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ORIGINAL ARTICLE

The Analysis of Euroleague Games According to Location and Game-Related Statistics

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Abstract

Euroleague, the professional basketball organization of Europe, has not been studied in terms of home-court advantage and game-related statistics (GRS). To evaluate the differences between home and away-court wins extensive data covering the 2010-2011 to 2018-2019 seasons was analysed for the nine-seasons and separately. There was a significant difference with large effect size, in the scores for total home-c and away-court win results. Multiple linear regression (MLR) was conducted to elaborate which GRS variables on winning according to location. The results revealed that defensive rebound, blocked-shot, turnover, and free-throw made, produced a significant contribution to winning in homeand away-court. Except these mutual GRS, steal and assist were the winning contributors, for the home-c yet two-points made and blocked-shot against were the winning contributors for the away games. These results may guide to basketball coaches and players in terms of training and game preparation.

Introduction:

Euroleague, the zenith of European basketball for 20 years (https://www.euroleague.net). The aim of the basketball like many games to score more points on offense and allows fewer points on defense. Any team performs better at home against an opponent than playing away against the same opponent, termed "home-court advantage" in sports (Albert & Koning, 2007). In professional sports, home teams prevail more than 50% of the games played under a balanced home and away schedule for all levels and dates (Jamieson, 2010). Notably, the volume of home-c advantage depends on the season in American leagues (Entine & Small, 2008; Swartz & Arce, 2014; Jones, 2015).

Three principal factors physiological; travel fatigue or routine disruption, psychological; crowd behavior, referees bias, territoriality, and tactical factors; venue familiarity may role is to build an advantage in favor of the home team (Neave & Wolfson, 2003; Nevill *et al.,* 2002; Stefani, 2007). Studies related to the issue of travel fatigue found that the home-c advantage increased as the distance from the away team (Pace & Carron, 1992). Research has examined that why long travel increases the home-field advantage may associate with distance, travel time, flight type, and jetlag (Pollard *et al.,* 2008). Crowd and noise are the psychological factors that manipulate the referees' decision in favor of the home team. A noisy crowd encourages players to give more effort and motivation while keeping away players out of the game (McEwan *et al.,* 2012; Nevill *et al.,* 2002). As a tactic, the home team's recognition of the field may improve the performance. In the NBA, players' advantage of background familiarity, colors and shapes, which could bolster perception (Albert & Koning, 2007). The study of Bray & Widmeyer (2000), revealed that familiarity has more influence than the crowd and noise effect, which was the major contributor to home-court advantage in sports.

There have been many conducted studies to find the influence of GRS on winnings in different levels and leagues (Cauševic, 2015; Dogan *et al.,* 2016; Milanovic *et al.,* 2016; Sampaio & Janeira, 2003). Winning teams are characterized by defensive rebounds and 2-and 3-point field goal percentages and had unsuccessful 3-point field-goals for the European and world championship games (Karipidis *et al.,* 2001), 2-point field goal, free-throw percentage, and defensive rebounds for the close score games from the Portuguese P. league (Sampaio & Janeira, 2003), assists, defensive rebounds and successful two and three-point field-goals in ACB league Garc?a *et al.,* (2014), assists, steals, and blocks are the main factors between the best and worst teams in Spanish League (Ib??ez *et al.,* 2008) two-point field goals made, defensive rebounds, and assists for U-20

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teams (Ib??ez *et al.,* 2008), defensive rebounds, steals, turnovers, assists, and offensive rebounds for the Turkish league(Dogan *et al.,* 2016).

The volume of home-court advantage measure on NCAA, NBA, and WNBA games, however, words the 2nd most prominent basketball organization Euroleague, has not been investigated in detail yet (Entine & Small, 2008; Swartz & Arce, 2014). The result of the game was mostly examined for specific competition qualities and small sample sizes (Marmarinos *et al.,* 2016; Sampaio *et al.,* 2010). This study aims to reveal the volume of home-court advantage and examine the contribution of GRS to win the games in Euroleague according to game location, whether a home or an away game. Analyzing the home-court advantage and GRS, clubs, coaches, players, spectators can develop a model or a strategy to get better.

Materials and Methods:

There have been 48 different teams from 16 different countries participated in the history of Euroleague for the last nine consecutive seasons. The data between the 2010-2011 to 2018-2019 seasons for the game results and the team`s GRS were obtained from Euroleague`s official website (www.euroleague.net). GRS for the first round and the top sixteen games, except for playoffs, a total of 3566 games were analyzed in this study. Game results, whether home or away win, are the dependent variable of the first study were normalized to 1 game. To explain the structure of basketball, 15 GRS were selected as discriminant variables of the second study. However, three of them (Foul-drawn, Free-throw, and Three-point attempt) were omitted because of the multicollinearity. That means, For Tabachnick *et al.,* (2007), the independent variables with a bivariate correlation of more than 0.70 should not be included in multiple regression analyses. So, all the independent variables and their explanations were presented in Table1.

Table-1: Definitions of Game Related Statistics used in the studies

Variable	Abbreviation	Definition
Home/ Away	Home Away	Place of game, where the game played, Home-court & Away-court. The dependent variable of the first study.
Win/Loss	Win/ Loss	Result of a game either a win or a loss. The dependent variable of the second study.
Offensive rebound	OFR	A rebound of attacking team
Defensive rebound	DER	A rebound of defending team
Assist	AS	A pass just before the score
Steal	ST	Gaining the possession of the ball in defense
Blocked shot	BS	Tipping or deflecting a shoot in defense
Blocked shot against	BS-A	A shoot being tipped or deflected in the offense
Turnover	TO	Losing the possession of the ball in the offense
Foul drawn	FL-D	Foul made to a player
Foul Committed	FL-C	Foul made by a player
Free-throw attempt	FT-A	Number of shots from the free-throw line
Free-throw made	FT-M	Number of successful shots from the free-throw line
Two-points attempt	2P-A	Number of shots from inside the 3-point line
Two-points made	2P-M	Number of successful shots from inside the 3-point line
Three-points attempt	3P-A	Number of shots from outside the 3point line
Three-points made	3P-M	Number of successful shots from outside the 3point line

The first objective of the study, paired-samples t-tests were conducted to determine the differences between home and away court winning ratios total games and separately in nine seasons. Before conducting, the underlying statistical descriptors were computed for between games. Despite the normality, it is needed for small sample sizes, across all winning games Shapiro-Wilk test concludes that no significant departure from normality distribution of each season (Shapiro & Wilk, 1965).The second objective, multiple regression analysis to predict the contribution of each GRS variable independently on the home and away-winning situation separately. The multiple linear regression statistics (MLR), based on an explanatory variable, were meant with the coefficient of determination (R), predictor's explained variance (R2), F-value, and statistical significance. The statistical analyses were performed using SPSS software release 26.0 (p =0.05).

Results:

Descriptive information of home and away from court win results for Euroleague teams were presented in table two. The volume of Euroleague teams' home-c win is M= .60, Sd=.22, and away-c win is M= .34, Sd=.23 over the last nine seasons. In 2018-2019, Euroleague teams have exhibited the highest volume with the M= .65, Sd=.20, and 2012-2013 has the lowest volume with the M= .55, Sd=.21. However, Euroleague teams both in 2016-2017 and 2017-2018 seasons exhibited the highest, with M= .37, Sd=.15, and M= .37, Sd=.18, but Euroleague teams demonstrated lowest away court win volume in 2015-2016 season with the M= .31, Sd.17. represents all descriptive and t-test results.

Specifically, a paired-samples t-test was computed to compare Euroleague teams home and away from court win performances for total nine seasons and for each season separately. There was a significant difference in the scores for total home (M= .60, Sd=.22) and away court results (M= .34, Sd=.23) conditions; with a large effect size [t(17,76)=191, p=0.001, ?2=0.452] (Cohen, 1988)(Table- 2). The home-c win and away-c win percentages of the Euroleague teams between the seasons from 2010-11 to 2018-19 are presented in fig.-1. These results suggest that playing at home effects

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results positively (Fig.-1).

Table 2. The Home-court and Away-court descriptive stats with paired sample t-test results (p<0.001 all)

Season	N	Home-Win		Away-Win		t	η2
		M	SD	M	SD		
2018-19	16	0.65	0.20	0.35	0.21	10.275	0.779
2017-18	16	0.63	0.17	0.37	0.18	6.659	0596
2016-17	16	0.63	0.21	0.37	0.15	6.516	0.586
2015-16	24	0.59	0.27	0.31	0.17	5.479	0.395
2014-15	24	0.57	0.23	0.33	0.28	5.319	0.381
2013-14	24	0.57	0.22	0.33	0.24	6.642	0.490
2012-13	24	0.55	0.21	0.35	0.28	4.537	0.309
2011-12	24	0.59	0.25	0.35	0.27	5.577	0.403
2010-11	24	0.62	0.22	0.33	0.23	6.746	0.497
TOTAL	192	0.60	0.22	0.34	0.23	17.764	0.452

The influence of GRS on winning, according to home and away-court was the momentous extension of the current study. Detailed results were presented in table 3. By evaluating the last nine seasons, mean scores of all the GRS showed higher value for the favour of home teams except for turnovers, fouls-committed, and blocked-shot against variables which are expected to be less. Especially for; assists, turnovers, fouls-committed, free-throw attempt, free-throw made, two-points attempt, two-points made.

For analyzing the home-c games, a multiple regression was carried out to investigate how GRS could significantly contribute to winning games in Euroleague. Before the report, the results, the assumptions of the MLR analysis, normality, linearity, and homoscedasticity of the residuals, were not violated. Highly correlated items between 0.669 and 0.970 for all regression models were not included (Field, 2009). Thus the assumption of the MLR analysis was met, and the results of the regression indicated that the model was a significant predictor of home winnings, and the predictor variables can explain 57,8 % of the variance in the data R2= .578, F(12,179) = 20,408; p<.001 (Table-3).

Table-3: Descriptive results of GRS for Home-court & Away-court

GRS (independent)	Number of Teams	Home Win		Away win	
		Mean	SD	Mean	SD
DER	192	23.919	2.017	23.084	1.954
ST	192	6.533	1.441	6.148	1.205
BS	192	2.788	0.949	2.491	0.779
FL-C	192	20.617	1.718	21.343	1.844
OFR	192	10.397	1.631	10.086	1.548
TO	192	11.730	2.745	13.313	1.779
AS	192	16.528	2.677	15.234	2.434
BS-A	192	2.573	0.693	2.888	0.679
FL-D*	192	20.981	1.649	20.253	1.520
FT-A*	192	18.819	3.052	17.202	2.794
FT-M	192	14.242	2.512	12.808	2.248
2P-A	192	39.543	3.037	38.298	5.006
2P-M	192	21.380	4.019	19.693	1.995
3P-A*	192	21.355	2.794	21.340	3.098
3P-M	192	7.689	1.419	7.442	1.464

Note: Items with an asterisk were not included in the multiple regression analysis.

Table 4. Multiple Linear Regression Table for Home-Win Model

	B	SE	ß	t	p.
Model(Constant)	−0.511	0.286		−1.791	0.075
DER	0.033	0.006	0.297	5.363	0.000*
ST	0.033	0.008	0.216	4.326	0.000*
BS	0.045	0.014	0.193	3.352	0.001*
FL−C	−0.010	0.007	−0.075	−1.387	0.167
OFR	−0.003	0.008	−0.024	−0.418	0.676
TO	−0.016	0.004	−0.194	−3.669	0.000*
AS	0.019	0.006	0.231	3.456	0.001*
BS−A	−0.025	0.017	−0.079	−1.540	0.125
FT−M	0.028	0.005	0.313	5.935	0.000*
2P−A	−0.003	0.005	−0.035	−0.490	0.625
2P−M	−0.006	0.003	−0.106	−1.890	0.060
3P−M	−0.003	0.012	−0.018	−0.240	0.811

Note: B= regression coefficient; SE= standard error; β = standardized regression coefficient. Home−win model: F(12.179)= 20,408 p<.001, R= 0.760, R2= 0.578, Adjusted R2= 0.549.

Table-5: Multiple Linear Regression Table for Away-Win Model

	B	SE	β	t	p
Model (Constant)	0.919	0.291		−3.158	0.002
DER	0.038	0.007	0.323	5.245	0.000*
ST	0.019	0.011	0.098	1.714	0.088
BS	0.039	0.017	0.130	2.274	0.024*
FL−C	−0.007	0.007	−0.053	−0.987	0.325
OFR	−0.004	0.008	−0.026	−0.473	0.636
TO	−0.028	0.008	−0.218	−3.577	0.000*
AS	0.006	0.008	0.067	0.828	0.409
BS−A	−0.062	0.019	−0.182	−3.237	0.001*
FT−M	0.022	0.006	0.218	3.960	0.000*
2P−A	−0.002	0.003	−0.051	−0.723	0.471
2P−M	0.027	0.010	0.233	2.709	0.007*
3P−M	0.011	0.013	0.071	0.844	0.400

Note: B = regression coefficient; SE = standard error; β = standardized regression coefficient
Away−win model: F(12,179) = 16,821 p < .001, R = 0.728, R2= 0.530, Adjusted R2= 0.498. *p<0.05,

While Defensive rebound (B = .033, p<.05), Steal (B = .033, p<.05), Blocked-shot (B= .045, p<.05), Turnover (B= -.016, p<.05), Assist (B= .019 p<.05), Free-throw Made (B= .028, p<.05), contributed statistically significantly to the model however, foul-committed (B = -.010, p=.167), offensive rebound (B = -.003, p=.676), Blocked-shot Against (B = -.025, p=.125), Two points attempt (B = -.003, p=.625), Two-points Made (B = - .006, p=.060), and Three-points made (B = -.003, p=.811), did not.

The final predictive model was:

Home win = -0.511+ (.033*DER) + (.033*ST) + (.045*BS) – (.010*FL-C)–(.003*OFR) – (.016*TO) + (.019*AS) – (.025*BS-A) +(.028* FT-M) – (.003*2P-A) – (.006*2P-M) – (.003*3P-M) (Table-4).

MLR was carried out for the away games to investigate how GRS could significantly contribute to winning games in Euroleague. The results of the regression indicated that

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the model was a significant predictor of away winning, and 53 % of the variance in the data can be explained by the predictor variables R2= .530, F(12,179) = 16,821 p < .001.

Although Defensive rebound (B = .038, p<.05), Blocked-shot (B= .039, p<.05), Turnover (B= -.028, p<.05), Blocked-shot Against (B = -.062, p<.05), Free-throw Made (B= .022, p<.05), Two-points Made (B= -.006, p<.05) contributed statistically significantly to the model however Steal (B = .019, p=.088), foul-committed (B = -.007, p=.325), offensive rebound (B = -.004, p=.636), Assist (B= .006 p=.409), Two points attempt (B = -.002, p=.471), and Three-points made (B = -.011, p=.400), did not.

The final predictive model was:

AWAY win = -0.919+ (.038*DER) + (.019*ST) + (.039*BS) – (.007*FL-C)–(.004*OFR) – (.028*TO) + (.006*AS) – (.062*BS-A) +(.022* FT-M) – (.002*2P-A) – (.027*2P-M) – (.011*3P-M) (Table-5).

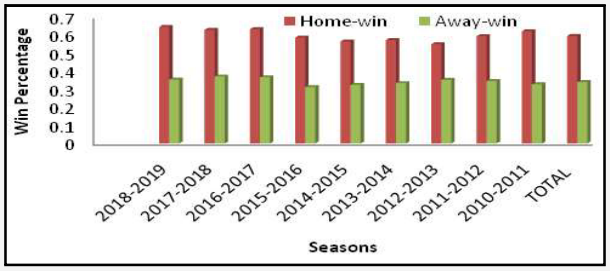

Figure-1: Home-Court & Away-Court Win Percentages

Discussion:

The impact of home-court advantage explored in the Euroleague games for the last nine seasons and each season separately. The data between 2010-201 and 2018-2019 season, exhibited that Euroleague teams won 60% of home and 34% of away court games in the last nine seasons. The home-court advantage reached its peak with 65% in 2018-2019 and hit bottom with 55% in 2012-2013. Home-court advantage, clearly laid out in this study, tried to explain by physiological, psychological, and tactical factors (Neave & Wolfson, 2003; Nevill *et al.,* 2002; Stefani, 2007).

However, in Euroleague, the dates when some changes were amended in the competition system overlapped with the season of lowest and highest volumes of home advantage. As a consequence of the changing system (2016-2017), a 4% sudden forward leap was observed in the home team winning and reached 63% home-court winning volume. Especially with the change of status, a sharp increase has been observed in spectators' numbers. Crowded noisy halls and difficult traveling to distinct locations such as Grand Canarias or Novgorod provide an advantage to the home team by adversely on referees, opposing team players in a psychological, physiological, and tactical manner.

The teamwork theory claims that home teams focus preliminary to teammates, however away teams focus on defense that makes them feel more cautiously, less aggressively, even less correctly than the home team. Further, this kind of defensive play specifically impairs teamwork (Tucker *et al.,* 2008). In this context, home teams dominate GRS related to teamwork roughly assists and steal, but away teams do more turnovers and score fewer points.

The secondary but the primary purpose of the study was to investigate the variations of GRS elements` in-home and away-court games. The data revealed that defensive rebound, blocked-shot, turnover, and free-throw made, produced a statistically significant contribution to winning both in-home and in away-court Euroleague games. Apart from these common GRS; steal, and assist are the two discriminant winning contributors for the home; however, blocked-shot against, and two-point made are for the away-court games.

Defensive rebound, which is among the considerable predictors of the winning show, statistically significantly contributes to winning both the home and away. Similar consequences with varying effect for the significant contribution of the defensive rebound were obtained in ACB league teams, (García *et al.,* 2014) NBA close games (Gomez *et al.,* 2016) at the Olympic games (Leicht *et al.,* 2017), Spanish leagues (Sampaio *et al.,* 2010), European championships (Trninic *et al.,* 2002). Away teams have strong perceptions of opponents' home advantage (Bray & Widmeyer, 2000), which may force them to miss more shots. Trninic *et al.,* (2002), explained this situation that winning teams forced losing teams for a higher number of challenged and missed shots and created a higher possibility for defensive rebounds. Indirectly, high-level performances are associated with firstly game rhythm, players' physical characteristics, and technical & tactical preparation.

Blocking the shot is another expected significant contributor to this study, which is a spectacular event as a dunk. The team shows an individual or collective rejection and aggression in the phase of defending the basket. Ibánez *et al.,* (2003, 2008), for the junior world championship games and Spanish professional basketball league, Doğan *et al.,* (2016), for the Turkish Professional league, revealed that a blocked shot is a significant predictor for winning.

Turnover showed a statistically significant contribution to winning the game both at home and away. Similar results with the varying outcome for the significant prediction of the turnover were obtained in different studies (Ibáñez *et al.,* 2009; Lorenzo *et al.,* 2010; Milanovic *et al.,* 2016; Sampaio & Janeira, 2003). In these studies, winning was predicted by fewer turnovers, which indicates both the high-level performance of the individual and the collective game and fitness levels of certain players (Trninic *et al.,* 2006).

Despite being the only closed skill of basketball, the number of free-throw made plays a vital role, especially in

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the last five minutes of close games, that is winning teams scores more than 60% of scores via free throws in that period. These data may help to explain the discriminatory power of successful free-throws in game-winnings. The result of the study corroborated with previous studies in the literature (Gomez *et al.,* 2016; Ib??ez *et al.,* 2009; Mateus *et al.,* 2016). The results showed that free-throw seemed to be the best discriminate variable between winning and losing teams for U-20 to NBA.

The exceptional elements of GRS, which are showed significant differences only for the winning home games are assist and steal. Some studies coincide with a current study via similar outcomes. Thus, Melnick (2001) found a strong correlation between team assists and the win-loss ratio in the NBA. Similarly, indicated that assist is one of the more substantial discriminant factors in close score NBA games (Lorenzo *et al.,* 2010) in a Turkish basketball league, (Doğan *et al.,* 2016) and balanced Spanish league (García *et al.,* 2014). According to Trninic *et al.,* (2006), assist is a factor that produces "easy shots." A higher number of assists produce greater shoot efficiency, making a more significant number of successful throws for two points and three points. Also, assists with stolen balls speed the game up, and the player's creativity came to a higher level of performance.

Steal is another significant contributor to Euroleague. Similar results are supporting the effect of steal on winning carried out by Garc?a *et al.,* (2014), Ib??ez *et al.,* (2008), and Milanovic *et al.,* (2016). Steals are one of the vital momentum changers of the game, which often collapse cooperation between two or more players in unsuccessful teams because of more significant pressure and aggression of the players playing defense in successful teams and results with fast-breaks and secure points. (Trninic *et al.,* 2006). A high number of steals can break up the opponent's defense and influence the result of the game.

Two-points made (field-goal percentage) and blocked-shot against are among the significant contributor for the away-winning. The study examined Olympic Games exhibited that combination of 'field-goal percentage' (two points made) and 'defensive rebounds' that provided the highest probability of winning (93.2%) (Leicht *et al.,* 2017). In another study, Trninic *et al.,* (2002), investigating the effect of GRS on European championships games, reported that the highest discriminative power was displayed in defensive rebounds, goal and free throw percentage.

Blocked-shot against is the most significant negative predictor of winning (see table 5). In detail, how a blocked shot excites and inflames the defense may depress the player on the offense, and players are going to hesitate to use the ball for the menace of the block. Ib??ez *et al.,* (2003, 2008), and Doğan *et al.,* (2016), reported that blocked shoot is the discriminant winning contributor for the various leagues.

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