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Economics of Salary Dispersion in the National Basketball Association

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Abstract

The purpose of this study is to discover the optimal amount of salary dispersion for an NBA team and the affect that dispersion has on team wins and revenue. The optimal amount of salary dispersion could be different for teams that want to maximize wins and teams that want to maximize revenue. For the purpose of this study, five different measures of salary dispersion are utilized to most effectively understand the effects. Empirical models are constructed and OLS regressions employed using cross-sectional data from the 2006-07 NBA season through the 2010-11 season to understand the relationship. The empirical evidence supports the idea that the larger the salary dispersion the greater the number of wins achieved. The evidence also implies that the amount of dispersion does not significantly affect the amount of revenue generated by a team. According to this study, a win maximizing team should attempt to hire as many superstars as possible given the NBA's salary constraints.

I. Introduction

Teams in the National Basketball Association (NBA) face important salary allocation decisions. NBA players provide different value to their respective team and therefore are worth different amounts of money. General managers have to determine how to allocate the total salary given to their signed players. An important research question to consider is: What is the best way to allocate salary amongst an NBA team? The term "best" in this situation can be interpreted in different ways. "Best" can be viewed as a salary distribution that maximizes wins. Wins are obviously important to both fans and management. "Best" can also be viewed as a salary distribution that maximizes revenue as each team is attempting to make money.

There are many reasons that this research is important. Understanding the results of salary distribution could play a significant role in the shaping of the league. Also, greater knowledge of how salary distribution affects wins and revenues could be helpful to general managers as they construct their teams more appropriately.

With general managers' knowledge of effective team construction increasing, the competitive balance of the NBA might improve. The biggest problem any sports league faces is competitive imbalance. A large amount of imbalance can lead to a contraction in the number of teams, or even the disbanding of the entire league (Rosen et al, 2000). The NBA has the biggest competitive imbalance problem of any of the four major sports leagues when it comes to number of wins and amount of revenue generated. At the end of the 2010-11 NBA season, two teams, the Boston Celtics and Los Angeles Lakers, have won a combined 33 NBA Championships in the NBA's 65 years. In addition, differences across teams in revenue generation are enormous. Within the last five years, there has been up to a 254% difference between the top and bottom teams in total revenue. The competitive imbalance problem deals with a problem at the league level, whereas the research question at hand deals with the team level disparity. They are connected, however, because if general managers knew how salary dispersion on a team level affects wins and revenues, they could use this knowledge to construct more competitive teams. This would increase the health of the league and everyone involved with the NBA would reap the benefits.

In addition to these facts on the importance of this topic in the NBA, this research is feasible because of the availability of relevant data. Production and productivity outcomes are more easily measured in sports compared to other business firms. Basketball players' productivity is much more easily measured than workers in other firms because of the statistics that are compiled with the sport.

This study aims to determine the optimal amounts of salary dispersion to maximize wins and maximize revenue. Based on economic theory provided in the following section, I hypothesize that the optimal amount of salary dispersion will be different for teams that have a goal of maximizing wins and teams that have a goal of maximizing revenue. Labor demand theory, human capital theory, and superstar theory all play a role in the following section. Based on these economic theories, I hypothesize that the greater the dispersion the greater the number of wins achieved. I also hypothesize that the greater the dispersion the greater the amount of revenue generated.

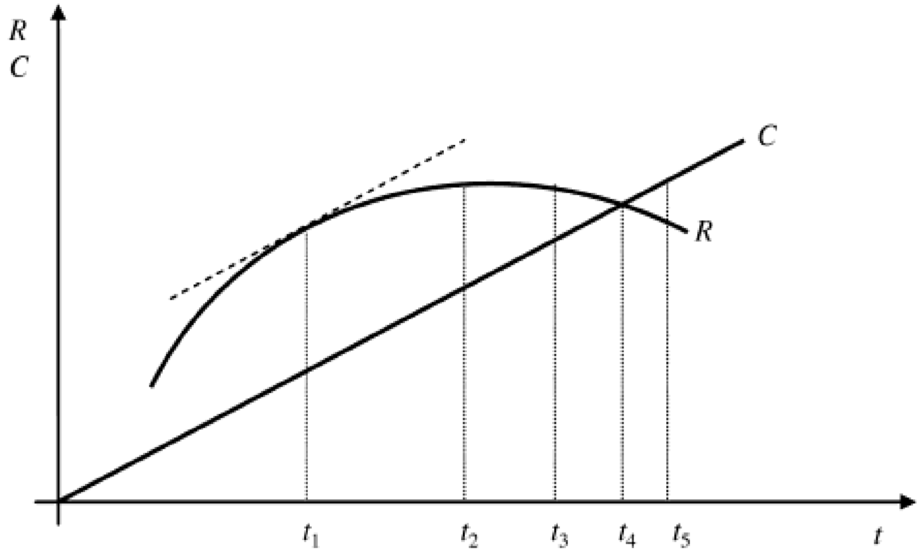
II. Theory and Literature Review

While a large amount of literature is published on the effects of wage disparities within firms, there is little on the effects of salary dispersion in the NBA. Most literature on salary dispersion in sports deals with the effect of salary dispersion on the number of wins and does not consider revenue. The literature that deals with wins and salary dispersion is relatively new and has mostly appeared after the Collective Bargaining Agreement (CBA) between the NBA owners and players' union was developed at the start of the 1995 season (Berri et al, 2004). This was the first time in NBA history where the salary dispersion within teams really exploded. The "middle-class" of the NBA was basically lost and teams had a combination of very high salaried players and relatively low salaried players (Berri et al, 2004). Many teams, as a result of the terms of the new CBA, allocated a substantial amount of team payroll to a few stars and then completed their roster with players offered the NBA minimum wage or close to it.

Berri and Jewell (2004) in addition to Katayama and Nuch (2011) saw this rapid change in distribution of salaries as a chance for a natural experiment to understand how changes in disparity impact team/firm performance. Each study defined the dispersion variable differently, but came to the same conclusions. Both studies found the amount of salary dispersion within a team to have no significant effect on team performance. The authors say that, for this industry at least, the idea of tournament theory, which states that pay inequality results in higher worker productivity, and pay compression school of thought, which states that wage equality will enhance cooperation and therefore performance, are both inapplicable (Berri et al, 2004). The datasets used, however, were admittedly somewhat small and both Berri and Katayama believe there could be a significant effect if the sample size was larger (Katayama et al, 2011). Another similarity of these authors was their conclusion that salary dispersion might not affect team performance because the lower salaried players will perform to their best abilities to maximize the amount of salary they can obtain on their next contract.

Stefan Kesenne (2007) discusses the multiple objectives of professional sports teams in The Economic Theory of Professional Team Sports. He acknowledges that professional sports organizations are businesses that attempt to maximize revenue and profit, but at the same time many teams are focused on maximizing wins. Studies have been inconclusive in accepting or rejecting the profit or win maximization goals. Kesenne provides a simple diagram that leads to his underlying hypothesis that revenue maximizing teams and win maximizing teams will have a differing amount of salary dispersion. Figure 1 shows the different amount of talent demand levels depending on team goals. The number of talents, or superstars, is represented on the horizontal axis and total revenue and cost is represented on the vertical axis. The variables t_1, t_2, etcetera, on the horizontal axis do not specifically mean one superstar, two superstars, and so forth. They represent different possible number of talents on a team, but not incremental increases in talents. The farther to the right on the horizontal axis, the higher the total number of talents on a team. Total cost (C) increases as the number of talents increases, but the revenue curve (R) is concave. According to Kesenne, this is a result of revenue increasing with the team becoming more successful, but then decreasing if the team becomes too good and public interest fades because of lack of uncertainty of outcomes. A revenue maximizing team will hire at the t_2 amount of talents on this graph, where the revenue curve is at its highest point. Under the assumption that the most successful teams have more talents, a win maximizing team would want to hire as many talents as financially possible. Therefore, a win maximizing team will hire t_4 amount of talents on this graph, where they can maximize the amount of talents without losing any money (Kesenne, 2007). This analysis makes clear that the revenue maximization point and win maximization point requires a different amount of talents and therefore a differing amount of salary dispersion.

Figure 1: Kesenne's Theory of Sports Teams



The effect of superstars on revenue has also been extensively studied, especially by Sherwin Rosen (1981) and Walter Oi (2008). Rosen discusses that the settings in which superstars are found share two common elements. The first is a close connection between personal reward and the size of a person's own market, and the second is a strong tendency for market size and reward to be skewed toward the most talented people in a specific activity. Oi believes that superstars' gigantic income and rare talents is what attracts attention. They both acknowledge that superstars are of interest to fans and, therefore, create attention. In most circumstances superstars are considered entertaining, and it is the search for entertainment, admiration, and a desire to understand how they are as good as they are that creates revenue for their firm.

Jerry Hausman and Gregory Leonard (1997) studied the effect that NBA superstars had on both team and league revenue during a number of seasons in the 1990's. Some of the avenues that superstars help produce revenues are through increases in television ratings, game attendance, and sport paraphernalia sales. They found that a superstar positively impacts both his team's total revenue and other teams' revenue (Hausman et al, 1997). This means that small market teams would attempt to free-ride off large market teams. According to Hausman, a suggestion to fix this free rider benefit is to impose a salary cap. A salary cap, however, could over correct the superstar externality. The NBA has tried to correct this problem by instituting a soft salary cap (Coon, 2011). This means that there are a few exceptions to the salary cap rule and teams are able to have a payroll that exceeds the salary cap, but are fined when payrolls exceed a certain luxury tax level. The luxury tax level is determined by a complicated formula, but is typically in the range of $12-13 million above the salary cap.

Salary dispersion and the effect it has on teams can also be explained within the framework of demand theory. Marginal revenue product (MRP) is the demand for labor curve. Human capital is an important concept in relation to the MRP curve because it is a major determinant of the marginal productivity of workers. Human capital refers to the productive capabilities of human beings as income generating components in the economy (Rosen, 2008). According to human capital theory, the higher the productivity that is obtained through investments in education and training, the higher amount of income a person should achieve. Also, human capital theory suggests that the returns to investments in education and training are directly related to the individual's innate ability and physical endowments. Therefore, the higher the basketball player's skill, the higher the amount of income he should generate and the higher his MRP.

According to Oi (2008), small differences in talent can be associated with large differences in income, especially when the market size is big, which is definitely the case with the NBA. This idea is illustrated in Figures 2 and 3. Figure 3 shows that with increased training all players' marginal product increases, but superstars' marginal product increases by a larger amount. The same thing occurs in Figure 2 with marginal revenue product increasing with training, but superstars' marginal revenue product increases by an even greater amount than it

Figure 2: Marginal Revenue Product Curve of Superstars and Normal Players

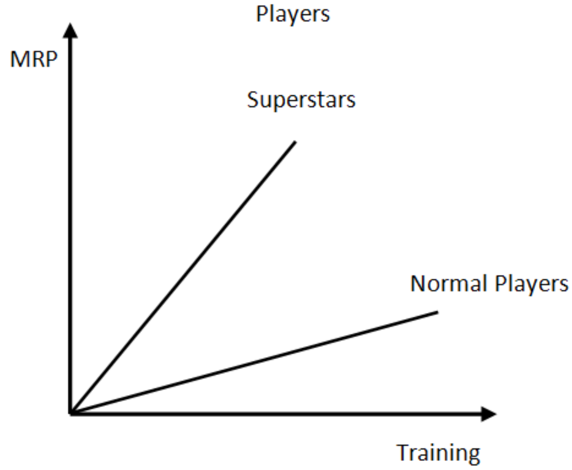
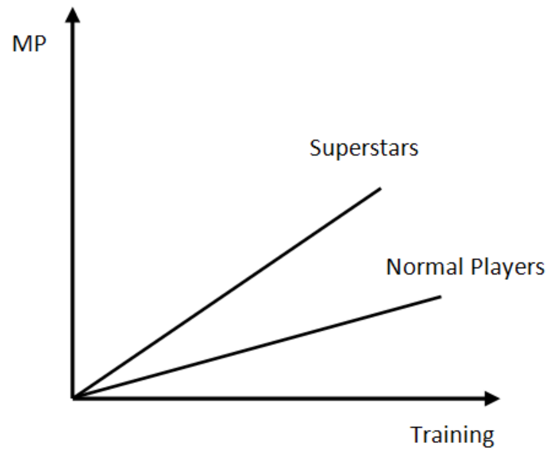


Figure 3: Marginal Productivity Curve of Superstars and Normal Players



did with marginal product in comparison to the normal players. This large difference in MRP allows superstars to earn a high income compared to normal players and could cause great salary dispersion within a team.

Each team, in essence, constructs its own demand curve and has a different curve than each other team (Rosen et al, 2000). This is in part because talent is distributed differently across teams. With the knowledge of the MRP of players and the presence of a salary cap, demand curves can be understood. With a larger number of high skilled players, a large amount of the team's total salary, which is restricted by the salary cap and luxury tax level, is devoted to a few players. Therefore, the demand curve would be very steep and inelastic. Teams with more balanced salary dispersion will have a flatter more elastic demand curve (Rosen et al, 2000). This idea is represented in Figures 4 and 5. Figure 4 represents a MRP curve of a team that employs a few superstars and the rest below average players, therefore creating an uneven distribution of talent. The superstars, as a result of their high skill level, receive larger salaries. Given the salary constraints a team faces, the rest of the team is filled with below average skill level players who receive much smaller salaries. This uneven distribution of talent, therefore, creates a large amount of salary dispersion and an inelastic MRP curve. Figure 5 represents a MRP curve for a team with players of similar abilities. Certain players would still make more than others, but the overall salary dispersion for the team would be much less. This more balanced distribution of talent, therefore, creates little salary dispersion and an elastic MRP curve.

Free agency in the NBA allows players to negotiate their contracts. Teams have to bid for players and players can decide if they believe the offer is fair. The potential producer surplus obtained by the team that signs the player is squeezed out by the player as a result of the ability to negotiate. At the extreme, players receive their personal MRP and teams receive no producer surplus. An interesting part to this is that teams offer salaries to players at what they believe the player's future MRP will be. The decision process of whom to sign and for what price enables each team to create its own unique demand curve (Rosen et al, 2000).

Figure 4: Team With High Salary Dispersion

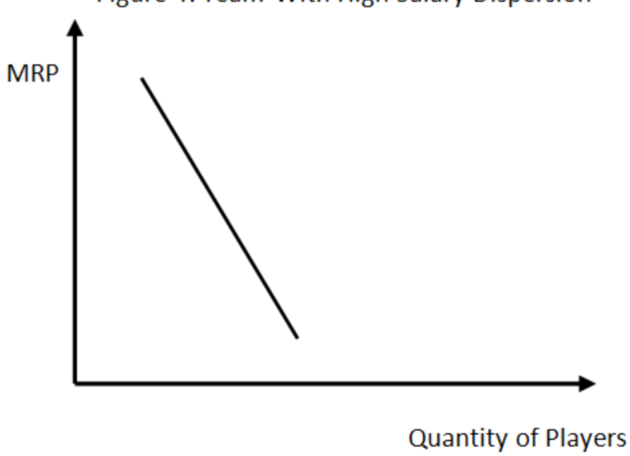
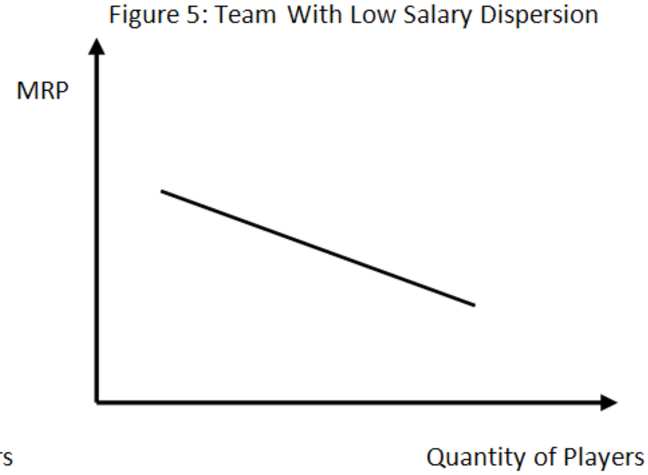


Figure 5: Team With Low Salary Dispersion



Kesenne's theory of professional sports teams along with demand for labor theory sets the stage for the remainder of this research study. When looking into the effects of salary distribution amongst NBA teams, both of these theories are relevant. They suggest that salary distribution can have a significant effect on the distribution of talent across teams. This will cause variation in MP schedules and MRP curves in asymmetric ways. Therefore, salary distribution can affect both wins and revenues, but not necessarily in the same way. The remainder of the paper will analyze the actual effects of salary distribution on wins and revenues in the NBA.

III. Data

Two different models each employing cross-sectional data are used to determine the effect of salary distribution on wins and revenues for NBA teams. This section discusses the data and the next section defines the variables in terms of definition, importance, and expected effect.

In the first model, the Wins Model, the number of wins a team achieves during the regular season is the dependent variable. It includes regular season wins, and not playoff wins, because every team participates in exactly 82 regular season games whereas not every team makes the playoffs. Using only regular season wins allows the study to be more consistent and accurate. This data is compiled from the NBA's website ("NBA.com"). In the second model, the Revenue Model, the team's total revenue of each season is the dependent variable. Forbes publishes valuations and other reported money figures, such as revenue, of sports teams every year (The Business of Basketball, 2011). The data for this study are from the 2006-07 to 2010-2011 seasons.

Total television market size in each NBA team's metropolitan area needs to be accounted for as that could play a role in a team's revenue and wins. This data is reported by Nielson Ratings, which is the most credible source when it comes to television monitoring ("Local Television Market Universe Estimates"). One limitation to the Nielson Ratings, however, is that it only reports figures for U.S. cities. The NBA is a multinational league with one team being located in Toronto, Canada. The Bureau of Broadcast Measurement (BBM) is Canada's equivalent of the United State's Nielson Ratings. The only year of data reported, during the range of this study, for Toronto's television market size was for the 2008-09 year. The other four years of television market size data for Toronto are estimations based on Toronto's population.

Another piece of data that is pertinent to this study is the luxury tax level in the NBA for each of the seasons. These figures are taken from the NBA's website ("NBA.com").

Finally, the last data that are needed are total team salaries, to see if each given team is above or below the luxury tax level, and a breakdown of team salaries by player in order to analyze the amount of wage dispersion for each given team. This data is reported by USAToday, which is a very reliable source for this type of data. Despite the reliability, there was a problem with some of the information retrieved from this source ("National Basketball Association Salaries"). When analyzing the salary data of the 2009-10 Houston Rockets, it was evident that the database double counted one player. Yao Ming, a player on the Houston Rockets, was included twice and this was corrected by removing the duplicate observation. Another shortcoming from this source was that it did not include the 2006-07 and 2007-08 Seattle Supersonics in its database as a result of their relocation to Oklahoma City. The salary figures for the two years of data in this study where Seattle did have an NBA team comes from the NBA's website ("NBA.com").

IV. Empirical Model

The empirical model section proceeds in three subsections. First, the dependent variables for each model are discussed. Then, the different definitions of wage dispersion that are used in this study are discussed in more detail. And lastly, the other explanatory variables that are needed as control variables in the regression model are discussed.

A. Dependent Variables

In this study, OLS regressions will be used to analyze the effect salary dispersion has on team performance and revenue. The dependent variable changes from the Wins Model to the Revenue Model. In the Wins Model, number of wins a team achieved during the regular season will be the dependent variable, and in the Revenue Model the total revenue generated by a team will be the dependent variable.

B. Salary Dispersion Measures

To better understand the relationship between salary dispersion in terms of team performance and team revenue, multiple measures of dispersion are utilized. Salary dispersion can be defined in a variety of ways, and this study investigates five different measures. Table 1 provides a short explanation and descriptive statistics about each dispersion variable and the other explanatory variables that are described in the next subsection. Each measure of dispersion used takes 12 players into account for each team because it is a requirement in the NBA that each team has at least 12 signed players at any given time. There are many more players that are signed to teams throughout a season, but they normally are signed to 10-day or 1-month contracts and, therefore, would be outliers in this study. Each measure of dispersion is predicted to have a positive effect on wins as well as on revenue.

The first measure of dispersion is each teams' Gini coefficient. The Gini coefficient measures the inequality among values of a frequency distribution. The possible values of the coefficient range from zero to one,

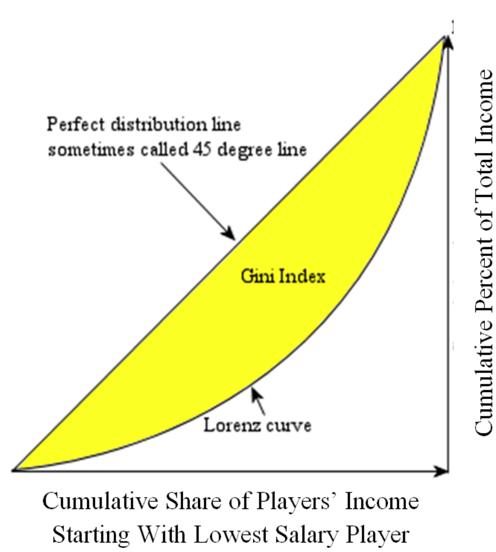
Table 1: Explanation and Descriptive Statistics of Variables

Variable	Definition	Minimum	Maximum	Mean	St. Dev.
Dependent Variables					
Model A					
Wins	Number of Regular Season Wins per NBA Team	12	67	41.00	12.89
Model B					
Revenue	Total Revenue of NBA Team	$81,000,000	$226,000,000	$124,350,000	$31,594,769
Explanatory Variables					
Models A & B					
Gini Coefficient	Gini Coefficient of NBA Team	0.15223	0.60316	0.40930	0.08219
Standard Deviation	Stnd. Dev. of NBA Team's Salaries	1,216,443.42	8,595,963.05	4,538,701.43	1,309,843.75
Top Player as % of Total Team Salary	Top Player's Salary as a Percentage of Total Team Salary	11.76%	35.31%	23.46%	4.49%
Top 2 Players as % of Total Team Salary	Top 2 Players' Salary as a Percentage of Total Team Salary	23.48%	65.13%	40.57%	6.58%
Top 3 Players as % of Total Team Salary	Top 3 Players' Salary as a Percentage of Total Team Salary	34.40%	78.29%	54.05%	7.89%
Gini Coefficient^2	Gini Coefficient of NBA Team Squared	0.02317	0.36380	0.17414	0.06486
Standard Deviation^2	Stnd. Dev. of NBA Team's Salaries Squared	1.48E+12	7.39E+13	2.23E+13	1.24E+13
Top Player as % of Total Team Salary^2	Top Player's Salary as a Percentage of Total Team Salary Squared	1.38%	12.47%	5.70%	2.12%
Top 2 Players as % of Total Team Salary^2	Top 2 Players' Salary as a Percentage of Total Team Salary Squared	5.52%	42.42%	16.89%	5.42%
Top 3 Players as % of Total Team Salary^2	Top 3 Players' Salary as a Percentage of Total Team Salary Squared	1.18%	61.29%	29.83%	8.78%
TVMarketSize	Number of Homes with TV's in Metro Area of Each NBA Team's Home City	566,960.00	7,515,330.00	2,350,181.73	1,822,547.28
LuxuryTaxAbove	A Team With Total Salary That is Above the Luxury Tax Level	0	1	0.39	0.49
LuxuryTaxBelow	A Team With Total Salary That is Below the Luxury Tax Level	0	1	0.60	0.49
Fixed Effect 06-07	Team Competing in the 2006-07 Season	0	1	0.20	0.40
Fixed Effect 07-08	Team Competing in the 2007-08 Season	0	1	0.20	0.40
Fixed Effect 08-09	Team Competing in the 2008-09 Season	0	1	0.20	0.40
Fixed Effect 09-10	Team Competing in the 2009-10 Season	0	1	0.20	0.40
Fixed Effect 10-11	Team Competing in the 2010-11 Season	0	1	0.20	0.40

with zero being perfect equality and one being perfect inequality. Normally the coefficient is applied to measure the distribution of income in a country or region. In this case, the measure is used to determine income dispersion within NBA teams. This measure of dispersion is different from those commonly used to test the effect of salary dispersion on performance and revenue. However, the Gini coefficient, while being a good overall indicator of the dispersion that exists on a team, does not explicitly address the affect of superstars' salaries.

In order to calculate each team's Gini coefficient, a Lorenz Curve is constructed for each team. The Lorenz Curve is a graphical representation that shows the degree of inequality that exists in the distributions of two variables (Byrnes, 2012). The two variables in this case are the population of each basketball team (12 players) and the amount of total salary. Figure 6 presents a typical Lorenz Curve and gives insight into how the Gini coefficient for each team is calculated. The number of players on a team is represented on the horizontal axis from one to 12. Player one is the player on the team that is paid the lowest amount of salary, while player 12 is the player on the team that is paid the highest amount of salary. The cumulative percent of salary paid by the team is represented by the vertical axis. This creates an upward rising curve from

Figure 6: Calculating the Gini Coefficient



player one to player 12. The perfect distribution line in Figure 6 represents perfect equality of income. As a result of no teams having perfectly equal distribution of salaries, no team's distribution follows the perfect distribution line. The Lorenz Curve represented in Figure 6 is more similar to that of a typical NBA team. The Gini coefficient is calculated by dividing the area in between the perfect distribution line and Lorenz Curve by the total area under the perfect distribution line. In terms of Figure 6, the Gini coefficient is the highlighted area divided by the entire triangle that is created from the 45 degree perfect distribution line. This method of calculating the Gini coefficient is applied to each team in this study to determine each team's respective Gini coefficient for each season.

The second measure of dispersion that is used is the standard deviation of each team's player salaries. This, like the Gini coefficient, is a representative measure of the dispersion that takes all players salaries into account. As the standard deviation of salaries increases, the wage dispersion on a team increases as well. This measure of dispersion has been used in past studies, however, it has not been utilized for the time frame that this study is reviewing (Berri, 2004). The effect of standard deviation on wins and revenue might be different in this study because of recent changes in the CBA, changes in the number of superstars in the league, and evolution of contract sizes in the NBA.

The last three measures of dispersion are all related. They are the top player salary as a percent of total team salary, top two player salaries as a percent of total team salary, and top three player salaries as a percent of total team salary (from now on referred to as TOP1, TOP2, and TOP3 respectively). These measures, unlike the first two, do focus on superstars' salaries compared to the rest of the team and not just overall distribution of team salary. Obviously, the higher the percentage of salary paid to top players, the greater the wage dispersion. These measures, have not been applied in published studies to test the effect salary dispersion has on team wins and revenue. Despite this, they are measures that completely take into account the salary of superstars and are a good representative measure of a team's salary dispersion.

C. Other Explanatory Variables

The other explanatory variables are the same in both the wins model and the revenue model. Despite the fact that this study is attempting to find the "best" amount of salary dispersion for an NBA team, other variables must be included in this model to control for other circumstances.

Dispersion Squared is the square of the respective dispersion measure for each regression. This is used in the empirical model to attempt to see if there is a parabolic curvature to the effect dispersion has on both wins and revenue. If there is, the maximum point on that curve would represent the "best" amount of dispersion for wins or revenue respectively. The predicted sign of this variable is negative, which would create a concave curve and, therefore, a maximum point representing the "best" possible dispersion level.

The television market size is a variable that controls for the metropolitan size of each NBA team. This takes into account the number of homes with a television in the metropolitan area of each NBA teams' home city. It seems obvious that the size of a team's market should have an impact on the amount of revenue generated throughout a season. It is also plausible that the market size could have an impact on wins as well considering the possibility of there being more money available from increased revenue for big market teams. There has historically been very little revenue sharing in the NBA, which makes the possibility of market size having an impact on wins even greater (Dosh, 2001). The market size variable is predicted to contain a positive effect on both team wins and revenue.

The next explanatory variable is a dummy variable that takes into account a team's salary position relative to the luxury tax level. The luxury tax level is greater than the salary cap level and needs to be controlled for in the study. This is because teams can have payrolls that exceed the salary cap due to certain league exceptions and are not punished for that, but are punished for exceeding the luxury tax level threshold. As a result of this, most teams have a payroll that does exceed the salary cap, but only some teams have a payroll that exceeds the luxury tax level. A luxury tax dummy variable is equal to one if the team has a payroll that is over the luxury tax threshold. The above luxury tax dummy variable, in this sense, is a proxy for the level of a team's payroll and is predicted to be positively correlated with wins and revenue. If teams are spending enough money to have a payroll that exceeds the luxury tax level, they most likely have a number of superstars that should create more wins and revenue.

The last variables are fixed effect dummy variables for time. These are included to deal with possible omitted variable bias. They control for things not already controlled for in the regression that may be correlated with time. Fixed effect dummy variables are defined for each year except for 2010-11 which is the reference year for each model. Each of the five seasons has its own dummy variable associated with it. There is no logical predicted relationship of the time dummy variables on wins and revenue.

Wins Model: Wins = $\beta_0 + \beta_1$(Dispersion Measure) + β_2 (Dispersion Measure^2) + β_3(MRKT) + β_4(LXTABOVE) + β_5(FE06-07) + β_6(FE07-08) + β_7(FE08-09) + β_8(FE09-10) + μ

Revenue Model: Revenue = $\beta_0 + \beta_1$(Dispersion Measure) + β_2 (Dispersion Measure^2) + β_3(MRKT) + β_4(LXTABOVE) + β_5(FE06-07) + β_6(FE07-08) + β_7(FE08-09) + β_8(FE09-10) + μ

V. Results

The results proceed in four separate subsections. The first subsection describes the insignificance of the dispersion measure squared variables and provides a justification for dropping them from the analysis. The second subsection presents the results of the Wins Model and the affect dispersion has on the number of wins a team achieves, and the third subsection presents the results of the Revenue Model and the affect dispersion has on the amount of revenue a team generates. Lastly, the indirect relationship of salary dispersion and revenue through wins is discussed.

A. Insignificance of Dispersion Measure Squared

After employing every regression in both models, the dispersion measure squared variable is always found to be insignificant. With the dispersion factor squared variable being insignificant, it is no longer possible to determine the exact "best" amount of salary dispersion for an NBA team. This is because the dispersion factor squared variable is responsible for creating the parabolic shape to the curve and, therefore, a max value of wins or revenue (depending on which model is being applied) according to dispersion. With dispersion factor squared being insignificant, the parabolic curve that it creates is insignificant and the point that represents the "best" amount of dispersion on the curve is not relevant. As a result of this, the dispersion measure squared variable is removed from each regression tested, which results in a linear curve instead of a parabolic curve. With a linear curve, a specific optimal level of dispersion cannot be found, however, the effect dispersion has on wins and revenue is still able to be seen. The effect that is represented by the linear curve will result in the optimal amount of dispersion to be either zero dispersion or the maximum amount of dispersion possible.

B. Wins Model

Five different regressions are run to determine the effect of salary dispersion on team wins. Table 2 presents the results of the five OLS regressions. Each regression tests a different dispersion measure. All of the other explanatory variables besides the dispersion measure remain constant in each regression of the Wins Model.

Each measure of dispersion tested, the most important variables to this study, reveals that there is a statistically significant positive relationship between team wage dispersion and the number of wins. As can be seen in Table 2, four of the five measures of dispersion are significant at the 1% level. The TOP1 measure is the only dispersion measure to not be statistically significant at the 5% level, but it is still statistically significant at the 10% level.

Next, a simulation is conducted to assess the magnitude of dispersion in determining wins. First, the standard deviation of each dispersion measure is calculated (provided in Table 1). Second, the standard deviation of the dispersion measure is multiplied times the coefficient of the dispersion measure found in Table 2. In terms of the Gini coefficient dispersion level, a one standard deviation increase in Gini coefficient will lead to 3.75 more wins during a season. When using the standard deviation of player salaries as the measure of dispersion, a team will generate 5.50 more wins when a team increases their total dispersion level by one standard deviation. These results show that having dispersion not only among superstars and regular players but across the entire team impacts wins in a positive manner.

Table 2: Regression Results Predicting Wins

	Wins Model				
	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5
Dependent Variable	Wins	Wins	Wins	Wins	Wins
Gini Coefficient	45.68 (3.883)***	-	-	-	-
Standard Deviation	-	4.20E-6 (4.988)***	-	-	-
Top Player as % of Total Team Salary	-	-	39.99 (1.758)*	-	-
Top 2 Players as % of Total Team Salary	-	-	-	46.16 (3.073)***	-
Top 3 Players as % of Total Team Salary	-	-	-	-	48.60 (3.992)***
TVMarketSize	-1.52E-6 (-2.935)***	-1.74E-6 (-3.418)***	-1.45E-6 (-2.663)***	-1.63E-6 (-3.033)***	-1.66E-6 (-3.177)***
LuxuryTaxAboveDummy	9.85 (4.574)***	4.73 (1.938)*	11.04 (4.988)***	10.87 (5.019)***	10.32 (4.846)***
Fixed Effect 06-07	.15 (.049)	1.36 (.473)	-.07 (-.024)	.02 (.005)	.31 (.106)
Fixed Effect 07-08	-.56 (-.188)	.30 (.103)	-.92 (-.298)	-.85 (-.281)	-.91 (-.308)
Fixed Effect 08-09	.10 (.034)	-.57 (-.200)	-.16 (-.051)	.01 (.002)	-.11 (-.037)
Fixed Effect 09-10	-3.91 (-1.219)	-2.50 (-.792)	-5.01 (-1.502)	-4.87 (-1.501)	-4.63 (-1.459)
Fixed Effect 10-11	-	-	-	-	-
Adjusted R^2	0.215	0.261	0.150	0.186	0.219
F-Value	6.829	8.522	4.760	5.856	6.977
Sample Size	150	150	150	150	150

Note: Values in parentheses are absolute t-statistics.

*** = significant at .01 level

** = significant at .05 level

* = significant at .10 level

The other three dispersion measures (TOP1, TOP2, and TOP3) also show a positive correlation with wins. The results become more significant and contain a larger effect with every additional player being included in the percent of total salary. For example, using the TOP1 measure contains a less significant and smaller effect on wins than does the TOP3 measure. These measures of dispersion only take the dispersion that exists from the highest paid players on a team compared to everyone else. The results indicate that the greater the salary dispersion of top paid players in comparison to the lower paid players, the more wins a team will achieve. The simulations of the effects of a one standard deviation change in the three dispersion measures (TOP1, TOP2, and TOP3) yield interesting results. A one standard deviation increase in TOP1, TOP2, and TOP3 is estimated to lead a team to win 1.80, 3.04, and 3.83 more games respectively in a season.

In all the regressions, the market size control variable is the only variable to have an opposite effect than what was predicted. This is a result that, at first, appears to have no logic. After reviewing the data, however, a reason for the size of the market negatively affecting wins emerges. A number of the big markets in the United States have two NBA teams. Both of these teams in each respective market technically have the same market size. In reality, however, one team most likely dominates the popularity within the market. For example, the New York Knicks and New Jersey Nets share the same New York City metropolitan market. The Knicks, however, are the much more popular team, while the Nets do not have nearly as many followers. This means the Nets really have a lower market size than would be reported by ratings systems. This effect is one possible explanation for the market size negatively affecting the number of wins achieved by an NBA team.

Every other control variable behaves according to the presumed logic. All of the fixed effect variables are statistically insignificant in all of the five regressions.

The market size had a statistically significant negative effect on the number of wins a team achieves during the regular season for each dispersion level tested. The coefficients of market size somewhat change depending on the measure of dispersion tested, but not by a great amount. If the market size of a team increases by one standard deviation, which is 1,822,547 people, a team will win anywhere from 2.64 to 3.17 less games throughout a season depending on the dispersion measure tested.

The luxury tax variable also contained statistically significant effects on wins for every measure of dispersion tested. This variable was positively correlated with the number of wins achieved. Depending on the measure of dispersion used, a team that has a payroll over the luxury tax level will obtain anywhere from 4.73 to 11.04 more wins.

These results do not show the specific amount of salary dispersion that is optimal for a team that has a goal of maximizing wins, however, they do show the linear effects of salary dispersion on wins. The results indicate that the greater the wage dispersion, the greater the number of wins achieved.

C. Revenue Regression

Similarly to the Wins Model, five different regressions are run to estimate the effect salary dispersion within a team has on team revenue. Table 3 presents the results of the five OLS regressions. Each regression tests a different dispersion measure. All of the other explanatory variables besides the dispersion measure remain constant in each regression of the Revenue Model.

Table 3: Regression Results Predicting Revenue

	Revenue Model				
	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5
Dependent Variable	Revenue	Revenue	Revenue	Revenue	Revenue
Gini Coefficient	26,471,653.47 (.984)	-	-	-	-
Standard Deviation	-	5.11 (2.627)***	-	-	-
Top Player as % of Total Team Salary	-	-	7,225,121.60 (.144)	-	-
Top 2 Players as % of Total Team Salary	-	-	-	34,842,116.53 (1.033)	-
Top 3 Players as % of Total Team Salary	-	-	-	-	37,529,509.59 (1.348)
TVMarketSize	6.96 (5.863)***	6.54 (5.576)***	7.07 (5.885)***	6.84 (5.675)***	6.81 (5.697)***
LuxuryTaxAboveDummy	29,756,439.65 (6.040)***	22,639,005.64 (4.017)***	30,523,010.42 (6.253)***	30,283,890.81 (6.226)***	29,854,020.91 (6.127)***
Fixed Effect 06-07	-1.08E7 (-1.601)	-9,443,672.39 (-1.421)	-1.08E7 (-1.589)	-1.10E7 (-1.620)	-1.07E7 (-1.591)
Fixed Effect 07-08	-9,330,021.43 (-1.376)	-7,939,754.83 (-1.191)	-9,613,850.40 (-1.414)	-9,452,187.99 (-1.396)	-9,494,599.63 (-1.406)
Fixed Effect 08-09	-7,593,773.59 (-1.120)	-7,874,987.25 (-1.188)	-7,978,633.39 (-1.169)	-7,517,117.55 (-1.108)	-7,592,407.54 (-1.124)
Fixed Effect 09-10	-2.04E7 (-2.777)***	-1.733E7 (-2.384)**	-2.14E7 (-2.907)**	-2.07E7 (-2.849)***	-2.05E7 (-2.830)***
Fixed Effect 10-11	-	-	-	-	-
Adjusted R^2	0.345	0.371	0.341	0.345	0.349
F-Value	12.208	13.557	11.993	12.231	12.401
Sample Size	150	150	150	150	150

Note: Values in parentheses are absolute t-statistics.

*** = significant at .01 level

** = significant at .05 level

* = significant at .10 level

In terms of the dispersion measures, there are conflicting results. Every dispersion measure carries a positive impact on revenue, but four of the five measures of dispersion are not statistically significant. The standard deviation measure of dispersion, however, shows a statistically significant relationship. With an increase in one standard deviation of the standard deviation of player salaries, a team will generate $6,693,302.84 more in revenues. It is interesting to note that the standard deviation of player salaries dispersion measure takes the dispersion across the whole team into account and not just the dispersion of superstars to regular players. The measures of dispersion that take only superstars compared to regular players on a team into account (TOP1, TOP2, TOP3) show no statistical significance in the effect dispersion has on revenues.

These results, similarly to the Wins Model, do not show a specific optimal amount of salary dispersion for a revenue maximizing team, but they do show the effects salary dispersion has on revenue. The most common result is that salary dispersion does not significantly affect revenues, but the model that measures dispersion by standard deviation does show that the greater the amount of dispersion, the greater the revenue generated.

Every control variable behaves according to the presumed logic and contains the predicted sign. The fixed effect variables were, once again, largely statistically insignificant. The one difference, however, is that in each regression, the Fixed Effect 09-10 variable was significant and negative. This shows that something related to time and unaccounted for in this study caused lower revenues during the 2009-10 season in relation to the 2010-11 NBA season (the omitted season for control purposes). The market size and luxury tax variables are extremely significant in every regression and both contain a large positive effect on revenue. In terms of the market size, depending on the measure of dispersion used, an increase of one standard deviation of market size would cause an NBA team to increase their revenue anywhere from $11,919,459.21 to $12,885,409.27. In terms of the luxury tax variable, a team that has a payroll over the luxury tax level will generate anywhere from $22,639,005.64 to $30,523,010.42 extra in revenue.

D. *Indirect Effect of Dispersion on Revenues Through Wins*

The theory and logic behind dispersion affecting revenue seems very strong, but the results indicate generally insignificant effects. However, there may be an indirect path whereby dispersion affects revenue. This indirect path has two steps: first, dispersion affecting wins in a significant way; second, wins affecting revenue in a significant way. If this is the case, dispersion can influence revenue indirectly through its influence on wins. In every regression of the Wins Model, dispersion has a significant impact on wins. If number of wins is a significant variable in affecting revenue, then salary dispersion would have an indirect effect on revenues. To test this, a regression is carried out to test if number of wins is a significant variable in determining revenue. The empirical model utilized is the same as the Revenue Model with the exception of substituting the dispersion measure variable with the number of wins variable. The results from the regression are provided in Table 4. The result shows that for every extra win a team achieves, revenues increase by $895,766.82. This result is statistically significant to the 1% level.

With this result, a point estimate can be deduced to find the indirect effect of dispersion on revenue through wins. A simulation is conducted to measure the indirect effect. The number of extra wins a team achieves with an increase of one standard deviation of each respective dispersion measure multiplied by the $895,766.82 that revenue increases per win would provide the point estimate of the indirect relationship of each dispersion measure. Table 5 provides all the relevant information for calculating the point estimates of the indirect effect of

Table 4 : Regression Results Predicting Revenue Using Wins

	Revenue Model Regression 1
Dependent Variable	Revenue
Wins	895,766.82 (5.363)***
TVMarketSize	8.25 (7.502)***
LuxuryTaxAboveDummy	20,494,260.60 (4.247)***
Fixed Effect 06-07	-1.10E7 (-1.779)*
Fixed Effect 07-08	-8,656,316.27 (-1.396)
Fixed Effect 08-09	-7,416,123.33 (-1.198)
Fixed Effect 09-10	-1.62E7 (-2.422)**
Fixed Effect 10-11	-
Adjusted R^2	0.452
F-Value	18.526
Sample Size	150

Note: Values in parentheses are absolute t-statistics.

*** = significant at .01 level

** = significant at .05 level

* = significant at .10 level

salary dispersion on revenue through wins as well as presents the actual point estimates. These values are only point estimates and a bootstrapping procedure needs to be applied in order to determine the variance of these results. Krinsky and Robb have demonstrated the bootstrapping procedure in previous literature and have determined variances from point estimates (Krinsky et al, 1986). This study, however, does not delve into the bootstrapping process, but the findings do indicate the possibility of strong indirect effects.

Table 5: Point Estimates of Indirect Effect of Salary Dispersion on Revenue Through Wins

Dispersion Measure	Amount of Revenue Generated for Each Extra Win	Number of Extra Wins a Team Achieves With an Increase in One Standard Deviation of Dispersion Measure	Point Estimate of Indirect Effect of Salary Dispersion on Revenue Through Wins
Gini Coefficient	$895,766.82	3.75	$3,359,125.58
Standard Deviation	$895,766.82	5.50	$4,926,717.51
Top Player as % of Total Team Salary	$895,766.82	1.80	$1,612,380.28
Top 2 Players as % of Total Team Salary	$895,766.82	3.04	$2,723,131.13
Top 3 Players as % of Total Team Salary	$895,766.82	3.83	$3,430,786.92

VI. Conclusions

The relatively new phenomenon of large disparities in salary among an NBA team has allowed a number of studies to be completed to test the effect that salary dispersion has on an organization. The aim of this study was to determine the "best" amount of salary dispersion for both a win maximizing NBA team and a revenue maximizing NBA team. Salary dispersion can be defined in a multitude of different ways. In order to most effectively deal with this issue, five different measures of dispersion are used in this study. Two of these measures deal with dispersion across an entire team while the other three deal with the amount of dispersion between superstars/team's highest paid players and the regular skilled players on a team. Using data from the 2006-07 season to the 2010-11 season, two empirical models were constructed and ten regressions employed that could help determine the "best" amount of dispersion for both types of teams.

It is interesting to discover, however, that after these models were tested, a specific "best" amount of salary dispersion is not able to be determined from the results. Despite this, the effect salary dispersion has on the number of wins a team achieves and amount of revenue a team generates is able to be determined.

Based on the results of this study, salary dispersion has a significant positive effect on the number of wins a team achieves throughout a season for all five definitions of dispersion. This relationship suggests that the "best" amount of salary dispersion is the maximum amount of dispersion possible given the salary constraints a team faces.

The results also indicate that salary dispersion contains a statistically insignificant effect on the amount of revenue a team achieves. Only one of the five measures of dispersion, the standard deviation of salaries, indicates that wage inequality significantly affects revenues. In general, there does not seem to be an optimal level of salary dispersion for generating revenue. After further tests, however, it is found that salary dispersion has a statistically significant positive indirect effect on revenues through wins.

The results that salary dispersion positively affects the number of wins achieved and that the direct relationship of dispersion and revenue is insignificant is in contradiction to previous literature. A possible reason for this contradiction is that all previous studies have investigated data from seasons when a different CBA was in effect. Berri and Jewell (2004) performed a study in an attempt to relate salary dispersion and the number of wins an NBA team achieves. They found that salary dispersion is not a significant predictor of number of wins. Their definition of dispersion was based on the standard deviation of the Herfindahl-Hirschman Index, which is a different definition than employed by this study, which could be another reason for the difference in results.

Katayama and Nuch (2011) also completed a study attempting to relate the salary dispersion among an NBA team and the number of wins achieved. They tested three different dispersion levels (players participating in every game for a given team, players participating in at least half of the games for a given team, and every player on payroll for a given team) and found salary dispersion to have no significant effect on the number of wins a team achieves. Once again, the definition of dispersion differed from Katayama and Nuch's study to this study.

Hausman and Leonard (1997) found superstars to have a high positive effect on total team revenue. The study just completed does not necessarily look at superstars specifically and their effect on revenue, but instead, the effect salary dispersion has on team revenue. Built into a number of the measures of dispersion, however, is the effect a superstar should carry. The TOP1, TOP2, and TOP3 salary dispersion measures take into account the dispersion that exists between the superstars of a team and the regular players. Teams with more superstars will have a higher percentage of money given to their top players and, therefore, if superstars did affect revenues positively, the dispersion measures would have a significant positive effect on revenue. The fact that these dispersion measures do not have a significant effect on team revenue alludes to the idea that superstars do not have a significant effect on revenues, which is in complete contradiction to Hausman and Leonard's study. Hausman and Leonard's study, however, took place during the time period of the NBA where there was no maximum salary for players, which is not the case for the study that was just completed here. According to Rosen and Oi (1981, 2008), part of the reason people are attracted to superstars is the extreme amount of money they receive. If this is in fact true, it is possible that setting a maximum salary for an individual player does not allow fans to reach their highest level of intrigue and therefore provide less revenue to the firm.

Based on the results from this study, an NBA team that wants to maximize wins should try to employ as much dispersion of wages as possible and try to acquire as many superstars as possible filling the remaining spots on their roster with low salary players. This seems to show that there must not be that great of a drop-off in talent level of the lower salaried players in the league and the middle salaried players. For a win maximizing team, general managers should get as many high-skilled, and therefore high-paid, players signed to their team as possible and then complete the roster with low-paid players instead of signing all middle-value players. Those teams that are most successful at signing superstars will have the most success.

This result can be connected back to the competitive imbalance problem that exists in the NBA today. The fact that greater salary dispersion leads to greater number of wins suggests one reason for the competitive imbalance problem. As already noted, teams most successful at signing superstars will have the most success on the court. With superstars in limited supply and the NBA instituting a soft salary cap with many exceptions to the rule, certain teams are presented the opportunity to become more successful in signing superstars. These teams that are able to do so will dominate the league in terms of number of wins.

In terms of policy implications of salary dispersion and revenues, the conclusions drawn from this study are more tentative. With salary dispersion having no direct significant effect on revenue it is impossible to state what an NBA team should strive to do in terms of salary dispersion to generate the most revenue. It seems, however, when looking at the indirect effect of salary dispersion on revenue through wins, more dispersion leads to more revenue. As a result of this, a revenue maximizing team should try to employ as much wage disparity as possible given the constraints. This implication is not as strong as the win maximizing team implication due to the nature of the indirect effect versus the direct effects.

These results might be able to be translated into other fields of business. Based off of these results, it is possible that in service business environments where team performance is important, like it is in the NBA, managers may benefit from hiring as many top notch employees at each respective job and then complete the hiring process with lower salaried workers. This may lead to increases in performance. This possibility suggests the need for future research that focuses on the applicability of NBA results on the non-sports sector.

One possible way to further explore this research is to create even more definitions of salary dispersion and test each one to see if the effect/absence of effect does change depending on the definition of dispersion. The definitions of dispersion utilized in this study may have a significant impact on the effect it has on both performance and revenue. In addition to this, the indirect effect of dispersion on revenue needs to be addressed further. The bootstrapping procedure needs to be applied to the point estimates in order to understand the variance of the indirect effect. With a better and more complete understanding of how salary dispersion affects firm performance and revenue, NBA teams will be able to construct their teams more appropriately.

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