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# Race and the Evaluation of Signal Callers in the National Football League

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Until recently, the position of quarterback in the National Football League (NFL) was not an option for Black athletes. Today, many teams use Black quarterbacks, a development that might suggest race is no longer relevant when it comes to the evaluation of signal callers in the NFL. By modeling quarterback performance and salary over 1995-2006, we find that Black quarterbacks are more likely to run with the football, yet this skill is not compensated in the market. Furthermore, we find evidence of performance-related salary discrimination against Black quarterbacks in the top half of the salary distribution.

***Keywords:*** *quarterback; salary; race; discrimination*

Although numerous studies have been offered examining discrimination in professional team sports like baseball and basketball, there is little a priori evidence that discrimination remains a problem in these sports. Consequently, it is not surprising that much of the recent research on the topic offers very mixed results with respect to the subject of discrimination. Depending on the issue examined and the methodology used, studies have found evidence of discrimination against Blacks,[1] Whites,[2] or no discrimination at all.[3]

The story of professional football is different. Specifically, Black quarterbacks have historically been a relatively rare occurrence in the National Football League (NFL). The first was Willie Thrower, who threw eight passes for the Chicago Bears on October 18, 1953. These were the only eight passes Thrower ever attempted.[4] It was not until 1968 that Marlin Briscoe became the first starting Black quarterback, leading the Denver Broncos of the American Football League.[5]

By the end of the 1993 season, only eight Black quarterbacks had ever received significant playing time in the NFL. Only in the mid-1990s, Blacks began to make substantial progress at this position. This marked, as Table 1 indicates, the first time

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**Table 1**
**Percentage of NFL Quarterbacks Who Are Black: 1971-2006**
**Minimum 100 Passes Attempted in a Season**

| Year | Black Quarterbacks | All Quarterbacks | Percent Black (%) |
|---|---|---|---|
| 1971 | 1 | 35 | 3 |
| 1972 | 0 | 31 | 0 |
| 1973 | 0 | 36 | 0 |
| 1974 | 2 | 38 | 5 |
| 1975 | 1 | 33 | 3 |
| 1976 | 1 | 36 | 3 |
| 1977 | 2 | 36 | 6 |
| 1978 | 1 | 33 | 3 |
| 1979 | 1 | 33 | 3 |
| 1980 | 2 | 36 | 6 |
| 1981 | 2 | 40 | 5 |
| 1982 | 1 | 30 | 3 |
| 1983 | 1 | 38 | 3 |
| 1984 | 1 | 41 | 2 |
| 1985 | 1 | 43 | 2 |
| 1986 | 2 | 41 | 5 |
| 1987 | 3 | 41 | 7 |
| 1988 | 3 | 44 | 7 |
| 1989 | 3 | 37 | 8 |
| 1990 | 3 | 37 | 8 |
| 1991 | 2 | 38 | 5 |
| 1992 | 3 | 42 | 7 |
| 1993 | 3 | 44 | 7 |
| 1994 | 3 | 43 | 7 |
| 1995 | 5 | 39 | 13 |
| 1996 | 5 | 43 | 12 |
| 1997 | 7 | 41 | 17 |
| 1998 | 8 | 42 | 19 |
| 1999 | 10 | 42 | 24 |
| 2000 | 11 | 35 | 31 |
| 2001 | 11 | 31 | 35 |
| 2002 | 10 | 37 | 27 |
| 2003 | 11 | 36 | 31 |
| 2004 | 6 | 37 | 16 |
| 2005 | 8 | 39 | 21 |
| 2006 | 11 | 36 | 31 |
| Totals | 145 | 1,364 | 11 |

Note: NFL = National Football League.

that more than three Black quarterbacks received significant playing time in the same season.

Table 1 shows that from 1996 to 2000 the number of Black quarterbacks attempting at least 100 passes in a single season rose from 5 to 11. The mark of 11 was again matched in 2001, 2003, and 2006, but never exceeded.

Relative to the 1970s and 1980s, Blacks appeared to have more opportunities in the 1990s and at the turn of the century. Still, it appears that the participation of Blacks has not changed much since 2000. Plus, even with an increase in the number of Black quarterbacks, this position is still dominated by Whites. From 2000 to 2006, there were 251 instances where a quarterback attempted 100 passes in a single season. Of these, 68 were offered by Black quarterbacks, that is, 27% of the population. When one notes that 65% of the NFL is Black,[6] it is easy to conclude that progress still remains in the effort to integrate the quarterback position. This can be further seen when we note that on the first weekend of the 2008 season, only six Black quarterbacks started in a league with 32 teams.

The number of Blacks participating at this position certainly suggests the possibility of discrimination. To further address this subject, we will focus our attention on two issues. First, we wish to evaluate the performance of Black and White quarterbacks on the field of play. Are there differences in the average performances of each population? Beyond on-field productivity is the larger issue of worker compensation. The employment data suggest that Blacks are still underrepresented at the quarterback position. Are there similar disparities in the wages paid to members of each population?

Becker defined three categories of wage discrimination by source: Employer, customer and coworker. Some investigators have attempted to assess the contributions of these different types to estimated racial salary discrimination in pro sports (see Kahn, 2000 for a useful survey of evidence and associated problems). Looking at the National Basketball Association (NBA) and using a model of salary that encompassed proxy measures for each type of discrimination, Bodvarsson and Partridge (2001) offered evidence consistent with both coworker salary discrimination by White players and customer discrimination by non-White fans. In football, Kahn (1992) found that White players tended to earn higher salary than non-Whites in more White metropolitan areas. However, it is not at all clear that metropolitan areas accurately represent teams' fan bases. In the NFL, the audience for each team is arguably more regional rather than confided to a specific metropolitan area. Furthermore, even if local influence on owner behavior is present, the definition of ''local'' is open to question. In any case, in Kahn's study the estimated effects were of small magnitude and were statistically insignificant in some regressions.

We suspect, but will not attempt to prove, that the source of any salary discrimination in football is with team management. Racial segregation of players by position is present, but this appears to be fairly standard across teams. It is hard to conceptualize a mechanism by which racial preferences by players would translate

into outcomes of pay bargaining between players and owners in football. Moreover, the players' union, which had a Black ex-player as its leader over our sample period, would have been unlikely to sanction any expression of racial prejudice by players in salary negotiations.

If employers indulge a taste for discrimination in pay-setting, how is it that such tastes are not punished by the market? A simple answer is that the market for football players is not competitive. There are just 32 teams in the NFL, and there is no rival league of comparable standing and audience appeal. Rents would appear to be abundant and the scope for noncompetitive practices is considerable as the NFL operates a player draft, restricted free agency, and a salary cap. An owner that practiced underpayment of Black quarterbacks could do so, knowing that rival teams would be bound by the hard salary cap and, even if performance dipped through such a policy, revenues would continue to be redistributed through the League. We should also stress that underpayment could arise out of genuine ignorance of a player's productivity and contribution to team revenues, rather than through direct expression of prejudice.

We shall proceed by comparing performance of Black and White quarterbacks (section 1). Section 2 will motivate and establish our empirical model for assessment of salary discrimination, section 3 will report our empirical results, and section 4 will conclude.

## 1. Comparing On-Field Performance

Player performance data exist in abundance in the sports of baseball and basketball, two sports that have been frequently investigated by economists interested in the issue of racial discrimination. Like these two sports, a number of metrics exist to evaluate the productivity of an NFL quarterback.

The plethora of metrics, though, presents a problem. Which measure should one use? Studies of baseball tend to follow the lead of Gerald Scully (1974) and use an index on performance like slugging percentage. The advantage of this metric is that it is commonly cited and simple to understand, although its connection to runs scored and wins is relatively weak.[7]

For quarterbacks, the most commonly cited statistic is the NFL's quarterback rating measure, but as the following equation reveals, it is hardly a simple or intuitive metric.[8]

$$\left(\frac{\frac{COMP}{PASSATT}-0.3}{0.2}+\frac{\frac{PASSYDS}{PASSATT}-3}{4}+\frac{\frac{PASSTD}{PASSATT}}{0.05}+\frac{0.095-\frac{INT}{PASSATT}}{0.04}\right)\cdot\frac{100}{6}$$

where COMP = Completions, PASSYDS = Yards passing, PASSTD = Touchdown passes thrown, INT = Interceptions thrown, and PASSATT = Passing attempt.

Beyond a lack of intuition, one should note that the quarterback rating may be biased against Black quarterbacks. To understand this contention, one should note that the quarterback rating system is actually only a measure of a signal caller's passing ability. Only four statistics, completions, yards, touchdowns, and interceptions are used, with each evaluated per passing attempt. Contributions made using a quarterback's legs are not considered.

Contributions using a quarterback's legs appear to be important, and there appear to be differences in running abilities across the population. To see this point, we collected data on 309 quarterbacks who attempted at least 100 passes in one regular season from 1971 to 2006. Given that quarterbacks appeared in multiple seasons, our sample initially includes 1,470 distinct observations. To address differences in rushing ability, we first calculated the number of Plays where the quarterback participated. Specifically, according to the NFL's definition of Plays, we aggregated passing attempts, rushing attempts, and sacks. We then examined the percentage of Plays that were rushing attempts. Our 28 Black quarterbacks offered 145 season observations. In this sample, 11.3% of the time the Black quarterbacks ran with the ball. In contrast, White quarterbacks only ran with the ball on 6.7% of their Plays.

When we turn to rushing attempts and yards per game we see a similar story. The average White quarterback from 1971 to 2006 ran with the ball twice per game, gaining an average of 7.3 yards. When we look at our sample of Black quarterbacks, we see that 84.1% exceeded the White average with respect to rushing attempts per game while 80.7% exceeded the White average for rushing yards per contest. Overall, the average Black quarterback ran with the ball 3.8 times per contest and gained 19.4 rushing yards.

To put this in perspective, consider the case of Warren Moon in 1997. At the advanced age of 41, Moon ran 17 times out 575 Plays for a rate of 3%. Of the White quarterbacks examined, 11% did not run as often as an old Warren Moon in 1997. Only one quarterback, Doug Williams in the last year he played in the NFL, failed to run as often as Moon. Such results highlight a key difference in the performances of Blacks and Whites at the quarterback position. White quarterbacks can often play without using their legs. We do not see such a pattern with respect to Black quarterbacks.

Given the formulation of the quarterback rating, a key offering of Black quarterbacks is ignored. Consequently, to assess the impact of this difference, we used a measure of performance detailed in Berri, Schmidt, and Brook (2006) and Berri (2007). These works detailed models of both points scored and points surrendered in the NFL. Specifically, a model was offered that regressed points scored by a team's offense on factors associated with acquisition of the ball, the ability to advance the ball across the field of play, the ability to maintain possession of the ball, and the team's ability to convert scoring opportunities into points. A second model was estimated connecting the same factors for the opponent to the number of points allowed by a team's defense. From these two models, we learn the impacts that

**Table 2**
**Value in Net Points of Various Performance Statistics Tabulated for NFL Quarterbacks**

| Variable | Net Points |
|---|---|
| Yards (passing or rushing) | 0.080 |
| Plays (passing attempts, rushing attempts, sacks) | −0.214 |
| Interceptions | −2.745 |
| Fumbles lost | −2.899 |

Note: NFL = National Football League.

passing yards, rushing yards, passing attempts, rushing attempts, sacks, interceptions, and fumbles lost have on offensive points scored and defensive points allowed. These estimated impacts are then used to estimate the value of yards, plays, interceptions, and fumbles in terms of net points. These results are reported in Table 2.

From Table 2, we see that each additional yard—via either passing or rushing—is worth 0.08 additional net points. A play—by itself—costs a team −0.214 points. Given these numbers, a team essentially has to gain about three yards for a play to break even. If we look at turnovers we see that each interception costs a team −2.745 net points while a lost fumble costs a team −2.899 net points. Such values—coupled with the value of a yard—tell us that each turnover is worth between 30 and 40 yards.

With such values in hand, we can now measure each quarterback's production of Net Points. Net Points simply involves multiplying the values in Table 2 by each quarterback's production of each statistic. We can also use a simpler model which Berri et al. (2006) and Berri (2007) label QB Score. QB Score is calculated as follows:

$$\text{QB Score} = \text{All Yards} - 3 * \text{All Plays} - 30 * \text{All Turnovers}$$

where All yards = Passing yards + Rushing yards–Yards lost from sacks, All Plays = Passing attempts + Rushing attempts + Sacks, and All Turnovers = Interceptions + Fumbles lost.

The simpler measure is derived from normalizing the value of plays and turnovers around one yard. As noted in Berri (2007), the correlation between QB Score per play and Net Points per play is 0.98. In other words, whether we look at QB Score or Net Points, our evaluation of quarterbacks is essentially the same.

With measures in hand, we offer Table 3, where we present our evaluation of the average performance of Black and White quarterbacks. This table begins by looking at this position prior to the leap in participation seen in the mid-1990s. Specifically, we compare the average performance of Black quarterbacks from 1971 to 1993 to what we saw on average from Whites playing this position.

**Table 3**
**Comparing the Average Performance of Black and White Quarterbacks 1971-2006**

| Sample | Black QBs 1971-1993 | White QBs 1971-1993 | Black QBs 1994-2006 | White QBs 1994-2006 |
|---|---|---|---|---|
| *n* | 39 | 824 | 106 | 501 |
| Completion percentage | 54.8% | 55.4% | 57.6% | 58.8% |
| Passing yards per passing attempt | 7.07 | 6.95 | 6.77 | 6.81 |
| Touchdown passes per passing attempt | 4.18% | 4.17% | 4.01% | 4.03% |
| Interceptions per attempt | 3.79% | 4.23% | 3.02% | 3.17% |
| Quarterback rating | 75.32 | 73.46 | 79.08 | 79.67 |
| Passing yards per game | 195.7 | 168.2 | 189.9 | 193.5 |
| Rushing yards per game | 17.6 | 7.5 | 20.1 | 7.0 |
| Yards lost from sacks per game | 16.5 | 14.9 | 13.4 | 12.6 |
| Plays per game | 33.3 | 28.1 | 34.2 | 32.5 |
| Yards gained per game | 196.8 | 160.8 | 196.6 | 188.0 |
| Fumbles lost per game | | | 0.28 | 0.24 |
| Interceptions per game | 1.05 | 1.02 | 0.85 | 0.90 |
| Net points per game | 4.9 | 3.4 | 6.0 | 5.5 |
| QB score per game | 57.2 | 39.7 | 60.3 | 56.4 |
| Yards per play | 5.90 | 5.73 | 5.75 | 5.78 |
| Fumbles lost per play | | | 0.8% | 0.7% |
| Net points per play | 0.146 | 0.120 | 0.175 | 0.170 |
| QB score per play | 1.715 | 1.415 | 1.762 | 1.735 |

Note: Data from 1971 to 1993 do not include fumbles lost, so Net Points and QB Score were each calculated without fumbles lost in the earlier time period. From 1994 to 2006, average Black QB Score play, without fumbles, would be 2.005. From 1994 to 2006, average White QB Score per play, without fumbles, would be 1.953. QB = quarterback.

From 1971 to 1993, the average Black quarterback was better with respect to the NFL's quarterback rating, which again only considers what a signal caller does with his arm. When we incorporate the quarterback's ability to run, the difference becomes even greater. Black quarterbacks in the earlier time period created more points both per play and per game, and not surprisingly, given our result with respect to points, Blacks also have a higher QB Score and QB Score per play.

When we look at more recent years, we see that both Black and White quarterbacks improved. With respect to the NFL's QB Rating, though Whites are now slightly ahead of Blacks, but again, this metric ignores what a quarterback does with his legs. When the rushing game is added, we again see that Blacks are more productive than Whites. A $t$ test of equality of mean values of rush yards earned by White and Black quarterbacks comprehensively rejects with $p$ value of .000.

## 2. Modeling Race and Compensation in the NFL

We are not the first to examine racial discrimination in the NFL. The first studies were offered by Mogull (1973, 1981). More recently, Kahn (1992) and Gius and Johnson (2000) offered studies with somewhat contradictory results. Specifically, in a study of worker compensation for the 1989 season, Kahn reports a wage premium for White players. In contrast, in a study of wages paid in the 1995 season, Gius and Johnson present evidence that minority players are paid more than Whites. More recently, a working paper by Doran and Doran (2004) confirms the work of Gius and Johnson with respect to every position but quarterback. In a study spanning data from 1994 to 2003, Doran and Doran report a premium paid to minorities at every position except that of the signal caller, where Whites are reportedly paid additional wages for similar performances.

To understand these results, it is useful to review the standard approach to uncovering the existence of salary or wage discrimination. The simplest method proceeds by the estimation of coefficients on a dummy variable to distinguish race. This assumes that the impacts of productivity measures on salary do not vary by race. If significant and negative, the race dummy represents a downward intercept shift in salary for the racial group in question. In a more sophisticated approach, researchers examine the relationship between pay and productivity, seeking to uncover differences in this relationship because of race by means of slope dummy variables. If one finds that statistically significant racial differences exist, the researcher concludes that evidence of discrimination has been uncovered. All other factors that may influence salary must be accounted for in the salary model. If not, the estimation and interpretation of racial differences is problematic.

We begin our discussion with our dependent variable, salary. Total salary includes base salary and bonuses related to signing and other bonuses related to performance. ''Other'' bonuses tend to be very small compared to signing bonuses and base salary. Base salary levels are set within a pay scale determined by collective bargaining agreement between the players' association (National Football League Players' Association [NFLPA]) and team owners.

The pay scales will reflect player experience in the NFL. Signing bonuses are determined through bilateral bargaining between the team owners and the player without union involvement. In any season, it follows that the variation in signing bonus will be somewhat larger than the variation in base salary. Over our sample period, it appears that an increasing share of total player salary is accounted for by signing bonuses. For the purposes of salary cap computation, any signing bonuses are pro-rated over the life of the player's contract, which will typically cover more than one season. The pro-rated salary measure is reported in *USA Today* and on Rodney Fort's Web site, www.Rodneyfort.com/SportsBusiness, and this will be used in our empirical analysis. This measure is now accepted as standard in studies of NFL salary determination.

**Table 4**
**Descriptive Statistics for Real Salary**

| Deflated by NFL Average Wage, 2000 Base Year | White $n = 435$ | Black $n = 95$ |
|---|---|---|
| Mean | $2,615,553 | $2,536,037 |
| Standard deviation | $2,284,601 | $1,930,611 |
| 10th percentile | $413,224 | $471,033 |
| 25th percentile | $793,444 | $819,596 |
| Median | $1,762,497 | $1,898,695 |
| 75th percentile | $4,110,626 | $3,938,629 |
| 90th percentile | $6,046,535 | $5,463,845 |
| Skewness | 1.072 | 0.716 |
| Kurtosis | 3.382 | 2.494 |

Note: NFL = National Football League.

Unlike other sports, only the signing bonus is guaranteed in the NFL. Hence, NFL players who do not perform can see their salary in the future reduced or eliminated. Consequently, although a player may have signed his current contract sometime in the past, current pay is tied quite closely to very recent past performance. Players who do not perform according to expectations can expect teams to either force the player to sign a new contract for less money or be cut from the team.

We want to compare determinants of quarterback salary for players that are some distance apart in time, as our sample period covers 1995 to 2006. For salary data in standard occupations, deflating nominal salary by a consumer price index is sufficient for this, but salaries in the NFL have considerably outstripped consumer price inflation, fueled by lucrative broadcast contracts. Consequently, we deflate salaries by the average NFL wage, taken as season averages from large samples of NFL players shown in files at www.rodneyfort.com/SportsBusiness.[9]

Table 4 shows some descriptive salary statistics. An examination of the distribution of salaries for Blacks and Whites reveals that little disparity exists in the compensation of each population at the median or below, but at the 75th and 90th percentiles, it seems that White quarterbacks earn more than Black quarterbacks. Consistent with this, the salary distribution for Black quarterbacks is less compressed and has less skewness and kurtosis compared to the distribution for White quarterbacks. The potential for discrimination is apparent in that Black quarterbacks do not appear to generate the very high rewards in the upper right hand tail of the salary distribution. Of course, it could simply be that the best Black quarterbacks are not as able as the best White quarterbacks. Multivariate regression is needed if we are to reveal genuine disparities by race, controlling for player productivity and other influences.

The specification of our multivariate regression depends on our measure of worker productivity. We shall offer results from estimation with four sets of productivity measures. For now, we summarize our measures by the vector

PERFORMANCE and note that this can be a single measure (e.g., quarterback rating) or a group of measures. We also note that current season measures of productivity always generated insignificant coefficients, either singly or in groups. Prior season productivity measures do appear to influence player salary.[10]

This finding emphasizes the importance of recent performance in a predetermined multiperiod salary bargaining. However, we experimented with career-based cumulative measures of productivity and could find no systematic influence from these. We would note that performance by NFL signal callers is surrounded by much statistical noise reflecting both player injuries, as well as the stochastic element in the performance of teammates on which the quarterback's performance will depend. The regular season itself is short with just 16 games, so variations in form and bad luck on critical plays will play a larger role in performance measurement than it would in a sport such as baseball, where ''true'' performance can be revealed over a 162-game season.

Beyond our measure of performance, we consider a collection of additional regressors.[11] These regressors can be divided into three groupings: Player characteristics, team characteristics, and race.

As is standard in Mincer-type sports salary regressions, the first regressor we note is a measure of experience. This will be total years of experience in the League including the current season (EXP). The predicted concave relationship between productivity and experience is captured by a squared term (EXPSQ). Years of experience, though, does not distinguish between time as a starter and time on the bench. We would expect starters—who would be involved in more plays than a back-up—to demand additional pay. To capture the impact of being a starter, we also include as an independent variable a quarterback's CAREER PASS ATTEMPTS.[12]

Quantity of play is not the entire story. Perceptions of quality are also important. Prior literature on NFL salaries has stressed the role of draft status as a predictor of salary (Kahn, 1992). The best college football players are drafted into NFL franchises in seven rounds. Ceteris paribus, a quarterback drafted in the first round is predicted to have more ability than a round six draftee. This is partly self-fulfilling because teams devote considerable coaching resources to ensure that their first round draft picks are nurtured into genuine on-field talent.[13] Kahn used the reciprocal of draft round, but we experimented with dummy variables for each round and found significant coefficients for the first two rounds only. Hence, we include DRAFT ROUND 1 and DRAFT ROUND 2 as our measures of draft status. We assume that the impact of draft status only holds if the player remains with the team that drafts him; once the player is traded, the impact of draft status is lost. If the player does stay with his drafting team, then the impact of draft status remains for the duration of his tenure with that club.

NFL players are broadly eligible for free agency after four seasons of experience. After 3 years, players have restricted free-agent status in which teams holding the player's contract are allowed to make offers that at least match those available on the free-agent market. Experimentation revealed that the impact of veteran or free-

agent status does not depend on whether we use 3 or 4 years as the qualifying period. Hence, we denote players with at least 3 years of NFL experience by a coding of one in the dummy variable, VETERAN.

A feature of our data is that quarterbacks that are traded seem to receive lower salaries. Some players experience a salary reduction in joining a new team followed by enhanced salary in later years. This suggests that free-agent trades are seen as risky by acquiring teams and that they need to be convinced of a new quarterback's ability before committing to a large contract. We capture the effect of player trades on salary by the dummy variable CHANGE TEAM. This takes a value of one for the season immediately after the player is traded.[14] The share of Black players who change team, that is are traded, in a given season is 17%. The share of Black player–season observations in our sample is 18%. Hence, there is no distinctive racial pattern to quarterback trades in our sample. It is not the case that Black quarterbacks are more prone to be traded than White quarterbacks.

The final player characteristic we consider is another measure of perception of reputation. Each year NFL fans, players, and coaches nominate a set of players to appear in the Pro Bowl. This is an indicator of fan and peer esteem and can be thought of as a reputation attribute. We use PROBOWL to indicate a player who has appeared in this special game, with a value of one starting from the season after the first appearance and continuing as one throughout the rest of the player's career. Hence, we hypothesize that once gained, Pro Bowl reputation persists even if the player does not subsequently receive nomination.

Beyond characteristics unique to the player, we also consider some characteristics of the team employing the player. The team's market size is proxied using log population of the local SMSA (LNSMSA).[15] We have reason to expect population and salary to have a fairly weak link. Team revenues in the NFL are shared to a greater extent than in other pro sports. The broadcast contract is negotiated centrally by the NFL, with equal shares of sales of broadcast rights. Gate revenues are shared between teams with the away team receiving 40% of revenues from ticket sales. Merchandise sales are organized centrally with revenues equally shared among teams. With these features of revenue distribution firmly in place, we do not expect the impact of local market size to be important.

Although marginal revenue might not vary much from team to team, the marginal productivity of a quarterback depends on the quality of his teammates. A quarterback needs a strong offensive line to protect him from an aggressive defense and give him sufficient time to throw the ball. He also needs good receivers to catch his passes.

The role of team complementarity in pro sports is an underresearched topic in sports economics (Borland, 2006). For the National Hockey League, Idson and Kahane (2000) captured complementarity of teammate performance as total team performance measure minus the magnitude of a particular player's contribution. Significant impacts of teammate productivity on player salary were found. In the NFL, such a direct approach is not possible for two reasons. First, performance

measures are not available for the offensive line. Additionally, it is difficult to separate the production of wide receivers from the production of quarterbacks. Do yards gained in a pass play ''belong'' to the quarterback or the wide receiver? Both are responsible for a successful play.

Rather than artificially attribute team performance measures to groups of players, we take as a proxy for the ability of teammates to be the total salary of a particular unit on a given team led by a quarterback. We introduce OFFENSE SALARY as the total salary of all the ''skill'' position players on the team, excluding quarterbacks of course. These are wide receivers, tight ends, and running backs. The ability of a set of skill position players is assumed to be correlated with OFFENSE SALARY. If more able skill position players raise quarterback performance, and hence salary, the coefficient on OFFENSE SALARY is expected to be significant and positive.

We should note that NFL franchises have to adhere to a league-wide salary cap, or a maximum payroll set as a proportion of team designated gross revenues. If a team spends more on its skill position players, it may decide to pay less to quarterbacks, given their ability. The ''thin'' market for NFL quarterbacks, with just 32 pro teams, might lead to reductions in quarterback salaries which are realizable, given monopsony power. If so, the coefficient on OFFENSE SALARY will be significant and negative. We experimented with a similar measure for offensive line players, following Simmons and Berri (in press), but this did not generate a significant coefficient. Offensive line salary is therefore excluded from our estimates.

Our final variable is player race. This is indicated by the dummy variable BLACK determined by visual inspection of player photographs. In our sample, all quarterbacks were unambiguously either White or Black. As noted above, the use of an intercept dummy to explore race-based disparities in salary is limited because it necessarily assumes that returns to player attributes are equivalent for each subgroup. A more sophisticated approach is to explore interaction terms between BLACK and the PERFORMANCE vector. Equation (1) reports the specific salary model we will estimate.

$$\begin{aligned} \ln\mathrm{SAL} = {} & b_0 + b_1 * \mathrm{PERFORMANCE} + b_2 * \mathrm{EXP} + b_3 * \mathrm{EXPSQ} \\ & + b_4 * \mathrm{CAREER\ PASS\ ATTEMPTS} + b_5 * \mathrm{DRAFT\ ROUND\ 1} \\ & + b_6 * \mathrm{DRAFT\ ROUND\ 2} + b_7 * \mathrm{VETERAN} + b_8 * \mathrm{CHANGE\ TEAM} \\ & + b_9 * \mathrm{PRO\ BOWL} + b_{10} * \mathrm{OFFENSE\ SALARY} + b_{11} * \mathrm{LNSMSA} \\ & + b_{12} * \mathrm{BLACK} + b_{13} * \mathrm{BLACK} * \mathrm{PERFORMANCE} + \mathbf{e}_t \end{aligned} \tag{1}$$

## 3. Empirical Findings

Salaries of players in professional sports are typically more highly skewed than in other occupations [see e.g., Hamilton (1997) for NBA and Lucifora and Simmons (2003) for Italian soccer]. Interestingly, the kernel density for Black quarterbacks

is less skewed than for White quarterbacks in our sample. Summary measures of skewness and kurtosis in Table 4 show considerable differences. With a kurtosis value in excess of three, the White salary distribution displays excess kurtosis and is leptokurtic. These properties are incompatible with a normal distribution. The White salary distribution might be influenced by some outlier observations for one player, Peyton Manning who received a much larger salary than his peers, but even when Peyton Manning is removed from the sample the differences in skewness remain.

Given the skewness in our data we follow the lead of Hamilton (1997) and Leeds and Kowalewski (2001) and explore these distributional differences below using quantile regressions (Koenker, 2005). At the median, quantile regression minimizes the sum of absolute differences from the fitted regression line. A particular advantage of this estimation method is that we can assess impacts of covariates, especially those involving race, at different points of the salary distribution, not just the median.[16] This is particularly relevant when our descriptive statistics in Table 4 seem to be pointing toward salary differences between Black and White quarterbacks at the 75th and 90th percentiles. Compared to Ordinary Least Squares, quantile regression is less sensitive to outliers and is more robust to departures from normality and also to heteroskedasticity.

Our preferred model contains a full set of performance measures, rather than a single measure, and is shown in Table 5. Before turning to our findings with respect to race and player productivity, it is useful to note our results with respect to our other regressors. We find that salary is positively affected by experience and its square, apart from the 0.1 quantile where inexperienced players would tend to be located. In addition, salary increases initially with experience, but declines as expected as a player reaches the end of his career. The turning point on experience is in the range of 7 to 10 years, implying plausible salary-maximizing age levels of 28 to 32. Also, draft positions 1 and 2, career pass attempts and offense salary deliver significant quarterback salary effects at some, if not all, quantiles. Other offense players appear to generate significant complementarities with quarterback productivity. Players who change teams experience salary reduction, ceteris paribus. Population, as we expected, is not found to be a significant predictor of salary.

What of quarterback performance and race? In Table 5, we disaggregate performance into five measures: PASS YARDS, TOUCHDOWNS PER ATTEMPT, COMPLETIONS PER ATTEMPT, INTERCEPTIONS PER ATTEMPT, and RUSH YARDS.[17] Of these, we predict positive coefficients on all variables with the exception of INTERCEPTIONS PER ATTEMPT, for which we expect a negative coefficient. When a quarterback's pass is intercepted it both deprives his team of a scoring opportunity and sets the opposition up with an opportunity to score points.

We also interact BLACK with PASS YARDS and RUSH YARDS.[18] In section 1 above, we highlighted the fact that Black quarterbacks tend to run with the ball more

**Table 5**
**Quantile Regressions of Log Real Salary: With Full Performance Measures**

| | Quantile | | | | |
|---|---|---|---|---|---|
| Variable | 0.1 | 0.25 | 0.5 | 0.75 | 0.9 |
| EXP | 0.094 (1.08) | 0.137 (2.34) | 0.191 (2.53) | 0.167 (2.79) | 0.139 (1.99) |
| SQEXP | −0.007 (1.35) | −0.008 (2.62) | −0.011 (2.86) | −0.011 (3.02) | −0.010 (2.84) |
| DRAFT ROUND 1 | 0.612 (2.85) | 0.842 (6.76) | 0.862 (6.99) | 0.713 (6.47) | 0.462 (3.35) |
| DRAFT ROUND 2 | 0.656 (3.26) | 0.723 (3.80) | 0.650 (3.75) | 0.520 (3.16) | 0.371 (2.11) |
| VETERAN | 0.589 (3.40) | 0.558 (3.82) | 0.419 (2.14) | 0.242 (1.67) | 0.104 (0.71) |
| CHANGE TEAM | −0.639 (3.79) | −0.531 (5.92) | −0.364 (2.88) | −0.417 (4.04) | −0.326 (1.98) |
| PROBOWL | 0.265 (1.45) | 0.281 (3.02) | 0.194 (1.74) | 0.101 (1.05) | 0.009 (0.08) |
| LNSMSA | 0.019 (0.26) | 0.016 (0.32) | −0.009 (0.20) | 0.007 (0.21) | 0.034 (0.62) |
| OFFENSE SALARY | 0.221 (1.14) | 0.340 (2.59) | 0.346 (2.63) | 0.438 (2.90) | 0.249 (1.43) |
| CAREER PASS ATTEMPTS | 0.120 (3.08) | 0.115 (3.21) | 0.145 (2.98) | 0.206 (4.63) | 0.223 (3.42) |
| PASS YARDS | 0.284 (4.80) | 0.273 (6.86) | 0.317 (6.98) | 0.262 (7.07) | 0.147 (2.76) |
| BLACK | 0.057 (0.34) | 0.094 (0.53) | 0.320 (1.44) | 0.170 (1.16) | −0.113 (0.50) |
| BLACK*PASS YARDS | −0.028 (0.22) | −0.116 (1.51) | −0.263 (3.40) | −0.219 (3.54) | −0.166 (2.27) |
| TOUCHDOWNS PER ATTEMPT | 0.007 (0.01) | 0.032 (0.07) | −0.524 (0.93) | −0.917 (1.92) | −1.015 (1.36) |
| COMPLETIONS PER ATTEMPT | 0.352 (1.68) | 0.011 (0.05) | −0.054 (0.15) | −0.119 (0.30) | 0.349 (0.50) |
| INTERCEPTIONS PER ATTEMPT | −2.497 (0.90) | −2.277 (1.20) | −0.425 (0.26) | −1.392 (1.73) | −3.775 (2.25) |
| RUSH YARDS | 0.024 (0.31) | 0.056 (1.06) | 0.044 (0.80) | 0.021 (0.44) | 0.059 (0.96) |
| BLACK*RUSH YARDS | 0.067 (0.44) | −0.025 (0.03) | 0.019 (0.25) | 0.065 (1.13) | 0.051 (0.83) |
| Pseudo $R^2$ | 0.42 | 0.46 | 0.45 | 0.40 | 0.33 |
| *N* | 530 | 530 | 530 | 530 | 530 |

Note: In Tables 5 and 6, dependent variable is log real salary for quarterbacks with positive pass attempts in previous season; sample period 1995-2006; salary is deflated by average NFL salary. Standard errors are bootstrapped with 200 replications. *t* Statistics appear in parentheses. NFL = National Footbal League; QB = quarterback.

than their White counterparts. Our model allows us to assess whether differences in passing and rushing performance are reflected in estimated quarterback salary.

The results in Table 5 show significant impacts of PASS YARDS at all estimated quantiles. The coefficient on TOUCHDOWNS PER ATTEMPT is, perhaps surprisingly, insignificant at any quantile. The coefficient on COMPLETIONS PER ATTEMPT is insignificant at all quantiles while the coefficient on INTERCEPTIONS PER ATTEMPT is only negative and significant at the 90th percentile. This suggests that the very best quarterbacks do suffer a salary penalty for the

**Table 6**
**Alternative Estimates of Race and Race Interacted With Performance**

| | Quantile | | | | |
|---|---|---|---|---|---|
| Variable | 0.1 | 0.25 | 0.5 | 0.75 | 0.9 |
| Quarterback Rating | | | | | |
| BLACK | −0.440(0.69) | 0.451 (0.69) | 1.684 (2.71) | 1.380 (2.61) | 1.047 (1.48) |
| BLACK* QUARTER-BACK RATING | 0.0044 (0.59) | −0.0079 (1.06) | −0.023 (3.05) | −0.021 (3.28) | −0.018 (2.02) |
| Pseudo $R^2$ | 0.36 | 0.39 | 0.40 | 0.35 | 0.30 |
| Quarterback Score | | | | | |
| BLACK | 0.112 (0.77) | 0.098 (0.82) | 0.328 (1.53) | 0.083 (0.56) | −0.273 (1.47) |
| BLACK*QB SCORE | −0.343 (1.67) | −0.311 (2.62) | −0.546 (3.22) | −0.392 (2.81) | −0.090 (0.49) |
| Pseudo $R^2$ | 0.40 | 0.44 | 0.44 | 0.38 | 0.30 |
| Pass and Rush Yards | | | | | |
| BLACK | 0.035 (0.19) | 0.183 (1.29) | 0.202 (0.19) | 0.221 (1.30) | −0.164 (0.61) |
| BLACK*PASS YARDS | −0.051 (0.40) | −0.143 (2.08) | −0.225 (2.47) | −0.239 (4.03) | −0.137 (1.60) |
| Pseudo $R^2$ | 0.42 | 0.46 | 0.45 | 0.40 | 0.31 |

interceptions that they create. The only performance measure that has systematically significant coefficients across the salary distribution is PASS YARDS. Our results suggest previous season pass yards achieved is the most fundamental performance measure by which NFL quarterbacks are rewarded.

In Table 5, we find that the marginal salary return to additional rushing yards is not significantly different from zero for all quarterbacks, Black and White, at all estimated quantiles. Note that the coefficient on RUSH YARDS remains insignificant when the interaction term with BLACK is removed. These results imply that Black quarterbacks are not rewarded for their distinctively greater rushing contributions, a result suggestive of salary discrimination against Black quarterbacks.

Evidence of salary discrimination is also provided by the significant, negative coefficient on BLACK*PASS YARDS at 50th, 75th, and 90th percentiles in Table 5. Black quarterbacks at median salary or above suffer reduced salary compared to White quarterbacks with similar characteristics, with the size of salary penalty rising with the number of pass yards. The BLACK intercept dummy has an insignificant coefficient at all estimated quantiles, so there is no offset to performance-related salary disadvantage to Black players. In the upper region of the salary distribution, therefore, Black players suffer a salary disadvantage that rises as performance levels, assessed by pass yards, increase.

In Table 6, we show coefficient estimates of BLACK and BLACK* PERFORMANCE from three alternative performance measures. Coefficients on control variables have consistent signs and magnitudes across the four sets of

estimates in Tables 5 and 6 . Hence, Table 6 focuses on estimates of BLACK and BLACK*PERFORMANCE. First, we use QUARTERBACK RATING. This model generates a negative and significant coefficient on BLACK*QUARTERBACK RATING at median, 0.75 and 0.90 quantiles, consistent with our preferred model in Table 5. However, at median and 0.75 quantile, there is a significant and positive coefficient on the shift term, BLACK. This has the potential to offset, and possibly dominate, the negative effect of BLACK* QUARTERBACK RATING. Although the market for quarterbacks may well respond to a counter-intuitive and artificial measure such as the quarterback rating, simply because it is widely publicized in the media, we find that the goodness of fit pseudo $R^2$ value is lower for the quarterback rating measure than for any of the alternatives in Table 5 and 6 . This suggests that we should place greater emphasis on alternative measures of performance.

When quarterback rating is replaced by QB SCORE, which introduces quarterback rushing yards as a feature of performance, the estimates show higher pseudo $R^2$ at all quantiles. The coefficient on BLACK*QB SCORE is negative and significant at 0.25, median and 0.75 quantiles, though not 0.90.

Finally, Table 6 presents results from estimation of a parsimonious model with the generally insignificant terms TOUCHDOWNS PER ATTEMPT, COMPLETIONS PER ATTEMPT, INTERCEPTIONS PER ATTEMPT all removed. As before, the coefficients on RUSH YARDS and BLACK*RUSH YARDS are insignificant at all estimated quantiles.[19] The coefficient on BLACK*PASS YARDS is again negative and significant at 025, median and 0.75 quantiles, though not 0.90.

The coefficients on BLACK*PASS YARDS, reported in Table 5, and their 95% confidence intervals, can be used to assess the extent to which Black quarterbacks suffer salary discrimination at median and above. Specifically, we can compute Black–White salary ratios as follows. Omitting other influences on salary that are common across race, for Black players:

$$\text{Log salary} = \alpha B + \beta BX + \gamma X$$

where B denotes race dummy and X represents a performance measure that gives rise to potential discrimination. Then Salary (Black) = $\exp(\alpha B).\exp(\beta BX).\exp(\gamma X)$. For White quarterbacks, Log salary $=\gamma X$ because B is zero. Hence, Salary (White) = $\exp(\gamma X)$. The Black–White salary differential is then the ratio of Salary (Black) to Salary (White) and is given by $\exp(\alpha+\beta X)$.

Table 7 shows computations of Black–White salary differentials at different levels of pass yards per season. A value of unity signifies parity of salaries between Black and White quarterbacks, holding other covariates constant, and hence an absence of performance-related salary discrimination. At low levels of pass yards, experienced by back-up quarterbacks, we find modest levels of discrimination with salary ratios over 0.85 for 100 yards passing, but as pass yards increase, the salary ratio worsens considerably with estimates of under 0.75% at each quantile, as pass yards reach 2,000 per season.

**Table 7**
**Estimated Black–White Salary Differentials by Pass Yards**

| Pass Yards | Estimate | Lower Bound | Upper Bound |
|---|---|---|---|
| Median | | | |
| 100 | 0.974 | 0.959 | 0.989 |
| 500 | 0.877 | 0.813 | 0.946 |
| 1,000 | 0.769 | 0.660 | 0.895 |
| 2,000 | 0.591 | 0.436 | 0.801 |
| 3,000 | 0.454 | 0.288 | 0.717 |
| 0.75 Quantile | | | |
| 100 | 0.978 | 0.967 | 0.990 |
| 500 | 0.896 | 0.844 | 0.953 |
| 1,000 | 0.803 | 0.712 | 0.908 |
| 2,000 | 0.645 | 0.507 | 0.824 |
| 3,000 | 0.518 | 0.361 | 0.748 |
| 0.90 Quantile | | | |
| 100 | 0.984 | 0.969 | 0.998 |
| 500 | 0.920 | 0.856 | 0.989 |
| 1,000 | 0.847 | 0.733 | 0.978 |
| 2,000 | 0.717 | 0.537 | 0.957 |
| 3,000 | 0.608 | 0.393 | 0.936 |

Note: Lower bound and upper bound are derived from 95% confidence intervals using regression estimates in Table 5.

As an example, Donovan McNabb is a Black quarterback located at the top decile of the salary distribution with an average per season pass yards figure of 2,500 up to 2005. At 2,000 yards, his salary differential, compared to White quarterback of similar experience and career pass attempts, is estimated at 0.72, with a confidence interval of 0.54 to 0.96. At 3,000 yards, McNabb's salary differential falls further to 0.61, within a confidence interval of 0.39 to 0.94. From the estimates of BLACK*PASS YARDS coefficients in Table 5, we see first, a falling coefficient as we move through the salary distribution from median to 0.90 quantiles and second, a higher standard error on the coefficient at the 0.90 quantile which is reflected in a wider confidence interval at the upper tail of the salary distribution. This example and Table 7 as a whole serve to show the potential for substantial Black–White salary differentials to emerge from our empirical results.

## 4. Concluding Observations

The argument that the NFL is truly color-blind is bolstered somewhat in our examination of performance and our initial study of compensation. Although there does exist differences in style between Black and White signal callers, in more recent

years the difference in overall production has narrowed. Furthermore, average salaries are quite similar.

Of course, the NFL does have a history of discriminating against Black quarterbacks. Even today, although Black quarterbacks are not uncommon, the number of Blacks at this position is far below the numbers we observe at other positions. The story with respect to compensation is also not entirely positive. Using a quantile regression approach, we see evidence that neither White nor Black quarterbacks receive additional reward for extra rush yards achieved. Because Black players appear to be more adept at rushing than White quarterbacks, this suggests a lack of reward for an additional skill that Black quarterbacks bring to their teams.

We also find that Black players receive less compensation than White counterparts for additional passing contributions on the field, in the upper range (median and above) of the salary distribution. The significant, negative coefficients on pass yards achieved by Black quarterbacks provide evidence of performance-related discrimination in compensation. Moreover, we have shown that these negative coefficients can translate into substantial, adverse Black–White salary differentials, especially for high levels of per-season pass yards.

The scorecard suggests progress of Black quarterbacks has been made. It is also suggested, though, that more progress remains to be made with respect to equity of salary by race amongst signal callers in the NFL.

## Notes

1. For a review of the literature examining this issue prior to 1990s, see Kahn (1991). More recent studies of racial discrimination in professional baseball have found that discrimination against Blacks exists in the market for baseball cards (Andersen and La Croix [1991] and Fort and Gill [2000]), the hiring of National Basketball Association (NBA) players (Hoang and Rascher [1999]), and the pay to players in the upper tier of the NBA's income discrimination (Hamilton [1997]). Evidence of customer discrimination against Blacks was offered by Kanazawa and Funk (2001) and Burdekin, Hossfeld, and Smith (2005).

2. Hanssen and Andersen (1999) presented evidence that although blacks were discriminated against in the voting for baseball's midseason All-Star game in the 1970s, in the 1990s, it is Whites who suffer from discrimination. This finding is echoed in basketball by McCormick and Tollison (2001), who find that Black players are favored in the allocation of playing time.

3. With respect to NBA salaries, Jenkins (1996), Dey (1997), Gius and Johnson (1998), Bodvarsson and Brastow (1998, 1999), and Eschker, Perez, and Siegler (2004) offer little evidence of discrimination. More recently, Berri, Schmidt, and Brook (2004) failed to find evidence of customer discrimination in an examination of gate revenue in the NBA.

4. The story of Willie Thrower is reviewed in Finder (2002).

5. Although Briscoe finished second in the voting for the American Football League (AFL)'s rookie of the year, he was cut from the team before the start of the 1969 season. Briscoe did enjoy a career as an NFL wide receiver, but he never played quarterback again. (Associated Press: February 22, 2005)

6. See Leeds and Von Allmen (2005).

7. Using team baseball data from 1995 to 2004, one can explain 81% of the variation in a team's runs scored with a team's slugging percentage. In contrast, a measure like on-base plus slugging (OPS)—which is on-base percentage plus slugging percentage—can explain 90% of runs scored. Asher Blass (1992) used

a linear weights model, which consists of regressing the number of runs a team scored in the regular season on each teams accumulation of singles, doubles, triples, non-intentional walks, hit batsmen, stolen bases, sacrifice flies, the summation of double plays and caught stealing, and outs. This model, when estimated with data from 1995 to 2004, explains 94%. Given both OPS and the linear weights model, it is surprising researchers still use slugging percentage as the measure of a hitter's output.

8. ESPN.com, as well as other Web sites, reports the equation for the NFL's quarterback's rating.

9. Our substantive findings regarding salary discrimination still hold if we deflate salaries by consumer price index.

10. Use of prior season productivity measures has the effect of reducing the sample size available for regression analysis from 607, as reported in the descriptive statistics in Table 4, to 530.

11. A similar set of control variables appears in Simmons and Berri (2008).

12. Alternative measures of on-field experience include career total plays, starts, or games. The career pass attempts measure has the advantage of capturing a quarterback's primary on-field function. Substitution of these alternative measures of experience does not affect the results reported below. When career pass attempts are included the $R^2$ value is slightly higher than when any of the alternative experience measures is used.

13. The best quarterbacks are not necessarily round one draft picks as the current example of New England's Patriots quarterback, Tom Brady (round six) testifies. Brady led the Patriots to three Super Bowl titles in 2001, 2003, and 2004.

14. Most trades occur in the off-season.

15. We initially supplemented the population measure with the proportion of African Americans in the SMSA population (BLACKPOP) as a proxy measure to capture possible customer discrimination (see Bodvarsson and Partridge, 2001; Hamilton, 1997). However, this did not deliver significant coefficients in any of our estimations and was dropped from the analysis. A problem with this measure is that it does not vary through time. Our SMSA population measure is time-varying.

16. See Reilly and Witt (2007) for an analysis of racial discrimination in Major League Soccer that uses quantile regression to estimate a salary model.

17. Inclusion of a further adverse characteristic, fumbles lost per play, results in an insignificant coefficient at all quantiles.

18. We also interacted BLACK with TOUCHDOWNS PER ATTEMPT, COMPLETIONS PER ATTEMPT, and INTERCEPTIONS PER ATTEMPT, but these terms delivered insignificant coefficients at all estimated quantiles and are omitted from the results in Table 5.

19. We regard this as indicative of discrimination, because rush yards contribute to team performance regardless of whether these are achieved by a running back or quarterback. Salary should reflect both individual and team performance, but we acknowledge that zero coefficients on RUSH YARDS and BLACK*RUSH YARDS may occur for reasons other than discrimination. Rushing yards by quarterbacks may be a consequence of unplanned, broken plays; this is termed ''scrambling'' in National Football League (NFL) parlance. Also running plays put quarterbacks at risk of injury, causing an adverse longer term effect on team performance. Each of these factors may cause teams to disregard the role of rushing yards when negotiating a quarterback's salary. Despite these factors, though, there is evidence that a quarterback's speed affects a quarterback's draft position (see Berri and Simmons [2008]). If rushing ability was not a positive for quarterbacks, it is hard to understand why a quarterback's speed would affect where a quarterback is chosen in the draft.

## References

Andersen, T., & La Croix, S. J. (1991). Customer racial discrimination in Major League Baseball. *Economic Inquiry*, *29*, 665-677.

Associated Press. (2005). Black quarterbacks tell of obstacles they had to overcome, February 22, 2005. Posted on ESPN.Com.

Berri, D. J. (2007). Back to back evaluations on the gridiron. In J. Albert & R. Koning (Eds.), *Statistical thinking in sports* (pp. 241-262). Boca Raton, FL: Chapman and Hall/CRC Press.

Berri, D. J., Schmidt, M. B., & Brook, S. L. (2004). Stars at the gate: The impact of star power on NBA gate revenues. *Journal of Sports Economics*, *5*, 33-50.

Berri, D. J., Schmidt, M. B., & Brook, S. L. (2006). *The wages of wins*. Stanford, CA: Stanford University Press.

Berri, D. J., & Simmons R. (2008). *The quarterback quandary: Drafting signal callers in the National Football League* (working paper). Lancaster, UK: Lancaster University Management School.

Blass, A. A. (1992). Does the baseball labor market contradict the human capital model of investment? *The Review of Economics and Statistics*, *74*, 261-268.

Bodvarsson, O. B., & Brastow, R. T. (1998). Do employers pay for consistent performance? Evidence from the NBA. *Economic Inquiry*, *36*, 145-160.

Bodvarsson, O. B. & Brastow, R. T. (1999). A test of employer discrimination in the NBA. *Contemporary Economic Policy*, *17*, 243-255.

Bodvarsson, O. B. & Partridge, M. D. (2001). A supply and demand model of co-worker, employer and customer discrimination. *Labour Economics*, *8*, 389-416.

Borland, J. (2006). Production functions for sporting teams. In Andreff, W. & Szymanski, S. (Eds.), *Handbook on the economics of sport* (pp. 610-615). Cheltenham, UK: Edward Elgar.

Burdekin, R. C., Hossfeld, R. T., & Smith, J. K. (2005). Are NBA fans becoming indifferent to race? Evidence from the 1990s. *Journal of Sports Economics*, *7*, 144-159.

Dey, M. S. (1997). Racial differences in National Basketball Association players' salaries. *American Economist*, *41*, 84-90.

Doran, J., & Doran, D. R. (2004). *Inequality in pay: A study of wage disparity in the NFL, Florida State University Department of Finance* (working paper). Available at SSRN:http://ssrn.com/abstract-628422.

Eschker, E., Perez, S. J., & Siegler, M. V. (2004). The NBA and the influx of international basketball players. *Applied Economics*, *36*, 1009-1020.

Finder, C. (2002). Trail blazer: Willie ''the pro'' Thrower opened door for black quarterbacks. Pittsburgh Post Gazette (February 24). Available from http://www.post-gazette.com/sports/columnists/20020224finder0224p1.asp.

Fort, R. D., & Gill, A. (2000). Race and ethnicity assessment in baseball card markets. *Journal of Sports Economics*, *1*, 21-38.

Gius, M., & Johnson, D. (1998). An empirical investigation of wage discrimination in professional basketball. *Applied Economics Letters*, *5*, 703-705.

Gius, M., & Johnson, D. (2000). Race and compensation in professional football. *Applied Economics Letters*, *7*, 73-75.

Hamilton, B. H. (1997). Racial discrimination and professional basketball salaries in the 1990s. *Applied Economics*, *29*, 287-296.

Hanssen, F. A., & Anderson, T. (1999). Has discrimination lessened over time? A test using baseball's all-star vote. *Economic Inquiry*, *37*, 326-352.

Hoang, H., & Rascher, D. (1999). The NBA, exit discrimination, and career earnings. *Industrial Relations*, *38*, 69-91.

Idson, T. L. & Kahane, L. H. (2000). Team effects on compensation: An application to salary determination in the National Hockey League. *Economic Inquiry*, *38*, 345-357.

Jenkins, J. A. (1996). A re-examination of salary discrimination in professional basketball. *Social Science Quarterly*, *77*, 594-608.

Kahn, L. M. (1991). Discrimination in professional sports: A survey of the literature. *Industrial and Labor Relations Review*, *44*, 395-418.

Kahn, L. M. (1992). The effects of race on professional football players' compensation. *Industrial and Labor Relations Review*, *45*, 295-310.

Kahn, L. M. (2000). A level playing field? Sports and discrimination. In Kern, W. (Ed.), *The Economics of Sports* (pp. 115-130). Kalamazoo, MI: W.E. Upjohn Institute for Employment Research.

Kanazawa, M., & Funk, J. (2001). Racial discrimination in professional basketball: Evidence from Nielsen ratings. *Economic Inquiry*, *39*, 599-608.

Koenker, R. (2005). *Quantile regression*. Cambridge: Cambridge University Press.

Leeds, M. A., & von Allmen, P. (2005). *The economics of sports,* 2nd ed. Pearson Education Inc.

Leeds, M.A. & Kowalewski, S. (2001). Winner take all in the NFL: The effect of the salary cap and free agency on the compensation of skill position players. *Journal of Sports Economics*, *2*, 244-256.

Lucifora, C., & Simmons, R. (2003). Superstar effects in sport: Evidence from Italian soccer. *Journal of Sports Economics*, *4*, 35-55.

McCormick, R. E., & Tollison, R. D. (2001). Why do black basketball players work more for less money? *Journal of Economic Behavior and Organization*, *44*, 201-219.

Mogull, R. (1973). Salaries and race: Some empirical evidence. *Industrial Relations*, *12*, 109-112.

Mogull, R. G. (1981). Salary discrimination in professional sports. *Atlantic Economic Journal*, *9*, 106-110.

Reilly, B., & Witt, R. (2007). *Determinants of base pay and the role of race in Major League Soccer: Evidence from the 2007 league season* (Discussion Paper, D19/07). Guildford, UK: University of Surrey Department of Economics.

Scully, G.W. (1974). Pay and performance in Major League Baseball. *American Economic Review*, *64*, 917-930.

Simmons, R., & Berri, D. J. (in press). Gains from specialization and free agency: The story from the gridiron. *Review of Industrial Organization*.

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