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Home Advantage in City and Same-Stadium Derbies: Evidence from European Professional Football

Vladimir I. Kolmakov^{*a,b}, Svetlana N. Chernyakova^a

^a*Siberian Federal University
Krasnoyarsk, Russian Federation*

^b*Institute of Biophysics SB RAS
Krasnoyarsk, Russian Federation*

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Abstract. The search for the main factors of the home advantage phenomenon in professional European football is a hot topic for scientific research. We assessed the contribution of individual factors to the home advantage using the statistical results of European city derbies, same-stadium derbies, and matches of the championships of microstates. We compared the statistical results of the European city and stadium derbies, as well as matches of the championships of Luxembourg and Malta, played in the presence of spectators in the stands (2017–2020) and without spectators in the Covid-19 pandemic (2020–2021). The number of home victories was compared with the number of away victories using a paired t-test, and the impact of the number of spectators in the stands on the outcome of matches was assessed based on a logistic regression model. Home advantage was present in European city derbies and Luxembourg championship matches before the Covid-19 pandemic. For popular city derbies from Europe’s elite leagues, home advantage has been maintained through the Covid-19 pandemic with no spectators in the stands. There was no home advantage in stadium derbies and Maltese championship matches. We conclude that the home advantage can be determined by the influence of only one factor – familiarity of the players of the home team with the football stadium. The information presented in the article can be used by players, coaches and managers of professional football clubs to improve the performance of the game.

Keywords: home advantage, football, city derby, same-stadium derby, spectators, familiarity, referee bias, Covid-19 pandemic, Malta, Luxemburg.

Research area: sport.

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Домашнее преимущество в городских дерби и дерби на одном стадионе: свидетельство европейского профессионального футбола

В.И. Колмаков^{а,б}, С.Н. Чернякова^а

^аСибирский федеральный университет
Российская Федерация, Красноярск

^бИнститут биофизики СО РАН

ФИЦ “Красноярский научный центр СО РАН”

Российская Федерация, Красноярск

Аннотация. Поиск основных факторов, приводящих к домашнему преимуществу в профессиональном футболе, продолжает оставаться актуальной темой для научных исследований. Предложено использовать статистические результаты европейских городских дерби, стадионных дерби, матчей чемпионатов малых по размеру государств, для оценки вклада отдельных факторов в домашнее преимущество. Проведен сравнительный анализ статистических результатов европейских городских и стадионных дерби, а также матчей чемпионата Люксембурга и Мальты, сыгранных в присутствии зрителей на трибунах (2017–2020 гг.) и без зрителей в пандемию Ковид-19 (2020–2021 гг.). Количество побед хозяев сравнивали с количеством побед гостей с помощью парного t-критерия, влияние количества зрителей на трибунах на исход матчей оценивали на основе модели логистической регрессии. Феномен домашнего преимущества имел место в европейских городских дерби и матчах чемпионата Люксембурга до пандемии Ковид-19. Для популярных городских дерби из элитных европейских лиг домашнее преимущество сохранялось в пандемию Ковид-19 при отсутствии зрителей на трибунах. Домашнее преимущество в стадионных дерби и матчах чемпионата Мальты отсутствовало. Сделан вывод о том, что домашнее преимущество может определяться влиянием только одного фактора – знакомства с футбольным стадионом игроками домашней команды. Представленная в статье информация может быть использована игроками, тренерами и менеджерами профессиональных футбольных клубов для повышения результативности игры.

Ключевые слова: домашнее преимущество, футбол, городское дерби, стадионное дерби, зрители, знакомство со стадионом, пандемия Ковид-19, Мальта, Люксембург.

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Introduction

Fans in Europe are well aware of the home advantage (HA) phenomenon in association football, which means that the home team more often beats the away team (Pollard, 2008; Lago-Penas, 2021). Currently, the main factors of HA in

European professional football are: the presence of spectators in the stands and their influence on players (1) (Pollard, Gomez, 2009; Inan, 2020); referee bias in favor of the home team under pressure from the local crowd (2) (Unkelbach, Memmert, 2010; Goumas, 2014); special tactics

of playing at home and away (3) (Staufenbiel et al., 2015); protection of the “territory” as a manifestation of natural behavioral reactions of the home team players (4) (Furley et al., 2018); anxious behavior and stressful state of players of the away team (5) (Jimenez et al., 2020); fatigue of the away team players after traveling to the match venue (6) (Nedelec et al., 2015); familiarity with the local stadium by the home team players (7) (Wunderlich et al., 2021); and adaptation of the home team players to the environment of the match venue (8) (Lichter et al., 2017; Damme, Baert, 2019). All these factors may be divided into social pressure of the crowd (1, 2 and 3), psycho-behavioral effects (4, 5) and physiological effects (6, 7 and 8).

Interestingly, football researchers still have no consensus on what effects and conditions play the dominant role in HA. This is due to two main reasons complicating HA research. Firstly, it is almost impossible to organize field experiments during football matches in order to determine the contribution of separate factors to HA. Secondly, some factors of HA are interconnected and influence each other. Therefore, HA is a complex, non-additive phenomenon that is difficult to study directly. Thus, the conclusions of football HA studies are often speculative and leave room for further research.

Theoretical framework

One of the well-known approaches in HA research is the comparative analysis of matches played in special circumstances. For example, such matches can be meetings between teams from the same city (so-called “city derbies”) or a microstate, the area of which is approximately the size of a big city, but at the same time, each team has its own home field. An example of such a country would be Luxembourg. Obviously, when considering HA in such matches, some physiological factors should be excluded: fatigue from moving and adaptation to local environmental conditions (6 and 8). There have been previous attempts to study HA in city derbies (Leite, Pollard, 2018). These authors indicated a relatively low level of HA for derbies compared to “normal” matches, even though. With the exception of HA, there are no signif-

icant differences between derby and normal matches despite the special attention given to derbies by fans and the media (Bakker et al., 2012).

In some European leagues (Seria A, Allsvenskan, Swiss Super League, etc.) teams from the same city share a stadium for home matches and occasionally play against each other (“same-stadium derby”). A striking example of such same-stadium derbies are the matches of the Italian Seria A championship between the teams Inter and Milan on San Siro Giuseppe Meazza Stadium in Milan, Lazio and Rome on Stadio Olimpico in Rome, Genoa and Sampdoria on Stadio Luigi Ferraris in Genoa (Van de Ven, 2011). Traditionally, away team fans are given no more than one sector of all tickets in the stands (Ponzo, Scoppa, 2018). Therefore, it can be assumed that in same-stadium derbies HA will be determined by the impact of social pressure of the local crowd (1, 2 and 3) and psycho-behavioral effects (4, 5). Obviously, there are no physiological factors in same-stadium derbies (6, 7 and 8). This provides an opportunity for researchers to study the influence of the number of spectators in the stands on HA. A situation similar to same-stadium derbies can occur in microstates like Malta where all matches are played in two or three stadiums.

During the global Covid-2019 pandemic, most European leagues featured football matches without spectators (McCarrick et al., 2021; Sedeaud et al., 2021). The Covid-19 pandemic provided a unique opportunity to explore HA in a natural experiment where matches were played without spectators in the stands (Sanchez, Lavin, 2021). Therefore, the 1st, 2nd and 3rd HA factors have been eliminated naturally. As a result, it became possible to answer the question: does HA exist in derbies and matches of the microstate championships without the support of the crowd? In this study an attempt was made to evaluate the contribution of individual effects on HA using the example of European club championships, based on a comparative analysis of balanced matches (home and away) before and during the Covid-19 pandemic. To achieve the goal, the following logical reasoning is proposed. If

HA occurs in city derbies during the Covid-19 pandemic, it is determined only by familiarity with the local stadium by the home team players (7) and the psycho-behavioral effect protection of the territory (4). In a same-stadium derby during the Covid-19 pandemic, HA should not be present, since all of the listed factors (1–8) are absent.

Methods

The HA was evaluated based on a comparison of the number of wins, draws and losses of the home team, home and guest goals. The possible occurrence of a referee bias was determined by the number of yellow cards presented to the players of the hosts and guests for various violations of the rules. For the analysis, statistical data of balanced matches (home and away) played from 2017 to 2021 were gathered, including city and same-stadium derbies of European professional leagues, as well as the Luxembourg and Malta championships. The study used match data only from those European leagues that had no spectators in their stadiums during the Covid-19 pandemic from March 2020 until the end of the season, as well as in the 2020–2021. These conditions were met by city derbies from 32 European leagues from 30 countries (Germany and England had two leagues each, Bundesliga and Bunesliga-2, and Premier League and Championship accordingly) and same-stadium derbies from 16 countries. To compare the distribution of home wins, draws and away wins, we looked at the last three full seasons with spectators (2017–2018, 2018–2019 and 2019–2020) for matches of the same teams that played in the pandemic.

To examine the relationship between HA and crowd density, city and same-stadium derby matches were ranked by the number of spectators in the stands held before the Covid-19 pandemic. Three ranks (categories) were allocated for city derbies: up to 1000 spectators, between 1000 and 10000, and more than 10000 spectators. There were two ranks for same-stadium derbies: under 10000 and over 10000. Data were obtained at four websites: uk.soccerway.com, www.transfermarkt.co.uk, www.bundesliga.com, www.soccer365.ru. In

general, the analysis covered of 3143 matches, including 815 played without spectators in the stands during the Covid-19 pandemic.

The number of home team wins was compared with the number of away team wins using a paired t-test (normality of data distribution is shown by the Shapiro test). The influence of the number of spectators in the stands on the result (home wins/away wins) was evaluated based on a logistic regression model. The impact of the number of spectators in the stands on count data such as the number of goals and number of yellow cards was assessed using Poisson regression models (Karlis, Ntzoufras, 2000; Benz, Lopez, 2021). Because the above measures can be correlated, they were assessed separately to avoid collinearity.

Results

The results of calculating the indicators of HA in European club football championships before and during the Covid-19 pandemic are presented in Table 1. In total, before the Covid-19 pandemic, the hosts beat the guests more often ($t=4.68$; $p<0.001$). At the same time, before the Covid-19 pandemic a very significant difference in the number of home wins over away wins was present at city derbies in general ($t=4.06$; $p<0.001$), and city derbies with >10000 spectators at every match ($t=3.33$; $p<0.001$). Significant difference was observed for city derbies, with <1000 spectators at every match ($t=2.45$; $p<0.05$) and for matches of the Luxembourg championship ($t=2.64$; $p<0.01$).

No significant differences were found between the victories of the home and away teams ($p>0.5$) for the entire dataset during the Covid-19 pandemic. Without spectators in the stands during the Covid-19 pandemic in European city derbies and the Luxembourg championship, the share of matches ending in a victory for the hosts decreased from 44.0 % to 40.7 %. At the same time, the share of guest wins remained almost unchanged (from 33.4 % to 33.5 %). That is, during the Covid-19 pandemic, home teams continued to win more often than away teams in European city derbies and Luxembourg. A significant difference during the Covid-19 pandemic was found only for those derby cities that had >10000 specta-

Table 1. Results of home advantage calculations in European club football championships before and during the Covid-19 pandemic

| Matches | Period | Num-ber of matches | Spec-tators (mean per match) | Home wins (%) | Draws (%) | Away wins (%) | Home goals (mean per match) | Guest goals (mean per match) | Home yellow cards (mean per match) | Guest yellow cards (mean per match) |
|--|-----------|--------------------|------------------------------|---------------|-----------|---------------|-----------------------------|------------------------------|------------------------------------|-------------------------------------|
| European derby city (>10000 at every match) | 2017–2020 | 319 | 33552 | 44.2 | 27.3 | 28.5 | 1.51 | 1.21 | 2.31 | 2.51 |
| | Covid-19 | 119 | 0 | 42.0 | 31.9 | 26.1 | 1.41 | 1.09 | 2.22 | 2.36 |
| European derby city (1000<DC<10000 at every match) | 2017–2020 | 337 | 3573 | 41.0 | 24.3 | 34.7 | 1.28 | 1.13 | 2.30 | 2.44 |
| | Covid-19 | 153 | 0 | 42.5 | 22.9 | 34.6 | 1.37 | 1.20 | 2.34 | 2.36 |
| European derby city (<1000 at every match) | 2017–2020 | 378 | 440 | 44.9 | 21.2 | 33.9 | 1.45 | 1.19 | 2.30 | 2.14 |
| | Covid-19 | 112 | 0 | 40.2 | 25.9 | 33.9 | 1.19 | 1.14 | 2.41 | 2.35 |
| Luxembourg | 2017–2020 | 567 | 439 | 45.0 | 19.9 | 35.1 | 1.77 | 1.57 | 2.16 | 2.37 |
| | Covid-19 | 143 | 0 | 38.5 | 23.8 | 37.8 | 1.50 | 1.44 | 2.47 | 2.26 |
| Malta | 2017–2020 | 507 | 1087 | 40.2 | 21.9 | 37.9 | 1.42 | 1.36 | 2.32 | 2.45 |
| | Covid-19 | 185 | 0 | 38.6 | 22.3 | 39.1 | 1.55 | 1.45 | 2.48 | 2.41 |
| European same-stadium derby (> 10000 at every match) | 2017–2021 | 76 | 27521 | 39.5 | 31.6 | 28.9 | 1.33 | 1.21 | 2.45 | 2.82 |
| | Covid-19 | 32 | 0 | 29.0 | 32.3 | 38.7 | 1.29 | 1.48 | 2.61 | 2.52 |
| European same-stadium derby (<10000 at every match) | 2017–2021 | 144 | 2792 | 37.5 | 30.6 | 31.9 | 1.23 | 1.14 | 2.27 | 2.87 |
| | Covid-19 | 71 | 0 | 38.0 | 23.9 | 38.0 | 0.99 | 1.08 | 2.69 | 2.59 |

tors per match before the Covid-19 pandemic ($t=2.14$; $p<0.05$).

In the same-stadium derbies and matches of the Maltese championship before the Covid-19 pandemic, there were no significant differences between the victories of the home team and the away team (on average 39.6 % and 35.8 % respectively). During the Covid-19 pandemic without spectators in the stands, the guests scored more victories than the hosts (38.8 % and 37.4 % respectively).

For the entire sample, the logistic regression model showed a statistically significant correlation between the number of spectators in the stands and the result of the match (win or loss of the home team) ($p<0.001$) (Table 2). In addition, the density of the crowd significantly

influenced the number of goals scored by the visiting team (Table 3). The more spectators were present in the stands, the fewer goals the away team players scored. There was no significant correlation between the number of spectators in the stands and the number of yellow cards shown to the players of both teams (Table 4 and 5).

Discussion

The current data show that the HA phenomenon is present in European derbies and championship matches in microstates. For the total sample, before the Covid-19 pandemic, the home teams had a clear advantage over the visiting teams in the number of home wins (see Table 1). Therefore, the comparative statistics

Table 2. Estimated regression parameters, standard errors, z-values and P-values for the logistic regression model of the influence of the number of spectators on the result

| | Estimate | Std. Error | z value | Pr(> z) |
|-------------|-----------|------------|---------|----------|
| (Intercept) | 1.447e-01 | 4.385e-02 | 3.300 | 0.000968 |
| Spectators | 1.125e-05 | 3.601e-06 | 3.124 | 0.001785 |

Table 3. Estimated regression parameters, standard errors, z-values and P-values for the Poisson regression model of the influence of the number of spectators on the number of goals scored by the away team

| | Estimate | Std. Error | z value | Pr(> z) |
|-------------|------------|------------|---------|----------|
| (Intercept) | 2.873e-01 | 1.666e-02 | 17.248 | < 2e-16 |
| Spectators | -5.278e-06 | 1.412e-06 | -3.738 | 0.000185 |

Table 4. Estimated regression parameters, standard errors, z-values and P-values for the Poisson regression for the influence of the number of yellow cards received by home team

| | Estimate | Std. Error | z value | Pr(> z) |
|-------------|-----------|------------|---------|----------|
| (Intercept) | 8.376e-01 | 1.258e-02 | 66.590 | <2e-16 |
| Spectators | 4.411e-08 | 9.421e-07 | 0.047 | 0.963 |

Table 5. Estimated regression parameters, standard errors, z-values and P-values for the Poisson regression for the influence of the number of yellow cards received by away team

| | Estimate | Std. Error | z value | Pr(> z) |
|-------------|-----------|------------|---------|----------|
| (Intercept) | 8.711e-01 | 1.235e-02 | 70.542 | <2e-16 |
| Spectators | 1.631e-06 | 8.909e-07 | 1.831 | 0.0671 |

of derbies and matches of the championships of microstates before and after the Covid-19 pandemic can be used to study individual factors of HA.

Past studies of Reade et al. (2020) and Fisher, Haucap (2021) showed that matches without spectators resulted in a lower HA. Our comparative studies also indicate the importance of spectators in the stands for HA: the fewer spectators, the lower the HA. It is known that the influence of local viewers can be multidirectional (Ramchandani, Millar, 2021). On the one hand, the positive reaction of the stands (applause, chants, enthusiastic exclamations) stimulate the players of the home team for additional effort and activity. On the other hand, the negative reaction of the stands (whistling, noise, chanting phrases with offensive content) causes fear among the players of the away team and leads to a decrease in the performance of technical and tactical actions. According to the data presented, in European city and same-stadium derbies, as well as the championships of Luxembourg and Malta, an increase in the number of spectators in the stands led to a decrease in the number of goals scored by guests against the hosts. That is, the audience influenced the performance of the players and the results of the match.

Although a decrease in the number of spectators in the stands leads to a noticeable decrease in the level of HA, it does not necessarily eliminate it. According to the data obtained, the “removal” of the crowd from the stands in the city derbies during the Covid-19 pandemic, which on average gathered about 33.5 thousand spectators for the period 2017–2020, did not lead to the loss of HA (see table 1). That is, crowd support is not the only factor in HA. Category (>10000 spectators at every match) is the most famous and watched football derby city in Europe and home team players are used to receiving support from larger crowds. Such city derbies have a long of confrontation history, they are often distinguished by special tension and spectator interest. For example, these are the derbies of London, Manchester, Liverpool, Glasgow, Belgrade, Istanbul, Lisbon, Madrid, Barcelona, Berlin, etc. The media, officials and

sports managers show great interest in them. Players tune in to the popular city derbies in a special way. Probably, during a pandemic in such matches, along with the factor of familiarity with the football stadium (7), the psycho-behavioral effects of protection of the territory by the players of the home team (4) and the feeling of anxiety among the players of the away team (5) become paramount. According to modern concepts, the factor of territorial protection acquired during human evolution is based on a change in the action of testosterone, the hormone of physical activity and aggressive behavior (Koundourakis, Margioris, 2019). An increase in the concentration of cortisol, a hormone of anxiety and fear, in players at away matches can lead to an increase in heartbeat and an increase in blood pressure (Slimani et al., 2017). This reduces the effectiveness of individual and collective tactical and technical actions in the game. The formulated assumption can be confirmed (or refuted) only by direct measurements of hormone levels in city derby participants.

The category of city derbies with the participation of less than 10000 spectators, but more than 1000 spectators in the stands included the matches of Dublin, Sofia, Plovdiv, Belgrade, Budapest, etc. The category of less than 1000 spectators in the stands included city derbies in Yerevan, Baku, Tbilisi, Skopje, Tallinn, etc. Consequently, only city derbies from non-elite European leagues were included in these “low-visited” categories. Before the Covid-19 pandemic, along with Luxembourg championship matches, they had a relatively low level of HA. During the pandemic without spectators, there was no HA. That is, the decline in occupancy to zero at low-visited city derbies and matches of the Luxembourg championship has become dramatic for home teams, although they are accustomed to low occupancy of the stands. On the one hand, this confirms the importance of the presence of even a small number of spectators in the stands for the home team. On the other hand, it indicates that the familiarity factor in city derbies from non-elite leagues and matches of the Luxembourg championship plays a smaller role than in popular European city derbies. In some European

leagues from smaller countries, clubs play each other four times a season (two home, two away) and have more time and opportunity to get to know the stadium during away games. Perhaps the coaches and managers of the visiting teams in the context of the pandemic Covid-19 have begun to use the “defensive” away model of the game less. That is, the absence of spectators in the stands in the little-visited city derbies increased the tactical courage of the coaches of European clubs.

For the studied data array, we found that the referee issued yellow cards to the players of the home team for gross violations of the rules of football, regardless of the number of spectators in the stands. Therefore, there was no unconscious referee bias in European derbies, Maltese and Luxembourg league matches. Although earlier, there has been much evidence of the influence of the crowd on the unconscious decisions of the referees in favor of the hosts for European professional football (for example, Lovell et al., 2014). It is possible that recently in European club football there has been a significant decrease in the number of unconscious erroneous refereeing decisions in favor of the hosts for the following reasons. Firstly, the introduction of a video review system in controversial cases during the match allowed the referee not to make instant decisions (Holder et al., 2022). Secondly, the psychological resilience of judges when making decisions under pressure from the audience has increased thanks to special training programs, including the use of digital technologies (Gulec et al., 2019). According to the literature data (Rovetta, Abate, 2021; Reade et al., 2022) the number of unconscious erroneous refereeing decisions decreased during the lockdown compared to the period before the pandemic Covid-19. That is, despite the positive changes in recent years, unconscious decisions of referees continue to be an urgent problem and a factor of HA in European football.

In our opinion, familiarity with the stadium is the main HA factor in city derbies without spectators. Familiarity with the football field allows the home team players to navigate better and perform technical actions more effi-

ciently than the players of the away team. It is known that moving to a new stadium can lead to the loss of HA (Pollard, 2002). In the last twenty years, many elite European clubs have built new home stadiums with original stands and pitch designs. However, recent work by Leite et al. (2022) shows that moving to a new stadium in European professional leagues did not result in a change in HA. It is possible that home clubs have started to conduct accelerated familiarization programs for players with the features of the new football stadium. Thus, club managers and coaches are aware of the importance of familiarity with the stadium as an important factor in HA.

Since matches without spectators during Covid-19 pandemic took place in the same place and at the same time, as if the fans were not prohibited, then the exclusion of crowd factors in our study is quite reasonable. However, one should take into account the introduced temporary new rules on the number and timing of substitutions in matches, breaks for drinking water, which could affect the tactics of the game. In addition, the fear of the players and referees of the Covid-19 infection could change the competitiveness of the matches. For example, players could avoid close contact, both within their own team and with the rivals. Therefore, the analysis of matches during Covid-19 pandemic may have a somewhat distorted view of the psychological pressure on players, referees and coaches from the football crowd.

Conclusion

We can conclude that in European city derbies and microstates championships, where each team has its own home stadium, there is a HA. It is shown that in such matches, HA can be associated with social pressure of the crowd, psycho-behavioral effects and familiarity with the local stadium by the home team players. At the same time, the more spectators in the stands, the higher the level of home advantage. In popular city derbies from the elite European leagues, the HA can be due to only one factor – familiarity with the stadium by the players of the home team. At present, there is no evidence of a HA in matches between teams in the championships of small countries that

do not have their own stadiums, and European some-stadium derbies.

Coaches, managers and players must apply up-to-date knowledge of HA factors in preparation for and during football derbies. It is especially important to consider HA factors in away derbies. This will improve the effectiveness of the team's game and reduce its dependence on HA factors.

In general, the obtained results allow us to recommend comparative studies of city and one-stadium derbies, as well as championships of small countries for studying HA factors. With their help, in the future, researchers may try to gain a deeper understanding of the mechanisms that explain the phenomenon of HA in European club football.

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