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Finding Value in the National Football League Draft: A Labor Market Analysis

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Abstract

The National Football League is a labor market, albeit it a very public and high profile one. The NFL Draft is governed by the NFL's Collective Bargaining Agreement. The 2005 CBA was not re-approved as it neared expiration, leading to a 2011 lockout that started in the spring, continued through the 2011 Draft, and was finally resolved in the fall. One criticism of the system was the inefficiency of rookie wages; another was that top picks received lower compensation under the new CBA. In looking at production and salary in both the pre and post-2011 Lockout, production decreased after the top picks, but efficiency increased. This phenomenon happened at nearly indistinguishable rates in both periods, demonstrating a lack of change. In looking at salary, testing for statistically significant difference in distribution, every round but the second statistically differed after the lockout. Every two round period but the first/second round combination changed as well. This demonstrates that the new CBA changed the salary structure by shifting money to different draft slots than before.

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JEL Classification: J440, J310, L2

Possible Journals: Journal of Sports Economics, Journal of Quantitative Analysis in Sport

Introduction

In the National Football League, teams and players agree to contracts which determine player salary. Each team has a set salary cap, and this is determined by the share of total revenue that the players get according to the Collective Bargaining Agreement (CBA). The 2005 CBA did not include explicit player slotted salaries. Prior to 2011, there was no explicitly rookie salary scale in the CBA, meaning that rookies received whatever their agents asked for, usually based on historical salaries. This leverage led to agents using the previous year's pick as a reference, so

the 5th pick in any given year would get more than the 5th pick the previous year. This was skewed heavily to the top of the draft, meaning that first few picks were getting $50 million before playing a single game, and the money dropping off dramatically, to about $20 million in the middle of the round and $12 million at the end of the round. As the CBA neared expiration, there was no consensus between the union and the teams. The 2010 season was played in an uncapped, meaning no salary cap on the teams because of future uncertainty, season. The lockout continued into the spring, and the 2011 NFL Draft took place with no CBA governing it. When the NFL was locked out without a CBA in 2011, there was a great debate about rookie salaries and whether the system should be changed. Massey and Thaler (2005) found that second round picks actually had the highest value, and first round picks were overvalued. In the final agreement, rookie salaries were slotted much lower because of the belief that rookies were overpaid compared to performance, and that is what I intend to investigate in this paper. I briefly investigate Massey and Thales's findings to see whether their conclusion holds up for a later time period, whether excessive rookie salaries were indeed a valid point of debate in 2011. However, my main question is whether there was in a change in salary structure overall, measured by the distribution of wages across the NFL Draft.

In answering these questions, there were some interesting answers. I find that although production does decrease as the picks go on in both the pre- and post-lockout periods, measured by a fitted polynomial model. General Managers are picking better at the top. However, even when accounting for salary distribution changes, efficiency did not improve. Looked at a fitted model of efficiency shows very little change after the lockout. In looking at the salary distribution, there is an overall change in distribution across the draft. Salary was redistributed, yet not every round felt it equally. The first round distribution change was significant, and every

other round besides the second round was significant as well. I also analyzed pairs of rounds, and the distribution changed significantly in every pair of rounds besides the first/second round pairing.

Literature Review

This paper is based on analysis of how NFL teams draft, with a brief look at efficiency but primarily at salary distribution. Salaries are skewed at the top of NFL Drafts because of the premium of picking earlier, with the belief that a player chosen earlier is better.

Teams believe they know the quality of who they are drafting, however literature suggests this is not the case. The need for analysis for value in the NFL Draft would not exist if teams could accurately draft, since higher picks would always be better. But research by Berri and Simmons (2011) suggests that higher picks are not necessarily better. NFL teams use metrics such as college statistics (yards, completion percentage, etc.), combine times (40 yard dash, bench press, etc.), and interviews to determine who to draft. However, Berri and Simmons found that all these statistics were essentially uncorrelated to performance in the NFL, most with a correlation coefficient of less than 0.1, and some even negative. Teams have a false sense that they can accurately predict NFL performance; at best, these are calculated risks and educated guesses.

With this, teams assign high certainty to their picks, and they value draft picks accordingly. Massey and Thaler (2005) investigate the value of NFL draft picks through draft day trades. Massey and Thaler measured the value of each pick by observing which trades were made, assuming that the traded picks summed to an equal number of "points" in value. They created a distribution for the value of picks that falls very sharply in the first round then gradually events out, and it looks very much like a simple rational function graph. A middle first

round pick is worth nearly half the "points" on the value scale of the first overall pick. Thus, trading for a higher pick, known as "moving up", near the top of the first round is very costly in terms of picks in the rest of the rounds. This steep cost is illustrated in one of the biggest trades in recent drafts: the Washington-St. Louis trade that brought Heisman Trophy winner Robert Griffin to Washington. The Washington Redskins traded the 6th pick, along with the 38th pick and their first round picks in 2013 and 2014, to the St. Louis Rams for the 2nd pick in the draft. That is a steep price to move up four spots in the draft, but the dynamics of the first round necessitate that cost.

Furthermore, teams may spend the high salary of a first round pick without any guaranteed of matched productivity. Massey and Thaler (2005) plotted both production and salary for each draft slot from 1991 to 2003. Since the Class of 1991 was observed for 12 years, while the Class 2003 was only observed one year, they weighted each class to counter this effect. To measure production, Massey and Thaler used league wide, non-position based, performance criteria of making a roster, starting a game, and playing the Pro Bowl. This was put into a function that took into account a player's year in the league and position, and the function generated a value of production. Salary was taken from available data over the period. Performance and salary both decreased throughout the picks and rounds. However, performance decreased at a smaller rate throughout the draft as compared to the sharp decrease in salary. Because of this, Surplus Value, which is defined as the performance function minus cost, increases through the first round and peaks toward the beginning of the second round. They then ran a regression for Surplus Value on dummy variables for each round, and found a positive and significant coefficient for the first round, although later round has more positive and more significant coefficients.

Massey and Thaler also found that teams also discount heavily because of the short lifespan of a sports executive and the pressure to win now. The discount of one year in the future is in excess of 100 percent, meaning that one year in the future is worth moving up approximately one round in the draft. This seems to be in the face of normal, rational human discounting. Both the future discounting and sharp decrease in the NFL Draft Pick Value Chart are highlighted in another franchise altering draft pick trade: the trade between the New York Giants and San Diego Chargers that brought Eli Manning to New York and Phillip Rives to San Diego. The Giants received the Charger's first overall pick in return for the fourth overall pick, a 3rd round pick, and their 1st and 5th round picks the following season. That is a steep price to pay if applies a discounting model more in line with inflation and other benchmarks.

My work builds on the monumental work of Massey and Thaler, Berri and Simmons, and others. Massey and Thaler looked at efficiency in the period before both the 2005 and 2011 Collective Bargaining Agreements. I look at the effect of 2011 Lockout specifically on production efficiency and salary distribution. My research looks at team ability to predict talent in the isolated sample of the first year, and I use a metric called Average Value. This is contrast to Berri and Simmons, who are various career statistics and regress on factors such as 40-yard dash and Wonderlic test at the NFL Combine. My research adds to the debate about the effect of the 2011 CBA that will continue into the negotiation of the next CBA in 2020.

Data and Methodology

This research intends to look at two areas: efficiency and salary. In terms of efficiency, this paper looks at production followed a similar trend in both periods, and whether efficiency improved under the new CBA because of the new salary structure. It also looks at rookie salaries and whether the salary structure changed in 2011, especially at the top end of the draft. To assess

that, I looked at data from the 2009, 2010, 2012, and 2013 NFL Drafts. Data was taken from pro-football-reference.com in a downloadable CSV format for production data, and spotrac.com from tables copied into Excel for salary data.

The production data is cumulative metric, and Pro Football Reference provides a single number for each player for each season. Data was only available for full seasons, so production was measured starting with the player's draft year until the end of the 2012 season. A player drafted in 2010 would have three seasons of observed production. The metric is called Career Average Value, and it ranges from 0 to approximately 15 for a season.

The salary data comes from Spotrac, a company that gathers historical data across various sports leagues, with the NFL being one of them. Salary data provided includes contract length, total salary, bonuses, and average salary. For this analysis, I used average salary. This includes bonuses, which are divided up over the length of the contract and added to the base salary per year.

Different NFL Drafts do feature different amount of picks. This is due to the "compensatory picks" awarded to teams that are added starting in the 3rd round for losing certain players. This formula is not public however. The amount of total picks in each draft range from 253 to 257, so I cut off each draft at pick 253 for consistency and simplicity of analysis.

First at looked at efficiency in a way similar to Massey and Thaler. I defined efficiency only in terms of first year production and salary to reduce effects of renegotiation and other external factors such as a player getting cut for poor performance. Efficiency is defined below in Equation 1.

(Equation 1)

$$\frac{Average\ Value\ in\ first\ season}{Salary\ in\ first\ year\ of\ rookie\ contract}$$

I looked at both a regression model and statistical tests to measure difference in distribution. For my regression model, my dependent variable is salary of the pick. I estimate that it's a quadratic model based on pick number, so I include a quadratic term. I also include CBA and CBA-related interaction terms: CBA equals 1 if the period is post-2011 lockout (i.e. 2012 and 2013 NFL Drafts, because the 2011 NFL Draft was conducted without a CBA and thus had different rules) and 0 otherwise (i.e. 2009 and 2010 NFL Drafts). The regression is displayed in Equation 2.

(Equation 2)

$$Salary = \alpha + \beta_1 Pick + \beta_2 Pick^2 + \beta_3 CBA + \beta_4 CBA{:}\,Pick + \beta_5 Pick{:}\,Pick^2$$

In addition, I included positional dummies for key offensive and defensive positions to measure if points in the distribution were distorted due to factors outside of pick number and draft year. I included positional dummies for quarterback (QB), running back (RB), wide receiver (WR), offensive lineman (OL), defensive end (DE), linebacker (LB), and cornerback (CB). The model is as listed below in Equation 3.

(Equation 3)

$$Salary = \alpha + \beta_1 Pick + \beta_2 Pick^2 + \beta_3 CBA + \beta_4 CBA{:}\,Pick + \beta_5 Pick{:}\,Pick^2 + QB + RB + WR + OL + DE + LB + CB$$

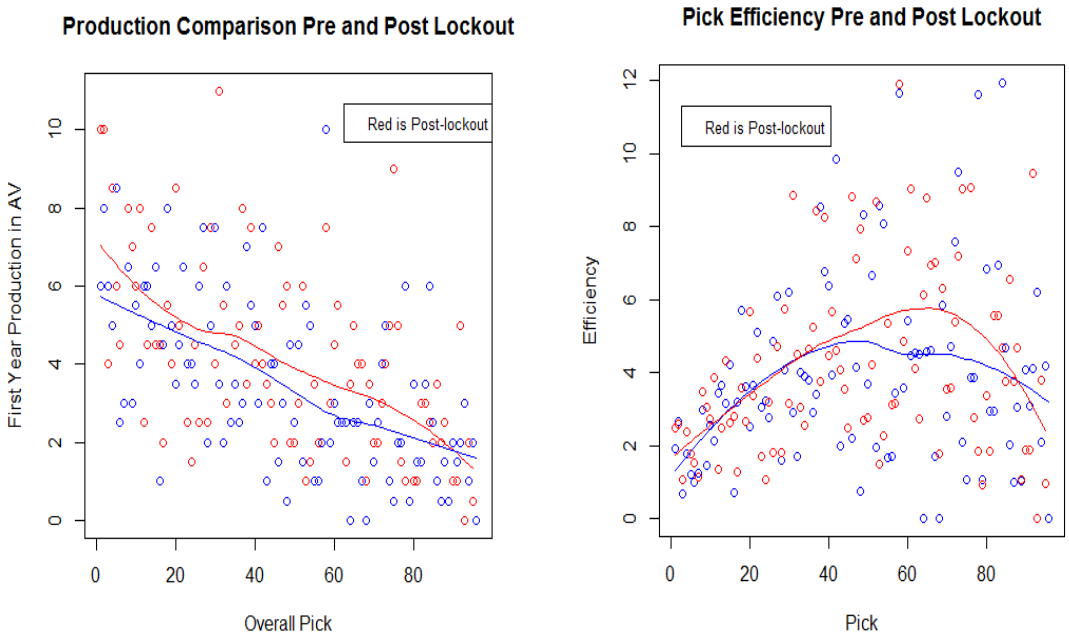
In addition to the regression, I used a test called the Kolmogorov-Smirnov test to measure distributions. I tested each round individually and as a pair with its round before/after, using both Average Salary and Year One Salary. The KS test is explained more in the results section.

Results

As expected higher drafted players do have higher production, and this can be seen when the Average Value for Year One is averaged for 2009 and 2010 as well as for 2012 and 2013. A

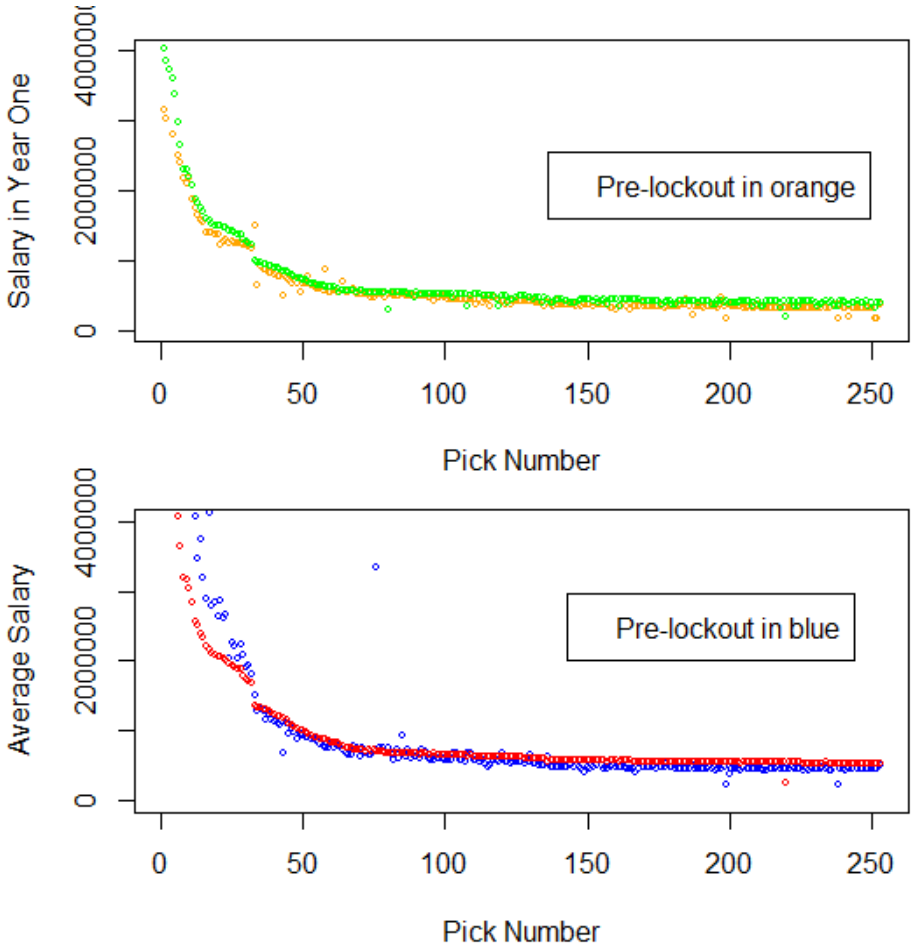
plot with fitted lines for each period is included below. The trend is the same, with a slight but not drastic production increase after the lockout. This demonstrates that production did not change because picks were paid under a different model. Because of this, efficiency was the same under both systems, increasing throughout the first three rounds without significant difference between the lines, as seen in Figure 2.

(Figure 1 on left, Figure 2 on right)



In looking at salary, I plotted two graphs, the average salary and year one salary, labelling for CBA status. This is averaged so there is one point per slot for the two years. Post-lockout seems to be higher on both.

(Figure 3)



I ran the model for all four draft years separately, each year with Picks 1-253, and two years with 2 years each of CBA having a value of 0 and 1 respectively. The quadratic model does hold, as Pick and Pick-Squared are significant. Our eye test of the plot of all points seemed to indicate that CBA would have some effect statistically. But surprisingly, CBA is not significant in any terms it is in, as seen in Figure 4.

(Figure 4)

lm(formula = Salary ~ Pick + P2 + CBA + CBA:Pick + CBA:P2)					
Residuals:					
Min	1Q	Median	3Q	Max	
-1031399	-229620	239	164119	13011006	
Coefficients:					
	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept	2147742	63191.96	33.988	<2e-16	***
Pick	-23965.8	1148.817	-20.861	<2e-16	***
P2	72.228	4.38	16.489	<2e-16	***
CBA	-55852.1	126383.9	-0.442	0.659	
Pick:CBA	1474.759	2297.635	0.642	0.521	
P2:CBA	-4.714	8.761	-0.538	0.591	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1					
Residual standard error: 575700 on 1006 degrees of freedom					
Multiple R-squared: 0.459, Adjusted R-squared: 0.4563					
F-statistic: 170.7 on 5 and 1006 DF, p-value: < 2.2e-16					

I looked at my positional regression to see if the pick model was impacted by positions. Only quarterback had a significant impact as a positional dummy. It seems that positional value is accounted for in draft order, except quarterback may be artificially inflated because of fan pressure. This is seen in Figure 5 below.

(Figure 5)

lm(formula = Salary ~ Pick + P2 + CBA + CBA:Pick + CBA:P2 + QB + RB + WR + OL + DE + LB + CB)

Residuals:

Min	1Q	Median	3Q	Max
-1017804	-231718	-6326	163430	12985142

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	2127335	81867.615	25.985	< 2e-16	***
Pick	-23736.8	1155.08	-20.550	< 2e-16	***
P2	71.385	4.406	16.201	< 2e-16	***
CBA	-53665.3	126553.5	-0.424	0.67162	
QB	258273.4	99591.65	2.593	0.00964	**
RB	6088.054	84558.79	0.072	0.94262	
WR	-45791.2	73391.7	-0.624	0.53282	
OL	45590.48	61855.36	0.737	0.46127	
DE	-15610.9	77379.96	-0.202	0.84016	
LB	-41957.1	71328.99	-0.588	0.55652	
CB	-65085.6	62682.6	-1.038	0.29937	
Pick:CBA	1464.358	2303.075	0.636	0.52503	
P2:CBA	-4.812	8.774	-0.548	0.5835	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 574300 on 998 degrees of freedom

(1 observation deleted due to missingness)

Multiple R-squared: 0.4658, Adjusted R-squared: 0.4594

F-statistic: 72.52 on 12 and 998 DF, p-value: < 2.2e-16

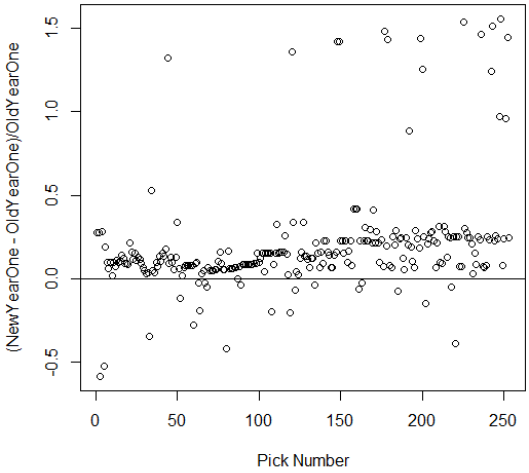
I also looked at the effect of the CBA on first year salaries. This is important because commentators have said that being a rookie is not as lucrative after the passing of the new Collective Bargaining Agreement. I looked at percentage change, measured in Equation 4.

(Equation 4)

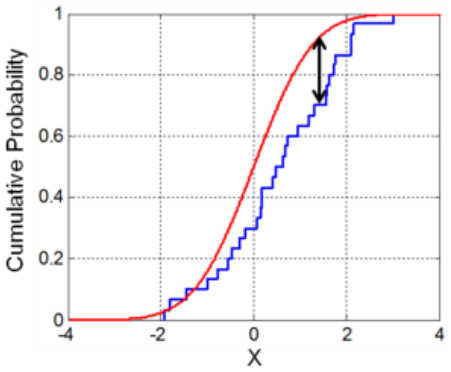
$$Percent\ Change_{Lockout} = \frac{(Post\ Lockout\ Year\ 1\ Salary) - (Pre\ Lockout\ Year\ 1\ Salary)}{Pre\ Lockout\ Year\ 1\ Salary}$$

The graph is included below, and first year salaries seem to have generally increased, although there is noise in the graph. The percentage change increase seems to grow as the draft picks approach the late rounds, as seen in Figure 6.

(Figure 6)



The distributions do seem to change, so I plotted both the pre- and the post-lockout salaries, and ran a test called the Kolmogorov–Smirnov test. This tests if two distributions are significantly different. KS test look at the cumulative distributed function (CDF) of each distribution, and finds the largest difference between them. It tests this difference relative to the whole distribution to see if this is significant, as shown in Figure 7 below.



I broke down my analysis of the salary distribution into the overall draft, each individual round, and each pair of rounds (first and second, second and third, third and fourth, etc). I did this for both Average salary and Year One salary. First I tested the whole draft as a distribution for Year One salary, and I got a significant test statistic as shown below.

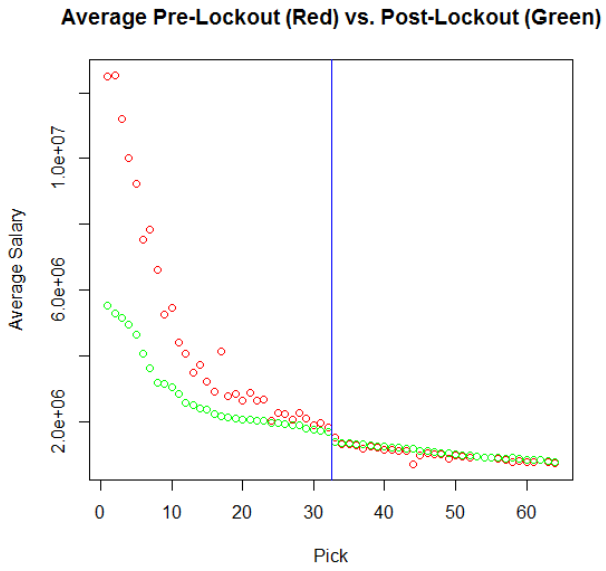
(Figure 8)

Two-sample Kolmogorov-Smirnov test

data: NewYearOne and OldYearOne
D = 0.3636, p-value = 5.884e-15
alternative hypothesis: two-sided

As can be seen in the output above, the p-value is near 0, meaning that the two distributions do differ. This is evidence for a salary distribution change in the first year of contrasts. In terms of Average salary, there is a striking plot that shows an isolated sample of the first two rounds, with the blue line separating the first round from the second round. With this observation, I decided to test each subset for Year One and Average salaries as I mentioned before.

(Figure 9)



I created a loop that would test each of these, and these are my results, broken down by round, either individual or combination, and Average/Year One. I included added significance codes to make it easier to understand. For Year One salary, every round but the 2nd is significant, although the first is only significant at the weak 0.1 level. Every round combination but the 1st/2nd is significant with a p-value of nearly 0. For Average salary, the 1st round is significant at the 0.05 level, the 2nd round is not significant, and the rest is significant at nearly 0. (Figure 10)

	Salary Distribution Tested			
Round	Average		Year One	
1	0.02141	*	0.08768	.
2	0.273		0.273	
3	0.0005322	***	0.0000003205	***
4	5.41e-11	***	5.41e-11	***
5	< 2.2e-16	***	1.821e-14	***
6	< 2.2e-16	***	7.059e-13	***
7	< 2.2e-16	***	4.352e-14	***
1 & 2	0.2115		0.5551	
2 & 3	0.02815	*	0.000372	***
3 & 4	0.0000001251	***	0.0000008924	***
4 & 5	2.22e-16	***	0.00000002011	***
5 & 6	2.22e-16	***	2.22e-16	***
6 & 7	< 2.2e-16	***	< 2.2e-16	***

From this, we see that the changes were not really at the top of the draft, but in the entire draft and the later rounds specifically. The money moved from the top to more evenly throughout the middle and final rounds. That is why there is commentary about the top draft picks being paid less, creating less lucrative opportunities for the superstars of the draft.

Conclusion

This paper aims to look into both the topics of efficiency and salary distribution in the NFL Draft before and after the 2011 Lockout. In looking at production plots and the fitted model for efficiency, it seems that production follows roughly the same pattern as before the lockout,

decreasing at a somewhat linear rate starting with the first few picks. Efficiency, in both periods, increases throughout the draft, as the increased production is overcome with exponentially higher salaries, as seen by our quadratic term regression model. Although the salary distribution seems somewhat similar, there is a change in distribution for most rounds and regions of the draft. Our KS tests showed that later rounds received the boost that came from more moderate salaries at the top of the draft. This change in distribution seems to indicate salary changed due to owner's recognition of inefficiencies in the previous CBA.

This research can be built on. The Collective Bargaining Agreement dictates the maximum increase in salary from year to year from a player's contract. With the readily available data, there is area to explore whether contracts actually follow these CBA rules in practice. In addition, research can be done on why pre-lockout contracts were much bigger than their respective post-lockout contracts. One possibility may be the reduced years of the later contracts. Other observations are that post-lockout salaries start higher because they may have to escalate slowly and have less years to fulfill. Pre-lockout salaries escalated quickly and went over longer years, this may be evidence of back-loading. These are various directions NFL Draft research can go from here.

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