HOME ADVANTAGE DURING COVID-19: STATISTICAL EVIDENCE FROM CZECH SPORT

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Abstract

The home advantage is a phenomenon across all sports, where the home team wins more matches and scores more goals than the away team. The home advantage is a very complex issue that is influenced by many different factors. One possible explanation is that the home fans positively influence the performance of the home team. The COVID-19 pandemic has negatively affected the world of sport. At the same time, it provided a unique opportunity to assess the impact of the home advantage on the performance of sports teams, as most of the 2020/21 season was played without spectators. The aim of the paper is to quantify the home advantage in the Czech top football and hockey leagues. The non-parametric two-sample Wilcoxon test was applied to the obtained data. The Wilcoxon test was used to compare the mean values of selected sports statistics (points scored, goals scored, etc.) in the seasons 2017/18 to 2020/21 (in seasons with and without spectators). Analysis of match statistics showed that the impact of the COVID-19 was slightly different for the two sports leagues.

Key words: home advantage, sport, COVID-19, Wilcoxon test, match statistics

JEL Code: L83, C12, C10

Introduction

The phenomenon of home advantage (further HA) has been studied in sport for many years. In most cases, bookmakers place emphasis on the venue when setting odds. The influence of the venue (i.e. "home" or "away") on the outcome of a sports match is a fairly frequently discussed phenomenon. According to this phenomenon, athletes should perform better at home and also have more success. The most common explanations for this phenomenon include fan influence, travel influence, familiarity with the field, referee bias, and a variety of other psychological aspects (Pollard, 2006).

The first authors to examine the benefits of the home environment were Schwartz and Barsky (1977). These authors believe that supportive fans exert an encouraging and motivational influence on their players that helps their on-field performances. In their

research, they were interested in the results in American baseball league, football league and ice hockey and revealed the positive influence of the home environment.

On the other hand, some authors in later years have been more cautious and reported that the effects of the home environment benefit are somewhat lower than originally expected. Rather, they consider factors such as the proximity of the fans to the playing field and the constant, loud and encouraging chanting to be decisive, which may encourage the home players to put in more effort and ultimately win the game. Another factor often cited as affecting HA is the influence of the fans on the referees. Research by Dosseville et al. (2015) states that referees tend to make more decisions in favour of the home team. For example, in the German and Italian football leagues, referees add extra time at the end of each half when the home team is down by a goal (Dohmen & Sauermann, 2016; Garicano et al., 2005).

A major limitation of the above research is that it has not yet been possible to study matches without the presence of home spectators over a long period of time. For this reason, spectators and fans are cited as the main factor responsible for HA (Pollard & Pollard, 2005). Indeed, never in the history of sport has there been such an extensive opportunity to examine the effect of spectator-free conditions on the performance of a sports team or individual. One is limited to a few studies that have examined Italian league matches played without spectators for safety reasons. However, these were only a few matches where the club was punished with this sanction.

The global pandemic COVID-19 in 2020 has brought a number of restrictions, including a ban on gatherings at sporting events. The main reason for this ban was public health concerns. This move makes it possible to conduct research on the impact of fans on the phenomenon of HA. The COVID-19 pandemic meant that for all sports disciplines in the world, spectators were banned from entering stadiums. The COVID-19 pandemic had the harshest economic impact on football and hockey. The COVID-19 pandemic, on the other hand, provided a unique opportunity to conduct research on the impact of fans on HA.

In 2021, several of these studies were carried out and dealt mainly with the area of football. These were mainly studies of foreign football leagues. For example, research by Reade et al. (2020) found a significant reduction in the percentage of home wins (43.8% with fans versus 41.2% without fans). McCarrick et al. (2020) examined all European football leagues that played a season without spectators. The results of their study showed that teams with spectator presence in their home stadium won on average 0.39 points per game more than away teams. On the other hand, teams without spectators in the home stadium won on average 0.22 points per game more than away teams. On the other hand, the study by Bryson

et al. (2021) found no significant effect on player performance in games without spectators. Research by Schlenker et al. (1995) found a differential effect of spectator presence across countries. For example, fewer points were scored by football teams in Germany and Spain in a home stadium without spectators. But almost no differences between the number of points scored at home and away with and without spectators was confirmed in Austria, Italy and England. Thus, this study suggests that the HA may be geographically sensitive. Thus, the available analyses are not consistent in terms of the effect of spectators on home advantage.

In this paper, two Czech sports leagues were evaluated. In line with the above literature, the aim of the research is to verify the impact of the COVID-19 pandemic on the HA in the top football and hockey leagues.

1   Data

Two Czech sports leagues were included in the analysis. The research focused only on matches in the regular season. All play-off matches in both sports leagues were excluded from the research. Play-off matches are subject to different playing conditions.

In the first case, it was the top Czech football league called Fortuna:Liga. Fortuna:Liga was examined based on data for the last four seasons (2017/18 to 2020/21). A total of 16 teams have always participated in the Fortuna:Liga in the 2017/18 to 2019/20 seasons. The Fortuna:Liga was played on a two-round, one-versus-one system. Each team played 30 matches (15 home and 15 away). A total of 240 matches were played during the 30 rounds. In the 2017/18 and 2018/19 seasons, the Fortuna:Liga was played with spectators. In the 2019/20 season, the last 5 rounds (25th to 30th) were played without spectators or with significant restrictions. It can thus be said that Fortuna:Liga ended the 2019/20 regular season without spectator support. A total of 18 teams participated in the 2020/21 season. Fortuna:Liga was played with the same system. Each team played 34 matches (17 home and 17 away). A total of 306 matches were played during the 34 rounds. The 2020/21 season was played almost entirely without spectators. Spectators were allowed to return in limited numbers (max. 1,000) only on 1 May 2021. They only saw the last four rounds of the regular season.

The second part of the paper analysed the top Czech hockey league called Tipsport ELH. The hockey league was also examined based on data for the last four seasons (2017/18 to 2020/21). There were 14 teams participating in the Tipsport ELH in each of the 2017/18 to 2020/21 seasons. The Tipsport ELH was played in a four-round, one-versus-one system. Each team played 52 matches (26 home and 26 away). During the 52 rounds 364 matches were

played. Tipsport ELH managed to play the entire regular season (52 rounds) with spectators in the 2019/20 season. The play-offs have been cancelled for the 2019/20 season. The 2020/21 season played the first two rounds with restrictions (max. 1,000). The rest of the 2020/21 season was played completely without spectators.

In total, we analysed 1,026 individual matches from the Fortuna:Liga and 1,456 matches from the Tipsport ELH. The data on individual football matches were obtained from the data on the Fortuna:Liga website. This data includes the number of points per game and goals scored. It was not possible to obtain further data on Fortuna:Liga. Data on hockey matches (points, goals scored, and shots on goal) were available in the database on Hokej.cz.

2   Methodology

Shapiro-Wilk test and two-sample Wilcoxon test were used to evaluate the data obtained. The Shapiro-Wilk test was used to test the normality of the data. The Shapiro-Wilk test is the preferred test of normality due to its good performance characteristics compared to a number of alternative tests (Shapiro et al., 1968). The test is used in statistics to test the hypothesis that a random sample of size n (x_1, x_2, … x_n) comes from a normal distribution with unspecified parameters μ a σ^2, $N(\mu, \sigma^2)$. The null hypothesis H_0 states that the sample data belongs to a normal distribution. The alternative hypothesis H_1 states that the data sample does not belong to a normal distribution. The test statistic to assess the normality of the data is the W statistic, which is given by equation (1).

$$W = \frac{b^2}{S^2} = \frac{\left[\sum_{i=1}^{k} a_{n-i+1}(y_{n-i+1} - y_i)\right]^2}{\sum_{i=1}^{n}(y_i - \bar{y})^2} \tag{1}$$

The test statistic W takes the value 1 if the data show a perfect fit to a normal distribution. If the value of the test statistic W is statistically significantly less than 1, H_0 on the fit to the normal distribution can be rejected and H_1 can be accepted.

In the present research, the non-parametric two-sample Wilcoxon test was applied to the obtained data. It is a non-parametric analogue of the test of the equality of the means of two independent random sets (x_1, x_2, … x_n) and (y_1, y_2, … y_m) with different number of elements. The null hypothesis H_0 states that the data samples have identical means (medians). The alternative hypothesis H_1 states that the data samples do not have identical means. H_0 can be written as $\mu_1 = \mu_2$. H_1 can be written as $\mu_1 \neq \mu_2$. The test statistic to assess the normality of the data is the W statistic, which can be expressed by equation (2).

$$W = \frac{R^+ - \frac{1}{2}n_x n_y}{\sqrt{\frac{n_x n_y}{12}(n_x + n_y + 1)}} \tag{2}$$

In relation (1) R^+ is the smaller sum of the ordinal numbers. If $|w| > W_\alpha$ i.e., the critical value of the distribution $N(0;1)$, H_0 of the agreement of the sign values at a given significance level is rejected. This means that the difference between the pair of means (medians) is statistically significant.

3   Results

The results of the research are divided into two parts. In this part the results for Fortuna:Liga are presented. In seasons with spectators, there were significant differences between the number of points scored at home and away. In these seasons it was possible to score 0.65 more points at home. Therefore, it can be concluded that the team scored on average 0.65 more points at home than away in the season with spectators. In the season played without spectators, i.e. 2021/21 (marked *), the situation is different at first sight (see Figure 1). The HA has dropped to a difference of 0.26 points per game on average. It can therefore be concluded that the team scored on average 0.26 points more at home than away in the season without spectators.

Fig. 1: Average difference between points scored at home and away
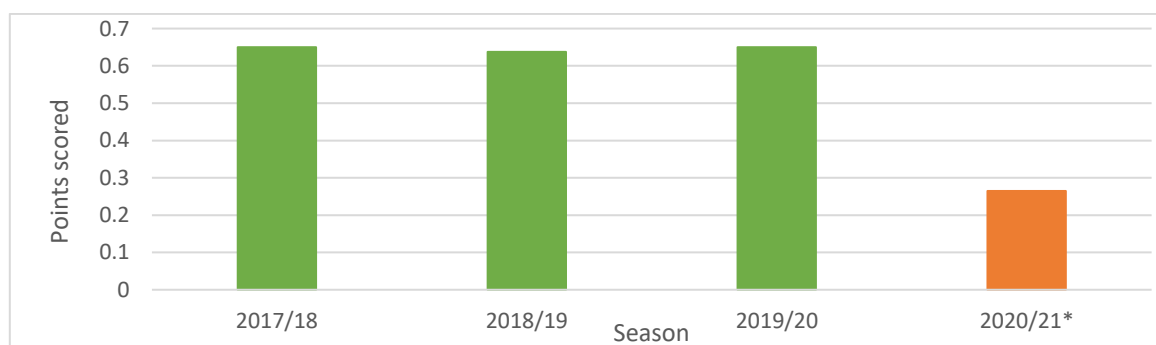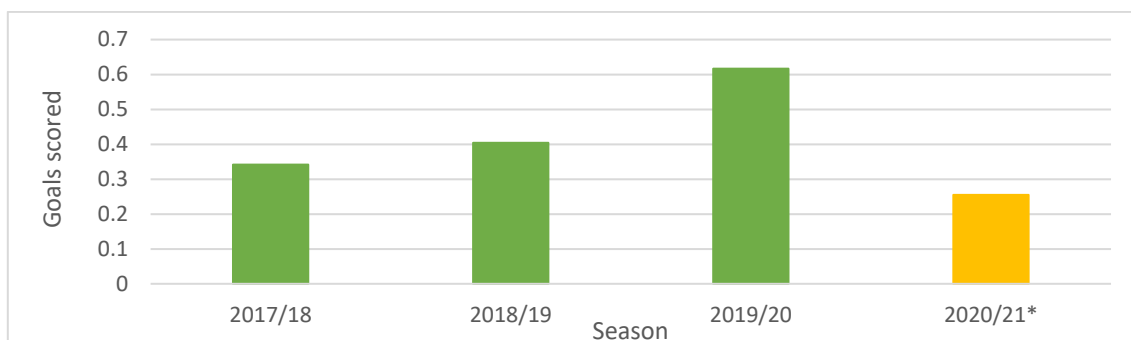

Source: own processing

In the seasons with spectators, there were also some differences between the number of goals scored at home and away. However, these differences are not so clear-cut. In seasons with spectators, the team scored on average 0.45 more goals at home than away. The most significant difference between goals scored at home and away was recorded in the 2019/20 season. In the season played without spectators, i.e. 2021/21 (marked *), the situation is

different at first sight (see Figure 2). The HA has dropped to a difference of 0.25 goals on average. It can therefore be concluded that a team scored on average 0.25 more goals at home than away in a season without spectators.

Fig. 2: Average difference between goals scored at home and away

Source: own processing

As the Shapiro-Wilk significance test showed that all the indicators did not have a normal distribution, the Wilcoxon test was used to investigate further. Using the Wilcoxon test, the two variables mentioned above were compared. The Shapiro-Wilk test and the Wilcoxon test were conducted at the 5% significance level.

Tab. 2: Wilcoxon W-test and P-values for Fortuna:liga

| Season	2017/18 and 2020/21		2018/19 and 2020/21		2019/20 and 2020/21	
	W	P-value	W	P-value	W	P-value
Number of points	25.5	0.00004*	19.0	0.00001*	18.5	0.00001*
Number of goals scored	120.0	0.41546	119.5	0.40644	74.5	0.01683*

Source: own processing, P-value < 0,05 *

Each variable was examined comparing the season with and without viewers. In the first case, it was a comparison of the median difference between the number of points scored at home and away. Table 2 shows that there are significant statistical differences between the difference in points scored at home and away in each year. Furthermore, the median difference between the number of goals scored at home and away was compared. Table 2 shows that there were statistically significant differences between the difference in the number of home and away goals scored only when comparing the 2019/20 and 2020/21 seasons. However, this could have been a one-off fluctuation.

The second part shows the results for the Tipsport ELH. In seasons with spectators, there were significant differences between the number of points scored at home and away. It

was an average of 0.5 points. Therefore, it can be concluded that the team scored on average 0.5 more points at home than away in the season with spectators. In the season played without spectators, i.e. 2021/21 (marked *), the situation is different at first sight (see Figure 3). The HA has dropped to a difference of 0.13 points per game on average. It can therefore be concluded that the team scored on average 0.13 points more at home than away in the season without spectators.
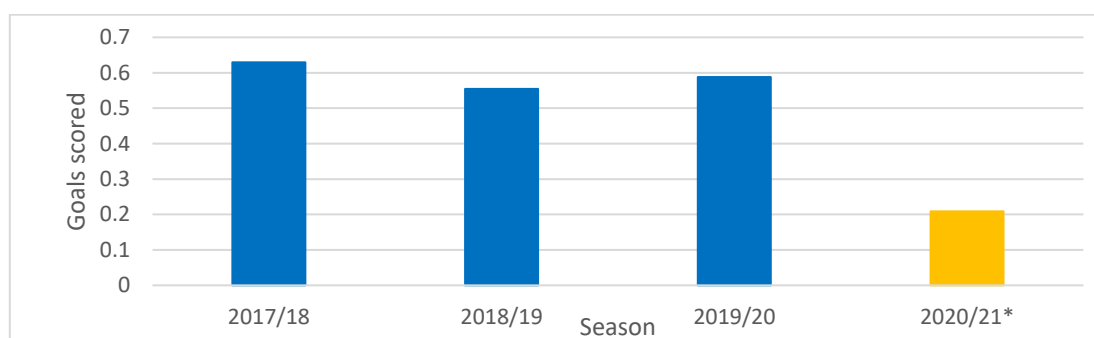
Fig. 3: Average difference between points scored at home and away
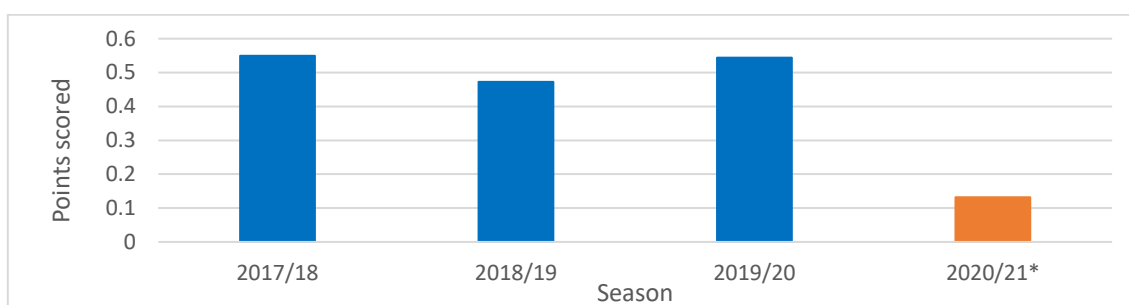
Source: own processing

In seasons with spectators, the differences between the number of goals scored at home and away were also significant. In seasons with spectators, the team scored on average 0.5 more goals at home than away. In the season played without spectators, i.e. 2021/21 (marked *), the situation is also different at first sight (see Figure 4). The HA has dropped to a difference of 0.2 goals on average. It can therefore be concluded that a team in a season without spectators scored on average 0.2 more goals at home than away.

**Fig. 4: Average difference between goals scored at home and away**

Source: own processing

The last indicator was the difference between the number of shots on goal at home and away. In seasons with spectators, it can be noted that the team at home took on average 3.4

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more shots on the opponent's goal than away. In the season played without spectators, i.e. 2021/21 (marked *), the situation is also different (see Figure 5). The HA has dropped to a difference of an average of 1.7 shots on the opponent's goal. Thus, it can be concluded that a team in a season without spectators shot on average 1.7 more shots on the opponent's goal at home than away.

Fig. 5: Average difference between shots on goal at home and away
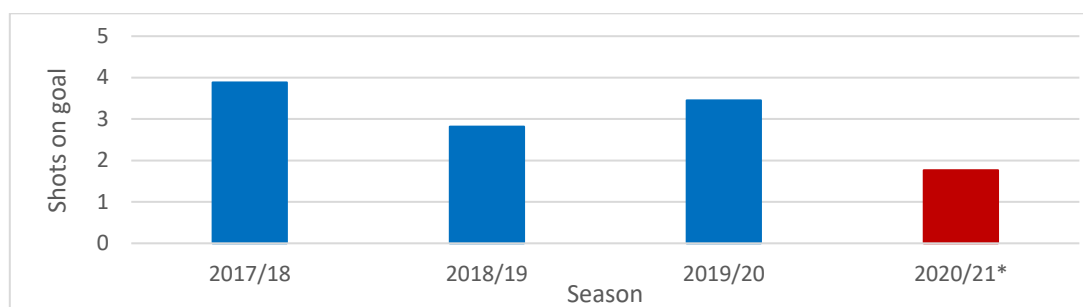
Source: own processing

As the Shapiro-Wilk significance test showed that all the indicators did not have a normal distribution, the Wilcoxon test was used to investigate further. Using the Wilcoxon test, the three variables mentioned above were compared. The Shapiro-Wilk test and the Wilcoxon test were conducted at the 5% significance level.

Tab. 3 Wilcoxon W-test and P-values for Tipsport ELH

Season	2017/18 and 2020/21		2018/19 and 2020/21		2019/20 and 2020/21	
	W	P-value	W	P-value	W	P-value
Number of points	7.0	0.00003*	7.0	0.00003*	18.0	0.00025*
Number of goals scored	52.0	0.03610*	51.5	0.04934*	50.0	0.02885*
Shots on goal	144.0	0.03646*	87.0	0.62939	112.0	0.53501

Source: own processing, P-value < 0,05 *

Each variable was examined comparing the season with and without viewers. In the first case, it was a comparison of the median difference between the number of points scored at home and away. Table 3 shows that there are significant statistical differences between the difference in points scored at home and away in each year. The median difference between the number of goals scored at home and away was also compared. Table 3 shows that there are significant statistical differences between the difference in the number of goals scored at home and away in each year. Finally, the median difference between the number of shots on goal at home and away was compared. Table 3 shows that there are statistically significant

differences between the difference in the number of shots on target at home and away only in the compared 2017/18 and 2020/21 seasons.

Conclusion

The aim of this research was to investigate the impact of COVID-19 pandemic restrictions on the HA of competitive sports leagues. An analysis of the statistical data on the matches showed that the differences in HA differed between the two sports leagues. More significant changes in selected statistics can be found in the Tipsport ELH, where the Wilcoxon test confirmed a significantly different difference between the number of points and the number of goals scored at home and away. Thus, it can be concluded that the HA in terms of goals scored and points gained in the Tipsport ELH in the 2020/21 season has completely disappeared. A similar conclusion was also reached by McCarrick et al. (2020) although in his case the study focused on football clubs. On the other hand, Wilcoxon's test, with the exception of one season, did not confirm a statistically significant difference between the number of shots on target at home and away. In the Fortuna:Liga, Wilcoxon's test also confirmed a significantly different difference between home and away points. It can thus be concluded that the HA in terms of points scored in the Fortuna:Liga in the 2020/21 season has completely disappeared. On the other hand, the Wilcoxon test did not confirm a statistically significant difference between goals scored at home and away, with the exception of one season. This finding may confirm the conclusions of the study by Bryson et al. (2021).

Acknowledgment

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