

Original Article

Analysis of Different Personnel Factors to Develop A Predictive Index to Make Optimal Decisions by Basketball Teams

Tanush Soni

Student, American Embassy School, A5-901 World Spa, Sector 30, Gurgaon, 122001, India

Received Date: 15 September 2021

Revised Date: 17 October 2021

Accepted Date: 27 October 2021

Abstract - The goal of teams in the National Basketball Association (NBA) is to win as much as possible. Several studies have been conducted to analyze the factors that go into making a sports team successful. Studies have mainly looked at a team's playbook strategy—the coach's strategy. The next step is to analyze personnel decisions—the strategy of the general manager. Through a mixed-method research approach, the research study analyzes data with respect to 10 different 'personnel' factors to develop a predictive index that could help basketball teams make optimal personnel decisions, particularly with regards to the coaching staff and player composition. Under the quantitative approach, a multiple regression analysis was used to identify the factors that exerted an impact on the performance of the NBA team in the 2019-2020 season and measure the extent of their impact on the performance of the team. After analyzing the factors, the strongest indicators of a team's success seem to relate to the star players on the team. A basketball team looking to reach the top, according to this model, would benefit from acquiring the best players available and playing them frequently in order to win, even at the cost of overall team composition.

Keywords - NBA, Basketball, Factors contributing to success, winning formula, predictive index.

I. INTRODUCTION

The National Basketball Association (NBA), which was established in 1949 and had been growing in prominence ever since, is one of the most recognizable basketball leagues in the world (Silva, 2021). A traditionally accepted view in sports economics is that sports leagues generally (Dietl, 2010) and the U.S. American sports leagues, in particular, are characterized by profit maximization (Prinz, 2019). However, Dietl suggests that evidence from the real world of major sports leagues corroborates that clubs tradeoff profits and wins. Whether primary or not, in any professional sports league, teams must focus on winning, and several studies have been conducted to analyze the factors that go into making a sports team successful. With respect to the NBA,

success factors have been studied for three main eras - the Classic Era (1980–1994), the Transitional Era (1995–2013), and the Modern Era (since 2013), the eras being defined based on the evolution of the three-point shot in a basketball game (Silva, 2021). Analysis has been based on 'game' factors such as field goal percentage, offensive rebounds, turnovers, and free throws (Oliver, 2011; Kubatko et al., 2007).

Further, studies have been conducted to see if stacking up on star power is the winning formula that can lead a team to success (Hatcher, 2015). Data from thirty NBA teams for the period 2009-2014 were studied, and the hypothesis that the more superstars a team has, the greater the number of wins was supported (Hatcher, 2015). With reference to a superstar equating to an Allstar, i.e., a player who is selected to play in the league's Allstar game featuring the best players from all 30 teams, current year Allstar status has the greatest association with the likelihood of winning an NBA championship (Bell).

The recent success of the 2016 Golden State Warriors (GSW) of the NBA substantiates this hypothesis. With Kevin Durant joining the GSW prior to the commencement of the 2016–2017 season, it became a potential super team with a combination of four-star players (Stephen Curry, Klay Thompson, Draymond Green, and Kevin Durant), two of whom (Stephen Curry, Kevin Durant) had previously been chosen as the Most Valuable Player (MVP) of the league. Season records show that the Golden State Warriors dominated the league and went on to win the championship not only in 2017 but in 2018, also with the same quartet. In the following year, 2019, when Kevin Durant departed GSW to join the Brooklyn Nets, and when the team lost Stephen Curry and Klay Thompson to serious injuries for an entire 2019-2020 season, the team dropped to the worst ranking in the NBA, ranking 30th out of all 30 teams.

However, other studies (Al-Amine, 2020) suggest that star power is not the only ingredient in a team's success. The 2018–2019 Denver Nuggets are a useful case-in-point. This



team, with no superstars, bested several other teams with multiple stars, such as the Portland Trailblazers with Damian Lillard and CJ McCollum, the Philadelphia 76ers with Joel Embiid, Ben Simmons, and Jimmy Butler, and the Houston Rockets with James Harden and Chris Paul, to become the second seed in the Western Conference after the conclusion of the 82-game regular season. What worked for them can be assessed in terms of 'game' factors like three-point shots attempted and converted, field goal percentage, rebounds, turnovers, free throws, assists, steals, blocks, etc. (Silva, 2021).

It would also be worthwhile to look at 'environment' factors like a philosophy of continuity, characterized by having the same coach and the same roster of players; player loyalty; coach-related factors - the number of years of experience the team's head coach had and the number of years that coach had spent with that team; the average salary for players on the team; the average experience of all players on the team; the average number of years a player has been on the team (Team Loyalty); and finally, the distribution of salary among players on the team (Gini Coefficient). An analysis of the Chicago Bulls with their three consecutive championship wins in 1996, 1997, and 1998 could reveal that their success can be attributed to excelling in 'game' factors as well as the 'environment' factors. In this modern era of the NBA, it would be challenging to be able to come up with the perfect combination that the Chicago Bulls achieved during its golden era. A possible alternative is to determine which of the game and environment factors make the greatest difference for successful teams and what teams can strive towards in order to achieve the right combination during the team formation process to improve its chance of success. An insight into the right combination of the environment factor(s) could thus be useful for team management of the NBA.

II. METHODOLOGY

The aim of the research study was to analyze data with respect to 10 different 'personnel' factors to develop a predictive index that could help make optimal personnel decisions by basketball teams, particularly with regards to coaching staff and player composition through a mixed-method research approach. Under the quantitative approach, a multiple regression analysis was used to identify the factors that exerted an impact on the performance of the NBA team in the 2019-2020 season and measure the extent of their impact on the performance of the NBA team in 2019-2020 season. These factors are as follows:

A. Average Salary (AVG SAL): To make money, you have to spend money. This factor aims to analyze whether spending more money on player acquisition correlates to winning in the NBA.

B. Average Experience (AVG EXP): This factor takes the average duration the players on a team's roster have been NBA players. This factor aims to analyze whether having a more experienced team correlates with winning in the NBA.

C. Player Loyalty: Players are not machines, so creating and recreating a roster on a yearly basis may not allow for team chemistry to build. This factor takes the average duration each player on a team's roster has been tenured with that very team. This factor measures how long each player on the roster has been with his current team, and subsequently, the average duration that the players on a given team's roster have been part of that franchise. This factor aims to analyze whether a team in which the players have been together and in the same "system" for a while correlates to winning in the NBA.

D. Gini Coefficient: The Gini Coefficient is a measure of income disparity and is used to measure the disparity in salary that players on a team receive. The Coefficient lies between 0 and 1, where 0 signifies complete imbalance in salaries, and 1 signifies equal salaries for each player. This factor aims to analyze whether teams should invest in a few expensive star players and surround them with inexpensive and lower-skilled players, or if they should look for a team of generally high-skilled players of equal salary, i.e., whether the team management has opted to create a well-rounded team, or whether it has sacrificed the depth of the team roster to obtain one or more high-paid star players.

E. Coach Loyalty: This factor aims to analyze whether a coach's tenure with the team is a factor contributing to success in the NBA. Specifically, whether a long-tenured coach is more likely to contribute to winning compared to a coach in his first year with the team.

F. Coach Experience: This factor aims to analyze whether the experience of the coach, as a factor of the number of years they have been coaching for, influences a team's winning status in the NBA.

Factors 6 and 7 reflect the importance of quality coaching to the success of the team. The NBA is replete with a history of successful coaches who have been instrumental in leading diverse teams to success. They have included the legendary Red Auerbach (Boston Celtics), Phil Jackson (Chicago Bulls and LA Lakers), Greg Popovich (San Antonio Spurs), Pat Riley (LA Lakers), and more recently, Steve Kerr (GSW). With the coach factors, we took into account how long they have been coaching and the years with the team.

G. Allstars: Sometimes, the best players are not linearly identified by the highest salary. However, each year, experts select the top players from the 30 teams as NBA All-Stars. This factor aims to analyze whether the number of recent Allstars correlates with winning in the NBA. Based on the examples of teams like the Golden State Warriors and the Chicago Bulls, it would seem natural to take this factor into consideration. Apart from evaluating the validity of this factor based on past anecdotal accounts, the multiple regression analysis would evaluate the extent of the impact. How much does it matter?

H. Average PER of top 3 players (AVG top 3 PER): The PER, Player Efficiency Rating, is a measure for how “good” a player is on the court. This takes into account factors such as points scored, assists, rebounds, fouls committed, etc. This factor takes the average of the top 3 PER’s on the team and aims to analyze how that correlates to winning in the NBA.

I. Average minutes of top three players with highest PER (AVG min of top 3 PER): It is entirely possible that due to the rolling substitutions in the NBA, that the statistically most efficient player on the team doesn’t even play half of the game. Hence this factor finds the average duration played by the statistically most efficient players and aims to see if that correlates with winning in the NBA.

J. Average PER of the three players who play the most minutes (AVG PER of top 3 min): Instead of looking at the duration played by the three most efficient players, this factor looks at the PER of the three players who play for the highest duration. This factor aims to analyze whether the quality of a team’s top 3 most used players correlates to winning in the NBA.

III. HYPOTHESIS

The hypotheses that were tested are as follows:

- Null Hypothesis: The factors identified above have no effect on the performance of the NBA teams. the image used in each figure is clear,
- Alternative Hypothesis: The factors as identified listed above have an effect on the performance of the NBA teams.

The outcomes of this quantitative analysis were also integrated with additional qualitative analyses to further determine whether the predictive index would be adequate in predicting the performance and how it could be further improved by identifying other factors for consideration.

IV. RESULTS AND DISCUSSION

The analysis of the aforementioned factors was then conducted using regression analysis. This correlational analysis allows for the assessment of the degree of dependency winning has on each factor. The first regression analysis conducted included all of the factors analyzed.

A multiple regression analysis was calculated to predict the winning percentage based on 10 factors. It was found that only Average Player Efficiency Ratings (PER) was statistically significant with (F(1,11)= 3.767,p < .05), with an R2 of .665 (Table 1). The R2 value of .665 indicates the impact of the given variables on the dependent variable, which in this case, wins percentage. This number isn’t extremely compelling, as the combination of independent variables identified contributes to just 66% of winning. Moreover, after analyzing the P-value, only the Average Player Efficiency Ratings (PER) of the three players who play the most minutes held statistical significance with this model. The model as a whole does not need to be discarded, owing to the small Significance F value. However, a deeper

exploration into the Independent variables could provide deeper insights.

Table 1. Regression analysis of 10 factors contributing to the winning percentage of NBA teams

Source	B	SE B	t	p
Intercept	-0.527	0.516	-1.021	0.320
AVG SAL	0.000	0.000	0.188	0.853
AVG EXP	0.011	0.021	0.533	0.600
Player Loyalty	-0.026	0.062	-0.416	0.682
Gini Coefficient	-0.071	0.440	-0.160	0.874
Coach Loyalty	0.003	0.007	0.370	0.715
Coach Experience	-0.005	0.006	-0.948	0.355
All stars	0.066	0.040	1.658	0.114
AVG top 3 PER	-0.002	0.017	-0.143	0.887
AVG min of top 3 PER	0.011	0.012	0.966	0.346
AVG PER of top 3 min	0.037	0.013	2.897	0.009
R2		0.665		
F		3.767		

B = coefficients
SE B = standard error

With such a large number of independent variables, the hypothesis was that certain factors would contribute to the winning percentage more than others, so the regression analysis was conducted again. However, this time the independent variables were categorized beforehand. The first category of independent variables was “coach-related” factors which included (i) the number of years of experience the team’s head coach had and (ii) the number of years that the coach had spent with that team. As shown in Table 2, when this analysis was run on the collected data, the results indicated that there was little correlation between the coach-related factors and winning percentage. A multiple regression analysis was calculated to predict the winning percentage contributed by coach-related factors. No significant results were found with (F(1,3)= 1.204,p > .05), with an R2 of .082 (Table 2). The R2 value reveals that an 8% of winning can be attributed to the coach-related factors, and after adjusting for the number of independent variables, that number drops even further to 1%. Furthermore, neither of the two individual

factors comprising this category indicated a significant p-value, suggesting that the coach-related factors also weren't the best model to predict winning in the NBA. The large significance of the F value further indicates that reliance on this category should be discarded.

Table2. Regression analysis on coach related factors contributing to winning percentage in the NBA

Source	B	SE B	t	p
Intercept	0.438	0.047	9.238	0.000
Coach Loyalty	-0.003	0.008	-0.324	0.749
Coach Experience	0.008	0.006	1.317	0.199
R2		0.082		
F		1.204		

B = coefficients
SE B = standard error

The lack of significance of the coach-related factors suggests that there should be a higher degree of influence from other factors on the winning percentage of the team. To investigate further, the next grouping of independent variables is related to the overall composition of the players on the team. This group included individual factors (i) the average salary for players on the team (Avg. Salary), (ii) the average experience of all players on the team (Avg. Exp), (iii) the average number of years a player has been on the team (Player Loyalty), and finally, (iv) the distribution of salary among players on the team (Gini Coefficient).

A multiple regression analysis was calculated to predict the winning percentage by the overall composition of the players. It was found that only the Average experience of the players was significant with (F(1,5)= 2.877,p < .05), with an R2 of .206 (Table 3). As shown in Table 3 below, the Significance F value is acceptable, so there is a benefit in looking further into the model. Three out of the four factors analyzed in this model - Avg. Salary, Player Loyalty, Gini Coefficient - yielded an extremely high P-value rendering them statistically significant. Hence, the only remaining factor of statistical significance is the average experience of the players on the team. The R2 and adjusted R2 values for this model relating to the overall composition of the players on the team are both relatively low, indicating that despite the validity of this model, it does not have a meaningful effect on the winning percentage of the team.

Table3. Regression analysis of factors relating to the overall composition of the players on NBA teams

Source	B	SE B	t	p
Intercept	0.006	0.245	0.024	0.981
AVG Sal	0.000	0.000	0.317	0.754
AVG Exp	0.051	0.017	2.949	0.007
Player Loyalty	-0.006	0.060	-0.101	0.921
Gini Coefficient	0.231	0.443	0.521	0.607
R2		0.206		
F		2.877		

B = coefficients
SE B = standard error

The next step was to look at the best players on the team, which included the Allstars on the team and the averages for the top three players on the team. The factors in this category included (i) the number of Allstars on the team, (ii) the average of the top three Player Efficiency Ratings (PER) on the team, (iii) the average number of minutes played by the top three players on the team, and (iv) the average PER of the three players who played the most minutes on the team.

A multiple regression analysis was calculated to predict the contributions of the best players to the team towards winning in the NBA. It was found that only the Number of All-Stars and Average Player Efficiency Ratings of the players was significant with (F(1,5)= 11.043,p < .05), with an R2 of .581 (Table 4). The R2 value of .581 indicates a 58.1% correlation between data around the top players on a team and winning. There is an extremely small significance F value, affirming the overall validity of the model. However, despite this, only two of the independent variables reveal a statistically significant P value: (i) the number of Allstars and (ii) the average PER of the three players who played the most minutes on the team.

Table4. Regression analysis on the contributions of the best players on the team towards winning in the NBA

Source	B	SE B	t	p
Intercept	-0.533	0.412	-1.294	0.207
Number of all stars(since past 2 yrs)	0.063	0.028	2.237	0.034
Avg PER ¹	0.000	0.013	-0.028	0.978
Avg minutes ^{1,2}	0.011	0.011	1.030	0.313
Avg PER - Duration ^{1,2}	0.035	0.009	3.957	0.001
R2		0.581		
F		11.043		

1 - Top 3 players
 2 - In terms of duration played
 B = coefficients
 SE B = standard error

Next, to try and create the most comprehensive model based on the data, a regression analysis was run on the three factors that were found statistically significant in the previous regressions that were run. Those three factors were (i) the average experience of players on the team, (ii) the number of Allstars, and (iii) the PER of the 3 players who played the most minutes. As shown in Table 5, when these factors were run together, there was a moderately high R2 value along with an extremely low significance F value, affirming the results from the earlier conducted regression models. However, only two of these three values were statistically significant in this model. Those two were factors from the “best players” categorization, and the non-significant factor was from the “team composition” category.

The significance of these results in the regression analysis reveals the following initial understanding for an NBA team looking to identify factors that significantly contribute to winning percentage- Being top-loaded with star players who play a high number of minutes in the game is a fundamental key for success in an NBA team.

Table 5. Regression analysis on the three factors previously indicating high impact on winning in the NBA

Source	B	SE B	t	p
Intercept	-0.208	0.131	-1.590	0.124
AVG PER of top 3 minutes	0.035	0.010	3.539	0.002
All Stars	0.062	0.027	2.293	0.030
AVG EXP	0.003	0.017	0.196	0.846
R2		0.623		
F		14.34*		

B = coefficients
 SE B = standard error

A multiple regression analysis was calculated to predict the contributions of the previous factors on the winning of a team in the NBA. It was found that only the Average Player Efficiency Ratings of the top 3 minutes and All-Stars of the players was significant with (F(1,5)= 14.34, p < .05), with an R2 of .623 (Table 5). While the regression analysis in this study revealed a strong correlation between star players and winning, however, this was around 62% of the equation — there are still 38% worth of factors not identified. However, pinpointing these factors is extremely hard because they are not always able to be represented by tangible statistics. For example, the regression analysis revealed very little correlation between coaching and winning; however, it is studied that coaches can have certain characteristics which improve the quality of the team (Al-Amine, 2020), but those characteristics are often difficult to quantify.

V. CONCLUSION

After analyzing ten factors across three different categories, the strongest indicators of a team’s success seem to relate to the star players on the team. While there may not be a perfect correlation between star players and winning, as there are other factors that do impact a team’s performance, this does provide valuable insight. A basketball team looking to reach the top of its league, according to this model, would be recommended to acquire the best players available and play them frequently in order to win, even at the cost of overall team composition.

However, the broad nature of the factors analyzed leaves scope for future studies to discuss what a star player brings to a team that contributes to team success. Is it just the

number of points they score, their intensity, their motivation to other players, or any of several other factors? Learning this would help a team take an active decision as to what qualities they are looking for in star players they hope to acquire.

VI. LIMITATIONS OF THE STUDY

One limitation of this predictive is that it is based on data from a single NBA season as opposed to a cumulation of several seasons. However, the data is well representative of the league as it represents all 30 NBA teams. Secondly, there are 10 factors analyzed, when in reality, the number of variables influencing a team's performance could well exceed that number. But the factors analyzed are overall indicative of optimal choices an NBA team can make in order to be successful.

ACKNOWLEDGMENT

I would like to acknowledge and recognize the efforts of Ms. Kah Ying Choo in helping me understand the research process, guiding me through my data collection, analysis, and presentation process.

REFERENCES

- [1] Al-Amine, R., Quantifying the Contribution of NBA Coaches using Fixed Effects, Towards Data Science, <https://towardsdatascience.com/quantifying-the-contribution-of-nba-coaches-using-fixed-effects-56f77f22153a>, (2020, September 29).
- [2] Bell, D. J., Nolan, J., & Agard, D. (n.d.), Estimating NBA Playoff Success Probabilities [Infographic], Northern Kentucky University. https://www.nku.edu/~nolanj1/SIS/Poster_Bell.pdf.
- [3] Grossmann, M., Dietl, H., & Lang, M. (n.d.), Competitive Balance and Revenue Sharing in Sports Leagues with Utility-Maximizing Teams, *Journal of Sports Economics* 12(3) (2009) 284-308.
- [4] Hatcher, T., & Seeborg, M., What is the Superstar Effect for an NBA Franchise?, 26th Annual JWP Conference, Illinois Wesleyan University, Digital Commons @ IWU (2015, April 18).
- [5] Kubatko, J., Oliver, D., Pelton, K., & Rosenbaum, D. T., A starting point for analyzing basketball statistics, *Journal of Quantitative Analysis in Sports*, 3(3) (2007).
- [6] Oliver, D., *Basketball on paper: Rules and tools for performance analysis*, Potomac Books (2011).
- [7] Prinz, A. L., Indirect evolution and aggregate-taking behavior in a football league: Utility maximization, profit maximization, and success, *Games*, 10(2) (2019) 22.
- [8] Silva, Rocha Da J. V., & Rodrigues, P. C., The three eras of the NBA regular seasons: Historical trend and success factors, *Journal of Sports Analytics*, Pre-press, (2021) 1-13