The crowd factor: The impact of the 12th man on home advantage in soccer

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Abstract:

Home advantage refers to the concept that teams playing at home have consistently won more games than the visiting teams (away teams). Various studies in the past have attributed this advantage mainly to crowd support and familiarity of playing conditions for the home team. Soccer fans have always believed that their presence boosts the winning chances of the teams they support and hence turned out at the stadiums with great enthusiasm and fervor. However, the Covid-19 restrictions have brought about an unimaginable change even in the soccer world – matches are being played in empty stadiums. This scenario has opened up the possibility to study the impact of the absence of crowds on home advantage. There has historically never been a big sample size of games without crowds to analyze the impact of crowd on home advantage. This thesis explores the extent of impact that the absence of fans has on the match results and the predominant factors that cause this. This thesis finds that the odds of a win for the home team are 1.276 times more when playing in the presence of crowds as compared to when playing in empty stadiums. Results also suggest that in the absence of supporters, there is a significant change in the behavior of referees as they tend to favor home teams under pressure of partisan crowds. On the other hand, players seem to be lacking motivation and aggression in absence of cheering fans.

Key words: soccer, fans, COVID-19, home advantage

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1.0 Introduction

The Coronavirus pandemic has affected the whole world in numerous ways and has had a considerable impact on the sporting world as well. There was an unprecedented halt of tournaments and leagues worldwide. Through the course of the pandemic, sporting leagues gradually began to resume. However, there was a glaring absentee - the crowd in the stadiums. Fans are the backbone of sports, especially soccer, and are often referred to as the 12th player (languagecaster.com). There has always been discussion if the teams playing at home ('home teams') gain an advantage because of the crowd support and the encouraging atmosphere created by them. Historically, there has never been a prolonged run of games played in empty stadiums before the pandemic, so it was tough to quantitatively evaluate the impact of the crowd's presence on the players and the results of matches.

Research shows a certain existence of home advantage in all sports, especially in soccer (Pollard, 1986). Home teams win about 67% of decided games and home advantage accounts for about 0.6 more goals than the away team per game (Staufenbiel, Lobinger and Strauss, 2015). Some experts believe that the major factor is the psychological support the players derive from the presence of fans or the players' familiarity with local conditions, whereas some suggest that the driving factor for the advantage is the referee's decision-making that is likely to be influenced by noisy home crowds. This study aims to explore the former hypothesis by evaluating a new dimension - the impact of the absence of fans in stadiums on home team performances. The criteria for the study include metrics such as goals scored, home wins and

impact on referee by looking at yellow cards awarded during the pre-Covid and post-Covid times. This thesis finds that the odds of a win for the home team are 1.276 times more when playing in presence of crowd compared to when playing in empty stadiums. Results also show that fewer yellow cards were given to away teams when there were no crowds in the stadium indicating change in referee's behavior in absence of crowds.

2.0 Literature Review

There are various studies that examine the impact of home advantage in soccer. One of the earliest studies on home advantage mentioned six reasons as the possible causes of home advantage: local crowd support, absence of travel fatigue, familiarity with local conditions, referee bias, special tactics, and psychological factors (Pollard, 1986). This section elaborates on a few of these factors that have been proven by previous researchers to act as driving influences for home advantage.

2.1 Impact on behavior of referees

Multiple studies have shown that the referees are likely to be harsher towards the away team by awarding fouls and punishing a player. This difference in a referee's behavior is possibly due to their decision-making being impacted by the thousands of home supporters putting the referee under pressure through screaming and shouting.

One study analyzed a few matches played in empty stadiums in 2007 in Italy to find whether there is a significant difference in the performance/ behavior of the players and the referees (Pettersson & Priks, 2010). The study looked at various parameters that could prove this. For teams, they measured the number of shots, number of tackles, pass accuracy and ball possession. For referees, the study compares the number of fouls, the number of yellow cards and red cards awarded to the home and away teams, in the presence of crowd and without crowd (Pettersson & Priks, 2010). The authors found no evidence that players were affected differently by pressure from the spectators, however, they found large and significant differences in the behavior of referees (Pettersson & Priks, 2010). The results showed that there was a statistically significant effect on fouls and yellow cards awarded to the away teams (Priks & Petterson-Lidbom, 2010). This strongly suggests that there is a substantial shift in referees' conduct in games without spectators rather than in the players' performance. However, the drawback of this study is that it looks at only 21 matches that were played in empty stadiums and does not factor in the quality of teams. The lockdown due the coronavirus pandemic allows the perfect opportunity to collect a large sample size of matches, as teams have played in empty stadiums for over 6 months during this period worldwide.

2.2 Different tactics and expectations while playing home and away

In soccer, teams approach a game differently based on whether it is a home game or an away game (Staufenbiel, Lobinger & Strauss, 2015). Since teams playing at home have a significant advantage, a draw is often considered a good result for the away team. The

psychology of the players and coaches differ when playing away, and consequently affects their decision making.

In 2015, Staufenbiel, Lobinger and Strauss performed a study to analyze how coaches approach home games and away games. In this study, they examined soccer coaches' expectations, goal setting and tactical decisions in relation to game location (whether home or away). The authors found that home team's coaches had higher expectations to win, set more challenging goals and went for more offensive and courageous playing tactics. They also found that coaches were less satisfied with tied scores at home and were more likely to change their approach during the game to achieve better results (Staufenbiel, Lobinger & Strauss, 2015). From the knowledge gained from this study, the authors determined it is likely that different playing styles in home and away grounds are a consequence of the tactical decisions of soccer coaches (Staufenbiel, Lobinger & Strauss, 2015).

This could be a potential reason as to why the home advantage may not have changed much due to a lack of crowd because coaches are still going into home and away games with same intentions of winning despite the absence of the crowd. If the current study finds that the home advantage is not impacted much in the absence of fans, then the aforementioned study would be particularly crucial as it signifies why teams are likely to win more at home regardless of crowd.

There have also been other studies that have tried to explain the reasons for home advantage. The popular belief is that the presence of home supporters is the major reason for

home advantage (Wolfson, Wakelin, & Lewis, 2005). However, studies mentioned above show that there could be other factors that contribute to home advantage. The current study examines results of over 2000 matches, where teams of all calibers have played an equal number of home games.

3.0 Theoretical Development

3.1Hypothesis Development

Hypothesis tests will be used to determine how results of matches are impacted as a consequence of playing in empty stadiums, and the reasons for this impact.

The presence of crowd support is expected to have an influence on the results, so home team results should have worsened with the absence of the fans in the stadium. There are two potential explanations behind this - the crowd causes a direct improvement in the performance of home players or the crowd pressure is able to convince and pressurize the referee to award favorable decisions throughout a match to the home team (Nevill & Holder, 1999). This leads to the first hypothesis -

Hypothesis 1: Home team performs better in presence of crowds than in their absence.

In order to explore how the approach of home and away teams change in the absence of fans, a comparison of goals scored by home and away teams would be useful. It is possible that

home players lack the extra push provided by their supporters, so they end up scoring fewer number of goals than they used to. Another possibility is that the away teams are scoring more goals than before because they feel equally confident and motivated as the home team, since the absence of home crowd reduces the intimidation that opposition players faced earlier. This forms the next hypothesis -

Hypothesis 2a*:* Home team scores less goals with no crowd relative to before.

Hypothesis 2b: Away team score more goals with no crowd relative to before.

Studies show that referees can be harsher towards the visiting team due to pressure and noise from supporters (Priks & Petterson-Lidbom, 2010). So, the lack of crowd should also eliminate this effect. To evaluate whether the referees' decision making is impacted, yellow cards are used as a measure to study if referees' actions change in the absence of fans. Yellow cards are given as punishment to players if the player commits a foul or for dissent. It is up to the referee to decide whether a certain foul should be deemed as a yellow card (Thepfsa.co.uk). To test if referees are indeed impacted by the home crowd, the yellow cards shown to home and away teams pre-COVID and post-COVID in empty stadiums can be compared. With no crowd support, referees could be punishing the home team more or punishing the away team lesser than before for one of the hypotheses to be confirmed. This leads to the next hypothesis:

***Hypothesis 3a**:* Referees award more yellow cards to home team post-COVID (with no crowd) relative to before

***Hypothesis 3b**:* Referees award fewer yellow cards to away team post-COVID (with no crowd) relative to before

3.2 Data description

The dataset used to evaluate the hypotheses consist of data from all matches in the top 2 soccer leagues of England (Premier League and the Championship) between September 2017 and January 2021 (football-data.co.uk). Each row corresponds to a match and consists of the goals scored by the home team and the away team as well as the yellow cards given to the home team and the away team. Each match was played at the home stadium of one of the teams, and that particular team is classified as the home team. Next, the result for the home team is recorded as win, draw or loss. A points system for the result of each match is helpful to compare mean points among different scenarios. 1 point was awarded for a win, 0.5 for a draw and no points for a loss. The date for each match is known, so a post-COVID dummy variable was added to the dataset to indicate whether the match was played in an empty stadium or not. The dummy variable assumed the value of 1 if the match happened post lockdown and 0 if otherwise. Post lockdown, all matches were played in empty stadiums without fans so this will help compare the effects of the crowd.

4.0 Analysis/Results

The five hypotheses were first tested individually through a two-sample t-test of means. Hypothesis 1 is supported using two sample t-test of means as the mean points earned by the home team pre-COVID was 0.57 compared to 0.52 in absence of crowd post-COVID and the p-value of 0.004 implies the difference in means is significant. The summary of the results of all the matches from the data is shown in the figure below-

Figure 1: Summary of results in the data set

	Pre-lockdown (no. of matches)	**Post-lockdown (no. of matches)**
Home Win	594	292
Draw	332	182
Home Loss	386	259
Total	**1312**	**733**

An ordinal logistic regression model would help understand more thoroughly the effect on home team's results when playing without fans. An ordinal logistic regression model is used when the response variable is a categorical variable with more than 2 levels. The response variable in this case is the home result with levels win, draw and loss, whereas the predictor variable is the post-COVID dummy variable with 2 levels – pre and post. The equation for ordinal logistic regression is parameterized as:

$$logit(P(Y \leq j)) = \beta_{j0} - \eta_1 x_1$$

Here, *j* represents the different levels of the response variable (win, draw and loss) and η_1 denotes the log odds. After running the regression, the value of η_1 is 0.2439. For ease in

interpretation to convert from log odds to odds, exp (η_1) is calculated, which equals 1.276. Hence, this can be interpreted as following - **the odds of a win for the home team are 1.276 times more when playing in presence of crowd compared to when playing in empty stadiums.** The ordinal logistic regression model also helped predict the probabilities of different scenarios, on average, as shown in figure 2:

*Figure 2: **Predicted Probabilities** of the results, pre-lockdown vs post-lockdown*

	Pre- Lockdown	**Post-Lockdown**
Home Win (%)	45.4%	39.5%
Draw (%)	24.9%	25.5%
Home Loss (%)	29.6%	35.0%

Figure 2 shows that the ordinal logistic regression model predicted a higher win percentage pre-lockdown (in presence of fans) for the home team compared to in absence of fans. Hypothesis 2a was also supported (p=0.0007) using two sample t-test of means as the average goals scored per match by the home team was 1.30 post-lockdown compared to 1.54 before lockdown. Hypothesis 2b was unsupported as the goals scored by the away team did not show much difference. The results of hypothesis 2a and 2b show that home advantage has reduced as the home teams' goal scoring numbers have decreased considerably, possibly due to a lack of home crowd support.

Hypothesis 3b is strongly supported (p=0.00004) using two sample t-test of means as the data indicates fewer yellow cards were given to away team when there was no crowd in the stadium. The mean of yellow cards awarded to the away team changes from 1.71 in presence of crowds, to 1.45 in the absence of crowd. This suggests that the crowd atmosphere could have

caused the referees to take more action as the crowd often exaggerates the impact of certain situations in the match. Referees are often accused of being influenced by the crowd noise when giving decisions, especially when it is a 50-50 decision or when the referee did not clearly see what happened. The results here could therefore imply that the referees are influenced by the fans. Hypothesis 3a is found to be not supported. This implies that the referee does give less decisions favoring the home team when the crowd is not present, which impacts the home team's chances of winning.

The results indicate that fewer yellow cards were given out to both home and away teams when there was no crowd in stadiums. When comparing the total yellow cards awarded per match pre vs post-lockdown, the results show a significant difference- 3.22 vs 2.89. One explanation could be that players have a higher adrenaline and higher aggression when fans are present as they are spurred on by the crowd. Dissecting further into the data to compare the average goals scored per match pre vs post-COVID, the results have a significant p-value. The mean goals scored were 2.71 pre-lockdown compared to 2.48 post-lockdown. This, along with the fewer yellow cards, reveal that there is an impact on the decision making of both the players and the referees when playing in empty stadiums. The reason for this is probably the lack of energy from the fans and suggests that the atmosphere created from the crowd gives extra motivation and energy to the players on the field, causing the players to be more attacking and aggressive.

Another interesting observation from the data is that the difference between yellow cards awarded to home and away teams post-COVID is 0.0027 compared to 0.2 pre-COVID. 0.0027 is an insignificant difference and this indicates that in absence of supporters, the referee has been punishing the home and away team equally when there is no external factor affecting the

referee's decision. Whereas, earlier, the away team would get punished more as the referee felt under pressure from the home crowd.

5.0 Discussion

5.1 Takeaways and Applications

The results of this study are of relevance to multiple stakeholders in the soccer community. The soccer betting industry is worth billions of dollars so the parties involved in betting would definitely be interested to know how empty stadiums influence the chances of a home team win (globenewswire.com). More specifically, total goals scored in a match and number of yellow cards are common metrics people bet on, so it would be useful for the parties involved to recognize that these metrics are also impacted when matches are being played in empty stadiums. Soccer teams can also change their tactics and strategies according to the results that show a decrease in goals scored by the home team while playing in empty stadiums. It is also, imperative that governing bodies of soccer examine further into the extent of how much referees' decisions are impacted by the crowds. Both teams and viewers want the matches to be conducted fairly, especially when the stakes are high. The referee associations need to be alarmed about this observation and ought to train referees how not to get impacted by the biased crowds.

This study could similarly be conducted to examine the impact of no crowds on other sports. The crowd atmosphere is fiercer and fans are more aggressive in European soccer leagues, compared to baseball or American football in the US (chatsports.com). It would

therefore be surprising if the results in other sports are as significantly different. The results can also be compared between different countries in soccer to explore how noteworthy the difference is in each country. For example, the results may demonstrate that referees in another country are actually fairer compared to England and are not as swayed by the crowds or that the crowds are not as influential in another country.

5.2 Limitations

This study has been conducted in the unprecedented times of COVID-19, so results could have been affected due to a lack of normalcy. For example, the results show that players have been less aggressive since lockdown. A reason for this could be that players have been less fit compared to earlier as they have spent a lot of time quarantining and have not been able to train as much during lockdown. More metrics such as distance covered, that are not easily accessible, could be used to further evaluate to how much the intensity of players has decreased.

Video Assistant Referee (VAR) has been widely introduced in soccer for the first time in 2019, where referees are able to watch replays of decisive calls to make their decisions. This should reduce the impact of crowd affecting referees as the referees can now watch the replay and rethink their original decision, which might have been initially awarded due to crowd pressure.

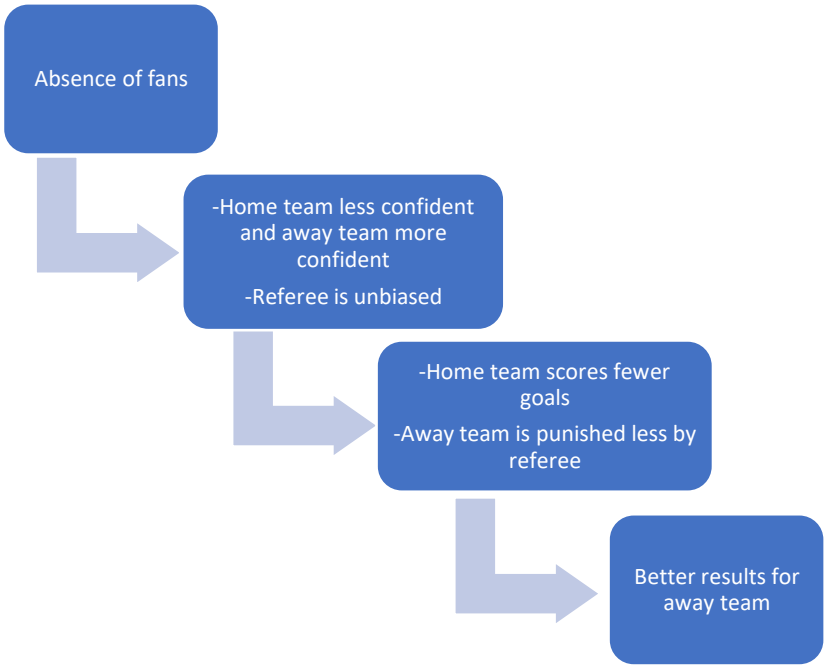
The study does not take into account the quality of teams. Although the results hold true on average, it could be possible that certain teams have been impacted more since playing in empty stadiums. For example, this would possibly hold true for teams known to have fiercer

home crowd. Results from more countries can be analyzed to validate the results and check if the results are similar elsewhere.

6.0 Conclusion

The impact of playing soccer since the outbreak of COVID-19 with restrictions on fans attending matches, are summarized in the figure below:

Figure 3: How soccer results are impacted when playing without crowd



The study confirms the hypothesis that home teams lose a considerable advantage when matches are played without supporters. The analysis shows that when crowd is present, home team is 1.276 times more likely to win the match compared to when playing in empty stadiums. The results also show that the referees award more yellow cards to the away team more when

fans are in the stadium. On the other hand, home and away teams are awarded an equal number of yellow cards when matches are played without crowd support. It may be a good idea for the referee associations to analyze further into why the difference is so huge. Furthermore, matches are found to be less aggressive and less attacking when played in empty stadiums. This is presumably so as the players have higher adrenaline, are more incentivized to attack and be more aggressive when they are galvanized by the support of frenzied fans.

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