TALLINN UNIVERSITY OF TECHNOLOGY
School of Business and Governance
Department of Finance and Economics

Daniel Hentilä

The link between salary and performance: Are NBA players overpaid?

Bachelor's thesis
Programme International Business Administration, specialization Finance and Accounting

Supervisor: Pavlo Illiashenko

Tallinn 2019

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Daniel Hentilä ……
(signature, date)
Student code: 166324TVTB
Student e-mail address: hentila.daniel@gmail.com

Supervisor: Pavlo Illiashenko
The paper conforms to requirements in force

……
(signature, date)

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ABSTRACT

The National Basketball Association (NBA) is one of the four major sports leagues in North America. Because of NBA's growing popularity and increased revenue that it brings, the value of players' contracts has increased substantially over the recent decade. This, in turn, started a discussion if high players' wages are justified by the players' performance. With the goal of contributing to this discussion, the present research explores the relationship between NBA players' salary and their on-court performance. The objective of the paper is to find out if salary has a positive relationship to player performance, measured by Player Impact Estimate (PIE) rating. The secondary objective is to discover if players in the NBA are paid according to their performance. Based on the analysis of financial and performance data for the 2017-2018 season (N=361) the thesis finds that there is a significant positive relationship between player salary and performance controlling for player's age, playing position, and team fixed effects. The results also show that players in the NBA are on average underpaid in relation to their performance.

Keywords: NBA, Salary, Performance

INTRODUCTION

The National Basketball Association (NBA) is one of the four major sports leagues in North America. NBA has gained a lot of popularity because of superstar player's as well as international player's entering the league. With the growing popularity the revenue that NBA franchises collect during a season has also been increasing. This has led to a situation where player's in the NBA are able to make bigger contracts since teams have more money to spend on players. NBA currently has the highest salaries of all four major sports leagues. Each team usually has one superstar player who can earn up to 20%-25% of a team's total payroll. This is possible due to the fact that NBA teams only have around 15 players' instead of over 20 player's that other leagues such as MLB, NHL and NFL have. The question that arises from these large contracts is, do player's in the NBA perform according to their given salary or do teams hand out large contracts just to acquire the player's they want. Should the payroll be distributed more evenly among teams' players and not so, that one or two players earn almost half of the whole team's payroll and the rest of the players get what is left. Or do the players with high salary actually perform according to their salary and the rest with smaller salary according to theirs. This research explores the relationship between player salary and player performance. The question that this research tries to answer is: are player's in the NBA under- or overpaid in relation to their on-court performance?

Previous studies that have been made, have tried to identify if players are under- or overpaid according to their ability to add wins for a team. Tyler Stanek attempted to find if players are under- or overpaid based on the value of players contribution to team revenue in terms of wins added (Stanek 2016, 1). Stanek used his own model as well as Arturo Galletti's model who is a director of analytics for The Wages of Wins Journal (Stanek 2016, 21). Stanek also used Hollinger's Estimated Wins Added (EWA) metric and David Berri's Wins Produced (WP) metric to calculate the contribution on team revenue a player has brought. The results Stanek got using his own model were that, player's in the NBA are overpaid by approx. $2,5 million according to EWA approach and $2,2 million according to WP approach. When Stanek applied Galletti's model he got the results that with the EWA approach players are $271,764 underpaid and with WP approach players are $671,691 underpaid (Stanek 2016, 34). The results that Stanek got from his study are quite different, so it is hard to say what is right. The initial thought is that players who

have higher salaries would also perform better. However, as previous studies have shown, there is a possible overcompensation of players in relation to their ability to add wins for a team.

Since the results in the existing literature are ambiguous, the aim of this research is to clarify the link between player salary and individual performance taking into consideration individual player performance and salary. The players' performance is measured with Player Impact Estimate (PIE) index (NBA Stats 2019) while players salary is measured either in millions of U.S. dollars or as a percentage of player's salary contribution to the team payroll. Due to the issue of data availability the sample covers 361 players during only one season, the 2017-2018.

The results received from the regression analysis that examined the relationship between player performance and salary showed a significant positive relationship. The relationship was measured on regular season performance as well as playoff performance level and both indicated a positive relationship. The second objective of this paper was to discover if players in the NBA are paid according to their performance. This was achieved by firstly calculating teams total PIE score which consist of adding together PIE scores from players who play in the same team. After this each player's individual PIE score was divided by the team PIE in order to obtain players individual contribution to their team. Lastly, the percentage of player's salary contribution to the team payroll was compared to the PIE contribution each player gives to their team PIE. The results showed that on average players in the NBA are underpaid in relation to their performance. The most underpaid were younger players in the league while older players were more overpaid.

The paper begins with background section which includes previous findings as well as important information that is needed in order to understand how the paper. The second part is the methodology part. Last part is the empirical part which goes over the results, and conclusion which completes the paper.

1. BACKGROUND

National Basketball Association or NBA is one of the four major sports leagues in North America in addition to NFL, MLB and NHL. Basketball is becoming the most popular sport in North America and NBA is attracting players from all over the world. This creates a huge fan base also outside of North America for NBA since each team has international players. With the rising popularity of NBA, the teams that play in the NBA are gathering huge revenues each year. This has allowed NBA to have the largest contracts in all of the four major sports leagues. Teams allocate their allowed salary cap to players unevenly and some players take around 20 to 25% of the whole team's payroll. The contracts are supposedly made with the fact that better performance equals a larger contract. This first chapter goes through previous studies made on the topic as well as explains factors that are essential in order to understand how teams pay for their players and how much are they allowed to pay. Also, is there some other value in a player for a team besides their performance on the basketball court.

1.1. Previous findings

Previous studies have examined how the salary in the NBA is distributed amongst the players and what are the traits in players that count when teams offer contracts. The research that is the closest match to this paper is Tyler Stanek's "Player Performance and Team Revenues: NBA Player Salary Analysis". Stanek analyzes how much revenue can a win bring to a team, and using player marginal revenue product (MRP), Stanek examines the possible under- or overpayment of players and superstars in the league (Stanek 2016, 1). Stanek attempts to find if players are under- or overcompensated for their on-court performance based on the value of player's contribution to team revenue in terms of wins added. This approach is inspired by the work of Neale (1964) who studies the revenue sharing practices in the Women's National Basketball Association (WNBA), where players are not employed and do not earn salary from their team but are employed and compensated by the league. This leads to a situation where players have the ability to earn their salary as a percentage of the revenue that they have brought to the league. This situation would end the revenue issue that arises from superstars (Stanek 2016, 21).

Stanek studies the possibility of under- or overpayment of player, relative to their marginal revenue product (MRP) by the revenue implications that a win has on a team. After finding out the MRP for a player, Stanek is using John Hollinger's Estimated Wins Added (EWA) statistics as well as David Berri's Wins Produced (WP) metric. These two measurements are used separately in the study with both multiplied with the sum of Wins and LagWins coefficients. Since lagged wins have happened in the past, Stanek discounts the lagged wins with a discount rate of 5% to account for the time value of money. When the MRP has been calculated for both Hollinger's EWA and Berri's WP, Stanek subtracts each player's MRP from their actual salary in order to find out if players are under- or overpaid relative to their MRP (Stanek 2016, 26). Stanek calculations for player MRP are done in the following way.

$$Players\ EWA\ MRP = Player's\ EWA \times Value\ of\ win\ (in\ U.S.\$) \quad (1)$$

$$Players\ WP\ MRP = Player's\ WP \times Value\ of\ win\ (in\ U.S.\$) \quad (2)$$

The data Stanek used for this study is compiled from seasons between 2009-10 and 2014-15, excluding season 2011-2012 since NBA had a lockout during that season missing 16 games from the regular season. For Hollinger's EWA, the data consist of 231 observations from which 30 are the top paid player's and 30 are the top EWA performers. For Berri's WP, the data consist of 254 observations from which 30 are the top paid player's and 30 are the top WP performers (Stanek 2016, 31).

Stanek's results for his question, if player's in the NBA are under- or overpaid based on Hollinger's EWA metric show that on average player's in the NBA are $2,546,746 overpaid compared to their actual salary (Stanek 2016, 33-34). In order to find out if player's in the NBA are under- or overpaid Stanek used his own calculation of players EWA multiplied with the value of a win from which player's actual salary would be subtracted. In a different calculation Stanek used Galletti's value of win instead of his own and got the results that players in the NBA are on average $271,764 underpaid relative to their marginal revenue product (Stanek 2016, 33-34).

The results Stanek got from calculations with Berri's WP metric were that on average player's in the NBA are $2,221,592 overpaid relative to their MRP (Stanek 2016, 34). The results between Hollinger's EWA and Berri's WP are more or less similar. Stanek also applied Galetti's value to calculate Berri's WP and got the result that on average NBA players are underpaid by $671,691.

The difference is more drastic between Hollinger's EWA and Berri's WP when Galetti's value of win is applied (Stanek 2016, 34-36).

After discovering that, based on Players MRP vs. Salary (Hollinger's EWA approach and Berri's WP approach) player's in the NBA are overpaid, Stanek studies if age has a positive relationship with salary (Stanek 2016, 36). The results were that both Hollinger's EWA and Berri's WP suggests that as player's get older in the NBA, they are increasingly overpaid relative to their MRP. These results support previous studies done by Leeds and Kowalewski (1999) who determined that veteran players are overpaid while younger players earn less (Stanek 2016, 36). These results can be somehow explained with the fact that the minimum salary for player's in the NBA is determined by the years of experience in the league. Meaning that a player with 5 years of experience will have a lower minimum salary than a player with 12 years of experience in the league. This still does not justify the fact that NBA veterans are overpaid relative to their MRP since the differences in the minimum salary are relatively small.

Other studies that have been made considering NBA player's performance and their respective salary are different determinants of salary. Three previous studies that have been made on the subject of how NBA player's salary is determined will be used in this paper. Two of these studies have been conducted by Kevin Sigler with the help of William Compton and William Sackley. The third study has been done by Tyler Stanek.

Sigler and Sackley in their article, NBA Players: are they paid for performance? study the relationship between NBA player's salary and their performance on the court. Sigler and Sackley studied the relationship with a simple regression equation. The regression equation was the following: Player Salary = function (REB, ASST, PTS), where the independent variables were respectively rebounds per game, assists per game and points per game (Sackley, Sigler 2000, 47-48). The results showed that rebounds and points had a positive relationship at a 95% confidence level to player's salary while assists were insignificant. The second study done by Sigler with William Compton, NBA Players' Pay and Performance: What Counts? continues Sigler's prior studies that showed that points scored, and rebounds had a positive relationship to salary. The reason for this study is the fact that the NBA is evolving and the determinants for salary are changing (Compton, Sigler 2018). The multiple regression that was conducted in Sigler's and Compton's study uses NBA players pay from the season 2017-18 as the dependent variable. This time their independent variables consist of points, experience, field goal %, 3-pointers made, rebound, assists, blocks, personal fouls and John Hollinger's Player Efficiency Rating (PER). The

results showed four variables that were significant at the level of 0.01**, these variables were points, experience, rebounds and personal fouls. Assists per game were significant at the level of 0.05*. Other variables were found insignificant. Sigler and Compton did a backward stepwise regression for their multiple regression results. They removed one statistically insignificant variable at a time. This eliminated the variable that had the highest P-value. After the backward stepwise regression, the same variables points', experience, rebounds, assists and personal fouls stayed in the multiple regression results (Compton, Sigler 2018).

1.2. NBA Collective Bargaining Agreement

Collective bargaining agreement (CBA) was created to solve disputes between the national basketball association and its owners and the players who play in different franchises. The current CBA agreed between NBA and National Basketball Players Association (NBPA) took effect on July 1, 2017 and it will be effective for seven years through seasons 2017-18 and 2023-24. Both parties, NBA and the NBPA have the ability to opt out of the agreement after the season 2022-23 with the condition that they inform the other party no later than December 15, 2022 (NBA Official 2017). The purpose of the agreement is outline rules for player contracts including 10-Day contracts, two-way contracts etc., minimum and maximum salaries, bonuses, travel expenses, legal investigations and many other (Caldwell 2010).

To keep this paper simple, this chapter will only go through the rules that are necessary in this research. The parts from CBA that are necessary for this paper are the NBA salary cap, the exceptions on the salary cap and luxury tax. Some changes that were made to the new 2017 CBA were the ability to give six-year extensions to two veteran players. This gives teams a better opportunity to keep their best players in their roster. The new 2017 CBA also made a rule that will shorten the preseason and make the regular season to start earlier. This rule was conducted in order to reduce the travel that teams face during the regular season. In the new 2017 CBA the over-36-rule was changed to over-38-rule. This rule states that teams are not allowed to offer five-year maximum contracts to players who are going to turn 38 years old in any part of the contract unlike the old rule which stated that five-year maximum contracts could not be offered to players turning 36 years old in any point of the contract (NBA Official 2017).

1.2.1. NBA salary cap

The salary cap in the NBA is assigned by the collective bargaining agreement. Salary caps purpose in the league is to increase parity. To keep any league interesting there has to be competition. Salary caps allows the league to have a competitive balance and make sure that not every game is predictable. Salary caps work so that each team is limited to a certain amount of many that they can pay to their players. This creates a situation where each team has an equal position when it comes to offering contracts to players. NBA teams are located all over North America in different cities that are different in sizes. Without the salary cap, big city teams such as Los Angeles Lakers who come from Los Angeles, California with a population of approximately four million, would have a much larger local market than Milwaukee Bucks who come from Milwaukee, Wisconsin with a population of almost 600,000 (Shorin 2017).

The salary cap in the NBA is what is called a soft cap. Soft cap allows teams to exceed their salary cap with different exceptions. Most of the major leagues in North America have hard caps which mean that there are very few exceptions on how to exceed the salary cap. NBA's salary cap is calculated with 'Basketball Related Income' or BRI. BRI means the aggregate operating revenues for salary cap year generated or to be generated by the NBA, NBA Properties, Inc. and any of its subsidiaries whether now in existence or to be created in the future, NBA Media Ventures LLC, and any other entities which are controlled or 50% owned by any of the recently mentioned companies. This revenue is compiled of regular season gate receipts, net of applicable taxes, surcharges, imposts, facility fees as well as many other that sources that come from NBA franchises (Collective Bargaining Agreement 2017, 125-127). The salary cap for each team is calculated as follows, the salary cap is 44,74% of the projected BRI for the salary cap year, less projected benefits for such salary cap year, divided by the number of teams scheduled to play in the upcoming season (Collective Bargaining Agreement 2017, 159-160).

NBA's salary cap has been rising each year and after 2015-16 season the salary cap has increased by almost 45%. In 2017-18 NBA's salary cap was just over $99 million. This means that each team in the NBA had $99 million to distribute in salaries for their 15-16 players. With the salary cap there also comes a minimum team salary that each team has to pay for their players. This is again to keep the competitive balance alive in the league. The minimum salary that each team has to pay for their players is 90% of the salary cap. If a team fails to meet this minimum salary requirement,

they are obligated to distribute the amount of shortfall to their players who were on the team roster during the season. The CBA also states that teams shall not exceed the salary cap that is mandated by the league but there are many different exceptions on how to exceed the salary cap. The salary cap can be exceeded with these exceptions: Mid-level exception, Bi-annual exception, rookie exception, two-way contract, disabled player exception, veteran free agent exception, minimum player salary exception, traded player exception as well as others. (Caldwell 2010).

1.2.2. NBA salary cap exceptions

NBA has many different exceptions how teams are able to exceed the salary cap that is set for each team. The mid-level exceptions allow teams to sign one or more player contracts during each salary cap year, not to exceed four seasons in length, that, in the aggregate, provide for salaries and unlikely bonuses in the first salary cap year totaling up to the amounts set forth. This amount was $8.406 Million for the 2017-18 salary cap year (Collective Bargaining Agreement 2017, 203-204). The Bi-annual exceptions allows teams to sign one or more player contracts not to exceed two seasons in length during each salary cap year. The salaries and unlikely bonuses in the first salary cap year are allowed to total up to amounts set forth. For the 2017-18 salary cap the Bi-annual exception amount totaled up to $3,290 million (Collective Bargaining Agreement 2017, 202-203). Two-way contracts are not included in the team's payroll. This means two-way player salaries are excluded from team's salary and thus, teams are not required to have any room in their salary caps or exceptions to sign, acquire or convert a player to a two-way contract (Collective Bargaining Agreement 2017, 192-193). Disabled player exceptions allow teams to sign or acquire one player to replace a player, who as a result of disabling injury or illness is unable to render playing services. (Collective Bargaining Agreement 2017, 200-202). Veteran free agent exception or Larry Bird exception as commonly referred to consists of two, qualifying veteran free agent and non-qualifying veteran free agent. The qualifying veteran free agent exception or Bird exception enables teams to go over the salary cap in order to re-sign their own free agents up to the player's maximum salary. To meet the requirements for this exception player must-have played for three seasons without clearing waivers or changing teams as a free agent. The non-qualifying veteran free agent exception or Non-Bird exception allows teams to re-sign their players for the amount of 120% of the players last contracts final salary cap year plus 120% of any bonuses whether likely or unlikely (Collective Bargaining Agreement 2017, 198-199). Minimum player salary exception allows teams to sign a player or acquire by assignment a player contract not to exceed two seasons in length. The salary provided for the player shall be equal to a minimum player salary that is applicable to that player with no bonuses of any kind (Collective Bargaining Agreement 2017,

207-208). With traded player exception, teams may for one year, following the date of the trade of a player contract to another team, replace the traded player with one or more players (Collective Bargaining Agreement 2017, 208-213).

These exceptions hold more rules to them, such as how much teams can pay for the players. All of these salary cap exceptions show that it is possible to go over the given salary cap and be able to pay larger sums to players.

1.2.3. Luxury tax

Luxury tax is a way to keep leagues is balance with respect to competitiveness. Collective Bargaining Agreement (CBA) predetermines a surcharge that teams are obligated to pay if they are to exceed a certain limit over salary cap. The reason why luxury tax exists follows the idea that the player salary growth would slow down as well as the fact that it would prevent larger franchises from acquiring the best players in the league (Dietl *et al.* 2009). NBA implemented the luxury tax to the league in 1999. It is a tax system that forces teams with an average team payroll that exceeds the salary cap by a predefined amount, to pay 100% tax to the NBA for each dollar the team's payroll has exceeded the tax level. The money that NBA obtains from teams who are obligated to pay luxury tax goes to franchises that are financially weaker (Dietl *et al.* 2009).

1.3. Superstar effect

NBA is often labeled as a superstar-driven league. This is mostly due to the fame and skills of the league's top players which include players such as LeBron James and Stephen Curry (Gupte et al. 2019). These stars can bring enormous benefits to a franchise other than just performing extremely well on the basketball court (Jane 2016). The Golden State Warriors won their first championship since 1975 in the 2014-15 season and have won two additional championships since that, in the 2015-16 and 2017-18 season. Golden State Warriors gate receipts have increased from $55 million in the 2013-14 season to $164 million in the 2017-18 season (Statista 2019). For NBA teams to win championships they have to have to right players and the right team. In the current season 2018-19, the Golden State Warriors have five players from the NBA All-Star team. NBA All-Star team consists of players that have been chosen to the team by fans, players, media and head coaches. Usually the players that get picked to the NBA All-Star team have been performing outstandingly during the season but also most of the chosen players are themselves so called "superstars". The Golden State Warriors having five NBA All-Star players attracts a huge number

of fans all over United States as well as tourists from around the world. This has created the massive increase of gate receipts for the Golden State Warriors over the past five seasons.

The superstar effect is created by an individual being able to attain considerable prominence and success in their field. The earnings of a superstar are much higher than the earnings of their competitors (Adler 2014). Sherwin Rosen is considered to define the phenomenon of stars by saying that superstars are a relatively small amount of people who make more money and dominate the field that they work in. Rosen explains the superstar phenomenon as follows. A person that is slightly more talented than their competitors will make a greater earning that the competitors who are slightly less talented. Why have person who is less talented than another, the less talented person is simply put a poor substitute for a greater talent (Adler 1985). Moshe Adler argues against Rosen's explanation that superstar effect occurs where consumption requires knowledge. Mosher argues: "As an example, consider listening to music. Appreciation increases with knowledge. But how does one know about music? By listening to it, and by discussing it with other persons who know about it. In this learning process lies the key to the phenomenon of stars" (Adler, M. 1985, Stardom and Talent).

NBA superstars are defined by their actions on and off the basketball court. Not all great NBA talents are considered as superstars as well as not all superstars are the greatest NBA talents. The impact an NBA player can have off the basketball court can make them have the superstar effect. At the end everyone has their own definitions of what NBA superstar is. There are some certain factors that clearly show that someone has that superstar effect. These can be seen in team ticket sales as well as ticket prices, the number of followers that player has on social media, actions on the court and others.

1.4. Player efficiency

Basketball is a team sport where team performance is measured mostly by teams wins and losses during a season. For a team to be performing well and getting as many wins in a season as possible, they have to have the right players. Each individual player on a team gives something to the team, some more and some less. The problem is that, it is difficult to measure how well an individual player is performing and how efficient they are on the basketball court since basketball is not a single player game (Van Curen 2012). Basketball on the other hand is one of the sports were an individual player can have a huge impact on the end result of the game. When measuring player

efficiency there are mathematical calculations that can be used in order to get a number which tells how efficient an individual player has been for a team that they play in. The most well-known ratings for player efficiency are, John Hollinger's, Player Efficiency Rating (PER), Spanish ACB League's, Performance Index Rating (PIR), and NBA's Player Impact Estimate (PIE).

John Hollinger's PER is probably the most well-known and used rating from the three earlier mentioned. PER measures player's per-minute productivity and is pace-adjusted. The fact that the rating is per-minute measure allows players to be compared even if they have not played the same number of minutes during a season. Also, pace-adjustment makes it possible for each player to have a fair PER score even if their team is more slow-paced then other teams. PER takes players individual accomplishments such as field goals, free throws, 3-pointers, assists, rebound, block and steals, as well as negative ones such as missed shots (field goals, free throws, 3-pointers), turnovers and personal fouls (Hollinger 2011). PIR metric is used in the Euroleague and the Eurocup as well as in many European basketball leagues. PIR metric has been criticized because of the fact that it does not take into account aby weighting system that would determine the importance of individual stats unlike PER and PIE rating (Wikipedia 2019). PIE is the most recent player efficiency rating from NBA and is being used on NBA's player stats. PIE is a simple metric that gives a performance indication at both team and player level. The former rating that NBA used was called efficiency (EFF), PIE is a major improvement to the former rating. PIE includes personal fouls to the rating and NBA has added a denominator to the PIE as well. According to NBA, the denominator removes the need to consider pace in the rating since the denominator acts as an automatic equalizer. PIE measures the overall statistical contribution of a player against the total statistics in games they play in. The result that PIE gives is comparable to other advanced statistics such as PER, using a simple formula. PIE calculation takes into account individual player points, field goals, free throws, rebounds, assists, steals and blocks, and also negatives such as missed shots, personal fouls and turnovers. PIE also takes into account all the above-mentioned stats but from the overall game (NBA Stats 2019).

2. METHODOLOGY

This thesis follows Stanek (2016) paper in which Stanek explores player performance and team revenues in order to come up with an NBA player salary analysis. This research explores the relationship between player salary and player performance in the National Basketball Association (NBA).

This research takes into account player performance during the regular season as well as the playoffs. It is important to include both of these since NBA regular season starts in October and ends in April having 82 games. The season has so many games that players are not necessarily able to perform at their best during every game. Adding the fact that only 8 teams from each conference gets a playoff spot. This is 16 teams out of the 30 teams total. The teams that know they have no shot in making the playoffs might not include their top players in the last games of the season but instead give more minutes to their bench player's. Also, teams that are on the bottom of the league might start to tank, which simply means teams start losing games in order to get the first pick in the upcoming NBA draft. In the NBA draft the worst team of the season has the highest chance of landing the number one pick. In the playoffs instead when the championship is on the line, players tend to perform at a much higher level. The teams that get into playoffs have only one thing on their minds and that is to win the championship. During the playoffs, better players tend to get more time on the court and might even play the whole game of 48 minutes.

The comparison between regular season performance and playoff performance is truly necessary. It does not always mean that when the playoffs start that each and every player increases their performance. For example, Damian Lillard who plays for the Portland Trailblazers had a Player Impact Estimate (PIE) of 16,5 during the regular season. During the playoffs Lillard's PIE was only 6,2 and their team lost the first four games in the first round of playoffs ending their season. This does not mean that Lillard was the only reason for the losses but to show that even though playoffs is the time when players tend to increase their performance it is not always the case. Other player's like LeBron James had a PIE of 19,1 during the regular season and in the playoffs his PIE

increased to 22,4. James led his team to the NBA finals where they lost the series to Golden State Warriors.

The data used in this research is compiled from Spotrac as well as NBA's own stat website. Spotrac is a website founded by Michael Ginnitti and Scott Allen which provides team and player contracts, salaries, salary cap management, payrolls as well as other information for North American leagues NFL, NBA, MLB, NHL and MLS. Spotrac has the latest data about NBA team payrolls and player salaries that are used in this research. NBA stats on the other hand is a website that provides information about performance statistics of NBA teams and players. NBA stats has the latest data of team and player performance that are used in this research. The data used in this research paper observes 361 player's that played in the 2017-18 season. The players were limited so that a player had to play at least 30 or more games during the season as well as average 7 minutes of play per game. The data was limited to this quantity in order to get more accurate answer about the relationship between player salary and player performance. Since player's might get injured before or during the season it is not fair to examine their relationship between salary and performance. Also, the playoff performance data was limited so that players had to play at least in four games during playoffs since four games is the minimum amount of games a team can play in the playoffs.

This research observes the season 2017-18 and the team payrolls and player salaries are collected from Spotrac which relies on collecting their data about player salaries from Basketball Insiders. Even though Spotrac has become one of the largest online resources for team and player contracts it should be remembered that the data from Spotrac is collected from another source and therefore has to be treated in the right way as it may have some errors. The data for team and player performance that comes from NBA stats and is collected by NBA itself since they keep track of the stats that happen during games, so this source can be considered as reliable. The data from NBA has various specific statistics about player shooting, assists, rebounds, turnovers etc. The most important statistic for this paper is the PIE measurement which measures player player's overall statistical contribution against the total statistics in games (NBA stats, 2019). PIE formula is as stated below (NBA stats, 2019). See definitions in appendix table 1.

$$PIE = (PTS + FGM + FTM - FGA + DREB + (.5 \times OREB) + AST + STL + (.5 \times BLK) - PF - TO)/(GmPTS + GmFGM + GmFTM - GmFGA - GmFTA + GmDREB + (.5 \times GmOREB) + GmAST + GmSTL + (.5 \times GmBLK) - GmPF - GmTO) \quad (3)$$

This paper measures player performance with Performance Impact Estimate (PIE) during the regular season as well as playoffs. This measurement gives each player a number that shows their PIE score. The aim of this research is to see how player salary contributes to player's PIE score. It has to be remembered that player's salary varies with age and experience. Players who have just entered the league usually have a rookie contract which is much lower than player's that have 10 years of experience. Age and experience do not only determine player salary, but usually more experience leads to a higher PIE score. Again, it is not the case that older more experienced player's necessarily have higher PIE score's but in the usual sense performance tends to increase with experience. In addition to taking into consideration age this research takes player position and team in to account. Table 1. shows descriptive statistics gathered from NBA stats and Spotrac. Performance metrics PIE and Playoff PIE display the differences that NBA players have in performance. These two metrics have been taken from NBA stats. Cap percentage (Cap %) which is the percentage of players salary contribution to the team payroll and base salary (Base Salary) which is the actual player salary in millions USD are taken from Spotrac. Age shows the age range in the NBA and it is taken from NBA stats.

Table 1. Descriptive variable statistics

	PIE	**Playoff PIE**	**Cap %**	**Base Salary**	**Age**
Observations	361	166	361	361	361
Mean	9,67	8,83	0,068	7,62	26,2
Std. Dev	3,17	4,84	0,067	7,63	4,3
Min	1,7	-7,3	0,0001	0,01	19
Max	19,4	26,6	0,289	34,68	40

Source: Author's calculations

Previous studies have shown that the determinants for player salary seem to be points, rebounds, personal fouls and experience (Compton, W., Sigler, K. 2018). This research uses OLS regression where PIE and Playoff PIE are used as the dependent variables. Independent variables consist of cap percentage, base salary, age. The regression also applies fixed effects, position and team to estimate the effect of salary to player performance.

To study furthermore the relationship between player salary and performance each team's total PIE is being calculated by adding up the PIE scores from each player in a same team. From there each player's PIE score is divided with total team PIE in order to find out what has been the

contribution of each player to the team PIE. This gives a result that can be compared to each player's actual cap percentage, the percentage amount that a player earns from their team's total payroll. Same calculations will be added to playoffs. The result from comparing the player's PIE contribution to their salary cap percentage will give suggestions about how much players are possibly under- or overpaid in relation to their performance on the court. The first assumptions are that younger less experienced players are underpaid in relation to their performance and older more experienced are overpaid. The equation for this calculation is stated as:

$$Suggested\ Salary = Cap\ \% - \frac{Player\ PIE}{Team\ PIE} \quad (4)$$

3. EMPIRICAL PART

This research aims to explain the relationship between player salary and player performance. It is important to understand that the results given in this research do not determine whether salary always leads to a better performance. Since player performance is calculated on an individual level this research does not take into consideration the fact that the presence of a certain player on the court can improve other's performance. This kind of presence on the court also contributes to the salary that a player receives. To examine the relationship between salary and performance this paper incorporates age and fixed effects position and team into the regression to gain a better understanding on how salary actually affects performance.

3.1. Regular season regression

Regular season performance might vary since each team plays 82 games during the season. It is still important to look at the relationship between player salary and player performance during the regular season because ultimately the regular season decides which teams get to play in the playoffs. Most players can keep a quite solid season performing well in each game. Some players might have a good start of the season and then performance starts to decline and vice versa.

The first regression takes player's share of salary, the percentage amount that a player earns from the team's total payroll, into consideration. The share of salary in the regression is named CAP. The NBA has a salary cap but due to different exceptions mentioned earlier in part 1.2.2. teams are allowed to go over the salary cap. This means that teams can have different sized payrolls and so, for example cap percentage of 20% can be different amount in different teams. In model 1 the regression takes into account player's age in addition to the share of salary. The second model takes the fixed effects position and team into consideration. The sample size for this regression is 361 observations.

Table 2. Share of salary and PIE regression

	Model 1		Model 2	
Variable	**Coef**	**St. error**	**Coef**	**St. error**
const	9.87***	(0,92)	9.00***	(1,25)
CAP	22.94***	(2,33)	21.80***	(2,26)
AGE	-0.07*	(0,04)	-0.09**	(0,04)
Position FE	NO		YES	
Team FE	NO		YES	
N	361		361	
Adj. R2	21 %		30 %	

Note: *** - p<0.01, ** - p<0.05, * - p<0.1. Dependent variable: PIE

Table 2. examines the relationship between salary and performance with player's cap percentage. The results show in model 1 that share of salary has a positive relationship with the dependent variable PIE at a significance level of 0.01. The results also indicate that age has a negative relationship to PIE with a significance level of 0.1. The negative relationship is fairly small, and the significance level is a bit high. In model 2, fixed effects position and team are taken into consideration. Share of salary coefficient remains more or less the same when fixed effects are put into the regression. Age becomes significant at 0.05 level with fixed effects, but the coefficient remains almost the same. Adjusted R squared shows that the regression can explain 21% in model 1 and 30% in model 2.

Table 3. Base Salary and PIE regression

	Model 3		Model 4	
Variable	**Coef**	**St. Error**	**Coef**	**St. Error**
const	10.07***	(0.92)	12.31***	(1.25)
BASESALARY	0.21***	(0.02)	0.20***	(0.02)
AGE	-0.08**	(0.04)	-0.09**	(0.036)
Position FE	NO		YES	
Team FE	NO		YES	
N	361		361	
Adj. R2	22 %		31 %	

Note: *** - p<0.01, ** - p<0.05, * - p<0.1. Dependent variable: PIE

As the first regression had 361 observations, so does the second regression. The second regression uses player's Base Salary which is player's actual salary as the independent variable and PIE as the dependent. Other independent variables and the fixed effects remain the same. Table 3. Shows in model 3 that Base Salary has a positive relationship with PIE at a significance level of 0.01. Age becomes insignificant when base salary is being used as independent variable instead of cap

percentage. Model 4 applies fixed effects position and team into the regression again. Base Salary's relationship with PIE remains quite similar to model 3 and Age remains insignificant. Adjusted R squared explains 22% in model 1 and 31% in model 2.

3.2. Playoff regression

This part of the research examines the relationship between player salary and playoff performance. Players tend to perform better during the playoffs and so, there should be a more positive relationship between salary and playoff performance than what salary and regular season performance has. Playoff regression has 166 observations which is almost 200 observations less than the regular season. These observations include the player's that did make it to the playoffs.

Table 4. Share of salary & Playoff PIE regression

	Model 5		**Model 6**	
	Coef	**St. Error**	**Coef**	**St. Error**
const	7.30***	(2.21)	8.25***	(3.01)
CAP	26.70***	(4.94)	26.26***	(5.07)
AGE	-0.021	(0.08)	0.002	(0.09)
Position FE	NO		YES	
Team FE	NO		YES	
N	166		166	
Adj. R2	15 %		15 %	

Note: *** - p<0.01, ** - p<0.05, * - p<0.1. Dependent variable: Playoff PIE

The next step this research takes, is to examine the relationship between salary and playoff performance. Just as the first two regressions did examine both share of salary and Base Salary relationship to PIE, the same independent variables are used for Playoff PIE. Table 4. Examines firstly the relation that share of salary has on Playoff PIE. The results in model 5 show that share of salary has an even more positive relationship to Playoff PIE at significance level of 0.01, than it did to regular season PIE. Age on the other hand becomes insignificant with a negative relationship. Model 6 applies the same fixed effects position and team into the regression. Share of salary remains fairly same with the same significance and Age turns to positive relationship but is still insignificant.

Table 5. Base Salary & Playoff PIE regression

	Model 7		Model 8	
	Coef	**St. Error**	**Coef**	**St. Error**
const	7.53***	(2.21)	8.67***	(2.99)
BASESALARY	0.23***	(0.04)	0.23***	(0.04)
AGE	-0.03	(0.08)	-0.002	(0.09)
Position FE	NO		YES	
Team FE	NO		YES	
N	166		166	
Adj. R2	15 %		16 %	

Note: *** - p<0.01, ** - p<0.05, * - p<0.1. Dependent variable: Playoff PIE

Second regression examines the relationship between Base Salary and Playoff PIE. All other independent variables and fixed effects remains the same. Table 5. Shows results in model 7 that indicate a positive relationship between Base Salary and Playoff PIE at a significance level of 0.01. The relationship is a bit more positive with Base Salary and Playoff PIE than the with Base Salary and regular season PIE. Age once again remains insignificant with a negative relationship. Model 8 shows the exact same positive relationship with Base Salary and Playoff PIE as did model 7. Age remains insignificant with a negative relationship. Adjusted R squared only explains 15% in model 1 and 16% in model 8.

3.3. Suggested salary

In order to examine if player's in the NBA are under- or overpaid in relation to their performance on the court, this research seeks to find each individual player's contribution to the team and compare that contribution to their respective cap percentage. PIE scores from player's who play in the same team are added up together in order to find out the total team PIE. After this each player's PIE score is being divided by their own team total PIE which gives a percentage value that shows the contribution to the total team PIE. To find out if player is under- or overpaid according to their contribution to the team, each player's percentage value of contribution is subtracted from their actual cap percentage.

Table 6. Suggested cap percentage

Age	Suggested Cap %
Mean	-1.47%
Mean ≥ 24	-4.64%
Mean 25-29	0.70%
Mean ≤ 30	0.59%

Source: Author's calculations

Table 6. shows the suggested cap percentage that players should have according to this method. Player's in the NBA on average are underpaid 1.47% according to this model. The most underpaid player's in relation to their performance are found to be players who are 24-year-old or under who are on average underpaid by 4.64%. This is most probably because of rookie contracts which are much lower in value than veteran contracts. Player between 25-29 years old are on average are overpaid by 0.70% and player's over 30 years old are on average overpaid by 0.59%. What these results suggest is that on average each player in the NBA should have cap percentage increased by 1.47%.

3.4. Limitations

The results showed that there is a positive relationship between player's salary and. Still it is important to look at some of the limitations that this research has. Firstly, this research only takes individual performance into consideration and not the team as a whole. Even though player's PIE score might be low, it does not mean that they are not playing well or contributing to the team. Many teams employ veteran players who have many years of experience in the NBA. Why teams do this is because, they have been in the league for many years and they can help young player's entering the league on and off the court. In these cases, usually the veteran salary is quite low as well, so their salary and performance go pretty much hand in hand. Also, some player's might have a great off-ball game, movement on the floor without the ball in their hand, which does not contribute to their PIE score but does to the team's overall game.

Superstar effect is another thing that this research does not take into consideration. Superstar effect does not change the fact that salary and performance have a positive relationship but when it comes to the suggested cap, players bring much more to their teams than just what they do on the court.

Many big-name players who are considered to be superstars might be somewhat responsible for the tickets sold to a game. These superstar player's might perform not according to their salary, but they contribute to their salary in other ways. For example, LeBron James played for the Cleveland Cavaliers in 2017-18 season. Cleveland Cavaliers during that season had a total attendance of 843,042 people in 41 games and their attendance was the second highest in the whole league. Next season LeBron James changed his team to Los Angeles Lakers and Cleveland Cavaliers attendance for the season 2018-19 dropped to 793,337 people in 41 games (ESPN, 2019). This shows that one superstar player can attract a lot of people to come and watch games and at the same time generate ticket revenues for their team. Other value that superstar players might bring to a team are revenue from sold jerseys and sponsorship.

Limitation in this research is also the fact that only one season is being observed. This research only examines the relationship between player salary and performance from one season, which means it does not show if in the past the relationship has been different. Having more season would lead to results that would show if the player salary and performance has had a positive or negative relationship throughout the seasons. Although only one season is being examined, it should give rather accurate results from the relationship.

Lastly what could be considered as a limitation is that the player's in the NBA earn higher salaries as they get more experience. That is why the suggested salary cap percentage shows that players who are 24 years old or younger according to the study are underpaid. This is due to the fact that rookie contracts are much smaller in comparison to what veteran contracts are. As young players enter the league they might be performing at a high level while having a low salary. Older and more experienced player's might have large salaries and their performance starts to decline as they get older. In addition to this, the author's model shows the average over- or underpayment of players.

CONCLUSION

The salary of an NBA player has a positive relationship to their on-court performance. However, is every NBA player paid according to their performance? Professional sports around the world are huge business and NBA is becoming the biggest sport in North America. NBA franchises are generating more revenue each year which increases the salary cap for teams. This increase in salary cap allows teams to offer bigger contracts to players. Still, is it the case that these big contracts, from which NBA players earn whopping salaries have a positive relationship to their on-court performance. Furthermore, do the players in the NBA actually perform according their given salary or should they be paid even more. This research examines if there is a positive relationship with player salary and performance as well as if players are paid according to their performance.

The regressions done in this research shows that there is a significant relationship between player salary and performance. This means that more player earns, the better they will perform on-court. Regression also examined the relationship with salary and playoff performance, since playoff performance usually tends to be better than regular season performance. The results showed a significant relationship as well. Players salary relationship to Playoff performance was not that much more positive than regular season performance which did not come as a surprise.

Author's own model examined if players in the NBA are paid according to their performance on-court. The results obtained from this model showed that on average players are underpaid, however this underpayment of players mostly comes from young players. Players who are 24-years old or younger are performing better in relation to their given salary. This can be explained by the rookie contracts in NBA which limits the amount of salary these young players are able to earn. As players get older, they become overpaid according to the model. This model may indicate that teams should allocate their payroll more evenly amongst their players. On the contrary, this model does not take into consideration superstar effect which in most cases is a reason to pay more for certain players.

This research shows a significant relationship between player salary and performance as well as a possible underpayment of players according to author's model, however, there are certain

limitations to notice. The performance metric PIE, which is used in the regressions and author's own model only accounts for individual statistics. PIE score does not bring justice to every player since player's PIE score might be low, but they are an important force on-court otherwise. Superstar effect is another limitation this research has. Players with superstar effect usually are performing great on-court but, in addition to their great on-court performance they are a major asset for teams. Superstars bring large amounts of revenue for their teams only with their presence. This is something that teams take into consideration in the contracts they offer for these superstar players. Lastly, this research only observes one season. The general idea is that higher salary has a positive relationship between performance and this research showed that there is. However, observing only one season does not tell if this has always been the case.

This paper explored the relationship between player salary and performance as well as the possible over- or underpayment of players. Player salary does not only consist of the performance they bring on-court. Therefore, this suggests that in future researches not only players performance should be taken into consideration but everything else they bring to a team. By including superstar effect which can indicate how much visibility and revenue a player brings to a team can give a better understanding on how player salary is determined.

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APPENDICES

Appendix 1. Definitions

Abbreviation	Definition
PTS	Points scored
FGM	Field goals made
FTM	Free throws made
FGA	Field goal attempts
DREB	Defensive rebounds
OREB	Offensive rebounds
AST	Assists
STL	Steals
BLK	Blocks
PF	Personal Fouls
TO	Turn overs
Gm	Game total