12-22-2016

Creating the Perfect NBA Team: A Look at PER and How It Affects Wins

Gregory Hamalian

Creating the Perfect NBA Team: A look at PER and how it affects wins

Gregory Hamalian

Submitted in Partial Completion of the
Requirements for Departmental Honors in Mathematics

Bridgewater State University

December 22, 2016

Dr. Ward Heilman, Thesis Mentor
Dr. John Pike, Committee Member
Dr. Kevin Rion, Committee Member

Table of Contents

1. ABSTRACT

Ever since Oakland Athletics' general manager Billy Beane began applying analytical tools to compose a baseball team, professional sports teams have used advanced metrics to build competitive rosters. We use an exploratory data analysis strategy to find what statistics best predict team wins. Finding that the Player Efficiency Rating (PER) statistic best correlate with wins, we investigate the statistic to find its strengths and weaknesses. We look for ways to improve the statistic and adjust it to better evaluate player effectiveness. We also look for methods to best predict how the PER will change from one season to the next based on player age and experience in the league.

2. INTRODUCTION

In 2003, Michael Lewis published the book *Moneyball: The Art of Winning an Unfair Game*. The book describes how the general manager of the Oakland Athletics, Billy Beane, took advantage of analytic gauges of player performance, including but not limited to defensive runs saved, average balls in play, and Wins Above Replacements, instead of traditional statistics like runs batted in, batting average, and stolen bases, to assemble a roster that could be competitive against franchises that had a larger budget. Since then, teams have being searching for methods to better evaluate talent, and smaller market teams have looked to get the most bang for their buck when signing players. Baseball, a sport with no salary cap, has a little more leeway when finding the price point (how much the team is willing to spend) of a player. However, the NBA is a salary cap league with guaranteed contracts. A team needs to be sure that a certain player can help their roster before extending an offer to that player, or it can set the team back for years to come. When a team overpays for a player that does not deliver results, it hinders that team's

ability to sign other free agents that could help the team because the team does not have space within the salary cap.

When analyzing what makes a team successful or unsuccessful, one must consider a litany of information. In basketball, previous research has shown that Player Efficiency Rating is a great indicator for team wins.[5] However, the PER statistic has some flaws, such as certain positions, on average, receiving higher ratings than other positions.

Not only could this new research benefit NBA teams, but also its methods might be applied to a wider category of decision problems, such as the design of successful hiring methods for companies. Every organization has a budget and efficiency allocating funds is key to being successful. As implied by the definition of the word, maximizing value helps a particular entity (whether it is a business, team, or organization, etc.) to achieve maximum success.

3. NATURE OF RESEARCH

As previously mentioned, the analytic and quantitative methods of building a professional sports team roster became popularized by Billy Beane, general manager of the Oakland Athletics. Oakland was a smaller market team, and Beane looked for a way to build a competitive roster while keeping the payroll small. Not only did he look at the analytics of a player in terms of how well they played the game, but he also looked at teams that had a high rate of "wins per dollar spent" (WPDS).[1] Essentially, WPDS measures how many wins a team accrues for each dollar spent on player salary. This became a very effective method of building a team as the A's became a consistent playoff team. The method was replicated by teams such as the Tampa Bay Rays and later the Kansas City Royals. While wins per dollar spent is a very powerful tool for smaller market teams in Major League Baseball (a non-salary capped league), it is almost irrelevant in the National Basketball League (NBA). The NBA has a salary cap and

teams spend approximately the same amount of money for total player salary, meaning the best teams in the league will naturally have the most wins per dollar spent.

Another attribute of a player that teams consider when deciding whether or not to pursue them is the player's personality. There is certainly something to be said for team chemistry and having players who like one another. It is commonly believed that when players are putting the team's collective success above individual accomplishments, the team will achieve more of their potential than a team of superstars focused on individual accomplishments. We are also aware that a team's mental-toughness is an incredibly important factor in success. Will the team overcome adversity? Will they be able to execute in the final minutes of a close game and come away with a victory? All of these are important factors in a team's success, however, it is beyond the scope of this research to quantify the exact amount of importance that should be placed on those factors. Anecdotally, one can make the argument that a portion of the error we find in the research can be attributed to our lack of knowledge of how chemistry and mental toughness affect success. So, instead of making an attempt to quantify an intangible statistic, we will only focus on the information we can compute using the data available to us.

Our studies continue previous research on the nature of NBA team success and what leads to wins. Previous research showed that the Player Efficiency Rating (PER) was a strong indicator of team success, but we believe the statistic is not as strong as it could be.[5] While the errors in our regressions were small, we believe we can reduce them further. The way we will do this is by taking a deeper look at PER and how the statistic is calculated. We conjecture that there are some flaws in the statistic, leading to aspects such as power forwards and centers having drastically higher ratings on average than other positions. Additionally, variables in the statistic such as adjusting for a team's pace seems unnecessary on a team scale (versus

comparing individual players, where pace can show what player is more effective per possession), as a team's pace has little to no correlation in predicting team success, which we will explain later.

4. WHAT PLAYER EFFICIENCY RATING IS AND SOME PROBLEMS WITH THE STATISTIC

Player Efficiency Rating (PER) is a per-minute statistic that essentially quantifies a given player's effectiveness on the court. The league average of PER is set to 15.00, meaning players are measured against others in the league. So, if the average player in 2016 is better than the average player in 1992, then a "good" player in 2016 must be better than a "good" player in 1992.

In addition to the per-minute statistic, PER is also adjusted for pace. Pace is the number of possessions (think opportunities for a player to score, assist, rebound, etc.) a team has in a game. By adjusting for speed and pace, all players are graded on the same scale.

To begin to calculate PER, one must start with uPER. uPER stands for Unadjusted Player Efficiency Rating. Before the league average is adjusted to a PER of 15.00, every player has their uPER. The formula for uPER is

uPER =

(1/MP)
*
3P Made
+
Value of assist
+
Value of field goal relative to league field goals
+
Value of a free throw
-
Cost of turnover
-
Cost of a missed field goal attempt based on league DRB%, because your team loses possession
-
Cost of missed FT, as your team did had a chance to score but did not
+
Value of a defensive rebound, securing a possession for team
+
Value of an offensive rebound, maintaining your team's possession
+
Value of a steal
+
Value of a blocked shot
-
Cost of a foul

Where,

Factor = (2 / 3) - (0.5 * (total assists in league / total field goals in league)) / (2 * (total field goals in league / total free throws in league))

Value of Possession (VOP) = total points in league / total (approximate) possessions in league

DRB% = league's defensive rebound percentage, calculated by (total defensive rebounds) / (total rebounds)

Value of assist = 2/3 * total assists

Value of a field goal = (2 - factor * (total team assists / total team field goals)) * field goals

Value of free throw = (Total free throws *0.5 * (1 + (1 - (total team assists / total team field goals)) + (2/3) * (total team assists / total team field goals)))

Cost of turnover = VOP * total turnovers

Cost of a missed field goal attempt = VOP * number of missed shots * DRB%

Cost of missed free throw = VOP* 0.44 * (0.44 + (0.56 * DRB%)) * missed free throws

Value of defensive rebound = VOP * (1 - DRB%) * total defensive rebounds

Value of offensive rebound = VOP * DRB% * total offensive rebounds

Value of a steal = VOP * total steals

Value of a blocked shot = VOP * DRB% * total blocked shots

Cost of a foul = VOP * ((league free throws made / league personal fouls committed) - 0.44 * (league free throws attempt / league personal fouls committed)*personal fouls committed

Each player is awarded an uPER, and then the PER can be calculated.

uPER_Pace = (uPER * (average league pace/ individual's team pace)

PER = uPER_Pace * (15/avg(uPER_Pace)

Where

PACE = number of offensive possessions a team has
League average uPER= total uPER in league / number of players in league[2]

As we can see, calculating uPER is a long formula. However, after uPER is calculated, PER is fairly easy to calculate as it is simply adjusting the score based on the team pace relative to the league and adjusting uPER to get to a league average of 15.00.

When researching the origins of PER, it seems the inventor of the statistic, John Hollinger, gave weights to values he believed would accurately represented the true strength of a player. It was not evident that he ran any type of regression to weight components of uPER. While the statistic may have been a great indicator of player skill and effectiveness when it was first calculated, the style of play has changed in the NBA and the statistic needs to be reexamined to ensure the weights of components are most accurately rating players according to their contributions on the court.

Immediately, we see a few problems with PER. The first being adjusting for pace. PER is adjusted for team pace, but it is likely a given player does not play at exactly his team's pace. In fact, strategy regarding pace often changes when substitutions are made. Suppose a team has an incredible young point guard. The point guard likes to run the floor and play an up-tempo style of play, so when he is on the floor, the team has a high PACE. However, his backup is a savvy veteran player that works the defense methodically to get his team the best shot. The entire team may have an average pace, but the young point guard will have an inflated PER while the veteran has a deflated PER, because during their time on the court, the team PACE is

dramatically different that the overall team PACE. However, while this may hurt an individual player's PER, for the purpose of our study we will ignore this fact as team pace does not appear to correlate to team success, which we will show later.

Additionally, when looking at PER across position, and not across the league, the average is rarely 15.00. For some reason, power forwards (PF) and centers (C) have a PER higher than point guards (PG), shooting guards (SG), and small forwards (SF). We will discuss possible causes for difference in PER among positions in due time, but for now we simply see this as a potential flaw in PER. As mentioned earlier, the style of play in the NBA has changed and centers and power forwards are no longer considered the most important part of teams.

In the 2013-14 and 2014-15 season, players that played at least 6.09 minutes per game had their PER measured. In that season, the average PER for all players at a given position were as follows,

2013-14:	PG: 14.58	SG: 13.34	SF: 13.16	PF: 15.04	C: 16.21
2014-15:	PG: 14.79	SG: 12.94	SF: 13.02	PF: 14.96	C: 16.91

With standard deviations,

2013-14:	PG: 4.06	SG: 3.30	SF: 4.48	PF: 4.31	C: 3.66
2014-15:	PG: 4.32	SG: 3.70	SF: 4.11	PF: 4.03	C: 3.74

Additionally, the medians for the seasons were as follows,

2013-14:	PG: 14.20	SG: 13.44	SF: 12.05	PF: 14.20	C: 16.17
2014-15:	PG: 13.92	SG: 12.36	SF: 12.33	PF: 15.03	C: 16.21

As we can see, centers and power forwards tended to have higher averages, as well as a higher median PER. Two different measures of central tendency give similar results, which suggest there is some real phenomena occurring which rates centers and power forwards higher than other positions. We will attempt to adjust the weights of certain variables to give a more

level distribution of PER across different positions. While this research looks at making the PER statistic more evenly distributed across positions, we acknowledge some would like to use different weights for different positions, and set each position average to 15.00. This would compare players against their own position, which some might find more desirable. However, we choose to evaluate all players together as our main goal is to use PER and predict team wins, and winning involves contributions from all positions working together.

A final issue with the statistic is that it does not appropriately capture a player's defensive impact on the game. The only pure defensive statistics measured by PER are steals and blocks, and defensive rebounds are in part a defensive statistic. However, there is much more that goes into defense than simply steals and blocked shots. In a previous study done by Franks, Miller, Bornn, and Goldberry, the authors argue that there are quantitative ways to measure a player's effectiveness defensively beyond simply blocks and steals.[4] The study looked at data that measured how frequently an opponent attempted a shot against a defensive player, as well as how frequently the opponent scored on the defender. While this research can be extremely informative and give us great results, we chose to ignore the findings for this particular research into PER, but acknowledge that using this information in future research may provide us with better results.

5. METHODS

We continue the research we performed in the ATP Summer Research Program. During the research program, we discovered that PER was a great predictor of wins, but also that the statistic fell short in some areas. One of the big flaws with the statistic is that when it ranked players, though the league average was set to 15.00, centers and power forwards consistently out-rated other positions. Our main goal will be to try to adjust certain variables in the formula

that calculates PER in order to make the statistic give more uniform ratings across positions. This will require an exploratory analysis approach.

One of the weaknesses of PER is that centers and power forwards, on average score higher than PG, SG, and small forwards. However, though all positions are important, today's NBA game places less importance on a dominant post player and many analysts would agree that the inside game in the NBA is a dying art. In an article published for the Atlantic, Kevin Fixler argues NBA centers are disappearing and post play has seen a dramatic decline in recent years. He argues that the play of guards and small forwards have dramatically increased. So why, if post play is not very strong, do post players, on average rank higher in PER? We believe this is due to the relative weighting scales for the statistics.

In examining the 2013-14 season, centers and power forwards had an average PER above 16, while point guards, shooting guards, and small forwards were all below the league average of 15. In order to correct this, we adjust the relative weights of particular statistics and try to even out the average so all 5 positions score relatively the same. As stated earlier, guards and small forwards are now the more dominant players in the NBA. From 1993-2004, only three times did a non-post player win the MVP award (Michael Jordan twice and Allen Iverson). When the PER was developed, centers did play an important role in team success. However, since 2004, no traditional low-post player has won an MVP award. Because modern basketball is changing, it is necessary to adjust the PER formula to accurately represent the current NBA.

Another negative aspect of PER is when it adjusts for team pace. While it is understandable to want to level the field when it comes to the opportunity to contribute to team success, statistics show that there is no correlation between team pace and wins. In the 2013-14 and 2015-16 seasons, teams that played at a relatively slower pace tended to be more successful.

However, in the 2014-15 season, teams that played at a quicker pace tended to be more successful. Because of this, we believe including pace in the PER statistic is overcomplicating and over-standardizing the statistic.

6. RESULTS

In looking at the 2013-14 season, ignoring the pace ratio in the PER equation, point guards and shooting guards had an average PER of 14.57 and 14.09 respectively. Small forwards were 13.68 while power forwards and centers had a PER of 16.5 and 16.44. The standard deviation of these scores was 1.33. However, when we made a slight adjustment to PER by weighting assists 50% more and 3 point shots 30% more (to adjust for guards), we saw the PER levels go to 16.12 for PG, 14.40 for SG, 13.56 for SF, 15.58 for PF and 15.15 for C. This brought the standard deviation between the 5 positions to 1.00. We then increased the cost of turnovers, by a factor of 10% and got the following results.

	PG	SG	SF	PF	C	Standard Deviation
Standard PER	14.57	14.09	13.68	16.50	16.44	1.33
Modified PER	16.06	14.45	13.56	15.59	15.11	0.98

At this point, one might question why these were the two variables we chose to adjust, and why we chose to adjust by the factors that we did. We begin by explaining why assists were increased by 50%. In the PER formula, rebounds are given almost a full VOP. This is because a defensive rebound ends the possession for the opponent and an offensive rebound continues the possession for a player's team. Centers and power forwards are typically the tallest players on the court and play the closest to the basket. They tend to get more rebound when compared to

point guards, shooting guards, and small forwards. In the 2013-14 season, the average rebounds per minute across the position were as follows

Point Guard	Shooting Guards	Small Forwards	Power Forwards	Centers
.107	.121	.168	.248	.296

As we can see from the table, centers rebound at nearly three times the rate of Guards and twice as often as small forwards, while power forwards also rebound at over twice the rate of guards and 1.5 times as frequently as small forwards. We assert this is one reason why C's and PF's tend to have higher PERs. In fact, if we calculate PER for the 2013-14 season without considering individual rebounds a player gathers, we find a dramatically different PERs across positions. The results are as follows.

	PG	SG	SF	PF	C
PER	18.31	14.24	12.96	14.90	13.79
Change	+3.74	+.156	-.72	-1.60	-2.65

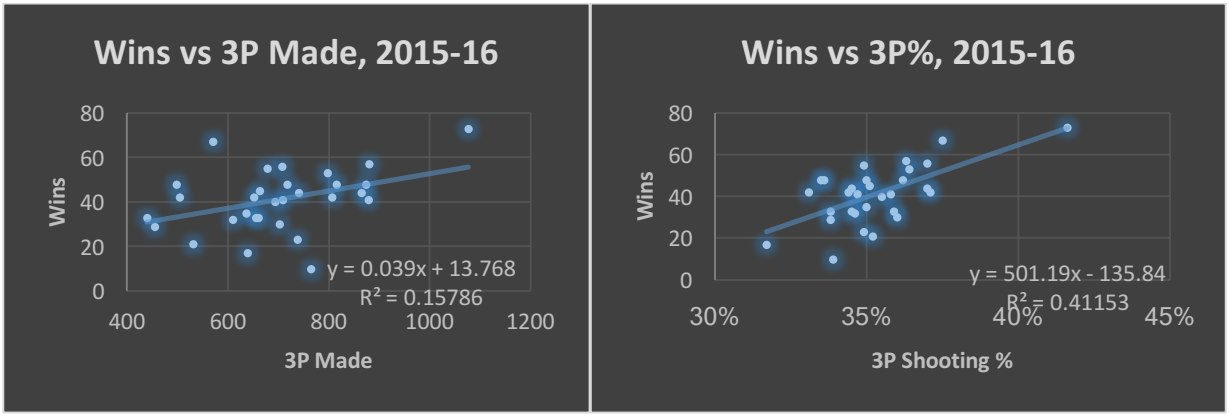
This shows us that rebounds dramatically influence individual PER. While we recognize the importance of rebounds, rebounds occur at approximately twice the rate of assists, explaining why players that accrue rebounds at a higher rate have a much higher PER. Because assists happen less frequently, their relative importance is increased. Another way to understand the value of an assist compared to a rebound is to think about the very definition of a rebound. After a missed shot, somebody will secure a rebound. Essentially, a rebound HAS to happen (unless the ball goes out of bounds on a missed shot attempt, which is very infrequent). However, made shots do not necessarily imply an assist. Assists do NOT have to happen, but rebounds do. In the 2013-2014 season, there were 101,689 total rebounds, compared to 52,226 assists. In the

2014-15 season, there were 106,502 total rebounds to 54,190 assists. By its very definition, an assist is a pass that directly leads to a score. Because an assist has a direct impact on a team's ability to score and thus win the game, we believe it should play a more important role in determining an individual's PER. Additionally, guards and small forwards tend to have higher assists than power forwards and centers. In 2013-14, the average assists per minute were as follows

Point Guard	Shooting Guards	Small Forwards	Power Forwards	Centers
.165	.082	.071	.053	.051

The table shows that on average, point guards record assists at 3 times the rate of power forwards and centers. Shooting guards and small forwards also record assists at approximately 1.5 times the rate. By giving more value to assists, we are able to level PER across positions.

Additionally, we believe 3-Point field goals were undervalued in the PER formula. The NBA is evolving and more emphasis is placed on teams that can shoot the 3-ball effectively. It is difficult to quantitatively evaluate the exact impact of 3-point field goals, but we can qualitatively see it gives teams an advantage. With that said, plotting team wins for over the past three seasons (2013-14, 2014-15, 2015-16) against 3-point shots made and 3-point shooting percentage, we do see some positive correlation between the deep-ball and wins.



The ability to shoot well has a greater impact than just the points added in the shot. Good three-point shooters do something called "stretch-the-floor." We can see that shooting percentage gives a much stronger correlation than simply making three-point shots. The R-value for threes made is around .4, while three-point percentage is roughly .65. Essentially, stretching the floor means the defense has to play further away from the basket in order to cover the shooter, which opens up more lanes to penetrate for teammates of the shooter and gives post players more room to operate. The more shooters a team has on the court, the more space (relative distance from one defender to the next) is created for the team offensively because the defense is further away from the basket covering these shooters which tends to lead to more efficient offensive play. An article on offensive theory states,

> "The most valuable commodity in any offense is space. Proper spacing provides operating room for offensive players, good opportunities for screening and allows you to control matchups. In addition, good spacing forces the defense to make decisions and adjustments that are contrary to good defense. It limits help possibilities, creates bad matchups and switches and allows time for the offense to study the floor when making decisions."[8]

Guards and small forwards tend to be better shooters than centers and power forwards. In 2013-14, average 3-point field goals made per minute were as follows

Point Guard	Shooting Guards	Small Forwards	Power Forwards	Centers
.0412	.0490	.0386	.0164	.0026

The table shows us that the players making the three-point shots are the PG, SG, and SF. By giving more weight to 3-point field goals, we again we able to make a more uniform distribution of PER among different positions, as well as more accurately showing a real contribution for team success.

There is one more change we believe we must make in order to get a PER that more accurately shows how a player contributes to team wins, which is an adjustment for turnovers.

In the current PER formula, turnovers only hurt the rating because it considers a turnover a loss of team possession. However, a turnover is much more than a loss of team possession, as you give the ball back to your opponent. There are two kinds of turnovers, dead-ball and live-ball turnovers. A dead-ball turnover occurs when the offensive team commits a foul or a violation (such as traveling or throwing the ball out of bounds). A dead-ball turnover allows for a team to reset their defense and play as they normally would. A live-ball turnover occurs when a player simply loses possession of the ball and the defending team gains possession without a stoppage in play. Live ball turnovers are more costly for a team as they allow their opponent to have the ball in what is called "transition," where they are more likely to get an open shot or a layup because the other team was unable to properly set up their defense. According to a website called inpredictable.com, between the 2011 and 2015 NBA seasons, the VOP of a possession after a live-ball turnover is roughly 1.194, whereas a dead ball turnover is only .986. Additionally, live ball turnovers account for roughly 60% of a team's turnovers.[3]

In our study, we are looking at the 2013-14 NBA season, where the league VOP was 1.047. Recall that a live-ball turnover gave the opposing a VOP of 1.194. This means s live-ball turnover adds approximately .15 VOP (difference of 1.194 and 1.047) to opposing teams. In the 2013-14 season, live ball turnovers accounted for 65% of team turnovers. This means on average, a turnover gave the opposing approximately a better VOP by .1, calculated .65 * .15. This added .1 in VOP means the opposing team will score approximate 10% more frequently (as VOP is approximately 1) as a result of a turnover, so we adjust the cost of a turnover by 10%, as it improved the other team's chance to score by roughly that much. This is our final adjustment to the PER formula.

Our next step is to take our new PERs and test them against team wins in order to see how well they work as predictors of team success. In previous research, we examined the top player PER overall, top 2 players overall, and top 3, 5 and 7 players based on minutes played. When we made the decision to differentiate between overall ratings and minutes played, we did so because we believe it gives the most accurate portrayal of a team. Frequently, the best player on a team will not play the most minutes, even though they make the most contributions. For this reason, we wanted to look at the top player and top 2 player PER. However, after the two best players, we believe that time on the court is a better indicator of a player's true value to a team. This is because the top two players are consistently accumulate the top 3 minutes on their team, and more time on the court means the player has more impact on the result of games. Because PER is a per-minute statistic, sometimes players that come in only a few minutes occasionally, or only play in "garbage time" (end of game when the score is not close), their own PER can be inflated even though they did not contribute much to team success.

Previously we found,

Top player PER, regression of best-fit was Wins = 42.005ln(PER) - 88.235 with an $R^2 = 0.2394$.

Top two player PER we had Wins = 55.317ln(PER) - 163.3 with an $R^2 = 0.2976$.

Cumulative 3 Player PER- Wins = 78.52ln(PER) - 268.49 with an $R^2 = 0.6323$.

Cumulative 5 Player PER- Wins = 90.481ln(PER) - 355.98 with an $R^2 = 0.4443$.

Cumulative 7 Player PER- Wins = 124.31ln(PER) - 540.94 with an $R^2 = 0.551$.

Where the R^2 value is the percentage of the response variable (i.e. wins) that is explained by our regression. We see that, generally, as we add more players to our model, the R^2 value increases. However, it is worth noting the 3-player cumulative PER has the best regression model. This suggests that having a strong three players is incredibly important in the NBA. After having a

solid core of three players, teams should then focus on their depth (number of quality players) to best increase their chances for success. Additionally, we can infer that have a many slightly above average players tend to lead to more success than one or two superstar players.

Our modified PER vs. Wins shows:

Top Player PER- Wins = 47.689ln(PER) - 112.45 with an $R^2 = 0.3748$.

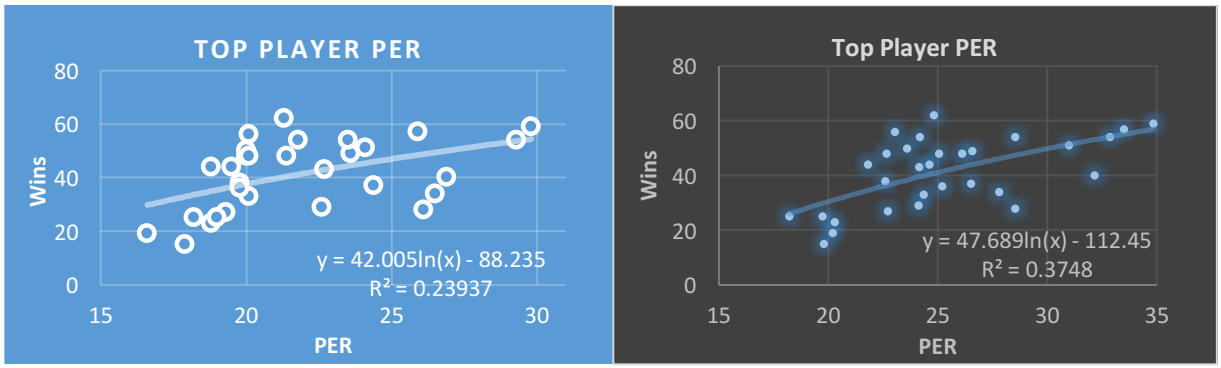
Top 2 Player PER- Wins = 61.631ln(PER) - 194.97 with an $R^2 = 0.357$.

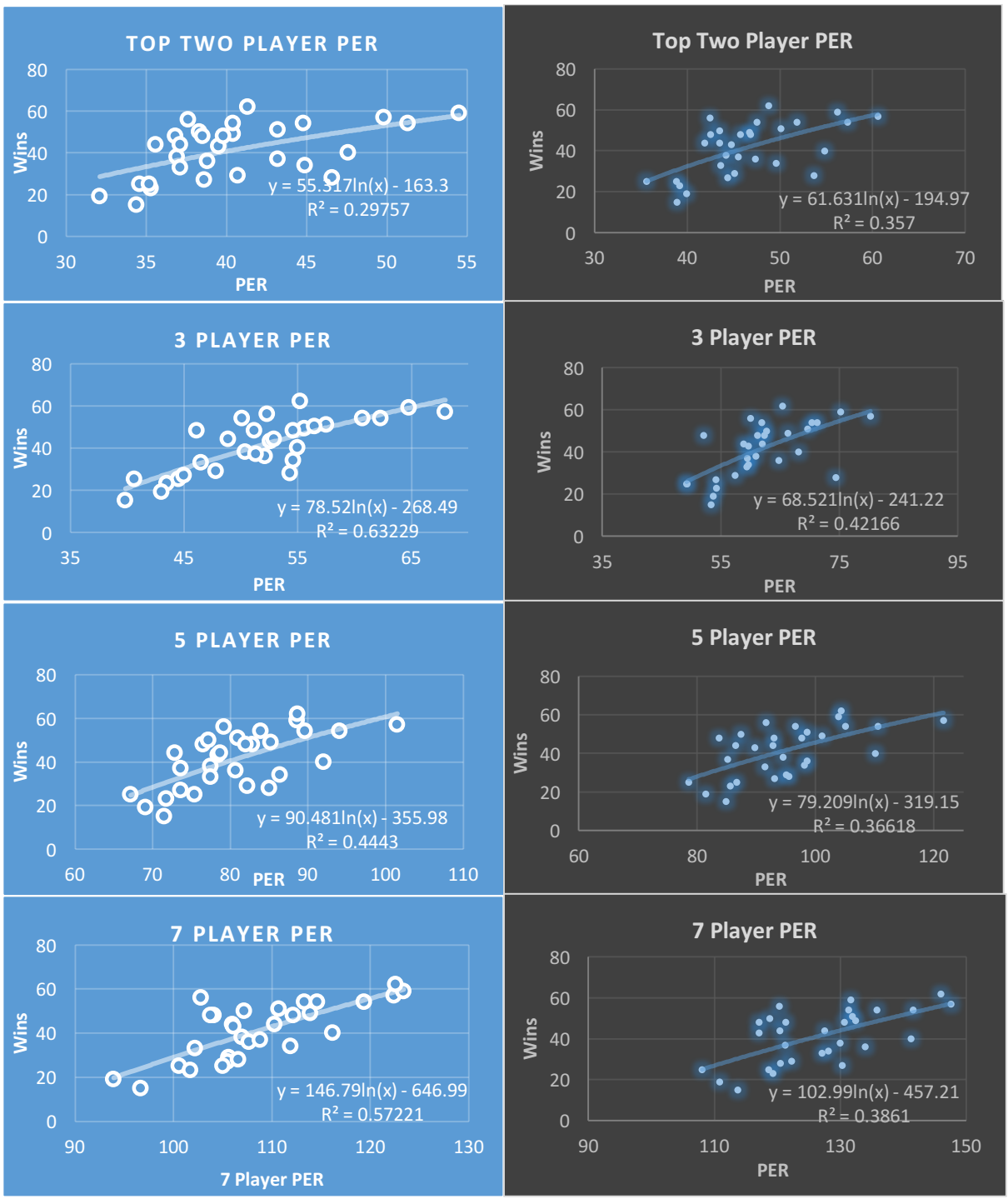
Cumulative 3 Player PER- Wins = 68.521ln(PER) - 241.22 with an $R^2 = 0.4217$.

Cumulative 5 Player PER- Wins = 79.209ln(PER) - 319.15 with an $R^2 = 0.3662$.

Cumulative 7 Player PER- Wins = 102.99ln(PER) - 457.21 with an $R^2 = 0.3861$.

The following graphs show the two results with PER. The standard PER is on the left, while our modified PER is on the right.





Our modified PER has a stronger regression model with the top players and top two players, but loses strength with three players, five players, and seven players. Additionally, we see very little variation in the R^2 values in our modified PER (between 35% and 42%) whereas

the traditional PER shows a dramatic increase in how the accuracy of the regression model (23% to 63%). With both PERs, the three-player PER had the least amount of error. This suggests perhaps the most important factor to team success is a strong three players. The second strongest correlation was found in the seven player PER, further suggesting team depth is another important factor in team success. These are obviously mixed results, and in further research we will attempt to determine why the modified PER was stronger compared to traditional PER with the top player and top two players, but weaker with three, five, and seven players.

7. CONCLUSIONS

First, the regression models that gave us the highest R^2 value were logarithmic regressions. We also produced linear and exponential regressions, but these regressions produced more error. The reason we believe logarithmic growth is the most accurate is because there are a limited number of games in the NBA season. There are 82 games in a season, and therefore a team can win at max 82 games. As a team improves, it becomes harder to win more games simply because there are not as many "losses" to change to "wins." Hypothetically, if a team loses 10 games in a season, adding a better player to their roster will only be able to affect those 10 losses. However, if a team loses 60 games, the better player can help the team win 60 more games. In short, as wins increase, it becomes harder to win more and more games.

Additionally, we see that the modified PERs are generally higher for the higher rated players and lower for the lesser rated players. We believe this is because the modified PER is more in line with the way coaches see the game and player effectiveness. The standard deviation among players in the modified PER in the 2013-14 season is 8.29, compared to under 4.15 in the standard PER system. The modified PER essentially rates better players higher, and less effective players lower. The modified PER took all league players into account when setting the league average to 15.00. We made this decision because we believe that standard PER of having "qualified players" skews results, because there is a difference between the average NBA player and the average qualified player. We wanted our PER to represent the entire league, not just a select portion of the league. Now, when we look at the minutes played of each player, this represents a coach's decision. The decision on which particular players to have on the court has a tremendous influence on the results of a game. When we look at the 2013-14 NBA season, the mean for minutes played for all players in the league was 1242.98 minutes, with a standard

deviation of 897.76 minutes. The standard PER league average for the same season was 14.48 (note: the league average is not 15.00 because we included players under the minimum threshold of minutes played and thus were not included in the calculation of the statistic for that season), with a standard deviation of 4.15. In our modified PER, we find the league average to be 15.00, with a standard deviation of 8.29. Now, we want to look at the relative difference between the statistics and their standard deviations.

	Mean value	Standard Deviation	Coefficient of Variation
Minutes Played	1242.98	897.76	.722
Standard PER	14.48	4.15	.286
Modified PER	15.00	8.29	.553

The table shows us that our modified PER varies to relatively closer extent to minutes played than the standard PER statistic does. This suggests that there is a slight problem in the traditional PER where players are rated more closely together, but coaches see a dramatic difference in the player ability on the court. However, our modified PER more closely illustrates the difference in the level of quantitative effectiveness on the court and a coach's perception of the player's qualitative effectiveness.

8. AREAS FOR FUTURE RESEARCH

While this research gave some insight into the PER statistic and some of the ways it could improve, we believe there is much more work that can be done in exploring the statistic and making a powerful indicator of team success. John Hollinger, the creator of PER, acknowledges the statistics weakness in measuring defensive effectiveness. We believe one way to improve the statistic would be to further the done by Franks, Miller, Bornn, and Goldsberry to

give players a numerical value for their defensive prowess. Adding this value to the weight for PER would improve the statistic by including the area of the game it least represents. Another area for future research is to run regressions using multiple statistics to find appropriate weights for PER components. This research looked at one statistic at a time, and we acknowledge results may be different when combining statistics.

Appendix

2013-14 NBA Player PER

Player	Team	PS	Mod PER	Trad PER	Min
teague,jeff	atl	PG	21.6136	20.0459	2546
millsap,paul	atl	PF	22.5854	23.2822	2481
korver,kyle	atl	SG	16.746	15.8608	2413
carroll,demarre	atl	SF	16.1945	16.4065	2343
mack,shelvin	atl	PG	17.441	15.4703	1494
scott,mike	atl	SF	17.3349	17.941	1484
williams,louis	atl	SG	18.0663	16.6793	1445
brand,elton	atl	PF	15.4791	16.521	1416
horford,al	atl	PF	24.1969	25.8245	960
antic,pero	atl	PF	14.1043	13.7673	928
schroder,dennis	atl	PG	8.35735	6.73756	641
ayon,gustavo	atl	PF	14.4091	15.222	429
muscala,mike	atl	C	11.6395	12.7104	215
jenkins,john	atl	SG	6.19095	5.49013	157
pittman,dexter	atl	C	13.8803	15.519	3
green,jeff	bos	PF	14.9704	15.2445	2805
bass,brandon	bos	PF	16.1012	17.496	2262
sullinger,jared	bos	PF	18.2145	19.0702	2041
bradley,avery	bos	PG	14.4753	14.8149	1855
bayless,jerryd	bos	PG	14.8326	13.753	1686
wallace,gerald	bos	SF	12.0597	11.6396	1418
olynyk,kelly	bos	PF	17.392	17.8314	1396
humphries,kris	bos	PF	19.5549	21.1786	1381
pressey,phil	bos	PG	12.9108	10.1859	1129
rondo,rajon	bos	PG	21.0264	17.7295	998
johnson,chris	bos	SF	12.7167	12.5896	790
faverani,vitor	bos	C	12.1248	12.9807	488
anthony,joel	bos	C	8.38205	9.25932	190
babb,chris	bos	SG	4.77352	4.22298	135
bogans,keith	bos	SG	12.0616	11.5107	55
blue,vander	bos	SG	0.91918	0.49178	14
johnson,joe	bro	SG	18.0136	17.6009	2574
pierce,paul	bro	SF	19.0152	19.0451	2101
williams,deron	bro	PG	21.8015	20.1	2058
livingston,shaun	bro	PG	16.7174	16.5179	1976
anderson,alan	bro	SG	11.0122	10.7612	1770
thornton,marcus	bro	SG	13.7448	13.584	1742
blatche,andray	bro	PF	20.1022	21.3445	1622
teletovic,mirza	bro	PF	16.653	16.2774	1399
plumlee,mason	bro	PF	19.948	21.7364	1275
garnett,kevin	bro	PF	14.562	15.186	1111
kirilenko,andrei	bro	SF	13.8368	14.1523	856
terry,jason	bro	SG	10.1685	8.44581	570
lopez,brook	bro	C	26.1616	28.9775	533
teague,marquis	bro	PG	6.04878	4.45433	439
taylor,tyshawn	bro	PG	7.37963	6.09531	271
gutierrez,jorge	bro	PG	10.978	9.93472	244
collins,jason	bro	C	4.30608	4.60678	175
walker,kemba	cha	PG	20.602	19.2426	2617
jefferson,al	cha	C	24.1431	26.0567	2557
henderson,gerald	cha	SG	14.8804	15.0104	2461
mcroberts,josh	cha	PF	17.2643	15.8709	2365
kidd-gilchrist,m	cha	SF	12.8341	13.8917	1501
zeller,cody	cha	PF	14.3599	15.1314	1412
tolliver,anthony	cha	PF	13.0471	12.6238	1300
ridnour,luke	cha	PG	12.2421	10.3279	1138
neal,gary	cha	PG	14.7988	14.2973	1113
biyombo,bismack	cha	PF	13.6784	15.379	1073
douglas-roberts	cha	SF	14.0237	13.9819	1017
taylor,jeffery	cha	SF	6.93934	6.78551	629
gordon,ben	cha	SG	7.93786	7.31883	280
pargo,jannero	cha	PG	24.1285	21.5688	244
hamilton,justin	cha	C	12.0295	13.0561	74
white,d.j.	cha	PF	2.50325	2.79878	10
noah,joakim	chi	C	22.6328	22.6563	2818
butler,jimmy	chi	SG	15.0024	15.1862	2594
dunleavy,mike	chi	SG	14.485	14.1458	2586
gibson,taj	chi	PF	16.4496	18.0154	2353
boozer,carlos	chi	PF	15.1266	16.2476	2143
hinrich,kirk	chi	SG	13.5404	12.0586	2120
augustin,d.j.	chi	PG	19.876	18.1368	1942
snell,tony	chi	SF	9.54152	8.9455	1235
martin,cartier	chi	SF	13.1811	12.9718	873
mohammed,nazr	chi	C	10.534	11.4768	562
rose,derrick	chi	PG	12.4451	10.8846	311
amundson,lou	chi	PF	8.87705	9.85582	176

brewer,ronnie	chi	SF	4.72636	4.00564	162
shengelia,tornik	chi	SF	4.61448	3.85326	158
james,mike	chi	PG	5.3157	1.66638	77
murphy,erik	chi	PF	0.53092	0.16792	65
thompson,tristan	cle	PF	15.8191	17.3902	2591
irving,kyrie	cle	PG	24.3402	23.3029	2496
hawes,spencer	cle	C	19.2714	19.088	2468
jack,jarrett	cle	PG	14.6703	13.3595	2253
deng,luol	cle	SF	17.3802	17.6231	2213
waiters,dion	cle	SG	16.6933	16.2763	2073
varejao,anderson	cle	PF	18.8981	19.8161	1803
dellavedova,matt	cle	SG	14.2079	12.4326	1276
zeller,tyler	cle	PF	16.2183	17.8226	1050
gee,alonzo	cle	SG	9.78658	9.94875	1021
miles,c.j.	cle	SG	18.6113	18.5021	987
bennett,anthony	cle	PF	7.51783	7.98317	666
karasev,sergey	cle	SG	3.11706	2.69052	156
felix,carrick	cle	SG	15.9787	15.4536	38
onuaku,arinze	cle	PF	5.31294	4.19284	31
curry,seth	cle	PG	15.6467	16.0978	13
edwards,shane	cle	SF	1.69578	-1.32036	11
hopson,scotty	cle	SG	4.33935	-7.73257	7
ellis,monta	dal	PG	20.1339	19.5121	3023
nowitzki,dirk	dal	PF	26.5749	27.4318	2625
calderon,jose	dal	PG	19.5792	17.6685	2472
marion,shawn	dal	SF	15.4235	16.018	2407
carter,vince	dal	SG	19.3646	18.4906	1975
dalembert,samuel	dal	C	17.6997	19.6676	1614
crowder,jae	dal	SF	13.6472	13.7815	1258
blair,dejuan	dal	C	18.6558	20.0989	1217
wright,brandan	dal	C	24.7537	27.3034	1083
harris,devin	dal	PG	19.3472	17.0062	817
larkin,shane	dal	PG	11.0696	9.53698	494
ellington,wayne	dal	SG	14.308	14.0694	398
mekel,gal	dal	PG	9.11339	6.21337	293
james,bernard	dal	C	8.88092	9.94882	145
ledo,ricky	dal	SG	14.9505	14.3002	34
foye,randy	den	PG	17.4971	16.2173	2487
lawson,ty	den	PG	25.1909	23.2192	2221
faried,kenneth	den	SF	22.14	24.2668	2179
chandler,wilson	den	SG	15.4704	15.2121	1925
hickson,j.j.	den	PF	18.3182	19.8828	1859
mozgov,timofey	den	C	18.5725	20.4549	1774
brooks,aaron	den	PG	16.7116	15.0258	1558
fournier,evan	den	SG	13.2759	12.6588	1502
arthur,darrell	den	PF	11.2191	11.4281	1164
robinson,nate	den	PG	19.9793	18.954	870
miller,quincy	den	SF	10.2651	10.5063	788
vesely,jan	den	SF	13.8816	15.2421	775
randolph,anthony	den	PF	14.5772	14.9223	527
mcgee,javale	den	C	10.3848	11.7398	80
smith,josh	det	SF	16.48	16.5623	2733
jennings,brandon	det	PG	20.9876	18.4396	2729
monroe,greg	det	C	19.9407	21.407	2693
drummond,andre	det	C	24.105	26.9448	2614
singler,kyle	det	SG	13.5835	14.023	2335
stuckey,rodney	det	PG	16.0144	16.5149	1949
caldwell-pope,ke	det	SG	11.1266	11.1743	1582
bynum,will	det	PG	18.6501	16.9935	1054
jerebko,jonas	det	PF	15.4441	15.8181	743
harrellson,josh	det	PF	15.6913	16.0885	314
billups,chauncey	det	PG	8.26433	6.19874	310
datome,luigi	det	SF	9.54292	9.48637	236
siva,peyton	det	PG	8.76189	6.69082	225
villanueva,charl	det	PF	15.1684	15.1113	179
mitchell,tony	det	PF	18.477	20.2637	84
thompson,klay	gsw	SG	17.3999	17.0673	2867
curry,stephen	gsw	PG	30.9579	28.87	2843
lee,david	gsw	PF	21.301	22.9435	2288
barnes,harrison	gsw	SF	11.7232	11.7454	2207
iguodala,andre	gsw	SG	17.1688	16.3659	2041
crawford,jordan	gsw	SG	18.1101	16.7757	1858
green,draymond	gsw	SF	15.2491	15.1076	1796
bogut,andrew	gsw	C	19.137	20.4558	1770
blake,steve	gsw	PG	16.1915	13.4378	1496
speights,marrees	gsw	PF	16.5347	18.1085	985
o'neal,jermaine	gsw	C	16.6605	18.4291	882
nedovic,nemanja	gsw	SG	0.45895	-2.14021	144
armstrong,hilton	gsw	PF	18.2587	19.7858	100
kuzmic,ognjen	gsw	C	3.33515	3.97084	95
parsons,chandler	hou	SF	19.4074	19.021	2785

harden,james	hou	SG	28.515	28.1014	2780
howard,dwight	hou	C	23.3478	25.6001	2396
jones,terrence	hou	PF	21.3014	22.9196	2083
lin,jeremy	hou	PG	17.9777	17.0316	2054
beverley,patrick	hou	PG	15.5046	14.9027	1750
casspi,omri	hou	SF	15.5028	15.4329	1284
garcia,francisco	hou	SG	11.9646	11.223	1083
hamilton,jordan	hou	SF	15.6538	15.518	1019
asik,omer	hou	C	15.4524	17.0994	964
motiejunas,donat	hou	PF	12.2314	12.8807	952
canaan,isaiah	hou	PG	12.8727	11.7683	253
smith,greg	hou	PF	14.4563	16.4796	100
daniels,troy	hou	SG	20.4087	18.8756	76
covington,robert	hou	SF	17.3645	17.5212	35
powell,josh	hou	PF	2.37648	2.9903	19
george,paul	ind	SG	23.0242	23.1262	2902
stephenson,lance	ind	SG	17.5893	16.9461	2747
west,david	ind	PF	19.4241	20.2075	2469
turner,evan	ind	SG	15.4275	15.221	2453
hill,george	ind	PG	16.1753	15.4308	2436
hibbert,roy	ind	C	14.2916	15.5905	2406
scola,luis	ind	PF	14.3782	15.3834	1398
mahinmi,ian	ind	C	10.6087	11.7518	1253
watson,c.j.	ind	PG	15.5106	15.0418	1194
allen,lavoy	ind	PF	14.7818	15.4191	1068
bynum,andrew	ind	C	16.4714	17.7012	517
sloan,donald	ind	PG	11.096	9.72609	392
butler,rasual	ind	SG	14.1896	13.9143	382
copeland,chris	ind	SF	20.8764	20.0825	268
hill,solomon	ind	SF	8.89541	8.68799	228
jordan,deandre	lac	C	19.7274	21.8009	2872
griffin,blake	lac	PF	27.0771	28.5383	2864
paul,chris	lac	PG	33.4931	31.0506	2168
crawford,jamal	lac	SG	21.2991	20.6773	2093
collison,darren	lac	PG	20.0421	19.2976	2071
barnes,matt	lac	SF	14.755	14.3433	1738
dudley,jared	lac	SG	11.1399	10.5979	1730
davis,glen	lac	PF	13.9817	14.9464	1668
redick,j.j.	lac	SG	20.1957	19.8752	988
green,willie	lac	SG	9.13641	8.44817	870
granger,danny	lac	SF	12.4149	12.3286	848
hollins,ryan	lac	C	12.6056	14.1397	485
bullock,reggie	lac	SG	8.39906	7.98263	397
turkoglu,hedo	lac	SF	14.2618	13.5002	394
jamison,antawn	lac	PF	9.15027	9.25456	248
jackson,stephen	lac	SG	0.80673	0.1379	106
vujacic,sasha	lac	SG	1.44072	1.69537	10
wayns,maalik	lac	PG	24.7549	23.196	9
meeks,jodie	lal	SG	17.8761	18.0231	2557
johnson,wesley	lal	SG	13.6177	13.5539	2241
gasol,pau	lal	PF	22.7035	23.6668	1883
young,nick	lal	SG	19.381	19.5984	1818
marshall,kendall	lal	PG	19.4827	15.4318	1568
hill,jordan	lal	C	21.6512	23.7982	1501
kelly,ryan	lal	SF	15.5546	15.4965	1314
sacre,robert	lal	C	13.9069	14.8627	1093
farmar,jordan	lal	PG	21.0237	18.3718	912
bazemore,kent	lal	SG	14.2982	13.6447	912
henry,xavier	lal	SG	14.657	15.0911	907
williams,shawne	lal	SF	11.8489	11.6107	754
kaman,chris	lal	C	19.5008	20.8505	736
brooks,marshon	lal	SG	18.1499	18.5177	320
nash,steve	lal	PG	18.1873	14.9567	313
harris,manny	lal	PG	13.5124	13.4769	179
bryant,kobe	lal	SG	14.7063	13.0216	177
harris,elias	lal	SF	9.2286	8.63758	12
randolph,zach	mem	PF	19.2639	20.4711	2709
conley,mike	mem	PG	23.5895	22.3658	2447
gasol,marc	mem	C	19.9059	20.3888	1976
lee,courtney	mem	SG	15.3637	15.5748	1974
prince,tayshaun	mem	SF	9.3079	9.12243	1949
miller,mike	mem	SF	14.5757	13.9232	1709
koufos,kosta	mem	C	16.7437	18.457	1351
allen,tony	mem	SG	16.7426	17.5237	1276
calathes,nick	mem	SG	15.3357	13.8071	1174
johnson,james	mem	PF	20.6442	20.7618	957
davis,ed	mem	PF	16.287	17.9052	956
udrih,beno	mem	PG	15.8861	14.0672	646
leuer,jon	mem	PF	18.5288	19.7057	643
morris,darius	mem	PG	12.9513	11.4837	305
pondexter,quincy	mem	SF	12.2216	11.7083	270

franklin,jamaal	mem	SG	5.85392	5.6288	162
james,lebron	mia	SF	32.8465	33.198	2903
bosh,chris	mia	PF	20.1641	21.6303	2529
chalmers,mario	mia	PG	17.3703	15.868	2182
cole,norris	mia	PG	11.1745	9.87965	2012
allen,ray	mia	SG	15.042	14.5134	1937
wade,dwyane	mia	SG	24.4309	24.9244	1776
battier,shane	mia	SF	10.2645	9.80204	1467
andersen,chris	mia	C	18.9062	21.0651	1396
lewis,rashard	mia	PF	12.4368	12.0971	975
beasley,michael	mia	SF	17.8266	18.9143	833
haslem,udonis	mia	PF	10.9387	12.0305	653
mason,roger	mia	SG	10.5633	9.37846	261
jones,james	mia	SF	18.1576	17.4861	236
oden,greg	mia	C	12.3485	14.0696	212
liggins,deandre	mia	SG	131.387	146.898	1
middleton,khris	mil	SF	14.5228	14.2839	2461
knight,brandon	mil	PG	19.7863	18.8382	2407
sessions,ramon	mil	PG	19.0467	18.3361	2215
antetokounmpo,gi	mil	SG	12.4381	12.3392	1899
henson,john	mil	PF	19.1128	20.5312	1858
ilyasova,ersan	mil	SF	15.1817	15.7993	1479
mayo,o.j.	mil	SG	13.594	12.8236	1348
pachulia,zaza	mil	C	15.8594	16.0978	1322
wolters,nate	mil	PG	15.5972	14.5794	1307
adrien,jeff	mil	SF	18.3922	20.0242	963
udoh,ekpe	mil	PF	8.24277	8.7376	804
sanders,larry	mil	C	14.6529	16.0098	586
raduljica,mirosl	mil	C	16.2943	17.5991	463
wright,chris	mil	SF	17.4484	18.9593	126
stephens,d.j.	mil	SG	15.4277	17.2491	16
mitchell,tony_b	mil	PF	33.5385	35.4814	10
love,kevin	min	PF	32.1435	32.6738	2797
rubio,ricky	min	PG	21.2269	18.5926	2636
brewer,corey	min	SF	14.7515	15.3026	2611
martin,kevin	min	SG	19.3118	19.7994	2174
pekovic,nikola	min	C	22.6851	25.0892	1665
cunningham,dante	min	PF	14.4722	15.3112	1635
barea,j.j.	min	PG	16.6659	14.0958	1470
mbah_a_moute,luc	min	SF	9.47769	10.0524	1002
dieng,gorgui	min	C	18.4474	20.0617	821
budinger,chase	min	SF	11.9216	11.6905	754
shved,alexey	min	PG	13.1823	12.322	667
hummel,robbie	min	SF	11.8847	11.7804	651
turiaf,ronny	min	C	15.4569	16.7688	608
muhammad,shabazz	min	SF	14.4711	15.9238	290
price,a.j.	min	PG	13.0986	11.41	101
davis,anthony	nor	PF	27.7826	30.4424	2360
gordon,eric	nor	SG	17.4947	17.052	2057
aminu,al-farouq	nor	SF	14.4222	15.1573	2044
evans,tyreke	nor	PG	21.7973	21.113	2024
roberts,brian	nor	PG	16.6377	15.4307	1671
morrow,anthony	nor	SG	15.8818	16.03	1427
rivers,austin	nor	SG	14.0972	13.2298	1340
holiday,jrue	nor	PG	21.7378	19.6769	1142
stiemsma,greg	nor	C	10.4474	11.2365	1007
ajinca,alexis	nor	C	15.3475	16.7311	952
smith,jason	nor	PF	13.2812	14.3558	826
anderson,ryan	nor	PF	20.9021	21.5682	795
miller,darius	nor	SF	10.6157	10.2414	726
withey,jeff	nor	C	16.1431	17.4701	687
babbitt,luke	nor	SF	14.5526	13.8536	473
thomas,lance	nor	SF	1.45754	0.49067	42
southerland,jame	nor	SF	13.5471	13.5425	30
ely,melvin	nor	C	4.0191	4.49359	27
childress,josh	nor	SF	5.31631	4.52723	24
anthony,carmelo	nyk	SF	26.5039	27.4198	2981
smith,j.r.	nyk	SG	16.6463	15.6553	2423
felton,raymond	nyk	PG	16.3617	14.4668	2020
shumpert,iman	nyk	SG	11.2909	10.8498	1962
hardaway,tim	nyk	SG	14.3617	14.2515	1879
chandler,tyson	nyk	C	17.0408	18.5959	1665
stoudemire,amare	nyk	PF	19.0202	21.191	1466
prigioni,pablo	nyk	PG	16.8605	14.6472	1284
bargnani,andrea	nyk	PF	15.3853	16.3359	1253
clark,earl	nyk	SF	10.5307	10.5894	769
martin,kenyon	nyk	PF	13.5835	13.8564	634
tyler,jeremy	nyk	PF	13.11	14.666	399
artest,ron	nyk	SF	12.9329	13.0945	389
murry,toure'	nyk	SG	13.2595	12.5095	373
aldrich,cole	nyk	C	19.397	21.1859	336

brown,shannon	nyk	PG	5.0224	5.34949	254
smith,chris	nyk	PG	0	0	2
durant,kevin	okl	SF	34.8271	35.5217	3118
ibaka,serge	okl	PF	21.3587	23.3782	2667
jackson,reggie	okl	PG	19.0596	18.192	2281
sefolosha,thabo	okl	SG	12.4257	12.3579	1589
lamb,jeremy	okl	SG	16.2765	15.9062	1543
fisher,derek	okl	PG	12.9725	11.9541	1430
butler,caron	okl	SF	14.7058	14.2907	1416
westbrook,russel	okl	PG	30.4994	29.4539	1409
collison,nick	okl	PF	13.7082	14.0589	1357
perkins,kendrick	okl	C	7.22277	7.43289	1206
adams,steven	okl	C	12.3269	13.4174	1200
jones,perry	okl	SF	11.6592	12.0048	767
roberson,andre	okl	SG	10.1537	10.8035	398
thabeet,hasheem	okl	C	2.41751	3.05773	193
gomes,ryan	okl	SF	0.52193	0.16432	33
williams,reggie	okl	SF	17.7604	18.432	18
shakur,mustafa	okl	PG	3.96891	-10.6195	11
ivey,royal	okl	PG	17.6464	-19.7297	5
afflalo,arron	orl	SG	18.9343	18.6598	2550
oladipo,victor	orl	SG	16.4123	15.8091	2486
nelson,jameer	orl	PG	18.9539	16.1288	2176
harkless,maurice	orl	SF	13.2938	13.7688	1955
harris,tobias	orl	SF	18.0577	19.2472	1847
vucevic,nikola	orl	C	20.277	21.9056	1814
moore,e'twaun	orl	SG	13.3558	12.9771	1506
o'quinn,kyle	orl	PF	18.0582	19.2802	1186
nicholson,andrew	orl	PF	10.8023	11.4893	1172
lamb,doron	orl	SG	9.4919	8.67621	697
maxiell,jason	orl	PF	8.69373	9.52943	487
dedmon,dewayne	orl	C	11.5404	12.9365	390
price,ronnie	orl	PG	11.0013	8.80084	380
jones,solomon	orl	PF	6.40081	6.83095	85
young,thaddeus	phi	SF	19.7447	20.5082	2717
carter-williams	phi	PG	20.197	19.1331	2415
anderson,james	phi	SG	13.7599	13.4594	2307
wroten,tony	phi	PG	16.1378	15.8841	1765
thompson,hollis	phi	SF	11.6669	11.7192	1742
williams,elliot	phi	SG	10.8706	10.6907	1157
sims,henry	phi	C	18.4538	19.7327	877
davies,brandon	phi	PF	8.87996	9.26628	573
mullens,byron	phi	C	15.5462	15.6741	416
varnado,jarvis	phi	PF	15.0736	16.2734	343
maynor,eric	phi	PG	9.63801	7.44408	325
orton,daniel	phi	C	12.2286	12.9271	253
brown,lorenzo	phi	PG	12.0672	10.0407	226
moultrie,arnett	phi	PF	7.34693	8.23552	188
ware,casper	phi	PG	16.6123	16.0127	116
thomas,adonis	phi	SG	9.53393	8.70497	37
johnson-odom,dar	phi	SG	-23.618	-26.8753	16
dragic,goran	pho	PG	26.1075	25.4832	2671
tucker,p.j.	pho	SG	15.4759	15.8885	2489
green,gerald	pho	SG	19.6097	19.6709	2327
frye,channing	pho	PF	15.756	15.7523	2316
morris,markieff	pho	PF	20.7444	21.9986	2151
plumlee,miles	pho	PF	15.6673	17.4332	1963
morris,marcus	pho	PF	17.3179	17.7125	1800
bledsoe,eric	pho	PG	23.9045	23.3641	1416
smith,ish	pho	PG	15.2555	13.8752	1011
goodwin,archie	pho	SG	11.3397	12.2742	533
barbosa,leandro	pho	PG	13.8655	13.7305	368
len,alex	pho	C	7.62855	8.76175	361
christmas,dionte	pho	SG	13.0776	13.1808	199
randolph,shavlik	pho	PF	8.09502	9.17042	96
kravtsov,viaches	pho	C	10.4146	11.9316	62
batum,nicolas	por	SF	19.7034	18.7239	2958
lillard,damian	por	PG	23.3446	22.0426	2935
matthews,wesley	por	SG	18.8289	18.5469	2783
lopez,robin	por	C	19.04	20.9277	2611
aldridge,lamarcu	por	PF	24.1768	25.8806	2496
williams,mo	por	PG	15.906	13.9493	1835
wright,dorell	por	SF	14.8255	14.2352	981
robinson,thomas	por	PF	15.1883	16.6112	877
freeland,joel	por	PF	12.6291	13.4059	724
mccollum,c.j.	por	PG	11.0294	10.5169	478
barton,will	por	SG	16.0346	16.0335	387
leonard,meyers	por	C	10.655	11.16	356
claver,victor	por	SF	10.5308	10.5279	182
watson,earl	por	PG	4.8611	2.42695	164
crabbe,allen	por	SG	10.1757	9.22497	98

gay,rudy	sac	SF	20.6991	21.5724	2532
thomas,isaiah	sac	PG	25.1917	24.108	2492
cousins,demarcus	sac	C	28.513	30.7533	2296
mclemore,ben	sac	SG	9.27888	9.09736	2185
thompson,jason	sac	PF	11.8663	13.0448	2011
williams,derrick	sac	PF	12.7593	13.649	1816
outlaw,travis	sac	SF	12.1883	12.1782	1068
evans,reggie	sac	PF	12.3415	13.7359	898
mccallum,ray	sac	PG	12.7345	11.3734	898
acy,quincy	sac	SF	11.0357	11.8136	852
johnson,orlando	sac	SG	6.67616	6.26102	392
gray,aaron	sac	C	9.0068	9.36334	350
landry,carl	sac	PF	11.9594	13.1831	233
cunningham,jared	sac	SG	10.6983	9.9019	81
ndiaye,hamady	sac	C	3.53423	3.40538	76
white,royce	sac	SF	8.76042	-9.79466	9
duncan,tim	san	PF	23.9919	25.2327	2155
belinelli,marco	san	SG	18.2166	17.7393	2015
parker,tony	san	PG	23.2016	22.2631	2002
diaw,boris	san	PF	16.8934	16.5943	1974
leonard,kawhi	san	SF	22.0333	22.8528	1924
green,danny	san	SG	16.814	16.3705	1652
ginobili,manu	san	SG	24.8194	23.4885	1554
mills,patty	san	PG	22.8193	22.1894	1523
splitter,tiago	san	PF	18.3596	19.4785	1272
ayres,jeff	san	PF	12.5243	13.1509	952
joseph,cory	san	PG	17.5501	17.2368	941
bonner,matt	san	PF	13.4247	13.1643	697
baynes,aron	san	PF	11.0862	11.4628	491
daye,austin	san	PF	13.4119	12.6942	151
james,damion	san	SF	5.12488	4.68823	52
derozan,demar	tor	SG	20.6753	21.0105	3020
lowry,kyle	tor	PG	25.0471	23.1046	2861
valanciunas,jona	tor	C	16.6793	18.5133	2283
johnson,amir	tor	PF	16.5938	17.6932	2214
ross,terrence	tor	SG	14.0181	13.8372	2156
vasquez,greivis	tor	PG	18.3601	16.2073	1778
salmons,john	tor	SF	9.93945	8.92971	1725
patterson,patric	tor	PF	16.259	16.7725	1536
hansbrough,tyler	tor	PF	14.5839	16.2596	981
hayes,chuck	tor	PF	10.9074	11.537	755
novak,steve	tor	SF	13.1825	12.5842	545
decolo,nando	tor	PG	16.1318	15.2045	500
fields,landry	tor	SF	9.75635	9.8719	322
buycks,dwight	tor	PG	8.73555	8.20838	147
stone,julyan	tor	PG	8.48691	7.46724	122
hayward,gordon	uta	SF	19.0864	18.3851	2798
burke,trey	uta	PG	16.3682	14.2462	2262
jefferson,richar	uta	SF	13.7829	13.4839	2211
favors,derrick	uta	PF	19.7326	21.5998	2202
burks,alec	uta	PG	17.7534	17.9153	2192
kanter,enes	uta	C	16.1628	17.7899	2138
williams,marvin	uta	PF	15.7344	15.941	1673
evans,jeremy	uta	SF	17.0249	18.51	1208
garrett,diante	uta	SG	9.36905	8.0004	1050
lucas,john	uta	PG	7.03044	5.88856	589
gobert,rudy	uta	C	13.0225	14.7009	436
rush,brandon	uta	SG	5.51219	4.62434	421
harris,mike	uta	SF	15.7711	17.4938	224
clark,ian	uta	SG	11.3869	10.3548	174
tinsley,jamal	uta	PG	5.30665	2.06958	110
thomas,malcomb	uta	PF	4.8021	5.34528	63
biedrins,andris	uta	C	2.24593	2.79889	44
wall,john	was	PG	24.5941	22.601	2980
ariza,trevor	was	SF	18.5165	18.3878	2723
gortat,marcin	was	C	18.9004	20.3938	2660
beal,bradley	was	SG	17.1384	16.5382	2529
webster,martell	was	SF	13.6693	13.3243	2164
hilario,nene	was	C	18.5897	19.2717	1562
booker,trevor	was	PF	16.113	17.4207	1553
miller,andre	was	PG	18.1346	16.4434	988
temple,garrett	was	SG	9.79541	8.94106	644
seraphin,kevin	was	PF	13.0639	14.4622	578
harrington,al	was	PF	11.6691	11.1627	513
gooden,drew	was	PF	19.8495	21.3759	394
porter,otto	was	SF	6.71705	6.9336	322
singleton,chris	was	SF	9.82887	10.4254	249
rice,glen	was	SG	8.14675	7.53262	111

Bibliography

1. Lewis, M. (2003). *Moneyball: The Art of Winning an Unfair Game*. New York: W.W. Norton.
2. Calculating PER. (n.d.). Retrieved October 27, 2016, from http://www.basketball-reference.com/about/per.html
3. Live Ball vs Dead Ball Turnovers. (2015, November 15). Retrieved from http://www.inpredictable.com/2015/11/live-ball-vs-dead-ball-turnovers.html
4. Franks, A., Miller, A., Bornn, L., and Goldsberry, K. (2015). Characterizing the Spatial Structure of Defensive Skill in Professional Basketball. {The Annals of Applied Statistics, 9}(1), 94-121.
5. Hamalian, Gregory. Building the Perfect NBA Team. (2016). ATP Summer Research.
6. Pelton, Kevin. Statistical Analysis Primer. (2007, September 12.) Retrieved from http://www.nba.com/thunder/news/stats101.html
7. Fixler, Kevin. The Mystery of the Disappearing NBA Center. (2012, May 15). Retrieved from http://www.theatlantic.com/entertainment/archive/2012/05/the-mystery-of-the-disappearing-nba-center/257204/
8. Offensive Theory: How to Score More Points by Understanding the Theory and Philosophy Behind Offense. (2016). Retrieved from https://www.breakthroughbasketball.com/offense/offensivetheory.html
9. Brown, Myles. The 25 Worst NBA Contracts of All Time. (2013, Feb 2013). Retrieved from http://www.complex.com/sports/2013/02/the-25-worst-nba-contracts-of-all-time/

Note: All statistics were retrieved from http://www.basketball-reference.com/