Winning more without improving skills

Familiarity factors and their effects on the home advantage in team sports during the Covid-19 pandemic

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Management summary

The global sports market is worth more than 400 billion U.S. dollars (Statista, 2019). A single match outcome can cost or gain a club millions in prize money. In addition, winning teams gain more exposure (Gibbs et al., 2014), and the purchase intention towards their sponsors increases (Ngan et al., 2011). One way of improving the winning chances, is by increasing the home advantage, which is the intrinsic benefit that home teams have during matches in their own accommodation compared to when they are the visiting team.

This thesis aimed to further uncover which factors drive the home advantage in team sports. This thesis looked at the home advantage in six professional European soccer competitions of matches without a crowd due to the Covid-19 pandemic. Although the crowd has been found in earlier studies as one of the most important factors of the home advantage, the impact of other factors is central in this work. During the recent Corona pandemic, spectators were not allowed during sports games. Therefore, when the crowd is not attending the matches, smaller factors that explain the home advantage could become more visible.

This thesis reanalyzes the effect of facility familiarity on home advantage since previous research had contradictory findings. Using a moderated regression analysis on 1,785 soccer matches, it was found that teams playing on an artificial turf field rather than a grass field during their home matches had a bigger home advantage. In addition, teams playing on uncommonly small fields during their home matches had a lower home advantage. This thesis also researched the influence of player familiarity on home advantage. However, no effect of player familiarity on home advantage has been found. In addition, no effect of the familiarity of the coach on home advantage has been found. The familiarity of the assistant coach did, however, have a positive effect on the home advantage.

These findings are of importance to soccer clubs, competition organizers, and sponsors. Soccer clubs can strategically adjust their accommodation to increase their home advantage by investing in artificial turf fields and avoid playing on uncommonly small fields during home matches. Competition organizers now have evidence that the allowed changes in fields give some teams an advantage and could therefore consider equalizing the playing field by tightening the regulations. Lastly, sponsors could benefit from the findings of this thesis by considering the above-stated findings to help pick a team to sponsor with a higher home advantage. This increases the chance of that team to win more games and thus, increases the exposure for the sponsors and the subsequent purchase intention towards products of the sponsors.

Preface

This thesis was written in order to complete my Master Marketing Analytics. I had chosen this master following my love for data and analytics. Both of which were a big part of this thesis as well. I am glad I could use the knowledge I gathered during the master in order to write a thesis contributing to the literature on home advantage in team sports.

Due to the Covid-19 pandemic, I followed the master completely online. Therefore, I sadly have never felt the atmosphere of Tilburg University, nor have I seen my fellow students in person. Oppositely, the Covid pandemic made this thesis possible since the absence of a crowd during soccer matches was the basis of this thesis.

I want to thank all teachers for providing their knowledge during the master and pre-master. I especially want to thank my thesis supervisor Barbara Deleersnyder. Her constructive thinking, useful feedback, and academic insights made this thesis possible. Lastly, I want to thank my friends and family who supported me during my education. In particular, my parents, who made my education possible and have spent countless hours reading my work and supporting me.

I hope you enjoy reading my master thesis as much as I enjoyed writing it.

Cas Ruger

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1. Introduction

1.1 The importance of the home advantage in team sports

According to Statista, the global sports market size in 2018 was worth 471 billion U.S. dollars (Statista, 2019). The sports market size in 2020 is estimated to be around 500 billion dollars, of which 44% is from spectator sports (clubs, sports teams, event revenue, media rights, sponsorships, and merchandising) (The Business Research Company, 2019). Of all spectator sports, soccer is the biggest in terms of annual revenue. This is due to the enormous global audience and sponsorships the sport attracts. The European soccer market as a whole generated 28 billion euro in the year covering the 2017/2018 season (Deloitte, 2019). The difference between losing and winning a match can cost or gain a team millions in prize money. For example, in the 2019/2020 Champions League, every team that entered the group stage earned 15.2 million in prize money. The difference between entering the group stage and getting knocked out is often only one match victory (UEFA, 2019). Another example is the difference in prize money between finishing first or second in your league. The winner of the LaLiga (the Spanish soccer league) of the 2020/2021 season will earn approximately 68 million euro prize money, whereas the number two earns 60 million euro (Fernández, 2020). These examples show that a single match outcome can cost or gain a club millions in prize money.

In addition, teams that rank higher in the competition, due to the fact that they win more games, gain more exposure, which is one of the most important elements potential sponsors look at while deciding whom to sponsor (Jensen, 2012; Lee & Ross, 2012). Furthermore, a winning team has a significantly stronger positive influence on consumers' intention to purchase the sponsor's products than a losing team (Ngan et al., 2011). This implies that increasing the winning chances of a team will increase the chances of earning prize money and could increase the revenue from sponsoring.

One way of increasing your winning chances is by benefiting more from your home advantage. The home advantage is defined by Courneya and Carron as "the consistent finding that home teams in sports competitions win over 50% of the games played under a balanced home and away schedule" (1992, p. 13).

Home advantage is an often-researched topic. It has been proven to be active in multiple team sports, including baseball, American football, ice hockey, basketball, and soccer (Carron et al., 2005). Home advantage is also proven to be active in lower professional leagues and amateur

leagues (Leite & Pollard, 2018). Although its existence is proven repeatedly, the exact factors and the extent to which these factors influence the home advantage are not well-understood.

The home crowd seems to be an important factor in the size and the presence of the home advantage. The covid-19 pandemic offered a natural experiment on the importance of the crowd in the home advantage since most professional soccer games continued without the presence of the fans. Research on the so-called "ghost games" showed that in the German soccer leagues, the overall home advantage of normally 0.29 goals was reduced to 0.15 goals without the support of the crowd (McCarrick, Bilalic, Neave, & Wolfson, 2020). This shows that the crowd is a key driver of the home advantage. At the same time, these numbers show that also other factors underlie the home advantage in team sports. The key objective of this thesis is to uncover these factors.

The familiarity of the players could be an important aspect of the home advantage. It is shown that national players during an international match experience a more substantial home advantage (Poulter, 2009). This could be because the players feel an even stronger attachment to the location. For this reason, players active at the same club for many years could also contribute more to the home advantage since they also are more familiar with the location and the people. In addition, players who have played at a club for an extended period of time could be more used to the field and the facilities, which again, could contribute to the team's home advantage. Whether this is the case has not yet been researched.

The same logic could hold for the familiarity of the coaches of the team with the club. He or she could also feel more familiar at home games or could have more performance drive in front of the home crowd when he or she is the coach for the same club for a longer period.

Lastly, facility familiarity is believed to contribute to the home advantage, but prior research offers contrary findings. Facility familiarity covers the extent to which players are used to certain stadium elements such as artificial grass, unusually small or big fields, or other unusual stadium elements. Multiple studies have investigated the home advantage of teams playing on artificial turf when this is not common in the competition and have found contrary results (Barnett and Hilditch, 1993; Silva et al., 2018). The same holds for teams playing on unusually field sizes (Pollard ,1986; Clarke and Norman ,1995).

1.2. Problem Statement & research questions

Against this background, the problem statement is the following:
To what extent does being the home team (versus the away team) increase the winning probability of that match, and to what extent does the familiarity of the players with the club, the familiarity of the coaches with the club, and facility familiarity factors influence this home team advantage?

To answer the problem statement the following research questions are formulated that will be investigated empirically in this study:

1. To what extent does being the home team (versus the away team) increase the winning probability?
2. To what extent does the familiarity of the players with the club influence the relationship between being the home team (versus the away team) on the winning probability?
3. To what extent does the familiarity of the coaches with the club influence the relationship between being the home team (versus the away team) on the winning probability?
4. To what extent do facility familiarity factors influence the relationship between being the home team (versus the away team) on the winning probability?

1.3 Academic and managerial relevance

1.3.1 Academic relevance

Home advantage is an often researched and proven phenomenon. It has repeatedly been proven that the home team, in both professional and non professional sports, has an advantage over the away team (Carron et al., 2005). Even though the topic is commonly researched, the factors and the extent to which these factors influence the home advantage is not well understood. This study contributes to the academic literature by investigating several new potential factors that could contribute to the home advantage as well as reanalyzing factors on which prior research offered contradictory findings.

Multiple studies researched the influence of playing in front of a home crowd and found that the crowd is a strong and significant factor contributing to the home advantage (Goumas, 2014; Nevill et al., 2002). In line with the previous findings McCarrick, Bilalic, Neave, and Wolfson (2020) found that the home advantage with the presence of a home crowd in the

Bundesliga (the German soccer league) is, on average, 0.29 goals. They also found that when there was no crowd, the home advantage dropped to, on average, 0.15 goals. This proves apart from the crowd, also other factors influence the home advantage in team sports (McCarrick, Bilalic, Neave, & Wolfson, 2020).

The contradictory findings on the impact of various facility familiarity factors might be due to the inference of the crowd that also influences the home advantage. By accounting for the noise, the density, size, and the atmosphere the crowd create, it will be possible to assess the impact of other drivers. In this study, the home advantage is examined during sport games held in the Covid-19 pandemic when there was no crowd at the matches, eliminating one important factor influencing home advantage. Hence this study reanalyzes the effect of facility familiarity on home advantage, but it is the first research doing this on games without a crowd.

Lastly, this research contributes to the existing literature on home advantage in team sports by investigating new factors that have previously not been researched, namely, the familiarity of the players and the familiarity of the coached with the club they are playing for and its impact on home advantage. There has not been a study on the impact of the number of years players or coaches have been at a club and its impact on home advantage. Therefore, this study also further extends the knowledge on home advantage in team sports by investigating new potential factors.

1.3.2 Managerial relevance

This study's contribution to the business field is three-fold. First, professional sport clubs benefit from gaining a better understanding of the factors influencing the home advantage of their team. Based on the findings of this research, professional clubs could consider making changes to their stadium by investing in artificial turf or opting for increasing (or decreasing) the size of their main field to gain a higher home advantage.

Additionally, the clubs can improve their decisions on what players and coaches to attach to the club. In soccer, it is, for example, common to quickly dismissal the coach if he or she underperforms (Frick et al., 2010). Replacing the coach has mixed results on the performance of the team. This research could further explain the effects of familiarity of the coach with the club on the home advantage, allowing sports clubs to make a more informed decision on replacing its coach based on the results. The same holds for the choice of whether a club should hold a player or sell him or her to a competing club. The highest contract of a team player is that of soccer

player Leonel Messi. He earns 555,237,619 euro for four seasons at a club. That is more than 138 million per season (Marsden & Llorens, 2021). Deciding to renew his contract or to let him go to another club is an important financial decision. This research investigates whether players who are more familiar with their club contribute more to the higher home advantage. These findings can help sports clubs to base the decision whether to keep or sell a player based on their contribution to the teams' home advantage.

Secondly, sponsors can benefit from this research. Companies pay large prices to be associated with sporting teams and gain exposure and involvement with their viewers. The most important factor sport sponsors look at while deciding which (if any) team to sponsor is the amount of exposure the team could receive (Lee & Ross, 2012). Jensen (2012) found that athletes who perform better and are higher ranked in the standings receive significantly more exposure than lower-ranked athletes. This also holds for sports teams (Gibbs et al., 2014). In addition, team performance significantly influences consumer's intention to purchase the sponsor's product. A winning team positively influences the purchase intention of the viewers to purchase the sponsor's product (Ngan et al., 2011). For sponsors, it is therefore of great importance that the team they sponsor is more likely to win since this gains more exposure and has a larger positive influence on the purchase intention of their products. Sponsors can better predict based on the results of this study what teams exploit the home advantage most and therefore contributes to the winning chances of the team. Based on this, they could select which (if any) team to sponsor.

Lastly, competition organizers can use the findings of this research to make competitions fairer. The contradictory findings on the effect of artificial turf and field sizes on the home advantage make it hard for competition organizers to make the rules stricter. This thesis could give more insights into the effects and the size in which these allowed modifications benefit certain teams.

1.4 Research design

This study will empirically examine the home team advantage in the soccer competition. It relies on quantitative secondary data of soccer matches to examine the formulated research questions. The data consists of two seasons (2019/20- 2020/21) and six professional international soccer competitions, namely Bundesliga, LaLiga, Serie A, Eredivisie, Premier League, and Premiership.

This dataset will contain all matches which did not have a crowd due to the pandemic regulations.

All matches between 2 teams in this competition are placed twice in the dataset: once as seen from the home teams point of view and once from the point of view of the away playing team (Ponzo & Scoppa, 2016).

To study the hypothesized relationships and evaluate the effect size of each of the factors, a moderated regression analysis will be used. This is in line with the regression approach used by Fischer and Haucap (2020), and Van Damme and Baert (2019).

1.5 Thesis outline

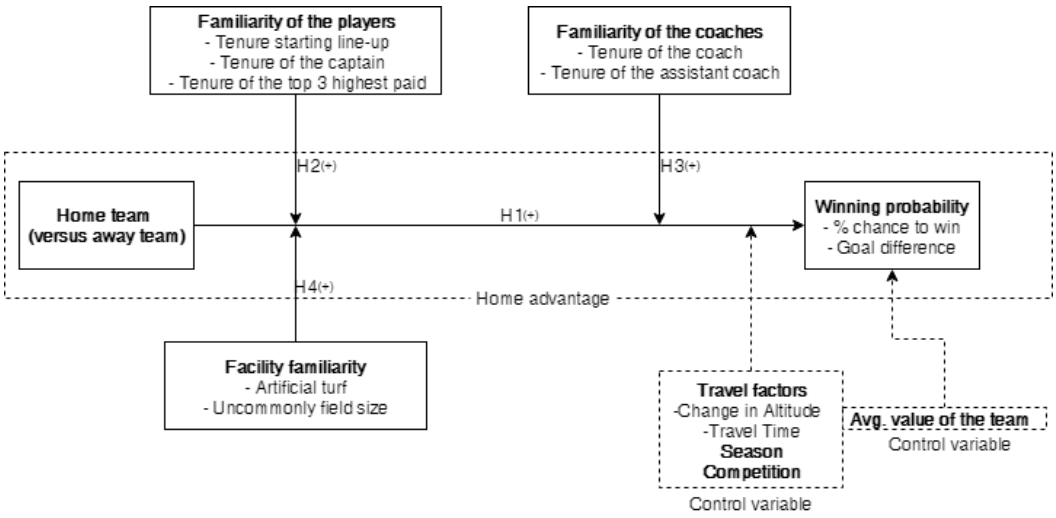
The introduction chapter explained the background for this research and motivated the problem statement, research questions, the relevancy of the research, and the research design. Next chapter will introduce the focal constructs and their hypothesized relationships that make up the conceptual model. The third chapter justifies the research method and elaborates on the data collection and analysis. The fourth chapter described the model results. Chapter five covers the discussion and formulates theoretical and managerial recommendations, followed by recommendations for future research.

2. Research framework

2.1 Conceptual model

The conceptual framework in Figure 1 gives a visual representation of the expected relationships and their signs. These variables and their relationships will be further explained in the remainder of this chapter.

Figure 1. Conceptual model



2.2 Main effect of the home advantage in team sports

The 'home advantages' is reflected in the positive relationship between being the home team (versus the away team or 'visitors team') and the probability of winning (see Figure 1). It suggests that when both teams have similar capabilities and strengths, the home team has a higher chance to win the game and will also score more often.

In some sports, the home team has an advantage over the away team because of the sports regulations. An example of this is baseball, where the rules stipulate that the home team starts in the field and the visitors at-bat. In most team sports, this slight advantage is eliminated by doing a coin toss at the start of the match. This prevents the starting team from having an advantage since this is random. But even in sports where regulations do not favor a home or away team, the winning chances of the home team are still proven to be higher.

A proven benefit for the home team is the fact that they play mainly for their own crowd. This helps the home team since the crowd peer pressures the empire for the home team's benefit. Courneya and Carron (1992) reviewed the research on home advantage up until 1992. They

found that the home team received more benefits (penalties, free throws etc.) and fewer reprimands (yellow cards, time penalties etc.). The impact of the home crowd on the referee got confirmed by Tilp and Thaller in 2020. They researched soccer games without a crowd and found that when the crowd was present, the home team would get more free kicks and fewer yellow and red cards compared to the matches without a crowd (Tilp & Thaller, 2020). This shows that referees have an (unintentional) home bias. This thesis covers matches without a crowd to further examine what factors other than the crowd and its related referee bias influences the home advantage.

Carron, Loughhead, and Bray (2005) summarized the research findings on the home advantage from 1992 till 2005 and did this in line with the research of Carneya and Carron (1992). They found that home advantage consists of multiple other factors such as the location, rules of the game, travel factors, and psychological aspects.

Bray, Marc, and Owen (2002) measured anxiety, self-confidence, and self-efficacy of hockey players before home and away matches and found that players experienced significantly lower anxiety and higher self-confidence and self-efficacy before home games. These findings are in line with previous findings using other methods such as asking hypothetical scenarios (Bray & Widmeyer, 1995; Terry, Walrond & Carron 1998). In addition, Carré, Muir, Belanger, and Putnam (2006) researched the hormonal and psychological levels of team players before home and away matches and found higher testosterone and cortisol levels while players competed at home. They again found higher self-confidence and lower anxiety levels for the home players. The exact reason why home players experience these benefits is yet to be researched. It is expected that the cheering of the home crowd and the fact that players are more familiar with their home field have an influence.

In this research, the referee bias will not play a significant role since all matches will be played without a crowd which is shown to dismantle the referee bias. The same holds for the rules factor since soccer rules do not favor the home or away team. The psychological part, however, will be an important factor. The increased confidence levels and the decreased anxiety levels of the home team players are expected to positively influence the winning probability of the home team. Therefore, the following main hypothesis is formulated.

H1: Being the home team (versus the away team) has a positive influence on the probability of winning the game.

2.3 Moderating effect of familiarity of the players with the club on the home advantage

The familiarity of team players with the club has not been examined as a factor driving the home advantage. However, the familiarity of the players with the club could have an influence on the presence and the extent of the home advantage. Player familiarity is the extent to which a player is known to a club and the people involved. A player who has played at a club for a longer period of time is therefore more familiar with the club. This could influence the psychological aspects described in the previous paragraph.

Hidalgo and Hernández (2001) found that over time, people become emotionally attached to a place. This same emotional attachment can be formed with a club. This emotional attachment could increase the home advantage if players feel more comfortable and safe when they are playing in the home accommodation (Hernández et al., 2007). This could indicate that players who are more familiar with their club, due to the extended period they have played at the same club, experience greater confidence when playing at home. As stated in chapter 2.2, home teams have higher self-confidence and lower anxiety levels, which could explain why home teams perform better (Bray et al., 2002). When a player is more familiar with the club this effect could get stronger, increasing the home advantage further.

For this research, the familiarity of the players will be measured using three variables, namely the tenure of the full lineup, the tenure of the team captain, and the tenure of the top 3 highest-paid players.

2.3.1 Tenure of the starting lineup

Tenure of the starting lineup measures the average extent to which the starting lineup players have played at the club. It is expected that when this number increases, the positive psychological aspects (confidence levels) increase since more players are more emotionally attached to the club. Therefore, the following hypothesis is formulated.

H2a: Teams where the starting lineup players have played with the club for a longer time have a bigger home advantage.

2.3.2 Tenure of the captain

Most team sports such as soccer, hockey, and water polo have a team captain. The captain is the designated player in the field who's role is to manage the team during the game. The captain is often one of the more experienced or senior members of the team, and they are the person that players look at for inspiration and guidance (Fransen et al., 2014). Due to their leadership role, the familiarity of the captain could be of importance for the home advantage. It is expected that a captain who has played at the club for multiple years feels more confident due to the stronger emotional link to the club and, therefore, could give better guidance and motivation during the home matches. For this reasoning, teams with a captain who is more familiar with the club could experience a greater home advantage due to the increased motivation and guidance at home games.

H2b: Teams where the captain has been a player at the club for a longer time have a bigger home advantage.

2.3.3 Tenure of the three highest-paid players

Torgler and Schmidt (2007) found a correlation between the amount a player gets paid in respect to their teammates and that player's performance and influence during matches. This suggests that the higher paid players of a team have a greater average influence compared to their teammates. Therefore, the third measurement measures the familiarity of the three highest-paid players. This could give a more apparent effect compared to the full lineup tenure since this measure looks at the most influential players in the team.

It is again expected that the players who play at the club for a longer period of time experience greater confidence due to the stronger emotional link to the club and. Therefore, the following hypothesis is formulated.

H2c: *Teams where the three highest-paid players have been playing at the club for a longer time have a bigger home advantage.*

2.4 Moderating effect of familiarity of the coaches with the club on the home advantage

The coach and assistant coach determine the starting lineup, tactics, and strategy's for each match. Coaches have most influence before the match starts but they can also change tactics and

strategy's during halftime or, in some cases, during matches. Multiple studies suggested that strategies and tactics from coaches are being influenced by the game location and by the crowd. Coaches tend to adopt more offensive strategies while playing at home rather than during away matches (Legaz-Arrese et al., 2013). Coaches can also influence their athletes by motivating them. Vargas-Tonsing and Bartholomew (2006) found that teams who received a pregame speech reported a greater team efficacy belief.

No research has evaluated the influence of familiarity of the coaches with the club and its influence on the team home advantage. However, it is plausible that coaches who are more familiar also feel greater confidence when playing at home, just like the players do. This could result in a better performance of the coach, resulting in better strategic adaptation, better speeches before matches, and more motivated players during home matches.

Moreover, coaches are involved in club decisions such as hiring people and field changes. A coach who has been involved in the club for a longer period of time could therefore apply changes to the club, which could increase the comfort he or she and the team experience during home matches. Hypothetically, a coach could be involved during the choice of making the field surface either grass or artificial turf. He or she then will choose the surface he or she is most comfortable with, increasing the comfort during home matches and positively influencing his or her performance as a coach. Based on these reasons, the following hypotheses are formulated:
H3a: Teams with a coach who has been active at the club for a longer time have a bigger home advantage.
H3b: Teams with an assistant coach who has been active at the club for a longer time have a bigger home advantage.

2.5 Moderating effect of facility familiarity factors on the home advantage

Facility familiarity is the extent to which players are used to the facility of their training and match accommodation. Since the home team often practices and plays more games on their own field, they are expected to be more familiar with the home field.
In most sports, field regulations leave space for interpretation, or there is room for differences. Fields may, for example, differ in types of surface (real grass versus artificial turf) and in size. These differences are expected to contribute to the home advantage in sports.

2.5.1 Artificial turf

In the year 1966, artificial turf became more popular in several sports. The introduction of artificial turf brought controversy among competitions and athletes. In some sports, artificial turf has become the standard, such as hockey and tennis. In other sports such as soccer and American football, artificial turf is allowed but not the standard.

According to a study commissioned by the FIFA (Fédération Internationale de Football Association), most professional soccer players prefer natural grass fields over artificial turf due to the risk of more injuries, change in ball movement, and need for various footwear with different surfaces (Roberts et al., 2014).

Research on the effect of artificial turf on home advantage is contradictory. Barnett and Hilditch (1993) study the effect of artificial turf on home advantage in the highest English soccer league. They found that home teams playing on artificial turf experienced a far greater home advantage. These findings got conformed by Hvattum (2015) in the highest Norwegian soccer league, and by Armatas and Pollard (2012) in the Highest Greek soccer league. Lastly, a recent study by Peeters and Ours (2020) showed an increased home advantage for teams playing on artificial turf in the highest English soccer competition, however, this accounted only for a very small part of the home advantage.

Alternatively, Pollard (1986) studied the highest English soccer league from 1988 till 1986 and found that teams playing on artificial turf did not experience a greater home advantage. Research by Silva, Braga, and Pollard (2018) on professional soccer matches (top two domestic competitions) worldwide also showed no increased home advantage for home teams playing on artificial turf.

An explanation for the different findings could be that the effect of artificial turf on the home advantage is very small, making it hard to find the effect due to factors such as the crowd which has a bigger influence on the home advantage. This thesis eliminates the crowd effects, which could therefore highlight the effects of other factors such as artificial turf on the home advantage.

Since most recent research found an increase in the home advantage for teams playing on artificial turf, and we eliminate other important factors driving the home advantages (such as the crowd), it is expected that teams who have an artificial turf court experience a greater home advantage. Therefore, the following hypothesis is formulated.

H4a: Teams that play on artificial turf in their home accommodation when the majority of other teams in the competition play on grass fields have a bigger home advantage.

2.5.2. Uncommon size of the field

In some sports, the official size of a field lies between two extremes, and therefore some difference in field size is allowed. In baseball, for example, the minimum distance from the home plate to the farthest outfield point is 120 meters, but there is no maximum distance. This makes the smallest official major league baseball field 120 meters long, whereas the biggest is 128 meters (Comerica Park Information, 2021). In soccer, every competition has its own rules regarding the size of the fields. The English soccer competition Premier League has a range from 90 meters to 120 meters for the length and 45 to 90 meters for the width (BBC Sport, n.d.). Since these changes are quite large, players might experience difficulties when playing on uncommonly large or small fields.

Pollard (1986) found that teams who played on the smallest and largest pitches between 1981 and 1984 had no bigger home advantage. Clarke and Norman (1995) reanalyzed these teams in 1995 and found that, when controlling for the team value, there was a trend towards a higher-than-average home advantage for teams with uncommon size playing fields. After 1995 no research has been done on the effect of the field size on the home advantage.

Uncommon field sizes could cause players to make misjudgments, for example, in the distance to the goal or to pass a ball. Furthermore, an uncommon field size could force teams to switch strategies from what they are used to. Soccer coach Mauricio Pochettino (coach of Premier Leagues Tottenham Hotspur) stated in an interview after losing to New Castle (an on paper worst team with an unusual small field) “Our style means we need a bigger space to play because we play a positional game”. Pochettino later in the interview said the team needed to adjust to the relatively small field, which was one of the reasons they lost the match (Cox, 2017). Unusual small fields could cause teams to change strategies to once which work better on smaller fields. The same holds for unusual bigger fields. Strategies that work on normal or smaller fields can cause problems on bigger fields. In addition, unusual big fields may require more energy from the players which they are not used to or trained for. This could cause players to fatigue faster if they are not used to playing on bigger fields. In contrast, smaller fields could benefit sprinters over long-running players in the team.

Since uncommon small and big fields could cause players to misjudge and could demand a change in strategy of teams, it is expected that playing on an uncommonly small and big field will have a positive effect on the home advantage since the home team is more used to the field size. In addition, there might be a difference in uncommonly small and big fields due to the fatiguing of players and preferred energy distribution during a match. Therefore, the following hypotheses are formulated.

H4b: Teams that play on uncommonly big field sizes in their home accommodation have a bigger home advantage.

H4c: Teams that play on uncommonly small field sizes in their home accommodation have a bigger home advantage.

2.6 Control variables

Apart from the hypothesized variables, this research will control for two types of variables that have been shown by earlier studies to influence either the team performance directly or the home advantage as a moderator. The first factors are the value of the team, competition, and season, which have a direct affect on the dependent variable team performance during the game. The second type of control variable relates to travel factors, which have an influence on the home advantage as a moderator (see Figure 1).

2.6.1 Average value of the team

Multiple studies have shown that the value of the team has an influence on the winning probability of the team (Hall et al., 2002; Torgler & Schmidt, 2007). Better players are valued higher, and therefore the higher valued team has a bigger chance of winning the game.

It has also been shown that, when the value of the team is not added as a control variable, the influence of the moderating factors can be misinterpreted. Pollard (1986), for instance, found no moderating effect of unusual field sizes on the home advantage, but when Clarke and Norman (1995) did the same research but controlling for team value, they did find a moderating effect. For this reason, the average value of the team is added as control variable.

2.6.2 Season and competition

The winning chances may differ across competition and seasons due to quality differences between teams across competitions and seasons (Pollard 2006). In addition, some competitions have a more aggressive playing style (Van Damme and Baert, 2019) which could interfere with the resold if this is not accounted for. Therefore, both season and competition are added as control variables.

2.6.3 Travel factors

Multiple studies have shown that travel factors influence the home advantage (Van Damme and Baert, 2019; Smith et al., 2000). The travel factors consist of the change in altitude between the home and away stadium and travel time by car. Both variables are included as control variables in this research. These factors influence the away team in a negative way and worsen their performance. A big change in altitude causes players to adjust to the new altitude, whereas the home team is used to it. The travel time negatively influence the away team's performance since the players are inactive for an extensive amount of time and can become dull from the ride. While extensive research has already found an impact of these variables, they are still accounted for in this study to prevent the interference of the effect of travel factors

2.7 Conclusion

This thesis will examine the influence of being the home team (versus the away team) on the probability of winning a match and improve the team score during a game. This is called the home advantage. Besides the presence and the extent of the home advantage, this research focuses on three groups of moderators and the extent to which they influence the home advantage. They relate to the familiarity of the players with the club, the familiarity of the coach with the club, and the facility familiarity (grass type and the size of the field).

The next chapter will introduce the methodology and elaborates on the data collection and preparation.

3. Research design

3.1 Data

3.1.1 Research setting

The data used in this study were soccer matches from the 19/20 and 20/21 seasons from six professional European competitions. The six competitions were the Premier League (166 matches), Serie A (418 matches), LaLiga (425 matches), Bundesliga (337 matches), Eredivisie (235 matches), and Premiership (204 matches). Each competition is the highest competition of its country. In every competition, each team plays every other team once at home and once away per season. In order to calculate the home advantage, each match is added twice in the data set. Once from the home team's point of view and once from the away team's point of view.

From the two seasons, only matches played without a crowd (due to the pandemic regulations) will be added to the dataset. In case a soccer match did have attendance (as form of test match or for other reasons), this match is excluded from the dataset. Every competition followed the country Corona-related regulations regarding the number of attendances. This causes some competitions to have more matches during the time frame than others. In Spain and Italy, it was the norm to play without a crowd from June 2020, whereas in the Netherlands, this regulation started in September 2020. Due to these regulations, the number of home and away matches of some teams were not balanced. This was the case if the first match of a head-to-head between two teams was played before these regulations were put in place.

The head-to-head matches in the competition Serie A between Genoa CFC and UC Sampdoria, AS Roma and SS Lazio, and between Inter Milan and AC Milan were excluded as both teams play at the same accommodation preventing any of the teams from having a home advantage. In addition, all matches from AZ in the Eredivisie were excluded since they switched stadiums during the time period, which by itself has an effect on the home advantage. This leaves 1,785 matches across the six competitions in the dataset, resulting in 3,570 observations for the analysis.

Table 1. Number of observations per competition and season

Competition	**Season 19/20**	**Season 20/21**
Premier League	180	152
Serie A	238	598
LaLiga	200	650
Bundesliga	158	516
Eredivisie	0	470
Premiership	0	408
Total per season:	**776**	**2,794**

3.1.2 Data collection and measurement

For this study, information from three different data sources are combined. Match-based statistics are collected from the sports API of Sportmonks. Sportmonks offers historical and live data from all European soccer matches. As can be seen in Table 2, the API of Sportmonks provides the information of which teams played, who won and with how many goals difference, which players played, who was the captain and who was the coach, at which venue the match was played (including its location and grass type), and the number of attendance. The additional information on team and coach factors was scrapped from the website Transfermarkt.com. This website contains the date a player/coach joined the team and the value of the player/coach. If the value of a player or the starting date could not be obtained, the player received the average value of the lineup of that match. Lastly, to calculate the travel factors, the API of Bing was used. This API calculates the distance between the home and away teams stadiums, the time it would take to travel from the away to the home stadium by car, and the change in altitude between the home and away stadium.

Table 2. Overview variables, their names, measurements, and data source.

		Measurement	Data source
Dependent variables			
Win1	Win	Winner of the match (1 if winner, 0 otherwise)	Sportmonks
Win2		Goal difference from the perspective of the observed team (goals scored by observed team - goals received from the opponent)	Sportmonks
Independent variable	**Home**		
Home versus away	Home	1 if the match information is related to the home team, 0 if it relates to the visitor team	Sportmonks
Moderating variables			
Team familiarity	**TeamFam**		
Team tenure	TTen	The sum of the number of days (in thousands) every player from the line up has played at the club divided by 11	Transfermarkt.com / Sportmonks
Captain tenure	CapTen	The number of days (in thousands) the captain has played at the club	Transfermarkt.com / Sportmonks
Top three tenure	TopTen	Number of days (in thousands) the top three highest-paid players have played at the club	Transfermarkt.com / Sportmonks
Coach familiarity	**CoachFam**		
Coach tenure	CoaTen	The number of days (in thousands) the coach has been working at the club	Transfermarkt.com / Sportmonks
Assistant coach tenure	AsCoTen	The number of days (in thousands) the assistant coach has been working at the club	Transfermarkt.com / Sportmonks
Facility familiarity	**FacilFam**		
Field surface type	Turf	1 if the match is played on artificial turf, 0 if the match is played on grass	Sportmonks
Size small	SizeS	The difference in 100 meters to the standard surface (105m*68m) for smaller fields	Individual data
Size big	SizeL	The difference in 100 meters to the standard surface (105m*68m) for bigger fields	Individual data
Control variables			
Team value	lnValue	The ln-transformation of the sum of players value in the starting lineup (in millions of euros)	Transfermarkt.com
Change in Altitude	Alti	The difference in 100 meters in altitude between the home and away stadium	Bing-api / Sportmonks
Travel Time	lnTraTime	The ln-transformation of the time by car from home to the away stadium in hours	Bing-api / Sportmonks
Competition	Comp	5 competition dummy variables to capture the effect of 6 different competitions, with Serie A as baseline	Sportmonks
Season	Season	A season dummy variable = 1 in the 19/20 season	Sportmonk

The dependent variable consists of two measures. Win1 is a binary variable which is 1 if the team has won the match, 0 if the team has lost the game, or the match was a tie. This is the most standard way to measure home advantage using single matches as input (Ponzo & Scoppa, 2016). Win2 is the goal difference measured from the point of view of the home team (e.g., +1 if the team won 1-0, -1 if the team lost 2-3, etc.). In the competition, Win1 is more important, since the goal difference is not taken into account for the ranking. However, Win2 could capture the home advantage in a more continuous way and is a good proxy to capture the advantage of the home team[1]. Therefore, adding the second continuous measure has become the standard in recent years (Fischer &Haucap, 2020). The focal independent variable is a dummy variable 'home' where being the home team is 1 and being the away team is 0. If the probability to win or the home team goal difference is consistently higher for the team playing in their home accommodation, this variable will be positive significant in the models.

The moderating variables regarding the familiarity of players and coaches have not been researched yet, and therefore have no standard measure. In this thesis, all tenures are measured in the number of days, starting from the date the players or coaches have signed their contracts with the club.

Previous research on the effect of uncommon field sizes looked at a balanced competition and only marked the biggest and smallest pitches as uncommon (Clarke & Norman 1995). This research deviates from this method and measures the field size as a continuous variable by taking the surface of the field minus the standard of the competition (105 x 69 meters). This way, more fields are included as uncommon (in contrast to only 2 fields per competition). The uncommon field sizes are measured using two variables, namely uncommonly small fields, which measure the change in surface in 100 meters between the home field and the standard if the field is smaller than the standard. And the second measure is the uncommonly big fields, which measure the surface between the home field and the standard in 100 meters if the field is bigger than the standard.

The measures of the control variables follow the standard measures used in previous research. This means that the team value is the value of the players from the starting lineup in

1. For example, if team A wins 1-0 during their home match and loses 0-6 during their away match (considering all other factors are the same), team A experiences a lower home advantage than team B, which could only be found using the Win2 measure

millions of euros (Fisher & Haucap, 2020). The travel time is measured in how many hours a car would take driving from the away to the home stadium. Lastly, change in altitude is the difference in the altitude between the home and away stadium in 100 meters (Van Damme & Baert, 2019).

3.1.3 Data descriptives

A summary of the descriptive statistics of the data set is given in Table 3. It shows for each variable in the model the mean, and the measures of variability.

Table 3. Data descriptives (N=3570).

Variable	Mean	Lowest	Highest
Win1	37.17%	0	1
Win2	0	-13	13
Home/Away	50%	0	1
Team tenure	0.8749	0.1005	3.0055
Captain tenure	1.946	0.008	5.777
Top three tenure	0.8417	0.0183	3.5270
Coach tenure	0.6822	0.0020	3.4040
Assistant coach tenure	1.623	0.001	44.304
Grass type	94.23%	0	1
Uncommonly small fields	20.33%	0	6.4000
Uncommonly big fields	8.456%	0	5.6000
Ln of team value	4.171	1.079	6.672
Ln of travel time	0.9526	-2.004	2.8334
Change in altitude	0.0039	-13.510	13.2200

Notes: for dummy variables, the % of observations with a value =1 is reported instead of the mean. The same holds for the uncommon field sizes, where instead of the mean the number of % of the observations are reported.

Only 37.2% of all observations are from the winners point of view, due to the fact that both loses and ties are coded as 0. It can also be seen that unusually small fields are more common than unusually big fields, but 105x68 is with 71.21% still the most common. Lastly, the tenure of the assistant coaches is on average larger than the tenure of the main coach.

3.2 Moderated regression analysis

To link the 2 game performance metrics (i) probability to win the game and (ii) score difference for each match to the focal independent variables, home advantage, the drivers of the home advantage, and the control variables, this study implements a moderated regression approach. The model equation is:

(1)

$$Win_{i,n} = \beta_0 + \beta_1 Home_{i,n} + \beta_2 TTen_{i,n} + \beta_3 CapTen_{i,n} + \beta_4 TopTen_{i,n} + \beta_5 CoaTen_{i,n} + \beta_6 AsCoTen_{i,n} + \beta_7 Grass_n + \beta_8 SizeS_n + \beta_9 SizeL_n + \beta_{10}(TTen_{i,n} * Home_{i,n}) + \beta_{11}(CapTen_{i,n} * Home_{i,n}) + \beta_{12}(TopTen_{i,n} * Home_{i,n}) + \beta_{13}(CoaTen_{i,n} * Home_{i,n}) + \beta_{14}(AsCoTen_{i,n} * Home_{i,n}) + \beta_{15}(Grass_n * Home_{i,n}) + \beta_{16}(SizeS_n * Home_{i,n}) + \beta_{17}(SizeL_n * Home_{i,n}) + \beta_{18} TraTime_n + \beta_{19} Alti_n + \beta_{20} Value + \beta_{21,25} \sum_{i=1}^{5} Comp_n + \beta_{26} Season_n + \beta_{27}(TraTime_n * Home_{i,n}) + \beta_{28}(Alti_n * Home_{i,n}) + \epsilon_{i,n}$$

In equation (1), $Win_{i,n}$ is the dependent variable, which is the outcome of the n'th match from the point of view of team i. The estimates from β18 till 28 are the control variables, and $\varepsilon_{i,n}$ is the error. Equation (1) is estimated twice with each of the two dependent variables. For Win1, as the dependent variable is binary, a logit-model is estimated were Win is the logit transformation of the Win1 variable: $\ln(\frac{probability\ of\ a\ win}{1 - probability\ of\ a\ win})$. The second dependent variable Win2 is a continuous metric and thus, an ordinary least-squared linear regression is adopted where Win2 is the home team goal difference.

The home advantage is measured by the inclusion of the dummy $Home_{i,n}$ and the interactions between the moderators and dummy $Home_{i,n}$. If teams in the soccer competition have a home advantage, β1Home will be significant. In addition, if a moderator has an influence on the home advantage the estimate of the interaction between that moderator and dummy $Home_{i,n}$ will be significant.

3.3 Conclusion

For six European soccer competitions (Premier League, Serie A, LaLiga, Bundesliga, Eredivisie, and Premiership) we acquire data of each match and team, resulting in 3,570 observations for the analysis. All variables and their measurements have been described, and the moderated

regression analysis to analyze the relationships is introduced. To analyze the effect of all variables on the chances to win as well as on the goal difference, two regression models will be estimated, once as a logit and once as a least-squared linear regression. From these models, the main effect of the home advantage as well as the influence of the moderating effects on this home advantage can be determined. In the next chapter, the results and findings of these moderated regression analyses will be described and the hypotheses will be tested.

4. Research Findings

4.1 model diagnostics and results.

Before the analysis are conducted and interpreted, the model assumptions have to be met. First, the multicollinearity between all numeric variables have to be low. This is not the case for the three variables measuring player familiarity (See appendix 1.1). Captain tenure has a correlation of 0.70 with team tenure, a correlation of 0.53 with the tenure of the three highest-paid players, and a correlation of 0.59 with team value. Team tenure has a correlation of 0.65 with the tenure of the three highest-paid players. These correlations are not considered low and could interfere with the results. Therefore, all three variables will be added to the model one by one (models 1-3) to check their effects before including them together in the model (model 4). As an additional check, the Variance Inflation Factors (VIF-values) are reported per model (see appendix 1.2). Model 1 till 3 have no VIF-values above 5, indicating no multicollinearity concerns. In model 4, the variable team tenure has VIF-values above five, which indicates multicollinearity (Alin, 2010). Second, the normality of residuals is checked using a P-plot analysis. This showed that the residuals are normally distributed (See appendix 1.3). Third, to check for homoscedasticity, the Breusch-Pagan test was conducted. All models had a significant *p*-value (see appendix 1.4), indicating all models had homoscedasticity, and thus the variance of the residuals are constant. Lastly, the linear relationship assumption is checked for the models with the dependent variable Win2. Plotting the fitted values and the residuals (Appendix 1.5) showed a straight line, indicating a linear relationship.

Prior to estimating the models, all continuous moderating variables are mean-centered by subtracting the mean of the variable from each observation. This allows for a clearer interpretation of the corresponding estimates.

In table 4, all models and their results are shown. All significant effects on the dependent variables for an alpha of .05 (using a one-sided test for the hypothesized effects, 2-sided test for other variables) are highlighted in bold.

Table 4. Results of the regression analysis

	Win 1 (chance of winning the game)				**Win 2 (goal difference)**			
Predictors	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Constant	**-4.104***	**-4.163***	**-4.361***	**-4.160***	**-3.624***	**-3.685***	**-3.844***	**-3.670***
Home team advantage (dummy home=1)	**0.396***	**0.400***	**0.413***	**0.399***	**0.460***	**0.463***	**0.471***	**0.467***
Team tenure	0.093			0.073	0.094			0.230
Captain tenure		0.030		0.023		0.022		-0.002
Top three highest-paid players tenure			-0.024	-0.054			-0.060	-0.141
Coach tenure	0.011	0.015	0.012	0.015	-0.018	-0.012	-0.010	-0.015
Assistant coach tenure	**-0.043***	**-0.043***	**-0.043***	**-0.043***	**-0.028***	**-0.028***	**-0.028***	**-0.028***
Artificial turf (dummy artificial turf=1)	0.040	0.040	0.057	0.035	-0.029	-0.033	-0.024	-0.031
Uncommonly small field surface in meters	**0.114***	**0.113***	**0.116***	**0.112***	**0.140***	**0.139***	**0.140***	**0.139***
Uncommonly big field surface in meters	0.023	0.025	0.022	0.022	0.088	0.090	0.088	0.085
Home * Team tenure	0.219			0.244	0.075			-0.033
Home * Captain tenure		0.086		0.074		0.051		0.067
Home * Top three highest-paid players tenure			-0.035	-0.231			0.003	-0.052
Home * Coach tenure	-0.083	-0.074	-0.081	-0.085	-0.057	-0.055	-0.065	-0.061
Home * Assistant coach tenure	**0.175***	**0.175***	**0.193***	**0.183***	**0.166***	**0.164***	**0.179***	**0.173***
Home * Artificial turf	0.375	0.399	0.345	0.401	**0.520***	**0.546***	**0.524***	**0.537***
Home * Uncommon small field surface	**-0.171***	**-0.170***	**-0.174***	**-0.176***	**-0.199***	**-0.196***	**-0.198***	**-0.202***
Home * uncommon big field surface	-0.052	-0.054	-0.056	-0.034	-0.112	-0.114	-0.117	-0.101
Travel time (in hours)	0.095	0.099	0.096	0.098	0.075	0.079	0.079	0.079
Change in altitude	-0.020	-0.021	-0.020	-0.020	-0.020	-0.021	-0.021	-0.019
Team value	**0.719***	**0.729***	**0.768***	**0.734***	**0.739***	**0.749***	**0.782***	**0.751***
Competition Premier League	**-0.544***	**-0.535****	**-0.518***	**-0.566***	**-0.585***	**-0.575***	**-0.566***	**-0.606***
Competition LaLiga	**-0.333***	**-0.334***	**-0.286***	**-0.351***	**-0.187***	**-0.182***	**-0.148***	**-0.197***
Competition Bundesliga	-0.169	-0.153	-0.131	**-0.214***	-0.132	-0.116	-0.102	**-0.175***
Competition Eredivisie	**1.390***	**1.411***	**1.446***	**1.394***	**1.426***	**1.444***	**1.471***	**1.424***
Competition Premiership	**1.874***	**1.920***	**2.003***	**1.910***	**1.852***	**1.890***	**1.958***	**1.878***
season 19/20 (dummy season)	0.141	**0.158***	0.157	0.158	0.089	0.102	0.104	0.101
Home * travel time	0.033	0.029	0.038	0.035	-0.007	-0.011	-0.007	-0.010
Home * change in altitude	0.048	0.051	0.050	**0.050***	0.036	0.038	0.038	0.036
Model summaries								
Null deviance (d.f.=3569)	4711	4711	4711	4711				
Residual deviance	4307 (d.f. 3545)	4304 (d.f. 3545)	4311 (d.f. 3545)	4300 (d.f. 3541)				
Likelihood ratio (compared to only the control variables)	-2153.7 (d.f. 25)	-2152.2 (d.f. 25)	-2155.5 (d.f. 25)	-2150.1 (d.f. 29)				
p-value	<0.001	<0.001	<0.001	<0.001				
AIC	4357.3	4354.3	4361	4358				
R2 adjusted					0.1484	0.1487	0.1479	0.1489
F					26.91	26.98	26.81	23.29
p-value					<0.001	<0.001	<0.001	<0.001
* *p* **<.05 based on 1-sided tests for hypothesis, and 2-sided for other variables**								

In all models, the predictors in Eq. 1 significantly explain the variance in the win variable, since the likelihood ratio tests (for win1 models) as well as the F-test (for win2 models) are highly significant. There is very little change between the four models for both dependent variables. Model 3 has the lowest AIC and therefore is the best fitting model to predict the chance of winning the game. However, Model 3 is not the best fit for predicting the goal difference. To predict the goal difference, model 4 (with all player familiarity variables included) has the highest R-squared adjusted (0.1489), meaning it predicts most variance in the goal difference. Model 4, however, also has the lowest F-value, namely 23.39, where the other models are all above 26.8. Since the significant variables do not differ between the models, but the p-values and estimates do slightly differ, model 2 is chosen to test for the hypothesis and to interpret the results. Model 4 violates the multicollinearity assumption and has a lower F-value, therefore, model 2 is the better model in predicting the goal difference.

Looking at the control variables, travel factors have no significant effect, neither as a main or moderating effect of the home advantage (see Table 4). The same holds for the season dummy. The competition and team value variables do have significant effects on the winning chance and goal difference of teams. As expected, teams with higher-valued players have a bigger chance of winning (β= 0.729, *p*-value= <0.001) and have, on average, a bigger favorable goal difference (β= 0.782, *p*-value= <0.001). The dummy variables LaLiga and Premier League have a significant negative estimate for both Win 1 and Win 2. This means teams these competitions have a smaller chance of winning (higher chance of drawing) and have a smaller chance of making goals (lower chance of having a big goal difference) compared to teams playing in the Serie A (=baseline competition). The opposite holds for teams in the competitions Eredivisie and Premiership.

4.2 Main effect: the presence of a home advantage in soccer games

In all models being the home team gives an advantage in both the chance to win the game and in goal differences in favor of the home team. This indicates that even when there is no crowd, the home team still has an advantage over the away team. The home team has a significant positive odds of 0.40 of winning the match (β= 0.400, two-sided *p*-value= 0.003) than the away team. The home team also has an average positive significant goal difference of +0.463 (β= 0.463, *p*-

value= <0.001) meaning the home team scores per match on average 0.463 more goals than the away team (or 1 more goal in every 2 to 3 matches). Therefore, the main hypothesis *H1: Being the home team (versus the away team) has a positive influence on the probability of winning the game* is accepted.

4.3 Moderating effects

Apart from the positive main effect of the home advantage, the model results show that this home advantage varies as a function of some of the proposed moderators. None of the player familiarity variables have shown any significant effect on either the winning chance (β = -0.023, *p*-value= 0.839) nor on the goal difference (β= 0.051, *p*-value= 0.290), hence the H2 hypotheses related to team familiarity can be rejected.

The tenure of the coach also has no significant influence on the home advantage in terms of winning chances (β =-0.074, *p*-value= 0.849) nor on the goal difference (β= -0.065, *p*-value= 0.575), therefore hypothesis H3a is rejected. However, a positive effect of the tenure of the assistant coach on the home advantage has been found. If an assistant coach tenure increases by 1 (the assistant coach has been the assistant coach of that team for 1000 days) the home advantage increases by 0.179, ceteris paribus (β= 0.179, *p*-value= 0.016). The tenure of the assistant coach also has a significant positive effect on the home advantage in terms of chance of winning the game (β = 0.175, two-sided *p*-value= 0.054). Therefore, hypothesis H3b is accepted.

Facility familiarity also has an effect on the home advantage. Teams playing on artificial turf during home games had a significant increased home advantage in terms of goals difference (β= 0.524, *p*-value= 0.041). Although the effect is also positive in the logit model, it turns out not significant for the chance of winning the game (β= 0.399, two-sided *p*-value= 0.214). Home teams playing on artificial turf had, on average, a goal difference of +0.524, ceteris paribus. Therefore, we accept hypothesis h5a.

Unlike the positive effect expected in hypothesis H4b, playing on a uncommonly small field seems to have a negative effect on the home advantage in terms of winning chances (β = -0.170, *p*-value= 0.003) and also in terms of goals difference (β = -0.198, *p*-value= <0.001). Therefore, hypothesis H4b is rejected. A possible explanation for the negative effect on home advantage could be that the away team is used to playing on a bigger field and therefore, has

more energy during the games on smaller fields of the visitors. Playing on an uncommonly big field showed no significant influence on the home advantage in terms of chance of winning (β = -.0054, *p*-value= 0.620) nor on the goal difference (β = -0.117, *p*-value= 0.163). This could be because very few teams play on uncommonly big fields. Thus, either the data is too sparse, or there is actually no effect. Since no effect of playing on an uncommonly big field on home advantage can be found, hypothesis H4c is rejected.

4.4 Robustness check

Multiple validations are used to check the robustness of the model findings. First, all continuous variables were ln-transformed in the models. This brought no changes to the significance of any variables, and the models had no lower AIC, nor did they predict more variance (See appendix 1.6). Second, the travel factor travel time has been replaced by an alternative measure, namely travel distance. Since, in some research, travel distance is added as travel factor (Damme and Baert, 2019). This does, however have a very high multicollinearity with travel time which was the reason why travel distance was excluded from the models. Replacing travel time with travel distance had no note-worthy effect on the other findings (see appendix 1.7). Lastly, the sample size was lowered by removing the winner and loser of the competition for matches during the 19/20 season and by removing the current highest and lowest team in the competition for matches during the 20/21 season. This left 3,172 observations for the analysis. The models had a lower R-square and a lower AIC as expected. The model for win 1 (chance of winning the match) showed a significant positive effect of artificial turf on the home advantage. This effect was not significant for win 1 in previous models. Other than that, no changes were found compared to previous models (see appendix 1.8).

4.5 Conclusion

Since multicollinearity was found between the three player familiarity variables, these variables had to be tested in the models one by one, resulting in 4 models per dependent variable instead of 1 model. Other than the multicollinearity, no assumptions were violated.

In every model, the main effect, namely the home advantage, was significant and positive, meaning the team that played at home had a bigger chance of winning the game and can expect a more positive goal difference.

None of the player familiarity variables showed any effect on the home advantage. The same holds for the tenure of the coach. The tenure of the assistant coach, however did show a positive effect on home advantage. In addition, teams playing on an artificial turf field surface had a significantly bigger favorable goal difference, and also a slightly higher winning chance. Lastly, playing on an uncommonly small field has a negative effect on the home advantage, but playing on an uncommonly big field has no influence on the home advantage.

Multiple validations have been done to check the robustness of the model, but these validations did not change the model results drastically nor came to different conclusions.

In the next chapter, the thesis and findings will be discussed, and the implications for the soccer clubs, competitions organizers, and sponsors are formulated. This chapter will end with the limitations of this research and suggestions for future research are given.

5. Discussion

5.1 Conclusions

Even for games in six main European soccer competitions (Premier League, Serie A, LaLiga, Bundesliga, Eredivisie, and Premiership) where no attendance was allowed due to the Covid measures, there is clear evidence of a home team advantage, providing support for H1. This shows that a crowd is not the sole factor explaining the presence of home advantage. More importantly, it allows us to further explore what other factors drive this effect. This thesis showed, based on a moderated regression analysis, that the familiarity of players with the club has no influence on home advantage, rejecting the positive hypothesized relationship H2. The amount of time the coach has been working at the club also has no proven effect on the home advantage, therefore hypothesis H3a is rejected. The amount of time the assistant coach of a team has been working at the club, however, does have a positive effect on the home advantage, which was also hypothesized, therefore H3b is accepted. Lastly, it was hypothesized that facility familiarity had an effect on the home advantage. It was expected that teams who play on artificial turf during their home matches have a bigger home advantage. This hypothesis (H4a) has been supported empirically. In addition, it was expected that having an uncommon field size has a positive effect on the home advantage. However, this effect has not been found. Having an uncommon small field even has a negative effect on the home advantage and having an uncommonly big field has no significant influence on the home advantage. Since both uncommon field sizes were expected to positively effect the home advantage, both H4b and H4c are rejected.

5.2 Implications for soccer clubs, competition organizers, and sponsors

The findings of this thesis offer clear recommendations to **soccer clubs** in making decisions to increase their home advantage. It has been proven that teams playing on uncommonly small fields during their home matches have a smaller home advantage ($\beta = -0.198$, p-value= <0.001). It is therefore recommendable to soccer clubs to avoid playing on an uncommonly small field during home matches, since playing on a regular field would increase their chance of winning more home matches and increases the goal difference during home matches (keeping all other factors the same). In addition, this thesis shows that teams playing on artificial turf during their

home matches have a bigger home advantage. Teams playing on artificial turf during their home matches have, on average, a 0.524 more positive goal difference. Meaning if a club changes from grass surface to artificial turf (keeping all other factors the same), the team will score one goal more per two to three matches during home games (or receive one goal less per two/three matches during home games). Lastly, it is shown that if an assistant coach has been the assistant coach for the same club for a longer period, the home advantage increases. It could therefore be beneficial for a club to keep the existing assistant coach rather than replacing him or her. However, the tenure of the assistant coach also has a negative effect on the winning chance and goal difference during away matches. Making the choice between keeping or replacing the assistant coach competition and time-dependent.

Sponsors could benefit from this thesis when looking for a team to sponsor. Winning teams gain more exposure (Gibbs et al., 2014), and if a team wins, the purchase intention of the viewers towards the sponsor's product increase (Ngan et al., 2011). For these reasons, it is beneficial for the sponsors of a team that the team wins. Therefore, it could be a better choice for sponsors to not sponsor a team playing on an uncommonly small field since this team experiences a lower home advantage and thus loses more matches during the competition. It is for sponsors a better choice to sponsor teams playing on artificial turf during their home matches since they have a bigger home advantage and, for that reason, win more matches. In addition, it could be beneficial for sponsors to sponsor a team with an assistant coach who has been working for the club for a longer time since this again increases the home advantage.

Lastly, **Competition organizers** now have evidence that the diversification between fields have an influence on the outcome of matches. Since some teams have an advantage due to the field regulations, competitions could consider making these field rules stricter to eliminate (unfair) field advantages. Teams playing on artificial turf have a significantly higher goal difference, which gives clubs with an artificial turf field an advantage over the teams which have a grass field. Furthermore, clubs that have an uncommonly small field experience a smaller home advantage. Restricting field size diversifications and eliminating artificial turf fields would thus make the competition fairer.

5.3 Limitations and future research

This thesis focused on six of the highest European soccer leagues. The results, therefore, are limited to soccer games and to the highest competitions in Europe. Although the results are expected to also extend to other team sports like hockey or basketball and other regions, more research should examine the home advantage in this context. Fisher and Haucap (2020) found there are differences in home advantages between professional teams and amateurs. Amateur teams could, for example, have a far lower assistant coach tenure. In addition, amateur teams more often train on a separate field than their game field due to money constraints. This could change the facility familiarity effects. These same changes could hold for other sports and other regions. Therefore, future research should examine the effects in amateur leagues, in other sports, and in other regions.

This research looked at six European competitions, resulting in 3,750 observations. However, playing on an uncommon big field is rare, and therefore only 302 observations had an uncommon big field. This low number of observations could explain why playing on uncommonly small field sizes (which had 726 observations) had a significant influence on the home advantage, but uncommonly big field sizes did not. Future research could look at more competitions hence increase the number of observations and find a (clearer) effect between playing on an uncommonly big field size and home advantage.

This thesis took the contract date for the current job as starting date for the tenure. However, some players and coaches were active at the club for a longer period of time. Players who were promoted within the club from a team with an age restriction under 19 to the first team had the starting date when they were transferred. The date at which a player joined the club could therefore be more accurate and could show a player familiarity effect on home advantage. In addition, the number of clubs a player has played at previously could be taken into account. This could show how committed the player is to the club. Whether this is the case has yet to be determined. The same holds for coaches. Some coaches were assistant coach before they became the main coach. In this thesis, if that was the case, the period of being the assistant coach was not added to the tenure, however, adding these years of experience at the club could change the effect of coach familiarity on home advantage. Lastly, this thesis did not take the age of the players nor coaches into account. Therefore, the positive effect of the assistant coach's tenure on the home advantage could be related to the age of the coach rather than the familiarity with the

club. Further research could take the age of both players and coaches into account to research whether this is the case.

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Appendix

1. Regression analysis

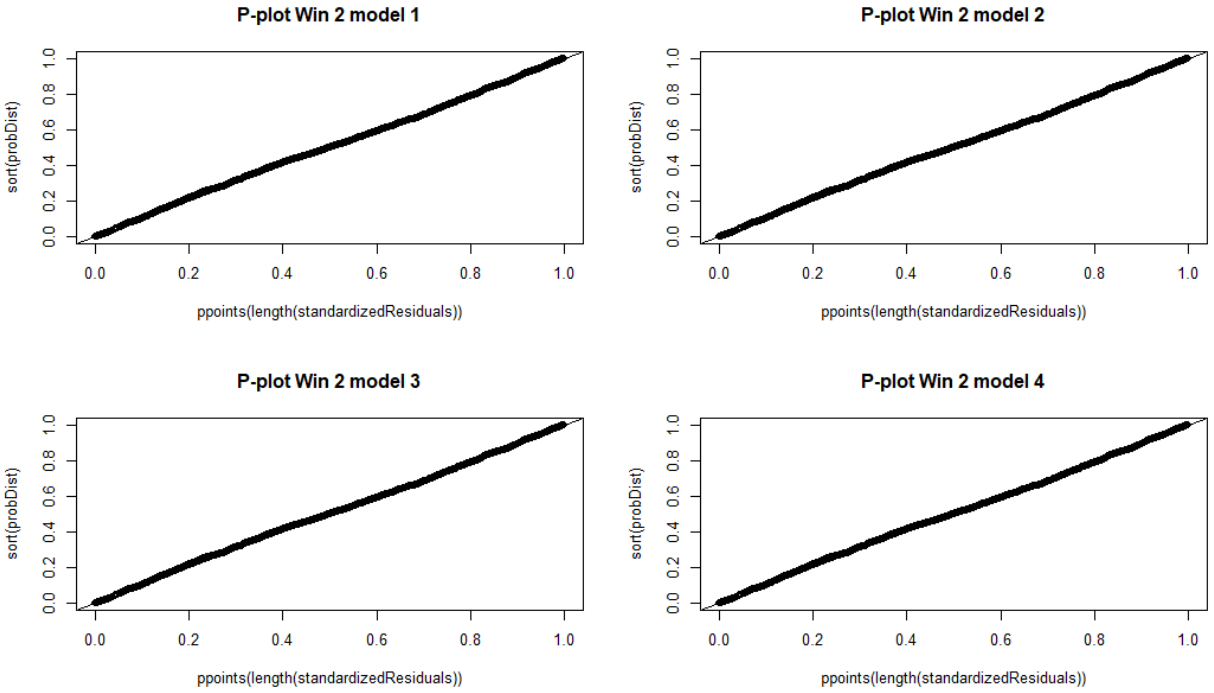
1.1 Correlation matrix of all numeric variables

Variables	Win 1	Win 2	TTen	CapTen	TopTen	CoaTen	AsCoTen	SizeS	SizeL	TraTime	Alti	Value
Win 1	1											
Win 2	0.77	1										
Team Tenure	0.16	0.18	1									
Captain Tenure	0.12	0.13	**0.70***	1								
Top three highest-paid players tenure	0.11	0.13	**0.65***	**0.53***	1							
Coach tenure	0.02	0.02	0.15	0.06	0.11	1						
Assistant coach tenure	-0.09	-0.12	-0.07	-0.06	-0.04	0.03	1					
Uncommonly small field	0	0	-0.08	-0.06	-0.07	0.12	-0.03	1				
Uncommonly big field	-0.01	0	0	0	0.03	0.01	0.03	-0.11	1			
Travel Time (in hours)	0.01	0	0.06	0.09	0.12	-0.01	0.08	-0.04	0.06	1		
Change in altitude	0.01	0	0	0	0.01	0.01	-0.03	-0.05	0.01	-0.02	1	
Team value	0.24	0.27	**0.59***	0.41	0.48	0.11	-0.03	-0.18	0.02	0.1	-0.01	1
***Correlation > .5**												

1.2 VIF-values of all used variables per model

	Win 1 (chance of winning the game)				**Win 2 (goal difference)**			
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Home team advantage (dummy home=1)	3.486409	3.462444	3.479383	3.48804	3.507359	3.504703	3.514649	3.518461
Team tenure	2.605331			**6.263173****	2.677657			**6.259741****
Captain tenure		2.218053		4.050226*		2.209314		3.924003
Top three highest-paid players tenure			2.428503	3.762507			2.392929	3.66717
Coach tenure	2.164485	2.131131	2.172785	2.188252	2.089149	2.059872	2.079976	2.102434
Assistant coach tenure	1.072965	1.072936	1.071798	1.073337	1.125898	1.121884	1.12012	1.126881
Artificial turf (dummy artificial turf=1)	2.254001	2.254624	2.257338	2.251651	2.148174	2.14414	2.142052	2.148321
Uncommonly small field surface in meters	2.193020	2.19111	2.203794	2.193949	2.247957	2.246708	2.245323	2.249908
Uncommonly big field surface in meters	2.038300	2.03276	2.071007	2.077898	2.081735	2.079697	2.079401	2.085289
Home * Team tenure	2.081085			**5.430312****	2.109819			**5.525704****
Home * Captain tenure		2.030567		3.849101		2.019525		3.816079
Home * Top three highest-paid players tenure			2.107939	3.512015			2.061374	3.454298
Home * Coach tenure	3.527743	3.467489	3.536897	3.562138	3.44324	3.413187	3.445141	3.467643
Home * Assistant coach tenure	3.430288	3.375889	3.421185	3.430063	3.401937	3.398631	3.409631	3.419046
Home * Artificial turf	2.280291	2.275182	2.265752	2.282437	2.167167	2.156661	2.147722	2.170112
Home * Uncommon small field surface	2.086936	2.072891	2.090748	2.091536	2.152554	2.140786	2.144464	2.15725
Home * Uncommon big field surface	2.003919	1.998129	2.040407	2.053125	2.050434	2.047517	2.048159	2.061097
Travel Time (in hours)	2.532211	2.522635	2.55027	2.534636	2.444408	2.440357	2.451381	2.454053
Change in altitude	2.145142	2.134658	2.154527	2.16018	2.043768	2.035588	2.036125	2.053332
Team value	3.631993	3.104047	3.392024	3.71363	3.386335	2.876073	3.117931	3.466159
Competition Premier League	1.491108	1.479109	1.473496	1.508377	1.489361	1.47577	1.472986	1.503301
Competition LaLiga	1.713157	1.680613	1.649653	1.719866	1.771451	1.732033	1.701737	1.77557
Competition Bundesliga	1.703730	1.643698	1.636883	1.819838	1.738163	1.669687	1.656813	1.8341
Competition Eredivisie	2.448433	2.393881	2.385182	2.461744	2.400911	2.341733	2.3438	2.407924
Competition Premiership	3.352504	3.10494	3.189003	3.337842	3.17741	2.957295	3.029403	3.196165
season 19/20 (dummy season)	1.176149	1.170317	1.172529	1.187802	1.171182	1.163966	1.170612	1.184237
Home * Travel time	3.577129	3.578852	3.617381	3.607106	3.469328	3.46883	3.481555	3.487853
Home * Change in altitude	2.142695	2.13447	2.155181	2.153562	2.04859	2.041323	2.042749	2.055306
*VIF-value > 4 **VIF-value > **5**								

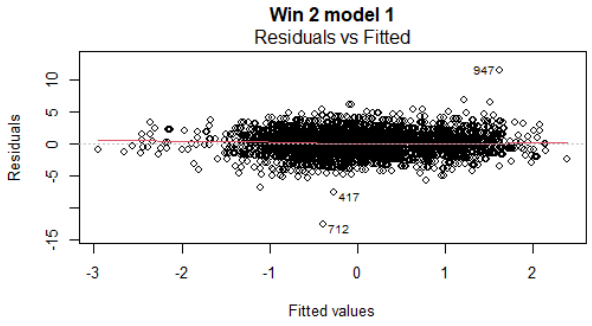
1.3 P-plot of 4 linear models on Win 2 (goal difference)

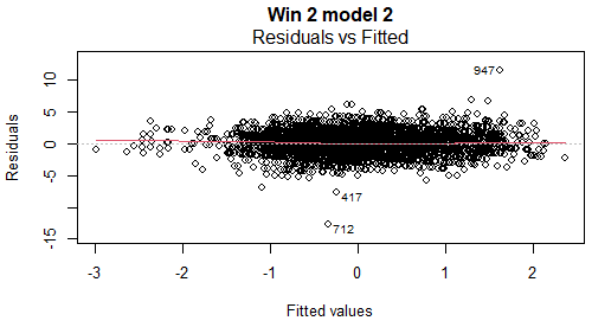


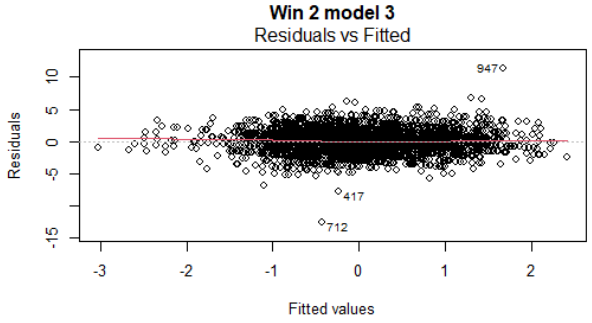
1.4 Breach Pagan test per model

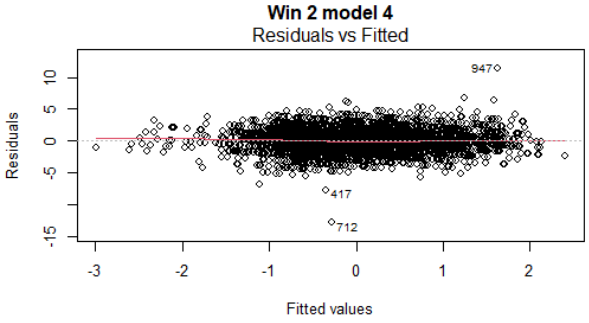
	Win 1 (chance of winning the game)				**Win 2 (goal difference)**			
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Breusch-Pagan value	100.64	98.81	101.20	99.152	47.22	48.23	45.20	51.84
Degrees of freedom	24	24	24	28	24	24	24	28
P-value	>0.001	>0.001	>0.001	>0.001	0.003	0.002	0.006	0.004

1.5 plots of the fitted values and residuals per model









1.6 Results of the regression analysis when all continuous variables are converted to ln (N=3570)

	Win 1 with all continuous variables ln-transformed	**Win 2 with all continuous variables ln-transformed**
Predictors		
Constant	**-4.385***	**-4.073***
Home team advantage (dummy home=1)	**0.356***	**0.486***
Captain tenure	0.017	
Top three highest-paid players tenure		-0.051
Coach tenure	0.082	0.079
Assistant coach tenure	**-0.110***	**-0.123***
Artificial turf (dummy artificial turf=1)	0.020	-0.049
Uncommonly small field surface in meters	**0.117***	**0.142***
Uncommonly big field surface in meters	0.022	0.086
Home * Team tenure		
Home * Captain tenure	0.111	
Home * Top three highest-paid players tenure		-0.027
Home * Coach tenure	-0.114	-0.122
Home * Assistant coach tenure	**0.165***	**0.194***
Home * Artificial turf	0.440	**0.605***
Home * Uncommon small field	**-0.160***	**-0.187***
Home * Uncommon big field	-0.052	-0.119
Travel time (in hours)	0.094	0.068
Change in altitude	-0.016	-0.017
Team value	**0.749***	
Competition Premier League	**-0.456***	**-0.494***
Competition LaLiga	**-0.243***	-0.074
Competition Bundesliga	-0.048	0.004
Competition Eredivisie	**1.508***	**1.541***
Competition Premiership	**2.002***	**2.011***
season 19/20 (dummy season)	0.134	0.091
Home * Travel time	0.033	0.006
Home * Change in altitude	0.046	0.036
Model summaries		
Null deviance (d.f.=3569)	4711.4	
Residual deviance (d.f.=3545)	4323.0	
Likelihood ratio (compared to only the control variables)	-2161.5	
p-value	<0.001	
AIC	4373	
R2 adjusted		0.1449
F		26.2
p-value		<0.001
* *p* **<.05 for 1-sided tests**		

1.7 Results of the regression analysis when travel time has been replaced by travel distance (N=3570)

	Win 1 with travel time replaced with travel distance	**Win 2 with travel time replaced with travel distance**
Predictors		
Constant	**-4.170***	**-3.918***
Home team advantage (dummy home=1)	**0.392***	**0.482***
Captain tenure	0.016	
Top three highest-paid players tenure		-0.051
Coach tenure	0.081	0.085
Assistant coach tenure	**-0.110***	**-0.113***
Artificial turf (dummy artificial turf=1)	0.025	-0.046
Uncommonly small field surface in meters	**0.119***	**0.145***
Uncommonly big field surface in meters	0.020	0.085
Home * Team tenure		
Home * Captain tenure	0.113	
Home * Top three highest-paid players tenure		-0.030
Home * Coach tenure	-0.113	-0.055
Home * Assistant coach tenure	**0.164***	**0.145***
Home * Artificial turf	0.427	**0.583***
Home * Uncommon small field	**-0.160***	**-0.197***
Home * Uncommon big field	-0.049	-0.123
Travel distance (1000 kilometers)	0.0836	0.059
Change in altitude	-0.016	-0.017
Team value	**0.747***	**0.792***
Competition Premier League	**-0.454***	**-0.493***
Competition LaLiga	**-0.247***	-0.076
Competition Bundesliga	-0.061	-0.003
Competition Eredivisie	**1.494***	**1.532***
Competition Premiership	**1.987***	**2.001***
season 19/20 (dummy season)	0.135	0.091
Home * Travel distance	0.004	-0.005
Home * Change in altitude	0.046	0.035
Model summaries		
Null deviance (d.f.=3569)	4711.4	
Residual deviance (d.f.=3545)	4323.7	
Likelihood ratio (compared to only the control variables)	-2161.8	
p-value	<0.001	
AIC	4374	
R2 adjusted		0.1441
F		26.0
p-value		<0.001
* *p* **<.05 for 1-sided tests**		

1.8 Results of the regression analysis when the highest and lowest team per competition and season are removed (N=3172)

	Win 1 with a smaller sample	**Win 2 with a smaller sample**
Predictors		
Constant	**-3.963***	**-3.486***
Home team advantage (dummy home=1)	**0.447***	**0.528***
Captain tenure	0.033	
Top three highest-paid players tenure		-0.020
Coach tenure	0.019	0.002
Assistant coach tenure	**-0.041***	**-0.027***
Artificial turf (dummy artificial turf=1)	-0.186	-0.286
Uncommonly small field surface in meters	**0.097***	**0.121***
Uncommonly big field surface in meters	-0.034	0.008
Home * Team tenure		
Home * Captain tenure	0.051	
Home * Top three highest-paid players tenure		-0.037
Home * Coach tenure	-0.116	-0.138
Home * Assistant coach tenure	**0.203***	**0.219***
Home * Artificial turf	**0.806***	**0.922***
Home * Uncommon small field	**-0.158***	**-0.201***
Home * Uncommon big field	0.020	0.002
Travel time (in hours)	0.024	0.079
Change in altitude	0.028	0.001
Team value	**0.683***	**0.709***
Competition Premier League	**-0.538***	**-0.526***
Competition LaLiga	**-0.305***	-0.138
Competition Bundesliga	-0.151	-0.123
Competition Eredivisie	**1.336***	**1.345***
Competition Premiership	**1.814***	**1.812***
season 19/20 (dummy season)	0.143	0.084
Home * Travel time		-0.038
Home * Change in altitude	0.046	0.011
Model summaries		
Null deviance (d.f.=3171)	4174.4	
Residual deviance (d.f.=3147)	3876.6	
Likelihood ratio (compared to only the control variables)	-1938.3	
p-value	<0.001	
AIC	3926.6	
R2 adjusted		0.1243
F		19.75
p-value		<0.001
* *p* **<.05 for 1-sided tests**		