## Theoretical Background

## Literature Review

## 2.1.1 The role of home advantage in sports

Home advantage has been widely studied in sports literature. One of the first to formally document the existence of a certain home advantage in sports were Schwartz and Barsky(1977). They find that home advantage exists in varying degrees across different sports. Furthermore in their research they suggest that the major contributor to home advantage is social support, opposed to familiarity and fatique for away teams. Nevill and Holder(1999) support this claim as they produce similar results in their analysis of home advantage in English and Scottish football matches. In a related study, Carron and Agnew(1994) examine crowd effects specifically to provide an overview of how crowds influence match outcomes. One of their main findings is a signicant positive relationship between home advantage and crowd density. In other words, more crowd support leads to a stronger home performance relative to away performance and consequently a higher chance of a home win than an away win.

One of the landmark studies in the area of home advantage in sports is the research conducted by Courneya and Carron(1992). In their paper they provide a comprehensive literature review on home advantage in sports, their framework has been used extensively in subsequent studies. Their framework on home advantage revolves around location factors that influence players, coaches and officials(referee) psychologically. Correspondingly behaviour of players, coaches and officials is influenced by their psychological state, the change in behaviour in turn alters the performance of players, coaches and referees. The four main factors behind home advantage in their framework are crowd factors, learning(familiarity) factors, travel factors and rule factors(specific rules that favor home team in some sports). Carron and Hausenblas(1997) apply this framework to assess the occurrence of home advantage. They claim that home advantage is relatively stable across time and is generalizable across team/individual sports, gender and professional and amateur sports.

Despite the increased complexity of models and data used, Carron, Longhead and Bray(2005) find that the framework is still relevant in the evolving situation, assessing that the framework still serves as bases for a majority of the research conducted on home advantage in sports.

## 2.1.2 The role of home advantage in football

Home advantage thus exists in each type of sport, on each level of competition and regardless of gender. However previous search shows that the intensity of home advantage varies widely across different sports. Schwartz and Barsky(1977) for example find that sports played on indoor venues such as Basketball and Ice-Hockey possess a substantially larger home advantage compared to sports with outside venues such as Football and American Football. They attribute the difference to the more enclosed and intense atmosphere inside a closed arena where acoustics of fan cheering seems to be more profound compared to a wide and open arena. Additionally, crowds are often closer on the pitch in an indoor arena compared to outside venues. The next paragraphs provide a synopsis of the literature on home advantage in football specifically.

Pollard(2008) provides an excellent overview of the consensus of home advantage in football. Similar to the work of Courneya and Carron(1992) he drafts a framework of the major factors of which home advantages in football sterns from. Some of the more interesting findings according to his review include those of Naeve and Wolfson(2003&2004) as well as Anderson, Neave and Wolfsson(2007) who find hormonal differences between home and away team players in match build up, with higher levels of testosterone for players when playhing a home match versus playing an a way match. Similarly to hormonal reaction when defending territory. This hormonal change could then be attributed to increased performance on the pitch for the home team. Pollard(2006) and Pollard and Seckin(2007) further scrutinize the sense of territoriality and its effect on home and away performance and find indeed evidence of a possible influence on home advantage. Furthermore, familiarity is a widely recognized possible component of home advantage. As outlined by ([16,18,21].)that familiarity with specific home turf conditions such as altitude and climate could play a role. In a similar fashion, artificial pitches seem to play a role in home advantage([19],).

The findings on the significance of travelling for home advantage are more ambiguous. ([2,3,12,13, 14,15,16].) find that travel distance seem to play a role albeit a minor one in conceiving of home advantage. Whereas on the other hand there are several studies who report an insignificant role for travel distance. ([2,3,12,13, 14,15,16].)However, what do seems to be noteworthy is a decrease in home advantage in local derbies due to the vanished travel distance for the away team. ([3,17,18].)

One of the factors that the literature seems to have reached consensus on is the role of referee bias in home advantage. According to ([9,22-26]) there exists overwhelming evidence of a referee bias in favour of the home team. ([27,28]) provide evidence of a referee bias in a laboratory setting Their findings have then been replicated in real settings by ([10,29-32]) In more recent research. (paper van mij eerder) find that referees give less cards to home teams and more cards to away teams on average, which could be interpreted as a sign of referee bias in favour of the home side. However the exact source of this referee bias remains somewhat unclear. Research like ours on the incidence of referee bias in ghost games settings could provide useful in discerning whether or not crowd support plays a major role in referee decision making. Inaugural research by(paper van mij eerder) on bundesliga matches seem to confirm the hypothesis that crowds indeed play a signifcant role in referee decision making. They find that referees give less cards to away teams in “ghost games” compared to matches with crowd attendance.

A final set of factors considered are tactical approaches to football matches as a driver of home advantage. There seems to be a difference in tactical approach between away and home teams according to (3,5.) For instance a more cautious approach from the away side might induce dynamics such as the beforementioned territorial factors influencing home and away performance. However, apart from slight evidence from european cup matches found by([39]) where there seems to be a psychological advantage for a team when playing the 2nd leg at home, evidence on the significance of tactical approaches in determining home advantage is not conclusive. (..[18,40,41].)

Somewhere where the literature appears to agree on is the difficulty of disentangling each of the various forces driving home advantage. Pollard(2008) cites that struggles concerning the unraveling of individual factors effect on home advantage sterns from the phenomenon that multiple psychological and physiological influences involved all interact with eachother and possibly reinforce eachothers significance. For exactly this reason do “ghost games” provide such an unique opportunity to specifically study changes in home advantage under ghost games in order to disentangle crowd effects from other drivers of home advantage.

Furthermore, examining whether a home advantage still exists without crowds could also shed light on the significance of the before mentioned factors. Hypothetically, if home advantage is completely absent or even turned into a home disadvantage during absence of crowds, other factors such as travel effects or territorial effects are clearly not important drivers for the establishment of home advantage.

## 2.1.3 Home advantage during Covid-19

A few preliminary studies attempted to investigate the influence of crowd absence on home advantage by analyzing “ghost games” played in the German leagues after the restart of the season 2019-2020. For example (..) find that home advantage has actually turned into a home disadvantage in case of “ghost games”. With not as profound consequences but equally interesting, (.Fischer & Haucap 2020) discover that there indeed seems to be a significant alteration in the strength of home advantage in the Bundesliga when crowd support is nonexistent. However, the German 2nd and 3rd leagues seem to be less affected by “ghost games” according to their analysis, due to lower occupancy rates on average in the lower tier leagues compared to the Bundesliga.

Early evidence thus seems to point to a significant drop in home advantage for teams without crowd support to back them in home games.

## 2.1.4 The drivers of bookmaker margins

Sports Betting markets are naturally intertwined with developments in sports. Football betting has become increasingly popular over the years.(…). Bookmakers in the football betting market heavily rely on accurate predicions of football match outcomes. These predictions are severely influenced by the emergence of “ghost games” in football as their impact on match outcome is unknown and uncertain. “Ghost games” thus provide a chance to measure to which extent increased uncertainty shapes bookmaker margins. Literature on drivers of bookmaker margins is not very abundant. One stellar contribution in this area is a study conducted by Lyocsa and Fedorko(2016) in which they scrutinize all the drivers of betting margins for tennis bets. They discovered that bookmaker margins vary substantially across factors such as tournament type, uncertainty on match outcome, weekday and seasonal trends. Of special interest is here the effect of uncertainty on bookmaker margins, where they assessed that increased uncertainty on match outcome and development is associated with higher bookmaker margins as bookmakers perhaps try to balance their books to remain profitable.

Another important driver of bookmaker margin seems to be the degree of insider trading within a certain market. (Brown 2012). Insiders with more information on game outcomes could bet significant amounts of money on outcomes they know are undervalued, which could in theory endanger the bookmaker of making losses. In a reaction to the risk of insider trading it is sensible for bookmakers to increase their margins to protect them from this risk.

As first researched by .. and later bookmaker margins have significant influence on arbitrage opportunities within the sports betting market. Arbitrage opportunities arrive when odds across bookmakers are spread in such a way that the inversed probability of the combination of most favourable odds on each outcome combined is below 1, implying a negative margin and thus a so called “surebet”. An example, with a coin toss where one bookmaker has odds of 2.5 for heads and 1.5 for tails and another bookmaker has heads priced at 1.5 and tails on odds of 2.5. Calculating the inverse probability. (1/2.5 + 1/2.5) then gives 0.80, which is below 1. Suppose a stake of 10 on both the 2.5 odds at the different bookmakers would render a 25 euro payout with a wager of 20 euro, a guaranteed 5 euro or 25 percent profit. Lower margins in general means higher possibility for arbitrage(González, & del Corral Cuervo 2018).Who find that the amounts of surebets have increased dramatically in recent years due to a sharp rise in the number of bookmakers especially from Asia. Uncertainty surrounding match outcome in “ghost games” could therefore possibly significantly influence arbitrage bettors, as their opportunities for finding surebets perhaps are limited because of higher margins. Similar to how less available information on smaller and more unknown leagues leads to higher margins on average for them.(González, & del Corral Cuervo 2018).

## 2.1.5 Contribution to the literature

We contribute to the current body of literature in several ways. Firstly, our natural experiment setting in the covid pandemic provides an excellent opportunity disentangle different effects of home advantage. Previous research could only analyze detached cases of matches without supporters spread across leagues and time. However, the significant number of games played without a crowd following the covid-19 pandemic provide an excellent opportunity to systematically scrutinize crowd effects in isolation. Secondly, we provide a comprehensive overview of crowd effects both from a team and referee performance, where other studies have a tendency to focus on either one of two. This allows us to compare the relative importance of both social influence of players and referees.

Thirdly,we analyze on an aggregate level where we aggregate data from matches in different countries into one comprehensive dataset to measure overall effects of covid-19 on home advantage and bookmaker margins. This is contrary to similar studies of home advantage in Corona which gravitated towards country specific analysis. We believe that such an aggregate analysis provides richer information on home advantage in general than single league studies where the results in that league might simply be a special outlier. Additionally, by aggregating the analysis, single country anomalys and specialties such as scheduling bias will have less influence on the final conclusions. Furthermore by analyzing the extended period of “ghost games” up to now, thus including more data, we further reduce the impact of confounding variables such as scheduling bias. Previously conducted studies that analyzed partial seasons had serious problems with scheduling discrepancies. Finally, we provide a practical application to show the relevance of knowledge on “ghost games” in other fields by combining the study on home advantage in “ghost games” with an analysis of bookmaker margins for those same ghost games. Drivers of bookmaker margins have been studied previously but the effect of shocks on the market has featured less prominently. Therefore our study could be seen as an inaugural investigation of bookmaker price setting and risk management in case of an external shock to the market. This also provides extra reasons why knowledge on home advantage is valuable and relevant in other areas of academic and business research outside the realm of football.

A schematic overview of the current body of literature and our contribution to it is presented in Table X.

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## Theoretic Framework

## 2.2.1 The impact of crowd absence on team performance

1: We forecast that the exclusion of home crowds will have detrimental effects on the home advantage for home teams. A home crowd can be a positive stimulus for home team players and can create an intimidating and hostile environment for the opposition.( Ponzo, M., & Scoppa, V. ,2018). Every football fan will know about the famous European nights at Anfield where teams regarded superior in terms of quality found their waterloo against an inspired Liverpool side backed by the roar of the crowd. Similarly in Belgium teams often loathe the away game against Standard Liege because of the extremely passionate home fans creating a very aggressive atmosphere. These sentiments in football are confirmed by Carmichael, & Thomas, (2005), who find that home advantage is significantly higher in compressed and intense atmospheres compared to more open and wide areas where crowds might be more distant from the pitch. For example an athletic track around stadiums might decrease the effect of supporters on team performance. Additionally, Carron and Agnew(1994) report a positive relationship between crowd density and home performance. In a situation of “ghost games”, crowd density will of course be 0. Additionally(Tilp and Thaller, 2020) hypothesize that awareness of the absence of crowd support could boost away team morale and increase confidence in retrieving a result. This could as outlined before by(.. stukje van literature review) alter tactical approaches and mentality of both home and away teams. Therefore, based on previous findings of similar studies, we expect home performance to suffer significantly in the new situation of “ghost games” and as a result we predict a sizeable drop in the probability of a home win, all other things being equal.

This leads us to generate the following hypothesis regarding the effect of crowd absence on home advantage.

*H1: Home advantage ise less pronounced or possibly turns into a home disadvantage in a siutation where no crowd is allowed to attend the match.*

## 2.2.2 The impact of crowd absence on referee performance

2: Based on (…) and (…) we expect that referee bias will be lower in matches without the influence of the home crowd. Referees can be heavily influenced in their decision making by the heavy cheering of the crowd favouring the home team.(Unkelbach & Memmert , 2010). Other work by (…) and (…) suggest that referees tend to award more extra time at the end of the first and second half if the home team is behind. The infamous “Fergie time” illustrates this perfectly. During the tenure of Sir Alex Ferguson at the helm of Manchester United, his side often received longer extra time in home matches, which more than once led to a late escape for the home side. In a similar fashion,(Neville and Holder, 1999 and Bokyo 2007) in their paper pose that crowds compel referee’s such that their decisions subconsciously favor the home team. (Endrich & Gesche, 2020) find that referees give more penalties to home teams, and more red and yellow cards to away teams. Therefore, in the case of “ghost games” we expect that referees will be less subject to social pressure of the crowd and consequently, less biased in decision making. This could benefit away teams in their chase to seize a result away from home. This leads to the following hypothesis on the effect of the absence of crowds on referee performance.

*H2: Crowd absence will positively influence referee performance, or in other words, reduce referee bias towards home teams.*

## 2.2.3 The impact of crowd absence on bookmaker margins

(Lyócsa & Fedorko (2016) identify that odd margins increase when uncertainty on the outcome of the event is higher. However, odds are the major source of differentiation for bookmakers. Decreasing or increasing the margin and indirectly the odds is a readily available tool for a bookmaker to lure consumers to place bets at their website rather than at rival bookmakers their website. Since bookmaker competition is ever increasing, bookmaker margins have decreased consistently in recent years to attract bettors to bet at their website, a finding confirmed by Forrest et al. (2005) and Strumbelj and ˇ Sikonja (2010). Therefore we expect bookmaker margins to revert back to their original levels as familiarity with the new circumstances will increase over time. This will make “ghost games” more predictable and the need for higher margins obsolete. Subsequently, bookmakers will reduce the margin again to increase the attractiveness of their odds for potential bettors. Based on the theory and current literature we formulate the following hypothesis on the effect of crowd absence on bookmaker margins.

*H3: Bookmaker margins are higher in the first weeks after the restart of football competitions but over time will return to levels pre-covid.*

## 2.3 Conceptual Model

Table Y shows the conceptual model we establish based on the current literature and hypotheses. This conceptual model will be used in later stages to build the correct model to analyze the data.