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Evaluating National Football League draft choices: The passing game

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Abstract

Recruiting competent personnel is crucial for the success of any organization, and especially in competitive sports, where the success of a team depends upon the quality of the players selected. This paper examines whether football executives are able to forecast who the most successful quarterbacks and wide receivers will be. Our data base is constructed from the NFL drafts between 1974 and 2005. We use a range of measures to determine the success of the players selected in the drafts, and conclude that, although their ability to rank the future performances of players is less than perfect, football executives are very successful at evaluating the talents of athletes. However, there was no evidence that teams which were more successful than others in drafting quarterbacks and wide receivers had a better overall success, as measured by their win-loss records.

Keywords: Sports forecasts; Personnel forecasts; National football league; Sports economics

"Without question, one of the primary factors affecting success in the National Football League is having talented players... [T]he most important step in securing the players a team needs is evaluating the available talent pool..."

Bill Walsh (Walsh, Billick, & Peterson, 1997, p. 113)

1. Introduction

Forecasting how personnel will perform is important to all organizations. It is especially important in professional sports, where a team's success depends on the talents of its players. The opening quote by Bill Walsh, a coach and later executive for the San Francisco 49ers, underscores this point. In this paper, we examine whether football executives have the ability to accurately forecast which players will have successful careers in the NFL. Our analysis focuses on one particular component of a professional football team's performance: the offensive passing game involving quarterbacks and wide receivers. This is obviously an important aspect of a NFL team's overall performance. Moreover, there are anecdotal statements that question whether NFL executives have the ability to evaluate the intrinsic talent of quarterbacks and wide receivers when they enter the NFL draft. Commentators note that Joe Montana was drafted only in

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the third round in 1979, later than three other quarterbacks, all of whom had less successful careers than he did. Other quarterbacks (such as Warren Moon and David Krieg) had very successful careers in the NFL but were not even selected in the draft. As for wide receivers, Jerry Rice, considered to be the best who has ever played, was the third wide receiver chosen in 1985. Terrell Owens, who ranks fifth in the all-time receiving yardage, was not drafted until the third round, when 11 wide receivers had already been selected.

Numerous management and labor issues have been covered in the literature on professional football. These include principal-agent problems (Atkinson, Stanley, & Tschirhart, 1988), compensation systems (Bishop, Finch, & Formby, 1990), union member behavior (Gramm & Schnell, 1994), managerial efficiency and tenure (Scully, 1994), and contract negotiation strategies (Conlin, 2002). Hendricks, DeBrock, and Koenker (2003) use NFL draft information to test hypotheses regarding uncertainty and hiring processes. Massey and Thaler (2005) conclude that the NFL draft choices are economically inefficient, in that managers overvalue early draft choices relative to later draft choices. The economic surplus of draft choices, measured as the difference between the projected economic value of players and their compensation costs, is maximized in the second round of the draft.

Hendricks et al. and Massey and Thaler examine players drafted for all positions taken together. The work most closely related to ours is that of Berri and Simmons (unpublished manuscript) for quarterbacks and Johnson and Rafferty (unpublished manuscript) for wide receivers. Much of Berri and Simmons' analysis uses data on quarterbacks' performances during seasons in which they have at least 100 plays. Holding years of experience constant, they find little correlation between the performance measures and draft rank in these data (cf. Table 3 of their paper). They conclude that any associations between the draft rank and aggregate performance, such as the total number of games played or the number of passes, must be explained by the fact that quarterbacks who are drafted earlier have more plays. They also find that the physical characteristics of a player (such as his body mass index, height, and time in the 40 yard dash) and his intelligence score (as measured by the Wonderlic test) predict the players' draft ranks, but are not as good at predicting their professional performance in their first four years of professional play as variables summarizing their college performance. Johnson and Rafferty examine the first five years of the careers of wide receivers who were drafted between 1988 and 2003. They find that the draft rank and scouts' ratings published in the *Professional Football Weekly* both play a role in forecasting players' performances, but that, controlling for these variables, a player's physical characteristics are generally statistically insignificantly related to performance. An exception is that a wide receiver's body mass index is positively related to the probability that he will be selected for the Pro Bowl.

In this paper, we use data on quarterbacks and wide receivers drafted by the NFL between 1974 and 2005. In contrast to the papers by Berri and Simmons for quarterbacks and Johnson and Rafferty for wide receivers, we focus on the *career* performance of players. In choosing draft picks, a manager is interested not only in the average performance per play or per season but also in the number of seasons the individual will play for the team, or his later value to a team to which he might be traded. Moreover, quarterbacks with a least 100 plays per season or wide receivers who lasted at least five years in the NFL are (almost) by definition successful players. Life tables based on our data indicate that only 19% of wide receivers and 24% of quarterbacks drafted in the third round or later play for at least five years. Part of a manager's forecasting skill is in identifying those players who will (or will not) fall into these successful groups.

We first describe the draft system and our data set and performance measures. The next two sections present our methods of analysis and summarize our empirical findings with regard to associations between draft rank and performance. We then examine the frequency with which football executives (1) fail to draft players who turn out to be successful, or (2) use early round picks for players who turn out to be unsuccessful. We also explore whether some teams are more successful at drafting than others. The last section presents our conclusions.

2. The draft: The talent pool

The draft is a method of allocating individuals who have not previously played in the NFL to the various teams in the league. The new players are, almost

without exception, men who have played football in college. Players who are "drafted" may only play for the team which selected them, unless the selecting team relinquishes or trades its right to the player. If a particular player is overlooked in the draft and is not selected by any team, that individual is considered to be a free agent, and can negotiate with, and play for, any team in the league.

Teams select their future players in a predetermined order based on the previous year's performances. The team with the worst record in the previous year makes the first selection, followed by teams in ascending order of their previous year's record. After the team with the best record has chosen its player, the first round of the draft is completed. This process is then repeated through the n rounds of each year's draft. While teams are free to choose players at any position, it is presumed that players who are chosen earlier have more potential than players who perform at the same position but are chosen in the later rounds of the draft.

There are numerous sources of information which can be used to assess the talents of players. Scouts watch college football games or study films of the games, college coaches provide assessments, and team combines administer physical and mental tests to invited athletes and provide opportunities for personal interviews. Finally, the most talented athletes are "worked out" by NFL coaches on their own college campuses. If the executives can successfully use this information to evaluate players' abilities and forecast their future success rates, there should be a relationship between the order in which players are chosen in the draft and their subsequent performance in the NFL. Those chosen earlier in each year's draft should outperform those taken later in the same draft.

It is not possible, however, to evaluate the executives' judgments or forecasts by simply comparing a player's position in the draft with some measure of his subsequent performance. The reason for this is that the selectees all play different positions. In order to obtain meaningful results, one must compare drafted selectees who play the same position. Since we are concerned with the offensive passing game, we do not evaluate the entire draft, but concentrate on individuals who play in two skill positions: quarterback and wide receiver. Because there are widely accepted measures of performance for these positions, we can determine whether there is a relationship between the order in which players are selected and their subsequent performances.

3. Data and performance measures

3.1. Data

The source of our data is a website: Pro-football-references.com. This website includes comprehensive statistics on the performance of every player who has ever been involved in an NFL game up until 2008. It also provides full information about each year's draft, i.e. the round in which each player was chosen, as well as the sequence in which players were taken. Our analysis is based on the drafts from 1974 to 2005. Although the website also includes data for the 2006–2008 drafts, they are not included here because there is not sufficient information about these players to analyze their lifetime performances. By ending with the 2005 draft, at least four years' performance data on each player are available.

Over this period, the number of rounds in the draft was not constant. In 1974–76 there were 17 rounds; this was reduced to 12 rounds from 1977 to 1992, 8 rounds in 1993, and only 7 rounds in subsequent years. In addition, the number of teams increased from 26 in 1974 to 32 in 2005, so that the number of players selected per round also changed. In order to provide a comparable set of data over time, we group players by the number at which they were selected. All players selected as one of the top thirty players in a draft year are designated Round 1. Players who were the 31st through 60th selections in each draft were grouped together, and are referred to as Round 2 picks. This process of creating groups continued until the 210th position was reached. All players selected later than position 210 were grouped together and designated as Round 8.[1] In the remainder of this paper, the word "round" will refer to these groupings.

Except for the actual number of rounds, the structure of the draft has not changed over the period that we are examining. However, there have been changes

[1] What we have called Round 8 differs from the conventional usage, because our Round 8 encompasses players taken from the eighth round in one particular year to as high as the 17th draft round in other years.

in the way the NFL is organized and the league's relationship with its players. The most important changes are related to the beginning of free agency in 1993 and the introduction of the salary cap in 1994. However, these changes do not have a material effect on the order of the draft, and also should not affect any of the performance measures, because the minimum league salary of a veteran player who goes to a new team has virtually no impact on the team's salary cap.

3.2. Performance measures

Quarterbacks

We use three indicators to measure a quarterback's performance: (1) the number of years played, (2) the number of passes thrown, and (3) the quarterback rating. The length of a quarterback's career measures how long coaches thought that he had the ability to perform in the NFL.[2] It also reflects his durability. This measure has the advantage that it is independent of the talents of the players surrounding the quarterback and of the offensive style of his team. For example, a quarterback on a run-oriented team will throw fewer passes than if he plays for a team without a good running back.

We examined two measures of years played. The first counts the number of years in which the quarterback actually participated in a team's offense and threw one or more passes. The second counts all of the years for which the player was in the league — from the date of the draft to the player's last appearance. The second includes time preparing to be successful while on a team's taxi squad, years spent on injured reserve, whether actually injured or not, and years when he was a backup quarterback at the end of his career but did not appear in a game. Our results are not sensitive to the choice of measure. Consequently, in this paper we only present results for the first measure. Tables for the other measure are available on request.

The number of passes thrown measures the contribution of a quarterback to the team, and distinguishes quarterbacks who are starters from those who are back-ups.[3] Finally, the quarterback rating (QR) was devised by a special study committee of the NFL in the 1970s and has been used to assess the performances of passers ever since. The QR is positively related to the number of completions, yards gained per attempt, and touchdowns per attempt, and inversely related to the number of interceptions per attempt (Carroll, 1986). We have set the QR equal to zero for quarterbacks who threw no passes. Because the QR is a measure of the efficiency of a quarterback's passes, it is possible for the QR to be high and the number of passes thrown to be low.[4]

Wide receivers

For wide receivers, we measure performance by (1) the number of years in the league, and (2) total yards of receptions. We examined two measures of years played: (1) the number in which he was an active receiver, and (2) the number in which he was in the league. The first measures the receiver's ability to perform at high levels over a long period of time as a starter. The second also includes years spent as a backup third or fourth receiver or as a return specialist on special teams. As in the quarterback analysis, in this paper we only report results for the first measure, since the results for the two measures are very similar. The total yards of reception reflects the offensive contribution of a wide receiver to the team(s) for which he plays, and distinguishes players who are starters from those who are back-ups.

4. Methodology for evaluating performance and draft position

We use a number of different approaches for evaluating the relationship between the draft position of a player and his subsequent performance. The comparisons are performed separately for quarterbacks and wide receivers.

[2] Number of years played is one of the measures of a player's success used by Hendricks et al. (2003).

[3] Passing yards is another potential measure. We found that the correlation between the number of passes thrown and passing yards was 0.998. We therefore only present our results for the number of passes.

[4] Six quarterbacks, only one of whom had more than 30 passes, had quarterback ratings exceeding that of Peyton Manning (QR = 94.7), who had the highest QR among players with more than 50 passes.

4.1. Individual draft years

We first focus on each draft year (1974–2005), and examine the relationship between the draft position of an individual quarterback (wide receiver) relative to other quarterbacks (wide receivers) and their subsequent performances.

The hypothesis is that there is a relationship between: (1) the order in which a player was drafted relative to others at the same position, and (2) their relative successes. The Spearman rank order correlation coefficient is used to test this hypothesis. If football executives were able to correctly forecast relative future success rates, then players selected earlier should be the most successful, and the Spearman coefficient should be negative and significant. If the Spearman coefficient is negative and significant, we are implicitly rejecting the hypothesis that the ability of the executives is inferior to selecting the quarterbacks and wide receivers randomly. As a minimum, the executives' performances should exceed this benchmark or standard of comparison. It would have been preferable to compare the executives' performances with those of knowledgeable sports analysts; however, such data were not available.

4.2. Pooling across all draft years

In using the Spearman Rank correlation for *each individual year*, we are evaluating executives' abilities to choose among those available in that particular draft for a particular position. In arranging players by the order of their selection only, we are ignoring the *overall position* of the player chosen. Two quarterbacks ranked as the numbers 1 and 2 overall choices in a specific draft – not just among quarterbacks – would receive the same order as the first two quarterbacks who were the 50th and 55th overall selectees. However, players who are chosen earlier are considered to have more potential than those chosen later. If executives choose wisely, then one would expect that players chosen in the early rounds of the draft would be likely to perform at higher levels than those selected in the later rounds.

To examine this hypothesis, we pooled the data from all of the draft years. Although the use of pooled data permits us to compare the performance measures across draft rounds, there is a complication: not all players had completed their careers by 2008. Of the players in our sample, 12% of the quarterbacks and 10% of the wide receivers were still active in 2008. The percentage of players still active is correlated with the round in which they were drafted. Among quarterbacks, 25% of first round choices (i.e., those chosen as picks 1–30) were still playing, compared to only 4% of eighth round picks (i.e., those taken later than 210).[5] As a result, a simple comparison of (say) the average number of years played by round picked would yield biased results by understating the performance difference. Since few quarterbacks drafted in the eighth round were still playing in 2008, a simple average of the number of years played approximates the completed career length for this group. However, since more than 25% of first round quarterbacks were still active in 2008, the actual average number of years played by this group as of 2008 is an underestimate of the number of years that they will play on average over the *entire* length of their careers. More formally, the sample is censored. We adopt two statistical methods that appropriately control for this censoring: life tables and a regression analysis that controls for censoring.

To analyze the number of years played, we have constructed life tables by round that show the probability that a player taken in that round survives to play for at least T years (S_T). The life tables are based on the Kaplan-Meier (or product limit) methodology (Cleves, Gould, & Gutierrez, 2002, pp. 88–92; Kaplan & Meier, 1959). Players' careers contribute to the calculation of survival probabilities until the time at which they are censored. The Kaplan-Meier technique is described in the Appendix.

We also regressed the performance measures on the actual rank at which a player was drafted.[6] Because players taken in earlier draft rounds are more likely to be censored, ordinary least squares estimates yield biased estimates of the coefficients. We therefore estimated the relationships using a censored normal re-

[5] Among wide receivers, 24% of first round picks and only 1% of eighth round picks were still active in 2008.

[6] In the later years covered by this study, there were 32 teams and 32 draft choices per draft. Using our convention, a player selected in the number 31 or 32 position of the first actual draft round would be placed in our Round 2. Conversely, when there were (say) only 26 teams, a player selected as 27 in the actual second round would be classified as a Round 1 choice using our definitions.

gression (Greene, 1990, pp. 727–739; Stata Corporation, 2001, pp. 174–188). In addition, because simple functions of performance and position did not seem to capture the relationships between these variables adequately, we estimated regressions in which the performance was related to a piecewise linear function (spline) of the actual draft rank at which a player was selected. The knots of the spline correspond to the endpoints of the ranks used to define the rounds (e.g., the first linear segment corresponds to ranks 1–30), as used in the life tables. We also added a knot at 290, corresponding to the approximate median position of players drafted later than 210.

5. Results

5.1. Performance and draft rank by draft year

Quarterbacks

The distributions of the Spearman rank correlation coefficients between the performance measures and draft order for quarterbacks, together with their statistical significance levels, are presented in Table 1. With two exceptions, there is a negative relationship between the order in which players were selected and their subsequent performance. When the quarterback rating is used as the measure of performance, the null that there is no correlation between the two orderings is rejected at the 5% level of significance for 15 of the 32 drafts. When either of the other two statistics is used as the performance measure for quarterbacks, the null is rejected a much larger proportion of the time: 24 of the 32 drafts for years played and 22 of the 32 drafts for number of passes thrown.

There is an explanation for the finding that the Spearman coefficients based on the QR are lower than for the other quarterback measures on average and reject the null the smallest number of times. In some years, a number of quarterbacks chosen very late in the draft had relatively high QRs but threw very few passes over their careers and stayed in the league for only a few years.[7] When this occurred, the value of the Spearman statistic based on the QR measure was reduced relative to the statistic based on the other performance measures.

Finally, we examined whether there are trends in the association between draft order and performance by regressing the Spearman coefficients for each measure on time. There were no statistically significant coefficients of the time variable, indicating that ability to identify "good" players and correctly forecast their success has not changed over time.

Wide receivers

Spearman rank correlation coefficients for wide receivers for the two measures of success, years played and reception yards, are negative and statistically significantly different from zero at the 5% level for all years. We regressed the Spearman coefficients for each measure on time. The coefficient of time was negative and significantly different from zero at the 10% level in the yards equation. However, this result is driven by an outlier, a Spearman coefficient of –0.32 in 1985. If this observation is removed, then there is no evidence that the magnitudes of the Spearman coefficients have changed over time.

Overall, the magnitudes of the Spearman correlation coefficients and their levels of statistical significance suggest that executives can effectively forecast both the future performance of quarterbacks relative to each other and that of wide receivers relative to each other in a given year's cohort of players.[8] *However, their ability to do so is less than perfect.*

5.2. Do players taken in earlier rounds have greater success? Pooled data

Quarterbacks: Years played

We first examine life tables of quarterback careers by the round in which they were drafted, then present the results of the censored regression showing the relationship between years played and the *rank* at which the player was selected.

Table 2 contains life tables showing the relationship between the round in which a quarterback is drafted and the probability that he will still be playing T

[7] For example, Kerwin Bell was drafted in the 180th position in 1988. He played for one year and threw five passes. His quarterback rating of 158.3 was 35 points higher than the second highest QR in our entire sample.

[8] This result is consistent with Spurr's (2000) finding with respect to baseball drafts: the earlier a player is selected in the draft, the more likely he is to reach the major leagues.

Table 1
Distribution of Spearman rank order correlation coefficients between draft rank and performance for quarterbacks and wide receivers, 1974–2005.

A. Quarterbacks			
Sign and significance level	Years played	Rating	Passes
Positive, not significant at the 0.05 level	0	2	0
Negative, not significant at the 0.05 level	8	15	10
Negative, significant at the 0.05 level	24	15	22
Mean value of the coefficient	−0.56	−0.45	−0.60
B. Wide receivers			
Sign and significance level	Years played	Yards	
Negative, significant at the 0.05 level	32	32	
Mean value of the coefficient	−0.57	−0.60	

Table 2
Kaplan-Meier estimates of the proportion of quarterbacks surviving to play T years by round drafted.

	Round drafted							
Year (T)	1	2	3	4	5	6	7	8+
1	1.000	0.970	0.884	0.826	0.865	0.657	0.596	0.316
2	0.984	0.879	0.814	0.739	0.595	0.457	0.426	0.234
3	0.951	0.849	0.721	0.630	0.481	0.343	0.307	0.175
4	0.884	0.788	0.649	0.584	0.453	0.286	0.284	0.163
5	0.799	0.697	0.499	0.457	0.425	0.229	0.284	0.137
6	0.725	0.606	0.394	0.355	0.340	0.171	0.255	0.124
7	0.644	0.542	0.310	0.305	0.283	0.114	0.199	0.103
8	0.603	0.542	0.282	0.305	0.227	0.114	0.170	0.089
9	0.561	0.470	0.197	0.305	0.198	0.076	0.142	0.076
10	0.494	0.362	0.169	0.244	0.198	0.076	0.106	0.048
11	0.400	0.217	0.141	0.183	0.113	0.038	0.106	0.041
12	0.375	0.181	0.113	0.146	0.085	0.038	0.106	0.041
13	0.275	0.109	0.113	0.146	0.085	0.038	0.106	0.025
14	0.225	0.109	0.084	0.110	0.085	0.038	0.106	0.017
15	0.141	0.072	0.056	0.037	0.000	0.000	0.106	0.017
16	0.084	0.036	0.028	0.037			0.106	0.017
17	0.056	0.036	0.028	0.000			0.106	0.017
18	0.028	0.036	0.000				0.106	0.000
19	0.028						0.000	
20	0.028							
21	0.028							
22	0.000							
Number drafted	61	33	43	46	37	35	47	171

years after he was drafted. The results indicate that, in general, the proportion of quarterbacks surviving to play for any given number of years is higher, the earlier the round in which the quarterback is drafted.[9] The differences in survival probabilities are quite large. For example, among quarterbacks taken in Round 1, 56% play for 9 years or more, while in Round 2 only 47% have careers of this length. Less than 32% of those taken in Round 8 play for at least one year. Seventeen of the 61 players taken in Round 1 played for more than 13 years, while only five of the 285 players taken after Round 2 had careers of this length.

[9] Logrank and Wilcoxon tests reject the hypothesis that the survival functions are equal across rounds at the 1% level.

Shaw and Hoang (1995) find evidence that the playing time of NBA players who are drafted highly exceeds that justified by their performance. They suggest that this finding is explained by managers' unwillingness to admit draft "mistakes". That is, the failure of a highly ranked pick to play is evidence of incompetent management. In the NFL collective bargaining agreement, players taken in the first 16 picks can sign an initial contract for a maximum of six years, those taken in picks 17 through 32 have a five year contract maximum, and those chosen after the first round sign contracts for three years. Presumably the incentive for managers to play draftees is higher in the early years of their careers, when their failure to play is more apparent to fans. When the initial contracts have expired, the incentive to retain players to justify their "high" draft status is less pressing.

The life tables indicate that quarterbacks taken in the first round have substantially higher probabilities of playing until year 7 than those taken in (say) round 2 — 0.64 vs. 0.44. For those taken after the first round, the probability of surviving to year four declines monotonically with increases in the round in which a player is drafted. Since the teams' initial contracts for these quarterbacks have expired by these dates, the fact that players drafted in earlier rounds continue to play is evidence that the underlying abilities of those taken in earlier rounds exceed those taken in later rounds.[10]

Table 4 (column 1) presents the results of the censored regressions in which the number of years played is related to the splines of the draft rank. The results are consistent with the hypothesis that players taken later in the draft (both within and across rounds) have shorter careers. This hypothesis implies that the coefficients should be negative, and, in fact, eight of the nine coefficients of the linear segments are negative. Fig. 1(a) displays the predicted values of the regression. The predicted number of years played drops sharply in the first round. On average a quarterback chosen first in the draft would play 9.5 years, compared to only 7.3 years for one chosen at the top of the second round (i.e., 31st in the draft).

Quarterbacks: Other performance measures

Column 2 of Table 4 reports the censored regressions of the quarterback rating on the splines of ranks at which players were drafted. Column 3 reports a similar regression for passing attempts. The predicted values from the regressions are shown in Fig. 1(b) and (c). The results indicate that the earlier a quarterback is drafted, the better his performance, and that there is a sharp drop from the first to the second round. Quarterbacks chosen first in the draft have ratings nearly 15 points higher and throw more than 780 more passes than those taken 31st. The number of passes thrown also declines markedly from the top of the second round to the top of the third round, although the quarterback rating for a quarterback taken 31st is only slightly below that of one drafted 61st.

Wide receivers: Years played

The life tables for wide receivers (Table 3) yield results that are even stronger than those obtained for quarterbacks.[11] More than 90% of first round picks play for at least four years, and over half play for at least eight years. Only about 70% of second round picks play for four years or more, and slightly under 40% play for at least eight years. Less than one-quarter of round 8 picks play for even two years.

Turning to the censored regressions relating the number of years played to the splines of the draft rank (Table 4, column 4), we note that the results are similar to those obtained for the quarterbacks. Predicted values are shown in Fig. 2(a). A wide receiver taken as number one is expected to play for nearly ten years, while one taken at the top of the second round is expected to play for only seven years, and one taken at the top of the third round for slightly more than five years.

Wide receivers: Pass reception yards

Table 4 column 5 presents the censored regression of pass reception yards, with the predicted values shown in Fig. 2(b). Eight of the nine coefficients of the splines of ranks are negative, and pass receptions decline sharply with draft rank in the first and second rounds. A number one draft pick can be expected to have 7100 receiving yards, compared with only 3800 yards for one taken at the top of the second round and only 2100 yards for one taken at the top of the third round.

[10] A similar observation applies to wide receivers. See Table 3.

[11] Logrank and Wilcoxon tests reject the hypothesis that the survival functions are equal across rounds at the 1% level.

Table 3
Kaplan-Meier estimates of the proportion of wide receivers surviving to play T years by round drafted.

	Round drafted							
Year (T)	1	2	3	4	5	6	7	8+
1	1.000	0.956	0.925	0.835	0.686	0.603	0.487	0.343
2	0.954	0.877	0.833	0.713	0.559	0.405	0.379	0.228
3	0.935	0.807	0.708	0.617	0.461	0.298	0.279	0.181
4	0.880	0.772	0.557	0.504	0.333	0.260	0.198	0.140
5	0.831	0.654	0.504	0.407	0.255	0.212	0.180	0.103
6	0.757	0.562	0.448	0.305	0.216	0.157	0.144	0.083
7	0.660	0.478	0.388	0.246	0.156	0.134	0.115	0.067
8	0.569	0.398	0.313	0.217	0.120	0.094	0.087	0.051
9	0.496	0.312	0.279	0.158	0.093	0.867	0.043	0.040
10	0.347	0.243	0.170	0.108	0.067	0.043	0.032	0.027
11	0.283	0.162	0.131	0.054	0.040	0.017	0.032	0.020
12	0.216	0.116	0.105	0.027	0.040	0.009	0.032	0.014
13	0.144	0.081	0.078	0.027	0.013	0.000	0.022	0.014
14	0.126	0.061	0.047	0.027	0.000		0.022	0.007
15	0.105	0.061	0.016	0.000			0.000	0.003
16	0.105	0.061	0.016					0.003
17	0.063	0.030	0.000					0.000
18	0.021	0.000						
19	0.021							
20	0.021							
21	0.000							
22								
Number drafted	108	114	120	115	102	131	113	408

Summary of findings

In summary, the evidence for both quarterbacks and wide receivers indicates that players taken in earlier rounds have longer careers, with those taken in the first and second rounds being much more successful, as measured by all of the criteria which we have selected for representing the performance. This suggests that football executives are very successful in evaluating the talents of athletes and predicting how they will perform.

6. How often do football executives make errors?

The preceding empirical results indicate that, on average, players taken early in the draft have measurably better performances than those taken later in the draft. Nonetheless, the Spearman rank order correlations between players' draft positions and subsequent performances among players taken in a given year are all less than one. Moreover, the fairly low pseudo-R^2s in the regression analyses suggest that much of the variation in player performance is not explained by draft ranks. In short, while executives pick well on average, they also make errors. Errors can be viewed as either failing to draft a high quality player early or using an early draft pick to pick a player who turns out not to be successful. Before looking at these errors in the next two sections, we need to point out some potential shortcomings of our measures. First, we can only identify "ex post" errors. At the time that the teams were drafting players, a quarterback (or receiver) may have seemed very talented. However, an injury may have cut short a promising career. If the injury was unpredictable, then we will be falsely counting this choice as an error. Second, players' performances will be affected by the characteristics of their teammates and the system within which they play. A high ranked receiver will accumulate fewer yards on a team with a poor quarterback and a coach who stresses the running game. As in the previous example, this will yield an upward bias to our estimates of draft choice errors.

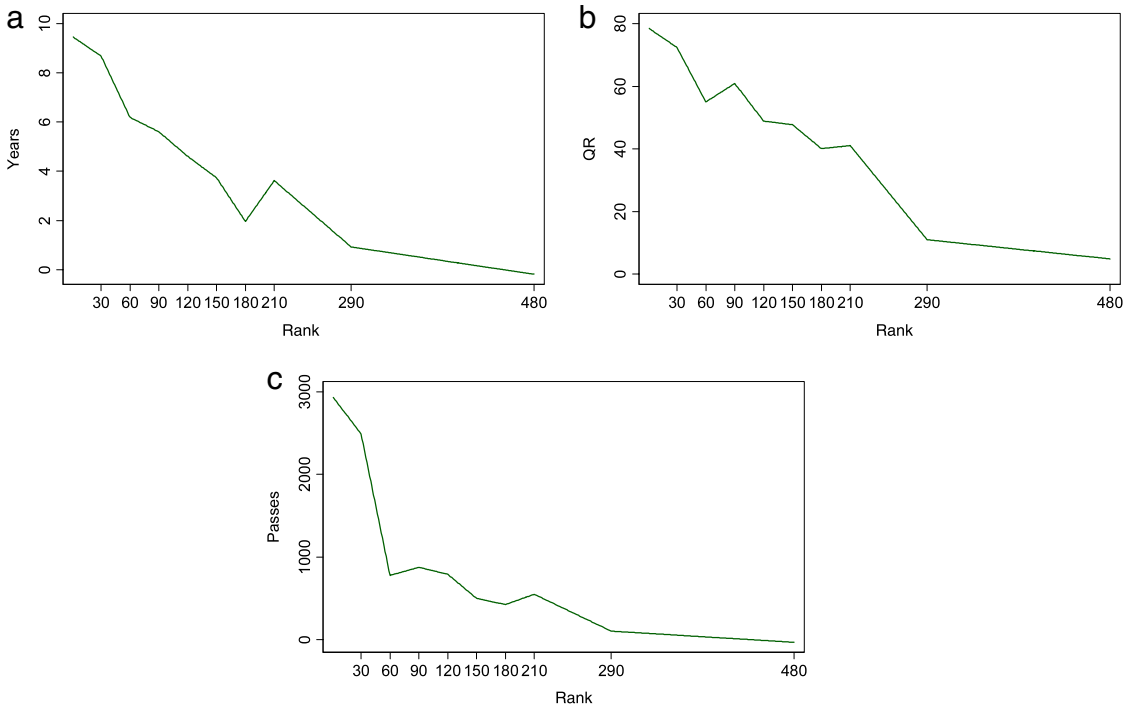

Fig. 1. Predicted values of performance measures for quarterbacks.

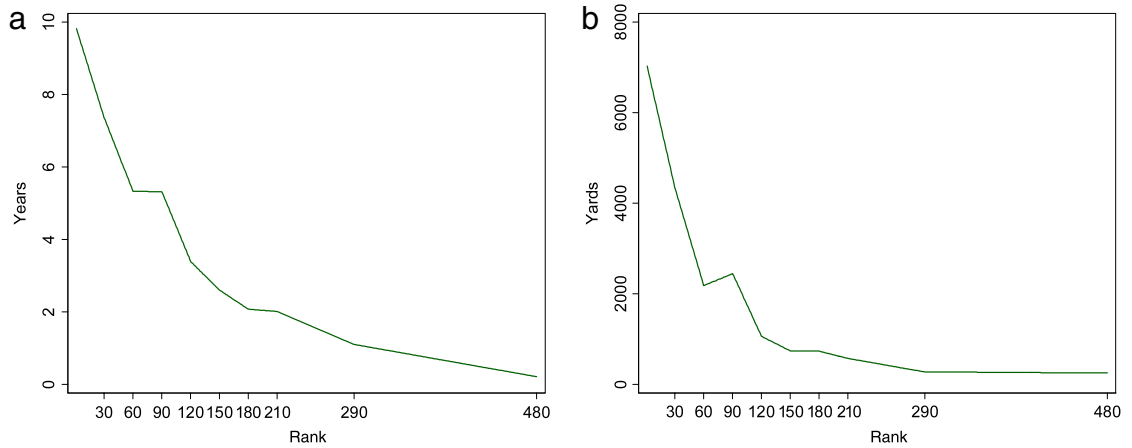

Fig. 2. Predicted values of performance measures for wide receivers.

6.1. Top players who are overlooked

The first type of error is exemplified by players who have extraordinarily successful careers but were not drafted as high picks or were not drafted at all. A prescient executive should have picked such players earlier. To investigate the frequency with which top players were overlooked in the draft, we performed two analyses. The first analysis examined whether there were any players whose subsequent performance was better than those taken in the first two rounds of a *given* year. The second analysis examined the frequency with which the very best players at each of the two positions were overlooked.

Cohort comparison

To determine how many players in a given year were drafted too low, we first examined the records of those drafted in the first two rounds. We then determined whether there were other players who were drafted in the same year and had superior records to those taken in the first two rounds. For quarterbacks, we used the number of passes thrown as our index of "quality". As an example, in 1986 there were three quarterbacks drafted in the first two rounds, and two of the other 13 quarterbacks drafted threw more passes than two of the three taken in Rounds 1 and 2. Thus, we would count two errors in that draft year.

Between 1974 and 2005, 95 quarterbacks were taken in the first two rounds, and 38 of the quarterbacks taken in later rounds outperformed the cohorts from the first two rounds, yielding an error rate of 40%. The results for wide receivers were similar. There were 216 wide receivers drafted in the first two rounds, and 91 of those drafted in later rounds in the same year had superior performances, as measured by receiving yards, yielding an error rate of 42%.

It should be noted that this criterion has some weaknesses in identifying draft errors. First, the number of identifiable potential mistakes is constrained by the number of players taken in Rounds 1 and 2. For example, in 1988, no quarterbacks were drafted in these rounds, so that the criterion leaves no room for errors in this year. Second, not all of the errors identified by this procedure are serious. It may be that the performance of the overlooked player is similar to that of a player mistakenly picked in the first two rounds. In addition, not all overlooked players had careers that were much more successful than those of players chosen earlier. For this reason, we also examined the best performers at each position.

Best performers

To obtain the frequency of *serious* errors that were made in the drafting process, we looked at the records of the top quarterbacks and wide receivers selected during our sample period. One measure of success is longevity in the NFL. We therefore examined the performances of the 65 quarterbacks and 121 wide receivers who played for at least ten years. In undertaking this analysis, we only use data from the 1974–1999 drafts, since players taken after 1999 could not yet have played for 10 years, given that our sample ends with the 2008 season.

The second measure of success is based on the performance records of the top 50 players at each position, as ranked by the number of passes thrown by quarterbacks and the reception yards for wide receivers. Each of the top 50 quarterbacks threw at least 2516 passes and each of the top wide receivers had at least 8129 reception yards.[12] The entire sample period can be used for this analysis.

Table 5 presents the percentage distribution by round of all quarterbacks (and wide receivers) drafted, as well as the percentage distributions among the best performers. The table indicates that top performers are disproportionately represented in the first two rounds of the draft. Only 19% of all quarterbacks who were drafted were chosen in those two rounds. However, 49% of the quarterbacks who played for ten years or longer and 60% of the top 50 passers were selected in these rounds.

Still, a considerable number of the best performers were selected in later rounds. Failing to pick a player who turns out to be successful is analogous to a Type II error in the statistical literature (i.e., accepting the null hypothesis when the alternative is true). In order to assess the Type II error rate of the NFL executives, it is necessary to adjust these figures for the number of quarterbacks drafted in later rounds. There were 391 quarterbacks drafted between 1974 and 1999 who could have played for ten or more years, with 75 drafted in the first two rounds and 316 in the later rounds. There were 33 later round picks among the 65 who played for ten or more years. Thus, the executives had an error rate of about 10% ($=100\% \times 33/316$) of failing to recognize a quarterback who would be successful, as measured by the number of years played. The error rate is smaller if one examines the top 50 passers. Of the players drafted in later rounds, 16 threw enough passes to qualify among top 50 passers, an error rate of 5%. In addition, there were also four quarterbacks who were not drafted at all, but who would have qualified in the top 50.[13] Adding these four to the sample yields an error rate of 6%.

Similar results are observed for wide receivers. While only about 17% of all wide receivers were taken

[12] The top 50 passers were drafted in the years 1974–2002, while the top 50 wide receivers were drafted from 1974 to 2001.

[13] These undrafted quarterbacks, with the number of passes thrown in parentheses, were: Warren Moon (6786), Dave Krieg (5311), Jim Zorn (3149), and Bobby Hebert (3121).

Table 4
Censored regression estimates of spline functions relating performance to draft rank: quarterbacks and wide receivers.

Column:		(1)	(2)	(3)	(4)	(5)
		Quarterbacks			Wide receivers	
Variable	Ranks	Years	Rating	Passes	Years	Yards
Constant		9.482[a]	78.687[a]	2947.0[a]	9.910[a]	7119.9[a]
		(0.786)	(5.980)	(238.2)	(.683)	(474.2)
R_1	$0 < \text{Rank} \leq 30$	−0.027[b]	−0.209	−15.2	−0.085[a]	−92.7[a]
		(0.047)	(0.359)	(14.4)	(0.031)	(22.0)
R_2	$30 < \text{Rank} \leq 60$	−0.083[c]	−0.580	−57.0[a]	−0.068[a]	−7109[a]
		(0.049)	(0.374)	(15.0)	(0.022)	(15.9)
R_3	$60 < \text{Rank} \leq 90$	−0.020	0.197	3.3	−0.000	9.0
		(0.044)	(0.344)	(13.6)	(0.021)	(15.0)
R_4	$90 < \text{Rank} \leq 120$	−0.033	−0.401	−2.8	−0.064[a]	−46.3[c]
		(0.046)	(0.353)	(14.0)	(0.022)	(15.3)
R_5	$120 < \text{Rank} \leq 150$	−0.029	0.038	−9.7	−0.026	−10.7
		(0.046)	(0.354)	(14.0)	(0.022)	(15.4)
R_6	$150 < \text{Rank} < 180$	−0.059	−0.254	−2.5	−0.018	−0.2
		(0.044)	(0.343)	(13.6)	(0.022)	(15.8)
R_7	$180 < \text{Rank} \leq 210$	0.055	0.032	4.2	−0.002	−5.3
		(0.039)	(0.302)	(11.9)	(0.006)	(13.5)
R_8	$210 < \text{Rank} \leq 290$	−0.034[a]	−0.375[a]	−5.6[c]	−0.011[c]	−3.7
		(0.011)	(0.086)	(3.4)	(0.005)	(4.2)
R_9	$\text{Rank} > 290$	−0.006	−0.032	−0.7	−0.005	−0.1
		(0.009)	(0.074)	(2.9)	(0.005)	(3.8)
Pseudo-R^2		0.07	0.04	0.02	0.08	0.02

Standard errors are in parentheses.
[a] Denotes statistical significance at the 0.01 level.
[b] Denotes statistical significance at the 0.05 level.
[c] Denotes statistical significance at the 0.10 level.

in the first two rounds, half of those who played for 10 or more years and nearly 70% of those among the top 50 in reception yards were taken in these rounds. The type II error rates for wide receivers are lower than those for quarterbacks. Of the 839 wide receivers drafted later than the second round between 1974 and 1999, only 48 had careers that lasted more than nine years, an error rate of 6%. Of wide receivers drafted later than the second round between 1974 and 2001, only 1.6% were among the top 50 in terms of yards of reception. One top wide receiver, Rod Smith with 11,389 yards, was undrafted. When he is included as well, the error rate is 1.8%.

One way to view these results is that executives make a substantial number of errors. That is, every team had two chances to draft players who would eventually be among the best performers in the NFL and did not take them. The other way to interpret these results is that most teams made unpublished forecasts that particular athletes did not have the potential to perform well in the NFL, and consequently they were not willing to take the risk of using an early draft round pick to choose them. If these draft intentions became public knowledge, a team with superior or inside information could afford to wait until the third or later rounds to take the "risk" of drafting this individual. This could be a possible explanation for the success of players who were chosen in the later rounds of the draft, but it does not explain why a small number of very successful players were never chosen. However, it must be remembered that there were only four highly successful quarterbacks and one wide receiver who were not drafted at all.

6.2. Top draft choices who were unsuccessful

The figures given in the previous section for overlooked players also help to identify choices that were unsuccessful. Of the 95 quarterbacks taken in the first

Table 5
Percentage distribution by draft round for the top and bottom performers among quarterbacks and wide receivers.

A. Quarterbacks							
Draft years:	1974–1999		1974–2002		1974–2005		
Draft round	All	Years ≥ 10	All	Passes ≥ 2516	All	Did not play	Played <3 years
1	11.8	33.9	11.7	46.0	12.9	0.0	1.2
2	7.4	15.4	7.7	14.0	7.0	0.6	2.0
3	9.0	9.2	8.9	8.0	9.1	3.0	4.7
4	9.7	12.3	9.8	10.0	9.7	4.8	6.7
5	7.9	10.8	7.9	4.0	7.8	3.0	7.8
6	6.4	3.1	7.7	6.0	7.4	7.2	9.0
7	8.4	4.6	9.1	6.0	9.9	11.4	13.3
8	39.4	10.8	37.3	6.0	36.2	70.1	55.3
Number	391	65	429	50	473	167	255
B. Wide receivers							
Draft years:	1974–1999		1974–2001		1974–2005		
Draft round	All	Years ≥ 10	All	Yards ≥ 8129	All	Did not play	Played <3 years
1	7.8	28.9	8.3	46.0	8.9	0.0	1.0
2	9.0	21.7	9.1	24.0	9.4	1.1	3.3
3	9.5	14.4	9.7	8.0	9.9	2.0	5.2
4	9.8	11.3	9.6	6.0	9.5	4.3	6.6
5	8.1	5.2	8.3	6.0	8.4	7.2	8.2
6	10.2	5.2	10.8	2.0	10.8	11.7	13.7
7	8.7	3.1	8.9	2.0	9.3	13.1	12.2
8	36.8	10.3	35.3	6.0	33.7	60.5	49.8
Number	1009	97	1079	50	1211	443	671

two rounds, 38 threw fewer passes than the number thrown by those taken in subsequent rounds in the same year, and of the 216 wide receivers taken in the first two rounds, 91 had fewer reception yards than others taken in later rounds of the same year. Of course, this measure would identify a team needing a quarterback taking Steve Bartkowski (3,456 passes) in the first round of 1975 as a mistake because he threw fewer passes than Steve Grogan (Round 4, 3593 passes).

To get at *serious* errors, we looked at the percentage distributions by round of players who did not play or played for fewer than three years. These figures are shown in Table 5. Relative to the percentage distribution of all quarterbacks or wide receivers drafted, those taken in Rounds 1 through 5 are underrepresented among those who played for fewer than three years. A player taken in the first two rounds who does not play at all or who plays for less than three years is a serious mistake, in the sense that this was a wasted draft choice. Of the quarterbacks drafted in the first two rounds, only four did not play at all, and only 8 of 94 (8.5%) played for fewer than three years. Only five first or second round wide receivers did not play at all, and only 29 of 222 (13.1%) played for fewer than three years. From these data, we conclude that very few serious blunders occurred in the first two rounds of the draft.

7. Do teams differ in their draft success?

Having found that NFL executives are relatively successful in identifying superior players, we then investigated whether some organizations had greater success rates than others. Over the period 1974–2005, teams changed owners, general managers, personnel directors, and coaches, so that we cannot identify individuals with greater personnel evaluation abilities. However, we can determine whether certain organizations had superior or inferior drafting capabilities. Our method for evaluating organizational competence in

Table 6
Censored regression estimates of team success in drafting quarterbacks and wide receivers.

Column:	(1)	(2)	(3)	(4)	(5)
	Quarterbacks			Wide receivers	
Variable:	Years	QR	Passes	Years	Yards
Constant	12.8[a]	88.69[a]	2787[a]	7.05[a]	3774.1[a]
	(1.3)	(9.90)	(417)	(0.57)	(419)
Rank	−0.02[a]	−0.19[a]	−6.42[a]	−0.021[a]	−12.76[a]
	(0.002)	(0.01)	(0.56)	(0.001)	(0.71)
Dummy variables for teams:					
49ers 1	−5.2[a]	−22.7	−900	0.21	416
	(1.6)	(12.0)	(505)	(0.79)	(581)
Bears 2	−3.9	−11.7	−955	−0.17	−301
	(1.6)	(11.9)	(503)	(0.74)	(545)
Bengals 3	−6.5[a]	−21.6[a]	−1275[a]	−0.01	12
	(1.5)	(11.4)	(482)	(0.75)	(552)
Bills 4	−6.1[a]	−30.6[b]	−1255[b]	−0.36	−322
	(1.6)	(12.1)	(511)	(0.74)	(539)
Broncos 5	−4.3[a]	−11.9	−1180[b]	−0.75	−468
	(1.6)	(12.6)	(529)	(0.74)	(543)
Browns 6	−6.6[a]	−19.8	−1269[b]	0.21	−31
	(1.6)	(12.4)	(527)	(0.74)	(540)
Buccaneers 7	−4.6[a]	−21.7	−695	−0.82	−415
	(1.6)	(12.0)	(506)	(0.76)	(557)
Cardinals 8	−5.8[a]	−16.7	−1218[b]	−0.22	188
	(1.6)	(12.4)	(523)	(0.75)	(544)
Chargers 9	−4.9[a]	−9.4	−823	−0.91	−596
	(1.5)	(11.9)	(501)	(0.75)	(544)
Chiefs 10	−6.9[a]	−31.9	−1592[a]	−1.00	−824
	(1.6)	(12.3)	(520)	(0.72)	(530)
Colts 11	−3.4[b]	−15.5	−147	−0.02	313
	(1.6)	(12.1)	(512)	(0.78)	(570)
Cowboys 12	−3.6[b]	−1.5	−626	0.35	208
	(1.6)	(12.3)	(520)	(0.77)	(567)
Dolphins 13	−4.5[a]	−13.4	−497	0.27	264
	(1.6)	(12.1)	(509)	(0.77)	(566)
Eagles 14	−4.7[a]	−14.1	−807	−1.37	−849
	(1.7)	(12.8)	(537)	(0.81)	(592)
Falcons 15	−4.6[a]	−12.3	−530	−0.47	−437
	(1.6)	(12.4)	(525)	(0.74)	(541)
Giants 16	−4.7[a]	−8.6	−930	0.41	−381
	(1.6)	(12.2)	(516)	(0.76)	(557)
Jaguars 17	−2.0	17.1	−792	−0.40	−714
	(2.6)	(19.6)	(815)	(1.08)	(790)
Jets 18	−2.6	−1.6	−495	−0.23	34
	(1.6)	(12.6)	(534)	(0.74)	(544)
Lions 19	−5.3[a]	−14.0	−1060[b]	−0.78	−482
	(1.6)	(132.3)	(524)	(0.74)	(540)
Packers 20	−5.1[a]	−11.9	−815	0.15	160
	(1.5)	(11.5)	(486)	(0.73)	(534)
Panthers 21	−5.9[a]	−34.6[b]	−710	0.70	1021
	(2.1)	(16.7)	(698)	(1.29)	(946)

Table 6 (*continued*)

Column:	(1)	(2)	(3)	(4)	(5)
	Quarterbacks			Wide receivers	
Variable:	Years	QR	Passes	Years	Yards
Patriots 22	−3.0[b]	5.5	−394	0.09	−88
	(1.6)	(12.0)	(506)	(0.75)	(547)
Raiders 23	−4.8	−13.7	−1076[b]	0.71	307
	(1.6)	(12.3)	(522)	(0.81)	(595)
Rams 24	−4.3[a]	−10.6	−926[c]	0.69	562
	(1.5)	(11.8)	(500)	(0.73)	(537)
Ravens 25	−6.4[a]	−13.2	−1202	1.06	−192
	(1.9)	(14.9)	(632)	(1.20)	(879)
Redskins 26	−3.9[b]	−1.3	−714	0.39	92
	(1.6)	(12.1)	(512)	(0.80)	(586)
Saints 27	−5.6[a]	−11.8	−1029	−0.76	−368
	(1.7)	(13.3)	(563)	(0.74)	(541)
Seahawks 28	−6.2[a]	−17.8	−1298[b]	−0.81	−490
	(1.6)	(12.5)	(531)	(0.81)	(592)
Steelers 29	−3.5[b]	−10.1	−851[c]	0.07	−116
	(1.6)	(12.2)	(516)	(0.72)	(526)
Texans 30	−5.6[b]	−5.2	−808	0.27	695
	(2.5)	(19.0)	(815)	(1.95)	(1402)
Titans 31	−5.4[a]	−21.2	−818	0.59	166
	(1.7)	(12.9)	(545)	(0.71)	(519)
Pseudo-R^2	0.078	0.049	0.020	0.066	0.015

Standard errors are in parentheses.
[a] Denotes statistical significance at the 0.01 level.
[b] Denotes statistical significance at the 0.05 level.
[c] Denotes statistical significance at the 0.10 level.

player selection is to regress measures of player performance on the rank of the player drafted and a set of dummy variables taking the value 1 if a player is drafted by that team and 0 otherwise. The Vikings are the excluded category. By including the rank at which a player was drafted, we measure the effect of a team's ability to spot talent and forecast success *given the rank at which it is drafting*.

Columns 1–3 of Table 6 report the censored regression estimates for quarterbacks for the three measures of quarterback performance, and columns 4–5 report coefficients for the wide receiver measures. For each of these equations, one cannot reject the hypothesis that the coefficients of the team dummy variables are equal at the 10% level of significance. This result is consistent with that of Spurr (2000), who found no statistically significant differences in teams' ability to select in the baseball draft.

We also examined whether the teams that are successful in drafting quarterbacks are the same teams that are successful in drafting wide receivers. The correlations between the coefficients of the team dummy variables in the quarterback equations and those in the wide receiver equations are small, and none is statistically significantly different from zero at the 5% level.

Finally, we explored whether the teams that were successful in drafting quarterbacks and wide receivers were also successful teams, as measured by their percentage of games won over the 1974–2005 seasons. Only the correlation between winning percentages and the coefficients for the team dummy variables in the years played by the quarterback is above 0.30, and that coefficient is barely statistically significantly different from zero at the 10% level. Thus, we conclude that (1) teams do not differ in their ability to identify successful quarterbacks and wide receivers, and (2) there is no evidence that teams' drafting abilities (as regards the passing game) are correlated with an overall measure of organizational success.

Table A.1
Example. Calculation of the Kaplan-Meier estimate of the proportion of round 1 quarterbacks surviving to play for T years.

Years (T)	(1) Number playing	(2) Finished career	(3) Censored	(4) Proportion surviving (S_T)
1	61	1	0	1.000
2	60	2	0	0.984
3	58	5	1	0.951
4	52	5	1	0.884

8. Conclusion

We have used a variety of techniques to evaluate football executives' abilities to forecast the relative performances of quarterbacks and wide receivers in the NFL. The analysis was based on the order in which players were selected in the NFL draft, together with several measures assessing their subsequent performances. We concluded that the NFL executives can, on average, effectively rank the future performances of players relative to each other. However, their ability to do so was less than perfect, because they sometimes chose players early in the draft when later draftees had better subsequent records. They also sometimes failed to draft players who later performed extremely well. There was no evidence that teams which had greater success in drafting quarterbacks or wide receivers than others had better overall success rates, as measured by the percentage of games won.

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Appendix. Life table estimation

The life tables 2 and 3 in the text show the probability that a player taken in a given round survives to play for at least T years (S_T). The life tables are based on the Kaplan-Meier (or product limit) methodology (Cleves et al., 2002, pp. 89–92; Kaplan & Meier, 1959). Players' careers contribute to the calculation of survival probabilities until the time at which they are censored. The following illustration for first round quarterbacks shows how the Kaplan-Meyer estimator is calculated for the first four years of play for quarterbacks drafted in the first round.

61 quarterbacks were drafted in the first round. Table A.1 lists the number of quarterbacks playing for various numbers of years (column 1), the number who exit the sample because they have completed play (column 2), the number who leave the sample because they are censored (that is, the number still active in 2008) and thus may play for additional years in the future (column 3), and the estimate of the proportion surviving to play for T years (column 4).

Of the 61 quarterbacks initially drafted, all play for at least one year. Hence, the proportion of those surviving to play for one year (S_1) equals 1.000. One player exits football after having played for one year, leaving 60 players who play for at least two years. Consequently, the proportion surviving to play for two years (S_2) is 0.984 (=60/61). After the second year, another two players leave football, leaving 58 who start the third year. The proportion surviving to play for at least 3 years ($S_3 = 0.951$) is the proportion playing for at least two years (0.984) times the proportion progressing from year two to year three ($0.967 = 58/60$). At the end of the third year, 5 players finish their careers and 1 player is censored (i.e., is still playing in 2008).[14] That is, one player was drafted in 2005 and continued to play through the 2008 season. This player may also continue to play in subsequent years. Of the 57 players still in the sample after three years, the proportion progressing from year three to play in year four was 0.930 ($= 53/57$). The proportion of players estimated to survive to play in year four (S_4) equals 0.884, which is the proportion surviving to play for three years ($S_3 = 0.951$) times the proportion progressing from year

[14] Jason Campbell, who played for the Washington Redskins, was drafted in 2005, but had played for only three years as of 2008, since he threw no passes in 2005.

three to year four (0.930). Note that the experience of censored players contributes to the calculation of survival probabilities up until the point at which they are censored. The implicit assumption is that in subsequent years the censored players would have the year-to-year progression probabilities of those who remain in the sample. Consequently, the figure 0.884 can be interpreted as the proportion surviving to play for four years in a hypothetical cohort of players who are drafted and observed until all complete their careers.

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