the stadium, and travel fatigue.[1]

As regards the first mechanism, the home team typically receives a stronger support from the crowd, which tends to stimulate players' effort and energy and lead them to perform better. In addition, the noise and the reactions of the crowd tend to subconsciously influence the referee's decisions in favor of the home team.

To evaluate the strength of this mechanism, some studies have examined the association between crowd size and team performance. The evidence is somewhat mixed. Pollard and Pollard (2005) show no difference in the magnitude of the home advantage despite considerable differences in crowd size between the first and second division in the leagues of Germany, England, France, Spain, and Italy. Similarly, Pollard (1986) and Clarke and Norman (1995) find that the home advantage varies little over the four divisions in England. Using a different approach, Salminen (1993) and Strauss (2002) have shown that spectators' support (e.g., cheering) for the home team is not related to home-team success.

In contrast to these findings, Agnew and Carron (1994) found a positive association between crowd density and the home advantage. Moreover, Pollard (2006) argues that the drop in the home advantage during the 1990s in England could be due to mandatory requirement for all-seater accommodation in stadiums implying less dense and more expensive seating, leading to less crowd support.

More clear evidence exists on the home bias of officials' decisions, which represents an indirect effect of the crowd operating through the referee. Many studies have shown that referees can be subconsciously influenced by the noise of a large crowd in the stadium and react by favoring the home team, awarding more penalties and less disciplinary sanctions to the home team or conceding more injury time to it when it is behind (Dawson & Dobson, 2010; Dohmen, 2008; Garicano, Palacios-Huerta, & Prendergast, 2005; Nevill, Balmer, & Williams, 2002; Page & Page, 2010; Scoppa, 2008; Sutter & Kocher, 2004).[2]

The second cause of the home advantage originates from the familiarity with the stadium: Home team players are generally more familiar with their own venue in terms of dimensions, playing surfaces, and other physical features and exhibit greater confidence when playing in a more familiar environment. The existing evidence shows that teams playing on unusual larger or smaller playing surfaces or on artificial surfaces (rather than on grass) enjoy an additional advantage compared with other teams whose home grounds are more standard suggesting the possible advantage gained by the home team on these pitches (Barnett & Hilditch, 1993; Clarke & Norman, 1995). Furthermore, the home advantage seems to be reduced when a team moves to a new stadium probably due to the loss of familiarity with home playing conditions (Pollard, 2002).[3] In contrast, Loughead, Carron, Bray, and Kim (2003) found that the home advantage did not change after teams relocate to a new venue.

Finally, researchers have analyzed the role of travel fatigue in the home advantage, arising from the fact that the away team has the disadvantage of traveling and suffer from disruption of the preparation. The evidence on this aspect is quite robust. Oberhofer, Philippovich, and Winner (2010) analyze if team performance in soccer is related to the distance from the home location and the away playing venue. They use data from German Football Premier League and show that team performance (measured in terms of scored and conceded goals) decreases with the distance to the playing venue. Similar findings are also confirmed in a study of the English Premier League matches (Clarke & Norman, 1995), showing that the home advantage increases with the distance traveled by away teams. In an analysis of the Australian League, Goumas (2014) finds evidence that in soccer competitions where time zones are crossed, travel effects, such as jet lag, may play an even greater role in home advantage than crowd support. In the same vein, Nichols (2014) studies U.S. National Football League matches and finds that visiting teams traveling from longer distances (and in particular from west to east, crossing at least one time zone) appear to experience poorer performance.

Some authors (Brown, Van Raalte, Brewer, Win-ter, & Cornelius, 2002; Pollard, 1986; Scoppa, 2015) have suggested that the higher home advantage in European and international competitions could be related to the larger distances travelled by away teams whose players are tired after long traveling. Furthermore, the reduction of the home advantage in recent times could be due to the fact that travel has become easier and more comfortable during this period.

All in all, although the evidence on the existence of the home advantage is solid, the mechanisms through which it operates are still unclear and in particular the empirical evidence is not conclusive on the relative relevance of crowd support, travel fatigue, and stadium familiarity (Courneya & Carron, 1992; Pollard & Pollard, 2005).

The purpose of this article is an attempt to evaluate the relative weight of these mechanisms in soccer. Specifically, in order to identify the role of crowd support—as distinguished from other factors—in this article, we exploit the fact that a number of teams (from the large cities of Rome, Milan, Turin, Genoa, and Verona) in the Italian "Serie A" share the same stadium: When playing one against the other—in the so-called same-stadium derbies—players of both teams are familiar with the pitch and facilities and, in addition, they suffer no travel fatigue and no interruption of preparation.

The only difference in a derby between, for example, Milan and Inter is that when Milan is the home team, because of season ticket holders and reservations for home team's supporters in the sale of tickets, only a sector of the stadium is reserved for visiting team's supporters. As a consequence, Milan enjoys much more crowd support than Inter. Therefore, by analyzing the existence of the home advantage in same-stadium derbies, we are able to neutralize the other two factors (familiarity with the venue and travel fatigue) and identify the "pure" effect of the crowd support.

A recent study of van de Ven (2011) investigates how crowd support contributes to the home advantage in derbies using the same idea that we exploit and data from the derbies of Milan and Rome. The author shows, surprisingly, that crowd support does not play any role in the home advantage and thus he argues that it is determined by travel fatigue and familiarity with the stadium. However, some features of this study could have affected its results: The author uses only a limited sample (64 matches), carries out *t*-test comparisons with "ad hoc" chosen teams, and does not use a regression analysis to control for other possible determinants of team performance.

We first estimate the impact of playing at home on team performance using as dependent variable both *points* earned by the teams and goals difference and controlling for a number of variables capturing the relative strength of the opposing teams. We compare the effect of playing at home in normal matches with that emerging in same-stadium derbies: We find a strong home advantage both in normal matches and in same-stadium derbies, although the effect for the latter is smaller in magnitude: Playing at home in normal matches increases the probability of winning by about 25 percentage points, while the probability of winning increases by 15–16 percentage points in same-stadium derbies.

To evaluate the effects of home crowd support on referees' behavior, we consider some relevant discretionary decisions of officials: awarding yellow cards, red cards, and penalties; and we build a measure of referee's decisions in favor of the home team. We find that referees are more prone to favor the home team.

Taking as constant the referees' influence on the outcome, we find that the home team tends to perform better, thanks to the direct support of the crowd. So, we conclude that crowd support in same-stadium derbies is an important determinant of team performance both through the encouragement of home players and by biasing referee's decisions.

This article is organized in the following way. The second section describes the data set we use and presents some descriptive statistics. In the third section, we carry out the empirical analysis both for normal matches and for same-stadium derbies. In the fourth section, we focus on the referee's decisions. The fifth section concludes.

Data and Descriptive Statistics

In the attempt to curb violence related to soccer events, especially after the tragedy of the Heysel Stadium in 1985,[4] in the early 90s Italian stadiums required all-seater accommodations and separate sectors between home and visiting supporters. The modernization of stadiums was also favored by the organization of the World Cup in Italy in 1990.

Given the neat separation between home and visiting supporters, in a typical match, a large number of seats are reserved to the home team's season ticket holders; for the remaining seats, home teams—in charge of ticket sales—tend to favor their own supporters above that of away fans. Thus, only a part of the stadium is reserved to visiting supporters.

The disparity in the crowd supporting the home and the visiting team is the first element we exploit in our estimation strategy. The second element we take advantage of is the fact that in same-stadium derbies—in contrast to other matches—there are no differences among teams in travel fatigue and in familiarity with the stadium. Therefore, in analyzing the performance of home and away teams in derbies—controlling for measures of teams' quality—we can safely relate any existing difference to crowd support, disentangling this effect from those related to travel fatigue and familiarity with the stadium.

Furthermore, we are able to compare the outcomes of teams in same-stadium derbies with the performance in "normal" matches that incorporate all the mechanisms affecting the home advantage. Therefore, any significant difference in the home advantage between these types of matches is suggestive of an impact due to travel fatigue and stadium familiarity.

In our empirical analysis, we use two samples of data: (1) all the matches from 22 seasons of the Italian soccer league Serie A from 1991-1992 to 2012-2013 and (2) the matches from same-stadium derbies played in the same 22 seasons. Our data have been collected from the websites of two leading Italian newspapers: *La Stampa* and *La Gazzetta dello Sport*.

The Italian Serie A until the season 2003-2004 was composed by 18 teams, while in the following seasons there were 20 teams. In each season, teams played each other twice (both as the home and as the visiting team) for a total of 34 matches before 2003-2004 and 38 matches after 2003-2004.[5] Therefore, we observe 7,398 matches. For each match, we have available data on teams, goals scored, goals conceded, the place, and the date when each game was played. For same-stadium derbies, we also collected penalties, yellow cards, and red cards.

Team performance is measured using different indicators of the outcome obtained on the pitch: The number of points gained in each match by the teams (*points*), the difference (*goals difference*) between the number of *goals scored* and the number of *goals conceded*. According to the rules of soccer, teams are awarded 3 points if they win a game, 1 point in case of draw, and 0 points if they lose. The sum of the points obtained in each game determines the final ranking.

In order to explain team performance, we consider a number of alternative variables that capture differences in the quality of opposing teams and some measures of past performance: The difference in the ranking positions before the current match between the two teams (*ranking difference*), the difference in the total points (*total points difference*) earned by the two teams in the current season excluding the current match, and the difference in points earned by the two teams, respectively, in the latest 4, 8, and 12 matches. Since these measures are highly correlated, to avoid collinearity, we use them separately in our regressions.

Descriptive statistics for all the matches are reported in Table 1. The difference between *points home* and *points visitor* is 0.706, with a standard error (*SE*) of 0.020, and a *t*-stat of 34.81 for the test of equality of means. One way to measure the home advantage is to determine the proportion of points earned by the home team with

Table 1. Descriptive Statistics.[a]

Variables	Observations	*M*	*SD*	Minimum	Maximum
Year	7,398	2,002.085	6.379	1991	2012
Goals home	7,398	1.529	1.237	0	8
Goals visitor	7,398	1.065	1.062	0	8
Goals difference	7,329	0.438	1.523	−4	4
Points home	7,398	1.707	1.274	0	3
Points visitor	7,398	1.001	1.191	0	3
Total points difference	7,398	−0.706	20.328	−70	68
Ranking difference	7,398	−0.002	7.941	−19	19
Points difference (latest 4)	7,191	−0.255	3.727	−11	12
Points difference (latest 8)	7,191	−0.345	5.710	−20	20
Points difference (latest 12)	7,191	−0.287	7.382	−31	26

Source. La Stampa and *La Gazzetta dello Sport* websites.
Note. Ranking difference is the difference in the ranking positions before the current match between the two teams and *total points difference* is the difference in points earned by the two teams in the current season excluding the current match. *SD* = standard deviation.
[a]All matches in 22 seasons (from 1991-1992 to 2012-2013).

respect to the total points awarded. In our sample, the proportion of points for the home team is 63%, a ratio in line with other main European championships (Pollard & Pollard, 2005). The *goals difference* between home and visitor is 0.464 (*SE* = 0.019), with a *t*-stat of 24.46.

In Table 2, we show descriptive statistics for same-stadium derbies. All the derbies in Serie A are same-stadium derbies with only one recent exception. Same-stadium derbies are matches between Milan versus Internazionale (in Milan), Juventus versus Turin (Turin), Rome versus Lazio (Rome), Genoa versus Sampdoria (Genoa), and Verona versus Chievo Verona (Verona). Some of these teams are not top clubs and played in Serie A only for a few seasons. Since the season 2011-2012 Juventus has its own stadium and the matches of Juventus versus Turin are no longer classified as "same-stadium derbies." We observe derbies in Milan and Rome for all the 22 seasons (two matches for each season), Turin for 10, Genoa for 9, and Verona for 1, for a total of 128 observations.

The difference between the home and the visiting team in points is 0.446. The difference is large, although less pronounced than in normal matches with a *SE* of 0.155. Therefore, the *t*-stat for the equality of means test is 2.86. The goal difference between the home and the visiting team is 0.188 (*SE* = 0.143) and the *t*-stat = 1.31.

Home Advantage in Derbies and in Other Matches: Empirical Results

In this section, to evaluate the extent of the home advantage, we estimate the impact of playing at home on team performance using as dependent variable firstly *points*

Table 2. Descriptive Statistics—Same-Stadium Derbies.

Variables	Observations	*M*	*SD*	Minimum	Maximum
Goals home	128	1.430	1.175	0	5
Goals visitor	128	1.242	1.114	0	6
Goals difference	128	0.187	1.374	−3	3
Points home	128	1.563	1.272	0	3
Points visitor	128	1.117	1.214	0	3
Total points difference	128	−0.445	18.547	−48	48
Ranking difference	128	0.000	6.690	−17	17
Points difference (latest 4)	128	−0.312	3.751	−11	8
Points difference (latest 8)	128	−0.594	5.539	−18	16
Points difference (latest 12)	128	−0.492	7.469	−18	20

Source. La Stampa and *La Gazzetta dello Sport* websites.
Note. Only same-stadium derbies in 22 seasons. *SD* = standard deviation.

home—estimating an ordered Probit model, given the ordinal nature of this variable (win, draw, and loss)—and then *goals difference*—estimating with ordinary least squares (OLS). In both cases, we contrast the effect of playing at home in normal matches with that emerging in same-stadium derbies.

Following Garicano and Palacios-Huerta (2005), we consider each match twice, from the perspective of the home team and the visiting team, clustering *SE*s at the match level. As a robustness check, we choose to randomly assign each match either to the home or to the visiting team considering each match only once. As we will show below, the results we find using the second procedure are almost identical.

To capture the home advantage, we simply use the dummy *home* (equal to 1 if the game is played at home and 0 if it is played away). Although some studies proxy the home factor with the crowd size (or crowd density, the number of people relative to the stadium's capacity), we believe that the use of crowd size measures could lead to several estimation biases, since crowd size is likely correlated either to the quality of the home team or to the quality of the visiting team. In fact, if the home team is performing well in a season, crowd size tends to be larger: Thus, it is hard to distinguish the impact on the outcome of a stronger team from the effect of a larger crowd, creating an upward bias; on the other hand, crowd size could be greater when the visiting team is a high-quality team or has many top players, imparting a downward bias on the estimated effect.[6] Using simply the dummy *home* we avoid these problems, since *home* is assigned randomly and is not related to the quality of the teams or to other unobservable factors. This corresponds to the reduced form of a model in which team performance is determined by the crowd support and this, in turn, is determined by playing at home.

In Table 3, we estimate a model for points with ordered Probit, considering all the matches played in 22 seasons (7,398). In the last row of Table 3, we report the marginal effects of home for the outcome of win. In column 1, the effect of playing

Table 3. Home Advantage and Team Performance for All Matches—Ordered Probit Estimates.

	(1)	(2)	(3)	(4)	(5)
Home	.6469***	.7424***	.7417***	.7001***	.7211***
	(.0267)	(.0276)	(.0279)	(.0275)	(.0277)
Total points difference		.0224***			
		(.0007)			
Ranking difference			−.0707***		
			(.0018)		
Points difference (latest 4)				.0639***	
				(.0037)	
Points difference (latest 8)					.0564***
					(.0025)
Cut 1	−.0705***	−.0617***	−.0834***	−.0531***	−.0514***
	(.0146)	(.0151)	(.0154)	(.0150)	(.0151)
Cut 2	.7174***	.8041***	.8252***	.7532***	.7725***
	(.0160)	(.0170)	(.0173)	(.0166)	(.0168)
Observations	14,796	14,796	14,796	14,382	14,382
Pseudo R^2	.036	.101	.132	.056	.070
Marginal effect of home for the outcome = win	.2351***	.2647***	.2621***	.2532***	.2596***
	(.0094)	(.0094)	(.0094)	(.0096)	(.0095)

Note. Dependent variable: Points home. This table reports ordered probit estimates. Standard errors (reported in parentheses) are corrected for heteroscedasticity and allowing for clustering at the match level. The symbols *, **, and *** indicate that coefficients are statistically significant, respectively, at the 10%, 5%, and 1% level.

at home is estimated without adding other explanatory variables. We find that the impact is strong and highly significant (*t*-stat is around 25). On the basis of the marginal effects, playing at home causes an increase in the probability of winning the match by about 23 percentage points.

In column 2, we control for *total points difference* (the difference of points earned by the two teams in the season excluding the current match). We show that the difference in the points earned constitutes a strong predictor of the current team performance. The variable *home* has a slightly stronger effect with respect to the first specification: The probability of winning if playing at home is 26 percentage points higher.

We find almost the same results for the home advantage in column 3, controlling for the *ranking difference* between the two teams. In columns 4 and 5, we control for the difference in points between the two opposing teams in, respectively, the latest 4 and 8 matches. Again, we find a very strong positive effect of playing at home. The variables measuring the relative quality of the teams have always the expected impact on the outcome of the match. Furthermore, we obtain very similar results using as control the variable *points difference* (*latest 12*; not reported).

Table 4. Home Advantage in Derbies—Ordered Probit Estimates.

	(1)	(2)	(3)	(4)	(5)
Home	.4090**	.4382**	.4437**	.4276**	.4510**
	(.2010)	(.2029)	(.2045)	(.2041)	(.2061)
Total points difference		.0149***			
		(.0057)			
Ranking difference			−.0588***		
			(.0145)		
Points difference (latest 4)				.0242	
				(.0274)	
Points difference (latest 8)					.0283
					(.0176)
Cut 1	−.2171*	−.2176*	−.2311**	−.2093*	−.2009*
	(.1122)	(.1136)	(.1149)	(.1128)	(.1132)
Cut 2	.6261***	.6559***	.6750***	.6370***	.6519***
	(.1195)	(.1219)	(.1238)	(.1218)	(.1235)
Observations	256	256	256	256	256
Pseudo R^2	.015	.040	.065	.018	.023
Marginal effect of home for the outcome = win	.1479**	.1579**	.1587**	.1550**	.1632**
	(.0705)	(.0720)	(.0720)	(.0728)	(.0732)

Note. Dependent variable: Points home. This table reports ordered probit estimates. Standard errors (reported in parentheses) are corrected for heteroscedasticity and allowing for clustering at the match level. The symbols *, **, and *** indicate that coefficients are statistically significant, respectively, at the 10%, 5%, and 1% level.

As discussed in the literature, the strong impact on team performance of playing at home could be due to several factors: crowd support (referee bias or encouragement of home players), familiarity with the venue or the environment, and travel fatigue for the visiting team.

To evaluate the relevance of crowd support and simultaneously isolate the effect of the other two factors contributing to the home advantage, in Table 4, we estimate the impact of playing at home focusing exclusively on same-stadium derbies (128 matches). As explained in details in the second section, this allows us to rigorously estimate the role played by crowd support in the home advantage by neutralizing both the effects of players' familiarity with the venue and the effects of travel fatigue. In fact, the latter factors are equivalent to the two opposing teams in a derby.

Notwithstanding a much lower number of observations (128 instead of 7,398), we find a strong and significant effect of playing at home. The coefficient on *home* ranges between 0.41 and 0.45, significant at the 5% level. In terms of marginal effects (the last row of Table 4), we show that playing at home in local derbies increases the probability of winning by about 15–16 percentage points.

Estimation results point out a sizable difference in the extent of the home advantage in normal matches with respect to same-stadium derbies: The home advantage

Table 5. Home Advantage in Normal Matches and Derbies Using One Observation for Each Match.

	(1)	(2)	(3)	(4)	(5)
Home (all matches)	.6469*** (.0267)	.7426*** (.0276)	.7419*** (.0278)	.7001*** (.0275)	.7213*** (.0277)
Home (derbies)	.3965** (.2020)	.4267** (.2039)	.4332** (.2056)	.4148** (.2052)	.4391** (.2069)

Note. This table reports ordered probit estimates. In the first row, we report only the coefficient on home using the same specifications as in Table 3. In the second row, we report the coefficient using the same specifications as in Table 4. Standard errors (reported in parentheses) are corrected for heteroscedasticity. The symbols *, **, and *** indicate that coefficients are statistically significant, respectively, at the 10%, 5%, and 1% level.

is larger in normal matches of about 8–10 percentage points in terms of probability of winning the match. Therefore, one might speculate that the crowd support effect contributes for about 60% (15 points out of the 25 points) to the home advantage, whereas both familiarity and travel fatigue account for the remaining 40%.

To check whether our results are affected by the use of two observations for each match, in Table 5, we report the estimates of the coefficient on *home* using only one observation for each match, randomly assigning the match to the perspective of the home or the visiting team. Comparing, respectively, the coefficients on the first row of Table 5 with the coefficients on home in Table 3 and the coefficients in the second row of Table 5 with the coefficients of Table 4, we show that the results (both in terms of the magnitude of coefficients and *SE*s) are almost identical following the two alternative procedures.

To better evaluate the difference in the home advantage between same-stadium derbies and normal matches, we first build a dummy *derby* equal to 1 for same-stadium derbies and 0 otherwise. Then, in Table 6, we use all the observations, including an interaction between *derby* and *home*, to estimate the difference between the home advantage enjoyed in normal matches and the home advantage in derbies. In these estimates, home measures the effect of playing at home in normal matches, whereas the combination of home and $Home \times Derby$ gives the effect of playing at home in derbies.

Although the statistical significance of the interaction is not strong (the p value ranges between .14 and .20), the evidence suggests that in derbies a lower home advantage emerges. In the joint estimations, we find—in line with separate estimates obtained in Tables 3 and 4—that the marginal effects of winning if playing at home are equal to about 25 percentage points for normal matches and 16 points for derbies (last two rows in Table 6).

Using Alternative Measures of Performance: Goals Difference

To check the robustness of our findings, in Tables 7 and 8, we evaluate the impact of playing at home on an alternative measure of team performance, *goals difference*, instead of points.

Table 6. Home Advantage: Joint Estimates With Interactions—Ordered Probit Estimates.

	(1)	(2)	(3)	(4)	(5)
Home	.6513***	.7477***	.7489***	.7046***	.7251***
	(.0270)	(.0279)	(.0281)	(.0278)	(.0279)
Derby	.1247	.1471	.1531	.1252	.1172
	(.0991)	(.1041)	(.1042)	(.1015)	(.1026)
Home × Derby	−.2493	−.2942	−.3067	−.2504	−.2344
	(.1982)	(.2082)	(.2082)	(.2031)	(.2053)
Total points difference		.0224***			
		(.0007)			
Ranking difference			−.0710***		
			(.0018)		
Points difference (latest 4)				.0639***	
				(.0037)	
Points difference (latest 8)					.0564***
					(.0025)
Cut 1	−.0684***	−.0591***	−.0804***	−.0509***	−.0495***
	(.0147)	(.0152)	(.0155)	(.0151)	(.0152)
Cut 2	.7197***	.8069***	.8292***	.7556***	.7745***
	(.0161)	(.0171)	(.0174)	(.0167)	(.0169)
Observations	14,796	14,796	14,796	14,382	14,382
Pseudo R^2	.036	.101	.133	.056	.071
Home (no derbies)	.2369***	.2666***	.2645***	.2547***	.2610***
	(.0095)	(.0095)	(.0095)	(.0096)	(.0096)
Home (in derbies)	.1476**	.1636**	.1581**	.1659**	.1783**
	(.0713)	(.0734)	(.0728)	(.0724)	(.0727)

Note. Dependent variable: Points home. This table reports ordered probit estimates. Standard errors (reported in parentheses) are corrected for heteroscedasticity and allowing for clustering at the match level. The symbols *, **, and *** indicate that coefficients are statistically significant, respectively, at the 10%, 5%, and 1% level.

Using all the matches, we estimate with OLS the same specifications of Table 4.[7] We find that playing at home increases the *goals difference* for the home team from 0.87 to 0.92 according to the specification (*t*-stat is always above 25).

As regards the home advantage in same-stadium derbies, we find in Table 8 that there is a strong and significant effect of about 0.44 goals more for the home team (almost significant at the 5% level), although the magnitude tends to be smaller than in normal matches.

All our estimates consistently show that home teams enjoy a sizable advantage also in same-stadium derbies, when the differences in players' familiarity with the stadium and travel fatigue are neutralized. This points to an effect of crowd support

Table 7. Home Advantage in Goals Difference (All Matches)—OLS Estimates.

	(1)	(2)	(3)	(4)	(5)
Home	.8700***	.9096***	.8687***	.9161***	.9231***
	(.0343)	(.0316)	(.0306)	(.0339)	(.0332)
Total points difference		.0281***			
		(.0007)			
Ranking difference			−.0833***		
			(.0018)		
Points difference (latest 4)				.0877***	
				(.0045)	
Points difference (latest 8)					.0754***
					(.0028)
Constant	−.4350***	−.4548***	−.4344***	−.4581***	−.4616***
	(.0171)	(.0158)	(.0153)	(.0169)	(.0166)
Observations	14,796	14,796	14,796	14,382	14,382
Adjusted R^2	.080	.218	.266	.125	.159

Note. This table reports OLS estimates. Standard errors (reported in parentheses) are corrected for heteroscedasticity and allowing for clustering at the match level. The symbols *, **, and *** indicate that coefficients are statistically significant, respectively, at the 10%, 5%, and 1% level. OLS = ordinary least squares.

Table 8. Home Advantage in Goals Difference in Same-Stadium Derbies—OLS Estimates.

	(1)	(2)	(3)	(4)	(5)
Home	.4375*	.4498*	.4401*	.4308*	.4557*
	(.2434)	(.2386)	(.2346)	(.2439)	(.2435)
Total points difference		.0139**			
		(.0062)			
Ranking difference			−.0558***		
			(.0148)		
Points difference (latest 4)				−.0108	
				(.0352)	
Points difference (latest 8)					.0153
					(.0205)
Constant	−.2188*	−.2249*	−.2201*	−.2154*	−.2278*
	(.1217)	(.1193)	(.1173)	(.1219)	(.1218)
Observations	256	256	256	256	256
Adjusted R^2	.021	.052	.090	.018	.021

Note. This table reports OLS estimates. Standard errors (reported in parentheses) are corrected for heteroscedasticity and allowing for clustering at the match level. The symbols *, **, and *** indicate that coefficients are statistically significant, respectively, at the 10%, 5%, and 1% level. OLS = ordinary least squares.

Table 9. Descriptive Statistics: Referee's Decisions in Derbies.

Variables	Observations	*M*	*SD*	Minimum	Maximum
Penalties: Home	128	0.195	0.436	0	2
Penalties: Visiting	128	0.148	0.399	0	2
Red cards: Home	128	0.227	0.456	0	2
Red cards: Visiting	128	0.313	0.599	0	3
Yellow cards: Home	128	2.648	1.220	0	6
Yellow cards: Visiting	128	2.727	1.424	0	8
Disciplinary sanctions difference	128	−0.336	2.178	−8	5
Penalties difference	128	0.047	0.515	−2	2
Referee's decisions	128	0.477	2.834	−8	9

Source. *La Stampa* and *La Gazzetta dello Sport* websites.
Note. SD = standard deviation.

for the home team, enjoying a larger number of supporters when playing at home in same-stadium derbies.

It remains to be seen whether the crowd affects the match outcome mainly through the encouragement of players or through its influence on the referee's decisions. In the next section, we try to investigate the possible impact of home supporters on some referees' decisions.

Home Crowd Support and Referees' Decisions

To evaluate the effects of home crowd support on referees' behavior, we consider some relevant discretionary decisions of officials for the home and visiting teams: awarding yellow cards, red cards, and penalties. The data on these decisions have been gathered only for derbies, since they are not readily available and need to be collected one by one for each match.

Descriptive statistics for referee's decisions are reported in Table 9. In each match, referees award on average 0.17 penalties, 0.27 red cards, and 2.69 yellow cards. Home teams seem to receive more favorable treatments: Penalties are awarded significantly more often to the home team (0.195 vs. 0.148, with a difference of +0.047, t-stat = 1.63), red cards are given significantly less to the home team (0.227 vs. 0.313, difference = −0.086, t-stat = −1.55), while yellow cards awarded to the home and to the visiting team are not significantly different (2.648 vs. 2.727, difference = −0.078, t-stat = −0.54).

In order to use a synthetic measure of referee disciplinary sanctions, we build a variable *disciplinary sanctions difference* as:

$$\text{Disciplinary sanctions difference} = (\text{yellow card home} + 3 \times \text{red card home}) - (\text{yellow card visiting} + 3 \times \text{red card visiting}),$$

Table 10. Disciplinary Sanctions and Other Referee's Decisions in Derbies.

	(1) Disciplinary Sanctions	(2) Disciplinary Sanctions	(3) Disciplinary Sanctions	(4) Referee's Decisions	(5) Referee's Decisions	(6) Referee's Decisions
Home	−.6719*	−.6792*	−.6708*	.9531*	.9544*	.9523*
	(.3858)	(.3871)	(.3829)	(.5020)	(.5040)	(.5011)
Total points difference		−.0083			.0014	
		(.0107)			(.0126)	
Ranking difference			.0440			−.0350
			(.0287)			(.0327)
Constant	.3359*	.3396*	.3352*	−.4766*	−.4772*	−.4760*
	(.1929)	(.1936)	(.1914)	(.2510)	(.2520)	(.2505)
Observations	256	256	256	256	256	256
Adjusted R^2	.020	.021	.034	.024	.020	.027

Note. This table reports ordinary least squares estimates. Standard errors (reported in parentheses) are corrected for heteroscedasticity and allowing for clustering at the match level. The symbols *, **, and *** indicate that coefficients are statistically significant, respectively, at the 10%, 5%, and 1% level.

in which we take the difference of the number of disciplinary sanctions between the home and visiting team, weighting red cards 3 times as yellow cards. The weight of 3 to red cards is chosen to take into account that the latter have a much higher impact on the final outcome than the yellow cards, given that a red card entails that the player is sent off and his team must continue the game with one less player. Below we use different weightings to check the robustness of our results.

Using OLS, we estimate whether there is a significant difference in disciplinary sanctions between the home team and the visiting team. In columns 1, 2, and 3 of Table 10, in which we include, respectively, no controls, a control for *total points difference*, and a control for *ranking difference*, we show that the home team is awarded significantly less disciplinary sanctions by referees than the visiting team.

To give an account of all referees' decisions (disciplinary sanctions and penalties), we also build the variable *referee's decisions difference* as:

$$\begin{aligned}\text{Referee decisions difference} = {} & (3 \times \text{penalties home} - \text{yellow card home} \\ & - 3 \times \text{red card home}) - (3 \times \text{penalties visiting} \\ & - \text{yellow card visiting} - 3 \times \text{red card visiting}),\end{aligned}$$

in which, in this case, penalties awarded to the home team enter positively while yellow and red cards for the home team enter negatively (and vice versa for the visiting team). Moreover, penalties and red cards are weighted 3 times as yellow cards (using alternative weights—see below—leads to very similar results). Positive values of the variable *referee's decisions difference* represents decisions favoring the home team and vice versa.

Table 11. Referee's Decisions (With Alternative Weights) in Derbies and the Home Advantage.

	(1)	(2)	(3)	(4)	(5)	(6)
Home	2.1746*	2.1611*	2.1746*	0.6875*	0.6923*	0.6878*
	(1.1634)	(1.1663)	(1.1657)	(0.3814)	(0.3828)	(0.3793)
Total points difference		−0.0151			0.0053	
		(0.0310)			(0.0095)	
Ranking difference			−0.0091			−0.0398
			(0.0812)			(0.0243)
Constant	−1.0873*	−1.0806*	−1.0873*	−0.3438*	−0.3461*	−0.3438*
	(0.5817)	(0.5831)	(0.5828)	(0.1907)	(0.1914)	(0.1896)
Observations	256	256	256	256	256	256
Adjusted R^2	.023	.021	.019	.021	.019	.032

Note: This table reports ordinary least squares estimates. Standard errors (reported in parentheses) are corrected for heteroscedasticity and allowing for clustering at the match level. The symbols *, **, and *** indicate that coefficients are statistically significant, respectively, at the 10%, 5%, and 1% level.

Using the same control variables of the first three columns, in specifications 4, 5, and 6 of Table 10, we show that referee's decisions in derbies tend to favor the home team, while the variables accounting for the quality of teams (*total points difference*, *ranking difference*) do not seem to influence referees' decisions.

To check the robustness of our results to different weightings of referee's decisions, using data of six seasons (from 2004-2005 to 2009-2010), we have estimated that the impact of the difference in yellow cards between the home and away team on the final outcome (*points home*) is -0.058 (t-stat $= -3.6$), the impact of red cards is -0.482 (t-stat $= -10.7$), and the impact of penalties is $+0.365$ (t-stat $= 7.8$). Therefore, we experimented using as an alternative the following weights: yellow cards $= -1$, red cards $= -8.31$ (equal to 0.482/0.058), and penalties $= +6.29$ ($= 0.365/0.058$).

$$\begin{aligned}\text{Referee decisions difference} = {} & (6.29 \times \text{penalties home} - \text{yellow card home} \\ & - 8.31 \times \text{red card home}) \\ & - (6.29 \times \text{penalties visiting} - \text{yellow card visiting} \\ & - 8.31 \times \text{red card visiting}).\end{aligned}$$

In Table 11, we report estimation results using these alternative weights to build *referee's decisions difference* and—using the same control variables of Table 10—we find very similar results (columns 1–3): Referee's decisions in derbies tend always to be significantly in favor of the home team.

As a further robustness check, we also use a weight of 2 for red cards and for penalties to build *referee's decisions difference* and again we find very similar results (columns 4–6). Reassuringly, the results do not depend on the weights used

Table 12. The Impact of Playing at Home Controlling for Referee's Decisions—Ordered Probit Estimates.

	(1)	(2)	(3)	(4)	(5)
Home	.3466*	.3763*	.3839*	.3659*	.3897*
	(.2070)	(.2087)	(.2097)	(.2100)	(.2115)
Referee's decisions	.0715*	.0699*	.0611	.0730*	.0757*
	(.0393)	(.0402)	(.0407)	(.0397)	(.0399)
Total points difference		.0148***			
		(.0057)			
Ranking difference			−.0569***		
			(.0146)		
Points difference (latest 4)				.0266	
				(.0275)	
Points difference (latest 8)					.0311*
					(.0173)
Observations	256	256	256	256	256
Pseudo R^2	.029	.053	.075	.032	.039
Marginal effect of home for the outcome = win	.1256*	.1353*	.1371*	.1324*	.1407*
	(.0743)	(.0742)	(.0740)	(.0752)	(.0754)

Note. Dependent variable: Points home. This table reports ordered probit estimates. Standard errors (reported in parentheses) are corrected for heteroscedasticity and allowing for clustering at the match level. The symbols *, **, and *** indicate that coefficients are statistically significant, respectively, at the 10%, 5%, and 1% level.

to aggregate referees' decisions: Playing at home in derbies leads to an increase of the referee's decisions in favor of the home team.

These findings reassuringly confirm for same-stadium derbies a well-established result (Dawson & Dobson, 2010; Garicano et al., 2005; Scoppa, 2008; Sutter & Kocher, 2004, among others), that is, the existence of home bias of referees which tend to penalize home teams less often than they do for visiting teams.

The Impact of Playing at Home Taking as Constant Referee's Decisions

In the previous section, we have shown that the home team in same-stadium derbies, thanks to the support of the crowd, not only attain better outcomes but also tend to benefit from more favorable referee's decisions.

It would be interesting to verify if—taking as constant the penalty and disciplinary decisions of the referee—the home team receives further benefits from the support of the crowd or, alternatively, if in same-stadium derbies the home advantage derives exclusively from the biased decisions of referees.

To this aim, an interesting attempt is to regress measures of teams' performance on the *home* dummy, on measures of teams' quality, and controlling, in addition, for the variable referee's decisions. In this way, the coefficient on the *home* captures any effect of playing at home, taking as constant the potentially biased referee's decisions. If all the

Table 13. The Impact of Playing at Home Controlling for Referee's Decisions—OLS Estimates.

	(1)	(2)	(3)	(4)	(5)
Home	.3378	.3508	.3465	.3346	.3581
	(.2490)	(.2438)	(.2400)	(.2484)	(.2481)
Referee's decisions	.1046**	.1038**	.0942*	.1041**	.1074**
	(.0470)	(.0476)	(.0477)	(.0469)	(.0476)
Total points difference		.0137**			
		(.0061)			
Ranking difference			−.0533***		
			(.0149)		
Points difference (latest 4)				−.0059	
				(.0345)	
Points difference (latest 8)					.0193
					(.0197)
Constant	−.1689	−.1754	−.1730	−.1673	−.1791
	(.1245)	(.1219)	(.1199)	(.1242)	(.1241)
Observations	256	256	256	256	256
Adjusted R^2	.063	.093	.125	.059	.065

Note. Dependent variable: Goals difference. This table reports OLS estimates. Standard errors (reported in parentheses) are corrected for heteroscedasticity and allowing for clustering at the match level. The symbols *, **, and *** indicate that coefficients are statistically significant, respectively, at the 10%, 5%, and 1% level. OLS = ordinary least squares.

advantages of playing at home go through more favorable referee's decisions, we should find that the variable *referee's decisions* is significant in explaining performance, while *home* should have no additional effect. On the other hand, if *home* were significant when controlling for referee's decisions, this would imply that playing at home gives additional advantages with respect to the influence of referees' decisions.

It is worthwhile to note that this evidence can be considered only suggestive, both because we do not have a comprehensive measure of all the decisions taken by the referee in a match (offsides, free kicks, etc.) and because referee's decisions could be themselves the consequence of higher motivation and effort provided by the home players in turn stimulated by the crowd support.

In Table 12, we use as dependent variable *points home* and estimate with ordered Probit the same models of Table 4 but using as additional control referee's decisions. In all the specifications, we find that referee's decisions has a direct positive impact on the outcome of the match. However—taking as constant the influence of referee's decisions on the match outcome—we find that *home* has still a positive and significant impact on points.

In the last row of Table 12, we calculate the probability of winning the match if playing at home—given referee's decisions: We find that the probability increases by about 13 percentage points. Therefore, taking as constant referee's decisions, we show that a large role is played by the support of the crowd, presumably through the encouragement and the motivation of players.

We find similar results in Table 13 in which we use as dependent variable *goals difference* (instead of *points home*) between the home and the visiting team. Similarly to Table 8, we show that playing at home increases by about 0.35 the *goals difference* between the two opposing teams. These effects are rather imprecisely estimated, given the low number of observations (*p* values are around .15). Again our estimates suggest the existence of a crowd support effect on the home advantage that arises through players' performance, in addition to the influence on referees' behavior.

Concluding Remarks

Whereas the home advantage in soccer is a well-documented phenomenon, there is little evidence on which factor plays the major role in its determination. The main mechanisms identified in the literature appear to be crowd support, familiarity with the stadium, and travel fatigue, but great uncertainty remains on whether and to what extent each of these factors contributes to the home advantage.

In this article, in order to identify the role played by crowd support and thus to disentangle this effect from the other mechanisms contributing to the home advantage, we have focused on same-stadium derbies: These matches allow us to neutralize any factor related to players' familiarity with the stadium and to travel fatigue in influencing team performance, given that these factors are identical to the two competing teams. The only remaining difference in derbies is the proportion of supporters for the two teams, which is largely in favor of the home team, because of season ticket holders and seat reservations for home supporters.

We have found that the crowd support has a strong and significant impact on team performance in derbies: The home team scores about 0.45 goals more than the visiting team and the probability of winning of the former is about 15 percentage points higher. This impact is slightly lower in magnitude that the home advantage emerging in normal matches, suggesting that a large part of the home advantage is due to the crowd support, although a significant role is also played by players' familiarity with the stadium and travel fatigue of the visiting team.

Finally, building a measure of referee's decisions in favor of the home team, we have investigated if the support of the crowd affects the outcome of the match mainly through its impact on the referee or through the encouragement of home players. Our results suggest that both these factors are at work: Referees are more prone to favor the home team (by giving them more penalties or awarding more red and yellow cards to the visiting team)—confirming the well-known "referee home bias"—but taking as constant the referees' influence on the outcome, we find that the home team tends to perform better, thanks to the direct support of the crowd.

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Notes

1. A fourth factor—considered for other sports—is represented by some specific rules of sport that tend to favor the home team. However, this asymmetry does not apply to soccer: Rules are identical for the home and the visiting team (Pollard, 2006).
2. Pope and Pope (2015), in evaluating the bias that referees exhibit toward players from their native country, find that the own-nationality bias is larger for players at home than for players away from home: Referees indulge more on their own-nationality favoritism when the home crowd is supportive of their decisions.
3. A recent study by Neave and Wolfson (2003) refers to a psychological trait as "territoriality," that is, "the protective response to the invasion of one's perceived territory" and shows that football players experience higher testosterone concentrations at home matches than away which increases their aggression and allows them to perform better.
4. Before the start of the 1985 European Cup Final between Juventus of Italy and Liverpool of England on May 29, 1985, in Brussels, a group of Liverpool fans breached a fence separating them from Juventus fans: Escaping fans were pressed against a wall causing 39 deaths and about 600 injured.
5. In the first half of the season each team plays once against all its opponents, while in the second half each team plays in the exact same order against the same teams, but a home game played in the first half will be an away game in the second half and vice versa.
6. Furthermore, even when information on crowd size is available (see, e.g., at the webpage, www.stadiapostcards.com, reporting attendance data from the year 2000-2001) typically data do not allow to distinguish the number of supporters of each team, which is the crucial factor to measure the crowd supporting each team.
7. We set the *goals difference* equal to 3 if it is above 3 (in 3% of the sample) to attenuate the influence of outliers.

References

Agnew, G., & Carron, A. (1994). Crowd effects and the home advantage. *International Journal of Sport Psychology*, *25*, 53–62.

Barnett, V., & Hilditch, S. (1993). The effect of an artificial pitch surface on home team performance in football (soccer). *Journal of the Royal Statistical Society, Series A (Statistics in Society)*, *156*, 39–50.

Brown, T. D., Van Raalte, J. L., Brewer, B. W., Win-ter, C. R., & Cornelius, A. A. (2002). World cup soccer home advantage. *Journal of Sport Behavior*, *25*, 134–144.

Clarke, S., & Norman, J. (1995). Home ground advantage of individual clubs in English soccer. *The Statistician*, *44*, 509–521.

Courneya, K. S., & Carron, A. (1992). The home advantage in sport competitions: A literature review. *Journal of Sport and Exercise Psychology*, *14*, 13–27.

Dawson, P., & Dobson, S. (2010). The influence of social pressure and nationality on individual decisions: Evidence from the behaviour of referees. *Journal of Economic Psychology*, *31*, 181–191.

Dohmen, T. J. (2008). The influence of social forces: Evidence from the behavior of football referees. *Economic Inquiry*, *46*, 411–424.

Garicano, L., & Palacios-Huerta, I. (2005). *Sabotage in tournaments: Making the beautiful game a bit less beautiful*. London, England: Centre for Economic Policy Research.

Garicano, L., Palacios-Huerta, I., & Prendergast, C. (2005). Favoritism under social pressure. *Review of Economics and Statistics*, *87*, 208–216.

Goumas, C. (2014). Home advantage in Australian soccer. *Journal of Science and Medicine in Sport*, *17*, 119–123.

Loughead, T., Carron, A., Bray, S., & Kim, A. (2003). Facility familiarity and the home advantage in professional sports. *International Journal of Sport and Exercise Psychology*, *1*, 264–274.

Neave, N., & Wolfson, S. (2003). Testosterone, territoriality, and the home advantage. *Physiology and Behavior*, *78*, 269–275.

Nevill, A. M., Balmer, N., & Williams, A. (2002). The influence of crowd noise and experience upon refereeing decisions in football. *Psychology of Sport Exercise*, *3*, 261–272.

Nevill, A. M., & Holder, R. L. (1999). Home advantage in sport: An overview of studies on the advantage of playing at home. *Sports Med*, *4*, 221–236.

Nichols, M. (2014). The impact of visiting team travel on game outcome and biases in NFL betting markets. *Journal of Sports Economics*, *15*, 78–96.

Oberhofer, H., Philippovich, T., & Winner, H. (2010). Distance matters in away games: Evidence from German football league. *Journal of Economic Psychology*, *31*, 200–211.

Page, K., & Page, L. (2010). Alone against the crowd: Individual differences in referees' ability to cope under pressure. *Journal of Economic Psychology*, *31*, 192–199.

Pollard, R. (1986). Home advantage in soccer: a retrospective analysis. *Journal of Sports Sciences*, *4*, 237–248.

Pollard, R. (2002). Evidence of a reduced home advantage when a team moves to a new stadium. *Journal of Sports Sciences*, *20*, 969–973.

Pollard, R. (2006). Worldwide regional variations in home advantage in association football. *Journal of Sports Sciences*, *24*, 231–240.

Pollard, R., & Pollard, G. (2005). Home advantage in soccer. A review of its existence and causes. *International Journal of Soccer and Science Journal*, *3*, 28–38.

Pope, B. R., & Pope, N. G. (2015). Own-nationality bias: evidence from UEFA Champions League football referees. *Economic Inquiry*, *53*, 1292–1304.

Salminen, S. (1993). The effect of the audience on the home advantage. *Perceptual and Motor Skills*, *76*, 1123–1128.

Scoppa, V. (2008). Are subjective evaluations biased by social factors or connections? An econometric analysis of soccer referee decisions. *Empirical Economics*, *1*, 123–140.

Scoppa, V. (2015). Fatigue and team performance in Soccer: Evidence from the FIFA World Cup and the UEFA European Championship. *Journal of Sports Economics*, *16*, 482–507.

Strauss, B. (2002). The impact of supportive spectator behavior on performance in team sports. *International Journal of Sport Psychology*, *33*, 372–390.

Sutter, M., & Kocher, M. (2004). Favoritism of agents—The case of referees' home bias. *Journal of Economic Psychology*, *25*, 461–469.

van de Ven, N. (2011). Supporters are not necessary for the home advantage: Evidence from same-stadium derbies and games without an audience. *Journal of Applied Social Psychology*, *41*, 2785–2792.

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