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The History of Basketball Factors that Influence Perfomance Better. An Analysis Through 40 NBA Seasons.

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ABSTRACT

The National Basketball Association (NBA) is considered the most competitive basketball league in the world. Numerous articles have analyzed the game through different perspectives to understand better the processes that lead being more competitive and successful. Our goal is to determine the game-related factors that influence professional NBA basketball teams' achievement of positive results, improving understanding of the game's complexity through the years.

We analyze the data for a total of 40 seasons, from 1979-1980 to 2018-2019, regular season and playoffs, into three groups through cluster analysis. These results are used later in discriminant analysis, distinguishing teams that reach at least the conference finals in playoffs to identify the performance profiles of the best teams.

The work helps us understand the evolution of the game through the indicators that have defined the successful performance of NBA teams during their history.

Keywords: Team performance; Cluster analysis; Discriminant analysis; Professional basketball; NBA.

JEL Classification: Z20; L83; L25; M12

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La Historia del Baloncesto Factores que Influyen en el Rendimiento Mejor. Un Análisis a través de 40 Temporadas de la NBA.

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RESUMEN

La National Basketball Association (NBA) está considerada la liga de baloncesto más competitiva del mundo. Numerosos artículos han analizado el juego a través de diferentes perspectivas para comprender mejor los procesos que llevan a ser más competitivos y exitosos. Nuestro objetivo es determinar los factores relacionados con el juego que influyen en la obtención de resultados positivos por parte de los equipos profesionales de baloncesto de la NBA, mejorando la comprensión de la complejidad del juego a lo largo de los años.

Analizamos los datos de un total de 40 temporadas, desde 1979-1980 hasta 2018-2019, temporada regular y playoffs, en tres grupos a través del análisis de conglomerados. Estos resultados se utilizan posteriormente en el análisis discriminante, distinguiendo los equipos que llegan al menos a las finales de conferencia en los playoffs para identificar los perfiles de rendimiento de los mejores equipos.

El trabajo nos ayuda a entender la evolución del juego a través de los indicadores que han definido el rendimiento exitoso de los equipos de la NBA durante su historia.

Palabras clave: Rendimiento de los equipos; Análisis de conglomerados; Análisis discriminante; Baloncesto profesional; NBA.

Clasificación JEL: Z20; L83; L25; M12

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1. Introduction

The National Basketball Association (NBA) is considered the most competitive basketball league in the world. Divided in two conferences, thirty teams mut play a stressful regular season, over 82 games under normal circumstances trying to rank among the best 8 teams in each conference to win the championship through a playoff system. So, NBA provides many games to analyze what teams do to achieve optimal performance throughout the season.

Professionals and researchers analyze the game and the evolution of the teams during a season through the statistical analysis of different game variables. These methods have evolved, from papers templates to sophisticated computer systems and tools, to record different teams and individual actions obtaining valuable information for decision-making at a particular moment in the game or throughout a season (Gomez et al., 2009, 2010; Oliver, 2004). The literature seeks to describe which statistics are effective in explaining teams' performance. Oddly enough, this field has developed so extensively in recent years that we find studies in which nearly all statistics are influential to teams' outcomes, with different levels of methodology and data analysis (Çene, 2018; Kubatko et al., 2007). One of most popular is Oliver (2004), that defines the four factors that influence basketball teams' results: efficiency in shooting, turnovers, offensive rebounds, and free throws made.

Other interesting elements that research try to relate with performance include where the game is played, or the importance of the game or the moment of the season (regular season or playoffs). This last question is very interesting for us, because we try to analyze and find differences in performance during regular season and playoffs. There are significant differences in competitive and psychological stress for players and coaches, and an increasing competitive of each new game that requires extra effort to win (Çene, 2018; García et al., 2013; Mateus et al., 2018). The teams use different game patterns at different moments so it may explain why certain factors of the game become more important at sometimes than at others (Sampaio and Janeira, 2003).

The methodological level of study also reveals different angles and tools of analysis, among them cluster, discriminant, and regression analysis (Çene, 2018; García et al., 2014; Gómez-Haro and Salmerón-Gómez, 2015, 2016; Lorenzo et al., 2010; Mateus et al., 2020; Mikolajec et al., 2013; Özmen, 2016; Pérez-Sánchez et al., 2019; Sampaio et al., 2010; Terramoto and Cross, 2010). Using a limited series of games or seasons in the analysis also restricts both the methodology and the conclusions that each study obtains. This study analyzes data from NBA teams for 40 seasons, from 1979-1980 to 2018-2019, in order to use the largest possible amount of data to strengthen the analysis and make it more reliable.

This study is structured as follows: Section 2 describes the set of data used and the methodologies applied. Section 3 presents the results from the discriminant analysis of regular season and playoffs in 40 years of NBA. In Section 4, we discuss the results. Finally, Section 5 establishes the most relevant conclusions derived from the analysis.

2. Data and Methodology

2.1. Sample

We analyze NBA teams that participated from 1979/80 to the 2018/19 seasons (a total of 40 seasons), distinguishing between games played in regular season and playoffs. To analyze different eras of the competition, we grouped the data in five-year periods of seasons: 1979/80 to 1983/84 (114 teams), 1984/85 to 1988/89 (117 teams), 1989/90 to 1993/94 (143 teams), 1994/95 to 1998/99 (145 teams), 1999/00 to 2003/04 (150 teams), 2004/05 to 2008/09 (150 teams), 2009/10 to 2013/14 (150 teams), and 2014/15 to 2018/19 (150 teams). This grouping shows the two important key aspects of our work. What are the factors that determine the good results of teams, and how these factors have evolved or changed over time? The game, the teams and their characteristics have changed over 40 years, so we understand that the factors that explain who has better results too. So, we can know through different game indicators how the game has evolved in these 40 years

Table 1 displays the information collected for each team and its opponent and table 2 describes the variables generated from the data. The first group of variables (Table 1) are season performance statistics, available in multiple websites. In this case the data were obtained from the database Basketball-Reference, which offers detailed statistics on all NBA teams and players from the 1946-1947 season to the present (de la Torre-Ruiz and Aragón-Correa, 2012; Kubatko, 2009). We obtained the data from team and its opponents (Team and Opponent Stats) for 40 NBA seasons. The rest of variables used (Table 2) were created by the authors and are presented (primarily) as original variables in this study.

Table 1. Basic NBA basketball season performance statistics

Variable	Description	Variable	Description
Age	Average player age	FTA	Free throw attempts
Wt	Average player weight	FT%	Free throw percentage (FT/FTA)
FG	Field goals (3P+2P)	ORB	Ofensive rebounds
FGA	Field goal attempts (3PA+2PA)	DRB	Defensive rebounds
FG%	Field goal percentage (FG/FGA)	TRB	Total rebounds (ORB+DRB)
3P	3-Point field goals	AST	Assists
3PA	3-Point field goals attempts	STL	Steals
3P%	3-Point field percentage (3P/3PA)	BLK	Blocks
2P	2-Point field goals	TOV	Turnovers
2PA	2-Point field goals attempts	PF	Personal fouls
2P%	2-Point field percentage (2P/2PA)	PTS	Points
FT	Free throws		

Table 2. Variables generated from basic statistics in Table 1 (the extension R refers to rival values)

Variable	Description	Formula
ORB%	Ofensive Rebound Percentage	100*ORB/(ORB+DRB.R)
DRB%	Defensive Rebound Percentage	100*DRB/(DRB+ORB.R)
TRB%	Total Rebound Percentage	100*TRB/(TRB+TRB.R)
Attacks	Number of attacks	FGA+0.4*FTA-ORB+TOV
Poss	Number of possessions	Attacks+ORB
PossA	Number of possessions per attack	Poss/Attacks
OER.A	Number of points per attacks	PTS/Attacks
OER.P	Number of points per possession	PTS/Poss
diffOER	Different between OER.A and OER.P	OER.A-OER.P
DER.A	Number of points received per attack	PTS.R/Attacks.R
DER.P	Number of points received per possession	PTS.R/Poss.R
diffDER	Different between DER.A and DER.P	DER.A-DER.P
OERP.A	Number of points in attacks where a field goal or a free throw has been taken	PTS/(Attacks-TOV)
OERP.P	Number of points in possessions where a field goal or a free throw has been taken	PTS/(Poss-TOV)
diffOERPA	Different between OERP.A and OER.A	OERP.A - OER.A
diffOERPP	Different between OERP.P and OER.P	OERP.P - OER.P
TOV%.A	Percentage of attacks where there is a turnover	100*TOV/Attacks
TOV%.P	Percentage of possessions where there is a turnover	100*TOV/Poss
AST%.A	Percentage of attacks where there is a assist	100*AST/Attacks
AST%.P	Percentage of possessions where there is a assist	100*AST/Poss
3PA.FGA%	Percentage of field goals that are 3-point field goal	100*3PA/FGA
3P.PTS%	Percentage of points from 3-point field goal	100*3*3P/PTS

FTAxPF.R	Number of free throw attempts per personal foul received	FTA/PFR
FTAxFGA	Number of free throw attempts per field goal attempt	FTA/FGA
ASTxTOV	Number of assists per turnover	AST/TOV
TOVnF	Number of turnovers not forced	TOV-STL.R
TOVnF%	Percentage of turnovers not forced	100*TOVnF/TOV
eFG%	Effective field goal percentage	100*(FG+0.5*3P)/FGA
ePTS%	Effectiveness points scored	100*PTS/(2*2PA+FTA+3*3PA)
TS%	True shooting percentage	100*PTS/2*(FGA+0.44*FTA)

2.2. Team clusters according to performance

In regular season, we distinguished winning from losing teams through a k-means analysis of number of victories achieved. Although we initially distinguished three groups/conglomerates, only two, the extreme cases, are considered in the discriminant analysis that follows. Table 3 shows the center (number of victories) and number of members in each group created for each five-year period. If we examine the center, the first group is composed by teams with the highest number of victories (winning teams) and the second by teams with the lowest number of victories (losing teams).

Table 3. Cluster center and number of cases (in brackets) in the case of the regular season per five years.

5 seasons period	Cluster 1	Cluster 2
1979/80 - 1983/84	57 (24)	21 (14)
1984/85 - 1988/89	59 (20)	21 (15)
1989/90 - 1993/94	57 (32)	21 (24)
1994/95 - 1998/99	62 (15)	19 (33)
1999/00 - 2003/04	58 (21)	23 (27)
2004/05 - 2008/09	59 (27)	21 (23)
2009/10 - 2013/14	57 (31)	17 (12)
2014/15 - 2018/19	62 (13)	20 (20)

In playoffs, we distinguish winning teams those that play conference finals (4 teams) and losing teams those that do not play.

2.3. Discriminant analysis

In a second phase, we perform a discriminant analysis to identify the characteristics that distinguish winning from losing teams, both regular season and playoffs, for the five-year period groups analyzed. The influencing variables in each period cluster analysis form our dependent variable, as in previous empirical analyses (Ibáñez et al., 2008; Salmerón-Gómez and Gómez-Haro, 2016; Sampaio et al., 2006).

Our work obtains a single discriminant function that distinguishes between the two groups identified. In all cases, for each five-year period considered, in regular season and playoffs, the self-values of the discriminant function explain 100% of the variance in the data. Also, the Wilks lambda p-values are less than 10^{-3} in all cases and thus less than 0.05 (unless otherwise indicated, we use 5% significance as the default), confirming that this function has discriminating power.

Finally, all variables shown previously in Tables 1 and 2 are used as independent variables.

3. Results

3.1. Discriminant analysis in regular season

We carry out the discriminant analysis, both in regular season and in playoffs. Table 4 shows the location of the centroids in the discriminant function for regular season analysis. This information is key to understanding the information in Table 5, which displays the standardized coefficients of the

canonical discriminant functions. A coefficient with a negative/positive sign must thus be interpreted in terms of a centroid with a negative/positive sign.

Table 4. Value of the centroids in the discriminant function in the case of the regular season.

5 seasons period	Cluster 1	Cluster 2
1979/80 to 1983/84	-5.456	9.353
1984/85 to 1988/89	4.71	-6.28
1989/90 to 1993/94	3.124	-4.165
1994/95 to 1998/99	-5.594	2.543
1999/00 to 2003/04	-4.43	3.446
2004/05 to 2008/09	5.853	-6.871
2009/10 to 2013/14	-3.212	8.297
2014/15 to 2018/19	-5.751	3.738

Table 5. Standardized coefficients of discriminant functions in the case of the regular season (the extension.R refers to opponent values).

5 seasons period	Variable	Function 1	5 seasons period	Variable	Function 1
1979/80	Age	-1.227	1999/00	OER.A	-1.552
1983/84	OER.A	-1.152	2003/04	DER.A	2.411
	DER.A	3.163		BLK.R	0.458
	FTAxFGA	-0.655		ePTS%.R	-1.083
	TOVnoF	1.001	2004/05	Age	0.576
	FG.R	-1.642	2009/10	FTA	-0.589
	DRB.R	0.985		STL	0.781
1984/85	Age	0.761		OER.A	1.888
1988/89	ORB	0.982		2P%.R	-1.078
	OER.A	1.32		OERP.A.R	-0.649
	DER.A	-1.758		FTAxPF.R.R	-0.365
	ASTxTOV	0.503	2009/10	FG	-0.959
	AST%.A.R	0.58	2013/14	OER.A	-0.851
1989/90	DRB%	0.317		DER.A	2.148
1993/94	DER.A	-0.881		TOV%.A	0.756
	OERP.A	1.05		FG%.R	-0.897
	TOV%.P	-0.484		FT%.R	0.387
1994/95	2PA	0.413		AST.R	0.709
1998/99	OER.A	-1.018		PF.R	-1.071
	DER.P	1.122	2014/15	FG	0.674
	FTAxPF.R	-0.556	2018/19	OERP.A	-1.801
	3P%.R	0.834		STL.R	0.909
	ORB.R	0.839		OERP.P.R	1.223

Considering the first conglomerate in Table 4 identifies winning teams and the second conglomerate loser teams, we obtain the following results:

- Seasons 1979/80 to 1983/84: The variables Average player age (Age), points scored per attack (OER.A), free throws per field goal attempt (FTAxFGA), and field goals scored by the opponent (FG.R) (negative coefficients) are identified as the winning teams (negative centroid). In contrast, number of points received per attack (DER.A), unforced turnovers (TOVnF), and defensive rebounds (DRB.R) by opponent (positive coefficient) are variables identified as the losing teams (positive centroid).
- Season 1984/85 to 1988/89: Average age (Age), offensive rebounds (ORB), points scored per attack (OER.A), assists per turnover (ASTxTOV) percentage of attacks in which the opponent made an assist (AST%.A.R) (positive coefficients) are variables identified as the winning teams (positive

centroid). Variable points received per attack (DER.A) (negative coefficient) is identified as the losers (negative centroid).

- Season 1989/90 to 1993/94: The variables defensive rebound percentage (DRB%) and number of points in attacks where a field goal or a free throw has been taken (OERP.A) (positive coefficients) are identified with winning teams (positive centroid), while points received per attack (DER.A) and percentage of possessions with turnovers (TOV%.P) (negative coefficients) are variables identified with the losers (negative centroid).
- Season 1994/95 to 1998/99: Points scored per attack (OER.A) and free throws attempted (FTA) (negative coefficients) are variables identified in winning teams (negative centroid), while 2-point field goals attempted (2PA), points received per possession (DER.P), 3-point field goal percentage by the opponent (3P%.R), and offensive rebounds (ORB.R) by the opponent (positive coefficients) are related with the losers (positive centroid).
- Season 1999/00 to 2003/04: Points scored per attack (OER.A) and effectiveness points scored (ePTS%.R) by the opponent (negative coefficients) are variables identified in winning teams (negative centroid), while points received per attack (DER.A) and blocks (BLK) (positive coefficients) are identified in losing teams (positive centroid).
- Season 2004/05 to 2008/09: Average age (Age), steals (STL), and points scored per attack (OER.A) (positive coefficients) are the variables identified in winning teams (positive centroid) while free throws attempted (FTA), percentage of 2-point shots (2P%.R) by the opponent, points scored by the opponent in attacks where a field goal or a free throw has been taken (OERP.A.R), and free throw attempts per personal foul received (FTAxPF.R) from the opponent (negative coefficients) are the variables identified with losing teams (negative centroid).
- Season 2009/10 to 2013/14: Field goals scored (FG), points scored per attack (OER.A), percentage of field shots (FG%.R) by the opponent, and number of personnel committed (PF.R) by the opponent (negative coefficients) are the variables related with the winning teams (negative centroid). In contrast, variables like points received per attack (DER.A), percentage of turnovers per attack (TOV%.A), percentage of free throws by the opponent (FT%.R), and assists (AST.R) by the opponent (positive coefficients) are related to the losing teams (positive centroid).
- Season 2014/15 to 2018/19: The analysis relates teams with points in attacks in which a basket shot was made (OERP.A) (negative coefficient) as winning teams (negative centroid). Field goals scored (FG), Steals by the opponent (STL.R) and points received in possessions where the opponent has thrown a field goal or a free throw (OERP.P.R) (positive coefficients) are variables related to losing teams (positive centroid).

3.2. Discriminant analysis in playoffs

In the discriminant analysis for playoffs, Table 6 shows the location of the centroids in the discriminant function. As in the previous point, this information is key to interpreting the information in Table 7, which presents the standardized coefficients of this function.

Table 6. Value of the centroids in the discriminant function in the case of the playoffs per five seasons period.

5 seasons period	Cluster 1	Cluster 2
1979/80 – 1983/84	1.159	-0.552
1984/85 – 1988/89	1.34	-0.447
1989/90 – 1993/94	1.244	-0.415
1994/95 – 1998/99	1.109	-0.37
1999/00 – 2003/04	-1.235	0.412
2004/05 – 2008/09	1.256	-0.419
2009/10 – 2013/14	-1.816	0.605
2014/15 – 2018/19	1.348	-0.449

Table 7. Standardized coefficients of the discriminant function in the case of the playoffs per five seasons period (the extension .R refers to rival values)

5 seasons period	Variable	Function 1	5 seasons period	Variable	Function 1
1979/80	AST	0.637	2004/05	DER.A	-0.871
1983/84	DER.A	-0.662	2008/09	ASTxTOV	0.491
	OERP.A	0.498		ePTS%	0.657
1984/85	STL	0.629	2009/10	STL	-0.417
1988/89	PF	-0.41	2013/14	PF	0.461
	OER.A	1.053		OER.A	-0.811
1989/90	3P%	0.521		DER.A	0.372
1993/94	diffOER	0.926		DRB.R	0.566
	OERP.A	0.658	2014/15	3P	0.899
	TOV%.A.R	0.48	2018/19	2P%	0.419
1994/95	OER.A	0.857		ORB%	0.533
1998/99	DER.P	-0.668		TOV%.A	-0.496
1999/00	OER.A	-0.852		PTS.R	-0.67
2003/04	DER.A	0.799			
	TOVnF	0.495			

As the first conglomerate identified teams that play at conference finals (winning teams) and the second conglomerate teams that do not (losing teams), the results are:

- Season 1979/80 to 1983/84: The results identify assists (AST) and points scored per possession by shots made (OERP.P) (positive coefficients) as variables related with teams playing in conference finals, winning teams (positive centroid). Teams that receive a high number of points per attack (DER.A) (negative coefficient) do not play in conference finals (negative centroid).
- Seasons 1984/85 to 1988/89: High steals (STL) and points scored per possession (OER.P) (positive coefficients) are variables identified with conference finals teams (positive centroid), whereas fouls made (PF) (negative coefficient) is identified with non-conference finals teams (negative centroid).
- Seasons 1989/90 to 1993/94: The analysis show that 3-point percentage (3P%), difference between points scored per attack and possession (diffOER), points scored per possession with shots made (OERP.P), and percentage of turnovers in attacks (TOV%.A) (positive coefficients) play in conference finals (positive centroid).
- Seasons 1994/95 to 1998/99. Teams that score points per possession (OER.P) (positive coefficient) emerge as the teams that play conference finals (positive centroid), whereas teams that receive a high number of points per possession (DER.P) (negative coefficient) do not reach the conference finals (negative centroid).
- Seasons 1999/00 to 2003/04: The results identify points scored per possession (OER.P) (negative coefficient) as teams that play conference finals (negative centroid), while points per attack (DER.A) and turnovers (TOV) (positive coefficients) are related with teams do not play conference finals.
- Seasons 2004/05 to 2008/09: Teams with good assists/turnover ratio (ASTxTOV) and effectiveness points scored (ePTS%) (positive coefficients) are teams that play conference finals (positive centroid). Points per possession received (DER.P) (negative coefficient) is the key variable for teams do not reach conference finals.
- Seasons 2009/10 to 2013/14: Steals (STL) and points scored per possession (OER.P) (negative coefficients) are key elements for teams that play conference finals (negative centroid), while points per possession (DER.P), personal fouls committed (PF), and opponent defensive rebounds (DRB.R) (positive coefficients) are variables associated with teams that do not (positive centroid).

- Seasons 2014/15 to 2018/19: In the last 5 year period, 3-point shots scored (3P), 2-point field goal percentage (2P%), and offensive rebound percentage (ORB%) (positive coefficients) are the key variables to teams that play conference finals (positive centroid), while attacks with turnovers (TOV%.A) and points received (PTS.R) (negative coefficients) indicate teams that do not (negative centroid).

4. Discussion

The analysis of five years period helps us to understand the processes of adjustment and evolution of the game. The winning teams impose a model of success that the rest of the teams try to replicate to repeat those patterns of success, demanding new adjustments to achieve high performances that differentiate us competitively from others. We believe that the five-season group work responds well to this question and helps us to understand better these processes of evolution and change, or not, of the indicators.

The analysis of both the regular season and the playoffs shows us very interesting results that we try to discuss in this section. First, the common aspects for winning teams in regular season. We are talking about how the factors evolve over time, but it is also interesting to know which factors remain unchanged. Age is one of them, and it makes sense: the older the age, the greater the number of years played in the NBA, the more important games played, and the more mastery of the game, after all, it is common to see that teams with certain maturity and experience are those that tend to have the highest level of success. Ages is influential in 1979/80-1983/84, 1984/85-1988/89 and 2004/05-2008/09 groups.

In this general view of common aspects, we see that most of the indicators that explain the success of winning teams are related with offensive aspects of the game with little differences: Points per attack-OER.A (1979/80-1983/84, 1984/85-1988/89, 1994/95-1998/99, 1999/00-2003/04, 2004/05-2008/09 and 2009/10-2013-14) and Points with attacks without turnovers-OERP.A (1990/91-1993/94 and 2014/15-2018/19). And then we find the little aspects of the game that differences winning teams in different 5 years group:

- Free thrown per field goals attempt-FTAxFGA (1979/80-1983-84).
- Assist per turnover ratio-ASTxTOV (1984/85-1988/89).
- Defensive rebounding percentage-DRB% (1990/91-1993-94).
- Free thrown attempt-FTA (1994/95-1998/99).
- Steals (2004/05-2008/09).
- Field goals scored-FG and personal foul made by opponent-PF.R (2009/10-2013-14).

All these variables support our idea that winning factors in regular season is about offensive factors, except steals in 2004/05-2008/09 period. Points scored per attack is the main winning factor in regular season with the support of other offensive variables. Some results of the analysis are interesting since even offensive statistics of the rivals appear as influential of winning teams, including Field goal-FG.R (1979/80-1983/84), Percentage of attacks with assists-AST%.R (1984/85-1988/89), effectiveness in points scored by opponent-ePTS%.R (1999/00-2003/04) and field goals percentage FG%.R (2009/10-2013/14). These questions suggest that winning teams base their victories on their scoring ability during regular season and that defensive capabilities are not as important in a context of matches every two days, with very long trips between cities and little rest. That is, even the rival's offensive benefits cannot outstrip those of the winning teams.

Losing teams have common aspects too. The main variable affects losing teams is Number of points received, per attack-DER.A (1979/80-1983/84, 1984/85-1988/89, 1990/91-1993/94, 1999/00-2003/04 and 2009/10-2013/14), per possession-DER.P (1994/95/95-1998/99) or through the points made by the opponent in attacks or possessions-OERP.A.R or OERP.P.R (2004/05-2008/09 and 2014/15-2018/19, respectively). This means that teams that if we point it out before the winning teams are the

ones that score the most, the losing teams are the teams that receive the points from these most successful teams.

In addition to this relationship, there are a few specific factors for each group that show specific differentiating details of the game, showing a weak offensive system in losing teams of each five-year group:

- Turnovers-TOV and Defensive Rebounds by the opponent-DRB.R (1979/8-1983/84).
- % Possessions with turnovers- TOV%.P (1990/91-1993/94) and %Attacks with turnovers-TOV%.A (2009/10-2013/14).
- 3-Point percentage-3P%.R and offensive rebounds-ORB.R by opponent (1994/95-1998/99).
- 2-Point percentage by opponent-2P%.R (2004/05-2008/09).
- Free throw percentage-FT%.R and Assist-Ast.R by opponent (2009/10-2013/14).
- Steals by opponent-Stl.R (2014/15-2018/19).

These statistics reinforce again the previous idea that teams win based on their offensive potential over losers in regular season and defensive capabilities.

Analyzing performance in playoffs, teams that play conference finals and teams that do not, we observe that winning teams in playoffs (that play conference finals) are again characterized by a higher number of points scored per possession (OER.P, OERP.P, diffOER) in different periods and losing teams by points received per possession (DER.A, DER.P). Also, teams in playoffs mut keep improving offense, adding more offensive variables to support winning teams in playoffs like:

- Assists-AST (1979/80-1983-84).
- 3-Point percentage-3P%) (1989/90-1993/94).
- Effectiveness points scored-ePTS% and Assist/turnover ratio-ASTxTOV (2004/05-2008/09).

But this time, to win championships it´s necessary a good defense too. In playoffs, results include characteristics related to a good defense for winning teams such as:

- Steals-STL (1984/85-1988/89 and 2009/10-2013/14).
- Turnovers/opponent possession ratio-TOV%.A.R (1989/90-1993/94).

This is very interesting. Teams that are good in playoffs require to performance good in offense again, but they need to add defensive elements to the game to be a winning team. This is related to greater equality in playoffs, since the teams reaching the playoffs have already shown a good level of offense and seek new play schemes in the playoffs to obtain advantages in a context of greater competitive equality.

Of the four factors Oliver (2004) identifies as key to winning basketball games, only turnovers appear in our study, such in absolute terms (total turnovers), in relative terms (turnover/number of game possessions or assist/turnover ratios), or as a characteristic of the opponent (steals).

Taking a view of recent last five years period (2014/15-2018/19) we find new elements of the analysis arise. In a period dominated by the Golden State Warriors (GSW) and the Cleveland Cavaliers (CC), winning teams in the regular season scored more points per possession in which a shot was made (field goal or free throw), that is, deducting possessions with turnovers from total possessions. This characteristic recurs in the 1990-94 period dominated by the Chicago Bulls, showing the high effectiveness of their attacks.

In the case of the playoffs, new factors arise, such as greater number of 3-point shots scored, better percentage of 2-point shots scored (more efficiency), and higher percentage of offensive rebounds. This last issue seems intrinsically related to the first two if we consider that a higher number of 3-point shots scored implies a higher number of attempts, and these long-range failed shots usually favor capture of the offensive rebound. As to offense, we find that all winning teams have a good level of offense in the regular season and that the margin of improvement in the final phase is related to the team's

ability to improve performance on its shots (higher score of 3-point shots and efficiency in 2-point shots) and the possibility of new possessions for attack via offensive rebound.

5. Conclusions

Over the years, the literature on sport management has developed a lot of interest on the analysis of team performance in different sports and perspectives (Çene, 2018; Gómez and Pollard, 2011; Zhang et al., 2019). This study on NBA teams has pursued a main objective, to analyze the evolution of significant statistics characteristic of successful teams. In regular season, success is associated with teams with the highest percentage of games won and in the playoffs with teams who played at least in conference finals.

The results for the regular season show that teams' success is based on their offensive potential, while the losers tend to have a poor offensive system. In the case of playoffs, successful teams are also characterized by turnovers by the opponent, indicating the need of defensive factors to their playing schemes that differentiate them from other playoff teams. All the winning teams have shown a great offensive level, so it is necessary to add defensive issues such as steals or have good assist-turnovers ratios to improve performance in the playoffs. These results are in line with Terramoto and Cross (2010), a study based on data for the 2004/05 to 2006/07 seasons. These authors establish that defense is more important in winning games in the NBA playoffs than during the NBA regular season. Similarly, based on 14 Euroleague seasons, Özmen (2016) establishes turnovers as the most important element, with their importance increasing as the season progresses.

Future analyzes should deepen the analysis of some variables that have shown counterintuitive results to better understand their behavior and meaning. Using fewer variables or grouping those similar variables can help us understand the behavior that some variables have had in the analysis. It would be interesting for future lines of research to work directly with the information on each game instead of the average season values for each team. Such analysis would enable establishment of factors influential in obtaining victory in a single match and thus further refine the results obtained in this study.

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