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HOW THE INCREASE IN THREE-POINT SHOOTING OFFENSES IN THE NBA HAS
IMPACTED WAGE DETERMINANTS FOR NBA POINT GUARDS

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ABSTRACT

As NBA offenses have changed over time, the desired skill set or roles of position players has changed. There is no better example of this phenomenon than the rise of three-point shooting offenses in the NBA, and more recently the increased frequency of three point attempts amongst point guards. Prior studies however, have determined that three-point shooting accuracy and frequency are both insignificant determinants of player salary. This paper attempts to determine if three-point shooting remains an insignificant salary determinant in the years after 2012 and isolates the point guard position specifically instead of including all NBA players. Using multivariable regression analysis, it was discovered that three-point frequency was a statistically significant and positive determinant of player salary in the years 2008 to 2013. This trend did not extend beyond 2013 and three point shooting variables were insignificant indicators of salary up until 2018. These findings could be important for both NBA managers and players, because it shows that a valued skillset for point guards is not translating into higher compensation. It may also alarm the NBA business model, that the skill that is so heavily emphasized in advertisements and the media is not being compensated for.

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Chapter 1

Introduction

While it may seem like a simple game, basketball is business. Team owners and managers estimate a player's productivity that they can provide then pay them the appropriate salary in order to compensate players for their performance. In the past managers and scouts evaluated players simply with what their eyes told them, a concept that is still used today, but at a much lower frequency. Each position in the NBA had a common role or skill set that was desired in order for teams to be successful. For example, a center position player should be tall and have a strong rebounding ability due to their close proximity to the basket.

While some desired skills have remained just as valuable in the NBA, researchers like Ghosh (1993) show how skill expectations for certain positions have changed as the NBA has evolved. This is the primary challenge facing NBA managers and talent evaluators today. They must determine what skills at each position lead to team success, and more importantly the monetary value of these skills. Various researchers have attempted to understand what the exact wage determinants for NBA players are and why some players are paid more than others. Berri and Schmidt (2010) argue that in the past basketball teams have failed to compensate players appropriately for their value. Berri and Schmidt claim that teams like the mid 2000's era Knicks valued and paid for high volume scoring over all else, leading to an inadequate understanding of where NBA wins actually come from. This research will attempt to investigate this problem from a more narrow focus: point guards' compensation for their three point shooting efficiency.

A New ‘Gimmick’ In The NBA

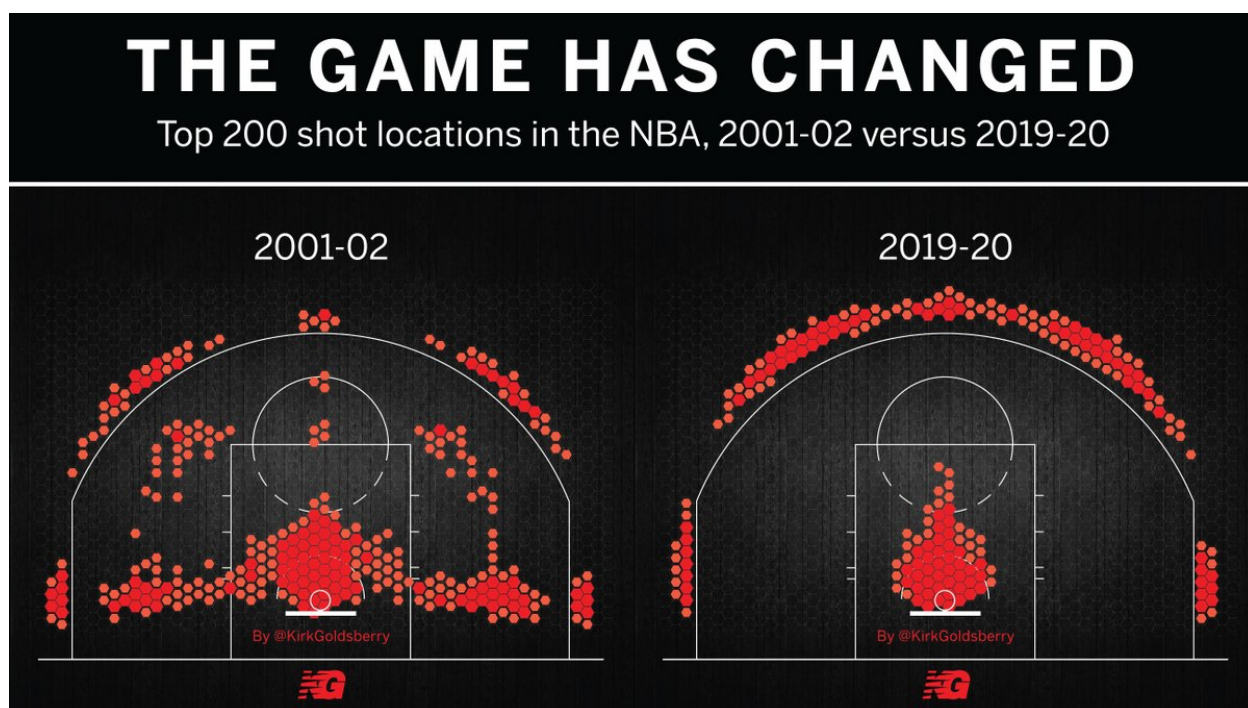
The NBA 3-Point shot was implemented in 1979 with serious backlash (Mather, 2016). The criticism was based on a resistance to change and a desire to keep the NBA game the same. Critics thought of it as a gimmick, while both media and coaches saw it as merely a tool for a losing team to catch up with a risky shot near the end of each quarter. Teams did not immediately focus on the 3-Point shot after its implementation, averaging fewer than three attempts per game (Mather, 2016). In 1979, NBA teams and strategies were tailored to the center position. Offenses were run through a ‘big man’, like Kareem Abdul Jabbar or Bill Russell, who dominated close to the rim (Ghosh and Steckel, 1993). Changing an entire offensive scheme to incorporate a difficult 3-point shot seemed inefficient. Decades later, the 3-pointer would become one of the focal points of NBA offenses.

Steph Curry and The Three Point Explosion

By 2012, the 3-point shot in the NBA was beginning to be heavily implemented; teams began shooting twenty 3-pointers per game compared to the average of 3 attempts when the shot was first implemented (Mather, 2016). Players like Steph Curry set the NBA on fire by breaking the 3-point shooting record with 272 made 3-point shots in the 2012-2013 regular season (Spencer, 2017). Not only did Steph Curry highlight the value of a player being able to shoot from long distance, but he was a role model for future players of the point guard position. Even NBA centers began changing their role and ‘spreading the floor’ by incorporating 3-point shooting into their skillset (Feldman, 2017). Statistical modelling and risk analysis related to the 3-point shot

was at an all-time high and academics began submitting academic papers on the subject (Goldman & Rao, 2013).

Figure 1.1 Top 200 shot locations in the NBA, 2001-02 versus 2019-20



Source: Sprawlball by Kirk Goldsberry

All of these changes have led to a significant change in NBA shot selection shown in Figure 1.1. In the last 20 years the NBA has almost erased the mid-point shot in favor of shooting from long distance. This explosion in three-point shooting could have a significant impact on the expectations of skills for each position, particularly point guards who are usually at the top of the court furthest from the basket.

Some researchers argue that teams are not paying players for performance that leads to winning. In the midst of this problem, trends seem to support 3-point shooting accuracy is a path to

success. This is supported by how frequently players of all positions shoot three-point shots and the greater emphasis scouts put on the skill in the modern era (post 2012). If three-point shooting is seen in a more positive light in the modern era compared to the past, then have managers made three point shooting a more significant wage determinant for certain players in the NBA?”

Previously researchers have shown that three-point shooting has not been a significant wage determinant for NBA salary (Lyons, Roberts, Livingston, 2015). These studies lack two key variables, the first being player position. The collective literature written on this subject generally includes all players rather than separating players by position. While three-point shooting may not be a significant wage determinant for the collective NBA, it could be meaningful for a subset of player. The second variable that the studies lack is a modern timeframe. Most sample years range from 1990 to 2010. Since the current three-point trend did not reach its peak until around 2012, investigating these wage determinants from 2012-2018 could be insightful.

This research will focus on narrowing down the sample to only players in the point guard position. Modern NBA offenses have gravitated towards point guards developing a longer distance shooting role and their unique position being furthest from the basket makes them a candidate for potential wage determinant change. In order to understand how much wage determinants for three-point shooting have changed for modern point guards compared to the past, this research uses a multiple variable regression for players from 2008-2012 and then 2012-2017. The break point being the season that Steph Curry broke the record for NBA three-point shots makes it a suitable candidate for a turning point in wage determinants. I hypothesize that

wage determinants for three-point shooting will increase for point guards and will be at a higher level of statistical significance than they were in years prior to 2012.

Chapter 2

Literature Review

Roles Changing In the NBA

Certain positions in the NBA have changed in what is statistically expected of their role. The most prominent example in the academic literature is the Center position. Ghosh (1993) has found that the Center position evolved from the 1970's to the late 1980's. The 1973-1974 NBA season was the first season where detailed statistics were consistently recorded. Analyzing box score statistics of the 1973-1974 NBA season compared to over a decade later in the 1987-1988 season, Ghosh isolated specific differences in what was expected of Centers. In the 1980's NBA teams looked towards Small Forwards and Guards for scoring more so than the prior decade. As the NBA grew the Center position became a more specific position that specialized to an even greater degree in defensive rebounding and blocks. Compared to earlier in the NBA where centers were a common scoring threat, this was not as frequent of a case in the 1980's.

Even in the modern era, the center position continues to change. According to Basketball Reference, NBA centers made more than twice as many three pointers in the 2017 season than the prior season (Feldman, 2017). Historically, NBA centers are making more three pointers in 2017 than the first 17 years after the three-point line was introduced combined (Feldman, 2017). These statistics provide evidence of the modern NBA center still evolving in the skills and roles that are expected of them.

While these studies and historical data analyses are helpful to understand that NBA roles can change, there is a lack of information about wage determinants. These studies often do not

include any information regarding whether NBA centers were compensated more for changing their skills or evolving their role in the NBA.

This idea of a particular position becoming more specialized in a certain statistical category fits directly into the idea of the point guard position becoming more specialized in three-point shooting in the years following 2012. Expectations for positions can change over time and with these new expectations we would expect players to be compensated differently for certain statistics.

Skills Based On Position

When determining how players are compensated, it is important to understand which roles or attributes are expected for each position. Researchers have questioned which specific skills have stronger relationships for each position when it comes to winning basketball games.

Researchers have determined that the average distance from the basket is a significant factor that alters the responsibilities of each position (Sampaio, 2006). When looking at the difference between what is expected of each position, the largest discrepancies have been between a guard's responsibilities relative to a center. Centers are responsible for box score statistics like rebounding which requires a close distance to the basket, while guards tend to have higher assists, steals, and 3 pt field goal rates relative to forwards or centers (Sampaio, 2006).

Fellingham (2007) highlight the importance of the point guard position outperforming the opposing point guard when it comes to defensive rebounding. Furthermore, the differences in position roles seemed to be even wider when looking particularly at NBA players rather than

international players in European leagues possibly due to the three-point line being pushed back one half meter in the NBA relative to Europe (Sampaio, 2006).

Several authors have attempted to determine the exact characteristics that result in a higher win percentage for each position. Regardless of position, assists and turnovers have been shown to be significant contributors to winning basketball games (Fellingham, 2007). Point guards, shooting guards, and small forwards have been shown to have a considerable increase in win percentage following 1-unit increase in field goal percentage compared to the opponents of the same position. Basketball pundits who have been part of national championship teams tend to argue that the point guard position needs to perform well in categories like outside shots, passing, and transition offense while categories like free throws and inside shooting are less important for winning (Trninic, 2000).

Lutz (2012) extended the concept of role differences between positions further by using cluster analysis to isolate subgroups of players in the NBA beyond the simple 5 positions. Rather than examine the relationship between labeled position and game-related statistics, Lutz determined what clusters of players had the highest effect on winning (point differential) NBA games.

One such cluster was called durable shooters. This subgroup of players had a higher tendency to shoot three pointers and long 2 pointers as well as a higher steal frequency than other players while also playing in a large number of games. Durable shooters match closely with what would commonly be referred to as the ideal point guard position in the NBA and closely matches Steph Curry's skillset. Not only were durable shooters the rarest players of the ten clusters, they were also the most frequent type of player on winning basketball teams with 66.67% of the 57 players in the group being on winning basketball teams.

While previous studies offer information about position roles and what each position needs to accomplish to increase the probability of winning, they offer no information regarding whether players are compensated comparably. There are also issues when it comes to sampling of players. Several studies analyzed single seasons such as 2000-2001 or the 1996-1997 NBA seasons, therefore player roles could have evolved. Some studies only considered qualitative opinions of NBA experts (Trnini, 2000) while others only looked at box scores from championship series (Sompaio, 2006). For the purpose of this research, I consider more modern regular season box score statistics over the course of several NBA seasons in order to determine if the teams now compensate point guards differently after 2012.

Salary Determinants

There have been several studies published regarding which specific statistics lead to higher wages. Researchers have attempted to identify which box score or general statistics are significantly related to higher salaries.

Points per game, field goal percentage, defensive rebounds, and assists are often found to be significant in determining player salary (Sigler, 2018). Fouls are also shown to be a significant predictor of salary, but it is difficult to determine the reason for this. Researchers are not sure if this is a result of less valuable players fouling more often as a team strategy or actual error. Most researchers agree that turnovers are another statistically significant determinant, however some researchers like Lyons (2015) argue that it could be due to multicollinearity. Other sources (Sigler, 2018) also identify general statistics like experience and minutes played that explain a

large percentage of variation in salaries. Experience and minutes per game therefore should be considered in analysis of future research.

Surprisingly, multiple researchers find that three point shooting does not have a significant role in determining player salaries (Sigler, 2018). It is important to note, however, that none of the reviewed literature isolated the point guard position specifically in their analysis. This could potentially ignore the expected roles of each position that were described previously.

Most previous studies used multiple regression analysis in order to determine which statistics can impact salaries. Several authors utilized a backward stepwise regression approach as well, eliminating the most insignificant independent variables one at a time (Sigler, 2018). The following analysis will analyze the most recent NBA season using the same approach.

Three-Point Shooting

NBA players have taken an increasing number of three-point shots ever since its implementation in 1979. The NBA has recently seen a surge of teams like the Houston Rockets that “live and die by the three” and attempt more three-point shots than two point shots in some cases. Players like Steph Curry have mesmerized NBA fans with his ability to shoot from distance efficiently. With these recent phenomena researchers have attempted to evaluate the difference in expected return for different shot selection in the NBA.

A common thread between the research on shot selection is the emphasis on risk tolerance. Players and coaches must decide if the risk of a longer distance shot outweighs the extra benefit of the additional point. After the three-point shot was implemented, players have been able to

score from distance with increasing efficiency. While the mean success rate for 2 point shots has been stable, the three-point success rate has been steadily increasing with lower volatility throughout the years (Fichman, 2018). Players have been able to track the ‘near optimal’ mixed strategy for two-point and three-point shots reasonably well as players have become better distance shooters. Goldman and Rao (2013) show that teams will attempt riskier 3-point shots later in the game as the probability of winning decreases, but the rare players that are able to hit three-point shots in critical situations are heavily valued and have, according to 3-point shooting statistical models, have an “even greater advantage when the chips are down.”

Current literature on three-point shooting lacks a narrow focus specifically to the point guard position. The aforementioned studies provide no information on the value or increased prevalence of three-point shooting when it comes to positional basketball and instead have chosen to focus their research on team statistics. An increase in compensation for efficient three-point shooting point guards would provide more evidence of the three-point shot seeing higher value overall in the NBA.

Chapter 3

Methodology

Data Collection

The NBA has published player box score statistics since its inception, adding more advanced statistics such as player efficiency rating and a player's plus-minus statistic as the league grew. This made player data readily accessible for researchers. The analysis required player box score statistics on a per-game basis, so that could these statistics could correspond with player salaries together in one data table.

Using the NBA advanced statistics database *NBAstuffer*, player box score statistics were compiled from the 2008-2009 to 2017-2018 season. Players were filtered to only include data for point guards since that is the position of interest. Measures of age, games played, three-point shots attempted, 3-point percentage, minutes per game, rebounds per game, and assists per game were all included. These specific variables are all correlated significantly with player salary based on past research. Players were coded as *First Name Last NameYear*, so point guard Chris Paul's 2008-2009 season statistics would be entered as Chris Paul2008.

Salary data was collected from *Basketball Reference* and includes the salary the player made in the season following their player statistics season. For example, Chris Paul's 2008-2009 season statistics were connected to his 2009-2010 annual salary. The data was organized based on the idea that a player's performance in their current season would influence their salary the following season. Salary and statistics cannot be recorded in the same year, assuming that players are compensated for what they do in the previous season. Players usually negotiate

salaries before the season begins. Yearly control variables were also added to account for any salary cap increases that could have an effect on annual salary. These variables were written as *Year_Dummy*, so the dummy variable for a 2009 salary would be *2009_Dummy*. Finally, control variables for the team a player played for were added to account for the ability of wealthier teams to pay their players more money could be accounted for.

When a player switched teams in the middle of a season, they ended up having two sets of box score statistics. To avoid two variables being created for one player, the weighted average of the two are used. If a player retired before 2017-2018 they were removed from the data set because they would not have a salary in the following year to correspond with their player statistics.

Players that averaged less than 5 minutes per game were also removed because that was a common practice in the Literature Review (NBA Players' Pay and Performance). A player that averaged less than 5 minutes per game should not be considered because of their limited impact on the outcome of the average NBA basketball game. Lastly, all NBA point guards on rookie contracts were removed from the data set because the salary cap for rookie players is much lower than players with multiple years of experience. A descriptive summary of the data set can be seen in the table below.

Table 3-1: Descriptive Statistics (N = 728)

| Explanatory Variable | 2008-2012 | | | 2013-2017 | | |
|-------------------------------|-----------|---------|---------|-----------|---------|---------|
| | Maximum | Minimum | Average | Maximum | Minimum | Average |
| Age | 38.00 | 19.00 | 26.18 | 39.00 | 19.00 | 26.39 |
| Games Played | 82.00 | 2.00 | 62.76 | 82.00 | 1.00 | 58.38 |
| Minutes Per Game | 38.50 | 6.00 | 25.31 | 37.40 | 5.32 | 23.83 |
| Three Point Attempts Per Game | 7.69 | 0.00 | 2.54 | 11.22 | 0.03 | 2.95 |
| Three Point Percentage | 66.70% | 0.00% | 33.29% | 100.00% | 0.00% | 33.41% |
| PPG | 25.00 | 1.30 | 10.48 | 31.60 | 0.80 | 10.62 |
| RPG | 6.20 | 0.00 | 2.57 | 10.70 | 0.00 | 2.75 |
| APG | 11.70 | 0.30 | 4.47 | 11.70 | 0.00 | 4.19 |

Regression

A linear regression is used and includes player statistics as the independent variables and the log of the players' salary as the dependent variable. The year and player's team are included as control variables. It determines the significance of 3-point shooting attempts and percentage compared to other significant salary determining variables. The natural log of salary is used instead of the standard number in order to interpret results as percent change. This helps avoid the long tails that salary can have on the right side of its distribution. The squared term of both age and games played are included to account for diminishing returns to salary.

The regression is written as follows:

$$\ln(\text{salary}) = \beta_0 + \beta_1(\text{Age}) + \beta_2(\text{Age Squared}) + \beta_3(\text{Games Played}) + \beta_4(\text{Games Played Squared}) + \beta_5(\text{Three Point Attempts Per Game}) + \beta_6(\text{Three Point Percentage}) + \beta_7(\text{Minutes Per Game}) +$$

$\beta_8(\text{Points Per Game}) + \beta_9(\text{Rebounds Per Game}) + \beta_{10}(\text{Assists Per Game}) + \beta_{11-13}(\text{Year Controls})$
 $+ \beta_{14-43}(\text{Team Controls})$

The regression is run twice, once with data from 2008-2013, and then with data from 2013 to 2018 in order to highlight any potential changes in the significance of 3-point shooting on salary determinants for NBA point guards.

Historically age and games played have been positively correlated with higher salaries amongst NBA players regardless of position. Age can be thought of like an experience variable, with veteran talent having valuable knowledge that must be compensated for. Like most jobs, more experience will lead to higher salaries on average. Games played on the other hand describes how often a player performs each season, with players with higher games played logically being more valued by coaches and management.

Minutes, points, rebounds, and assists per game have all previously been significantly positive wage determinants for NBA players, no matter the era. Points and assists increase teams' scoring, helping them win games. Rebounds increases the number of possessions a team has to score. Finally, minutes per game highlights the value the player has on the court and how frequently they are used by their team. All of these desirable outcomes should be determinants of higher salaries for these players so these coefficients are expected to be positive and significant.

Historically, both three point attempts and three point percentage have not been significantly correlated with salary in the NBA. These variables however are predicted to have positive and significant correlations in the regression due to the change in time period and sample of players. With modern NBA offenses emphasizing three point shooting it would make sense that players

are compensated for efficiency in distance shooting. Furthermore, the sample specifically isolates point guards rather than all players is rare compared to the literature. The point guard's position changing from a pass first mindset to a scoring first mindset could create this new positive relationship between these variables and salary. I expect β_5 and β_6 to be larger in the second regression for years after 2012 than the first.

Chapter 4

Results and Discussion

Results for the 2008-2012 seasons with rookies included

In order to better understand how the inclusion of rookies affects the data set, the regressions for 2008-2012 and 2013-2017 was analyzed once with rookies included and once without. The R-squared values for the two regressions were .67 and 0.57 respectively, which is similar to prior research which had R-squared values commonly ranging around 0.62. The comparable R-squared values provide support for the validity of the results of this research.

Table 4-1: 2008-2012 Player Data Including Rookies (N = 342)

| Category | Explanatory Variables | Coefficient | Standard Error | P> t |
|----------------------|-------------------------------|-------------|----------------|-------|
| Experience Factors | Age | 0.4997558 | 0.0987216 | 0 *** |
| | Age Squared | -0.0081034 | 0.0017653 | 0 *** |
| | Games Played | 0.0171159 | 0.0104955 | 0.104 |
| | Games Played Squared | -0.0001416 | 0.0000982 | 0.15 |
| | Minutes Per Game | -0.0086891 | 0.0143404 | 0.545 |
| Three-Point Shooting | Three-Point Attempts Per Game | 0.0366328 | 0.0357096 | 0.306 |
| | Three-Point Percentage | -0.5255886 | 0.5029944 | 0.297 |
| Box Score Statistics | PPG | 0.0687323 | 0.0164288 | 0 *** |
| | RPG | 0.0419471 | 0.0737886 | 0.57 |
| | APG | 0.1606325 | 0.0312562 | 0 *** |

Significance: * P < 0.10, ** P < 0.05, *** P < 0.01

Player Years and Teams Are Controlled For In The Regression

The results regression with rookies included for the 2008-2012 season resulted in similar relationships that had been significant before in prior literature. Age is a significant positive relationship with point guard salary. Based on the analysis a point guard that was 1 year older

explains a large increase in salary but is also counteracted by the age squared variable as the player ages. Age has diminishing returns to salary as the player gets older. The significance of age in determining salary consistent with prior studies. This supports the rational idea of a player getting old enough, that their age actually begins to have a negative relationship with their salary as the point guard becomes less athletic and physically strong.

Not all of the variables in the regression were correctly predicted however, and some differed considerably from prior literature. Scoring statistics consistent with prior findings include points per game and assists per game. Both of these variables have been found to be positive in the past, and remain positive in this regression as well as statistically significant. Just scoring one more point per game can explain a 7.4% increase in point guard salary, and one more assist explains an over 17.35% increase. Assists having a higher coefficient than points per game could be a result of manager's valuing passing out of their point guards more than scoring in this time period. On the other hand, an assist leads to a field goal which leads to at least two points, which could explain the coefficient for assists being about twice as large as points per game. This is an important relationship to isolate, because as we see in the later sample, this relationship does not remain the same. Rebounding also had considerably different results than earlier studies.

Rebounding has long been thought of having a positive relationship with player salary across multiple positions, however in this regression it is an insignificant determinant. Isolating the point guard position and narrowing the focus suggests that these prior studies should not have applied their wage determinants to all player positions.

The variable games played did not show a statistically significant relationship. A point guard entrusted to participate in more games is likely to be more valuable than a player that only plays

a few games per year, so this result was opposite of what has been shown in prior literature.

Minutes per game also was insignificant which also differed from the literature review.

The regression output does not support earlier predictions in the methodology section regarding three point attempts per game and three-point percentage. Both of these variables had some of the largest p values out of all the included variables. According to the regression, point guards' three-point volume and efficiency were not significant contributors to their salary during these years, much like studies of past years that have shown similar insignificance.

Results for the 2013-2017 seasons with rookies included

The 2013-2017 seasons output similar results to the prior five years for some of the variables, but also had noticeable differences to the earlier time period. The most stable and unchanging variable between the two time periods was points per game(ppg). PPG has always been a significant contributor to player salary regardless of position and the 2013-2017 regression was no different. In fact, the coefficients for the PPG variable only differ by about 0.001 highlighting the stability of the variable over time. Games played also had a different relationship to the 2008-2012 regression with the coefficient for gp being significant and positive explaining roughly 3.8% increases in salary for each additional game played. The games played squared coefficient was negative as expected, displaying the same relationship from before. The p values of .000 and 0.002 respectively for these variables indicate higher statistical significance in 2013-2017 than the earlier time period. Rebounding again was an insignificant determinant, which highlights a difference between this research and prior literature. When considering all NBA players

regardless of position, rebounding has been shown to be a significant wage determinant.

Isolating the point guard position may have shed light on the lack of emphasis of this skill amongst the league's smallest players.

Table 4-2: 2013-2017 Data Including Rookies (N = 386)

| Category | Explanatory Variables | Coefficient | Standard Error | P> t |
|----------------------|-------------------------------|-------------|----------------|-----------|
| Experience Factors | Age | -0.1597703 | 0.1600172 | 0.319 |
| | Age Squared | 0.0035608 | 0.0029172 | 0.223 |
| | Games Played | 0.0367589 | 0.0099967 | 0 *** |
| | Games Played Squared | -0.0003027 | 0.0000967 | 0.002 *** |
| | Minutes Per Game | 0.0670342 | 0.0190915 | 0.001 *** |
| Three-Point Shooting | Three-Point Attempts Per Game | -0.0271422 | 0.0491248 | 0.581 |
| | Three-Point Percentage | 0.0684188 | 0.6048158 | 0.91 |
| Box Score Statistics | PPG | 0.0645347 | 0.0232205 | 0.006 *** |
| | RPG | -0.050154 | 0.0764233 | 0.512 |
| | APG | 0.0630196 | 0.0484854 | 0.195 |

Significance: * P < 0.10, ** P < 0.05, *** P < 0.01

Player Years and Teams Are Controlled For In The Regression

Some of the variables in the 2013-2017 regression look drastically different than the earlier time period. Age has a much less significant correlation in the later time period with a 0.319 p value. This could be evidence of possible collinearity between age and minutes per game(mpg) in this period that could be influencing the significance of the variable. Minutes per game saw a major uptick in significance in this time period. Averaging one more minute per game explains 6.7% of a point guards' salary increase. Assists also have dropped in significance compared to the earlier time period with its p value increasing from 0 to 0.19. This could support the idea of the point guard role changing and moving from a 'pass-first' position to a scoring position, however since

the points per game variable has a very similar coefficient as the earlier period, more evidence is required to support this claim.

When it comes to the main focus of the research, three-point efficiency's impact on salary, it seems that distance shooting still has not significantly impacted point guard salary even in the modern time period. Three-point attempts per game and three-point percentage both are assigned p values of over 0.50, providing little support to the earlier prediction that point guards would be compensated more for three-point skill after the three-point revolution of 2012.

Analysis Excluding Rookies

Table 4-3: 2008-2017 Data Without Rookies (N = 522)

| Category | Explanatory Variables | 2008 - 2012 | | 2013 - 2017 | |
|----------------------|-------------------------------|-------------|----------|-------------|-----------|
| | | Coefficient | P> t | Coefficient | P> t |
| Experience Factors | Age | 0.6455369 | 0 *** | -0.0749958 | 0.767 |
| | Age Squared | -0.0105169 | 0 *** | 0.0021444 | 0.626 |
| | Games Played | -0.013299 | 0.273 | 0.042389 | 0 *** |
| | Games Played Squared | 0.0001493 | 0.19 | -0.0003525 | 0.002 *** |
| | Minutes Per Game | -0.01434 | 0.416 | 0.091642 | 0 *** |
| Three-Point Shooting | Three Point Attempts Per Game | 0.0868885 | 0.045 ** | -0.0353168 | 0.557 |
| | Three Point Percentage | -0.8771335 | 0.148 | 0.1457531 | 0.847 |
| Box Score Statistics | PPG | 0.0944608 | 0 *** | 0.0603932 | 0.039 ** |
| | RPG | -0.0352031 | 0.697 | -0.0648427 | 0.517 |
| | APG | 0.176144 | 0 *** | 0.0444763 | 0.455 |

Significance: * P < 0.10, ** P < 0.05, *** P < 0.01

Player Years and Teams Are Controlled For In The Regression

After running the regressions shown in tables 4-1 and 4-2, it became evident that the inclusion of rookies in the sample could potentially be skewing the results. Rookies, especially those that enter from the draft, could have inflated salaries combined with a more amateur skill set that make determining statistical significance difficult when lumping them in with seasoned players. After running both regressions without including rookies, the results were compared to the respective time periods.

Both age and age squared were significant in the 2008-2012 period, but lost their statistical significance in the later time period. This is consistent with the regressions run that included rookies. Eliminating rookies, however, did cause some coefficients to increase or decrease to further extremes. For example, the p value for age increased from 0.319 to 0.767 in the 2013 sample after rookies were eliminated. In the same sample, assists p value increased to become even more insignificant, providing further evidence for point guards no longer being compensated for playing a facilitating role.

The most significant change that removing rookies caused in the analysis was in the three point attempts variable. In the 2008-2012 sample, three point attempts per game became a significant explanatory variable at the 4.5% level. The variable three-point percentage also saw an increase in statistical significance but the p value of 0.148 is still too high to argue that three-point percentage is a meaningful explanatory variable for salary. Three-point percentage remaining an insignificant salary determinant across sample years supports thoughts from prior literature regarding managers prioritizing scoring volume and attempts over shooting efficiency. A one-unit increase in three-point attempts per game explains an 9.1% increase in salary. This trend did

not carry through to the 2013-2017 sample. Both three-point percentage and attempts per game experienced little change in significance following the removal of rookies.

The results in the 2008-2012 sample are not consistent with the prediction made in the methodology section. The coefficient for three point shooting attempts was positive and significant in the 2008-2012 sample but not in the 2013-2017 sample. This is the inverse of the predicted relationship. This prediction was made because an increase in three point shooting prevalence was thought to increase the value of the skill. This analysis may actually support that the opposite effect is taking place. In the 2008-2012 sample, the players that take a large frequency of three point shots are rarer. In the future when high volume three-point shooting became much more common for point guards, it seems the supply of high volume three point shooting point guards increased dramatically, causing that skill set to become less rare and therefore not significant for determining player salary.

Chapter 5

Conclusion and Implications

Implications

The results from the regression analysis provide implications for how NBA managers continue to evaluate and assign value to talent. While prior literature provides considerable evidence for position roles and desired skills changing over time in the NBA, this data set suggests that managers still adopt consistent patterns for paying their players. While there is evidence that the NBA three-point surge created a short period of increased salaries for long distance shooting point guards, this trend has disappeared in the last few seasons. Managers still prioritize points per game, age, and other experience variables more than three point shooting skill when paying point guards.

These results could be an alarm to managers that they are not necessarily paying their point guards in accordance to what wins basketball games in the modern NBA; shooting three point shots efficiently. While there are a variety of other factors other than team wins that drive salary for players, this analysis highlights a possible disconnect between media fanaticism for the long distance shot and how teams actually reward their point guards.

These results offer some interesting problems for the greater NBA organization. Long distance shooting has driven new eyeballs to television screens across the globe and is a major money maker for the NBA as a whole. Therefore, it could be in the NBA's best interest to create

incentives for teams to pay their point guards more for these abilities in order to guide the NBA product into what they appear to be advertising so heavily.

Challenges and Suggestions For Improvement

After considering the results and critiquing the data collecting process for this research, there are areas for notable improvement and future research on the relationship between three-point effectiveness and salary.

The first and most beneficial change that could be made to the data collection process would be using actual NBA contract data rather than annual salary data for players. Contract data is more useful than annual salary data because it would allow the research to not consider years where players were playing under a guaranteed salary. For example, if Chris Paul signed a contract in 2011 for 10 million dollars a year for 3 years, then his statistics in 2012 and 2013 would not necessarily be significant determinants of his salary in 2014, which would still be that 10-million-dollar figure. Furthermore, annual salary data does not account for the ‘contract year phenomenon’ that David Berri and Martin Schmidt explain in their book *Stumbling on Wins*. Berri and Schmidt provide evidence for players recording more appealing statistics during the year before they negotiate a new contract, as opposed to years playing under contract. This research did not consider the impact that this may have on player salary and future research should be able to account for this phenomenon.

While the prediction of three-point effectiveness becoming a more significant wage determinant for point guards in the more modern NBA may have been unsupported, there still is value in

considering other types of players. A subgroup of NBA players called ‘role players’ or ‘three and D players’ would be a compelling sample to analyze. These players are not all stars or the best players on their teams, but they fill a specific role on the offensive end of shooting from distance and spacing the floor. If there were a way to possibly use cluster analysis to isolate this subgroup of players, then it could be interesting to see if three point shooting significantly affected their wages more as the NBA has evolved.

This analysis lacked in accounting for possible superstar externalities. Those few point guards in the NBA with high marketing potential could see their salaries skewed because they can bring revenue to teams not only through play but through their national persona. A player’s name and brand must also be a factor when hiring NBA talent and it was difficult to capture this phenomenon in the regressions. In addition to that the regression failed to control for the veteran minimum salary. Players that reach a certain age threshold may be paid more than they are actually worth simply because of their experience they bring to a team.

A final suggestion for continued research is going beyond box score statistics and considering more advanced NBA analytics. Player efficiency rating, win shares, and usage percentage could significantly impact salary for point guards with the NBA becoming a more analytical league. Perhaps accounting for these advanced statistics could capture a clearer picture on what truly determines a point guard’s wage.

Appendix A
Sample of Raw Data

| Player | AGE | GP | 3PA | 3P% | MPG | PPG | RPG | APG | Salary |
|----------------------|------------|-----------|------------|------------|------------|------------|------------|------------|---------------|
| Allen Iverson2008 | 33.00 | 57.00 | 1.70 | 0.28 | 36.70 | 17.50 | 3.00 | 5.00 | 1029794.00 |
| Andre Miller2008 | 32.00 | 82.00 | 0.60 | 0.28 | 36.30 | 16.30 | 4.50 | 6.50 | 6730800.00 |
| Anthony Carter2008 | 33.00 | 78.00 | 1.10 | 0.24 | 22.90 | 5.30 | 2.60 | 4.70 | 1306455.00 |
| Anthony Johnson2008 | 34.00 | 80.00 | 1.70 | 0.39 | 18.50 | 5.30 | 1.80 | 2.50 | 2160000.00 |
| Antonio Daniels2008 | 33.00 | 74.00 | 0.80 | 0.37 | 13.80 | 4.10 | 1.00 | 2.40 | 5863580.00 |
| Baron Davis2008 | 29.00 | 65.00 | 5.00 | 0.30 | 34.60 | 14.90 | 3.70 | 7.70 | 12150000.00 |
| Beno Udrih2008 | 26.00 | 73.00 | 1.50 | 0.31 | 31.10 | 11.00 | 3.00 | 4.70 | 6031800.00 |
| C.J. Watson2008 | 24.00 | 77.00 | 1.60 | 0.40 | 24.50 | 9.50 | 2.50 | 2.70 | 1000497.00 |
| Chauncey Billups2008 | 32.00 | 79.00 | 5.00 | 0.41 | 35.30 | 17.70 | 3.00 | 6.40 | 12100000.00 |
| Chris Duhon2008 | 26.00 | 79.00 | 4.10 | 0.39 | 36.80 | 11.10 | 3.10 | 7.20 | 6031800.00 |
| Chris Paul2008 | 23.00 | 78.00 | 2.30 | 0.36 | 38.50 | 22.80 | 5.50 | 11.00 | 13520500.00 |
| Chris Quinn2008 | 25.00 | 66.00 | 2.10 | 0.41 | 14.60 | 5.10 | 1.10 | 2.00 | 1055000.00 |
| Chucky Atkins2008 | 34.00 | 33.00 | 1.70 | 0.26 | 12.50 | 3.00 | 0.70 | 1.80 | 1306455.00 |
| Derek Fisher2008 | 34.00 | 82.00 | 3.70 | 0.40 | 29.80 | 9.90 | 2.30 | 3.20 | 5048000.00 |
| Deron Williams2008 | 24.00 | 68.00 | 3.30 | 0.31 | 36.80 | 19.40 | 2.90 | 10.70 | 12323900.00 |
| Devin Harris2008 | 25.00 | 69.00 | 3.20 | 0.29 | 36.10 | 21.30 | 3.30 | 6.90 | 8400000.00 |
| Earl Watson2008 | 29.00 | 68.00 | 1.30 | 0.24 | 26.10 | 6.60 | 2.70 | 5.80 | 6600000.00 |

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June 2019 – Aug 2019

- Suggested modifications to Dimensional's first year client experience and presented my findings to team members both inside and outside my department
- Learned how to clarify Dimensional's specific investment philosophy to clients and explain their perspective on financial markets
- Organized client data using Microsoft Dynamics and CRM
- Conducted portfolio analysis of client investments using the Dimensional ReturnsWeb program

Sutor Bank

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Summer Internship

June 2018 – July 2018

- Designed a research project explaining the development of the DAX index from its creation to present day
- Explained Sutor Bank's investment philosophy to clients using charts and economic models from Microsoft Excel
- Attended and participated in a Dimensional Fund Advisors conference titled "Structuring Effective Client Communication"
- Published a quarterly review detailing important events in the German stock market for Sutor Bank clients
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- Led a competitive analysis project that compared other nearby financial firms' fee schedules, services, and transaction costs; the analysis is now used in client referral meetings
- Published multiple financial planning blog post that were later highlighted by the personal finance blog: *Abnormal Returns*
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Delta Sigma Pi

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- Planned and organized "rush" events for over one hundred Penn State Students
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