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The Underpaid Superstar

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# **The Underpaid Superstar**

The Max Contract's Effect on Parity within the 2015-2016 NBA Microeconomy

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## **Abstract**

Parity amongst teams is often thought to be the ideal towards which a sports association should strive. Most leagues implement salary caps, reverse order drafts, and/or revenue sharing to promote competitive balance. However, in the 1999 collective bargaining agreement, the NBA adopted a max contract that limits the amount that an individual player can be paid. Theoretically this works against parity as high-end players can be obtained below market value, which in turn provides surplus wins to the teams that are able to acquire these players. Here we will show empirically that the max contract does in fact negatively affect competitive balance in the 2015-2016 NBA microeconomy, though the benefits only significantly impact a small handful of teams.

## **Introduction**

Sports associations foster interesting and unique microeconomies, ripe for investigation. The differences in economies between leagues can often be striking. For example, the MLB operates as a (relatively) free market. Team payrolls across the league in 2015 ranged from \$60 million to upwards of \$300 million.<sup>1</sup> However, this is not the case for all sports associations. Unlike the MLB, the NBA caps both the overall payroll of a team (a salary cap), as well as the amount that any one player can receive in a given season (a max contract that varies depending on tenure). Entering the 2015-2016 season only 11 NBA players made \$20 million or more per year, a stark contrast to the 28 MLB players that did so as of March 2015.<sup>2</sup> This difference can most likely be attributed to the presence of a max contract in the NBA. Even if the salary cap were kept at \$70 million, its level in 2015, it is not hard to imagine that in a world without max contracts the best NBA players might make upwards of \$30 million a season (as we will see later).<sup>3</sup> This being the

case, it is fair to say that the best players in the NBA, the “superstars,” are likely acquired below market value under the current collective bargaining agreement (CBA). Thus, teams that are able to land “superstars” at a max contract may have a competitive advantage over those teams that cannot. There has been research done on the excess value given to teams by the max contract, most notably by statistician Nate Silver.<sup>4</sup> However, this has not yet been expanded to the effect that this excess value has on competitive balance. My hypothesis is that the presence of a max contract detracts from parity in the NBA, as it gives an unfair advantage to those teams that are able to sign a player for less money than he would theoretically go for in a free market. By maintaining a salary cap whilst doing away with the max contract, I believe that a greater level of competitive balance would be attainable.

## **Literature Review**

Parity in sports is, at its heart, an economic issue. Sports franchises exist to create revenue and, as Berri, Schmidt, and Brooke (2004) suggest, wins are the greatest factor in increasing a team’s revenue (within the NBA).<sup>5</sup> Increased competitive balance not only means a more equal spread of revenue across the league, but also likely provides an overall increase in profits as previously disinterested markets are untapped. Ideal deviation of winning percentages in the NBA, which we will use to define true parity, can be calculated as follows:

$$\sigma = 0.5 / \sqrt{82}$$

where 82 is the number of games played by a team in a single NBA season.<sup>6</sup> Intuitively, this is the deviation that should result if each team within the league has a 50% chance at victory each game. An empirical definition of perfect competitive balance is imperative in our attempt to determine the magnitude of the max contract’s effect on parity within the current NBA economy.

Max contracts were introduced to the NBA in 1999, after a labor lockout forced a new CBA between the NBA and the NBA Players Association. As Hill and Groothuis (2001) point out, this new CBA focused on moving money from the highest paid players towards those in the middle, the “median voters.”<sup>7</sup> This movement resulted in greater income equality, as the players in the top 40% of salaries lost earning potential to the remaining 60%.<sup>8</sup> However, promoting income equality likely came with a tax on competitive balance. Fershtman and Fishman (1994) conclude that, in a market where consumers search amongst homogenous products for low prices, a price ceiling will drive up the price of goods that initially had values below the price ceiling due to increased market power.<sup>9</sup> Only goods that had prices above the ceiling will see their price decrease.<sup>10</sup> In the NBA it is easy to see that players are heterogeneous goods, as there are clear differences in individual talent level. However, in the words of *Moneyball*'s Peter Brand (Jonah Hill), “Your goal shouldn't be to buy players, your goal should be to buy wins.”<sup>11</sup> Unlike players, wins are a homogenous good. An NBA player's value comes from the wins that he brings to his team. By capping the price of a singular player with a price ceiling, there are excess wins that are not being paid for. Further, the work of Fershtman and Fishman suggests that price ceilings can also actually bring up the price of cheaper goods, theoretically creating a middle class of players in the NBA that are more expensive on a win per dollar basis than those athletes receiving max contracts. In fact, research by Késenne (2000) has shown that while a salary cap should theoretically increase parity, a max contract will theoretically decrease parity.<sup>12</sup>

Max contracts also affect competitive balance in less apparent ways. Sanderson and Siegfried (2003) note that max contracts drive a player to prioritize choosing a team with which he can win rather than choosing the team that is willing to offer him the most money.<sup>13</sup> Because the contract that teams can offer a “max player” is capped, such a player will likely receive the same/similar

offer(s) from a handful of teams. Thus, his decision is no longer strictly monetary; the quality of players that are already on a team becomes one of the most influential factors in his landing spot. Kopkin (2012) proposes that players are also likely to choose to play for teams that hail from states with lower state income taxes, finding an inverse relationship between a team's state income tax level and the skill of said team's free agent signings.<sup>14</sup> Clearly variables such as surrounding talent and state income tax level take on an inflated role in player decision-making when max contracts are in place. This results in a further decrease in parity, on top of that which the max contract already causes by undervaluing "superstars."

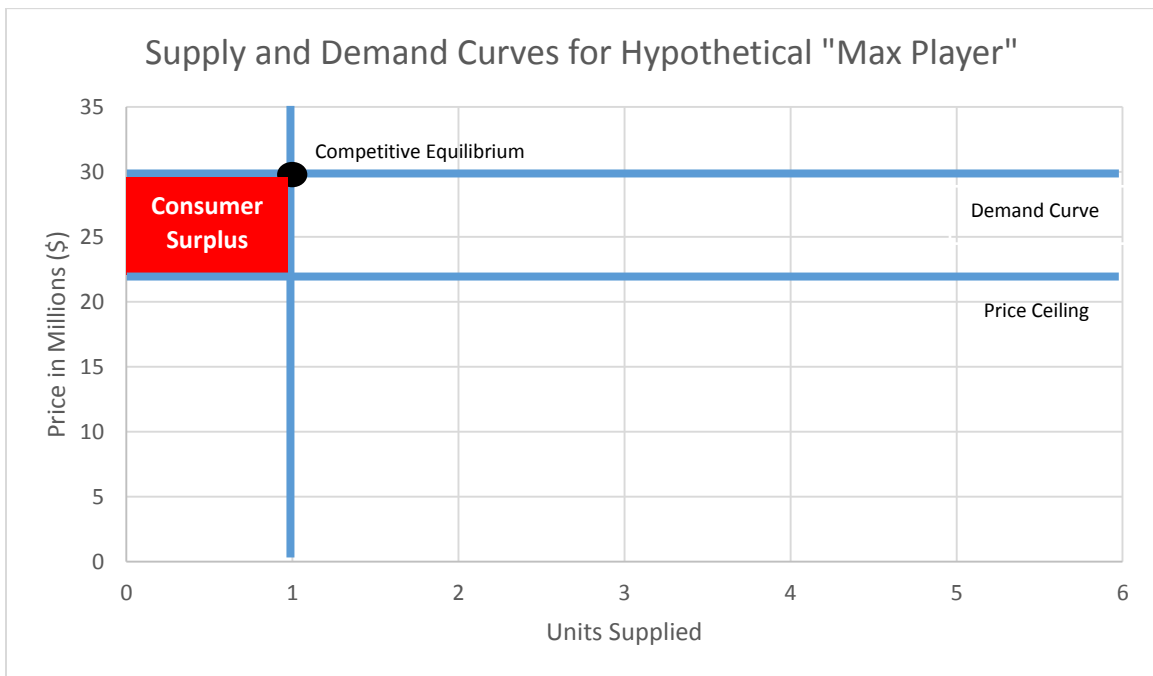
Although it is clear that the max contract has some sort of effect on parity within the NBA, there has yet to be an empirical estimate of this effect. In this paper we will provide such an estimate, and deem whether the effect significantly hinders the competitive balance of the league.

## **Theory**

In order to measure the max contract's effect on parity, we must first get a handle on the general microeconomy of the NBA. If we accept that a given player would rather play in the NBA than not, regardless of the contract offered to him, we can say that the supply of this player's talents is highly inelastic (for simplicity we will assume perfect inelasticity at 1 unit). Clearly this is a broad generalization, but it is likely applicable to the vast majority of NBA athletes. Even the minimum salary, a little over \$500,000 in 2015-16, is more than enough to justify playing a game for a living (to most). Next, if we assume that a team would buy multiple players of identical talent at a given price level we can say that demand is perfectly elastic. Undeniably this is less intuitive than the thinking employed on the supply side. However, if we replace individual players with the wins that these players provide, it is not unreasonable to believe that demand should be perfectly elastic. If a team can acquire wins below market value they will theoretically

do so infinitely, just as they should not be willing to pay more than market value for a win. Again this is a generalization. For example, small market teams may be forced to pay more than market value for wins in order to compete with the appeal of markets such as Los Angeles and New York. Nevertheless, perfectly elastic demand for wins in the NBA is theoretically sound; thus, we will employ it in this study. Hence, when a price ceiling (the max contract) is enforced on a hypothetical “superstar’s” contract, we should see something similar to the situation depicted in Figure A. We will assume that in a free market this superstar would be worth \$30 million per year based on his performance in previous seasons.

**Figure A**



Due to the max contract of \$22.97 million imposed upon players with 10+ years of experience, our hypothetical “superstar” is unable to earn his free market salary of \$30 million. This inherently creates imbalance in the market, as the player is losing out on \$7.03 million in salary. In turn, the team that signs this player has consumer surplus equal to the difference between the

equilibrium salary and the max contract, again \$7.03 million. We will use this team surplus that price ceilings introduce to measure the effect that the max contract has on competitive balance in the NBA.

## **Methodology**

Ideally we would like to compare two identical leagues, one with the max contract and one without. However, this is not possible, so our approach is going to need to be a bit more sophisticated.

In order to calculate consumer surplus, we will need an approximation of any given player's value. Luckily valuing athletes is not a new concept, so we have plenty of established work to pull from. To simplify things, we are going to want to use a single statistic to summarize a player's relative talent level. In this study that statistic will be Value Over Replacement Player (VORP). VORP is a measure of the value that a player provides to his team when compared to that which would be provided by a minimum contract/non-rotation player ("a replacement player").<sup>15</sup> However, NBA contracts are not given out retroactively, so it would be remiss of us to simply look at a player's VORP when determining how much he should have been paid in a season. Rather, we are going to need to PREDICT VORP going into a season to evaluate how much money a player should be making. Thus, we will create a predictive regression model built from a host of statistics and measures from previous seasons to predict a player's VORP going into a given season (See Figure B for a comprehensive list of covariates). Ultimately, we will use this model to predict VORP in the 2015-2016 season.

To create our predictive model, we will implement linear regression on the dependent variable of VORP in the 2014-2015 season, based on a host of covariates (See Figure B). As prediction is



our focus, we will use intuition, adjusted R-squared, and mean squared prediction error (MSPE) as our criteria for model selection. Adjusted R-squared is a measure of how well a model explains the variability in a dependent variable, with a penalty invoked for the inclusion of additional independent variables. Because traditional R-squared will never decrease with the inclusion of more covariates, adjusted R-squared is preferred when forming a predictive model as to discourage over-fitting. MSPE is a measure of the error in the predictions provided by a model as opposed to the true values in a dataset. This means that a lower MSPE is preferable. To measure MSPE we will split our data into two equal subsets. Then we will “train” a linear model on one subset, using the other to “test” our models predictive power by calculating MSPE based on the predictions that our “trained” model renders on the “test” set. Once this is done we can merge the two subsets together again and recreate what we have determined to be our ideal model, as this will allow said model to be as informed as possible.

The next step is to determine the price that a player would go for on an open market with no price ceiling. First, we need to translate our predicted VORP values to Wins Above Replacement (WAR), which is as simple as:<sup>16</sup>

$$WAR = 2.4 * VORP$$

WAR is a rough estimate of the wins that a player adds to his team above that which the previously defined replacement player would provide. Therefore, if we multiply a player’s WAR prediction by the approximate value of a win, we will get an estimate of the contract that said player should receive in competitive equilibrium.

The aforementioned statistician, Nate Silver, has developed the following process through which one can estimate the value of a win in a given NBA season.<sup>17</sup> To calculate the market value of a

win we take the total payroll across the NBA in the 2015-16 season (\$2,330,456,901) and divide by the number of teams (30) to get the average payroll per team (\$77,681,896.70). We then subtract \$12,000,000 from this value, as we can assume that a team will need on average approximately \$1,000,000 per player to simply field a replacement level 12-man roster. This leaves us with the average payroll above the minimum that teams are currently spending on acquiring talent, also known as average payroll over replacement (\$65,681,896.70). Silver cites that the Pythagorean win expectation model predicts that an average team would win 41 games, while a replacement level team would win 16 games. Thus, we divide the aforementioned average payroll over replacement by the difference between these two values (25), as spending the average payroll over replacement should theoretically move a team from replacement level to average. This leaves us with an approximate value of a win in the 2015-16 NBA of \$2,627,275.87.

Now that we have the pieces with which to estimate free market contracts, we calculate consumer surplus just as we did for the team that signed the hypothetical player described in Figure A. As we are primarily interested in the effect of the max contract, we will only calculate the surplus achieved on the signings of those players currently making “max money.” Grouping “max players” by team will allow us to sum the surplus value in dollars that each team is receiving due to the max contract. Using the previously calculated value of a win we can translate this dollar value back into wins, giving us the number of surplus wins that each team is receiving from the max contract.

The final step is to definitively determine the effect of the max contract on parity within the NBA. First we will use an F-test on equality of variance to see if the distribution of wins across all thirty NBA teams is significantly affected by the surplus wins that the max contract

introduces. If this does not prove to be significant, we can alternatively perform Z-tests on the difference in winning percentages of specific teams with and without the surplus wins provided by their max contract players. Because there is ultimately one champion in a NBA season, if even one team significantly benefits from the max contract this can be viewed as a negative effect on parity. If any of these tests prove statistically significant, we can surmise that the max contract is in fact altering the competitive balance of the NBA.

## **Data**

Player age, contract, draft spot, minutes played, performance related statistics, and position data from 1995-2016 were extracted from BasketballReference.com.<sup>18</sup> A table of performance-based statistics extracted is provided in Figure B.

I chose to observe data from 1995 onwards, as 1995 saw the debut of the longest tenured player active in the 2015-2016 season (Kevin Garnett).

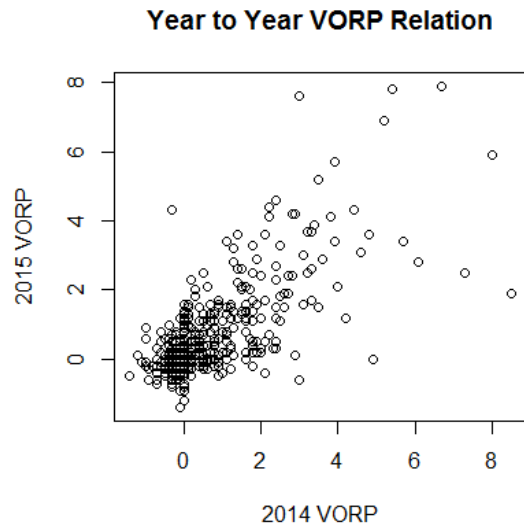
Data was organized in both MySQL and Microsoft Excel. Analysis was performed in R.

**Figure B**

Performance Based Variables				
Player Efficiency Rating (PER)	True Shooting Percentage (TS%)	3-Point Attempt Rate (3PAr)	Free Throw Attempt Rate (FTr)	Offensive Rebound Percentage (ORB%)
Defensive Rebound Percentage (DRB%)	Total Rebound Percentage (TRB%)	Assist Percentage (AST%)	Steal Percentage (STL%)	Block Percentage (BLK%)
Turnover Percentage (TOV%)	Usage Percentage (USG%)	Offensive Win Shares (OWS)	Defensive Win Shares (DWS)	Win Shares (WS)
Win Shares Per 48 Minutes (WS/48)	Offensive Box +/- (OBPM)	Defensive Box +/- (DBPM)	Box +/- (BPM)	Value Over Replacement Player (VORP)

It seems intuitive to believe that those players who perform well in a given season will continue to do so the next. Examination of Figure C confirms this belief.

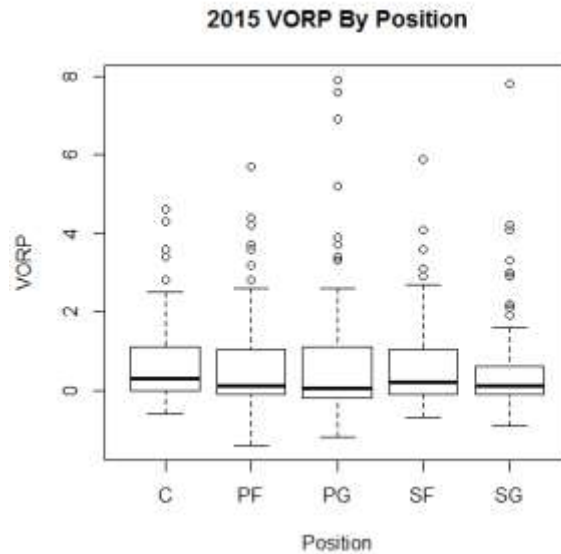
**Figure C**



There is a very clear positive correlation between VORP in 2014 and 2015, which leads us to believe that VORP in the previous season will likely be a key regressor in our predictive model.

Examination of the distribution of VORP across positions in 2015 can be seen in Figure D.

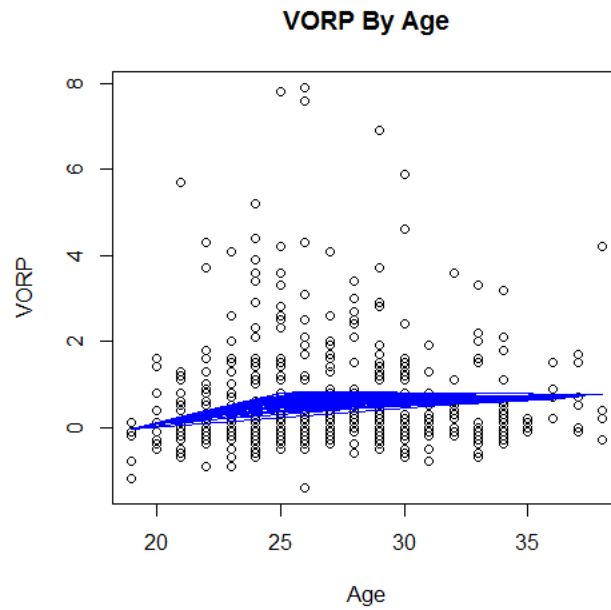
**Figure D**



As the focus of this study is players on max contracts, the outliers in Figure D are likely to be the most important data points. VORP is designed to allow comparison across positions, so it is not strange to see a fairly similar distribution throughout.

Similarly, we can observe the distribution of VORP across age groups. Intuition would lead us to believe that there is likely a peak age, a prime, at which an athlete's physical and mental attributes reach an optimal combination for performance. Observation of Figure E does not quite back this up. VORP rises until age 26, where it then seems to level off. This could potentially be attributed to older players retiring before their skills decline too much, leaving only those older players that defy the normal aging curve in the NBA, which in turns skews the results.

**Figure E**



## **Results**

After trimming and validating a model with 2014-2015 VORP as the dependent variable we settled upon a linear regression of the form depicted in Figure F. Notably, age and position were both dropped from our model. The issues noted in the data section likely contributed to their insignificance (standardization of positions and bias in the age curve).

## Figure F

Baseline 2<sup>nd</sup> Round Draft Pick (Picks 31-60):

<b>Independent Variable</b>	<b>Coefficient</b>	<b>Standard Error</b>	<b>Significance</b>
Intercept	-.0189463	.1060365	
VORP (Year – 1)	.5096991	.0689015	***
VORP (Year – 2)	.3186263	.0486630	***
PER (Year – 1)	.0772739	.0184670	***
PER (Year – 2)	-.0048857	.0093690	
PER (Year – 3)	-.0052998	.0090993	
PER (Year – 4)	.0002861	.0113828	
PER (Year – 5)	-.0194904	.0095985	*
TS% (Year – 1)	-1.3896340	.5741827	*
3PAr (Year – 1)	.2793490	.2572089	
FTr (Year – 1)	.6828021	.3074180	*
OWS (Year – 1)	-.1364531	.0427331	*
Top 4 Draft Pick	.3678474	.1469565	*
Drafted Picks 5-14	.0358407	.1134286	
Drafted Picks 15-30	.0721009	.1053222	
Undrafted	-.0678134	.1146519	

Observation of the model uncovers some relationships that are not entirely intuitive. We see that PER in Year – 2, PER in Year – 3, PER in Year – 5, TS% in Year – 1, and OWS in Year – 1 all have negative coefficients, which is strange considering all are thought of as measures of positive on-court performance. However, inclusion of PER in Year – 5, TS% in Year – 1 and OWS in Year – 1 all improved either the adjusted fit and/or predictive ability of the model so they were retained. PER in Year – 2, Year – 3, and Year – 4 were also retained as to maintain a consistent model. Skipping years would likely lead to strong over-fitting. Furthermore, it is strange that there is a higher coefficient on the factor for players drafted between picks 15 and 30 than those drafted between 5 and 14. This can likely be attributed to survivor bias, as mediocre players drafted between 5 and 14 are more likely to stick around the league than those drafted between 15 and 30 due to lingering hopes regarding “potential.”

Cross validation was implemented to test the predictive power of potential models. Models that did not include draft position yielded slightly lower MSPE values. However, because we are focused on predicting the value of the best players, and the top 4 draft pick factor is significant to our model, we decided to retain draft position as an independent variable. The lowest MSPE was obtained relying only on VORP Year – 1 and VORP Year – 2 as independent variables.

However, when fitting a model that looked only at stats from Year – 1 we saw that VORP, PER, TS%, 3PAr, FTr, OWS, and draft position were all retained using stepwise model selection.

Thus, we decided that they should be retained in our final model. It should be noted that USG% and TOV% were also significant when restricting to one year prior, however their significance dropped substantially in a more complex model so they were dropped.

Once our final model was created, we plugged in the data for each player in the NBA at the beginning of the 2015-2016 in order to predict their performance. As the focus of our research is



the surplus value created by players on max contracts, we centered our analysis on only those players that are both receiving their maximum contract AND are predicted to outperform this contract. Results for these players are shown in Figure G, separated by team.

**Figure G**

<b>Team</b>	<b>Player</b>	<b>Predicted Salary</b>	<b>Actual Salary</b>	<b>Surplus Wins</b>
<b>Cleveland Cavaliers</b>				
	LeBron James	\$35,418,111.96	\$22,971,000.00	4.737649407
	Kevin Love	\$19,862,299.29	\$19,500,000.00	0.137899217
	Kyrie Irving	\$19,379,050.49	\$14,746,000.00	1.763442715
<b>Houston Rockets</b>				
	James Harden	\$34,939,972.31	\$15,756,438.00	7.301682533
<b>Oklahoma City Thunder</b>				
	Russell Westbrook	\$33,524,605.20	\$16,744,218.00	6.386990955
	Kevin Durant	\$27,473,401.19	\$20,158,622.00	2.784168681
<b>Los Angeles Clippers</b>				
	Chris Paul	\$28,330,548.54	\$21,468,696.00	2.61177466
	DeAndre Jordan	\$21,700,073.00	\$19,500,000.00	0.837397028
	Blake Griffin	\$21,526,793.43	\$18,907,725.00	0.996876064
<b>San Antonio Spurs</b>				
	Kawhi Leonard	\$23,902,361.33	\$16,500,000.00	2.817504405
<b>Sacramento Kings</b>				
	DeMarcus Cousins	\$22,930,257.37	\$14,728,844.00	3.121641495
<b>Washington Wizards</b>				
	John Wall	\$22,037,800.47	\$15,851,950.00	2.354473143
<b>Chicago Bulls</b>				
	Jimmy Butler	\$19,533,798.55	\$15,260,000.00	1.626703385
<b>Utah Jazz</b>				
	Gordon Hayward	\$15,797,223.29	\$15,409,570.00	0.14754952

Given these results, we can now perform hypothesis tests to see whether the max contract truly influences parity in the NBA. Our initial test uses an F-statistic to determine whether or not the difference in winning percentage variance between a league in ideal parity and a league with maximum contracts is significant (See page 3 for the standard deviation of winning percentage under true parity). To find the variance in winning percentage in a league with maximum contracts (assuming parity is otherwise held constant) we simply add the additional variance in winning percentage that the max contract introduces to the NBA to the variance under true parity (we can safely assume independence). This test has a null hypothesis that the two variances are equivalent, while the alternative is that the variance in a league with max contracts is higher (29, 29 are the degrees of freedom; the number of teams in the league, 30, minus 1 is 29). We conclude that we are 80% confident that the league with a max contract has a higher variance. This is not a statistically significant result, though more testing is certainly warranted.

We now use Z tests to determine whether any one team is benefitting from their max contract related gains in winning percentage. The null hypothesis for these tests is that there is no significant difference in the winning percentage of a team that is getting excess value from their max contract players and a team that is not. The alternative hypothesis is that the surplus wins created by the max contract significantly increase a team's winning percentage. Thus, these are one-sided Z tests. To find our Z statistics we divide by the deviation of winning percentages in a league with max contracts that is otherwise held to parity, calculated the same way as in our F test. We find that the Cleveland Cavaliers and the Houston Rockets show a slight statistically significant increase in their winning percentages because of the max contract ( $\alpha=.10$ ), while the Oklahoma City Thunder show a significant increase ( $\alpha=.05$ ). These results support our

hypothesis that max contracts have a negative effect on parity within the NBA, as these effects only benefit a few teams.

## **Conclusion**

Surely it is impossible to ever obtain true parity within the NBA, not to mention any other sports association or league. There will always be players on contracts that prove to be worth more than they are paid, just as there will be players that underperform, resulting in negative value for their respective team. Athletes do not perform at a constant level, so the fact that they are often signed to multi-year contracts means that there is inherently going to be variation in the value that each team is receiving as opposed to the amount of money they are spending. This being said, the fact that the max contract itself is directly responsible for raising the winning percentages of some teams in the NBA raises questions regarding its practicality. It is one thing if a team is gaining an advantage through shrewd drafting, signings, and player development; but should a rule be handing them an advantage that other teams are not able to capitalize on due to scarcity of elite talent?

An attempt to quantify the max contract's effect on parity resulting from its effect on the salaries of non-max players could theoretically be of further interest. Quantifying such effects would be tough due to difficulty in determining causation, though certainly presents an interesting endeavor. Nonetheless, from where we stand now it is apparent that the max contract does result in superstars that are being paid below market value.

Criticizing the max contract relies on the assumption that parity should be of the utmost concern when evaluating regulations within the NBA. From a fan's perspective this is an easy mindset to take on, as a higher rate of parity theoretically leads to a more balanced and competitive product

on the court. However, fan preference is only one factor that affects rules in the NBA economy. We have already seen that the implementation of the max contract redistributed earning potential from the top 40% of NBA salaries towards the bottom 60%.<sup>19</sup> Further, it is generally recognized that by redistributing wealth the 1999 CBA also shifted power from superstar players back towards owners. Take this quote from agent David Falk,

"I don't think this labor dispute is about economics. I think the owners are sick and tired of young and basically uneducated men, many of whom haven't finished college, in a position to demand large sums of money. But I see the frustration. And yet, at the same time, remember that Stern is the man who has been saying for the last 20 years that these are the 300 greatest athletes in the world."<sup>20</sup>

This begs the question of who really should have more power in labor negotiations between “max players” and owners. Should it be the ten to twenty athletes that are the best in the world at what they do, or an owner that is in a financial position that has allowed him/her to purchase a team? Consider this: In a league that, in 2013, was 76.3% African-American there is only one African-American owner.<sup>21</sup> That owner? Michael Jordan.

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