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By: Johnny Ducking, **Peter A. Groothuis**, & James Richard Hill

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Abstract Exit discrimination is defined as the involuntary termination of employment due to racial characteristics holding productivity constant. We test for exit discrimination in the National Football League (NFL) using a panel study on career length. Our analysis focuses on six positional groups: defensive backs, defensive linemen, linebackers, running backs, tight ends and wide receivers. In our analysis, in addition to race, we include performance variables to determine their importance in determining career length. Using both parametric and semi-parametric hazard models, we find no evidence of exit discrimination in the NFL.

Keywords Discrimination · National football league · Hazard model

Literature Review

Labor market discrimination comes in many forms. Becker (1957) provided a seminal treatment for analyzing its theoretical foundations. Labor economists have found the area of professional sports to be a productive area in which to conduct empirical studies of labor market discrimination. With the abundance of readily available measures of employee productivity and salary information, researchers discovered a virtual laboratory to conduct experiments according to Kahn (2000).

J. Ducking (✉)
North Carolina A & T State University, Greensboro, NC, USA
e-mail: jcduckin@ncat.edu

P. A. Groothuis
Appalachian State University, Boone, NC, USA
e-mail: groothuispa@appstate.edu

J. R. Hill
Central Michigan University, Mt Pleasant, MI, USA
e-mail: hill1jr@cmich.edu

In major league baseball, Gwartney and Haworth (1974) used data following the fall of the color barrier in baseball to support Becker's theoretical assertion that less discriminatory employers could gain a competitive advantage by hiring more productive black players at a lower cost. Despite the influx of black players into Major League Baseball (MLB), Pascal and Rapping (1972), Scully (1974), Medoff (1975) and Mogull (1975) still found significant performance differences between black and white baseball players suggesting barriers to entry. Similar findings emerged in the National Basketball Association (NBA) concerning black-white performance differentials (Scully 1973 and Brown et al. 1991) and in the National Hockey League (NHL) for French-Canadian versus non-French-Canadian players (Lavoie et al. 1987).

Pay Discrimination

The vast majority of research into labor market discrimination in professional sports focuses on pay discrimination. Scully (1974) found significant pay discrimination against black players using 1968-69 data in baseball. Using the technique developed by Oaxaca (1973), Hill and Spellman (1984) did not find evidence of pay discrimination against minority players using 1976-1977 baseball data, nor have most researchers since. Perhaps, the addition of salary arbitration to the MLB collective bargaining agreement in 1973 and the addition of free agency in the 1976 agreement have eliminated pay discrimination in baseball. Or perhaps, using a Becker-like argument, market competition for the best players in a competitive environment to achieve a winning team has overcome personal prejudice. Recently however, Palmer and King (2006) and Holmes (2011) both conclude that there is pay discrimination against black and Hispanic players in the lower ranges of the salary distribution in baseball.

In hockey, both Lavoie et al. (1987) and Jones and Walsh (1988) found significant pay discrimination against French-Canadian defensemen using 1977–78 data. Research into pay discrimination in the NBA has provided similar results. Kahn and Sherer (1988) created quite a stir with their finding of substantial pay discrimination against black players in a league that was dominated (75 %) by black athletes. However more recent research (Hill 2004 and Bodvarsson and Brastow 1999) has failed to find salary discrimination in the NBA using data from the 1990s. The institutionalization of pay in the NBA through various collective bargaining agreements may have eliminated most possibilities of personal prejudice in contracting. However, Kahn and Shah (2005) suggest there was pay discrimination against nonwhite marginal players in the 2001-02 season.

Positional Discrimination

An offshoot of barrier-to-entry discrimination can be found in the positional segregation sports literature. Pascal and Rapping (1972) and Scully (1974) among others found that blacks in baseball were more likely to be found in the outfield versus pitching, catching or infield positions. The offered explanations could easily be characterized according to Becker's (1957) separation of the source of personal prejudice by customers (fans), fellow employees (players), or employers/managers (team owners/

coaches). In the NBA Kahn and Sherer (1988) found underrepresentation of blacks at the center and forward position but in an earlier study Curtis and Loy (1978) did not observe positional segregation patterns. Lavoie (1989) found evidence of positional stacking involving minority (French-Canadian) hockey players. More recently, Pitts and Yost (2013) found position segregation in college football where black high school quarterbacks and white high school running backs were more likely to change positions in college than their white and black counterparts, respectively.

Exit Discrmination

Johnson and Marple (1973) pioneered a new branch of discrimination research when they found evidence from 1970-71 NBA data that marginal white players had longer careers than marginal black players. Hoang and Rascher (1999) more formally developed a model to explore the concept of racially-based retention barriers in the NBA. They, too, found evidence that, performance being equal, there was “exit discrimination” in the NBA. Groothuis and Hill (2004) failed to confirm Hoang and Rascher’s results using more recent data, height as an added explanatory variable, and a duration model that allowed for both stock and flow samples. Jiobu (1988) found evidence that race decreased career length, ceteris paribus, for black players but not Hispanics using Major League Baseball data from 1971 to 1985. Again, Groothuis and Hill (2008) failed to find exit discrimination in MLB using more recent data from 1990 to 2004 and a model that better accounted for performance decay.

Discrimination in the NFL

Overall very few studies have examined discrimination in the NFL (Ducking et al. 2014, Keefer 2013, Gius and Johnson 2000, Kahn 1992, Mogull 1981, Mogull 1973 and Scully 1973). Most of these studies examined wage discrimination. Keefer (2013), Kahn (1992) and Mogull (1981) all find white players were paid a wage premium. Using career earnings, Ducking et al. (2014) find no evidence of compensation discrimination. Lastly, Gius and Johnson (2000) found black players were paid a premium of about ten percent; however, their results were only significant at the ten percent level.[1] Scully (1973) focusing on positional discrimination, found that black players tended to be overrepresented at the defensive backs, running backs, and wide receivers positions while being underrepresented as quarterbacks, kicking specialists, centers, guards, and linebackers. No study has looked at exit discrimination in the NFL.

Theory

The textbook definition of discrimination in the labor market implies that certain individuals or groups of workers are somehow treated differently than others unrelated to ability or performance. As discussed above labor economists have explored a variety

[1] Although Gius and Johnson (2000) find a ten percent wage premium for black NFL players their specifications do not include any performance variables suggesting that the race variable is capturing the impact of performance.

of formats for this differential treatment. Exit discrimination may represent the most recent path of research in the field. Hoang and Rascher (1999) define exit discrimination as "the involuntary dismissal of workers based on the preferences of employers, coworkers, or customers." Research on this topic assumes that all turnover is involuntary; Kahn (1991, p. 406) argues that the high salaries paid in sports make voluntary quits unlikely. Thus these studies are essentially survival models. If white players have longer careers than black players with similar performance statistics then exit discrimination is said to exist.[2]

Jiobu (1988) and Hoang and Rascher (1999) concluded that career length for black players in Major League Baseball and the NBA respectively were lower than their white counterparts, ceteris paribus. While Jiobu does not make any calculations on the impact of exit discrimination on career earnings, Hoang and Rascher (1999) conclude that this form of discrimination led to almost a two and a half times greater decrease in black career pay compared to the more heavily analyzed form of pay discrimination.

The motivation behind this form of discrimination could obviously come from personal prejudice on the part of owners/coaches or fans. Hoang and Rascher (1999) focused on customers as the source of the prejudice; the pay premium for white players was explained by the higher value of their performances compared to black players because of the prejudiced preferences of white, majority fans. Hoang and Rascher (1999, p.74) hypothesized:

> "To satisfy the fans, there is a minimum number of white players on a team. The second assumption, that the pool of quality available talent is becoming increasingly black, causes annual replacement of players with rookies to occur mostly among black players. The white players have longer careers simply because there are fewer qualified white rookies to replace them,…"

In his study of exit discrimination in Major League Baseball, Jiobu (1988, p.532) does not specifically test for customer discrimination but he does state:

> "Perhaps, motivated by the concern that white fans will not support a predominantly black team, management has silently placed an "invisible ceiling" on the black percentage. When coupled with the desire to have a winning team, this ceiling would generate strong pressures to (a) employ as many black players as possible in order to capitalize on their performance, but (b) in order to remain under the ceiling, to eliminate black players as soon as their performance declined, and (c) to retain white players of declining but similar ability."

Given the predominance of black athletes in the NFL today, the two arguments advanced above for baseball and basketball could easily be applied to football. Our

[2] Due to the potential for injury and health related issues some of the exit in the NFL might be employee initiated particularly with running backs such as Rashard Mendenhall, Tiki Barber, Ray Lewis and Barry Sanders. To address this concern we perform our survival analysis by analyzing a varying subset of players including those who earn the mean wage and below, one million and below, and five hundred thousand and below. We find that all specifications are essentially the same as the full specification. In all specifications, we find that performance lowers the likelihood of exit and that race has no influence on exit.

current research attempts to address this gap in the sports economics literature on discrimination by using both a Weibull proportional hazard model and a semi-parametric hazard model to test for differential survival patterns between black and white professional football players in the NFL.

Data

We use NFL data from 2000 to 2008 on six positional groups to perform this analysis. We split these groups into an offensive sample and a defensive sample. The offensive sample includes running backs, tight ends and wide receivers. The defensive sample includes defensive backs, linebackers and defensive linemen. These six positions are chosen because productivity measures are available and there are typically at least 3 players that play these positions for each team during a football game. Quarterback, punter and kicker are positions in which less than 3 players play in a game. These positions are excluded because of the small sample size. Offensive linemen are excluded because productivity measures are not available. We utilize productivity and demographic information as control variables in this analysis. Performance and demographic data are obtained from the NFL official website (www.nfl.com/players).[3]

In both the offensive and defensive models, we include games played and games started. These and all other player performance variables are time varying, and measured by season. Games played measures how often the player is used on the field by the team. This captures an intensity margin of productivity. Those players who are considered starters, and hence start the game, are typically considered the highest performing players. While these are crude proxies, they accurately measure the team's perception of the value of the player and thus are expected to have a positive impact on a player's career length or probability of duration.

Defensive player productivity is measured by tackles, sacks, passes defended, interceptions, and forced fumbles. Tackles are defined as the total number of times a player tackles an opponent during a season. Sacks are defined as the total number of times a player tackles the opposing quarterback behind the line of scrimmage during a season. Passes defended and interceptions measure the total number of times a player breaks up a pass or catches a pass thrown by the opposing quarterback. Forced fumbles are defined as the total number of times a defensive player causes an offensive player to lose the football. Tackles, sacks, passes defended, interceptions, and forced fumbles are expected to have a positive impact on career length because they measure the impact of the player's ability to help his team stop their opponent from scoring.

Offensive player productivity is measured by touches, yards, touchdowns, fumbles, and fumbles lost. Touches are defined as the sum of a player's rushing attempts and

[3] Our data are right truncated to provide the ability to use parametric survival analysis. Players are excluded if they play for more than one team during a season. Players are also excluded from the sample if a season is missing or skipped in the USA Today's NFL salary database (content.usatoday.com/sportsdata/football/nfl/salaries/team) or if their salary is not available in this database.

receptions, the number of opportunities a player has to gain yards. Touches are expected to have an ambiguous impact on career length because holding yards (and other measures) constant, an additional touch is simply another opportunity for a player to get injured or it might control for increased performance. Yards are defined as the sum of a player's rushing and receiving yards. Yards are expected to have a positive impact on career length because they measure the impact of the player's ability to help the team get closer to a scoring opportunity. Touchdowns are defined as the sum of a player's rushing and receiving touchdowns. Touchdowns are expected to have a positive impact on career length because they measure the impact of the player's ability to help the team score points. Fumbles represents the number of times a player has possession of the football and loses possession while fumbles lost measures those fumbles where the opposing team recovers possession. Fumbles and fumbles lost are expected to have a negative impact on career length because they represent either an opportunity for the opposing team to gain possession, or an actual loss of possession.

In addition to direct performance measures, we include demographic variables believed to be associated with performance. Body mass index and age are all measured during the first season the player enters professional football. Body mass index is expected to have a positive impact on player career length, while age is expected to have a negative impact.[4]

The defensive sample contains 653 players and 2,347 player years. Defensive backs represent 42.7 % of the defensive players while defensive linemen represent 29.6 % of the defensive players. Linebackers represent the remaining 27.7 % of the defensive players. Defensive backs have slightly shorter careers than other defensive positions and hence represent only 40.5 % of the defensive player years, while linemen and linebackers represent 31.1 % and 28.4 % of the defensive player years respectively.

The offensive sample contains 414 players and 1,368 player years. Running backs and wide receivers represent 39.7 and 41.4 % of the offensive players respectively. Tight ends account for only 18.9 % of the offensive sample. Running backs have slightly shorter careers than other offensive players and represent only 38.5 % of the offensive player years. Tight ends have slightly longer careers and represent 20.5 % of the player years, while wide receivers represent 41.0 % of player years.

The failure variable used to indicate whether a player's career length ends is a set of dummy variables representing each season a player played in the NFL. It is coded 1 for the season a player exits the NFL and 0 for all seasons the player does not exit the NFL. We determine which seasons a player plays in the NFL by the season variable that is included in both the NFL official website data and the USA Today NFL salary database. We determine which season is the player's last season in the NFL by identifying the last year indicated by the season variable in both the NFL official website data and the USA Today NFL salary database. In Fig. 1, we plot failure rates by both race and tenure. We find that for both offensive and defensive players' failure rates follow a bathtub plot with high failures early then lower amounts of failure for early

[4] In additional specifications weight, weight squared, and height were included. Weight and height both were found to be insignificant while weight squared was found to increase career length suggesting that player BMI might best capture the influence of height and weight on career length.

years of tenure and then increases for latter years of tenure (Groothuis and Hill 2004). For defensive players the white player failure rate is higher at all years of tenure except year six. For offensive players white players have lower failure rates for years two and three but higher failure rates than blacks for years four through seven.

Player performance measures are time varying, while player demographic variables are fixed throughout the player's career. We also include year as a time trend to capture changes to career length that might occur over time. To measure potential discrimination we use three measures. We first use a dummy variable equal to one if the player is

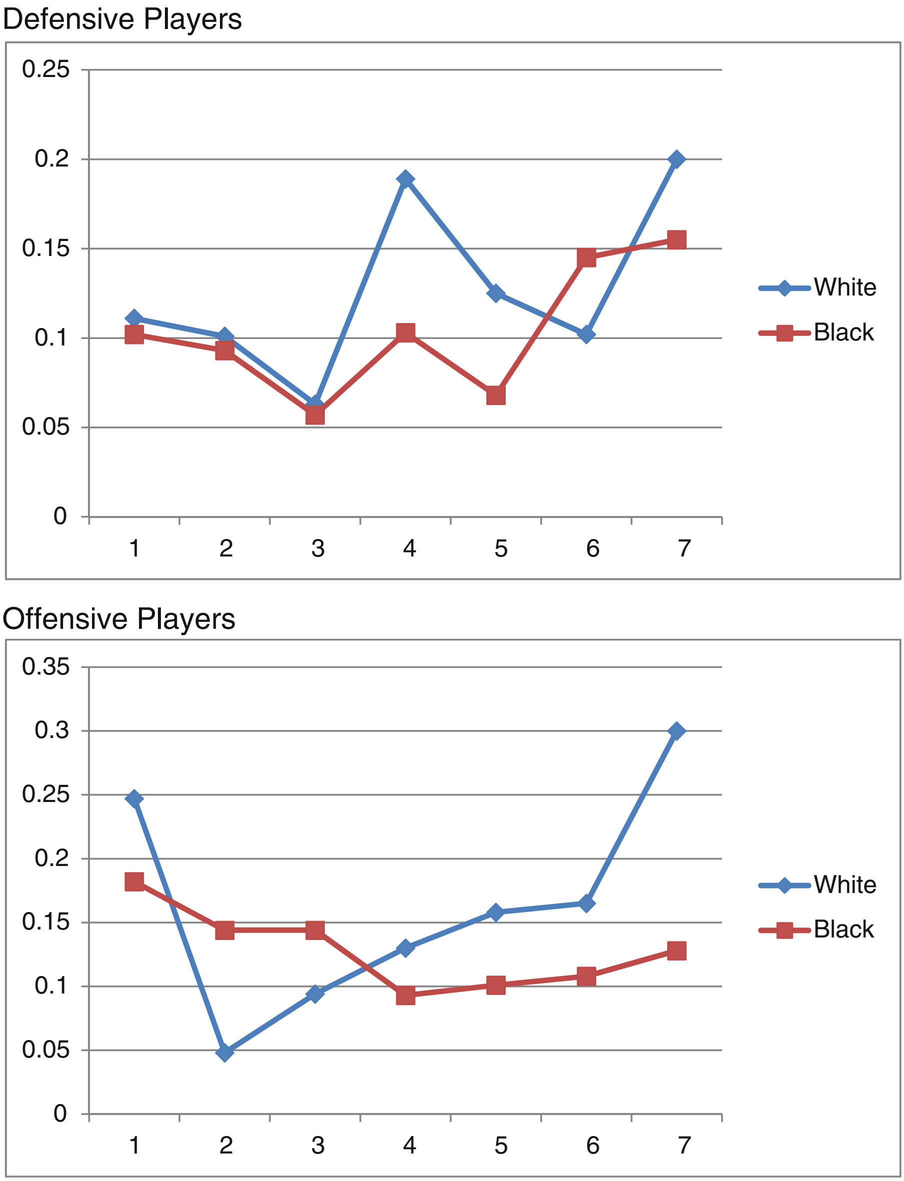

Fig. 1 Failure Rates

black and zero otherwise. We also use percentage of black residents in the NFL team's home location and an interaction term between the player's race and percentage of black residents. If exit discrimination is present it should be found in the dummy variable or the interaction term.

Empirical Model

In order to analyze if exit discrimination on career length is present in the NFL, we estimate two different hazard models using data from the NFL. We use two different techniques to test for robustness of the results. Both of the hazard models estimate the impact of race and other relevant explanatory variables on the length of time a player spends in the NFL. A hazard model defines an event which ends a spell of time, and such an event is called a failure, which is a statistical term with no implication that the event is desirable or undesirable. The failure in this research is the end of a player's NFL career. The hazard model calculates the conditional probability that the failure occurs between time period t and t+1, given that the failure has not occurred before time period t.

Parametric Hazard Model

The first model we estimate is the Weibull proportional hazard model with an inverse-Gaussian distribution as the assumed distribution of the frailty for both the sample of defensive positions and offensive positions.[5] The Weibull proportional hazard model assumes that the baseline hazard function has a Weibull distribution and allows covariates to have a proportional impact on the hazard. The baseline hazard is denoted by $h_0(t)$, time is denoted by t, the set of covariates is denoted by x_j, and the Weibull proportional hazard model is denoted by $h(t|x_j)$. The parameter p describes the direct effect of time, net of other explanatory variables, in Weibull distributions. If $p>1$, the hazard increases over time, while if $p<1$, the hazard decreases over time. In sports, the hazard increases over time ($p>1$) because the hazard of ending a career is large and growing year by year, based on aging. The hazard is exponentiated because it must be positive to be a conditional probability of an event occurring at time t given that the event did not occur before t.

$$\mathrm{h}_0(t) = pt^{p-1} exp(b_0) \tag{1}$$

$$\mathrm{h}\left(t \middle| x_j\right) = h_0(t) exp\left(x_j b_x\right) \tag{2}$$

$$\mathrm{h}\left(t \middle| x_j\right) = pt^{p-1} exp\left(b_0 + x_j b_x\right) \tag{3}$$

[5] For a discussion on frailty see Bodenhorn et al. (2012) and Price et al. (2008).

The Weibull distribution allows for flexibility in the baseline hazard and is an appropriate choice as long as the baseline hazard is monotonically increasing or decreasing. The proportional hazard model allows both time-varying and time invariant covariates to have a proportional impact on the baseline hazard. There are many other possible functional forms, but the estimates from hazard models are not sensitive to these alternatives as long as there are no policy spikes, times at which many failures occur, such as 52 weeks of unemployment or the date of reauthorization of welfare benefits (Manton et al. 1992). There are no such fixed policy times in sports careers.

Two important issues that might arise in survival time models are right censoring and left censoring. Those terms are based on a left to right time scale as in a graph. Right censoring refers to incomplete spells where a player's career has not ended by the last year of the panel study. Right censoring is handled by hazard models with the survivor function, which is the probability at time t that a spell has not ended by time t. Left censoring occurs when players start their careers before the panel begins. Our data has no left censoring. All careers in our data set begin either at the start of the panel, 2000, or after the panel study begins.

Semi-Parametric Hazard Model

To test for survival effects we estimate semi-parametric hazard functions following Berger and Black (1998), and Groothuis and Hill (2004). Since our data is at the season level we calculate our hazard model as a discrete random variable. As with Groothuis and Hill (2004), we model the durations of a single spell and assume a homogeneous environment so that the length of the spell is uncorrelated with the calendar time in which the spell begins.[6] This assumption lets us treat all the players' tenure as the same regardless of when it occurred in the panel study. For instance, all fourth year players are considered to have the same baseline hazard regardless of calendar time so a fourth year player in 2002 has the same baseline hazard as a fourth year player in 2008.

As the hazard function is the conditional probability of exiting the NFL given that the NFL career lasted until the previous season, the hazard function must have a range from zero to one. In principle, any mapping with a range from zero to one will work. For our purposes we choose the logit model. The intuition behind the logit model for the hazard function is relatively simple. For each year during the study in which the player is in the NFL, the player either comes back for another season or ends his career. If the career ends, the dependent variable takes on a value of one; otherwise, the dependent variable is zero. The player remains in the panel until he exits the NFL or the panel ends. If the panel ends before the end of the player's career, we say the worker's spell is right-hand censored. If a player begins his NFL career at the start of the panel and plays for 6 years he will enter the data set 6 times: the value of his dependent variable will be zero for the first 5 years (tenure one through five) and be equal to one for the sixth year. Note for all players who are right-hand censored, we do not know when their career ends so their dependent variables are always coded as zero. To simplify the computation of the likelihood function and be able to keep the long careers, we simply approximate the dummy vector with a 4th order polynomial of the players' tenure in NFL, which reduces the number of parameters to be estimated from 8

[6] For technical details of semi-parametric hazard model see Berger and Black (1998).

Table 1 Means offensive players

Variables	All*	Black*	White*
Games played	12.18 (4.91)	12.16 (4.88)	12.27 (5.12)
Games started	5.47 (5.74)	5.40 (5.78)	5.81 (5.46)
Total touches	54.21 (77.82)	59.72 (82.42)	25.27 (30.07)
Total yards	391.27 (430.22)	419.71 (448.38)	248.60 (288.97)
Total touchdowns	2.46 (3.21)	2.62 (3.36)	1.65 (2.21)
Fumbles	.84 (1.32)	.93 (1.39)	.35 (.68)
Fumbles lost	.47 (.85)	.52 (.89)	.22 (.49)
Age	22.52 (1.01)	22.49 (1.06)	22.80 (.91)
Height	72.94 (2.64)	72.55 (2.46)	74.99 (2.31)
Weight	221.86 (24.7)	217.75 (23.41)	242.55 (21.39)
Running backs	.38 (.42)	.41 (.49)	.22 (.40)
Tight end	.21 (.40)	.13 (33)	.60 (.49)
Wide receiver	.41 (.49)	.46 (.49)	.18 (.38)
Black	.84 (.37)	1.00	-
White	.16 (.37)	-	1.00
Years played	2.97 (1.98)	2.97 (1.97)	2.96 (2.05)
Observations	1,368	1,132	219
Career length	3.78 (2.42)	3.81 (2.47)	3.53 (2.51)
Observations	1,368	1,149	219
Players	414	341	73

* Mean (standard deviation)

to 4. Thus, the hazard function becomes

$$\Pr(t, xb) = Pr(\phi(t) + xb) \tag{4}$$

where ϕ (t) is a 4th order polynomial of the player's tenure in NFL. The 4th order polynomial therefore includes tenure to the first, second, third, and fourth powers. Once again, we choose the Taylor series approximation technique over using tenure dummies due to the small number of observations for high tenures.[7]

Results

In Table 1 we report the means of the variables for the offensive players as a whole and for the black and white subsets of players. We find that there is little difference between games played and games started between non-white and white players with each group playing slightly over 12 games and starting about 5.5 games on average. We do find

[7] When higher order polynomials of the fifth and sixth power are included results do not change suggesting that a fourth order polynomial is flexible enough to capture the influence of the baseline hazard. When using dummy variables we find that the results are the same as when using the Taylor series approximation, using tenure through the fourth power.

Table 2 Exit discrimination offensive player model

Variables	Weibull Haz. Ratio[1]	Logit Model
Games played	.873** (6.89)	-.137** (704)
Games started	.888** (2.75)	-.084** (2.18)
Total touches	1.03** (3.44)	.022** (3.25)
Total yards	.992** (4.26)	-.006** (3.60)
Total touchdowns	.914 (1.06)	-.052 (0.59)
Fumbles	.869 (0.70)	-.060 (0.38)
Fumbles lost	1.12 (0.34)	-.07 (0.22)
Age	.961 (0.60)	.505** (5.59)
BMI	.813 (3.34)	-.192** (3.19)
Tight end	1.27 (0.58)	.399 (1.09)
Running back	1.94* (1.81)	.708** (2.04)
Black	.562 (0.88)	-.330 (0.53)
Percent black city	.987 (0.73)	-.006 (0.37)
Black * Percent black city	1.01 (0.79)	.010 (0.55)
Year	.859** (1.94)	.516** (5.11)
Constant	1.6e+135** (1.96)	-1044.22** (5.09)
Wald / Pseudo R^2	376.06*	.333
Observations		1,368
Players		414

-(z- statistic in parentheses)

** significant at 95 % level

*significant at 90 % level

Standard error adjusted for 414 individual players

[1] Inverse-Gaussian frailty specification

that non-white players have more touches, more total yards, more fumbles and fumbles lost than white players on average. This might be due to non-white players having a higher productivity on the offensive positions or due to players being in different positions. When it comes to position, we find that sixty percent of white players are tight ends, eighteen percent wide receivers and twenty two percent running backs, while forty one percent of non-white players are running backs and forty six percent are wide receivers and only thirteen percent are tight ends. We also find that white players are taller and heavier than non-white offensive players. Lastly, we find that average years played is the same and career length is slightly longer for non-white players than white players.

In Table 2 we report the results of both the Weibull hazard model and the Berger and Black semi-parametric model for offensive players. The Weibull coefficients reported are hazard ratios. Coefficients less than one are associated with variables that increase career length. In the Berger and Black model the logit estimates the likelihood of exiting a career. Negative coefficients are associated with variables that increase career length. Once again, we report both models to test for the robustness of the results. We find in both models performance increases career length (lowers the probability of exit)

Table 3 Means defensive players

Variables	All*	Black*	White*
Games played	13.04 (4.38)	13.11 (4.32)	12.69 (4.75)
Games started	7.30 (6.60)	7.32 (6.59)	6.74 (6.66)
Tackles	41.19 (32.34)	41.19 (32.01)	39.37 (33.81)
Sacks	1.29 (2.30)	1.20 (2.17)	1.78 (2.92)
Passes defended	2.98 (3.88)	3.19 (4.05)	1.59 (2.16)
Forced fumbles	.63 (1.05)	.65 (1.05)	.51 (.98)
Interceptions	.72 (1.34)	.78 (1.41)	.32 (.71)
Age	22.60 (.97)	22.57 (.95)	22.87 (1.13)
Height	73.50 (2.24)	73.31 (2.21)	74.66 (2.11)
Weight	241.13 (43.02)	239.09 (43.83)	248.71 (32.30)
Defensive linemen	.31 (.46)	.29 (.45)	.39 (.48)
Defensive backs	.41 (.49)	.44 (.49)	.23 (.41)
Defensive line backers	.28 (.44)	.27 (.44)	.38 (.42)
Black	.88 (.33)	1.00	-
White	.12 (.33)	-	1.00
Years Played	3.01 (1.94)	3.00	3.15
Observation	2,347	1999	282
Career Length	4.23 (2.37)	4.19 (2.36)	4.47 (2.49)
Observations	2,347	2,065	282
Players	653	581	72

*Mean (standard deviation)

with increases in games played and games started all significantly increasing career length in all models. Total yards significantly increases career length in the Weibull specifications of the model but has no significant impact on duration in the Logit models. We do find, however, that increases in total touches lower career length in all models, supporting the conjecture that more touches lead to potential injury. We also find that BMI increases career length; younger players exhibit significantly longer careers in the Weibull models and a significantly higher probability of duration in one of the Logit models.

When it comes to exit discrimination neither model finds that race, percent of the team's fan base that is black, or the interaction term influences career length. We do find, however, that the position played does influence career length. We find that running backs have shorter careers. Overall our results show that career length for a player on offense is influenced by performance and not by race.

We report the means of the defensive players in Table 3. We find that white players on average play slightly fewer games and start slightly fewer games. Non-white players have more tackles, interceptions and passes defended but fewer sacks than white players. The differences in productivity might be due to the positional makeup of each defensive position. We find that white players have a larger proportion of defensive lineman and linebackers while non-white players have the largest proportions of

Table 4 Exit discrimination defensive player model

Variables	Weibull Haz. Ratio[1]	Logit coefficient
Games played	.893** (4.01)	-.137** (6.31)
Games started	1.00 (0.03)	.006 (0.17)
Tackles	.965** (3.31)	-.038** (3.51)
Sacks	.539** (3.70)	-.462** (2.57)
Passes defended	.774** (3.81)	-.156** (2.02)
Forced fumbles	.931 (0.36)	.097 (0.45)
Interceptions	.770* (1.61)	-.417* (1.79)
Age	.931 (0.97)	.321** (4.04)
BMI	.836** (3.83)	-.144** (3.20)
Defensive linemen	1.51 (1.15)	.153 (0.44)
Defensive backs	.559 (2.12)	-.493* (1.93)
Year	.737 (3.33)	.201** (2.08)
Black	1.41 (0.60)	.601 (1.15)
Percent black city	1.00 (0.32)	.010 (0.03)
Black * percent black city	1.01 (0.44)	. -.0004 (0.84)
Constant	2.8** (3.32)	-409.899** (2.10)
Wald / Pseudo R^2	124.33**	.356
Observations players		2,347 653

–(z- statistic in parentheses) ** significant at 95 % level *significant at 90 % level

Standard error adjusted for 653 individual players in both specifications

[1] Inverse-Gaussian frailty specification

defensive backs. As with the offensive players, we also find that defensive white players are taller and heavier than non-white defensive players. Lastly, we find that average years played is the same and career length is slightly longer for white players than non-white players. Overall we find that eighty eight percent of players on defense are non-white and twelve percent white.

In Table 4 we report the results of both the Weibull and Berger and Black Logit models. As with offensive models, we find that productivity increases career length. The more games played, tackles, sacks, and passes defended the longer the career and the lower the likelihood of exit. Interceptions and games started are of expected sign but are statistically insignificant. This could be due to the collinearity of the performance variables. As with offensive players, we find that an increase in a player's BMI increases career length; younger players exhibit significantly longer careers in the Weibull models and a significantly higher probability of duration in one of the Logit models.

The coefficients on the race dummy in the Weibull and the logit model are insignificant. In addition, both the percentage of city that is black and the interaction term between race and percentage black are also insignificant. The insignificant coefficients in all specifications suggest that exit discrimination is not present for defensive players. Our results show that career length for a player on defense is influenced by performance and not by race.

Conclusion

Our results are consistent with recent findings in both the NBA and Major League Baseball that failed to find evidence of exit discrimination in the 1990s. In both our parametric Weibull and semi-parametric Berger and Black analysis, we find that performance variables are important in determining career length for both offensive and defensive players in the NFL. We find no evidence that race affects the career duration of black players. Past research had suggested that discrimination by majority, white fans led owners in sports to keep less talented white players on rosters. Our results suggest that team owners in the pursuit of championships keep talented players regardless of race. This may be an affirmation of Becker's theoretical implications of market competition overcoming labor market discrimination.

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