The Returns to Elite Sports Programs: Signaling vs Value-Added

Jordan Holbrook *

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Abstract

This study explores the critical question of what distinguishes the few hundred professional athletes selected from the vast pool of high school football players in the United States. It focuses on the influence of college football program quality on an athlete's journey to the National Football League (NFL). Leveraging a unique dataset tracking highly recruited high school athletes, their college team characteristics, and subsequent professional labor market outcomes, this research employs a robust empirical strategy to provide selection-corrected estimates of the impact of elite sports programs. The findings reveal significant returns to participating in top-ranked college football programs, markedly increasing the likelihood of being drafted into the NFL. However, these advantages are transient and do not persist throughout an athlete's entire career. Notably, athletes from both top and bottom-ranked programs exhibit similar earnings potential and career trajectories once they become a professional athlete and enter into the NFL.

Key words: Education, Human capital, Signaling

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*University of Houston, Science and Research 2, Office 133, 3623 Cullen Boulevard, Houston, TX 77204. Email: jcholbrook@uh.edu. Grateful to Professor Chinhui Juhn and Professor Yona Rubinstein for their courses in labor economics and the economics of education; Professors Aimee Chin and Vikram Maheshri for their feedback and insight. I am thankful for comments, feedback, and help with programming from: Angelo Santos, Horacio Rueda, Yujie Zhang, & Charter Sevier.

1 Introduction

Each year over 1.2 million high school students compete in the most popular sport in the United States, American Football, many with the ambition of becoming a professional athlete. Yet, similarly, each year only, slightly over 250 athletes are selected by professional teams into the National Football League (NFL). What separates these 250 athletes from the 1.2 million of their peers? Does the 'quality' of the athlete's collegiate program matter in determining who gets selected to become a professional athlete? If the quality of the college football program a student athlete attends indeed has an impact, to what extent does this impact persist over the course of the athlete's career, and how significant is its magnitude throughout their career length? This study focuses on measuring the returns to participation in elite college sports programs in terms of professional sports labor market outcomes and quantifying the impact of the returns throughout the entire duration of a professional athlete's career.

For more than 50 years economists have been interested in studying the returns to program participation. 'Programs' such as schools, colleges, or training programs have all generated speculation on obtaining accurate estimates of the return to participation. Obtaining unbiased estimates of the effects of college characteristics on student outcomes is particularly challenging as it involves understanding the effect of selection on outcomes for both observable and unobserved characteristics of students. The effect of selection on observable characteristics can be nuanced, with questions such as how predictive are test scores of students earning potential or are returns to education heterogeneous across racial or ethnic groups? Furthermore, the effect of selection on unobserved characteristics is a significant confounding factor as unobserved characteristics can influence both where students attend college, and subsequently where they are employed and how much they earn. Studies in the economics literature have shown divided results on this and similar topics.

In anticipation of many of the challenges of this type of research, this study proposes a focus on student athletes with the potential to add both simplicity and new data to this

research setting. There is an abundance of data and measures on student athletes. Sports in and of itself is a data dominated industry and beginning in high school and on to college and the professional leagues, there are many objective performance measures that can be leveraged to address key questions.

Finally, a further challenge in this domain is differentiating the impact of an individual's own productivity on their earnings versus the effect of their environment. That environment may be a team, department, peers, or a particular firm brand. From the context of student athletes not only are there objective performance measures for individuals, but also an abundance of objective performance measures for the teams in which the athletes participate. Arcidiacono, Kinsler, and Price (2016) use professional basketball data to measure individual versus team productivity and quantity the role of peer productivity spillovers. They find despite large spillovers; worker compensation is largely set up individual productivity. Considering the aforementioned, studying the returns to elite sports programs in the setting of student athletes is an important undertaking.

Understanding the returns to elite sports programs is of particular interest for the millions of high school student athletes competing each year and seeking to continue to compete at the collegiate, and ultimately professional level. Similarly, parents, coaches, school administrators, and policymakers would be better informed regarding investment decisions based on the returns to elite sports program participation. For many athletes the journey towards collegiate athletics is one of thousands of hours of practice and preparation. In the United States high school sports are an integral part of the education experience and for some students an athletic scholarship provides the best opportunity not only get into college, but also for a free or highly subsidized education at a leading university (Ransom & Ransom, 2018).

In this paper, I build a novel panel data set of highly recruited high school athletes, observing the characteristics of the college teams they participate in as well as their professional athlete labor market outcomes. First, using data on these top high school athletes and the college teams they were extended scholarship offers I employ a dependable empirical

strategy, known as the matched applicant or Dale and Krueger method, to address threats to identification from selection on unobservable characteristics. With this data and strategy, I provide selection-corrected estimates of the returns to elite sports programs on the main outcome variable of job placement. I then continue to follow these student athletes into their professional careers and investigate five measures of professional athlete labor market success throughout the entire career trajectory. In contrast to Dale and Krueger (2002, 2011) but consistent with Chen, Grove, & Hussey (2012) I find substantial returns to higher quality college teams in terms of initial job placement. Student athletes that participate in top ranked college football programs are three to five times more likely to be employed professionally. A one standard deviation increase in college program quality increases the likelihood of being drafted by 32% of the mean. I provide strong evidence that these elite program returns are transitory and do not persist throughout an athlete's entire career. Athletes from top and bottom ranked programs have similar earnings potential and career progression throughout their early, mid, and late career stages. Conditional on being an professional athlete, athletes from top and bottom ranked programs have equal propensity for successful labor market outcomes.

The remainder of this paper is organized as follows. Section 2 describes the methods and empirical strategy I employ to measure the payoffs to elite sports programs. Section 3 describes the various data sources used to build the panel dataset of student athletes. Section 4 reports the results and main findings, and section 5 summarizes and concludes.

2 Methods

2.1 Measuring Returns to Participation

Traditionally, the college application process involves students first submitting college applications, then colleges and universities determine which students with be accepted. The college selection process for most student athletes is slightly different. Normally, it is colleges

that first reach out to students, establish contact, and then offer athlete scholarships; then, athletes determine which college team to play for by accepting the scholarship offer and signing a Nation Letter of Intent (NLI) during an official signing period.

In this application process for athletes, one of the challenges to estimating labor market returns is that student athlete characteristics causing different schools to extend a scholarship offer are not observed by the researcher. Furthermore, if any of these unobserved characteristics are correlated with the college team quality, then our estimate of the returns to participation would be biased. Specifically, if one believes the correlation to be positive, for example more talented or ambitious players are recruited by higher ranked college sports programs, then our estimate will be biased upwards.

The model linking student athlete characteristics to labor market outcomes such as job placement and earning I will assume takes the following form:

$$y_{ij} = \beta_0 + \beta_1 Q_j + \beta_2^{'} X_{1i} + \beta_3^{'} X_{2i} + \epsilon_{ij} \tag{1}$$

y_{ij} represents outcomes for individual student athlete i, on team j. β_1 measures the payoffs for the quality of a college team and X_1 are student athlete observable characteristics and X_2 represent unobservable student athlete characteristics.

To address the selection problem similar to the aforementioned studies, I use a selection-adjusted frame work following Dale and Krueger (2002, 2011), to attempt to control for unobserved factors in recruiting (X_2) . The strategy is operationalized by including two variables in my model: (1) total number of scholarship offers, (2) average qualify of all the college teams in each scholarship offer set.

$$y_{ijg} = \beta_0 + \beta_1 Q_j + \beta_2^{'} X_{1i} + \beta_3^{'} X_{2ijg} + \epsilon_{ijg} \tag{2}$$

Similar to Dale and Krueger (2002), a critical assumption of this empirical strategy is that student athletes' scholarship acceptance decisions are not correlated with the error term or the X2 variable. There are possible scenarios where this assumption may not be true and thus the selection adjusted estimates of the returns to participation still may be biased. Additionally, another assumption from this research setting is that all collegiate athletes have ambition to play professionally. There perhaps are some very talented high school and college athletes who did not wish to have a professional career regardless of whether they would be selected by a professional team or not. Furthermore, there may be non-professional benefits to participating in college sports but not playing professionally. These benefits would not be captured in this current research design and are beyond the scope of this study. While it currently must be the case that not all collegiate athletes have desires to play professionally, the data sample of this study is already highly selective. ESPN 300 ranked high school athletes are already part of the top 1% of athletes in the country. These are not ordinary high school players but have already demonstrated significant talent and skill early on in their athletic careers. Thus, the previous assumption seems reasonable in this context.

3 Data

In this section, I report my data sources as well as the context of the study. I then define my sample and relevant variables of interest. Finally, I introduce summary statistics for the sample of student athletes and exhibit characteristics of the college football program in which these athletes participate.

A key advantage of studying student athletes is an abundance of data on these individuals. Highly recruited student athletes have observable measures not only of their demographic characteristics, but also athletic performance starting in high school following each year of participation in collegiate sports and then ultimately performance as a professional athlete. With the popularity of American Football in the United States, elite student athletes are

the subject of hundreds of blogs, media articles, interviews, and performance rankings from sports analysts, professional talent scouts, and recruiting coaches across the country. Student athletes can be followed throughout their collegiate and professional careers creating a unique setting of pre and post college measures connected to professional athlete labor market outcomes.

Additionally, professional athletes have relatively short professional athletic careers compared to the average professional. The average career length of NFL players is 3.3 years. Thus, in the context of this study focusing on the effect or return to elite sports programs there is potential to study the impact of the return over the entire professional athletic career. Other studies seeking to answer similar questions about the returns to education typically suffice with observing a cross section of outcomes such as labor market earnings at one or two moments. For example, Dale and Krueger observe labor market earnings 1995 for college students from the 1976 cohort of the College and Beyond survey, or roughly 13-16 years into post-college careers. Mountjoy and Hickman's more recent study of students enrolled at Texas universities observes labor market earnings around 10 years into their careers (Mountjoy and Hickman, 2021)

3.1 High School Athletes

Starting in 2006 the largest sports network in the United States (ESPN) started collecting data and evaluating high school football athletes from all over the country. Professional scouts, analysts, and coaches employed by ESPN reviewed game film on top high school players and assigned each player a recruiting grade and national rank. These metrics were meant to assess the readiness of the high school player to compete at the collegiate level as well as a measure of the athletic skill and talent of the individual. This data has been recorded for each high school graduating class since 2006. Additionally, each high school student athlete in the database has a profile page with a detailed scouting report, recruiting activity, and player news in the media.

Along with detailed athletic ability information, the ESPN database consists of information on athletic scholarship offers. The player profile page lists each college football program that has extended an official scholarship offer. Additional information includes the status of the scholarship offers, i.e., whether the offer was accepted or not as well as if the athlete participated in an official campus visit. Other information included the student athlete's hometown and high school. I collect scholarship information on each athlete including the total number of scholarships offered, scholarship offers in athlete's home state, and which scholarship offer was ultimately accepted. This information is vital to my eventual empirical strategy.

The culmination of this high school student athlete information came to be known as the ESPN 300 and this publicly available data is displayed at www.espn.com. In subsequent years ESPN expanded the athlete rankings from only the best 300 high school players but ranked the top 100 players for each of the 16-18 position groups in American Football. I employ several web-scraping and data mining approaches to collect this public information and display it in a database appropriate for econometric analysis. The high school data set has on average 1,600 athletes graded by ESPN analysts for the years 2006-2022. Table 1 reports the summary statistics and information recorded in this dataset.

Table 1 provides statistical information on various characteristics of high school athletes. On average, the ESPN 300 high school ranking for these athletes is 46.42, with a standard deviation of 28.69. The range of rankings spans from the top-ranked athletes at 1 to the lowest-ranked athletes at 100. In terms of grades, the ESPN 300 high school athlete grade averages at 77.03, with a standard deviation of 4.49. The grades range from a minimum of 44 to a maximum of 95. This indicates that these athletes, as a whole, tend to be highly ranked and athletically talented.

The average high school graduation year for these athletes is 2014, with a standard deviation of 4.84. The range of graduation years spans from 2006 to 2022. On average, these athletes receive 8.67 scholarship offers, with a minimum of 1 and a maximum of 89.

The average height of these athletes is 73.95 inches, with a standard deviation of 2.46. The range of heights spans from 65 to 82 inches. In terms of weight, the average weight is 221.74 pounds, with a standard deviation of 43.5. The weight range varies from a minimum of 43 pounds to a maximum of 396 pounds. On average, these athletes have around 12.08 top recruit peers, with a standard deviation of 8.05. The number of top recruit peers ranges from 0 to 30. Additionally, these athletes have a high acceptance rate of scholarship offers, with an average of 0.90 and a standard deviation of 0.29. Finally, a small percentage of these athletes, around 0.06 on average, are selected in the NFL Draft, with a standard deviation of 0.24. The selection rate ranges from 0 to 1. Overall, Table 1 provides insights into the characteristics and outcomes of high school athletes in terms of rankings, grades, graduation years, scholarship offers, physical attributes, and post-high school achievements.

3.2 Measures of College Quality

One of the unique challenges of this study was defining a metric evaluating college football program quality. Ranking team and program performance has been the fixation for sports fans and analysts as long as sports teams have existed, and college football is no exception. Many of the large television and sports network providers have their own proprietary ranking of teams each season. There are many ways to measure college football program quality, however, a measure with two key attributes, time invariance and transparency, is important for a multitude of reasons. I merge the high school athlete's dataset to another publicly available online database, sports-reference.com. Sports-reference.com is a premier online database for most collegiate and professional sports. I collect college characteristics for the teams where high school players were recruited, including information on the number of wins and losses for each team, team strength of schedule, and conference championships won. Table 2 reports the main college characteristics. Utilizing this data, I measure college team 'quality' to designate which college teams are more or less elite in terms of football performance.

College team quality is measured by the Simple Rating System (SRS) metric. This metric is composed of two parts: average margin of victory and Strength of Schedule (SOS). Average margin of victory is the point differentiate for each game of a football season. The number of points scored minus the number of points allowed. Each team's average margin of victory is then weighted by the quality of the competition they face. The quality of competition is measure by the SOS metric. SOS is compute using the equation (5) considers a team's opponents winning percentage as well as their opponent's opponents' winning percentage. This formula was used in part for post-season tournament seeding in the Bowl Championship Series (BCS) from 1999-2011. To compute this metric for a simple season involves setting up a system of N equation and N unknowns and solving the system simultaneously. Equation (7) demonstrates how compute the SRS metric. This metric is computed and reported by sport-reference.com which contains the aforementioned college football program characteristics for 299 division I FBS and division I FCS schools.

$$SOS = \frac{2 \times (OpponWin\%) + 1 \times (Oppo.oppo.win\%)}{3} \tag{3}$$

$$b = \text{Average margin of victory: (Points scored) - (points allowed)} \tag{4}$$

$$\text{Simple Rating System} = (SOS)^{-1} \times b \tag{5}$$

While there are many ways to evaluate college team quality, our metric has several useful properties: time invariant— teams can be compared in terms of their SRS regardless of the number of years a college program has participated in college football, uniform across divisions – college football in the US has several tiers of leagues in which teams compete (Division I, Division II, Division III, etc.) under the SRS metric teams in different leagues can be compared, and finally stability – SRS is a relatively stable quality metric that changes little from year to year. Additional quality metrics are evaluated in the later section on robustness checks, including a discussion of the sensitivity of the findings to each quality ranking.

3.3 Professional Athlete Labor Market Outcomes

Becoming a professional American Football athlete most typically involves being selected to play for one of the 32 NFL professional teams in an event called the NFL draft. Each NFL team will take turns to choose a college player to compete for one of the professional team's 53 roster positions, this is also known as being "drafted." There are seven rounds in total during the NFL draft and 32 teams which equates to a total of around 250 players being selected in each year. Typically, the teams with the worst regular season performance are allowed to make their selection of a college player first and then continues from worst team to best team (typically measured by the number of games won in the previous season). NFL draft picks can be traded among teams and a higher draft pick order is generally more valuable as a team can select the top talent from among the collegiate players first before their rival team can select.

This study investigates the labor market outcomes of professional athletes, with a particular focus on the unique context of the National Football League (NFL). The overarching research question centers on understanding the returns to elite sports programs for student athletes. This inquiry encompasses five primary outcome measures, each offering valuable insights into the dynamics of the athlete labor market.

First and foremost, the study examines whether a student athlete secures a spot on a professional NFL team through the draft selection process. This initial outcome serves as a crucial measure of job placement or employment, given that only a small fraction, approximately 5%, of the 25,000 high school athletes in the dataset make it to the NFL. It forms the foundation for assessing the immediate returns on investment in elite sports programs.

Moving beyond selection, I also investigate the metric of career length. This measure, conditional on being drafted, gauges how long a particular athlete's NFL career endures. This is especially significant given the unique labor market structure of professional sports, where career trajectories differ drastically from the typical working adult who might spend

35 to 45 years in a career. The NFL, characterized by the physical and high-impact nature of American football, sees relatively short professional careers. These careers are marked by publicly available performance data and mandated disclosure of contract and salary details by all teams. This distinctive data setting enables an examination not only of short-term outcomes but also medium and long-term trajectories over an athlete's entire career.

In addition to career length, the study reports three more crucial measures: Max Contract Length, Career Total Earnings, and Average Annual Earnings. Max Contract Length is a reflection of an athlete's ability to secure longer-term contracts, which are associated with greater career longevity, higher earnings, and enhanced productivity. It also serves as an indicator of the employer's valuation of the athlete, signifying stability and commitment beyond the inherent risks of injury in American football.

Career Total Earnings provide a comprehensive view of an athlete's financial success over their entire career, encapsulating the culmination of contracts, bonuses, and earnings. This measure helps in assessing the overall economic impact of a career in the NFL and its association with elite sports programs.

Finally, Average Annual Earnings shed light on how much an athlete makes in a typical football season. This figure encompasses various components, such as Base Salary, Signing Bonus, Performance Bonus, and Workout Bonus. It offers a more granular view of an athlete's yearly income and provides insights into the economic stability and financial well-being of NFL players.

In sum, this research leverages the unique data context of the NFL to explore the labor market outcomes of student athletes who have participated in elite sports programs. The five outcome measures - NFL draft selection, career length, max contract length, career total earnings, and average annual earnings - collectively contribute to a comprehensive understanding of the returns to elite sports programs, illuminating the multidimensional nature of success in the NFL labor market.

3.4 NFL Labor Market Descriptive Statistics

The NFL professional athletes are numbered at 1,696 active roster positions. Each of the 32 professional teams has 53 active roster positions available each season. The football season begins in late August and so teams have "training camp" in July for athletes to competitive for an active roster position. Athletes that do not make the active roster cut can choose to remain on a professional team's "practice squad" which is a group of non-competition eligible athletes. Even if an athlete makes the 53-man active roster, they can still be demoted to the practice squad for poor performance or injury. Athletes can also be promoted during the regular season from the practice squad to the active roster if a team has no more than 53 players on their active roster.

The NFL transition probability matrix presented in Table 9 is a useful tool for understanding the dynamic nature of the National Football League (NFL) and the careers of its players. This matrix, organized in an upper triangular format, embodies several distinctive properties that provide valuable insights into the NFL's labor market dynamics. The rows represent Draft Classes or groups of athletes that started their NFL career at the same time. Columns represent subsequent seasons in the league with each cell representing the proportion of athletes in a Draft Class still with an active roster spot in the league in a future year.

One distinct feature is the proportion of the draft class is always decreasing as NFL seasons add up. This highlights the constant influx of new talent, the competitive churn within the league, and the limited longevity of NFL careers. Some draft classes may lose as little as 5% of the initial players, but in other years a draft class can lose up to 25% of the total initial players. Thus, every season NFL athletes must compete to maintain their roster position.

Table 8 provides summary statistics labor market outcomes, Max Contract Length, Total Career Earnings, Average Annual Earnings, and Career Length measured in years. The average NFL athlete career is around 4.63 years with $4.71 Million in annual earnings. The

longest contract ever awarded was 10 years and is still considered unprecedented as 95% of contracts in the NFL are four years or less.

The Figure 6 depicts the percentage of NFL players who remain in the league for consecutive years, specifically tracking their continuity from Year N to Year N+1. The x-axis represents the number of years a player has spent in the NFL (ranging from 1 to 10 years), while the y-axis depicts the percentage of players who continue their NFL careers into the next year. The figure shows the conditional transition path. Conditional on being an active roster athlete in year N what percent of those athletes make it to year N+1. Each line on the graph corresponds to a different year of experience in the NFL, with a unique marker style distinguishing each line.

This figure provides valuable insights into the player retention dynamics within the NFL over time. It allows us to observe how the percentage of players remaining in the league changes as they accumulate more experience. In many types of industries employee turnover rates tend to be higher in the earlier years of their careers due to factors like limited experience and poorer quality matches between firm and employee. As employees gain more experience, turnover settles and becomes more consistent for older more experience workers. The NFL is a different labor market environment. In any given year an active roster athlete has between a 55% and 75% chance of being an active roster athlete the next year. The highly competitive environment is consistent across different stages of a career. Analyzing these retention patterns can be crucial for understanding the career trajectories of NFL players and making informed decisions related to player management and team strategy. Figure 4 shows that each year is an uphill battle for athletes to compete for active roster positions regardless of experience levels.

Figure 4 is an kernel density estimate of Average Annual Earnings distribution categorized by number of years in the length. Athletes start out with a four-year rookie contract and upon competition are eligible to negotiate subsequent contracts with other teams if negotiations with their original team cannot be agreed on. WE see that the distribution of average annual

earnings is a concentrated tight distribution. For athletes still in the league after 4 years the annual earnings distribution is substantially different being wider and more dispersed as well as extremely long right tailed. These years are typically the prime earning years for athletes. After 8-7 years in the league, contracts on average are shorter and for less money due to diminished productivity and increased injury risk. This is not always the case and very football position specific, but informative on average. Looking at the second panel of Figure 4, we see that for "Rookies" or athletes with less than five years of experience 80% make less than $4 Million. While for athletes with five or more years of experience 80% make less than $13 Million.

4 Empirical Results

4.1 The Effect of Elite Programs on Job Placement

Table 3 presents the main model specifications estimating the effect of college sports participation on job placement as a professional athlete. The outcome variable for this model is whether a student athlete was selected by a professional team in the NFL draft. I include four specifications for this model that highlight the progression of the empirical strategy. First, is baseline specification with minimal controls. I investigate the effect of college team quality with minimal controls for student athlete height and weight. Specification (2) adds measures of student athlete athletic skill pre-college as measured by the ESPN 300 analysts; these measures are the equivalent of student's own standardized test score but for athletic ability. With specification (3), I address the impact of peer quality. There are two potential sources of peer effects, one is the quality of teammates on a college football team before the incoming college freshman join the team. Second, is the quality of teammates who were recruited together as high school students, and all will be joining a particular college team at the start of a new season. Specification (3) seeks to capture the later source of peer effects by including the number of top high school athletes recruited to the same college team for

each individual student athlete observation. There is sustainable variation in number of top ESPN high school athletes recruited to college team rosters. The quality of peers that enter the college program with a student athlete could affect athletic development and the outcome of being selected in the NFL draft.

Finally, specification (4) incorporates all previous control variables as well as two control variables that seek to mitigate concerns of unobserved factors that influence recruiting and bias college team quality. These variables are the total number of scholarships offered to the high school athlete, and the average college team quality of all the teams in the scholarship offer set for each high school player. Average team quality of the scholarship offer set is computed by first matching each school in the offer set to its related quality measure of winning percentage, then compute the average winning percentage from each high school athlete's scholarship offer set. Finally, I create quartile bins on the continuous average scholarship offer set winning percentage variable and include dummy variables for each quartile bin.

Matching Dale and Krueger 2002, 2011, all explanatory variables are determined prior to when the student athlete begins college. Looking at model (1) we see that for a 1 standard deviation increase in college program quality as measured by the Simple Rating System metric (SRS) increases the likelihood of being drafted by a professional team 0.043 percentage points. When we add in measures of athletic skill, measured in high school, this job placement premium on college team quality shrinks substantially to 0.027 percentage points. Additionally, accounting for incoming peer compositions further decreases the coefficient of interest to 0.024 percentage points. Finally, I add in the variables from the scholarship offer set model (4) to similarly replicate the self-revelation model of Dale and Krueger 2002. The coefficient of interest, the effect of participation in a college sports program, again diminishes when the additional controls are added into model three but still captures a large and significant effect. For a 1 standard deviation increase in college team quality (SRS), the likelihood of being drafted into the NFL increases by 0.018 percentage points.

The average likelihood of being drafted is reflected in the constant term with a value of

0.056 percent in specification (4). Thus, for high school athlete participating in a college sports program one standard deviation higher in college team quality (SRS), increases the likelihood of being drafted by 32% of the mean. Moving from the lowest ranked school to the highest ranked school would 192% change in the likelihood of being drafted, or changing the likelihood of being drafted from 0.056 to 0.164. Moving from a median ranked school to a top ranked school results in a 96% percent increase in the likelihood of being drafted with the likelihood change from 0.056 to 0.11. This effect is larger than the impact of an individual student athlete's incoming peer group, and smaller but of similar magnitude as the impact of the athletes own athletic skill as measured by the ESPN 300 analyst grade and rank. Athletic skill is intuitively the largest determinant of a professional athletic career, yet the impact participation in a more elite college football program has a significant return in terms of job placement as a professional athlete.

Figure 3 illustrates impact of participating in an elite college football program. Taking the predicted probability of being drafted from model (4) of Table 3 and graphing if along with the measure of college team quality (SRS), going from the bottom quartile to the top quartile is associated with a three to five time increase in the predicted probability of being selected in the NFL draft. There is extreme variation in salaries between college athletes selected first in the NFL draft versus being selected in the later rounds, however, at the time of writing "Mr. Irrelevant", the affectionate title for the college athlete selected last in the NFL draft each year had a salary of over $700,000 for each year of the four-year rookie contract. Thus, just being selected by an NFL team to play football professionally increases earnings dramatically.

4.2 Robustness Check – Sensitivity of Returns to College Quality Measure

As stated previously there are many ways to measure college program quality and I discuss the sensitivity of my preferred specification results (Table 3, col 4) to alternative

measures of college program quality. I re-estimate equation (2) six times, only varying the college program quality measure. I choose six other program quality measures with similar attributes as those of my preferred quality measure, Simple Rating System (SRS), including: total program winning percentage (total wins / total games), Strength of Schedule (SOS) (see equation 5), number of professional players from a particular college program, number of years a program was ranked in the top 25 in the nation, number of conference championships, and winning percentage of post-season or national competitive tournament games. Each of these alternative quality measures captures some dimension of what it means to be a national competitive or elite college football program.

As demonstrated in Table 4, each of the alternative measures is associated with a positive and significant impact on the outcome of being selected in the NFL draft. Estimates of the impact of participation in more elite college football program range from 0.003-0.044 percent. Thus, my preferred quality measure is a towards the median of all the quality measure estimates, what I consider a conservative estimate of the return to an elite sports program regarding job placement.

4.3 Job Placement Effect Heterogeneity by Position Group

Similar to many other sports, athletic performance in American Football is measured differently for different position groups. There is substantial variation in how performance is measured as well as the types of measures available for different position groups. There are three positions groups where performance is easiest and most transparent to measure. These positions are quarterback, running backs, and wide receivers, collectively known as "offensive skill positions." As these position groups are those most likely to score offensive points during a football game. Generally, speaking points are scored by advancing the ball forward as measured by positive yards gained. I investigate whether the returns to elite sports programs are homogeneous across position groups or heterogeneous by position type.

Table 5 presents position-specific returns to elite sports programs, focusing on quarter-

backs (QB), running backs (RB), and wide receivers (WR). The analysis assesses the impact of various factors on the performance of college football players in these positions. The results indicate that college team quality, measured by the Simple Rating System (SRS), has a statistically significant positive effect on the performance of QBs and RBs, with coefficients of 0.018 and 0.020, respectively. For WRs, the effect of college team quality is slightly higher, with a coefficient of 0.025. This suggests that playing for a high-quality college team positively influences the subsequent likelihood of a professional athlete career.

Similar to the main results, I investigate the influence of high school athletic ability and the number of top recruits in the player's cohort on the outcome of being selected to become a professional athlete. High school athletic ability has a statistically significant impact on RB performance, with a coefficient of 0.088, indicating that more athletically gifted high school RBs tend to perform better in college and become professional athletes. The number of top recruits in the cohort, however, does not appear to have a significant effect on any of the three positions. Overall, this table provides insight the returns to elite sports program for different position groups, such that there is sufficient evidence to reject the hypothesis of homogeneous returns across position groups. The returns are position specific with the impact of college program quality being most advantageous for WRs with a 38% increase in mean likelihood of being drafted. RBs and QBs having 33% and 37% increases in mean likelihood with a one standard deviation increase in college program quality.

4.4 The Effect of Elite Sports Programs on NFL Labor Market Outcomes

Table 6 presents the monetary returns to elite sports programs, focusing on various financial aspects of college football players' professional careers, including log average earnings, log career earnings, max contract length, and max years in the league.

The results indicate that college quality (SRS) has a negative effect on log average earnings, log career earnings, and max contract length, but with coefficient values that are not

statistically significant. This suggests that players from higher-quality college programs tend to have similar average and career earnings as well as similar maximum contract lengths to their lower-quality college program peers. On the other hand, high school athletic ability has a positive impact on log average earnings and log career earnings, indicating that more athletically gifted high school players tend to earn more throughout their careers. However, it does not significantly affect max contract length or max years in the league.

Interestingly, the number of top recruit peers has a positive effect on max contract length, suggesting that players who come from high school cohorts with more top recruits tend to secure longer contracts in the NFL. However, it does not significantly influence other monetary outcomes I examine the effect of a more elite college sports program on the career length of NFL athletes. Professional athletes' career earnings are largely a function of the total number of games and seasons an athlete competes in at the professional level. With the same model specifications as in the previous sections we find that for a 1 standard deviation increase in college team quality decreases the total career length of a professional athlete by -0.257 years on average and conditional on being drafted. Considering the average career length of a professional NFL player is 4.06 years. The effect of college team quality can be interpreted as a 6.3% reduction in career length It is not intuitive, however, why attending a more competitive college program would be associated with shorter careers on average. More research is needed to address this question adequately. One plausible hypothesis is that career length as an American Football player is a partly driven by being healthy enough to compete professionally. Injuries are a major part of the game and many retirement decisions come from resulting injuries. If more competitive college programs are associated with more injuries early in the athlete careers of student athletes, it could explain this phenomenon. As injury status in a variable currently unavailable in my data set this hypothesis is unable to be falsified in this current study.

4.5 Income Distribution by & Transition Paths by College Program Quality Tier

I have shown evidence that the return to elite sports programs is transitory and does not persist throughout the entire length of a professional athlete's career. I augment these finding with further analysis of the earnings distribution and career transition path with heterogeneity by the college program quality ranking of an individual athlete. Using the same college quality measure for all previous results, I group college programs into quintiles called "Tiers" with Tier 1 presenting the top quintile and Tier 5 representing the bottom quintile. I then investigate all the previous NFL labor market outcomes categorized by the college program Tiers of each professional athlete.

Figure 5 is a refinement of Figure 4, but with heterogeneity by an athletes' college program quality Tier. Striking we see that there is little to no variation in the earnings distribution between athletes from top-programs versus bottom-programs. This similarity in the earnings distribution is persistent for athletes at different stages in their professional careers with each panel in the figure representing a different stage of an NFL career. Figure 5 demonstrates that the earnings distributions are almost identical and overlapping regardless of college program quality tier.

Figure 7 is a refinement of Figure 6 augmented with heterogeneity in athletes' college program quality tiers. Similar to Figure 5 the conditional transition path is extremely similar for Top-program or Tier 1 athletes to Bottom-program, Tier 5 athletes. There is no significant deviation in conditional transition paths. This demonstrates that top-tier athletes are equally likely to lose an active roster position in the subsequent year as bottom-tier athletes.

Both these figures provide supporting evidence that the return to an elite sports program is a transitory short run effect of increasing the likelihood of getting into the NFL. But conditional on being an professional athlete, athletes from top and bottom tier programs have equal propensity for successful labor market outcomes.

5 Conclusion

The results of this study shed light on the significant impact of participating in elite college sports programs on job placement for professional athletes in the NFL. The analysis reveals that college team quality, as measured by the Simple Rating System (SRS), has a positive effect on the likelihood of being selected in the NFL draft. A one standard deviation increase in college team quality increases the likelihood of being drafted by 32% of the mean. Additionally, the returns to elite sports programs are found to be position-specific, with wide receivers benefiting the most, followed closely by running backs and quarterbacks. However, these returns are transitory, as they do not persist throughout an athlete's entire career. There is little variation in earnings distribution and transition paths between athletes from top-tier and bottom-tier college programs, indicating that college program quality does not significantly influence long-term career earnings or stability in the NFL labor market. These findings emphasize the short-term advantages of elite sports programs in terms of job placement but highlight the dynamic and competitive nature of professional athletic careers in the NFL.

References

Anderson, Michael L. 2012. "The Benefits of College Athletic Success: An Application of the Propensity Score Design with Instrumental Variables. NBER Working Paper No. 18196." National Bureau of Economic Research. Publication Title: National Bureau of Economic Research ERIC Number: ED533309.

Arteaga, Carolina. 2018. "The effect of human capital on earnings: Evidence from a reform at Colombia's top university." *Journal of Public Economics*, 157: 212–225.

Barrera-Osorio, Felipe, and Hernando Bayona-Rodríguez. 2019. "Signaling or better human capital: Evidence from Colombia." *Economics of Education Review*, 70: 20–34.

bcsguestwriter. 2012. "Top-50 Largest Athletics Department Spenders."

Berg Dale, Stacy, and Alan B. Krueger. 1999. "Estimating the Payoff to Attending a More Selective College: An Application of Selection on Observables and Unobservables."

Bordón, Paola, and Breno Braga. 2020. "Employer learning, statistical discrimination and university prestige." *Economics of Education Review*, 77: 101995.

Brewer, Dominic J., Eric R. Eide, and Ronald G. Ehrenberg. 1999. "Does It Pay to Attend an Elite Private College? Cross-Cohort Evidence on the Effects of College Type on Earnings." *The Journal of Human Resources*, 34(1): 104–123. Publisher: [University of Wisconsin Press, Board of Regents of the University of Wisconsin System].

Case, Anne, Angela Fertig, and Christina Paxson. n.d.. "The lasting impact of childhood health and circumstance." 24(2): 365–389.

Chen, Weiwei, Wayne A. Grove, and Andrew Hussey. 2013. "The Payoff to School Selectivity: An Application of Dale and Krueger's Method to MBA Programs."

College Athletics Spending And The Movement Towards Revenue Sharing. 2021. Archive Location: World Last Modified: 2022-02-10T01:56:22-07:00 Publisher: https://athleticdirectoru.com/ Section: Articles.

Conti, Gabriella, and James J Heckman. n.d.. "Understanding the Early Origins of the Education–Health Gradient." 5(5): 585–605.

Dale, Stacy, and Alan B. Krueger. 2011*a*. "Estimating the Return to College Selectivity over the Career Using Administrative Earnings Data."

Dale, Stacy, and Alan Krueger. 2011*b*. "Estimating the Return to College Selectivity over the Career Using Administrative Earnings Data." National Bureau of Economic Research w17159, Cambridge, MA.

Dale, Stacy B., and Alan B. Krueger. 2014. "Estimating the Effects of College Characteristics over the Career Using Administrative Earnings Data." *The Journal of Human Resources*, 49(2): 323–358. Publisher: [University of Wisconsin Press, Board of Regents of the University of Wisconsin System].

Dale, Stacy Berg, and Alan B. Krueger. 2002. "Estimating the Payoff to Attending a More Selective College: An Application of Selection on Observables and Unobservables." *The Quarterly Journal of Economics*, 117(4): 1491–1527. Publisher: Oxford University Press.

Desrochers, Donna M. n.d.. "Academic Spending Versus Athletic Spending: Who Wins?" 16.

Dickson, Matt, and Colm Harmon. 2011. "Economic returns to education: What We Know, What We Don't Know, and Where We Are Going—Some brief pointers." *Economics of Education Review*, 30(6): 1118–1122.

Huntington-Klein, Nick. 2021. "Human capital versus signaling is empirically unresolvable." *Empirical Economics*, 60(5): 2499–2531.

Mabel, Zachary, C. J. Libassi, and Michael Hurwitz. 2020. "The value of using early-career earnings data in the College Scorecard to guide college choices." *Economics of Education Review*, 75: 101958.

Massey, Cade, and Richard H. Thaler. 2013. "The Loser's Curse: Decision Making and Market Efficiency in the National Football League Draft." *Management Science*, 59(7): 1479–1495. Publisher: INFORMS.

Staff, Sportico. 2021. "Sportico's Intercollegiate Finance Database."

Weiss, Andrew. 1995. "Human Capital vs. Signalling Explanations of Wages." *Journal of Economic Perspectives*, 9(4): 133–154.

Zimmerman, Seth D. 2019. "Elite Colleges and Upward Mobility to Top Jobs and Top Incomes." *American Economic Review*, 109(1): 1–47.

Figures and Tables

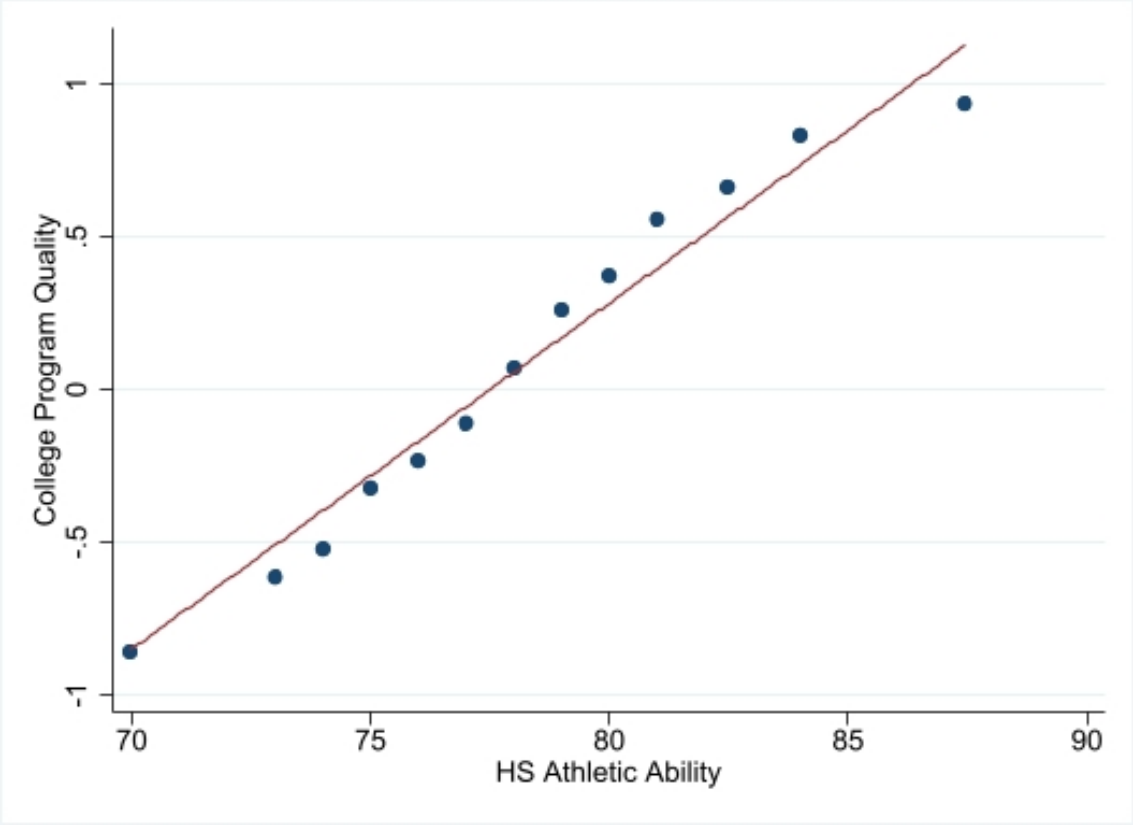

Figure 1: Selection into College Football Programs by ESPN 300 HS Athletes

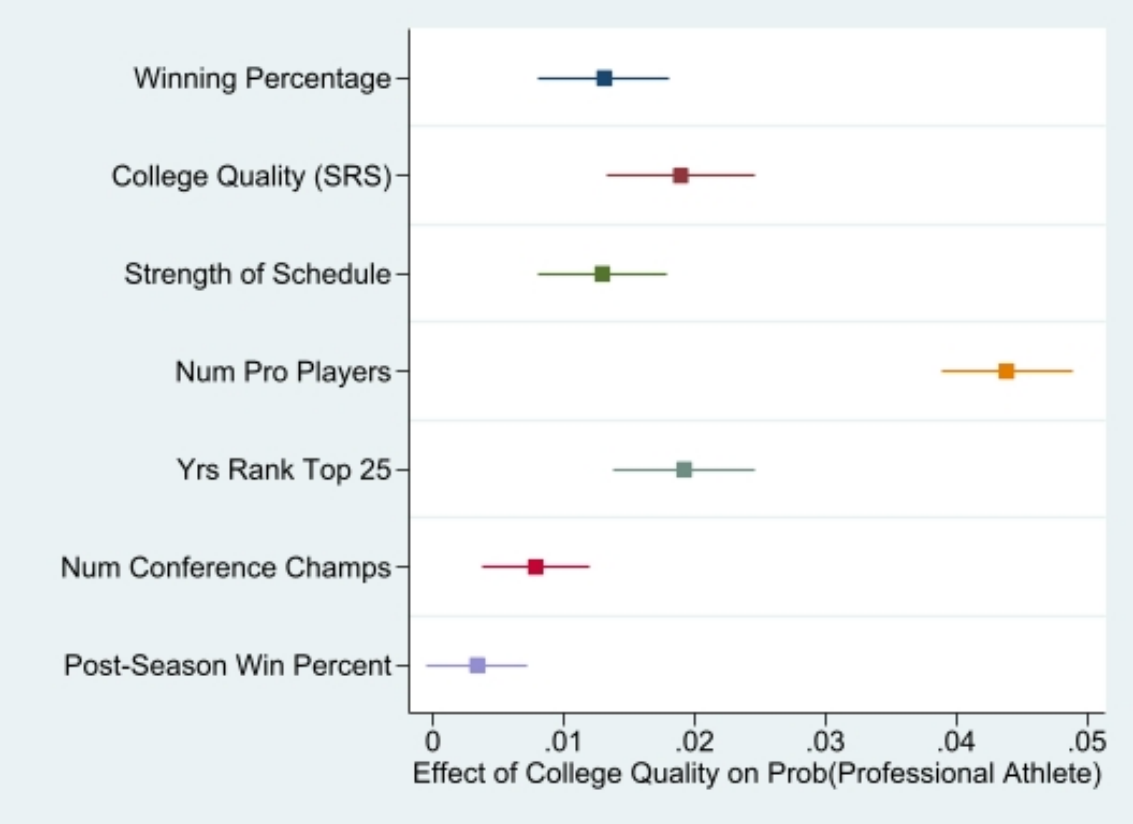

Figure 2: Sensitivity Analysis - College Program Quality Measures

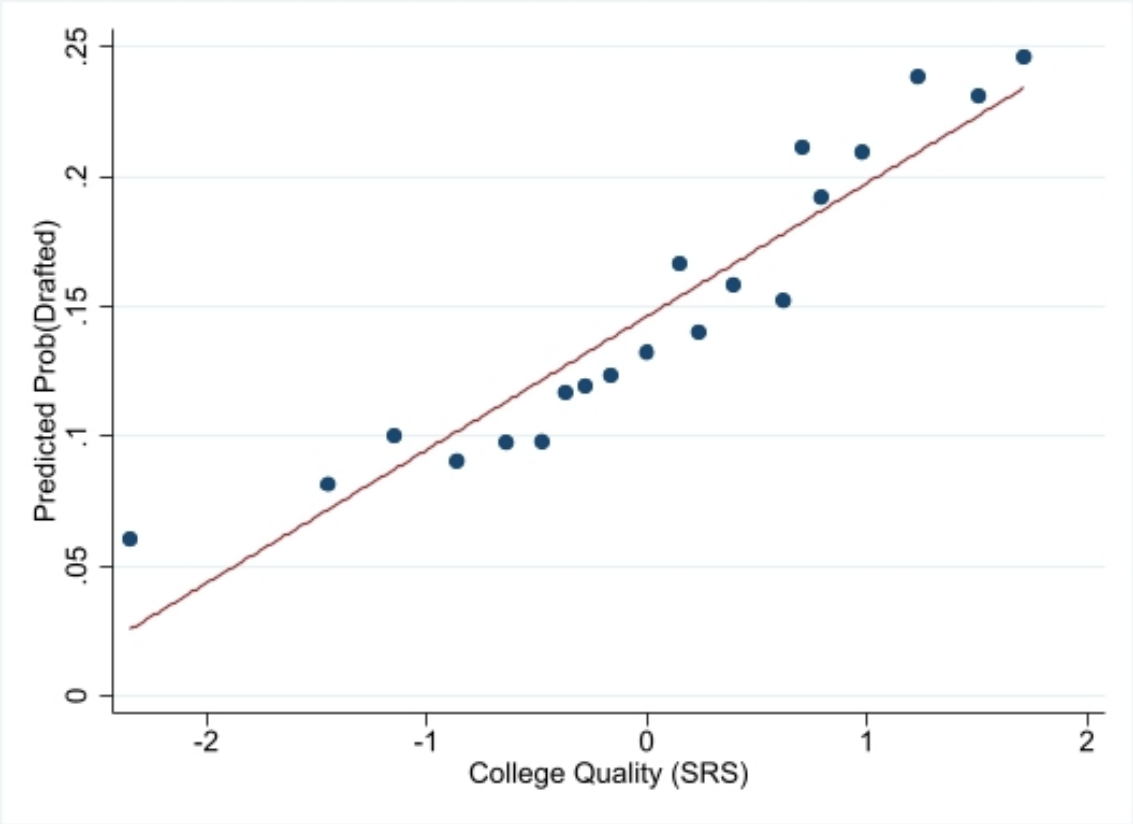

Figure 3: Predicted Probability of Selected in NFL Draft by College Quality

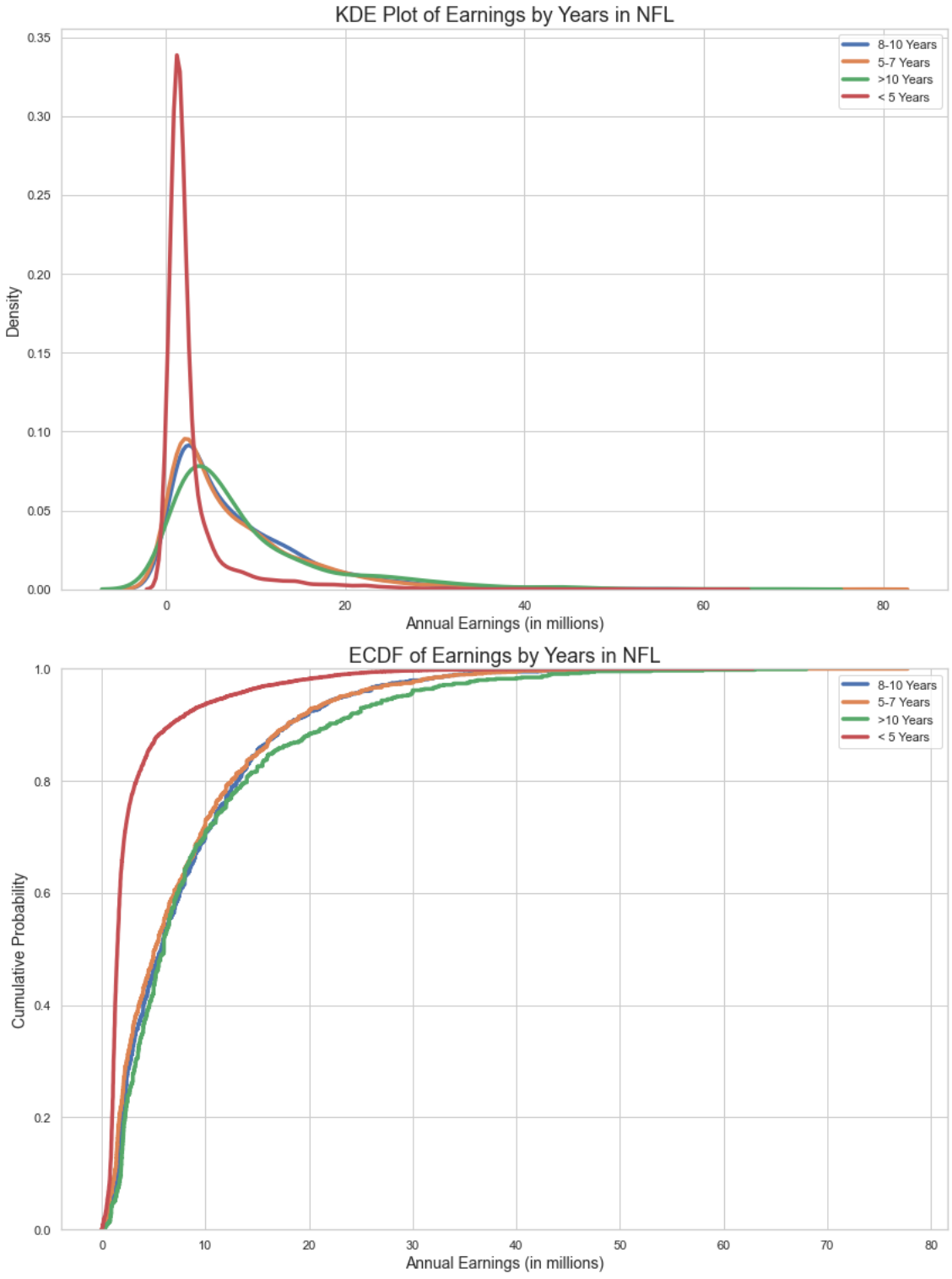

Figure 4: Kernel Density Estimate & Empirical CDF Earnings by NFL Career Length

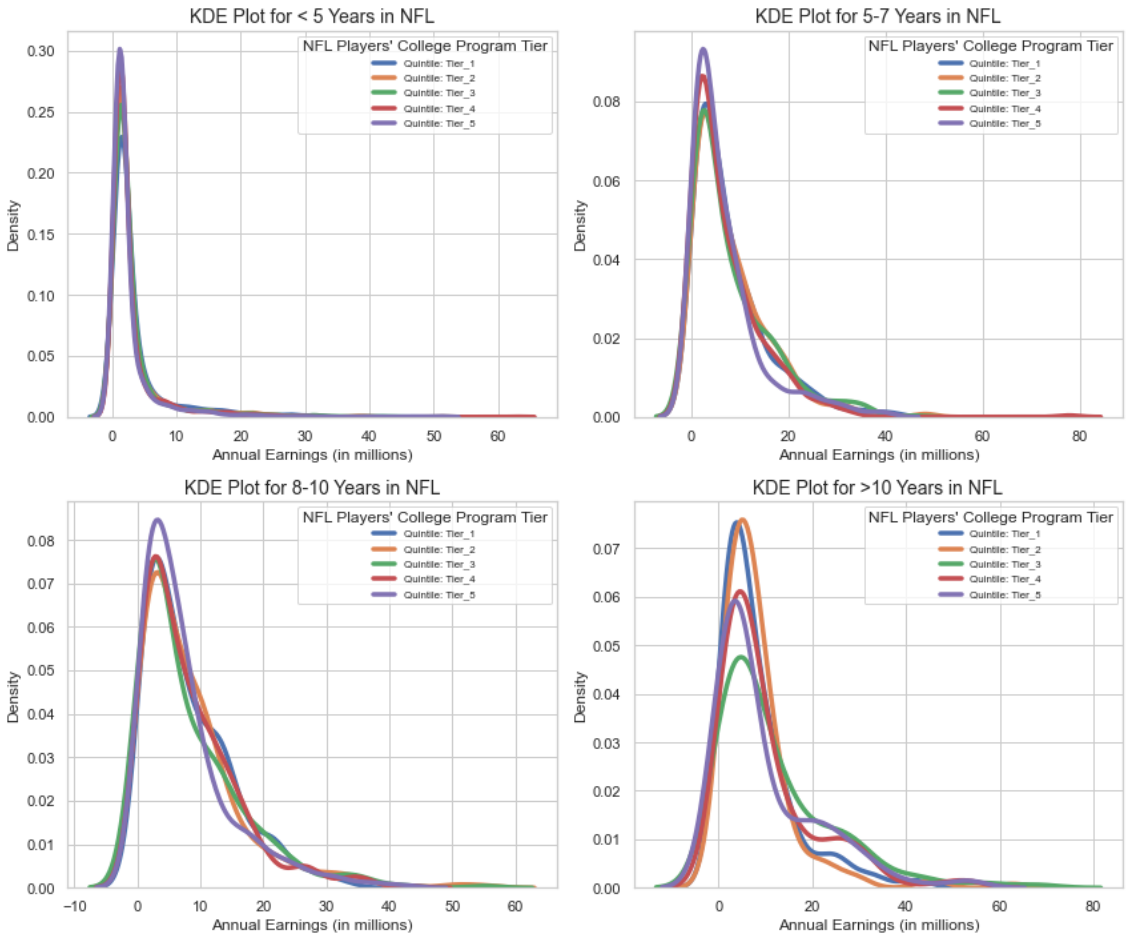

Figure 5: Kernel Density Estimate Earnings by NFL Career Length & College Tier

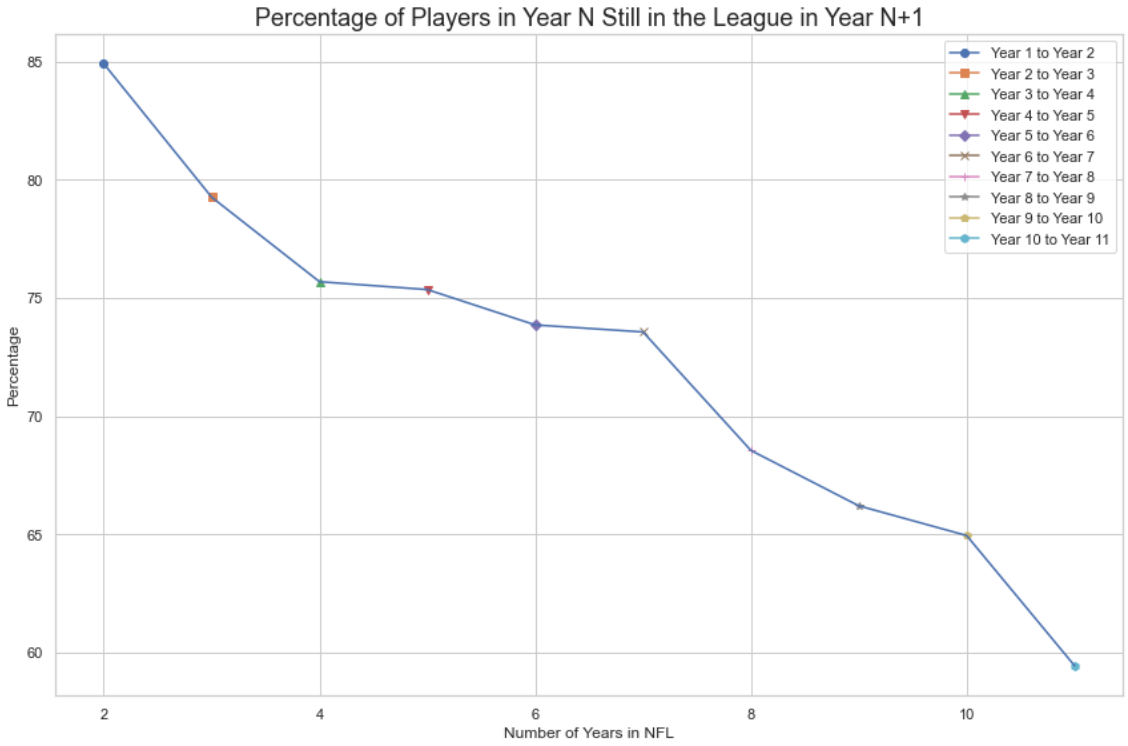

Figure 6: Conditional Transition Plot by NFL Career Length

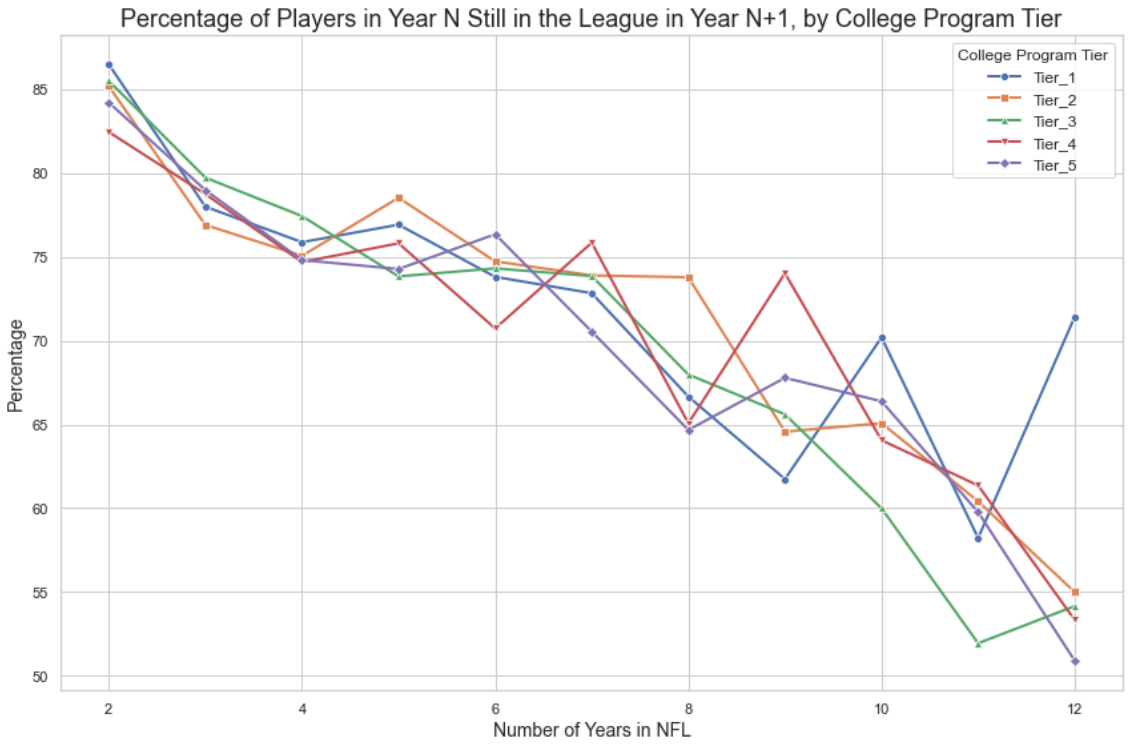

Figure 7: Conditional Transition Plot by NFL Career Length & College Tier

High School Athlete Characteristics	Mean	Std. dev	Min	Max
ESPN 300 HS Rank	46.42	28.69	1	100
ESPN 300 HS Athlete Grade	77.03	4.49	44	95
HS Graduation Year	2014	4.84	2006	2022
Total Scholarship Offers	8.67	7	1	89
Height	73.95	2.46	65	82
Weight	221.74	43.5	43	396
Num Top Recruit Peers	12.08	8.05	0	30
Accepted Scholarship Offer	0.90	0.29	0	1
Selected in NFL Draft	0.06	0.24	0	1

Table 1: Summary Statistics ESPN 300 HS Athletes

College Football Program Characteristics	Mean	Std. dev	Min	Max
College Team Start Year	1912.74	20.94	1869	1975
Number of Years	106.67	21.18	19	133
Total Games Played	1127.53	201.67	218	1356
Wins	638.15	170.72	105	961
Loss	451.07	107.66	82	675
Win/Loss Percentage	0.58	0.09	0.348	0.764
Simple Rating System	5.35	5.46	-13.41	14.73
Strength of Schedule	2.35	3.06	-7.75	6.21
Years Ranked in Top 25	24.44	17.30	0	62
Conference Championships	13.84	11.27	0	49

Table 2: Summary Statistics College Football Program Characteristics

Selected in NFL Draft	(1) **College Quality**	(2) **HS Ability + College Quality**	(3) **HS Ability + Peers + College Quality**	(4) **Scholarship Offer sets**
College Team Quality (SRS)	0.043***	0.027***	0.024***	0.018***
	(0.00)	(0.00)	(0.00)	(0.00)
HS Athletic Ability		0.026***	0.025***	0.028***
		(0.00)	(0.00)	(0.00)
Num Top Recruits in Cohort			0.007**	0.007**
			(0.00)	(0.00)
Athlete Controls (Height, Weight)	✓	✓	✓	✓
Scholarship Offerset Controls				✓
Constant	0.072	0.069	0.067	0.056
	(0.00)	(0.00)	(0.00)	(0.00)
R^2	0.058	0.077	0.078	0.088
N	20,260	20,260	20,260	20,260

Standard errors in parentheses

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

Table 3: Returns to Elite Sports Programs

	College Quality Measure Coefficient	Std. Error	R^2
Winning Percentage	0.013***	(0.00)	0.043
Simple Rating System	0.019***	(0.00)	0.043
Strength of Schedule	0.013***	(0.00)	0.043
Num Pro Players	0.044***	(0.00)	0.054
Years Rank Top 25	0.019***	(0.00)	0.044
Num Conference Champs	0.008***	(0.00)	0.042
Post-Season Win Percent	0.003*	(0.00)	0.041

Standard errors in parentheses

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

Table 4: Sensitivity Analysis - Alternative Measures of College Program Quality

	(1) Quarterbacks (QB)	(2) Running Backs (RB)	(3) Wide Receivers (WR)
College Team Quality (SRS)	0.018***	0.020**	0.025**
	(0.01)	(0.01)	(0.01)
HS Athletic Ability	0.014	0.088***	0.043
	(0.01)	(0.02)	(0.03)
Num Top Recruits in Cohort	-0.016	0.015	0.002
	(0.01)	(0.01)	(0.01)
Athlete Controls (Height, Weight)	✓	✓	✓
Scholarship Offerset Controls	✓	✓	✓
Constant	0.047	0.059	0.065
	(0.02)	(0.02)	(0.04)
R^2	0.118	0.098	0.070
N	1,752	1,508	1,593

Standard errors in parentheses

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

Table 5: Position Specific Returns to Elite Sports Programs

	(1) Log Ave Earnings	(2) Log Career Earnings	(3) Max Contract Length	(4) Max Years in League
College Quality (SRS)	-0.015	-0.068	-0.038	-0.257**
	(0.04)	(0.06)	(0.03)	(0.11)
HS Ability	0.101***	0.115*	-0.013	-0.146
	(0.04)	(0.06)	(0.03)	(0.11)
Num Top Recruit Peers	0.008	0.013	0.048**	-0.011
	(0.03)	(0.04)	(0.02)	(0.08)
Athlete Controls (Height, Weight)	✓	✓	✓	✓
Scholarship Offerset Controls	✓	✓	✓	✓
Constant	14.66	15.41	3.93	4.06
	(0.09)	(0.14)	(0.07)	(0.26)
R^2	0.02	0.01	0.01	0.05
N	1722	1703	1722	1722

Standard errors in parentheses

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

Table 6: Monetary Returns to Elite Sports Programs

	Annual Earnings ($ Millions)	Career Earnings ($ Millions)	Max Contract Length (Yrs)	Num Years in League	Obs Count
Tier 5	4.29	12.01	3.22	4.56	3,048
Tier 4	4.56	13.81	3.34	4.58	3,095
Tier 3	5.01	15.09	3.33	4.53	2,994
Tier 2	4.85	14.77	3.29	4.63	3,023
Tier 1	5.06	15.37	3.44	4.53	2,993

Table 7: NFL Labor Market Summary Statistics by Player College Program Tier

	Year	Draft Year	Draft Round	Max Contract Length	Career Earnings	Annual Earnings	Career Length
Count	14946	14946	14946	14946	14946	14946	14946
Mean	2016.5	2012.88	3.58	3.33	14.23	4.71	4.63
Std	3.5	4.77	1.98	1.36	24.55	6.41	3.20
Min	2011.0	1996.00	1.00	1.00	0.00	0.00	1.00
25%	2013.0	2010.00	2.00	2.00	1.62	1.20	2.00
50%	2017.0	2013.00	3.00	4.00	4.38	1.93	4.00
75%	2020.0	2016.00	5.00	4.00	16.44	5.38	7.00
Max	2023.0	2022.00	7.00	10.00	332.96	77.75	23.00

Table 8: NFL Labor Market Summary Statistics

	Proportion NFL Player Cohorts Over Time											
Draft Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2011	1.00	0.94	0.80	0.67	0.52	0.44	0.39	0.31	0.26	0.21	0.15	0.10
2012	-	1.00	0.89	0.81	0.68	0.57	0.50	0.42	0.32	0.29	0.21	0.14
2013	-	-	1.00	0.95	0.86	0.73	0.63	0.49	0.42	0.35	0.27	0.17
2014	-	-	-	1.00	0.89	0.82	0.71	0.61	0.50	0.37	0.32	0.21
2015	-	-	-	-	1.00	0.92	0.82	0.71	0.63	0.53	0.47	0.36
2016	-	-	-	-	-	1.00	0.94	0.83	0.72	0.61	0.57	0.47
2017	-	-	-	-	-	-	1.00	0.91	0.80	0.70	0.65	0.54
2018	-	-	-	-	-	-	-	1.00	0.92	0.85	0.79	0.66
2019	-	-	-	-	-	-	-	-	1.00	0.88	0.80	0.66
2020	-	-	-	-	-	-	-	-	-	1.00	0.94	0.78
2021	-	-	-	-	-	-	-	-	-	-	1.00	0.89
2022	-	-	-	-	-	-	-	-	-	-	-	1.00

Table 9: NFL Transition Probability Matrix by Draft Year