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Do High School Football Recruit Ratings Accurately Predict NFL Success?

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SUBMITTED TO

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Abstract

This paper explores the correlation between the recruit ratings of football players coming out of high school and their future levels of success in the NFL. Specifically, I look at a player's star rating, numerical rating, and overall rank within his high school graduating class, according to 247Sports's Composite Rating system, as the key variables for a player's recruit rating. I measure NFL success by a player's position in the NFL draft specific to both round and overall pick, average games played per season over his NFL career, highest annual cash earnings during his NFL career, and average Approximate Value per season in the NFL. Results indicate a significant relationship between recruit ratings and NFL success only when considering NFL draft selection as the measure for success. Broadly, recruit ratings don't appear to correlate with success in the NFL.

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Table of Contents

I. Introduction

"I don't know if I'm different from everybody else, but there's really only two things to me that are really, really important – recruiting good players in the program and developing those players once they get here." Nobody knows it better than University of Alabama head football coach, and six-time college football national champion, Nick Saban, recruiting is everything in football. The objective is simple: attract more high-caliber players to your program than your opponent. With roughly 1.06 million high school football players as of the 2016-2017 season, finding the right ones is a much more laborious task than it might seem.[1] The exhaustiveness of the process today, however, pales in comparison to its pre-2002 counterpart, a year marking the start of digital recruit rankings as introduced by Rivals.com. As an entirely new industry began to emerge around these recruit rankings, and their presence became central to the world of college recruiting, more companies began to enter this recruit-rating market. One of these new companies in particular dramatically impacted the already revolutionary industry.

247Sports.com separated itself from the rest of the industry by its implementation of the 247Sports Composite Rating system, which brought a unique kind of neutrality to the recruit rating industry by considering a player's ratings by the other major rating companies like Rivals.com and ESPN. While the subjectivity of recruit ratings allows for biases by individual rating companies, 247Sports's Composite Ratings helps eliminate these biases by equally weighting the ratings of all the major companies, providing the best possible representation of how players rank across the entire industry.

[1] High school football participation data can be found at https://www.statista.com/statistics/267955/participation-in-us-high-school-football/.

The system assigns both a star rating and a numerical rating to each player, representative of current talent as well as future potential in college and the NFL. All of the major companies in the industry assign each player a star rating with a cap at five stars, which, in the case of 247Sports's own rating system, is given to the top 30 players. Subsequently, four stars are assigned to the remaining prospects in the top 300, three stars to the remaining prospects in the top 10%, and two stars to the rest. Because each company assigns stars differently, "the 247Sports Composite Rating assigns stars based on an approximate average distribution of stars from the industry." The numerical rating, with a maximum of 1.0000, is determined by converting "average industry ranks and ratings into a linear composite index." A rating of 1.0000 indicates that the player was determined to be the single best recruit by all rating companies.[2]

These recruit ratings are primarily intended to represent current talent and projected success at the college level. Across the world of college football, there's a general consensus that recruit ratings are accurate projectors of performance in college. There's no shortage of research concerning how team-level recruiting class rankings have historically correlated with on-the-field success, as 247Sports's own Chris Hummer noted in an article earlier this year that when looking at the 32 programs in the national championship over the last 16 years, 30 had one or more top-10 recruiting classes over the previous four seasons (Hummer, 2018). Further, from 2011-2017, teams with at least one top-10 recruiting class accounted for 63% of teams ranked in the top-5 at the end of each season (Hummer, 2018). Many of these companies, however, 247Sports in

[2] Information about 247Sports's Composite Rating method can be found at https://247sports.com/Article/247Rating-Explanation-81574.

particular, claim their ratings to be reflective of NFL potential as well, an idea that hasn't seen such research and discussion. In accordance with 247Sports's own rating system, five-star players have "excellent pro-potential," a four-star player "will be an impact-player for his college team… is projected to play professionally," a three-star player "will develop into a reliable starter for his college team… many have significant pro-potential," and a two-star player "may have little pro-potential, but is likely to become a role player for his respective school."

The primary purpose of this paper is to assess if 247Sports's Composite Rating system does, in fact, transcend potential at the college level. More specifically, I aim to identify a correlation between a player's recruit ratings and his level of success in the NFL.

Because there is generally a positive link between performance in college and a career in the NFL, this analysis may be important for college program recruiting strategies regarding how much importance to should place on the rankings of their incoming recruits each year, a metric which holds significant weight and is commonly referred to in the college football media world. Additionally, college program prestige and tradition are commonly evaluated with respect to how many of their players have a career in the NFL. Many prospects consider this heavily in their decision regarding which program to play for, so this assessment may bring to light how programs can improve their NFL track record and attract more prospects. Should this study find no link between NFL success and the 247Sports Composite Ratings, major recruit rating companies may need to rethink how they evaluate prospects or simply reconsider what their ratings are intended to represent.

II. Literature Review

Scholarly research is very limited thus far concerning how recruit ratings translate to NFL success. Previous research focuses mainly on the success of star-rated high school recruits during their college careers, regardless of whether or not they went on to have careers in the NFL. Most of this research isn't done at an individual level but looks at overall college team success and how it correlates with recruiting class rankings, which, as I noted earlier in considering Chris Hummer's account of why recruit rankings matter, has been met with a general agreeance that higher rankings do equate to better team performance.

In 2009, Trent J. Herda and several fellow researchers presented a scholarly investigation of this topic with their study, "Can Recruiting Rankings Predict the Success of NCAA Division I Football Teams? An Examination of the Relationships among Rivals and Scouts Recruiting Rankings and Jeff Sagarin End-of Season Ratings in Collegiate Football," (Herda et al, 2009). Their research considered the recruit ratings among 100 NCAA Division I football programs' 2002 recruiting classes. This was a longitudinal study tracking each team's performance over the period 2002-2006, as measured by the Jeff Sagarin end-of-season performance ratings, which consider wins and losses as well as each team's score margin for the season, which reflects how many points a team scored during the season relative to their opponents (Herda et al, 2009). The authors assessed recruiting classes by their total point system ratings and average star ratings, as collected from the Rivals and Scouts recruit ratings. The purpose of the research was to unveil how effective recruiting class ratings are in determining team success.

In analyzing the data, the researchers focused on the Pearson coefficient, R, as well as the R-squared statistic. The researchers considered a 5% significance level in concluding that recruiting classes with higher total points and average star ratings don't relate to higher end-of-season performance ratings, although their regressions yielded significant results. For the Rivals rating service, the R-squared values for the average star ratings versus the Jeff Sagarin end-of-season ratings over the time period had a range of 0.280 – 0.403, while the total points system ratings versus the Jeff Sagarin ratings yielded R-squared values from 0.303 – 0.445 (Herad et al, 2009). R-squared values ranging from 0.113 – 0.178 and 0.264 – 0.389, respectively, were produced when considering the Scouts recruit ratings (Herda et al, 2009). All of these values were deemed statistically significant.

Ultimately, the research indicated that the total points and average star rating systems used by Rivals and Scouts explained 11 – 45 percent of the variance in the Jeff Sagarin end-of-season ratings. Although results were statistically significant, the explanation of less than half of the end-of-season ratings by the recruiting class ratings implies the presence of a multitude of other factors influencing the success of NCAA Division 1 football teams. Some of these include strength of schedule, coaching staff capability, and the ability to develop players effectively. The study also presented data limitations in only evaluating one year of recruiting classes. Additionally, because of the subjectivity of prospect ratings, looking at rating services individually may introduce biases that affect results while the use of 247Sports's Composite Rating, which considers all major rating companies, can eliminate these biases as much as possible. Despite these

limitations and potential external influencing factors, recruit ratings did prove to be significant in the determination of college football team success.

This study, like the research of 247Sports's Chris Hummer, contributes directly to my topic of interest as it provides an important foundation for the conversation of how recruit ratings relate to NFL performance. Their findings indicate that recruit ratings do effectively execute their primary goal of reflecting player potential at the college level. This opens the door for discussion beyond the sphere of college football, allowing us to move past the basics of recruit ratings and hold rating companies accountable for their supposed long-term assessment of player potential onto the professional field.

One such study exploring this relationship was done in 2016 by Texas Lutheran University professors Reza O. Abbasian, John T. Sieben, and Amy L. Gastauer. The researchers looked at the correlation between high school star ratings and individual success in both college and the NFL, specifically whether or not each athlete received awards for their college successes, such as all-conference or all-American designations, and if they were drafted by an NFL team (Abbasian et al, 2016). They brought some interesting additions to this conversation, citing a study by Bud Elliot and Peter Berkes in 2015, which found the average high school ratings for the players on the teams in the 2015 Super Bowl to be just around three stars, which may not be entirely unusual as a large number of college players have three-star ratings relative to those with four and five stars. Particularly interesting was the fact that neither Super Bowl team had any five-star players.

Abbasian and his fellow researchers focused their investigation on two questions, "was the average three-star lineup for each team at the Super Bowl due to the large

number of two and three-star available players and a scarcity of four and five-star players in the NFL?" and "does a high star ranking translate into an early pick in the NFL draft?" (Abbasian et al, 2016). To assess this, they considered the prospect ratings from the Rivals rating service for ten years of graduating high school classes, 2003 – 2012. Data concerning NFL draftees was collected from NFL.com. The likelihood of being selected in the NFL draft for each star rating was calculated through implementing a Logistic binary model where a value of 1 was used for "becoming an NFL player" and 0 for "not becoming an NFL player."

All the models ran by the researchers pointed to higher star ratings leading to a higher probability of being drafted into the NFL. They found the relationship between star ratings and average pick numbers in the NFL draft to be demonstrated by a linear regression with y representing the average pick number and x representing the star rating. After combining the average pick numbers for zero and one-star players to account for a lack of relevant data points, their regression yielded an R-squared of 0.955, indicating that star ratings do have a significant positive correlation with the probability of being drafted into the NFL, and, as might be expected, a negative correlation with draft pick numbers, signifying that higher rated players tend to be drafted earlier (Abbasian et al, 2016).

They also went on to investigate how a star-rated prospect's decision about which college program to play for affects his position in the draft. They used a Logit model to compare the probabilities of NFL success (being drafted) for players who attended what are considered the Power Five Conference schools, which are historically the largest producers of NFL players and include the ACC, Big-10, Big-12, Pac-12 and SEC

conferences, versus those who attended schools in the remaining Non-Power Conferences. The researchers' purpose in doing this was to isolate the effect of star ratings on draft selection. Implementing a multiple linear regression produced the equation:

$$y = 183.18 - 17.87x_0 - 5.22x_1,$$

with pick number as the dependent variable, and star ranking and a Power Five Conference dummy variable, respectively, as the independent variables. With a p-value of 0.22, they found no statistical difference between draft placement for players at Power Conference schools versus Non-Power Conference schools, concluding that a player's star rating is the primary determinant of his draft selection.

With a stated goal of exploring the relationship between a player's star rating and his future college and NFL success, I find the choice of NFL draft selection as an indicator of success in the NFL to be problematic. An article by ESPN writer Paul Kuharsky references Titans general manager Mike Reinfeldt regarding NFL draft success rates, or hit rates, "judging productive players or players who have NFL-caliber traits over the last five or six years, he sees a .560 hit percentage for the first and second rounds; .350 for the third, fourth and fifth rounds; and .333 for the sixth and seventh rounds," (Kuharsky, 2011). This suggests that about 59.5 percent of draftees never become productive NFL players.

This disconnect between draft selection and actual future performance makes draft placement a misleading indicator of success in the NFL. A player's position in the draft is much more representative of his success in college than how he will fare as an NFL player. The draft is then no more of an indicator of NFL success than are star

ratings, as both are simply projections of how players are expected to perform as assessed by recruiters across the industry. This calls for the need for further research concerning the efficiency of the NFL draft in assessing NFL potential, which perhaps will be investigated separately in future research. Additionally, the Abbasian (2016) study neglects to consider that undrafted players account for a significant portion of NFL rosters, making up 31.4 percent of total NFL players in 2013, clearly limiting the scope of their findings as to how star ratings broadly relate to success across the league (Dulac, 2014). Their findings, while valuable to the discussion of how star ratings correlate with performance in college and placement in the NFL draft, still leave much to be found about the relationship between these ratings and actual proven on-the-field success in the NFL.

To improve on the previous research, I find it necessary to consider more accurate indicators of success as an NFL player. My research considers not only draft selection, but focuses on a player's average games played per season, highest annual cash earnings, and average Approximate Value per season over his NFL career. I'm also the first to use 247Sports's Composite Ratings in investigating this topic. For these reasons, I believe my research to be the most comprehensive and relevant to date in identifying a relationship between recruit ratings and success in the NFL.

III. Methodology

To evaluate variables that determine a player's level of success in the NFL, I run a series of regressions employing the following generic model:

$$Success_i = \alpha\, Composite_i + X\beta + \varepsilon, \quad (1)$$

where $Success_i$ represents one of five metrics for player i's level of success in the NFL, and $Composite_i$ takes the form of one of my chosen metrics for player i's recruit rating. X contains various controlling variables which I believe to correlate with a player's level of success in the NFL. I also include a number of dummy variables in equation (1) for some of my regressions, which I will discuss shortly.

A. Outcome Variables

In the model, the $Success_i$ variable takes the form of various metrics for NFL success: $Pick_i$, $Round_i$, $GPPY_i$, $Earnings_i$, *or* AV_i, depending on the regression. The outcome variables $Pick_i$ and $Round_i$ correspond with player i's selection in the NFL draft. Lower values for both variables indicate an earlier selection in the draft, which implies a more successful projected NFL career. I expect these to negatively correlate with recruit ratings, indicating that as a recruit is rated higher, he is selected earlier in the draft. When a player's overall recruiting class rank is used as the metric for his recruit rating, however, $Pick_i$ and $Round_i$ should have a positive correlation as both are more desirable as their values decrease. Another outcome variable, $GPPY_i$, represents player i's average games played per season throughout his NFL career. Good performance is rewarded with increased playing time, accordingly, a higher $GPPY_i$ value suggests more on-the-field success. I expect higher recruit ratings, lower in the case of overall recruiting class rank, to correlate with increased average games played per season. The outcome variable

$Earnings_i$ reflects player i's highest annual cash earnings during his NFL career. I expect that players who experience more on-the-field success in the NFL will realize higher maximum annual cash earnings during their careers. Therefore, I expect increases in the $Earnings_i$ variable to relate to higher recruit ratings. Finally, the AV_i outcome variable represents player i's average Approximate Value per season over his career. Doug Drinen's Approximate Value method assigns a numerical value to a player's season, calculated by various equations which are particular to each position group and incorporate extensive relevant in-game statistics.[3] A higher Approximate Value indicates a more successful season. I believe this to be the most comprehensive metric for a player's success in the NFL, and to be the most telling of the relationship between recruit ratings and success as an NFL player.

B. Key Explanatory Variables

Depending on the regression, I implement $Star_i$, $Rating_i$, or $Rank_i$ as my $Composite_i$ variable, all three of which come from 247Sports's Composite Ratings. The explanatory $Star_i$ variable reflects the star rating assigned to player i, calculated through 247Sports's Composite Rating system, which assigns stars based on an average star distribution across the recruit rating industry. I expect higher star ratings to correspond with greater levels of NFL success. $Number_i$ represents 247Sports's Composite numerical rating assigned to player i. Each player's numerical rating has a maximum of 1.0000, which indicates that player was the top-rated recruit across all rating companies. Further,

[3] More information regarding Doug Drinen's Approximate Value method can be found at https://www.sports-reference.com/blog/approximate-value-methodology/.

higher values for $Number_i$ should relate to higher levels of success in the NFL. Finally, $Rank_i$ reflects player i's overall rank within his particular graduating class, according to 247Sports's Composite Rankings. A value of 20 for $Rank_i$ would indicate that player i is, on average considering all rating companies' rankings, the 20th best player in that particular graduating class. I expect lower values for $Rank_i$ to equate to more success as an NFL player. The correlations between these $Composite_i$ variables and the various $Success_i$ variables will reveal the extent to which recruit ratings effectively project player performance in the NFL.

C. Independent Control Variables

I include independent variables $Height_i$, $Weight_i$, and $Offers_i$ as controls which may have a direct influence on a player's success in the NFL. They represent height in inches, weight in pounds, and number of college offers. All else constant, I expect larger players, according to both height and weight, to typically be more successful in the NFL. For example, consider two wide receivers with the same levels of production in college and similar athleticism as far as speed, quickness, explosiveness, etc. The 6'2", 200-pound receiver will generally be more successful than his 5'10", 180-pound counterpart as he is likely much stronger and will have a higher likelihood of overpowering his opponents. Accordingly, I expect a player's height and weight to contribute positively to his level of success in the NFL.

The controlling independent variable $Offers_i$ relates to player i's number of scholarship offers coming out of high school. Programs offer scholarships to players they are confident will develop into productive college players and go on to represent their program well in the NFL. Consequently, more scholarship offers for a player indicates a

more optimistic projection for his future on-the-field success. Therefore, I expect players with more scholarship offers to have more success in the NFL as their number of offers reflects, although not necessarily directly, their potential in the NFL as evaluated by a number of college recruiters.

D. Year Entering NFL Dummies

Some of my regressions include a dummy variable for a player's year entering the NFL. This is an attempt to control for any unobserved yearly effects which broadly influence player performance in the NFL as measured by my various outcome variables. For example, when highest annual cash earnings is used as my outcome variable, controlling for a player's year entering the NFL will absorb any external influencers, such as a recession, which might broadly affect the earnings of all players in the NFL.

E. Position Dummies

In various regressions I include dummy variables for a player's position. I include dummies for the following positions: quarterback, running back, wide receiver, tight end, offensive lineman, defensive lineman, linebacker, defensive back, and athlete. Athletes are players which generally play a variety of skill positions, including running back, defensive back, wide receiver, and occasionally linebacker. These dummies allow me to control for the extent to which a player's position broadly affects his level of success in the NFL. For example, because only one quarterback is on the field at a given time, it may be particularly difficult to be successful at the quarterback position. Or, for example, when using annual earnings as the outcome variable, these dummies will control for any systematic differences in earnings across positions. Position dummies might also be able to capture the differing effects of a player's height and weight on his

NFL success across positions. I would expect height and weight to be more instrumental to a player's success for positions like offensive and defensive lineman, where size is generally critical to the evaluation and performance of a player.

F. *College Team Dummies*

Finally, I include dummy variables for each player's college team to evaluate how a player's college decision affects his NFL success. Considering each program's historical level of success and the competitiveness of their conference, I divide the teams into four tiers: $Team1_i$, $Team2_i$, $Team3_i$, *and* $Team4_i$. To demonstrate, if player i played for the University of Alabama, one of the most dominant programs in the history of college football, $Team1_i = 1$, and the dummies for the other tiers take on values of zero. If player i instead played for the University of Akron, historically a very unsuccessful program, $Team4_i = 1$. I assign teams with less extreme historical levels of achievement to the middle two tiers, $Team2_i$ and $Team3_i$. These dummies are important as a recruit's decision to play for a more prestigious team may significantly affect his professional success. For one, more successful programs generally develop their players more effectively. Players in these programs also have much more exposure to NFL recruiting and are likely to be more prepared for NFL-caliber competition as they typically play in more competitive college football conferences.

IV. Data

There are no available comprehensive datasets with the information necessary for my research, so I compiled data from three main sources: 247sports.com[4], pro-football-reference.com[5], and spotrac.com[6]. Information regarding graduating high school players was easily accessible through 247sports.com, where I was able to find the 247Sports Composite Ratings for my years of interest, 2005-2012. The number of players evaluated by 247Sports's recruiters over this period ranged from 2,151-3,102. For each of the eight graduating classes from 2005-2012, I included every twentieth prospect in my sample, beginning with the top ranked prospect and stopping at the 1,981st ranked prospect in each year, initially leaving me with 800 observations. I ended up with 767 observations in total after eliminating players whose football careers ended for reasons unrelated to their performances on the field, like, for example, legal issues and career-ending injuries. Through 247sports.com I was able to collect data regarding each player's 247Sports Composite star rating, numerical rating, rank, high school graduation year, height, weight, number of college offers, college team played for, and position played.

I collected data for each player's overall pick and round selected in the NFL draft, year entering the NFL, NFL career total Approximate Value, and games played throughout NFL career from pro-football-reference.com. I converted statistics for career Approximate Value and total games played to per-season measures by dividing them by

[4] Recruit rating data can be found at https://247sports.com/Season/2018-Football/CompositeRecruitRankings?InstitutionGroup=highschool.
[5] Data relevant to my metrics for NFL success can be found at https://www.pro-football-reference.com.
[6] Player annual earnings data can be found at https://www.pro-football-reference.com.

each player's number of years in the NFL. 63 of the total 767 players were selected in the NFL draft and 88 actually made an NFL team, indicating that 25 of the players with NFL careers started their careers as undrafted free agents. The years that players entered the NFL span from 2009-2017. Data regarding players' highest annual cash earnings over their NFL careers was collected from spotrac.com, which provides a detailed breakdown of the portions of a player's annual earnings that come from his contract, bonuses, etc. I exclude bonuses in players' highest annual cash earnings as they aren't necessarily reflective of on-the-field performance. For example, a player receives a signing bonus upon joining an NFL team, but the player receives this bonus regardless of whether or not he turns out to be a successful player for the team. In my sample, these earnings range from $0.0512 - $6.700, in millions.

Summary statistics and correlation matrices can be found in the Appendix in Tables 2-5.

V. Results

A. NFL Draft Pick Determinants

Table 6 shows the effects of recruit ratings and various controlling variables on a player's overall pick in the NFL draft. The table includes results from five regressions which use player star ratings and overall class ranks as the variables for recruit ratings.

a. Star Rating

The first regression in Table 6 looks at how a player's star rating correlates with when he is selected in the NFL draft, controlling for height weight, and number of college offers. This model describes 32.2% of the variation in player NFL draft selection. Star ratings and player weights both appear to have significant negative correlations with when a player is picked in the draft, at the 1% and 10% significance levels respectively. The coefficients indicate that each additional star a player receives, he is selected a relatively substantial 40.74 picks earlier, and every additional pound a player weighs, he is selected approximately 0.35 picks earlier.

In my second regression, when removing the height variable because of a fairly high collinearity with weight, 0.67, and implementing dummy variables for player positions, both star rating and weight remain significant at the same levels. The magnitude of the weight coefficient almost doubles, as height may have been capturing some of its effects, and the star rating coefficient increases slightly, in terms of absolute value. Interestingly, the dummy variable for defensive backs is significant at the 10% level with a p-value of 0.08, indicating that, holding everything else constant, defensive backs tend to be selected 81.61 picks later in the draft.

The third regression expands the sample, beyond only players who were selected in the NFL draft, to include all 767 college players. This is done by assigning an arbitrary value of 300, necessarily larger than the maximum 251 in the sample, to the draft pick outcome variable for those who weren't drafted. I also make this same adjustment to the dummy for a player's year entering the NFL by adding four to the high school graduation year for players who didn't have NFL careers, as players generally graduate from college in four years. These changes drop the R-squared to 0.18 and decrease the magnitude of the star rating coefficient by about 15 draft picks, which would be expected due to a majority of the sample not being selected in the NFL draft. A player's weight becomes significant at the 1% level, to be interpreted that heavier players are not only selected earlier in the draft, by also seem to have a higher likelihood of being drafted at all. A player's number of college offers also has a significant negative relationship with draft picks at a 5% significance level with a coefficient of -1.13. Because college offers become significant when expanding the sample to include all college players, although a player's number of college offers doesn't seem to equate to earlier draft selection when considering only players who were drafted, it appears to be a significant determinant of whether or not a player is selected in the NFL draft at all. No dummy variables for position are significant in this regression.

b. Rank

Very similar results are found in regressions four and five when using a player's overall rank in his given graduating class as the variable for recruit ratings. When limiting the sample to include only drafted players, weight maintains significance, and the player rank coefficient indicates that as a player's rank decreases by one, which is

more favorable as one is the best possible rank, he is selected in the draft about 0.06 picks earlier, at a 1% significance level. This coefficient is extremely small because player ranks have a large range from 1-1,981. Upon inclusion of the entire sample in the following and final regression, rank remains significant with a decreased magnitude. Height actually becomes significant at the 10% level in this case, indicating that, all else constant, as a player's height increases by one inch, his draft placements improves by 1.66 picks. Not included in the table, a number of regressions controlling for yearly effects and the prominence of a player's college football program had no significant effects on any of the coefficients.

B. NFL Draft Round Determinants

Table 7 includes five regressions with a player's round selected in the draft as the outcome variable and star rating and rank again as the key explanatory variables.

a. *Star Rating*

Star rating and weight continue to be significant, although weight is only marginally significant and becomes insignificant when I control for position and year entering the NFL in the second regression, which explains an impressive 62.9% of the variation in draft round selection, considering only players who were drafted. None of the position dummies exhibit significance, indicating no systematic difference in the round players are drafted across positions. Star rating is consistently significant at the 1% level for all regressions in which it is included. Even when considering the entire sample of college players and controlling for year entering the NFL and each player's college team in the third regression, results show that as a player has one additional star, he is drafted

almost an entire round earlier, which is substantial as there are only seven rounds, exhibiting a coefficient of -0.83 and a p-value of 0.00. Height, weight, and number of college offers also become significant at the 5, 1, and 10% levels respectively. As players are taller, heavier, and receive more college offers, they tend to be drafted in earlier rounds, all of which align with my expectations.

b. Rank

Columns five and six show regression results when using player rank as the key explanatory variable. Rank appears to have a slightly stronger relationship with draft round selection as the first regression using player ranks, regression four, including only dummies for players' years entering the NFL, displays a higher R-squared value, 0.46, than the initial regression using star ratings, 0.32. The coefficients for player rank are, again, very small as these ranks range from 1-1,981. Results in regression five, accounting for all players in the sample, drafted or not, indicate that as a player is ranked one position higher, he is drafted 0.001 rounds earlier, which seems minimal but equates to a significant difference of being drafted an entire round earlier if a player is ranked 1,000 spots higher[7], not unreasonable as the maximum rank in our sample is 1,981. The number of college offers also becomes significant, with an additional offer relating to being drafted 0.44 rounds earlier, at a 5% significance level. Not included in the table are several regressions which employ dummies for position and college team played for, which resulted in no significance and had no substantial effects on any coefficients.

[7] 0.001 * 1,000 = 1

C. Average NFL Games Played per Season Determinants

Table 8 shows the effects of star and numerical ratings, and various controlling variables, on a player's average games played per season throughout his NFL career.

a. Numerical Rating

Regressions one and two use a player's numerical rating as the key explanatory variable of his average games played per year in the NFL, where more games played per year relates to a higher level of success and should correlate with better recruit ratings. In regression one, controlling for height, weight, and number of college offers, neither a player's numerical rating nor his height, weight, or number of college offers are significant determinants of how many games he plays per season in the NFL. A higher numerical rating doesn't correlate with more success in the NFL in terms of games played per year. The model exhibits a lackluster 2.1% explanation of the variation in average games played per year. Upon the implementation of position and year dummies and the elimination of the height variable for collinearity, there are no significant changes in coefficients or p-values, although the R-squared increases to 0.31. There is, however, significance in the quarterback and running back dummy variables at 5 and 10% levels. These coefficients indicate that, all else constant, players who are quarterbacks and running backs play 7.83 and 6.01 less games per year compared to other positions. This follows intuition as there is generally only one quarterback and one running back on the field at a given time, making them two of the most competitive positions. The use of college team dummy variables doesn't significantly change any results.

b. *Star Rating*

Regressions 3-5 show the effects of a player's star rating on his average games played per year. Again, no variables exhibit any significance as determinants of games played per year. Star ratings don't appear to significantly affect how many games a player sees playing time in per season. Not shown in the table, the use of dummy variables didn't yield any significant coefficients, signifying, contrary to the previous regression, that there is no systemic difference in games played per year across positions. The employment of college team and year dummies has no significant implications. The insignificance of the college team dummies follows that, contrary to what I expected, a player's choice of which college program to play for doesn't significantly affect his success in the NFL, as measured by games played per year.

D. Highest Annual Earnings Determinants

Table 9 presents the determinants of a player's highest annual cash earnings during his NFL career, with star rating and player rank as the determinants of interest.

a. Star Rating

The initial model using star ratings and the primary control variables, with no dummies present, exhibits no significant coefficients and explains only 3.22% of the variation in the highest annual cash earnings during a player's NFL career. The results in regression two, after employing position dummies, reflect no significant differences in annual cash earnings across positions, which I find unusual as certain positions, quarterbacks for example, are typically paid much more relative to other positions. It may be that the quarterbacks particular to my sample weren't very successful in the NFL, not an unreasonable possibility as quarterback is undoubtedly the most competitive position

in football, and therefore the most difficult to find success in. When controlling for a player's year entering the NFL in the third regression, the R-squared for the model rises dramatically to 0.549, and the coefficient for the running back position dummy variable becomes significant at a level of 5%. This reveals that when controlling for yearly effects, running backs tend to be paid $1.77 million less, relative to other positions. Like quarterbacks, this might be explained by a general underachievement of the running backs in the sample.

b. Rank

Column four presents the results when player rank is the independent variable of interest. No variables display any significance, and the model explains only 3.6% of the variation in a player's highest annual cash earnings. Better player ranks don't relate to higher annual cash earnings in the NFL as I expected. Although I don't include them in the table, regressions with controls for position, year entering the NFL, and college team yielded insignificant results. Recruit ratings seem to be unrelated to a player's cash earnings.

E. Average Approximate Value per Season Determinants

Table 10 shows the correlations between star and numerical ratings and a player's average Approximate Value per season, as calculated by Doug Drinen's position-specific formulas which assign a value of success to a player's season.

a. Star Rating

Regressions 1-3 surprisingly reflect no significant correlation between a player's star rating and his average seasonal Approximate Value. Higher star-rated players don't

seem to realize more success on the field as measured by this metric. The second regression presents interesting results indicating a 10% level of significance in the effect of the college program a player chooses to play for on his average Approximate Value per season in the NFL. Playing for a tier three team, which is only generally more successful than teams in the fourth tier, correlates with a 4.80 lower seasonal Approximate Value than players who play for teams in the other tiers. Playing for a team in the fourth tier relates to an even larger decrease of 5.77 in a player's seasonal Approximate Value. These results make sense as they indicate that playing for a worse college program, for example moving from a third-tier team to one in the fourth tier, increases the magnitude of the coefficient, relating to a larger decrease in a player's average seasonal Approximate Value. These results are relatively large considering the maximum seasonal Approximate Value in the sample is 15. An explanation for these effects may be that players on less prestigious teams tend to play in less competitive conferences and have less effective coaching, making them less prepared to perform at the professional level. Results in column three indicate that when controlling for star rating, weight, number of college offers, and year entering the NFL, running backs and tight ends systematically have lower Approximate Values compared to other positions, by 3.65 and 4.08 respectively at a 10% level of significance. These significantly negative coefficients aren't necessarily surprising as running back and tight end are positions which normally have one player on the field at a given time, making them, like quarterback, very competitive and more difficult to find success in.

b. Numerical Rating

Column four exhibits the determinants of average Approximate Value per season when a player's numerical rating is the key explanatory variable. No regressions result in a significance of the numerical rating coefficient, indicating no relationship between a player's NFL success and his numerical rating as a college recruit. The employment of any dummy variables has no significant effects, although, like the regressions including star rating as the variable of interest, tight ends reflect an Approximate Value disadvantage relative to other positions, but this significance disappears upon the implementation of college team dummies. Again, not included in the table, playing for third and fourth-tier college teams has a negative effect on a player's average Approximate Value per season relative to players who played for teams in the other tiers, both significant at the 10% level.

VI. Conclusion and Suggestions

This study has shown that recruit ratings don't have a significant relationship with a player's level of success in the NFL.

Models in Tables 6 and 7, which analyzed the determinants of when a player is selected in the NFL draft, did present significant evidence that as a player has a higher star rating and overall rank, he tends to be drafted not only in earlier rounds, but he is also selected earlier within those rounds. As I mentioned in the discussion of the Abbasian (2016) study however, draft selection isn't necessarily an accurate representation of a player's success in the NFL. Weight also exhibited a consistent significant negative correlation with draft selection, following that heavier players are typically selected earlier in the draft. A player's number of college offers also became significant when expanding the sample to include all 767 players, indicating that players with more college offers must have a higher likelihood of being selected in the NFL draft. Dummies for position and college team showed no significance.

Models including average games played per season in the NFL as the outcome variable showed no significance with recruit ratings. Height, weight, and number of college offers were consistently insignificant as well. Position dummies, when controlling for year entering the NFL, displayed significance in the quarterback and running back coefficients, indicating that, holding numerical rating, weight, and number of college offers constant, quarterbacks and running backs in the sample play 7.83 and 6.01 less games per season relative to other positions. Dummy variables for a player's college team had no effect on NFL games played per season.

Table 6, with highest annual cash earnings during a player's NFL career as the outcome variable, also showed no significant effect of a player's recruit ratings, according to star rating and rank. The only significance in any of these regressions was the running back position dummy when controlling for star rating, weight, and year entering the NFL, which showed that running backs have lower highest annual cash earnings, compared to other positions, by about $1.77 million. Neither weight, height, nor number of college offers displayed significance.

Finally, analysis of the determinants of average Approximate Value per NFL season yielded insignificant recruit rating coefficients. Higher recruit ratings don't appear to relate to more on-the-field success in the NFL as measured by Doug Drinen's Approximate Value method. Results indicated a significant effect of a player's decision about which college team to play for on his NFL success, according to average Approximate Value per season. Playing for third or fourth-tier teams seems to put players at a disadvantage for success in the NFL. The results also showed that running backs and tight ends tend to have lower average Approximate Values.

Future research could look more directly at player performance statistics as metrics for NFL success. For example, for a wide receiver we could look at success as measured by average number of receptions and receiving yards per season. It might also be helpful to include dummy variables to control for the NFL team a player spends most of his career playing for. The NFL franchise a player spends his career with might have significant effects on his ability to be successful for a variety of reasons. It's no secret that certain franchises, like the Cleveland Browns for example, have a history of drafting supposed NFL superstars, only to lead to disappointing, insubstantial careers. This was

the fate for Johnny Manziel, Trent Richardson, and Brady Quinn, just to name a few. This might be the result of a multitude of factors. For one, these unsuccessful franchises are already at a competitive disadvantage usually because of poor management and bad coaching, which negatively effects individual player success regardless of talent and ability. Playing for these unsuccessful teams can also be quite enduring both mentally and physically, depleting players' energy and drive to work harder and become more successful.

It would also be interesting in future research to look at player participation in the Pro Bowl over a number of years and how it correlates with recruit ratings. The top 90 or so players in the NFL each year are selected to participate in the Pro Bowl. With Pro Bowl selection as the outcome variable, we could be sure that we have an accurate metric for success in the NFL, but this would present data limitations as all successful players in the NFL aren't able to be selected for the Pro Bowl, but only the most successful. Ultimately, this is a topic which has been studied very minimally, and any future research will be beneficial to better understanding recruit ratings and how they relate to NFL potential.

VII. Appendix

Table 1[8]

Variable Definitions

Variable	Definition
Round	Round selected in the NFL draft for a given player
Pick	Overall number selected in the NFL draft for a given player
Earnings*	Highest annual cash earnings during NFL career for a given player
GPPY	Average games played per year during NFL career for a given player
AV	Average Approximate Value per season during NFL career for a given player
Stars	247Sports Composite star rating for a given player
Rating	247Sports Composite numerical rating for a given player
Rank	247Sports Composite overall ranking for a given player
Height	Height in inches for a given player
Weight	Weight in pounds for a given player
Offers	Number of college scholarship offers for a given player
DL	Dummy variable equal to one if a given player is an defensive lineman
OL	Dummy variable equal to one if a given player is an offensive lineman
QB	Dummy variable equal to one if a given player is a quarterback
RB	Dummy variable equal to one if a given player is a running back
LB	Dummy variable equal to one if a given player is a linebacker
WR	Dummy variable equal to one if a given player is a wide receiver
DB	Dummy variable equal to one if a given player is a defensive back
TE	Dummy variable equal to one if a given player is a tight end
ATH	Dummy variable equal to one if a given player is an athlete
Team1	Dummy variable equal to one if a given player played for a first tier college program
Team2	Dummy variable equal to one if a given player played for a second tier college program
Team3	Dummy equal to one if a given player played for a third tier college program
Team4	Dummy equal to one if a given player played for a fourth tier college program

[8] * = in millions of US dollars

Table 2[9]

Summary Statistics

Variable	Observations	Mean	Std. Dev.	Min.	Max.
Round	63	3.92	1.82	1	7
Pick	63	117.13	67.69	1	251
Earnings*	88	1.19	1.46	0.05	6.7
GPPY	88	10.30	4.90	0	23
AV	88	2.39	2.65	0	15
Stars	767	2.90	0.69	2	5
Rating	767	0.84	0.06	0.7	1
Rank	767	988.58	572.48	1	1981
Height	767	73.94	2.65	61	81
Weight	767	221.57	42.91	150	370
Offers	767	4.00	3.45	0	24

[9] * = in millions of US dollars

Dependent Variable Correlation Matrices

Table 3

	Stars	Height	Weight	Offers
Stars	1.00			
Height	0.09	1.00		
Weight	0.13	0.67	1.00	
Offers	0.37	0.06	0.07	1.00

Table 4

	Rating	Height	Weight	Offers
Rating	1.00			
Height	0.11	1.00		
Weight	0.16	0.67	1.00	
Offers	0.40	0.06	0.07	1.00

Table 5

	Rank	Height	Weight	Offers
Rank	1.00			
Height	-0.11	1.00		
Weight	-0.14	0.67	1.00	
Offers	-0.42	0.06	0.07	1.00

Table 6 – NFL Draft Pick Determinants

Variables	(1) Pick	(2) Pick	(3) Pick (300 if not selected in draft)	(4) Pick	(5) Pick (300 if not selected in draft)
Stars	- 40.736*** (9.428)	- 41.013*** (9.473)	-26.191*** (3.012)		
Rating					
Rank				0.055*** (0.019)	0.024*** (0.004)
Height	2.958 (3.664)			3.408 (3.998)	-1.658* (0.934)
Weight	-0.349* (0.201)	-0.640* (0.350)	-0.305*** (0.094)	-0.448** (0.214)	-0.037 (0.058)
Offers	-0.527 (1.574)	0.835 (1.596)	-1.126** (0.599)	-0.632 (1.733)	-1.239** (0.588)
QB		73.624 (46.822)	-5.381 (50.439)		
RB		25.352 (48.081)	-3.497 (50.365)		
WR		62.975 (44.931)	-5.231 (50.355)		
TE		48.479 (49.579)	2.307 (50.336)		
OL		77.117 (57.715)	23.901 (50.250)		
DL		76.449 (49.473)	10.669 (50.040)		
LB		8.326 (48.012)	3.396 (50.011)		
DB		81.609* (45.734)	1.990 (50.241)		
ATH		-19.084 (45.888)	-11.897 (50.539)		
Dummy for year entering NFL	No	No	No	No	No
Dummy for year entering NFL (HS grad year + 4 if not selected in draft)	No	No	Yes	No	No
Constant	129.339	358.424	427.431	-53.087	397.060

	(252.304)	(75.461)	(54.329)	(280.970)	(61.692)
Observations	63	63	767	63	767
R-squared	0.322	0.482	0.179	0.214	0.1067

Standard errors in parantheses
*** p<0.01, ** p<0.05, * p<0.10

Table 7 – NFL Draft Round Determinants

Variables	(1) Round	(2) Round	(3) Round (10 if not selected in draft)	(4) Round	(5) Round (10 if not selected in draft)
Stars	-1.101***	-1.017***	-0.828***		
	(0.254)	(0.282)	(0.976)		
Rating					
Rank				0.002**	0.001***
				(0.001)	(0.000)
Height	0.059	-0.064	-0.84**	0.006	-0.49
	(0.099)	(0.121)	(0.035)	(0.106)	(0.030)
Weight	-0.009*	-0.015	-0.009***	-0.008	-0.001
	(0.005)	(0.011)	(0.003)	(0.006)	(0.002)
Offers	-0.003	0.018	-0.035*	-0.030	-0.44**
	(0.042)	(0.043)	(0.019)	(0.045)	(0.020)
QB Dummy		1.676	-0.214		
		(1.342)	(1.633)		
RB Dummy		0.784	-0.475		
		(1.493)	(1.635)		
WR Dummy		1.235	-0.315		
		(1.244)	1.630		
TE Dummy		1.102	0.152		
		(1.392)	(1.630)		
OL Dummy		1.977	0.848		
		(1.735)	(1.627)		
DL Dummy		1.419	0.308		
		(1.431)	(1.620)		
LB Dummy		-0.270	0.002		
		(1.365)	(1.619)		
DB Dummy		1.437	-0.206		
		(1.243)	(1.628)		
ATH Dummy		-0.919	-0.577		
		(1.276)	(1.637)		
Dummy for year entering NFL	No	Yes	No	Yes	No

Dummy for year entering NFL (HS grad year + 4 if not selected in draft)	No	No	Yes	No	Yes
Constant	5.630	14.270	20.085	3.557	13.024
	(6.785)	(8.969)	(3.040)	(7.713)	(2.010)
Observations	63	63	767	63	767
R-squared	0.320	0.629	0.186	0.454	0.124

Standard errors in parantheses
*** p<0.01, ** p<0.05, * p<0.10

Table 8 – Average Games Played Per Season Determinants

Variables	(1) GPPY	(2) GPPY	(3) GPPY	(4) GPPY	(5) GPPY
Stars			-0.057	-0.877	-0.397
			(0.710)	(0.783)	(0.809)
Rating	-0.411	1.614			
	(8.750)	(9.532)			
Rank					
Height	-0.196				
	(0.275)				
Weight	0.020	0.030	0.014	0.012	0.002
	(0.016)	(0.033)	(0.013)	(0.013)	(0.013)
Offers	-0.368	-0.071	-0.039	-0.069	0.005
	(0.128)	(0.013)	(0.126)	(0.125)	(0.129)
QB Dummy		-7.825**			
		(3.888)			
RB Dummy		-6.010*			
		(3.541)			
WR Dummy		-3.872			
		(3.583)			
TE Dummy		-5.265			
		(4.112)			
OL Dummy		-5.964			
		(5.216)			
DL Dummy		-4.003			
		(4.209)			
LB Dummy		0.393			
		(3.778)			
DB Dummy		-2.347			
		(3.384)			
ATH Dummy		-1.976			
		(3.610)			
Team1				-0.843	-1.767
				(4.975)	(4.992)
Team2				-3.765	-4.295
				(5.099)	(5.135)
Team3				-3.208	-3.224
				(5.093)	(5.073)
Team4				-8.113	-7.709
				(5.813)	(5.940)

Dummy for year entering NFL	No	Yes	No	No	Yes
Constant	20.915	8.554	7.577	13.701	16.948
	(19.867)	(8.848)	(3.447)	(6.606)	(6.999)
Observations	88	88	88	88	88
R-squared	0.021	0.312	0.015	0.105	0.2297

Standard errors in parantheses

*** p<0.01, ** p<0.05, * p<0.10

Table 9 – Highest Annual Earnings Determinants

Variables	(1) Earnings	(2) Earnings	(3) Earnings	(4) Earnings
Stars	0.055	0.101	0.034	
	(0.211)	(0.219)	(0.172)	
Rating				
Rank				-0.000
				(0.000)
Height	0.038			
	(0.081)			
Weight	0.004	0.012	0.006	0.005
	(0.004)	(0.009)	(0.007)	(0.004)
Offers	-0.013	-0.288		-0.020
	(0.038)	(0.039)		(0.038)
QB		-0.919	-0.959	
		(1.073)	(0.925)	
RB		-1.323	-1.773**	
		(1.012)	(0.846)	
WR		-0.425	-0.278	
		(1.008)	(0.855)	
TE		-0.804	-1.178	
		(1.091)	(0.971)	
OL		-1.261	-0.606	
		(1.381)	(1.233)	
DL		-1.550	-0.838	
		(1.138)	(1.001)	
LB		-0.474	-0.449	
		(1.087)	(0.898)	
DB		-1.195	-0.677	
		(0.982)	(0.809)	
ATH		0.344	0.134	
		(1.051)	(0.859)	
Team1				
Team2				
Team3				

Team4				
Dummy for year entering NFL	No	No	Yes	No
Constant	-2.787	-0.764	3.366	0.203
	(5.544)	(1.776)	(1.537)	(0.959)
Observations	88	88	88	88
R-squared	0.0322	0.133	0.549	0.036

Standard errors in parantheses
*** p<0.01, ** p<0.05, * p<0.10

Table 10 – Average Approximate Value per Season Determinants

Variables	(1) AV	(2) AV	(3) AV	(4) AV
Stars	0.477	0.239	0.294	
	(0.380)	(0.454)	(0.431)	
Rating				6.548
				(4.645)
Rank				
Height	0.067	0.065		0.074
	(0.147)	(0.157)		(0.146)
Weight	0.007	0.008	0.028	0.006
	(0.008)	(0.009)	(0.018)	(0.008)
Offers	-0.011	-0.015	-0.036	-0.018
	(0.067)	(0.073	(0.074)	(0.068)
QB Dummy			-2.307	
			(2.196)	
RB Dummy			-3.649*	
			(1.998)	
WR Dummy			-1.969	
			(2.016)	
TE Dummy			-4.078*	
			(2.292)	
OL Dummy			-4.023	
			(2.913)	
DL Dummy			-3.127	
			(2.361)	
LB Dummy			-1.026	
			(2.127)	
DB Dummy			-3.120	
			(1.909)	
ATH Dummy			-0.402	
			(2.035)	
Team1		-4.189		
		(2.804)		
Team2		-3.873		
		(2.883)		
Team3		-4.799*		

		(2.851)		
Team4		-5.772*		
		(3.336)		
Dummy for year entering NFL	No	Yes	Yes	No
Constant	-5.772	0.591	-1.204	-10.282
	(9.974)	(11.409)	(3.636)	(10.548)
Observations	88	88	88	88
R-squared	0.0509	0.181	0.250	0.0554

Standard errors in parenthesis
*** p<0.01, ** p<0.05, * p<0.10

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