

Facility-to-Facility Travel Mileage Influences Basketball Home-Court Advantage

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Abstract

Home team advantage exists in all major professional sports in the United States, with the NBA having the highest home team advantage (about 60% win rate for home teams). Various models have been put forth to describe home team advantage in the NBA, however, to-date the complete set of factors influencing home team advantage has not been detailed. Here, we analyze the role of travel in affecting home team advantage. We find that home team advantage is strengthened when the visiting team has traveled a greater facility-to-facility distance to the game. This study provides a more complete picture of the factors influencing home court advantage in the NBA.

1 Introduction

Home team advantage is well documented in many major team sports including basketball, hockey, soccer, baseball, and football (Courneya and Carron 1992). Commonly analyzed as the percentage of home team wins in a season, home team advantage ranges from about 52% in baseball to about 60% in basketball depending on the season. Attempts to model home team advantage using single parameters have been limited and a picture is emerging in which the psychology and physiology of players, referees, and coaches are affected by a large number of factors (Legaz-Arrese et al 2013). However, the current understand of the combinatorial set of factors influencing home team advantage is incomplete.

The components of home team advantage are traditionally divided into the following broad categories: crowd effects, familiarity with facilities, rules favoring home team, territoriality, and travel (Legaz-Arrese et al 2013). Specific to the NBA, the size of the crowd has been shown to be a contributing factor to home team advantage, but this effect is modest. Interestingly, although NBA facilities are highly regulated and not likely to play a role in home court advantage, altitude of facilities has been shown to be the sole contributor to team-to-team variability in NBA home court advantage (Swartz and Arce 2014), indicating altitude is a significant contributing factor. While the NBA does not have any rules favoring the home team (unlike baseball, for instance), basketball is a

free-flowing game and referees must make real-time assessments of fouls. This has been reported to influence home team advantage, since referees must make instantaneous decisions and are susceptible to crowd approval (Legaz-Arrese et al 2013). While these factors all contribute to home team advantage, no single aspect can completely model the phenomenon.

A widely held belief is that travel fatigue plays a large role in home team advantage. This may be enhanced in the NBA due to the scheduling format. As opposed to baseball which plays many consecutive games in the same city, or football which only plays a single game each week, teams in the NBA travel from city to city playing consecutive games on the road without returning home. These road trips can be extensive, ranging up to nine days and over 10,000 km. While it is intuitive that travel may reduce performance, previous statistical analyses have not shown a substantial role for travel in home team advantage. For example, when taking into account jet lag (Lew and Schwartz 2003) and crossing time-zones (Street and Huizenga 199), little or no affect is seen on home team advantage in professional baseball and football. In light of the NBA’s relatively extensive travel schedule, it is possible that travel influences home team advantage more in the NBA than other professional sports. However, a landmark study reports that lack of rest rather than extensive travel contributes to NBA home team advantage (Entine and Small 2008). Specifically, this study found no indication that the number of consecutive games the visiting team has been on the road affects home team advantage.

In the current study, we break down the role of traveling in home team advantage. Specifically, We find previous travel distance of the visiting team as a modest contributor to home team advantage. Alternative, we find no correlation between the cumulative distance the visiting team has traveled on their current road trip and home team advantage. Shedding light on unproven intuition that travel mediates home team advantage by affecting player physiology, this study provides progress towards completely describing home court advantage.

2 Modeling home court advantage

To model home court advantage we look at scoring differential between home and visiting teams, which accurately reflects home court advantage (citation). In the 2014-15 NBA season, home teams scored 2.41 points more than visiting teams on average. Approximately 1.2% of points scored in the season can be attributed to home court advantage. The NBA schedule contains long road trips for teams that often include multiple games away from home spread out over long distances. Remarkably, these road trips can comprise up to nine games away from home. We hypothesized that as teams travel to games, the physical and emotional wear on players may strengthen as their travel distance increases. As such, we developed a linear model to predict home team point differential using the visiting team’s facility-to-facility distance traveled as a predictor (equation 1).

$$Y_{ij} = \beta_0 + \beta_1 * X_i + \epsilon \quad (1)$$

where:

Y_{ij} = Score differential between home team and visiting team
 β_0 = Score differential when visiting team has traveled 0 miles
 β_1 = The effect of traveling X_i miles to arrive at game

This model, adapted from (Entine and Small), does not takes into account team strength. The NBA schedule is nearly balanced, meaning teams play an equal number of home and away games against each team. Because of this, models of home court advantage typically do not include team strength as a predictor. Since team strength is complicated to account for, we prefer a simpler approach that does not include team strength.

3 Visiting team facility-to-facility travel distance strengthens home team advantage

Fitting our model (equation 1) to the 2013-14 and 2014-15 NBA seasons (Figure 1), we find that when visiting teams have traveled zero kilometers to arrive at the game, home team advantage only results in a 1.4 point advantage ($\beta_0 = 1.6$, $p < 0.001$). This represents the interesting case in the the NBA where a visiting team plays in their home town due to Los Angeles having multiple NBA teams.

Additionally, our model predicts that cumulative travel distance has a modest but significant effect on home team advantage. For every 1000 km traveled on the visiting teams road trip, home team advantage is predicted to strengthen by 0.68 points ($\beta_1 = 0.00068$, $p = 0.016$). We note that this is a very modest (albeit significant) contributor to home team advantage. Practically, this phenomenon can manifest itself often in the NBA since many teams travel thousands of kilometers across the country.

4 Home team traveling does not affect home team advantage

In addition to the visiting team traveling, the home team often needs to travel home from an away game prior to their game. We wondered if the distance traveled by the home team (if any), has an affect on home team advantage. We adapted our initial model (equation 1) to incorporate this parameter (equation 2) and applied this model to the 2013-14 and 2014-15 NBA seasons.

$$Y_{ij} = \beta_0 + \beta_1 * X_i + \beta_2 * X_j + \epsilon \quad (2)$$

where:

Y_{ij} = Score differential between home team and visiting team

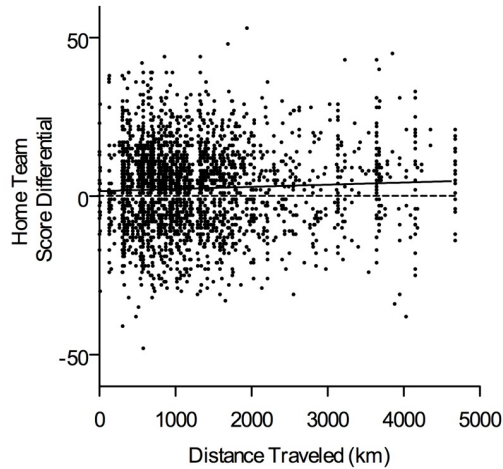


Figure 1: Plot of score differentials from the NBA 2013-14 and 2014-15 seasons versus the facility-to-facility travel distance of the visiting team. Linear fit is included to show modest correlation between variables.

β_0 = Score differential when visiting team has traveled 0 miles

β_1 = The effect of the visiting team traveling X_i miles to arrive at game

β_2 = The effect of the home team traveling X_j miles to arrive at game

As opposed to visiting team travel, home team travel had minimal effect on home team advantage. For every 1000 km the home team traveled to arrive at their home game, home team advantage was lessened by 0.26 points, which was not significant ($p = 0.37$) We hypothesize that familiarity and comfort with their home city may alleviate the physiological and psychological burden of traveling.

5 Cumulative travel distance of visiting team has minimal affect home team advantage

The NBA schedule contains long road trips for teams that often include multiple games away from home spread out over long distances. Remarkably, these road trips can comprise up to nine games away from home. We hypothesized that as teams travel greater distances, the physical and emotional wear on players may strengthen home team advantage (Figure 3). As such, we modeled as a function of the visiting team's cumulative travel distance instead of immediate travel distance.

Interestingly, cumulative travel distance had little affect on home team advantage. This is in accordance with a previous study showing that the total

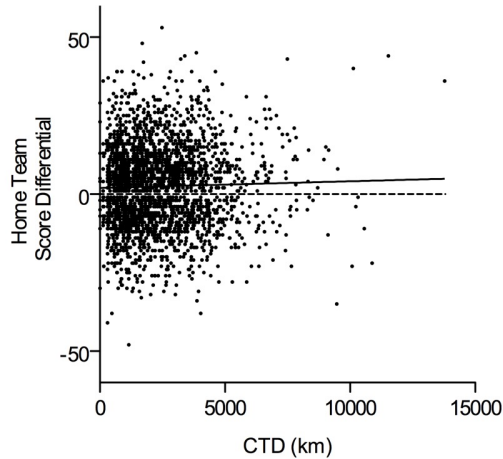


Figure 2: Plot of score differentials from the NBA 2013-14 and 2014-15 seasons versus the cumulative travel distance (CTD) of the visiting team. Linear fit is included to show modest correlation between variables.

days on the road did not affect home team advantage (citation). For each 1,000 cumulative miles, home team advantage was only strengthened by 0.21 points ($p = 0.18$). We conclude that cumulative road trip length is far less important than the most recent travel distance in influencing NBA home team advantage.

6 Historical affect of facility-to-facility travel distance on home team advantage

To assess the historical impact of facility-to-facility travel distance on home team advantage, we looked at each NBA season individually since the most recent lockout season (Figure 3). Due to contract negotiations, the 2010-11 NBA season was unusually short and excluded from our analysis. In all three years analyzed, a positive correlation between travel distance and home team score differential was identified. Additionally, the magnitude of the impact increased each season. While neither individual year trends and between year trends are significant, we see this as an exciting possibility to look at in the future.

Year	$\beta_1 * 1000$	p
2012	0.50	0.20
2013	0.60	0.13
2014	0.75	0.06

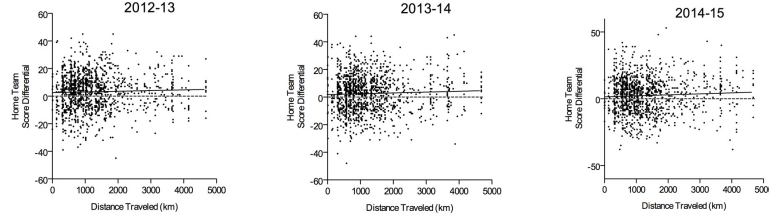


Figure 3: Plot of score differentials from 2012-13, 2013-14 and 2014-15 individual NBA seasons versus the facility-to-facility travel distance of the visiting team. Linear fit is included to show modest correlation between variables.

7 Does distance from home affect home-court advantage?

Lastly, we examined whether the visiting team’s distance from their home city influences home court advantage (Figure 4). Proximity to home may impact home team advantage in a few ways. First, visiting teams may attract more of their own fans to games which are closer to their home city. This could limit the role of crowd social impact which has been proposed to play a role in home court advantage (citation). Secondly, longer distances from home are indicative of longer travel which is an important aspect of home court advantage. Therefore, proximity to home city may be a good metric for predicting home court advantage.

When modeling home team point differential to include proximity to the visiting team’s home city, only a modest effect seen using the 2013-14 and 2014-15 NBA seasons. For each additional 1000km from the visiting team’s city, home team advantage increases by 0.45 points per game, which is not significant at the 5% level ($p = 0.08$). We note that this predictor may be confounded by rivalries being more common between neighboring cities and therefore, it will be interesting to evaluate the effect of rivalries on home team advantage.

8 Conclusion

In this current study we identify facility-to-facility travel mileage as having a very modest, but significant impact on home court advantage in the NBA. This sheds light on the long-held intuition that travel should be a contributor to home court advantage (Lagaze-Arrese et al 2013). In light of a previous study (Entine and Small 2008) that failed to show duration of travel (measured in cumulative games on the road) as a predictor of home court advantage, our findings are especially of interest. Our results indicate that a visiting team with a long road trip comprising many close stops (such as playing the many California teams) is less affected by home team advantage than a visiting team making

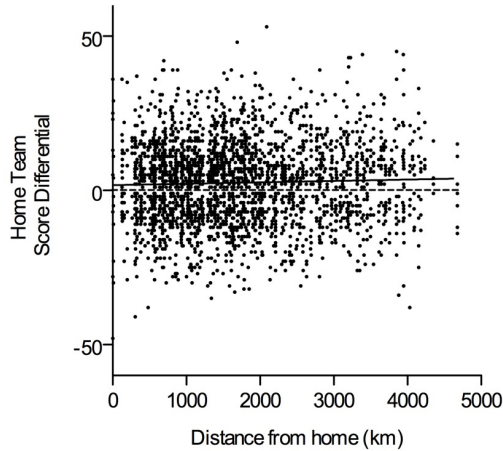


Figure 4: Plot of score differentials from 2013-14 and 2014-15 NBA seasons versus the visiting team distance from home. Linear fit is included to show modest correlation between variables.

many distant stops on a road trip. This appears to be different from the role of spending many days on the road, which has no statistical affect on home court advantage.

The NBA has been experiencing an apparent decline in home court advantage since the late 1990s. Originally, this apparent decline is thought to be mainly due to the increased regulation and monitoring of referees. Additionally, in recent years The NBA has adopted instant replay technology to overturn incorrect referee calls. However, a recent study showed that there has not actually been a decrease in home court advantage after correcting for the points per game each year (Swartz and Arce 2014). Instead, the apparent decline in home team advantage can be entirely ascribed to the decline in points scored per game since the 1990s. In light of this, it will be interesting to see how facility-to-facility distance traveled has affected home court advantage throughout the history of the NBA. Domestic travel has significantly improved since the inception of the NBA in 1946. We find it very likely that high-distance road trips 50 years ago were a greater burden on visiting teams than they are today.

Our report here sheds light on the many factors influencing home team advantage in sports. Specifically, visiting team facility-to-facility travel distance has a significant impact on home team advantage. We note that the impact of cumulative travel distance is modest. However, we expect any single contribution to home team advantage to be limited, and instead only the combinatorial consequence of multiple factors will completely describe home team advantage. Future work should devise models that incorporate a variety of predictors in order to fully describe home team advantage.

References

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