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Player Compensation and Team Performance: Salary Cap Allocation Strategies across the NFL

Max Winsberg
Claremont McKenna College

CLAREMONT MCKENNA COLLEGE

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SUBMITTED TO

PROFESSOR JOSHUA ROSETT

AND

DEAN NICHOLAS WARNER

BY

MAX WINSBERG

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Abstract

The National Football League's salary cap constrains the available resources each franchise is allotted to spend on player personnel. I examine the effects of executive management's compensation allocation strategies on team performance from 2006 to 2013. The findings suggest that spending more than the league-average on offensive lineman hurts overall team performance. Spending above the league average on both the offensive line and quarterback positions negatively affects offensive performance as well. This supports previous research stating that taking a superstar-approach to cap distribution negatively affects team performance. Furthermore, I find evidence of increased compensation inequality among players under the Collective Bargaining Agreement of 2011 compared to that of 1993.

I. Introduction

In 1993, the National Football League ("NFL") and its players' association agreed on a collective bargaining agreement ("CBA") that created a salary cap, or limit, on the amount of money each franchise is allowed to spend on its players in a particular season. In exchange for team salary caps, the players received the right to gain free agency for the first time. Free agency allows players to switch teams upon the expiration of their contract with their current team. The creation of free agency created a new dynamic in the sport as it opened the door for franchises to sign players who were previously unavailable to them.

The combination of both free agency and the NFL salary cap created the need for franchises to allocate their available resources as efficiently as possible. Teams needed to find an optimal relationship between player compensation and team performance. This relationship between compensation and performance is common throughout economics and finance research. The study of allocating available resources to maximize performance has been studied at length and is discussed in the literature review in the ensuing section. The purpose of this study is to determine the potential effect of player compensation allocation on team performance. The measure of team performance that I use primarily consists of each team's number of regular season wins over the duration of the study (2006-2013).

The paper proceeds in the following order. To conclude Section I, I provide a brief history on the NFL salary cap and a literature review of previous studies on related topics. In Section II, a model is supplied to examine the relationship between player compensation and team performance, while Section III, outlines the data and variables used in the study. I report the results of the study in Section IV and offer possible explanations for the results produced. Finally, a summary and conclusion are provided in Section V. This section includes a discussion on further work needed to advance this preliminary study.

History of the NFL Salary Cap

The NFL instituted a hard salary cap for the 1994 season in accordance with the 1993 CBA between the NFL and the National Football League Players' Association (NFLPA). The introduction of the salary cap was designed to create greater parity among NFL teams and is often credited for the league's enormous popularity. Under the 1993 CBA, the NFL set the salary cap for each new league year based on a percentage of their Defined Gross Revenues. In 2006, the formulation was changed to include a percentage of the NFL's total salary, which added other revenue streams such as local advertising.

The hard salary cap forbids teams from exceeding the league's salary cap ceiling for that specific year.[1] A team's salary cap is the sum of each player's "cap value" on their 53-man roster. Player contracts consist of a base salary and various bonuses which can be earned over the life of the contract. A player's base salary is not guaranteed, meaning they can be released at any time during the contract and the team no longer has the obligation to pay them their base salary. Bonuses, on the other hand, are paid as lump sums at the date in which they are earned and generally cannot be recovered. The different type of bonuses include signing bonuses (paid at beginning of contract), training camp bonuses (paid at beginning of training camp), roster bonuses (paid upon making the 53-man roster), and an assortment of incentive bonuses. These incentive bonuses are distinguished between “likely to be earned” bonuses (LBTEs) and “not likely to be earned” bonuses (NLBTEs). A player’s cap value is calculated as:

Cap Value = Base salary + (total contract signing bonus/number of seasons of contract duration) + training camp bonus + roster bonus + LTBEs (1)

As mentioned previously, the sum of each players cap value on the 53-man roster cannot exceed the league’s salary cap. Table 2 shows the league wide salary cap for the years 2006-2013, the focus of this research. In 2008, the NFL owners opted out of the 1993 CBA which led to an uncapped year in 2010. The NFL cautioned the 32 teams not to take advantage of the uncapped year by front-loading contracts in order to have a reduced cap hit in future capped seasons. Most teams listened and treated the 2010 season as if there was a cap in place even though nothing was ever put into writing. However, the Dallas Cowboys and Washington Redskins did not adhere to the advice and severely front-loaded their contracts during this 2010 season. The NFL retaliated by stripping the Cowboys of $10 million of cap space and the Redskins of $36 million of cap space over the 2011 and 2012 seasons. Although neither team technically violated the salary cap, the penalty remained after appeals from both the franchises. I will include the 2010 season in my regressions for this study due to 30 of the 32 teams treating the season as if there was a salary cap in place. However, an altercation may be needed to normalize the effects of the Cowboys and Redskins generous spending.

The NFL and NFLPA agreed to a new CBA in 2011 which reinstated the salary cap starting in the 2011 season. The 2011 CBA created a $120 million salary cap for the 2011 season and introduced a salary floor that would not be enforced until the 2013 season. The cap floor required each team to spend at least 88.8% of the salary cap in 2013 and 90% thereafter. The salary floor is intended to deter teams from significantly reducing player contracts in an effort to minimize costs. The cap floor is based on total cash spent over two separate four year periods allowing teams to spend less than the floor in certain seasons without violating the CBA.

Literature Review

In 1994, the NFL instituted a salary cap that limits the amount of money a given team can spend on its roster. The introduction of this hard salary cap resulted from the new collective bargaining agreement in an effort to create parity across the different franchises. Larsen, Fenn, and Spenner (2006) confirm the implementation of the salary cap in the NFL did increase competitive balance by spreading the wealth of talent around the league. They found that teams' cap spending from 2000-2002 was negatively correlated with their spending from 2004-2005. This implies that the salary cap is effective in reducing teams from constantly spending more than other teams year after year. With a salary cap and increased parity in the NFL, it is important for teams to strategically allocate resources across players and positions to maximize wins and increase return to owners.

Kowalewski and Leeds (1999) focus on the distribution and structure of salaries in the NFL from 1992-1994, before and after the implementation of the salary cap. By using Gini coefficients, Kowalewski and Leeds conclude that the salary cap created a less equal distribution of salaries in the NFL. The Gini coefficient, which measures statistical dispersion of income distribution, rose from 0.393 in 1992 to 0.479 in 1993. The rise in the Gini coefficient shows a significant increase in the inequality of contracts in the NFL. Furthermore, Kowalewski and Leeds found that "superstars" received higher pay after the salary cap in 1994 in relation to the pre- salary cap era in 1992. The increase in salary for superstars seemed to come at expense of the marginal players in the NFL. Players in the 60^{th} percentile in salary distribution earned less money under the new salary cap rules, whereas the players at around the 65^{th} percentile earned higher salaries post salary cap. The increase in salary inequality started to push the "NFL toward a two-class system with a small group of very wealthy players and a much larger group of (relatively) poor players" (p.219). The effect of the inequality of pay between the superstars and everyone else is discussed below on when analyzing team success in relation to resource allocation.

In a later study, Kowalewski and Leeds (2001) dive deeper and look at the effect of the salary cap on the compensation of offensive skill players in the NFL. Offensive skill players consist of the players who regularly touch the football such as quarterbacks, running backs, wide receivers, and tight ends. The authors employ a quantile regression for players at the 25^{th} and 75^{th} quantiles of income distribution[2]. This regression allows them to compare and contrast players that are highly-paid with players that receive lower levels of income. The results showed that all offensive skill players' mean salaries rose, but only quarterbacks' median salary increased as well. This illustrates that the salaries of running backs, wide receivers, and tight ends became skewed to the right after the introduction of the salary cap. Unlike their previous study, Kowalewski and Leeds indicate that it is easier for players in the .25 quantile to increase their wages, while it was less common for those players that were already compensated well in the .75 quantile. Intuitively, this makes sense as “a player’s bargaining power from having a good year is greater when he is relatively underpaid than when he is relatively highly paid” (p.256).

An important factor to consider in the Kowalewski and Leeds findings revolves around non-guaranteed contracts in the NFL. Franchises can release a player who is not performing well and not be stuck with his base salary for future years. Teams frequently sign players to large contracts and release them before the end of the agreement. This can partially account for why it is less common for players who are already highly paid to achieve further economic gain. Thus, guaranteed money, often signing bonuses, are a better indicator of the economic commitment a franchise makes to its players. Signing bonuses are usually collected in the early years of a contract and must be paid even if the player is released. Finally, Kowalewski and Leeds observe compensation post-salary cap is more reliant on performance. This differs with the pre-salary cap era where players were compensated mainly for which position they played.

Rosen (1981) points out in particular labor markets, even small differences in talent can cause enormous differences in income distribution. This seems to be the case with player contracts in the NFL. Rosen labels this the “superstar effect” where “the income distribution is stretched out in its right-hand tail compared to the distribution of talent” (p.846). This “superstar effect” can help explain the two-class system that Kowalewski and Leeds (1999) found in NFL wages.

Quinn, Geier, and Berkovitz (2007) delve further into the allocation of teams' salary cap by analyzing every NFL franchise's budget from 2000-2005. Their findings are consistent with Rosen's "superstar" income distribution and are supported by a "marginal win utility product" model rather than the standard marginal revenue product model. This seems accurate because there is not a significant drop off in talent when comparing the highest paid players down to the lowest paid players. Thus, the "superstar" income distribution makes sense because small differences in talent results in large pay inequality due to the large impact on wins of even small difference of talent. In addition, the authors investigate salary cap distribution among players and on-field results. They found that teams with a higher than average winning percentage allocated more of their money on players ranked 15th through 30th in relation to cap spending, and less on players ranked 35th to 53rd. However, the researches failed to obtain a statistically significant correlation between income distribution and winning percentage. They suggest a relationship may in fact exist between the two variables, but they cannot reach a statistically significant conclusion from their data set.

Borghesi (2008) analyzed the 1994-2004 NFL seasons in an attempt to develop a relationship between wage distribution and team performance. Borghesi cites Lazear's work (1989, 1991) that supports firm efficiency when pay among employees is distributed relatively evenly. With this in mind, Borghesi set out to discover how to best allocate compensation amongst a team's roster. Teams may choose to employ a superstar approach or a more egalitarian method to filling out their roster under the constraints of the salary cap. In his statistical analysis, the author regressed a player's base and bonus pay separately because of the important differences between them. As mentioned previously, signing bonuses are usually collected in the early years of a contract whereas a player's base salary can be voided if the team releases the player. Results from Borghesi's regression revealed teams that spend more than the league average on bonuses to any defensive position are likely to perform better on defense than those teams that do not. Moreover, the findings point to a significant, positive relationship between performance and base pay for running backs and quarterbacks. Performance bonuses are incentive based and are collected when a player reaches a predetermined benchmark, such as 500 rushing yards in a season. In contrast to base salary, "superstar" approaches to the offensive side of the ball concerning bonus pay tended to backfire as those offenses performed fairly poorly. Furthermore, when Borghesi's regression included a team's win-loss record he found a significant relationship between overall team performance and positional spending for quarterbacks, tight ends, and the defensive line. The author concludes by stressing "teams that compensate players the most inequitably are those most likely to perform the worst" (p.15) due to a negative estimate for the bonus Gini coefficient. Borghesi suggests this is because of the presence of a highly-paid superstar increases the dissatisfaction of lower-paid teammates to the point of disruption.

The literature to date has emphasized the increase in salary inequality in the NFL since the introduction of the hard salary cap in 1994. It also touches on the relationship between the distribution of wages and a team's on-field performance. The aim of this study is to analyze the relationship between resource allocation distribution and team performance in an attempt to understand the components of an optimal wage distribution strategy. As with any industry, the NFL is constantly evolving and new strategies are likely to have been implemented to help gain a competitive advantage. In particular, I use

Gini coefficients to gain further insight on the strategies NFL general managers are employing to maximize the effectiveness of their limited resources. In the models developed below, I predict teams with an above-average win-loss record spend more money on “critical” positions, such as quarterback and defensive line, than teams with an average or below-average win-loss record. I also expect to see a more inequitable pay structure at these critical positions because of the high perceived value at these positions.

II. The Model

This study is conducted assuming that owners and general managers are driven to construct the best team they possibly can in relation to team performance. Thus, the objective function of executive management in this study is measured mainly by the number of regular season wins per year and secondarily by unit performance. This study assumes that teams will make resource allocation decisions with the goal of maximizing the number of wins in a season. I assume this because it seems contradictory to believe general managers would focus on anything other than team performance with their jobs on the line. However, perhaps not all owners are as committed to team success as others. Some owners may value maximizing profits more than maximizing wins. This can lead to teams spending a lot of money on a popular player that is more likely to enhance fan attendance and merchandise sales. This rationale behind the allocation of cap space among players would lead to alternative predictions. Therefore, finding results opposite the prediction of this study may be consistent with profit maximization rather than win maximization. However, I am not able to directly support this alternative conclusion due to lack of information on team profits.

The purpose of this study is to examine the effect of management's compensation allocation decisions on team performance. The goal of NFL general managers, like management of any firm, is to find effective strategies to maximize performance under resource constraints. In the NFL, general managers must find a way to best utilize its team's cap space under the constraints of the collective bargaining agreement. Some franchises may employ a strategy of superstar pay where they pay premium prices on top athletes and fill in the rest of the roster with relatively lower-paid players. Other teams may choose to spread out their cap space and utilize a more egalitarian approach in player compensation. This would allow a franchise to sign and retain more middle-tier talent than teams that exhaust a majority of their cap space on a small number of players.

Strategies for compensation structures may have changed over the duration of this study due to the different cap constraints and CBA's in place at the time. Teams could have adjusted their allocation strategies with each of the three different set of rules (1993 CBA, 2010 uncapped year, and 2011 CBA). For example, teams could have used the lack of salary floor in 2011 and 2012 to go well below the salary cap in order to carry over unused cap space in future years. This will be monitored with the comparison of Gini coefficients for total team spending and positional spending throughout the league during the researched period.

Gini coefficients are used to measure income inequality and statistical dispersion among individuals in a group setting. This study uses Gini coefficients to compare team and positional compensation variances relative to the NFL average. A coefficient of 0 represents perfect competition and a coefficient of 1 represents utmost inequality among values.[3] Thus, a low Gini signifies an egalitarian pay approach with a high Gini representing more of a superstar approach.

Other variables used in this study comprise positional, unit, and team compensation numbers and ratios. These variables include the percentage of the NFL salary cap a team spends, the percentage of cap a franchise spends on its quarterback compared to the rest of the offense, and the percentage of compensation given to the defensive line in comparison with the rest of the team. The reasoning behind picking these variables is discussed in the next section. These variables allow me to explore any relationship between these independent variables and the dependent variables being examined such as a franchise's total number of wins per season. These variables describing the construction of each franchise will hopefully give us more insight on the roster construction of a football team and its relation to team performance. Different general managers value each position differently and thus spend more resources on certain positions than others. The purpose is to determine which pay strategies produce the best outcomes.

The OLS regression model that I use to quantify the relationship between team performance and player compensation is defined as:

$$P_{it} = \beta_0 + \beta_1 POS_{it} + \beta_2 UNIT_{it} + \beta_3 CAP_{it} + \beta_4 GM_{it} + \beta_5 OWN_{it} + \mu_{it}, \quad (2)$$

where P_{it} is team i's performance (either number of wins in the regular season, offensive points scored per game ranking, or defensive points allowed per game ranking) in season t.

When P_{it} is measuring the number of team wins a season, POS_{it} is a vector that includes the positional compensation terms QB_{it}, DL_{it}, and OL_{it}. $QB_{it}, DL_{it}, OL_{it}$ contain the compensation figures for the quarterback, defensive line, and offensive line positions respectively for team i in year t. The independent variable $UNIT_{it}$ is a vector that includes the unit compensation terms OFF_{it} and DEF_{it}. OFF_{it} and DEF_{it} are comprised of the total amount of cap spent on offensive and defensive players respectively for team i in year t.

When P_{it} is measuring offensive unit performance, POS_{it} is a vector that includes the positional compensation terms QB_{it} and OL_{it}. The independent variable $UNIT_{it}$ is a vector that includes the unit compensation term OFF_{it}.

When P_{it} is measuring defensive unit performance, POS_{it} is a vector that includes the positional compensation term DL_{it}. The independent variable $UNIT_{it}$ is a vector that includes the unit compensation term DEF_{it}.

For all measures of performance, CAP_{it} includes the total amount of cap spent by each team i in year t. GM_{it} contains any general manager retention for team i in year t. OWN_{it} is comprised of ownership retention for team i in year t.

Among all of the independent variables, I predict that an increase in compensation for quarterbacks and defensive linemen will be positively correlated with increased team performance. These two positions are often of high value to franchise management and because of this I expect them to have a significant effect on team success.

Selection of Variables

Teams must determine which positions they think are most important for maximizing wins and how to correctly allocate their cap space amongst the different positions. This study will focus mainly on the compensation and performance of three positions generally thought to be of significant importance to a team's success. These positions include quarterback, offensive line, and defensive line.

These three positions were selected over others for a variety of reasons. First, Borghesi (2008) found a significant relationship team between performance and the compensation of quarterbacks and members of the defensive line. Specifically, there was a link between the number of wins a team accrued during the season and the amount of compensation allocated to these positions. Next, there has been a recent trend to select these positions at a higher frequency in the early stages of the first round of the NFL's first-year player draft.[4] First round draft picks are considered to be one of a team's most valuable resources because of the ability to select and retain an elite player to build a team around. Therefore, general managers use first round draft picks on positions they think are most important to the success of their team. Examining the frequency of players selected at a specific position is thus a good approach of observing the value management places on certain positions compared to others. In the 2013 NFL Draft, the selection of players playing either offensive or defensive line was staggering. The top-six picks of the draft consisted of three offensive lineman and three defensive linemen. In addition, the top-14 picks of the draft included five offensive linemen and six defensive linemen. The recent trend of valuing these positions above others factored significantly in including offensive and defensive linemen in this study.

Finally, these positions account for 18 of the top 25 highest-paid players in the NFL.[5] Quarterbacks rank first with nine of the highest-paid players, defensive line ranks second with five players in the top-25, and offensive line is tied for third with four players. The large amounts of money teams are willing to spend on these positions illustrate just how much they value these positions.

Additionally, I will control for managerial stability, such as ownership and general manager retention. New personnel in key executive positions are likely to have an effect on compensation strategy.

III. Data

I have compiled a data set of 256 team-year observations for the 2006-2013 NFL seasons. The data set includes positional compensation data, productivity statistics, and executive management retention for each of the eight seasons studied. The compensation data consists of the “cap hit” for each team’s position groups and offensive and defensive units. Productivity statistics consist of a team’s regular season win-loss record and their points per game (PPG) ranking for both points allowed and points scored. Executive management trends contain both general manager and ownership stability. Player compensation data were obtained from *USA Today*, *NFL Players’ Association* (NFLPA.org), *Over the Cap* (overthecap.com), and ianwhetstone.com.

Productivity stats were obtained from the *National Football League* (NFL.com) and executive trends from *Pro-Football-Reference*.

The data for the productivity and executive trends statistics are likely to be accurate because they can be confirmed through multiple outlets. The compensation data are less reliable as it is difficult to track exact compensation figures for NFL teams because they are not readily available for the public. Compiling data from different sources can be a cause for concern, but the sources they are collected from are reliable. After cross checking compensations figures among the different sources I believe any errors in the data and variables would be immaterial.

Summary statistics are located in Table 3 and a correlation table among key variables is located in Table 4.

IV. Results

Team Performance

Table 5 shows the positive correlation associated with the number of wins in a season and the percentage of salary cap a team spends in a given season. The regression coefficient illustrates that a 10% increase in salary cap spent is associated with just over one additional win per season. The low R^2 signifies an overall lack of predictive power of the equation, but it is not surprising given the cross-sectional nature of the data. However, the P value of .002 displays a significant relationship between the overall cap spending and the number of wins earned in the regular season. The correlation between the two variables might help show the advantage of spending close to, if not more, than the entire salary cap in any given season. Teams that believe they will be poor in the upcoming season may then be inclined to spend as little as possible in order to carry over unused cap space to future years. This unused cap space would allow them to spend more in future years and thus possibly increase their chance of winning more games in upcoming seasons.

Total cap space spent on offensive linemen and number of wins per season was found to be negatively correlated at the 95% confidence level. An additional $1,000,000 in cap space spent on the offensive line position is correlated with a reduction of about half a game won per season. This negatively correlated relationship is a bit surprising at first glance, but may be feasibly explained by several possible reasons. Teams usually carry around eight to nine offensive linemen on their 53-man roster, a number that is normally greater than every other position on the team besides the defensive line. If a team spends a large amount of money on their offensive line, they will be sacrificing vital resources available to invest in the rest of the team. Additionally, successful offensive lines are generally associated with having strong chemistry. A team with five linemen who work well together may be more effective than an offensive line with high-priced players that don’t cooperate as well. Hence, general managers may be better off focusing on acquiring offensive linemen through the draft where their rookie contract compensation will be significantly lower than acquiring offensive linemen through free agency. Offensive linemen acquired through free agency may also not perform as well with their new team because they are not familiar with the offensive linemen already present. These results can also be seen in Table 5.

Unit Performance

Table 6 shows the correlation between total cap spent on quarterbacks and that team's offensive points scored per game ranking. It is important to note that a ranking of one means that team's offense scored the most points per game out of any team in the NFL. Thus, a team with a lower number in this ranking system performed better offensively than a team with a higher number. There is a positive correlation between the total amount spent on the quarterback position and a team's offensive points per game ranking. As just discussed, this means that the more a team spends on a quarterback the worse they perform on offense. Specifically, an additional $1,000,000 spent on the quarterback position is associated with a team's offense dropping a little less than two spots in the NFL's offensive points scored per game ranking. The importance of having a good quarterback can pressure a team into overspending on the position leading to an imbalance between compensation and performance. Franchises are more willing to spend money on quarterbacks and as a result are more prone to significantly overpaying these players.[6] This imbalance in compensation to performance can adversely impact a franchise's win-loss record. Borghesi (2008) finds similar results as he notes the negative correlation between unexplained starter pay and offensive performance.

A similar reduction in offensive performance is found with an increase in spending on offensive linemen as shown in Table 6. Every additional $1,000,000 spent on offensive linemen is associated with a team dropping about two and a half spots in offensive points scored per game rankings. Performing well in any team sport requires contribution from all team members. These findings so far support previous research in the area that advise against superstar spending and support a spread-the-wealth type of approach. Additionally, it is important to note that offensive line compensation and performance of both the overall team and the offensive unit has been negatively correlated. While these results are far from conclusive, it is interesting to point out that this has been the only position group researched that has two negative relationships with team performance.

I did not find a significant relationship between defensive line compensation and the performance of that defensive unit as whole as seen in Table 7. A possible reason could be the lack of other data points on the defensive side of the ball. Regarding the offense, I researched the compensation of six of the starting eleven players. This allowed for the study of a majority of the offense and possibly is the reason why I found potential relationships between performance and the compensation of quarterbacks and offensive linemen. Most defenses start either three or four defensive linemen which accounts for only a minority of the defense.[7] Increased data points from the other defensive positions may help illustrate a relationship between the compensation of defensive linemen and team or unit performance. Conversely, it may be the case that linebacker or defensive back positions serve as a better determinant of compensation and performance.

Differing Cap Constraints

I computed inter-team Gini coefficients for each franchise's total cap spent, along with the Gini coefficients for the three positions of interest around the league over the duration of the study. Relatively low Gini coefficients are expected because of the similar cap constraints placed on each franchise due to all teams having to adhere to the CBA. However, we can still track the effect of the three differing sets of rules (1993 CBA, uncapped 2010 season, and 2011 CBA) on the distribution of player compensation. Did one set of cap constraints promote higher inequality of pay among players?

The Gini coefficients do point to a difference in the distribution of compensation among players depending on the rules in place at a certain time. By looking at the Gini coefficients in Table 8 we can see that there is more of a discrepancy in overall team salary under the 2011 CBA than under the 1993 CBA. Intuitively, the uncapped 2010 year will stimulate higher income inequality because franchises were not bound to the same set of rules. As mentioned previously, the Dallas Cowboys and Washington Redskins spent significantly more money than the other teams in the league that year which help push the Gini coefficient upwards. The Gini coefficients are likely boosted because the additional spending of these two teams were concentrated on a few players.[8] However, the Gini coefficients for overall team spending from 2011-2013 (adhering to the 2011 CBA) are still considerably higher than the 2006-2009 seasons that were subject to the 1993 CBA. The mean Gini coefficient for the 2006-2009 seasons is 0.016 compared to 0.034 for the 2011-2013 seasons. Figure 1 helps visualize the results in a bar graph.

Table 9 shows the results of a two-sample t-test comparing the mean Ginis for NFL teams both under the 1993 CBA and under the 2011 CBA. The p-value of 0.0319 in the Pr(|T| > |t|) row shows a significant difference between the means of the two variables. However, the very small sample size must be taken into account.

A similar trend can be found when examining the Gini coefficients for positional spending among teams over the duration of the study. Table 10 highlights the Gini coefficients for each position over the time period studied. The seasons played under the 2011 CBA result in a higher mean Gini coefficient for each position in comparison to the seasons played under the 1993 CBA. The mean Gini for the quarterback position under the old CBA is 0.206 in comparison to 0.260 under the new CBA. The mean Gini increased from 0.152 to 0.203 among defensive linemen and increased from 0.122 to 0.163 among offensive linemen. The offensive line is the only position group whose mean Gini may regress back to 1993 levels as indicated by its 0.122 Gini coefficient in 2013. The mean Ginis both before and after the 2011 CBA for each position is shown in Figure 2.

Tables 11-13 display the t-tests comparing the mean Ginis for each position studied under the two different salary caps. Both the mean Ginis for the quarterback and defensive line positions are significantly different for the differing cap constraints at the 95% level. The defensive line p-value shows significance at the 99% level. Conversely, the mean Ginis for the two different salary cap era for the offensive line position are only significantly different at the 90%. Once again, sample size here is extremely small and must be taken into consideration.

Gini coefficients are significantly highest amongst the quarterback position. This should not be surprising because, as discussed earlier, they tend to be the highest-paid position. The high value placed on the position will cause general managers to spend a great deal and sometimes overpay for marginal talent. When mixing some of the highest-paid players in the NFL with rookies (and other lower-paid quarterbacks) it is easier to comprehend a possible reason as to why the quarterback position has greater income inequality.

Potential reasons for the 2011 CBA producing higher Gini coefficients in comparison to the old CBA may stem from rule changes enacted in the current CBA. First, the lack of a salary cap floor for the 2011 and 2012 seasons may be associated with a greater inequality in team spending under the current CBA. Teams more concerned with turning a profit, instead of producing wins, could have planned to spend less during these years to keep costs down. The difference in spending between these franchises and franchises that spent near the salary cap limit may have produced the higher Gini coefficients related with the 2011 CBA.

Second, a new rule allowing franchises to carry over unused salary cap to future years may also be part of the explanation. Teams that foresee themselves being poor in the upcoming season may spend less in the current year in order spend more in future years by carrying over their unused cap space. This too creates an increase in team spending inequality as team spending deviates further from the mean in both directions. This carry over strategy is similar to the big bath strategy used by upper management in financial reporting.[9]

Additionally, a rule change significantly reducing rookie contract compensation may have something to do with the increased income inequality. Under the 1993 CBA, rookie contracts were skyrocketing to the point where the unproven rookies drafted in the first round were getting paid significantly more than established NFL veterans.[10] The reduction in rookie compensation freed up more money for each franchise and allowed general managers to spend more in free agency. This increase in resources may have very well driven up the prices on free agents because most teams could now afford to spend a significant amount on free agents. This situation would once again create a greater disparity in compensation amongst NFL players.

The possible explanations for an increase in income inequality I provided are only a guess to what I believe may have happened. I leave it up to future researchers to further dive into this topic and explain the reasoning behind the results I have gathered.

V. Summary and Conclusions

The implementation of the NFL salary cap in 1994 forced NFL teams to make tough resource allocation decisions during the construction of their roster. This study attempts to understand the effects of different compensation strategies on team performance. We find that overspending on the offensive line position is negatively correlated with team and unit performance. In addition, we found that paying more than league average on the quarterback position is negatively associated with offensive performance. These findings contest my hypotheses stating that spending more on key positions would benefit team performance.

Although this study only focused on three position groups, we found no evidence linking increased team performance with over-compensating players. This lack of evidence coincides with previous research suggesting that overpaying players does not lead to better team performance (Borghesi, 2008).

Thus, it is interesting to learn of an increase in player income inequality since the application of the 2011 CBA. The new rules of the 2011 CBA likely play a part in the increased salary inequality amongst players. This begs the question of whether the NFL Players' Association actually endorsed the idea of greater income inequality among its players by reducing rookie contract compensation. The reduction in rookie salaries allowed franchises the opportunity to spend more money to acquire veteran players.

However, the small sample size observed in this study leaves it up to future researchers to further study the impact of the 2011 CBA on player compensation equality. Additionally, this study did not find any compensation allocation strategies that were positively associated with increased team performance. I surely missed out on key independent variables, such as the remaining position groups, which future researchers may include in their own studies to produce more significant results.

Appendix

Table 1

Definition of Variables

Variable	Definition
QB	Total salary cap spent on the quarterback position for a given team
DL	Total salary cap spent on the defensive line position for a given team
OL	Total salary cap spent on the offensive line position for a given team
QB%	Salary cap spent on the quarterback position divided by total salary cap spent for a given team
DL%	Salary cap spent on the defensive line position divided by total salary cap spent for a given team
OL%	Salary cap spent on the offensive line position divided by total salary cap spent for a given team
QB/OFF	Salary cap spent on the quarterback position divided by total salary cap spent on all offensive players for a given team
DL/DEF	Salary cap spent on the defensive line position divided by total salary cap spent on all offensive players for a given team
OL/OFF	Salary cap spent on the offensive line position divided by total salary cap spent on all offensive players of a given team
OFF	Total salary cap spent on all offensive players of a given team
DEF	Total salary cap spent on all defensive players of a given team
OFF%	Total salary cap spent on all offensive players divided by total salary cap spent on all players of a given team
DEF%	Total salary cap spent on all defensive players divided by total salary cap spent on all players of a given team
CAP	Total salary cap spent on all players of a given team
CAP%	Total salary cap spent on all players of a given team divided by the NFL’s salary cap ceiling
GMNEW	A dummy variable equal to one if there was a new general manager for a team in the current year, and zero otherwise
GMFRD	A dummy variable equal to one if the general manager of a team was fired in the current year, and zero otherwise
OWN	A dummy variable equal to one if there was a change in ownership in the given year, and zero otherwise

Table 2

NFL Salary Cap by Year

Year	Salary Cap
2006	$102 million
2007	$109 million
2008	$116 million
2009	$123 million
2010	Uncapped*
2011	$120.6 million
2012	$123 million
2013	$133 million

* No salary cap during the 2010 season

Table 3

Summary Statistics of Independent Variables

The data compiled is from the 2006-2013 NFL seasons. QB, DL, OL, OFF, DEF, and CAP are all represented in millions ($).

Variable	Observations	Mean	Median	Std. Dev	Min	Max
QB	256	11.16	10.77	4.99	2.13	26.74
DL	256	20.48	20.14	6.67	7.24	38.44
OL	256	20.62	20.47	5.52	7.26	35.00
OFF	256	58.27	57.57	8.96	35.17	100.15
DEF	256	55.05	54.52	9.12	33.71	88.20
CAP	256	116.83	116.23	12.36	90.11	178.24
QB%	256	9.4%	9.1%	3.9%	1.9%	20.4%
QB/OFF	256	18.9%	18.2%	7.4%	4.7%	44.6%
DL%	256	17.5%	17.4%	5.3%	5.3%	30.1%
DL/DEF	256	37.4%	37.4%	11.1%	10.0%	64.8%
OL%	256	17.7%	17.6%	4.5%	6.4%	32.5%
OL/OFF	256	35.4%	34.9%	8.0%	15.6%	60.0%
OFF%	256	49.9%	50.2%	5.7%	35.7%	63.9%
DEF%	256	47.1%	47.0%	5.9%	31.9%	61.2%
CAP%	256	99.2%	99.7%	5.4%	76.2%	118.3%
Gini Team	8	.0309	.0247	.0226	.0119	.0813
Gini QB	8	.2302	.2256	.0328	.1899	.2969
Gini DL	8	.1736	.1725	.0280	.1341	.2165
Gini OL	8	.1434	.1251	.0306	.1137	.1893

Table 4

Correlation Matrix

There are 256 team-year observations from the 32 franchises spanning the 2006-2013 NFL seasons.

	Wins	OPPG	DPPG	QB	DL	OL	OFF	DEF	CAP	CAP%	GMNEW	OWN
Wins	1											
OPPG	-0.77	1										
DPPG	-0.66	0.31	1									
QB	0.77	-0.03	0.13	1								
DL	0.76	-0.18	0.61	0.14	1							
OL	0.04	-0.07	0.10	-0.10	-0.12	1						
OFF	0.59	0.22	0.11	0.46	0.06	0.51	1					
DEF	0.26	-0.34	0.31	0.09	0.34	-0.23	-0.26	1				
CAP	0.29	0.79	0.20	0.34	0.32	0.24	0.60	0.59	1			
CAP%	0.00	0.12	0.12	0.28	0.28	0.20	0.49	0.38	0.71	1		
GMNEW	0.26	0.00	0.20	0.02	-0.09	0.04	0.01	0.02	0.02	-0.09	1	
OWN	0.08	0.45	0.40	-0.07	-0.03	0.02	0.02	0.16	0.16	0.18	-0.02	1

Table 5

Determinants of Team Wins

This table contains results from an OLS regression clustered by each individual NFL franchise. The dependent variable is number of wins a team earns in the regular season. There are 256 team-year observations from the 32 franchises spanning the 2006-2013 NFL seasons. The coefficient estimates are listed with associated p-values. *, **, and *** note significance at the 10%, 5%, and 1% levels.

$R^2 = 0.20$

Variable	Coefficient	P-Value
QB	-0.08612	0.771
DL	-0.0688	0.761
OL	-0.6384**	0.037
QB/OFF	7.7972	0.646
DL/DEF	0.1286	0.993
OL/OFF	34.2022	0.102
OFF	-0.3590	0.585
OFF%	75.8071	0.255
DEF	-0.9091	0.260
DEF%	114.9002	0.174
CAP	0.7410	0.289
CAP%	12.3023***	0.002
GMNEW	-0.6453	0.262
GMFRD	-2.5767	0.000
OWN	-1.8362	0.080

The dependent variable, number of wins in the regular season, is significantly correlated with both the total cap space spent on offensive linemen and the percentage of the NFL salary cap a team spends in a season.

Table 6

Determinants of Unit Performance
-Offensive Unit Performance

This table contains results from an OLS regression clustered by each individual NFL franchise. The dependent variable is offensive points per game scored ranking. There are 256 team-year observations from the 32 franchises spanning the 2006-2013 NFL seasons. A negative coefficient shows an increase in performance due to the ranking of 1 being the best and the ranking of 32 being the worst. Coefficient estimates are listed with associated p-values. *, **, and *** note significance at the 10%, 5%, and 1% levels.

$R^2 = 0.15$

Variable	Coefficient	P-Value
QB	1.8640**	0.030
QB%	-279.6485	0.112
QB/OFF	14.7820	0.817
OL	2.3088*	0.070
OL%	-263.2913	0.145
OL/OFF	6.9543	0.890
OFF	-1.2273	0.216
OFF%	135.0914	0.345
CAP	-0.1044	0.791
CAP%	-38.5574	0.124
GMNEW	56.3532	0.000
GMFRD	7.5456	0.000
OWN	2.2042	0.450

The dependent variable, offensive points per game scored rank, is significantly correlated with the total cap space spent on quarterbacks and the total cap space spent on offensive linemen.

Table 7

Determinants of Unit Performance
-Defensive Unit Performance

This table contains results from an OLS regression clustered by each individual NFL franchise. The dependent variable is defensive points per game allowed ranking. There are 256 team-year observations from the 32 franchises spanning the 2006-2013 NFL seasons. A negative coefficient shows an increase in performance due to the ranking of 1 being the best and the ranking of 32 being the worst. Coefficient estimates are listed with associated p-values. *, **, and *** note significance at the 10%, 5%, and 1% levels.

$R^2 = 0.12$

Variable	Coefficient	P-Value
DL	0.4784	0.606
DL%	15.8281	0.905
DL/DEF	-27.1620	0.489
DEF	0.9396	0.305
DEF%	-158.9495	0.170
CAP	-0.5239	0.197
CAP%	-22.84771	0.115
GMNEW	1.9385	0.201
GMFRD	6.0873	0.000
OWN	2.6905	0.399

There are no significant relationships between the dependent variable, defensive points allowed per game rank, and any of the independent variables.

Table 8

Gini Coefficients of Total Salary Cap Spent Amongst NFL Teams

The 2006-2009 seasons fall under the rules of the 1993 CBA. The 2010 season is an uncapped year where there are no limits on salary cap spending. The 2011-2013 seasons are played under the rules of the 2011 CBA.

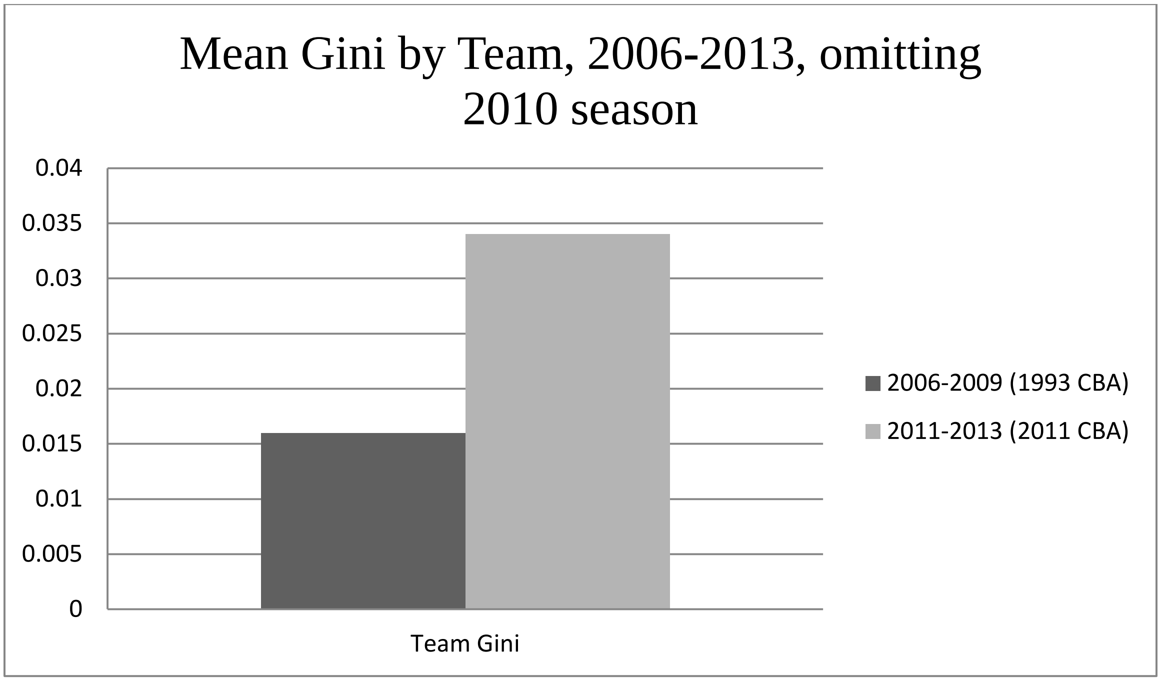
Year	Gini
2006	0.016
2007	0.012
2008	0.016
2009	0.020
2010	0.081
2011	0.042
2012	0.030
2013	0.029

*shaded region indicates the uncapped 2010 season

There is a significant rise in team Gini coefficients after the implementation of the 2011 CBA.

Figure 1

Comparison of Mean Gini Coefficients by Team Adhering to Different CBAs



*2010 season omitted due to lack of salary cap

Table 9

T-Test Comparing Team Gini Means under the 1993 CBA and 2011 CBA

Two-Sample t-test with unequal variances

Variable	Observations	Mean	Std. Error	Std. Dev	95% CI	
1993 CBA	4	.0160651	.0016832	.0033663	.0107086	.0214217
2011 CBA	3	.0338683	.0040098	.0069452	.0166155	.0511211
Combined	7	.0236951	.0040054	.0105973	.0138942	.0334959
Diff		-.0178031	.0043487		-.0325168	-.0030895

diff = mean (1993 CBA) – mean (2011 CBA) t = -4.0939
Ho: diff = 0 Satterthwaite's degrees of freedom = 2.71078

Ha: diff < 0 Ha: diff! = 0 Ha: diff > 0
Pr (T < t) = 0.0160 Pr (|T| > |t|) = 0.0319 Pr (|T| > |t|) = 0.9840

There is a significant difference between team Gini means for the 1993 and 2011 CBAs. This is illustrated by the p-value of 0.0319 in the difference of means test above.

Table 10

Inter-Team Gini Coefficients by Position

The 2006-2009 seasons fall under the rules of the 1993 CBA. The 2010 season is an uncapped year where there are no limits on salary cap spending. The 2011-2013 seasons are played under the rules of the 2011 CBA.

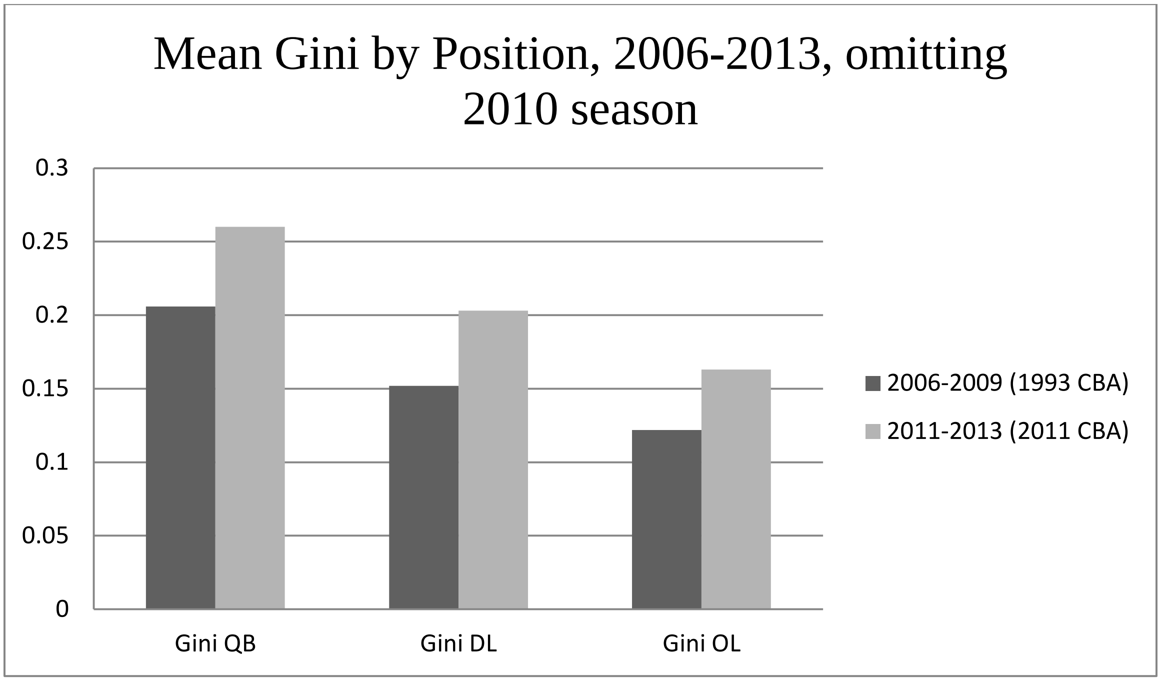
Year	Gini QB	Gini DL	Gini OL
2006	0.205	0.171	0.127
2007	0.213	0.160	0.114
2008	0.217	0.142	0.122
2009	0.190	0.134	0.123
2010	0.235	0.174	0.171
2011	0.297	0.196	0.189
2012	0.236	0.195	0.179
2013	0.248	0.217	0.122

*shaded region indicates the uncapped 2010 season

There is a significant increase in all positional Gini coefficients after the implementation of the 2011 CBA.

Figure 2

Comparison of Mean Gini Coefficients by Position Adhering to Different CBAs



*2010 season omitted due to lack of salary cap

Table 11

T-Test Comparing QB Gini Means under the 1993 CBA and 2011 CBA

Two-sample t-test with unequal variances

Variable	Observations	Mean	Std. Error	Std. Dev	95%	CI
1993 CBA	4	.2063357	.0060406	.0120812	.1871118	.2255596
2011 CBA	3	.2604671	.0185571	.0321419	.1806222	.340312
Combined	7	.2295348	.0133873	.0354196	.1967772	.2622925
Diff		-.0541314	.0170921		-.0980681	-.0101946

diff = mean (1993 CBA) – mean (2011 CBA) t = -3.1670
Ho: diff = 0 Satterthwaite's degrees of freedom = 5

Ha: diff < 0
Pr (T < t) = 0.0124

Ha: diff! = 0
Pr (|T| > |t|) = 0.0249

Ha: diff > 0
Pr (|T| > |t|) = 0.9876

There is a significant difference between the quarterback Gini means for the 1993 and 2011 CBAs. This is illustrated by the p-value of 0.0249 in the difference of means test above.

Table 12

T-Test Comparing Defensive Linemen Gini Means under the 1993 CBA and 2011 CBA.

Two-sample t-test with unequal variances

Variable	Observations	Mean	Std. Error	Std. Dev	95%	CI
1993 CBA	4	.1519129	.0083315	.016663	.1253984	.1784275
2011 CBA	3	.2022582	.0071355	.0123591	.1715565	.2329599
Combined	7	.1734895	.0114263	.0302312	.1455302	.2014487
Diff		-.0503453	.0115248		-.0799707	-.0207199

diff = mean (1993 CBA) – mean (2011 CBA) t = -4.3684
Ho: diff = 0 Satterthwaite's degrees of freedom = 5

Ha: diff < 0 Ha: diff! = 0 Ha: diff > 0
Pr (T < t) = 0.0036 Pr (|T| > |t|) = 0.0072 Pr (|T| > |t|) = 0.9964

There is a significant difference between the defensive line Gini means for the 1993 and 2011 CBAs. This is illustrated by the p-value of 0.0072 in the difference of means test above.

Table 13

T-Test Comparing Offensive Linemen Gini Means for 1993 CBA and 2011 CBA

Two-sample t-test with unequal variances

Variable	Observations	Mean	Std. Error	Std. Dev	95% CI	
1993 CBA	4	.1215867	.0028643	.0057285	.1124713	.1307021
2011 CBA	3	.1633489	.0208761	.0361585	.0735262	.2531715
Combined	7	.1394848	.0116529	.0308306	.1109712	.1679984
Diff		-.0417622	.017792		-.0874979	.0039735

diff = mean (1993 CBA) – mean (2011 CBA)
Ho: diff = 0

t = -2.3473
Satterthwaite's degrees of freedom = 5

Ha: diff < 0
Pr (T < t) = 0.0329

Ha: diff! = 0
Pr (|T| > |t|) = 0.0658

Ha: diff > 0
Pr (|T| > |t|) = 0.9671

There is a significant difference between the offensive line Gini means for the 1993 and 2011 CBAs. This is illustrated by the p-value of 0.0658 in the difference of means test above.

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Endnotes

[1] There are a few exceptions where teams can go above the salary cap limit. An example of this includes a team's salary cap carry over where they are allowed to carry over unused salary cap space into future years.
[2] Players in the 25th quantile are comprised of the players in the income distribution quantile from .2-.3. Players in the 75th quantile are comprised of players in the income distribution quantile from .6-.8.
[3] Gini coefficients are calculated by finding the area between the Lorenz curve and the line of perfect equality and dividing it by 0.5.
[4] The NFL draft consists of seven rounds and the order of each round is determined in reverse order of its record the previous year. Therefore, the last place team in the NFL picks first and so on.
[5] As noted by the *Business Insider* list of the highest-paid players in the NFL
[6] There are currently 15 teams starting three defensive linemen while the other 17 teams start four.
[7] The big bath is a financial statement manipulation strategy where upper management concludes they will not meet earning targets so they manipulate the financials to take as big of a loss as possible. The rationale behind this is to artificially increase earnings in future years to paint management in a better light.
[8] For example, the Dallas Cowboys signed Miles Austin to a contract with a $17 million base salary in the year 2010.
[9] The top-five picks of the 2010 NFL draft all received contracts north of $60 million with every contract containing at least $30 million of guaranteed money. Sam Bradford, the first pick of the 2010 draft, became the second-highest player in the NFL in 2011 before ever taking at the NFL level.