Value Added: Exploring the Dynamic Impact of Player Value on NFL Salary Cap Management

Introduction:

The NFL is unique among major professional sports leagues in that it strictly enforces a hard salary cap on its teams. This means that every team works with the same baseline set of resources for roster-building. Since the NFL also operates with an unrestricted free agency model, this means that veteran players on the open market should be paid exactly what they are worth. Therefore, it is nearly impossible for teams to get extra value or flexibility on a player's contract once they are a veteran. The notable exception to this is rookie contracts. When a player enters the league, the NFL/NFLPA's Collective Bargaining Agreement (CBA) mandates that the player is paid a salary in relation to his draft position, which is much less than the market average for their position. This allows teams to create surplus value by having a player who would normally be earing top-of-the-market money for a significantly cheaper price because of the CBA laws, giving the team much more financial flexibility to add market-price veteran players, thereby improving the quality of their roster. In this paper, we will investigate how teams choose to build their rosters while creating surplus value, investigating what avenues teams have to create surplus value, and how creating surplus value can impact both on-field performance and roster construction methods.

Data:

This project largely used 2 datasets, both obtained through the nflreadr R package [1]. The first dataset was the contract data provided by the package, sourced from OverTheCap.com [12]. This dataset consists of 42,111 contracts signed starting in the year 1983. The row for each contract contains the team(s) for which the player played under that contract, the year the

contract was signed, the contract's total value at signing, the contract's AAV (Average Annual Value), as well as the per-year percentage of the salary cap taken up by the contract. This contract dataset did not include data for fifth-year options of first-round players, so these were compiled from lists on nfltraderumors.com and integrated into the larger contract dataset [2-11].

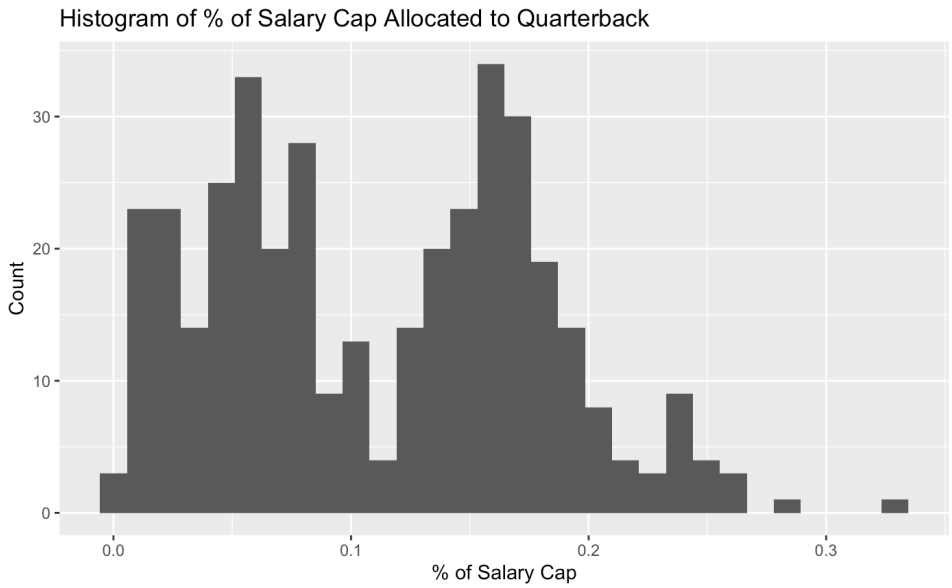
The second dataset was the package's year-by-year roster dataset. This dataset contained the full rosters of all teams for any given year, including the season, the player's name, their position, as well as their draft position.

We compared the contract data to the roster data to create year-by-year earnings for players based on their contract's AAV in any given year. This year-by-year data was filtered to include data exclusively from 2011 on, reflecting the point at which the NFL began operating under its new CBA. We then grouped these player contract years by team to create salary cap distributions for teams by season, which we could then use to visualize the development of the markets as well as the ways in which teams prioritize different positions.

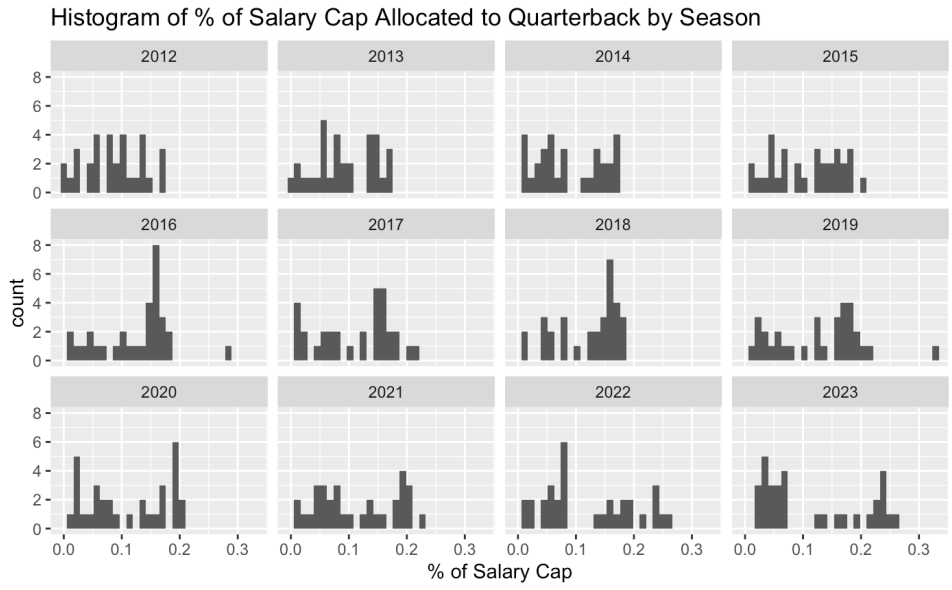
Methods:

1. Understanding The Foundation of Roster Building

The quarterback (QB) is the foundational piece of roster-building in the modern NFL. This is illustrated in the major gap between quarterback salaries and all other positions. In 2024, the highest-paid quarterback earns $55 million per year, while the highest-paid non-quarterback earns $35 million per year, a difference of about 10.8% of the salary cap. To understand how teams build cohesive rosters, we must first understand how teams decide to pay their most important player, as well as how those decisions have evolved over the last decade. The following histogram displays a distribution of the percentage of the salary cap taken up by QBs since 2012.



This histogram is clearly bimodal in nature, indicating that teams either prefer to pay their quarterback a lot of money or very little. To illustrate how this trend has developed, the following histogram now separates by year.



The timeline of histograms shows that this divide between the highly paid QBs and the cheap QBs continues to grow. Elite quarterbacks are taking up an ever-higher share of salary cap resources, meaning that the surplus value teams gain from having elite quarterbacks on rookie

deals is continually increasing. Since teams are restricting their ability to have valuable veterans on roster by paying their quarterbacks increasingly higher salaries, they must either be confident that the value of having an elite quarterback outweighs the loss of ability to pay good veteran players, or that they can gain surplus value by drafting other positions to make up for that loss of value on the quarterback contract. From this initial analysis we attempted to see where teams gaining surplus value on quarterbacks chose to allocate the extra funds.

2. Building The Rest of the Roster Around Quarterback Allocation

Once we understood how teams set the foundational piece of the roster, the next step was visualizing the rest of the roster in relation to the quarterback. To do this, we divided the data by quarterback allocation. The divide on the QB histogram occurs at roughly 0.12 (12% of the salary cap), so the seasonal data was split into seasons where the quarterback was taking up more than 12% of the salary cap, and seasons where the quarterback was taking up less than 12%.

Once this split was made, we created timelines of the average valuation of the other positions within the split to see how teams decided to allocate funds to every position depending on their financial flexibility. We also measured which positions were devalued the most once a team was paying their quarterback highly.

3. Creating the Surplus Value Rating

Based on a potential cause of the variation in the timeline data, we decided to measure how much of an impact inexpensive high-quality players have on team output. To do this, we calculated a "Surplus Value Rating" for each player, created by subtracting their 6^{th}-year AAV from the base 5^{th}-year option salary of that year. We then tagged every player with a positive Surplus Value Rating and summed the total positive Surplus Value Rating of every team by season, only accounting for the players who were still on rookie deals that season, on which

linear regression was then performed. These ratings were cut off at the 2020 season, as many rookies drafted after this point have not yet signed second contracts, so their true Surplus Value Ratings are unobtainable. The linear model returned significant results, prompting us to further investigate the impacts of Surplus Value Rating.

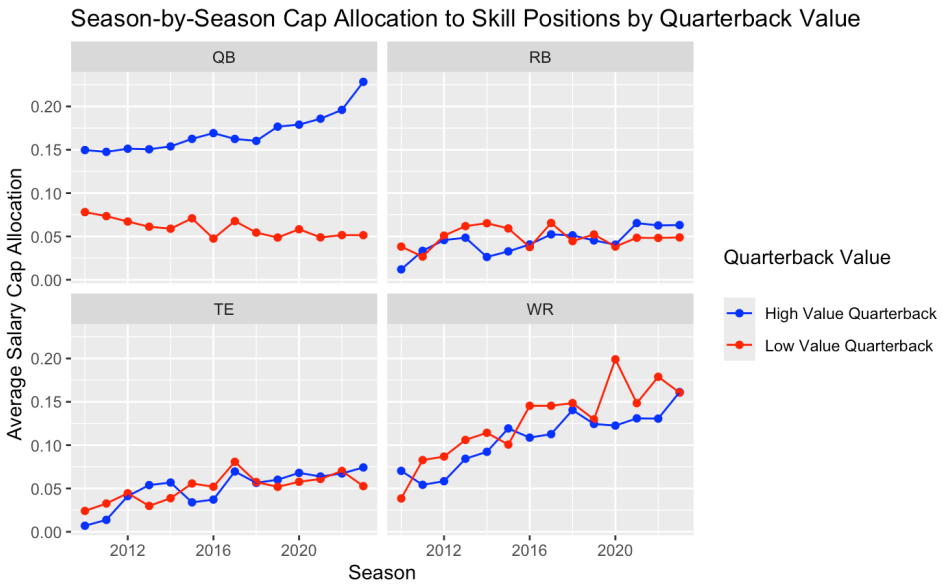
4. Understanding Surplus Value

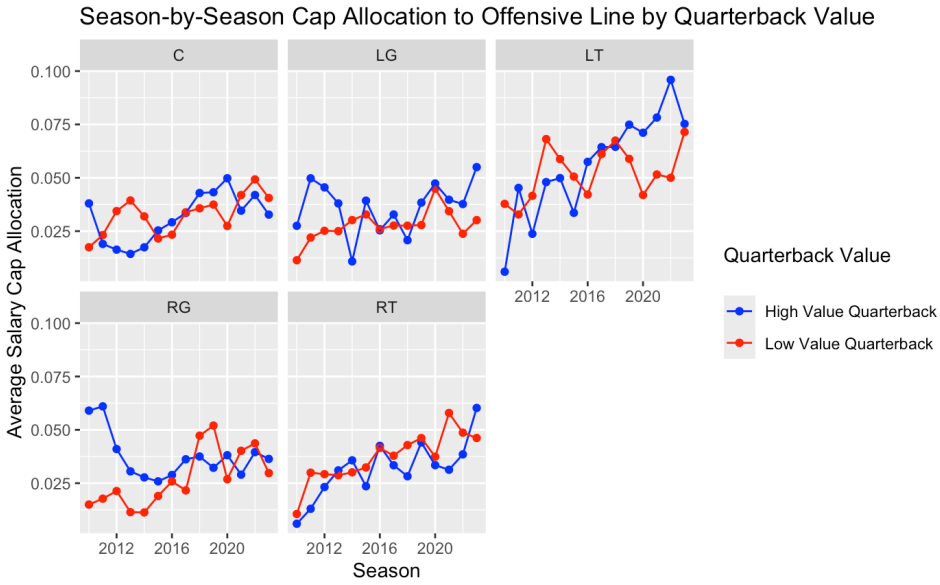
Once the impact of the Surplus Value Rating had been modeled, we visualized the distribution of Surplus Value Rating across different positions, to see which ones were providing the most extra value season to season. This was done by taking the average of the surplus value teams gained by position and creating a season-by-season area plot.

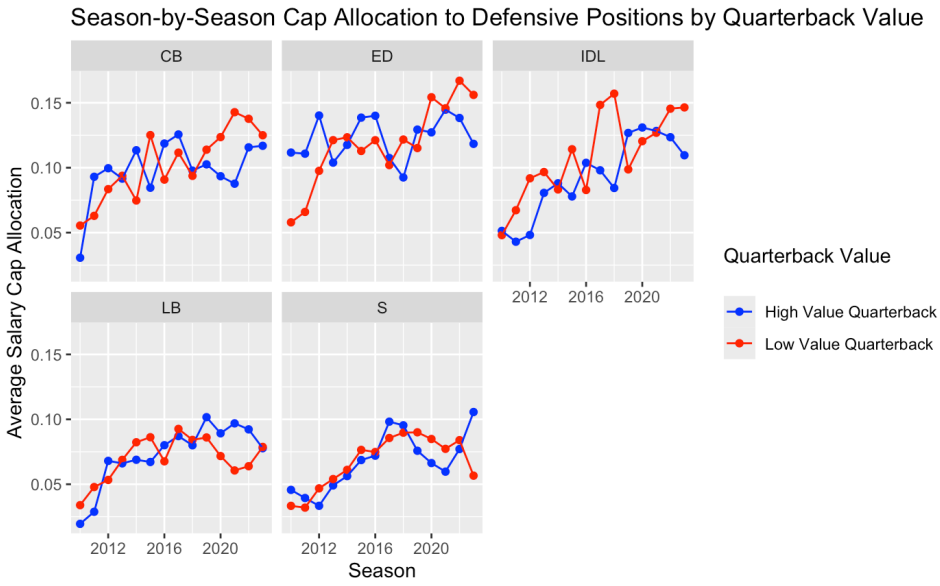
Results:

1. Differences in Positional Valuation Based on Quarterback Salary

For each position group (offensive skill positions, offensive line, defensive positions), We created a timeline graph comparing the average valuation of a position between teams with cheap QBs and teams with expensive QBs, as well as year-by-year bar plots that show which positions changed most in terms of their value by the two types of QB contract roster builds.



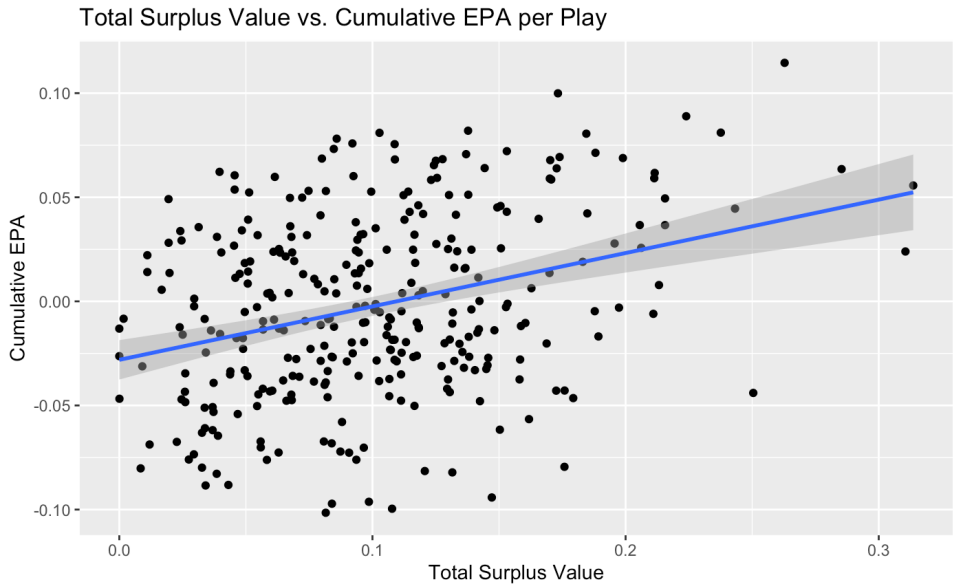




Although the graphs do show that the average value is climbing for certain positions (WR, LT, RT, ED) there is very little in these graphs to suggest that teams favor any particular position depending on the salary of their quarterback. This indicates that teams are not particular about paying a specific position, even if some are valued higher than others. Rather, it appears that teams pay the good players they have, while trying to find value at other positions.

2. Linear Regression on Surplus Value Rating

We graphed the total Surplus Value Rating against cumulative EPA (average of offensive and defensive EPA per play) and we noticed a fair positive correlation. The linear model returned a p-value of 2.82e-9, indicating that Total Surplus Value Rating is significantly correlated with Cumulative EPA, with an R-squared value of 0.1062, meaning that this model accounts for roughly 10% of the variation in Cumulative EPA.

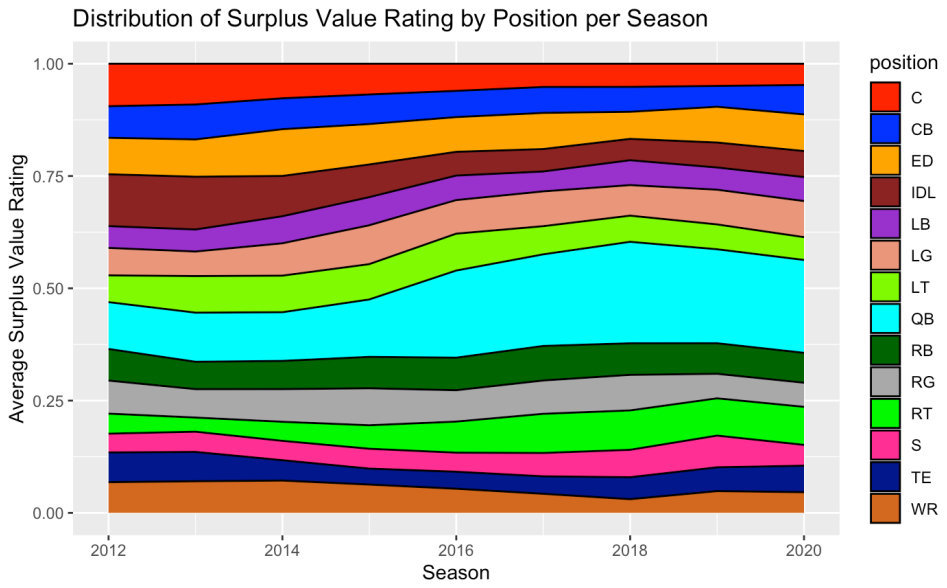


Although the model does not explain a large amount of variation in cumulative EPA, there are many factors that could explain this. Primarily, NFL teams are not exclusively built on the young players they have on roster. Having good young players certainly grants teams more flexibility to build their roster however they would like, but the other players on the team are equally as important. Every player on a roster is important to the success of the team, but having more flexibility to choose who those players are makes roster-building much easier.

3. Positional Surplus Value Distribution

Examination of a positional season-by-season area plot of Surplus Value Rating shows that quarterbacks are consistently the positions that create the most surplus value. As

quarterbacks consistently take up the highest percentage of the salary cap, this is not surprising. However, the graph does show that the average surplus value that teams get on quarterbacks is consistently growing.



Aside from quarterbacks, the other positions have remained consistent in terms of the average surplus value that teams get. It was noted in the value comparison section that teams do not favor paying a specific position depending on the salary of the quarterback, which is reinforced by the relatively consistent average Surplus Value ratings for the non-quarterback positions in the area plot. In fact, it can be seen on the area plot that the non-quarterback positions seem to normalize over time, with no positions besides quarterback accounting for more than 5% Surplus Value Rating on average by 2020. As the NFL has evolved, teams appear to be moving away from the belief that only a specific position can provide value to the roster, while others are not necessarily as high priority. Finding a valuable quarterback remains the most important step in team building, but teams gain roughly the same surplus value from non-QB positions, so they pay talented players at those spots as they come.

Analysis:

Surplus Value Rating proved to be a good measure of how teams value positions, as well as having a significant degree of association with team output; teams that create more surplus value through good drafting tend to perform better on the field. Because quarterbacks are valued so highly in the NFL, teams get by far the most surplus value on quarterbacks. The other positions are similar in terms of the surplus value teams get by having talent on a rookie contract. It follows, therefore, that a team should prioritize finding a quarterback, which is reflected in how highly quarterbacks are taken in the draft as well as how high the salaries of the best quarterbacks are. The other positions are equal enough that paying one or the other does not make a difference, the quality of the player that is being paid takes precedence.

This is contingent on the fact that teams can make up the Surplus Value lost in paying elite players by consistently finding good players in the draft. Signing a veteran player will always give less flexibility than drafting a rookie because of how cheap rookie contracts are. Once a player is being paid as a veteran, their capacity to give surplus value is very low. While there are examples of players outperforming veteran contracts, they are infrequent, so the best way for teams to get surplus value is by drafting well.

Conclusion:

The NFL's salary cap makes it impossible to pay every good player a max contract at the same time. Thus, teams must pick and choose which players they feel are worth paying. This study showed that beyond the one high-value position of quarterback, teams are generally indiscriminate about the positions to which they allocate money, simply paying talented players as they come. However, positional value does still exist in the NFL; wide receivers and edge rushers are still very high-value players, but if a team can't find one of these pieces in free

agency or through the draft, they are increasingly comfortable with finding other players around which to build the roster, maximizing the talent that they can find. Drafting talented players proved to be a productive avenue for maximizing potential talent deficiencies because of the flexibility given by the surplus value of rookie contracts, and was shown to positively associate with on-field performance.

When a team does have to pay a very high-value player, it becomes far more important to continue creating surplus value because of the reduced flexibility the expensive contract creates. Even if a player is elite, once they are being paid top-of-the-market money, they are no longer a source of surplus value on their team, even if their play wins games by itself. It is important to be sure that the player being paid is worth that contract, because a lack of flexibility created by a player who does not provide value on the field limits the ceiling of a team, further necessitating good drafting.

The easiest way to win games in the NFL will always be drafting good players. When everyone has the same resource baseline, the only way to gain an advantage over other teams is to have players who are performing above the level the resources allocated to them would suggest. Consistently having good surplus value gives teams flexibility to pay their stars without sacrificing the talent level of the rest of the roster. While talent remains the most important factor of success in the NFL, continually finding cheap talent proves to be a close second.

References

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