The impact of team payroll on the NBA team's success.

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1. Abstract

This study examines the relationship between team payroll and success in NBA. Researchers have indicated that there is a positive correlation between team payroll and team success. By measuring different metrics like team revenues, team spending on players' salaries, and team performance metrics such as win-loss record, playoff appearances, and championship wins. The findings have important implications for team owners, executives, and policymakers, as they highlight the importance of investing in player salaries for achieving success in professional sports.

However, the relationship between payroll and performance is not always straightforward. Other factors such as team chemistry, coaching, and player health can also play a role in a team's success. Some studies have found that teams with high payrolls may struggle with player morale and team cohesion, leading to underperformance.

Additionally, there is a well-known phenomenon in the NBA known as the "luxury tax" which penalizes teams that exceed a certain payroll threshold. This tax can limit a team's ability to spend freely on players, potentially reducing its competitiveness.

2. Introduction

The National Basketball League (NBA) is regarded as the top basketball league in the world. It consists of 30 teams in two conferences East and West. 29 of the teams are in the United States and one team is in Canada (Toronto Raptors). People have been showing an increased interest in whether there is a relationship between salary allocation and team success in professional sports over the years.

Research has been conducted and measured by different metrics ranging from team revenue to winning percentage. This research across various professional sports leagues has shown that there is a positive correlation between team payroll and team success. Based on my research on the years 2016-2020 season, it is important to look at some major changes relating to TV deals and salary caps during that time.

The NBA and the NBA players' Association (NBAPA) enter into collective bargaining agreements (CBA) which determine various aspects of player contracts, revenue sharing, and trades. These agreements have influenced salary distribution in NBA teams over time. The implementation of the "max contract" allows players to receive between 25-35% of a team's salary cap, leaving limited room for the other 13 members of the roster if two max contract players are on the team. General Managers often employ this strategy to create a "super team," which typically includes three or more-star players that outshine the other teammates.

The salary cap in the NBA has been increasing over the years. In 2016 the league signed a huge $24 billion TV deal for nine years and according to the new collective bargaining agreement that year, the salary cap rose to $94 million from $70 million the previous year. This led to an increase in the luxury tax limit standing at $113 million, rising almost $28 million over a year. This created a term known as the superstar effect which helps teams sign multiple superstars on their rosters to compete for championships.

Unlike other professional leagues, NBA only consists of 15 active players, leading to a greater impact of investing in star players. With the season comprising 82 games, there is a higher chance of individual effects to be seen.

Seeing the significance of salary in improved performances this paper will take a statistical approach to investigate between team payroll and an NBA team's success. As managers in the league come under increased pressure to build contenders around star players, this paper focuses on whether the majority of team payroll given to the star players still results in a positive effect on team performance.

3. Literature Review

The NBA is one of the most popular professional sports leagues in the world, with fans tuning in from around the globe to watch their favorite teams and players compete. One factor that has long been debated is the impact of team payroll on a team's success. In recent years, numerous studies have been conducted to better understand this relationship.

One study by Run Repeat (1991-2022) analyzed the changes in NBA salaries over the years, including the impact of Collective Bargaining Agreement updates and luxury tax. This study found that salaries have increased over time but changes in regulations have affected how much teams are willing to pay for players.

Another study by Cody (2016) examined how the introduction of salary caps in the NBA affected competitive balance within the league. Contrary to previous research, Cody found that the 1999 CBA had no effect on parity within the NBA, and there is evidence that the league's openness to international players has had a greater impact on competitive balance.

Kuehn and Rebessi (2019) analyzed the impact of team fit on NBA rookies' career earnings. The study found that playing with teammates who helped facilitate an additional point per 100 possessions could increase a player's second contract value by up to 23.6%. This highlights the importance of finding the right team fit for a player's long-term success.

In a study by UC Berkeley Economics, the relationship between on-court performance and team revenues was analyzed. The findings suggested that there is a positive correlation between team performance and revenue.

Another interesting study by Meadow Lake Now (2019) found evidence that NBA player salaries can have an impact on playing time, with players who earn higher salaries receiving more playing time than their lower-paid counterparts.

Zack Stice (2020) investigated the impact of athlete branding and social media presence on NBA players' salaries. While previous research has shown that off-court sponsorships and endorsements can be influenced by a player's brand presence, Stice's study found that there is little research on how branding affects league-specific salaries and team valuations of players.

The "superstar effect," where a superstar has a bigger impact on their team than in any other league, makes the NBA stand out above other sports leagues. This is because the NBA has a smaller active roster, with only 12 players compared to 23 in the NHL, 25 in MLB, and 53 in the NFL, as pointed out by (Rockerbie, 300).

Salary Dispersion and the Team Performance in the National Basketball Association by Robert Pierce which was published in 2017 from Skidmore College is the closest to my paper. Robert Pierce also looks at salary dispersion over the past 20 seasons from 1995-96 to 2015-16. It

investigates the relationship between salary dispersion and win-loss records and playoff performances for teams.

Overall, these studies highlight the complex relationship between team payroll, player performance, and overall team success in the NBA. While there is evidence that player salaries can impact team performance and revenue, finding the right team fit and optimizing player performance remains crucial for long-term success.

4. Data

The data on salary dispersion was found on basketball reference by collecting annual team salaries from the 2016-17 to 2020-21 regular season. The data contains wins, losses, compiled salaries for all players including disabled players, assists, wins and losses each year, and standard deviation of player efficiency ratings(per). The research can also be conducted for only a particular team for further research to determine their own success.

The database also includes players with two-way contracts and those with disabilities. The NBA active roster normally comprises 15 players. As a result, each squad may include between 15 and 20 players. Since the conventional contract gave no clear signal, I ignored salaries that were equal to zero in order to determine the player's position. I created an Excel document that listed each team's name, conference (east or west), and salary standard deviation. Teams tend to perform better when player wages have bigger standard deviations.

I used information from the player efficiency rating (PER), which assesses per-minute production based on standardized NBA players and has a league average of 15 players, to analyze individual performance and team chemistry. I was able to determine the variation in each team

member's overall performance by calculating the standard deviation of PER. As per the superstar effect, I predicted a large positive link between the standard deviation of PER and the team winning %. A higher number of assists may indicate the presence of a superstar player who draws multiple defenders, leaving teammates open for shots. I also used the assists data (AST) to gauge team chemistry. As a result, I anticipate a positive connection between the quantity of team assists per game and their winning percentage.

Variable Descriptions

Variable Name	Source
Team Name	BasketballReference.com
Year	
Conference	
Wins	
Losses	
Win Percentage	
Standard Deviation of Salaries	
Payroll	
Standard Deviation of Player Efficiency Rating (PER)	
AST (Assists)	

Descriptive Statistics (round offed**)**

	Mean	**STD**	**Min.**	**Median**	**Max.**
Win_percentage	0.499	0.143	0.207	0.506	0.817
sdsalaries	7.442	2.174	3.338	7.299	14.138
sdPER	6.758	2.801	3.020	6.150	27.640
AST	23.924	2.117	18.500	23.800	30.400

I found that the average winning percentage for the NBA has been around 50% since the 2016–17 season, meaning that for every game won, a game is also lost. The 2018 New York Knicks had the lowest winning percentage among the teams studied, with a mark of 20.7%, while the 2016 Golden State Warriors had the best mark of 72.2%.

On a 15-player squad, the highest-paid players make over $7 million on average, in contrast to their teammates, according to the team salary standard deviation average, which is approximately $7.44 million USD. The lowest pay variance is 3.34 million dollars, set by the 2017 Chicago Bulls, and the biggest is 14.12 million dollars, set by the 2020 Golden State Warriors. This suggests that more proven all-stars than any other club in the league receive a bigger portion of their team's payroll.

The average standard deviation of PER is 6.75. The 2017 Washington Wizards have the lowest standard deviation of PER at 3.02, while the 2017 Utah Jazz have the highest standard deviation of PER at 27.64, indicating that the Utah Jazz's greater dispersion in PER scores may be due to the influence of a star player on the team's performance, as per the superstar effect. Both teams are small-market franchises with lower payrolls than the average, implying that they

either depend on a single star to carry the team or have a roster filled with mediocre players. Lastly, the average number of assists in each NBA team is approximately 24 assists, with the 2016 Toronto Raptors having the lowest number of assists per game at 18.5, while the 2016 Golden State Warriors have the highest number of assists per game at 30.4.

The range of assists per game is apparent, but it doesn't seem to be connected to the superstar impact. Instead, it seems that an NBA team's style of play, like pass-centric offenses or isolated scoring, affects how many assists are made. Controlling for assists is still important, though, because strong team chemistry allows players to play at their best, which improves team performance.

5. Empirical Study and Regression Model

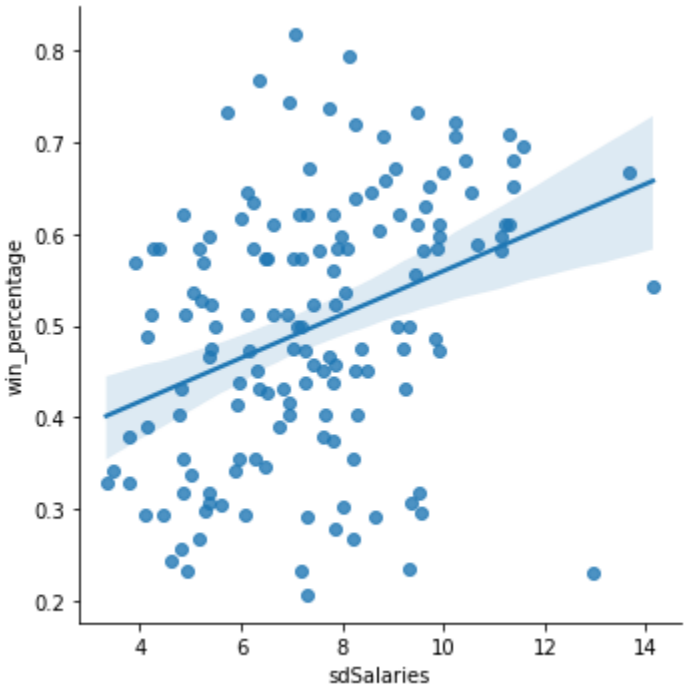

Figure – Winning percentage against the standard deviation of team salaries. (Total observations = 150).

The standard deviation of team salaries and winning percentage have a 0.32 correlation, which shows a positive relationship between the two variables. This suggests that an NBA team with an unequal salary distribution, where several stars significantly outperform their average teammates in terms of contribution to team performance, wins more games. This lends credence to the superstar effect, as teams with players of different talent levels frequently triumph over those with players of similar ability.

As seen in the figure, the lack of a strong relationship between team pay and performance suggests that a player's salary may not always be an accurate reflection of their abilities or influence their performance. For instance, underwhelming players who are overpaid on teams in bad places and who were unable to sign star players could motivate their colleagues to work harder during practice. The quality of these players does not immediately improve as a result, and as a result, the impact on the team's winning % is unaffected. The quality of a team's players, as measured by the current advanced metric, PER, which has a direct impact on team performance, determines how salaries are distributed.

In the first model, I tried just with win percentage as the dependent variable and a log of the standard deviation of salaries to see my regression results.

$$Win\ percentage = \beta_0 + \beta_1 * LNsdSalaries$$

R Squared – 0.134	Coefficient and Std. Error	Confidence Interval
constant	0.1552 (0.068)	(0.023, 0.288)
sdSalaries	0.1751 (0.035)	(0.107, 0.243)

My model is as follows:

$$Win\ percentage = \beta_0 + \beta_1 * LNsdSalaries + \beta_2 * sdPER + \beta_3 * AST$$

Where,

Win percentage = number of wins in a season / 82

AST = number of assists per game for any team

sdPER = standard deviation of PER score of individual players

LNsdSalaries = log of standard deviation on any NBA rosters (from the 2016-17 season).

R Squared – 0.212	Coefficient and Std. Error	95% CI
constant	-0.2102 (0.134)	(-0.472, 0.052)
sdSalaries	0.1382 (0.035)	(0.069, 0.208)

sdPER	0.0089 (0.003)	(0.003, 0.015)
AST	0.0158 (0.005)	(0.005, 0.026)

The above model is similar to previous research and almost yields the same conclusion.

This suggests that teams with greater salary inequality tend to win more games, with a one percentage point rise in the standard deviation of team salaries assigned to each player resulting in a 13.8% increase in team winning percentage.

We acquire a thorough assessment of a player's contribution to team performance by adjusting for the standard deviation of PER. PER considers a player's overall performance metrics and how they affect the performance of the team. The better a player is, and generally speaking, the better the team plays, the higher their PER score. The predicted coefficient on the team winning % is more accurate when we include the standard deviation of PER as compensation for pay dispersion. Teams having a lower standard deviation of PER can rectify the upward bias introduced by the specification's standard deviation of team wages as well as minimize the effect of other teams on their performance.

The NBA salary dispersion model may consider different scenarios, but it still has significant flaws that need to be addressed. First off, the NBA has a "soft" wage cap model in contrast to other professional sports leagues, allowing teams to exceed the cap through exception rules without having to pay the luxury tax. This includes the Larry Bird and Mid-Level exclusions, which exempt players' salaries from being counted toward the total annual team payroll.

Second, the $94 million USD increase in the wage ceiling encourages larger-market clubs to sign numerous high-caliber players, which weakens the relationship between team salaries and winning percentage. Thirdly, while some teams strive to win championships, others may try to tank in order to acquire high draft picks, which lowers the club's average PER and alters the relationship between team wages and victories. Finally, the model oversimplifies the variations across players' scenarios and makes it difficult to integrate them because it does not consider the complexity of some players' max contracts.

The conference variable was added additionally to see the results with the same 150 observations. The coefficient of determination (R-squared) indicates that the model explains approximately 21.4% of the variation in the dependent variable. This shows that the data does not fit this model particularly well. The adjusted R-squared (0.192) is lower than the R-squared which indicates that the inclusion of some of the independent variables may not be helpful in improving the model fit. This is a extra decision I took to take forward my research as seen in the python data file.

6. Conclusion

The results of this study show that even after adjusting for the standard deviation of PER and the number of assists, wage dispersion in NBA teams has a favorable effect on team winning %. These findings support Robert Pierce's (2017) research on the application of tournament theory to player pay. Using updated NBA data from recent seasons and various measures of pay dispersion, the study was able to successfully confirm his conclusions. Though not showing a very significant impact you can say salary has a say in the team winning games.

More data will have to be researched on what are the other factors contributing to a win along with the salary dispersion.

In my above model, I still want to add in the conference level to improve my regression model. For the future, we could look at how player efficiency ratings of teams and find a model to reduce salary dispersion in order to win more games as more and more players become costly to acquire.