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Ian Gregory-Smith, Alex Bryson, Rafael Gomez

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RFBerlin
ROCKWOOL Foundation Berlin –
Institute for the Economy
and the Future of Work

Gormannstrasse 22, 10119 Berlin
Tel: +49 (0) 151 143 444 67
E-mail: info@rfberlin.com
Web: www.rfberlin.com

Discrimination in retention decisions and its impact on career earnings. Evidence from the National Football League *

Ian Gregory-Smith
ian.gregory-smith@newcastle.ac.uk

Alex Bryson
a.bryson@ucl.ac.uk

Rafael Gomez
ralph.gomez@utoronto.ca

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Abstract

This paper examines the role that racial discrimination plays in the decision to retain or release an employee and demonstrates the implications for estimating pay gaps. Our empirical setting, professional American football players (NFL), allows us to separate the retention decision from the wage decision. For the first four years of a player's career, wages are mechanically determined and players are under a restricted 'rookie' contract, during which they can be released without cost. Players who survive in the league beyond four years receive a large uptick in their remuneration upon signing their first 'free-agency' contract. Consequently, marginal decisions over employment retention during the rookie contract have substantial implications for earnings realised over a player's career. We find subtle but significant differences in retention rates between Black and White players (approximately 3 percentage points) that can't be explained by a comprehensive set of individual characteristics including their productivity. We also show that traditional wage gap estimates, which appear to show equal earnings between Black and White players conditional upon playing position and productivity, mask underlying disparities in career earnings that become apparent when adjusting for these unequal retention rates.

Keywords: *Discrimination; Wages; Retention*
JEL Classification: *JEL Codes J71, J31, Z22*

*Corresponding Author: Ian Gregory-Smith, Economics, Newcastle University Business School, 5 Barrack Road, NE1 1SE ian.gregory-smith@newcastle.ac.uk

1 Introduction

There is an unsatisfactory discrepancy in the literature on labour market discrimination. Qualitative studies, as well as laboratory and field experiments, have uncovered unambiguous evidence of members of minority groups being treated unequally (Bertrand & Duflo, 2017). It is clear that minority business leaders are under-represented and where success stories exist, they are often set against a background of prejudice and overcoming discriminatory barriers (Burns, 2021). In contrast, large sample regression based analyses often struggle to identify discrimination (Guryan & Charles, 2013). While unconditional pay gaps are universal (Goldin, 2014), once one conditions upon job title, experience and hours worked the amount of the pay gap that can be attributed to discriminatory practices shrinks substantially (Sin, Stillman, & Fabling, 2022). Additionally, unobservable characteristics confound the measurement. In the absence of time-varying individual level productivity, together with strict standards for identifying causal effects post the 'credibility revolution' (Angrist & Pischke, 2010), it has become difficult to attribute unexplained wage differences to wage discrimination (Bolotnyy & Emanuel, 2022).

This paper advances a key mechanism that may account for the disparate findings on wage discrimination. We argue that the direct focus on wage gaps is misplaced. Rather, discrimination is more likely to occur through the retention mechanism than the pay setting process because, in many industries, there is more discretion in retention than pay setting. By law, organisations expose themselves to punitive litigation if they are paying unequally for the same role. In contrast, organisations are free to give second chances to under-performing employees but there is no obligation to extend generosity to everybody equally. If retention rates vary by race, regression estimates of wage discrimination will suffer from sample selection bias. The observed wage distributions may even appear similar. However, the marginal minority candidate (who would have received lower than average wages) will have been selected out of the sample. If unaccounted for, regression estimates of wage discrimination will be downward biased.

It has long been understood that estimates of wage discrimination face sample selection issues. The landmark Heckman (1979) selection estimator was motivated by the case of non-random selection by women into the labour force. But an explicit treatment of unequal retention over an employee's career is usually infeasible. Data on wages, retention, and their determinants are required for individual employees as well as an understanding of the structure of the appraisals system experienced by that individual. Moreover, in administrative matched employee-employer datasets, it is difficult to distinguish the determinants of wages from the determinants of retention. For example, unobserved individual productivity impacts both wages and retention, making identification problematic.

In this paper, the empirical setting of the National Football League permits an explicit treatment of retention in the estimation of wage discrimination between black and white players. First, there is a large sample of panel data on player earnings and individual productivity for the duration of their professional careers, available and verifiable in the public domain. Second, the institutional regulation of the NFL offers a unique opportunity to distinguish determinants of retention from the determinants of wages because of the way NFL contracts are structured. For the first four years of

a player's career they are subject to a restricted 'rookie' contract, with player wages mechanically determined by drafting position. After four years, the player becomes a free agent 'veteran', where they can obtain their market wage rate. Consequently, players who survive in the league to free agency receive a large discontinuous uptick in their remuneration on becoming veterans. This allows us to identify the impact of early career survival on free agency earnings. For these workers, who are among the highest paid in the world, even small discrepancies in retention between races may have large implications for earnings realised over the career.

Prior examination of wage discrimination in the NFL mirrors the disconnect between qualitative studies and regression based approaches in the broader literature. Dufur and Feinberg (2009) report racial stereotyping as prevalent using interviews with potential NFL draftees. Mercurio and Filak (2010) analyse text of media reports and find sharp differences in the way Black and White quarterbacks are described. Black quarterbacks were viewed as more athletic but given to mental mistakes and poor decision making. In contrast, regression based analyses find limited evidence of racial discrimination in wage setting (Burnett & Van Scyoc, 2015; Ducking, Groothuis, & Hill, 2014; Mogull, 1973, 1981). Gius and Johnson (2000) find evidence that Black players are actually paid 10% more than White players, ceteris paribus. Where evidence of discrimination from quantitative data is reported, it is localised to a specific playing position, e.g. linebackers (Keefer, 2013) and quarterbacks (Berri & Simmons, 2009). In particular, Berri and Simmons (2009) find that Black quarterbacks (QBs) are more productive at rushing but that rushing productivity was undervalued in the NFL.

An exception to this reading of the literature is Volz (2017) who provides quantitative evidence that black quarterbacks are more likely to be benched conditional upon performance and other observable variables such as age and experience. This finding reinforces our motivation to focus on the implications of unequal survival rates. A second connection between duration in the league and wage discrimination can be found in Berri, Farnell, and Simmons (2023) who find that the initial salary advantage that comes from being chosen early in the NFL draft (when teams select the most promising college players) diminishes more quickly over time for Black quarterbacks than it does for White quarterbacks.

This paper contributes to the literature that uses sporting settings to estimate discrimination (see Palacios-Huerta (2023) for a recent review). We build a model of a sporting league that focuses on the decision to retain or release Rookie players. Consistent with this model, we find that Rookie players are more likely to be kept on the team when more Veteran players at the same position are cut from the roster and, all else equal, Black Rookie players are more likely to be cut from the team than White Rookie players. We then present estimates of wage discrimination adjusting for unequal player retention. Without adjusting for player retention, our findings mirror those papers that do not find evidence of wage discrimination. At face value, Black and White players in the NFL are remunerated similarly. This holds when controlling for a set of characteristics including playing position, player attributes and on-field player productivity. It is only after adjusting for unequal retention rates - approximately 3 percentage points conditional on observables and fixed effects - that unequal earnings emerge. We also consider alternative drivers of this racial retention penalty.

We show injury rates for Black and White players are not the source of this retention penalty. Nor is it the case of playing in an 'outside the frame' position, i.e. being different than the skin-colour stereotype associated with the playing position. There is no retention penalty for White players playing in stereotypically Black positions.

1.1 Background

Papers considering labour market discrimination have primarily focused on differences in market wage rates between demographic groups. These market wage gaps can emerge from a model of taste-based prejudice from employers, coworkers or customers (Becker, 1957) or from a statistical model, where employers are not prejudiced but use demographic information to solve an optimisation problem with hidden information on employee productivity (Arrow, 1972; Phelps, 1972). While these models are very different in terms of where they locate the source of economic discrimination, they both feature a very direct, almost mechanical, relationship between the wage decision and the hiring decision. In a taste-based model, prejudice raises the marginal cost of hiring a Black worker which, under certain conditions, results in lower equilibrium wages for Black workers. In a statistical model, all employees are paid their expected productivity, but expected productivity can be lower for a Black worker than it is for their identically productive White counterpart.

While these models are the starting place for understanding how wage gaps may emerge in the macroeconomy, the automatic connection of the hiring decision and a market wage is a simplification. In most professional careers, employee wages evolve significantly over the duration of their employment, with negotiations over wages undergoing separate processes from the initial decision to hire, and subsequent decisions to retain. In the executive labour market at listed firms, this distinction is formally separated in the establishment of separate sub-committees to the Board for hiring and remuneration and with separate shareholder votes on continued service and remuneration. Gregory-Smith, Main, and O'Reilly (2014) present evidence of gender bias in hiring of boardroom directors in UK listed companies but no evidence of gender discrimination in wage setting. Discretionary decisions on hiring and retention are quite different to the wage setting process.

An advantage of studying labour market discrimination in the NFL is its institutional governance which imposes constraints on hiring and wages. The majority of players enter the league through the college draft system with wages determined by their draft number, with a fixed floor wage for late round picks. After selection by a Franchise, the player is unable to leave for another team for a period of four years, unless released by the Franchise. There is only limited scope to adjust wages during this 'Rookie' period. If widespread discrimination occurs during this period against Black players, we would not expect to be able to see it in wages, conditional upon the initial draft selection[1]. Instead, discrimination, if it is prevalent during the rookie period, is much more likely to manifest itself in the retention decisions of the Franchise.

After the Rookie period is over, players who continue on in the league can expect to experience a significant increase in their pay. At this point, the constraints on player mobility lapse, the player

[1]Gregory-Smith, Bryson, and Gomez (2023) examine racial discrimination in the draft order and do not find robust evidence of bias against Black players

becomes a 'free agent' and is able to join the Franchise which bids the highest for their services. Such 'veteran' players are scarce, highly sought and with the NFL product being sold to a global market have the characteristics of 'superstar' workers (Rosen, 1981), commanding wages several multiples of an imperfect substitute. Gregory-Smith (2021) shows that while QBs in the NFL earn their marginal product on average, starting QBs earn several multiples of their backup QB. If a Franchise wishes to retain a veteran player, they will need to offer a contract that is competitive. Yet progression to free agency is far from guaranteed. Irrespective of the contract signed with a Rookie, a Franchise can typically release the player at their discretion without the obligation to pay the remainder of the contract. In our sample, only 48.9% of drafted players survive to free agency. After release, if a player is unable to resign with another team, their career earnings will be several multiples less than they otherwise might have been.

There is an additional feature which serves to increase the importance of survival to free agency. NFL Franchises are bound by the annual salary cap, which limits the total expenditure by the Franchise to an ex-ante amount negotiated with the players' union (NFLPA). However, how a player's total remuneration is charged to the salary cap is not straightforward. An important feature is the ability of the Franchise to spread the charge of a signing bonus over the duration of the contract. This salary cap flexibility becomes crucial when retaining players who reach free agency, as these players typically command much higher salaries. By offering large upfront signing bonuses which can be spread across multiple years for salary cap purposes, teams can provide competitive total compensation packages to keep their best players from leaving for other teams, without immediately eroding their salary cap space.

Since wages for free agents are relatively unconstrained, one might expect racial discrimination to be observable in wages at this point. While this is an empirical matter, ex-ante there are good reasons to suspect that wage discrimination at this point is difficult even if Franchises had reason to discriminate against Black players. Wage discrimination is illegal and there is a large amount of information relating to player productivity and wages in the public domain for veteran players. Together with the fact that NFL players use professional agents to negotiate their contracts, it is hard to imagine that malpractice in wages can persist over time without the Franchise exposing themselves to litigation[2].

A reasonable question that follows is: if information pertaining to productivity and wages is public knowledge how could racial discrimination persist in retention decisions? We argue that the decision over player retention incorporates a wider degree of managerial discretion than decisions over wages. First, a player cannot appeal against being released by their Franchise on grounds of performance. If a Franchise discriminates in retention it is unlikely to face legal repercussions. The natural break in employment that occurs with the decision to decline to offer a Rookie a new contract is analogous to a firm that is free to decide to release an employee on a fixed term contract, or

[2]We are not aware of any unequal wage law-suits involving players, either past or present. There are, however, on-going law-suits pertaining to unequal pay for non-playing staff e.g. Robinson vs. Kansas City Chiefs (2025), and Flores vs. NFL (2022). Additionally, former players Kevin Henry and Najeh Davenport were successful in court (2020), overturning the use of race as a factor in determining eligibility for concussion-related dementia payments.

at the conclusion of a probationary period[3]. Second, many of the players who are on the margin of being retained or released are not high profile players. They are fringe squad players, who's playing time on the pitch is limited. Unlike the large amount of on-field productivity information for veteran players, the sample of on-field productivity information in the public domain for these marginal players during their rookie period is often much smaller. The Franchise has private information over their performances in practice as well as their off-field behaviour, fit with teammates and relationship coaching staff. Ultimately, the retention decision is a judgement call, made subjectively by the Franchise.

There is substantial evidence to suggest that subjective decisions are prone to biases. Palacios-Huerta (2023) reviews several papers from professional sports that have documented biases in decision making. In particular, attention is drawn to studies examining performance evaluation and discrimination. Some biases occur simply due to failures of rationality. For example, Gauriot and Page (2019) show that managers in professional soccer give more playing time to 'lucky' players who's shot narrowly scores against 'unlucky' player's who's shot narrowly misses. However, other biases originate from preferences. For example Bryson and Chevalier (2025) find taste-based racial discrimination by inexperienced managers in Fantasy Football. In international cricket, Sacheti, Gregory-Smith, and Paton (2015) find evidence of bias towards players of the same nationality by umpires when making subjective decisions and Parsons, Sulaeman, Yates, and Hamermesh (2011) present evidence of racial bias in the subjective judgments of baseball officials. The following section outlines how racial bias could play a role in the decision to retain or release NFL players.

2 Model

In order to provide some structure for the empirical analysis of player retention and release, we build a model of Franchise behaviour in a competitive league, where different wage setting rules apply to Veteran and Rookie players. The model begins with Késenne (2014, p.63-65), which is a variant of the well known model of a sporting league by Quirk and Fort (1992). Késenne (2014) allows for two types of players: top players, akin to veteran NFL players; and regular players, akin to the Rookie players who are on the margin of being retained or released. The pool of top players is fixed and have their wages determined in the market, while regular players are in excess supply and on a fixed low wage. Regular players have only the fraction of the productivity of a top player. Our contribution will be to introduce the retention / release decision to this framework as well as the possibility of bias against Black players, through the use of a taste discrimination parameter.

[3] Specific legal frameworks vary by jurisdiction but a retention lawsuit carries a higher burden of proof than an unequal pay lawsuit. For a retention lawsuit, a legal defence for the employer is to provide a reasonable non-discriminatory justification for unequal retention such as employee performance. This returns the burden of proof to the employee to demonstrate that the employer's reason is pre-textual, masking true discrimination. By contrast, in an unequal pay case, the burden is on the employer to demonstrate the unequal pay is due to a material factor and also proportionate to the amounts paid.

Franchises in the league have the objective function:

$$\max_{L^T} \pi_i = f(w_i) - c.L_i = f(L_i^T + \varepsilon(1 - L_i^T)) - c^T L_i^T - c^R(1 - L_i^T) \tag{1}$$

where: π_i is Franchise i's profit; $f(w_i)$ is the revenue function which is increasing in the win percentage and wins depend only the proportions of top players (L_i^T) and regular players (L_i^R) with $w = L_i^T + \varepsilon.L_i^R$; ε represents the productivity parameter for regular players, with $0 < \varepsilon < 1$; c^T is the wage rate for top players; c^R is the fixed minimum wage for regular players, with $c^T > c^R$.

Franchises choose the optimal proportion of top players, with the regular players subsequently filling the remaining squad places. Késenne (2014) presents the equilibrium as:

$$MR_i = f'(w) \cdot (1 - \varepsilon) = c^T - c^R = MC \tag{2}$$

The equilibrium condition shows marginal revenue from hiring an additional top player depends on the difference between their productivity and those of the regular player. In equilibrium, this is equal to the marginal cost given by the difference between the wage rates for talented players and regular players.

Under the assumption that the strategic effect of hiring talent upon the win percentage of a rival Franchise j is fully internalised by Franchise i, equation (2) holds for all Franchises in the league in equilibrium so that:

$$MR_i = MR_j = c^T - c^R. \tag{3}$$

The assumption that the strategic effect is fully internalised has been discussed in the literature. In short, where the number of Franchises are fixed and the pool of talent is likewise fixed, as is effectively the case in the NFL, the simplifying assumption that strategic effects are internalised is considered appropriate (See Szymanski (2006) for details). Note however, that the relationship between wins and revenue $f(w)$ may vary between Franchises. So different levels of top talent between Franchises are likely to emerge in equilibrium. For example, larger Franchises with bigger fan base may have a stronger relationship between wins and revenue and will therefore choose a larger proportion of top players.

2.1 Retention

We introduce player retention and release to the above model by considering two periods. At the start of the season (period 1), the Franchise is in equilibrium in equation (2). Over the course of the season, Franchises experience depreciation in the stock of top talent. By the end of the season, a proportion δ of top players, either through age, injury or poor form, are no longer considered top players worth their market rate and are released by the Franchise. At that point, period 2, Franchises

must decide whether or not to retain their regular players approaching free agency. Having observed the productivity of the player over the course of the season, we assume that the Franchise knows whether they are now a top player, worth a market rate. The retention of top players increases the talent stock by μ. Rookies who do not convert to top players are not retained since the Franchise would prefer to draw a new regular player at the fixed minimum wage rate, rather than pay a regular player their market rate.

Dropping subscript i, Franchise wins in period 2 are:

$$\begin{aligned} w_2 &= (L_1^T - \delta + \mu) + \varepsilon(1 - L_1^T + \delta - \mu) \\ &= L_1^T + \varepsilon(1 - L_1^T) + \mu \cdot (1 - \varepsilon) - \delta \cdot (1 - \varepsilon) \\ &= w_1 + (\mu - \delta) \cdot (1 - \varepsilon) \end{aligned} \tag{4}$$

The impact of on revenue and costs from period 1 to period 2 are:

$$\Delta R = f'(w_2) \cdot (\mu - \delta) \cdot (1 - \varepsilon) \tag{5}$$

$$\Delta C = (c^T - c^R) \cdot (\mu - \delta) \tag{6}$$

The optimising Franchise chooses $\delta = \mu$,[4] so that retained talent offsets depreciation and the Franchise returns to the equilibrium of equation (2). If $\delta \neq \mu$, the Franchise would be out of equilibrium. This might occur if the Franchise does not have enough rookie talent converting to top talent. Such Franchises would be incentivised to hire veteran players from the market, since the marginal revenue from new talent would be above the marginal cost, returning the Franchise towards equilibrium over time.

2.2 Retention and discrimination

We now introduce discrimination to the retention decision with a Becker type taste-based discriminator parameter. This is the most parsimonious formulation of labour market discrimination given that our model continues with the full information assumption adopted in the literature. The alternative would be to consider a statistically discriminating Franchise. However, when retaining players, franchises already have a substantial amount of individual level information on which to base their decision. We argue that any additional information contained in the group average or group variance to be relatively inconsequential[5].

For now, we assume all franchises have the same disutility θ for the proportion of the retained

[4] FOCs with respect to μ produce the same equilibrium condition as before $= f'(w) \cdot (1 - \varepsilon) - c^T - c^R = 0$

[5] Moreover, a statistical model of discrimination requires the introduction of imperfect information which represents a non-trivial increase in complexity. Such a model is not necessary to generate the propositions that we wish to test empirically.

players who are Black, $\mu_B = \mu - \mu_W$. Franchises must choose the optimal proportion of White players μ_W and Black players μ_B to retain. The firm's objective function in period 2 becomes:

$$\begin{aligned}\max_{\mu_W,\mu_B} U_2 &= f(w_2) - c.L_2 - \theta\mu_B \\ &= f(w_1 + (\mu_W + \mu_B - \delta)\cdot(1-e)) \\ &- c^T L_1^T - c^R(1-L_1^T) - (c^T - c^R)\cdot(\mu_W + \mu_B - \delta) - \theta\mu_B\end{aligned} \tag{7}$$

Black talent and White talent add to wins, and therefore revenue, in the same manner as before, so the marginal revenue of μ remains unchanged, irrespective of whether it is White or Black talent that is retained. Due to their prejudice, the Franchise feels a burden on the cost side. For reasons given earlier, we do not allow for direct wage discrimination in the market, i.e. $C^T = C^{TB} = C^{TW}$. The only impact on costs is the direct disutility of retaining Black players:

$$\Delta \mathrm{C} = (c^T - c^R)\cdot(\mu_W + \mu_B - \delta) + \theta\mu_B \tag{8}$$

In equilibrium, the Franchises chooses μ_W and μ_B until the marginal revenue equals marginal cost:

$$f'(w)\cdot(\mu_W + \mu_B - \delta)\cdot(1-\varepsilon) = (c^T - c^R)\cdot(\mu_W + \mu_B - \delta) + \theta\mu_B \tag{9}$$

The prejudiced Franchise would like to offset the depreciation in its talent stock by retaining only White players, setting $\mu_W = \delta$ and $\mu_B = 0$. This returns to the franchise to the equilibrium in equation (2), and the league to equation (3), albeit a league resembling the NFL in the 1930s. Today, top White players in the NFL are in relatively short supply. The majority of regular players who become top players are Black. Therefore, we expect prejudiced Franchises to meet the shortfall in talent renewal with Black players. Let $\zeta = \delta - \mu_W$, represent the shortfall. Such Franchises will retain top Black players so long as:

$$f'(w)\cdot(\mu_B - \zeta)\cdot(1-\varepsilon) \geq (c^T - c^R)\cdot(\mu_B - \zeta) + \theta\mu_B \tag{10}$$

Equation (10) shows the retention of Black players is increasing in the shortfall of player talent after retaining white players, increasing in the productivity gap for top talent, decreasing in the wage premium for top talent; and decreasing in prejudice.

2.2.1 Heterogeneous Prejudice across Franchises

Prejudice in the NFL with respect to retention could vary between franchises. For example, if Franchise prejudice is a reflection of customer discrimination, Franchises located in metropolitan areas with a greater proportion of Black fans might be less prejudiced in retention. Alternatively, franchises with a greater number of Black non-playing staff, or a head coach who is also Black, may be less prejudiced.[6]

We can extend the model above to allow Franchise i to be prejudiced in retention and franchise j to be non-prejudiced by setting $\theta = 0$ for franchise j. The sections above already describe how a prejudiced and unprejudiced franchise will choose to retain talent. Franchise j will treat White and Black talent as perfect substitutes and will choose $\mu_W^j + \mu_B^j = \delta$ to fully offset depreciation. So long as there is a sufficient supply of new emerging talent, whether Black or White, Franchise j returns to equation (2) in period 2 and experiences the same wins as it did in period 1.

$$w_2^j = w_1^j - (\delta - \mu_W^j - \mu_B^j) \cdot (1 - \varepsilon) = w_1^j \tag{11}$$

However, Franchise i experiences a cost when retaining Black talent (in the same manner as before). Given a shortage of White talent, i will retain some Black players but will only do so, so long as equation 10 is satisfied. If prejudice is sufficiently large to outweigh the gains from offsetting the depreciation in talent, then Franchise i will have less talent, and consequently fewer wins in period 2 than it did in period 1.

$$\begin{aligned} w_2^i &= w_1^i - (\delta - \mu_W^i - \mu_B^i) \cdot (1 - \varepsilon) \leq w_1^i \\ &= w_1^i - (\zeta - \mu_B^i) \cdot (1 - \varepsilon) \leq w_1^i \end{aligned} \tag{12}$$

The equilibrium of the league still requires the marginal revenues of the franchises to be equal.

$$MR_i = MR_j = f'(w_2^i) \cdot (1 - \varepsilon) = f'(w_2^j) \cdot (1 - \varepsilon) \tag{13}$$

Note that although prejudice might cause i not to offset all of its talent deprecation, we can't conclude that j will have more wins than i in equilibrium, without assuming the functional form of $f(w)$ for i and j. i will have fewer wins than it could have in the absence of prejudice but whether i or j has more wins still depends on the relation between wins and revenue $f(w)$. For example, if Franchise i is sufficiently large, then its marginal revenue from winning may be sufficiently higher than j's to offset the advantage j has from retaining talent without prejudice.

[6] We do not find evidence supporting these specific channels, albeit we have information only for a subset of observed retention decisions, see appendix table A.6. There could be substantial variation in prejudice between coaches of the same background, or metropolitan areas with similar demographics that we are unable to observe.

To illustrate, we assume a quadratic functional form between wins and revenue $f(w) = aw - bw^2/2$. We calculate the proportion of wins for teams i and j with varying degrees of prejudice for team i. Table 1 shows two cases: the left hand side considers the symmetric case, and the right hand side, gives the prejudice franchise i a larger market than j, so it is able to generate more revenue from wins $f(w) = 1.5(aw - bw^2/2)$.

Table 1: Win Proportions with Varying Prejudice Levels Under Different Market Sizes

	Equal Revenue Functions			Team i with 1.5× Revenue		
Prejudice (θ)	μ_B^i	Team i	Team j	μ_B^i	Team i	Team j
0.0	0.300	0.5000	0.5000	0.300	0.5349	0.4651
0.2	0.240	0.4877	0.5123	0.260	0.5278	0.4722
0.4	0.180	0.4748	0.5252	0.220	0.5205	0.4795
0.6	0.120	0.4612	0.5388	0.179	0.5130	0.4870
0.8	0.060	0.4469	0.5531	0.139	0.5053	0.4947
1.0	0.000	0.4318	0.5682	0.099	0.4973	0.5027

Notes: Note: Parameters used: $a = 10$, $b = 8$, $c^T - c^R = 2$, $\varepsilon = 0.2$, $\delta = 0.4$, $\mu_W = 0.1$, $\zeta = 0.3$. Team j is never prejudiced and always sets $\mu_B^j = \zeta = 0.3$. On the right hand side, with no prejudice, team i has more wins due to its market size advantage. This advantage diminishes as team i increases in prejudice.

In both cases, the prejudice franchise's retention of Black talent declines in its prejudice. At high enough levels of prejudice, this can more than offset a market size advantage. However, it is also worth noting that prejudiced franchises who are larger, retain more black talent than prejudice franchises who are smaller, ceteris paribus. This is because the revenue forgone from lost wins due to their prejudice is larger than it would otherwise be in the symmetric case.

3 Data

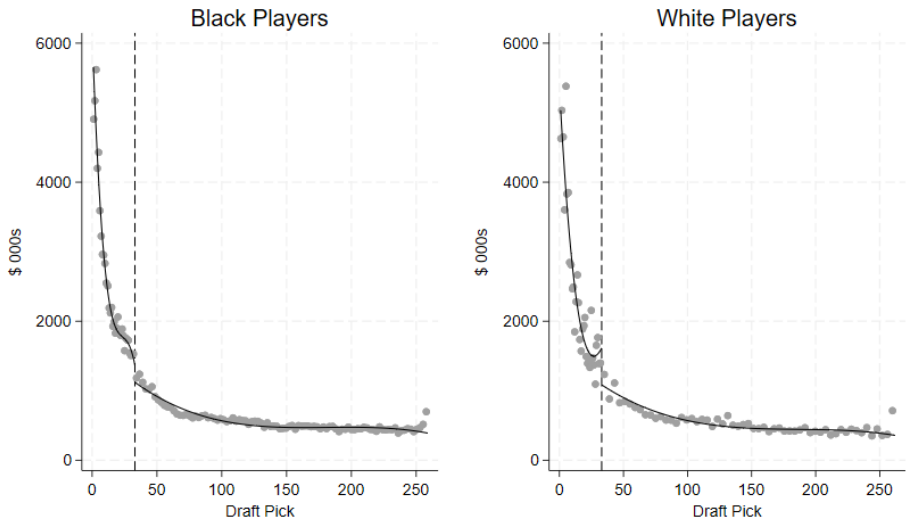
This paper combines data from public websites as well as hand collected data on race. Wage data is obtained from *spotrac.com*, which provides detailed breakdown of a player's compensation contract. This allows us to distinguish types of payments received by the player in the year and charges to the official NFL salary cap. For example, a signing bonus is paid to the player up front but amortised over the life of the contract for the purposes of satisfying the salary cap. The panel wage data spans the seasons 2011 to 2023, single row wage data for drafted players extends back to 2005, and panel data on player retention and release extends back to 2000.

The measure of race was hand collected according to the player's skin colour as observed in publicly available images. Players were assigned one of four categories: Black, White, Non Black and Non White, and Unclassified[7]. The race sample covers all draft combine attendees from 2000-2023. After merging these data into the sample of players who entered the league via the draft, there are 4,837 players, 3,497 Black, 1,172 White and 163 players who were neither Black or White[8]. Upon

[7]The authors are grateful for research assistants at the University of Toronto: Michael Muir, Jack Rasmussen, Adam Zelnicker & Justin Zelnicker. There were 11 players who we could not confidently classify into one of the three categories and these are dropped from the analysis. Further details of the collection process are provided in Gregory-Smith et al. (2023)

[8]The numbers for the drafted and race matched panel are: 20,960 player-season observations consisting of 3,544 Black players, 1,143 White players and 186 Non White Non Black Players.

Figure 1: Black / White Rookie Year 1 Compensation



Drafted players 2005-2023. Compensation is measured as the charge to the league's salary cap in nominal dollars. Fit line is a 3rd order polynominal containing a small discontinuity at 1st Round consistent with Keefer (2016).

merging into the single row sample of wages, on-field productivity and physical characteristics there 2,750 completed player careers (i.e. not right censored). See appendix A.1. for summary statistics of all variables used in the paper.

3.1 Descriptive statistics

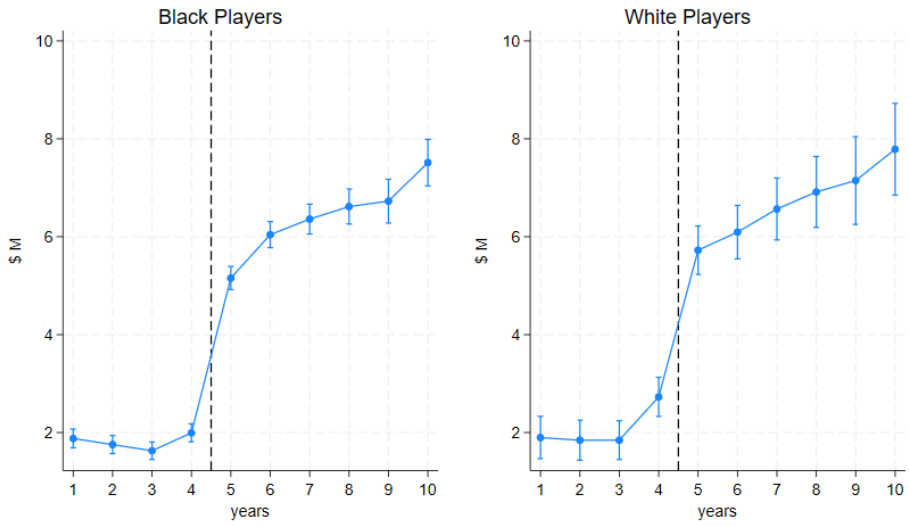
Figure 1 displays the distribution of rookie wages who were drafted between 2005 and 2023 against their draft pick number. The draft consists of seven rounds of 32 picks, with each Franchise allocated one pick per round in principle[9]. The NFL operates a reverse order draft, with the Franchise with the worst winning record in the season prior being allocated the first pick. The key insight provided by Figure 1 for this paper is to illustrate the very tight relationship between rookie wages and the draft order. All other variables, including the player's race, are of secondary importance for rookie wages. Hence we are able to study racial differences in retention without fear that wages during the rookie period are adjusting systematically with a player's race. This would otherwise confound the relationship between retention and race[10]. Rookie wages are set by the draft (Gregory-Smith et al., 2023).

At the conclusion of the rookie contract, the player becomes a free agent 'veteran'. Only 52.51% of drafted players survive to free agency. We expect players to earn substantially more under veteran contracts for two reasons. First, veterans are able to earn their market rate by going to the highest bidder, whereas rookies are bound by their draft contract. Second, the distribution of veterans is selected as lower performing players drop out of the league. Figure 2 shows when the disparity

[9]Franchises can trade their draft pick option.

[10]For example, if Franchises were able to substantially underpay black players there would be a strong incentive to retain them, even if they had a direct aversion to retaining black players.

Figure 2: Black / White Career Earnings



All NFL players 2011-2023. Post estimation margins of tenure on annual contract value. Controls: Position FE, Year FE, Drafted round (inc undrafted), Physical observables.

between rookie and veteran earnings occurs. We make use of all NFL drafted and undrafted players but the sample is limited to the period 2011-2023 for which annual earnings data is broken down and available as a panel, constructed at the player-season level. The graph reports the estimated margins of tenure on the annual contract value, conditional upon variables that determine players wages such as the player's position, their performance and their draft pick. The vertical line indicates the free agency payday. The financial benefits of surviving in the NFL accrue to players in a dramatically non-linear fashion. Players who survive until free agency receive a large discontinuous uptick in their compensation. This is the case for both white and black players. Survival into free agency is a critical determinant of a player's career earnings, with further increases available for players who survive each subsequent season[11].

With survival to free agency, being a crucial determinant of career earnings, are there differences in longevity between Black and White players on average? Using the matched race and draft panel 2000-2023, Table 2 shows the incidence rates and survival times at the lower quartile, median and upper quartile for drafted NFL players who played at least one game. Here, exit is defined as permanent exit from the league. There are small unconditional differences in survival times between white and black players. The 50th percentile White player lasts seven seasons, compared to the six survived by the 50th percentile Black player. There is more variation within race across positions. The median wide receiver lasts 4 or 5 seasons, while the median QB lasts 7 or 9. This complicates the picture because very different numbers of black and white players select into different playing positions. White players are more represented at positions with the lowest exit rates (QB and Special Teams), while Black players are more represented at positions with the highest exit rates (WR and

[11] In the appendix, we show the distribution of the log of annual earnings for veteran and rookie players drafted in the years 2005-2023. The veteran distribution is more compact on its right hand side with a bunching of high earning players (see Figure A.3)

Table 2: Survival times by position and race

	Time at risk	Incidence rate	Players	Survival time 25%	50%	75%
Black players	18,369	0.137	3544	4	6	9
White players	6,601	0.124	1143	4	7	10
Other players	1,020	0.144	186	3	6	9
Black players						
QB	285	0.102	51	4	9	11
Oline	2,647	0.124	488	4	7	9
RB	2,022	0.152	411	3	5	8
WR	2,719	0.154	569	3	5	9
Dcover	4,534	0.139	916	4	6	9
Dline	3,451	0.125	670	4	7	10
LB	2,696	0.135	587	4	6	9
Special	14	0.071	3	8	8	.
White players						
QB	1,058	0.110	163	3	7	12
Oline	3,082	0.120	543	4	7	10
RB	192	0.177	44	4	5	7
WR	208	0.173	49	3	4	7
Dcover	220	0.150	41	3	6	7
Dline	609	0.135	119	4	7	9
LB	754	0.138	157	4	6	9
Special	478	0.094	74	3	9	15

Notes: The table shows the survival times (in seasons) by position for the drafted and race matched panel 2000-2023.

RB).

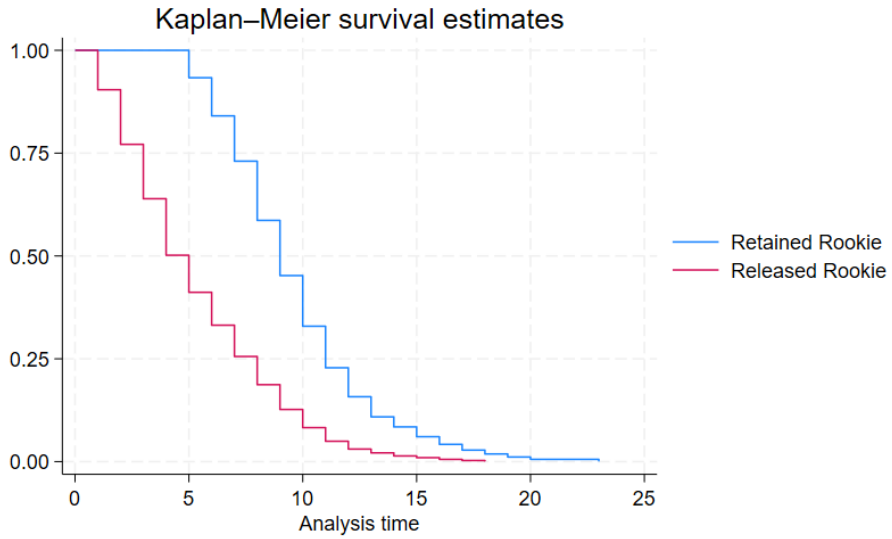
We further show in the appendix (see table A.2) that White players have higher survival rates to free agency (49.0% of White players, 44.4% of Black players and 46.0% Non Black, Non White). Survival rates among Quarterbacks are similar, though it is interesting no Black Quarterbacks survive 15 years and there are simply too few Non Black Non White Quarterbacks to generate survival statistics. We do not wish to infer too much about these differences at this stage. For example, higher rates of survival from groups that have fewer players could plausibly reflect a more intense selection process, resulting in a higher average ability and longer careers. The corresponding non-parametric hazard rates are shown in appendix Figure A.1. These are suggestive of differences between Black and White players, albeit the precision with respect to Quarterbacks is limited by their low representation in the sample.

3.2 Retention and Release

The descriptive analysis above uses the broadest interpretation of player survival, focused only on survival in the league. However, the data, structured as a player-season panel allow a more detailed inspection of the retention decision on individuals by Franchises. We observe the decision to retain or release a player by each Franchise at the end of, or part way through, the season, except for the final year of the sample, where the decision is censored. Players who are released will then either drop out of the league (and our sample) or be rehired by a new Franchise.

First, as an indication of the importance of Franchise retention on a player's career, Figure 3 shows survival rates for players retained for every year of their Rookie contract, against players released or traded during the same period. The differences between these groups are substantial. Only half

Figure 3: Impact of Rookie Retention/Release on Survival



The sample comprises drafted players between 2000-2023. Players released by their Franchise during the Rookie period have the opportunity for reemployment at another Franchise. Nevertheless, approximately 50% do not survive in the league beyond the rookie period and those that do continue to have lower survival rates than their counterparts who were retained for the full rookie period.

of the players released continue in employment at another Franchise to 5 years and their group exit the league at a higher rate than retained players for the entirety of the period of analysis. Of course, these groups highly selected. Franchises deliberately retain the best players. Nevertheless, the retain versus release distinction is striking.

Table 3 shows the outcomes of the annual retention decisions for players drafted 2000-2023. In 63.9% of decisions, players are retained by their Franchise. Of those that are released, 58.5% are rehired by a another Franchise for the next season, with the remaining 41.5% exiting the league and ending their NFL career. That over half of released players obtain another position at another franchise indicates the importance of this channel for a player's career. There are notable differences

Table 3: Annual retention decisions

Decision	All	Black	White	Other	B-W Perc.
Total	23,168	16,434	5813	921	
Retained	14,793	10,331	3,865	597	
Retained Perc.	63.9%	62.9%	66.5%	64.8%	-3.6%***
Released	8,375	6,103	1,948	324	
Released Perc.	36.1%	37.1%	33.5%	35.2%	3.6%***
Of those Released					
Left League	3,476	2,510	819	147	
Left League Perc.	41.5%	41.1%	42.0%	45.4%	-0.9%
New team	4,899	3,593	1,129	177	
New team Perc.	58.5%	58.9%	58.0%	54.6%	0.9%

Notes: The table shows the number of annual retention decisions outcomes, broken down by race.
*** Chi-squared test for equality of proportions significant at 1%

Table 4: Outcomes following Mid-season Trade

Outcome	All	Black	White	Other	B-W Perc.
Total	671	526	128	17	
Returned	103	72	27	4	
Returned Perc.	15.4%	13.7%	21.1%	23.5%	-7.4%**
Retained	110	86	24	0	
Retained Perc	16.4%	16.3%	18.8%	0.0%	-2.4%
New team	168	130	33	5	
New team Perc.	25.0%	24.7%	25.8%	29.4%	-1.1%
Left League	238	190	40	8	
Left League Perc.	35.5%	36.1%	31.3%	47.1%	4.9%
Censored	52	48	4	0	
Censored Perc.	7.7%	9.1%	3.1%	0.0%	

Notes: The table shows the outcomes for season starting t+1, for players who were traded during the season t. 'Returned' identifies those players who returned to their original team. 'Retained' identifies those players who were kept by their new team. 'New team' identifies players who were released and picked up by a new Franchise in t+1. 'Left league' identifies players who were released and not picked up. 52 trades occurred in the final season of the sample, hence their outcome is censored.
** Chi-squared test for equality of proportions significant at 5%

between Black and White players. The franchise retention rate is higher for White players by 3.6 percentage points, while Black players are marginally more likely to be rehired by another Franchise after being released (0.9 percentage points).

We also observe whether a player is traded during the season and their destination in the subsequent season. Mid-season trades represent situations where a player is traded directly to another Franchise, typically in return for another player or future draft picks. Table 4 shows the outcome for the traded player in the following season. 15.4% of players traded make a return to their original Franchise who traded them. A similar number, 16.4% are retained by the new Franchise, while the majority are released again, with 25% finding a new team and 35.5% dropping out of the league. There are some differences in likelihood of the outcome between races but the relatively small number of mid-season trades makes only the returning players difference statistically significant, with White players being more likely to make a return to their original Franchise. Nevertheless, this difference is 7.4 percentage points and is perhaps an indication of more 'second chances' being given to White players.

We are also able to inspect an important implication of our model: namely that Franchises consider the depreciation in their Veteran talent stock, when choosing to retain their regular Rookie players. Table 5 presents evidence that this is indeed the case. Measuring the depreciation in talent as Veterans in the same position as the Rookie in question, Table 5 shows that when Franchises lose more Veterans, the likelihood of Rookie retention increases. This holds upon controlling for player age, playing time, player productivity, and sets of Position, Franchise and Season fixed effects. Column (4) additionally controls for how many players are cut at other positions on the same team in the same year. The results from the Probit model imply that when veteran turnover at a rookie's position increases by one standard deviation (0.13), the rookie's chances of being kept on the team for another year rise by 1.7 percentage points. This effect size is moderate but meaningful in terms

Table 5: Impact of Veteran release on Rookie retention

	OLS (1)	OLS (2)	Probit (3)	Probit (4)
% Veterans in same position released	0.078***	0.13***	0.082***	0.13***
	(3.41)	(5.83)	(3.58)	(5.76)
% Veterans released		-0.32***		-0.32***
		(-13.2)		(-13.3)
Age	-0.071***	-0.070***	-0.072***	-0.070***
	(-41.5)	(-40.9)	(-44.3)	(-43.1)
Games Played	0.026***	0.026***	0.021***	0.021***
	(41.2)	(41.9)	(36.6)	(36.9)
Games Started	0.0024***	0.00083	-0.0011	-0.0028***
	(2.59)	(0.92)	(-1.07)	(-2.69)
Productivity	0.017***	0.021***	0.032***	0.035***
	(10.4)	(12.6)	(14.6)	(16.4)
Season FE	Yes	Yes	Yes	Yes
Position FE	Yes	Yes	Yes	Yes
Team FE	Yes	Yes	Yes	Yes
Team-Season FE	Yes	No	Yes	No
Observations	26,411	26,411	26,260	26,411
R-squared	0.248	0.216	0.2104	0.1837

Notes: The table presents the impact of Veteran releases on Rookie retention. Each observation is one annual binary retention decision on each Rookie NFL player for the seasons 2000-2022 (the 2023 decision is right censored). % Veterans in same position released counts the number of veterans in the same position as the player in question who were released, divided by the total number of players in the same position who played for the franchise that season. % Veterans released controls for the total amount of rotation at the team in that season, hence team-season FE are not included in columns (2) and (4). Probit columns (3) and (4) report the average marginal effects after probits and the pseudo R-squared. Consistent with our model, Franchises are more likely to retain Rookie talent when more Veterans in their position are released.

Table 6: Race and Rookie Retention of Draftees

	OLS (1)	OLS (2)	Probit (3)	Probit (4)
Black		-0.031***	-0.033***	-0.030***
		(-3.28)	(-3.52)	(-3.20)
Other		-0.036*	-0.035*	-0.036*
		(-1.89)	(-1.90)	(-1.94)
% Veterans in same position released	0.12***	0.12***	0.12***	0.078**
	(3.40)	(3.38)	(3.45)	(2.05)
% Veterans	-0.26***	-0.26***	-0.26***	
	(-8.41)	(-8.39)	(-8.67)	
Age	-0.088***	-0.089***	-0.087***	-0.089***
	(-36.7)	(-36.8)	(-39.3)	(-40.2)
Games Played	0.020***	0.020***	0.015***	0.015***
	(22.0)	(21.9)	(17.7)	(17.7)
Games Started	0.0025**	0.0025**	-0.0010	0.00033
	(2.29)	(2.32)	(-0.85)	(0.27)
Player Productivity	0.019***	0.019***	0.032***	0.029***
	(9.78)	(9.89)	(13.0)	(11.7)
Season FE	Yes	Yes	Yes	Yes
Position FE	Yes	Yes	Yes	Yes
Team FE	Yes	Yes	Yes	Yes
Team-Season FE	No	No	No	Yes
Observations	14,179	14,179	14,179	13,974
R-squared	0.209	0.209	0.1967	0.2392

Notes: The table presents the impact of Veteran releases on Rookie retention by Race for drafted NFL players 2000-2023. Columns (1) and (2) are OLS and columns (3) and (4) are average marginal effects after probit and the pseudo R-squareds.

of the probability of survival to free agency. An accumulative 6.8 percentage points over the four year rookie period amounts to approximately 14% of the total probability of survival to free agency. Table 6 shows that Non-White NFL Rookie draftees are more likely to be released by their Franchise during their Rookie period by approximately 3% points. This is consistent with the broad differences between White and Black players shown in table 3 but controlling for the same comprehensive set of controls as in Table 5.

3.2.1 Robustness Check: Outside the Frame Stereotypes

Racial stereotypes can run in different directions. For understandable reasons the majority of attention in the literature has focused on unequal treatment of Black players and Black players at the quarterback position in particular. An alternative approach is to consider players who do not fit the stereotypical image of a playing position. Black, White and non-black non-white players, select or are selected into different playing positions. Therefore, we can recast our analysis in terms of a disadvantage against players who do not fit the typical image of that playing position. While in theory one could extend this idea to stereotypes associated with physical attributes (e.g. height with respect to Quarterbacks), in practice it becomes harder to separate the impact of these attributes on performance from the pure stereotype effect. Therefore, we limit our investigation to racial playing position stereotypes. Appendix table A.3 shows the percentage of players who are outside the frame by playing position. Appendix table A.4 shows that being outside the frame of the idealized stereotype does not appear to have a strong impact on the retention decision, irrespective of whether one controls for skin colour (column 2) or interacts skin colour with being outside the frame (columns 3 and 4).

3.2.2 Robustness Check: Injuries

To what extent can we explain differences in retention rates with injuries? If retention differences between black and white players arise due to differences in injury rates then it becomes much harder to consider the retention differences as racially motivated. Our injury data comes from mangameslost.com and contains week by week injury data on individual NFL players for the years 2009 to 2020, omitting the 2019 season which was not available.

Appendix table A.5 shows significant variation across playing positions in injury rates. The two positions where Black players have the lowest representation, QB and Special teams, are the two positions that have the fewest number of injuries and fewest weeks out due to injury. With that said, the total numbers of players in these positions is also the lowest and the largest number of injuries occur at the Oline position which is a majority containing 47.3% Black players. Note, the differences in retention rates reported in Table 6 are robust to controlling for playing position fixed effects and reveal differences in white and black retention rates within position. Therefore it is important to consider whether differences in injury rates occur between black and white players within position.

To analyse within position differences in retention and injury rates we merge the player level data to the smaller sample of players for whom we have both race and injuries identified. This results

in a sample of 14,668 player-years. Appendix Figure A.2 shows the estimated marginal effects (with 95% CI) of player and race on the average weeks lost per season due to injury. Non-white players do not have significantly higher injury rates than White players by position. At the Wide Receiver position, White players lose more time to injury on average than Black players. However, the standard errors on White players at Wide receiver are wide due to the small numbers of White players at this playing position. In any case, it is safe to conclude that higher retention rates for White players overall can't be explained by lower propensity for injury.

4 Estimating wage gaps with sample selection

The data above illuminate four stylised facts. First, player wages are intensely backloaded. Second white players, and white quarterbacks in particular, constitute the majority of players with long careers. Third, the probability of being released during as rookie is higher for black players, ceteris paribus. Fourth, being released during the rookie period greatly reduces the likelihood of a long career. Altogether, these features of the data suggest sample selection bias could have severe consequences when estimating the role of race on wages.

The structure of NFL contracts suggest a convenient simplification to the selection problem. We split a player's career into two periods ($t = 1, 2$), the rookie contract (years 1 to 4) and free agency (years 5 to career end). We shall treat the rookie contract as a selection period, where s=1 if a player survives to free agency and s=0 otherwise. We then estimate the earnings of NFL players in free agency as a Heckman (1979) selection model:

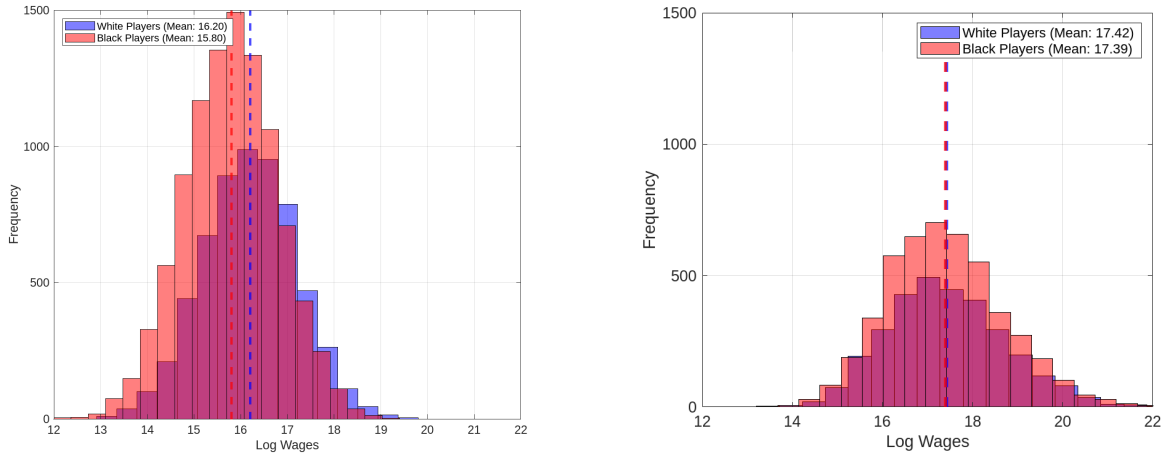
$$y_{i2}|(s_{i2} = 1) = X_{i2}\beta + \gamma\hat{\lambda}_{i2} + v_{i2} \tag{14}$$

where, y_{i2} denotes a player i's total earnings in free agency ($t = 2$), X is a vector of explanatory variables including race, productivity, draft position and playing position, and $\hat{\lambda}_{i2} \equiv \lambda(X_i\hat{\delta})$ is the estimated inverse Mills ratio from the Probit:

$$P(s_{i2} = 1|X_{i1}) = \Phi(X_{i1}\delta) \tag{15}$$

Non-random attrition of marginal players truncates the observed wage distribution in free agency, which would shift the mean of the observed wage distribution to the right. Since we obtain an estimate of γ from equation (14), we have a direct test of whether the estimation of free agency wages suffers from non-random attrition. Moreover, if attrition rates are higher for black players than white players, then the observed distribution will be truncated to a greater extent for black players. Absent a correction term for attrition, estimates of the marginal effect of race would suffer from an omitted variable bias if $\gamma \neq 0$. It could be possible to observe near identical wage distributions for Black and White players (as we do) and yet conclude wage discrimination exists after adjusting for unequal selection rates. Arguably, such wage discrimination may be more likely to persist because it is not directly observed.

Figure 4: Simulation of free agency earnings with unequal retention rates



(a) True unobserved earnings distribution

(b) Observed earnings after selection

Simulated data for 10,000 Black players and 6,000 White players, where the true log wage mean is targeted at 16.20 for white players and 15.80 for black players. Assumed survival rates to free agency of White 52% and Black 48% resulting in 3120 White players and 4800 Black players in free agency. Wage regression results: Uncorrected coefficient for Black players -0.0304, Heckman corrected coefficient for Black players -0.4135***. Mills ratio coefficient (gamma): 5.8764

Figure 4 illustrates how we expect unequal retention rates to impact the wage distribution in free agency by simulating data. The left hand side (a) presents the 'true' data with a specified earnings distribution distributed about a log mean of 16.2 for White players and 15.80 for Black players, a true pay gap of 0.4 log points at the mean. The right hand side (b) simulates observed free agency earnings data after accounting for the differences in survival rates (52% for white players, 48% for Black players). If one ran a naive regression on (b), the observed data, one would incorrectly conclude there is no pay gap between Black and White players at the mean (difference -0.0304). However, including the selection correction (mills ratio) from a first stage probit, returns a corrected coefficient for Black players at -0.4135***, close to the true unobserved gap of 0.4 log points at the mean.

In the simulation, it is straightforward to structure the first stage probit to identify unequal selection rates for black and white players. Estimating the selection model with real data is more challenging. In particular, a shortcoming occurs if identification arises only from the different functional form of the selection equation (Probit) and the earnings equation (OLS). A stronger case for identification can be made if there is a determinant of selection that does not impact earnings. We first use the proportion of veterans released by the team in the final year of the player's rookie contract. We already have an indication from Table 6 that this increases the chances of a rookie player's retention and hence is very likely to play a role in their survival to free agency. All else equal, the release of a greater number of incumbents should create squad space for the rookie players, who might have otherwise been released. We also exploit the fact that there is an element of randomisation when the drafting player enters the league. Drafting players do not choose where they play. They are assigned to Franchises in a reverse order of finish i.e. the weakest performing side in season t-1 receives the first pick. However, there is some variation in the drafting order because teams are able to trade

their draft picks. For example, a team may swap a veteran receiver for draft picks in future seasons. Therefore, a two similarly talented draftees may find themselves allocated to very different teams.

We use the win rate of the Franchise three seasons prior to the draft as a determinant of survival that is excluded from the wage equation. Rookies allocated to weaker teams are likely to receive more playing time during their rookie period, thereby giving management more information on which to base their retention decision. However, with weaker teammates, their playing statistics are likely to be worse. While coaches will have some understanding of who is responsible for the success or failure of a particularly play, it is not possible to separate all the individual contributions. For example, if a rookie Quarterback takes several sacks (tackled behind the line of scrummage for a loss of yards) over the course of a season, it is likely they will be on the hook for the losses that result. However, the cause of the sacks may have been a mix of receivers not getting open in time, running backs being ineffective, offensive linesmen getting pushed back, amongst other things. Thus we argue that the pre-determined win rate of the Franchise to which the rookie is allocated potentially serves as a determinant of their retention in the selection equation [12] .

4.1 Earnings: Results

Table 7 mimics a typical wage gap regression. We estimate the natural log annual earnings averaged over a player's career, for players drafting between 2005 and 2023 by OLS and without correction for sample selection. This is a pooled cross-section with one observation per player-career. Draft year fixed effects control for wage inflation over the sample period. In column (1) the unconditional Black-White wage gap is estimated at approximately 6% of a log point in favour of Black players but this gap is not statistically different from zero. Columns (2) through (5) add controls: player tenure, free agency, a ten year dummy, player productivity as measured by 'average value', their draft position, player measurables (height, weight and speed over 40 yards) and playing position, and column (6) further controls for draft team fixed effects. The strongest determinants of wages are a player's playing position (particularly if they are a Quarterback) and their productivity. In none of the specifications is there statistically significant evidence of a wage penalty against Black players in general, or for Black quarterbacks specifically. There is weak evidence that players classified as Non Black and Non White earn less than White players. These represent players with Hispanic, Pacific Island or Asian backgrounds albeit the number of observations on these players is low (3.7% of the sample) and the result is not statistically robust across specifications.

An alternative approach often used in the literature is to estimate wages for Black and White players

[12]The correction for selection to free agency is an approximation because the selection process does not stop upon reaching free agency. Veteran players continue to have their performance monitored and remain at risk of dismissal throughout their career. An alternative approach would be to model the selection process on an annual basis as suggested by Wooldridge (2002)[p585-586]. This approach is designed to correct for non-random attrition in panel data which we have for a shorter sample period for NFL players serving 2011-2023. This approach would have the advantage of more accurately capturing the selection process, considering a formal decision of player retention being made at the end of each season. Additionally, the approach is more efficient since it makes use of annual observations of wages and playing performance. Unfortunately the downside of this approach in our context is that there are many more right censored observations and fewer observations. This becomes a significant issue when controlling for playing position e.g. a much larger number of Quarterbacks in the cross-section would be necessary to consider the wage discrimination of Black and White Quarterbacks.

Table 7: Absence of annual wage gaps without selection correction

	(1)	(2)	(3)	(4)	(5)	(6)
Black	0.060	0.018	0.019	0.026	0.027	0.027
	(0.92)	(0.37)	(0.39)	(0.53)	(0.55)	(0.55)
Quarterback	0.39***	0.73***	0.80***	0.91***	0.78***	0.78***
	(2.67)	(6.52)	(6.59)	(7.35)	(6.40)	(6.39)
Black QB	0.16	-0.012	-0.13	-0.15	-0.16	-0.20
	(0.49)	(-0.053)	(-0.56)	(-0.68)	(-0.72)	(-0.88)
Non White Non Black	0.050	-0.099	-0.067	-0.067	-0.054	-0.073
	(0.36)	(-1.03)	(-0.69)	(-0.69)	(-0.56)	(-0.76)
Control Variables						
Tenure					-0.064***	
					(-4.19)	
Free Agent					-0.16***	-0.17***
					(-2.92)	(-2.98)
+Ten Years					0.25***	0.27***
					(3.00)	(3.22)
Productivity (AV)		0.076***	0.083***	0.072***	0.093***	0.094***
		(4.88)	(5.28)	(4.54)	(5.84)	(5.90)
Draft pick		-0.0066***	-0.0064***	-0.0064***	-0.0065***	-0.0066***
		(-22.6)	(-21.7)	(-22.0)	(-22.2)	(-22.3)
Height			0.018	0.019*	0.021*	0.023**
			(1.60)	(1.70)	(1.84)	(1.99)
Weight			0.0026**	0.0026**	0.0024*	0.0025*
			(1.97)	(2.02)	(1.89)	(1.89)
Yards			-0.57***	-0.55***	-0.55***	-0.56***
			(-3.99)	(-3.84)	(-3.90)	(-3.96)
NFL Games		0.0065***	0.0062***	0.011***	0.0070***	0.0069***
		(9.35)	(8.89)	(8.38)	(7.19)	(6.98)
NFL Starts		0.096***	0.094***	0.093***	0.073***	0.074***
		(6.67)	(6.52)	(6.51)	(4.91)	(4.95)
Position FE	No	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Team FE	No	No	No	No	No	Yes
Observations	2,750	2,750	2,750	2,750	2,750	2,750
R-squared	0.068	0.574	0.577	0.580	0.581	0.589

z-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: 1. Sample is NFL Drafted players from 2005-2023. Wages are a player's annualised total pay (salary plus any signing other bonuses) received during the player's career.

separately and perform a Oxaca decomposition. We perform this exercise in the appendix and find no significant unexplained differences in Black and White players earnings (see Table A.7). If one were not to investigate further, one would be drawn to conclude that there is no pay disparity between Black and White players in the NFL.

However, as shown above, significant differences in retention rates exist between Black and White players. As these have consequences for the amounts earned in the lucrative free agency period, we wish to estimate a player's earnings in their free agency period, adjusting for possible sample selection.

Table 8 presents the first and second stages of the Heckman correction model on free agency earnings. We use the full maximum likelihood estimator and provide two-step estimates for comparison in the Appendix. After adjusting for selection, Black players earn 0.11-0.17 fewer log points and Non Black Non White players earn 0.024 - 0.15 fewer log points, depending upon the selection equation specification. While none of these differences are statistically significant at 5% or below, the coefficient on Black earnings is marginally significant at 10% and the point estimate has reversed the sign of a Black advantage (+0.06) in the OLS estimates on annual earnings (Table 7) to a Black penalty (-0.17) in free agency earnings. Larger and statistically significant wage gaps are reported with respect to Black Quarterbacks (0.44-0.93) log points, while noting the challenging for inference with a low number of Black Quarterbacks playing in the NFL over the 18 year period. The twostep estimates in appendix Table A.8 are similar, with marginally stronger results on the unexplained difference in Black earnings (0.22 fewer log points and statistically significant at 5%).

Looking across the columns, the specification of the selection equation is important. In particular, controlling for race in the selection equation reduces the adjustment to Black earnings and Black Quarterback earnings. This is because the adjustment to Black earnings in the Heckman model comes via the correlation in the unobservable error term in the selection equation and the wage equation. With race specified in the selection equation, and with Black players having lower selection rates, the mechanism by which unequal selection bias between black and white players impacts wage gaps is shut down.

The impact of the excluded instruments are reported in the selection equation. The 3 year win rate, while positive, is short of statistical significance [13]. The percentage of Veterans released in the same position during the decision year on a player's rookie contract is a much stronger instrument. This is the case whether one additionally controls for the percentage of all Veterans released and without team fixed effects (columns 2 and 4), or whether one includes the team fixed effect (columns 6 and 8). The estimated *athrho* is a transformed estimate of the correlation in errors between the selection equation and wage equation. That it isn't close to zero is evidence that the observed veterans wages are indeed highly selected[14].

[13] We experimented with different time periods for the prior win rate (e.g. wins in the previous season) but in no case did the win rate predict selection

[14] The negative sign on *athrho* indicates that the structural residuals in the selection model and earnings model are inversely correlated. Note this does not imply that the wages would have been higher among unselected players than selected players with the same covariates. As we observe the covariates for unselected players, we can predict their veteran earnings. Predicted earnings among unselected players are less than half the predicted wages of selected players

Table 8: Earnings gaps with Heckman Selection

	Veteran Earnings	Selection	Veteran Earnings	Selection	Veteran Earnings	Selection	Veteran Earnings	Selection
Black	-0.11	-0.055	-0.16		-0.13	-0.049	-0.17*	
	(-0.93)	(-0.62)	(-1.56)		(-1.04)	(-0.55)	(-1.67)	
Non Black Non White	-0.024	-0.15	-0.15		-0.043	-0.13	-0.15	
	(-0.11)	(-0.96)	(-0.87)		(-0.19)	(-0.80)	(-0.86)	
QB	0.71**	0.58***	0.79***	0.48***	0.62**	0.61***	0.72***	0.50***
	(2.42)	(2.72)	(2.83)	(2.63)	(2.12)	(2.83)	(2.58)	(2.68)
Black.QB	-0.44	-0.59	-0.93**		-0.30	-0.63*	-0.84**	
	(-0.86)	(-1.60)	(-2.14)		(-0.59)	(-1.70)	(-1.97)	
% Veterans released in position		1.05***		1.04***		1.15***		1.14***
		(4.45)		(4.47)		(5.10)		(5.11)
% Veterans released		0.29		0.29				
		(1.30)		(1.32)				
3 year WR		0.10		0.11		-0.12		-0.11
		(0.59)		(0.65)		(-0.46)		(-0.44)
athrho		-1.62***		-1.62***		-1.69***		-1.70***
		(-14.0)		(-14.2)		(-13.3)		(-13.4)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Position FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Team FE	No	No	No	No	Yes	Yes	Yes	Yes
Observations	2,235		2,235		2,235		2,235	
Selected		1,062		1,062		1,062		1,062

Notes: 1. Sample is NFL Drafted players from 2005-2023 with completed careers. Wages are total earnings during the free agency period, i.e. after the conclusion of the first Rookie contract. Full ML estimates from the Heckman Selection model.

5 Conclusion

In this paper, we consider whether retention in the NFL is different for Black and White players. Differences in the likelihood of retention have implications for player earnings realised over the course of their career. Yet simply comparing like-for-like players is not sufficient to reveal these differences in earnings. At face value, Black and White players at all positions are remunerated similarly, even after controlling for observable characteristics such as player productivity. It is only after examining total pay earned over a significant length of time and adjusting for sample selection do unequal earnings for Black and White players emerge. In other words, because lower earning Black players (and Black QBs in particular) exit the sample faster than the equivalent White QBs, the observed distribution of Black QB pay is shifted upwards. This is not visible in our traditional wage gap estimates of annualised earnings.

We argue that prior papers that have not controlled for retention may have underestimated wage differences, even when the observed wage distributions between groups appear similar. That more attention hasn't been paid to the retention process is puzzling. The motivating application that lead to the development of the Heckman (1979) selection model was the estimation of female earnings in the US population. The concern there being that female participation in the labour market was self selected with the consequence that observed average female earnings were overstated compared to the full picture facing women in the population.

Modern empirical applications estimating wage gaps in the labour market have focused on addressing the challenging of identifying causality and have sought to understand to what extent wage gaps can be confidently attributed to employer discrimination, rather than differences in choices over,

at the mean. Additionally, the correlation between the predicted wage residuals and the predicted selection residuals is strongly positive (0.932) as we would expect.

for example, human capital investments. Where discrimination has been shown to be a factor, the research question has often sought to distinguish whether the type of discrimination is taste-based, statistical or some other variant. While some wage discrimination studies attempt to adjust for sample selection, a full consideration of the retention process is often absent. It is likely that data limitations on retention decisions have constrained inquiry.

Additionally, it is surprising that there is not more theoretical work on a model of discrimination in the labour market which places unequal retention at the centre. While there have been a number of important theoretical advances beyond the early discrimination literature (for example see Bohren, Imas, and Rosenberg (2019)), there is further scope for theoretical work to model the dynamic relationship between retention and career earnings.

Our findings show that observed wages between black and white players, conditional on observables but not selection/retention differences, are approximately equal. Indeed, in none of the specifications where unequal retention is not accounted for, is there statistically significant evidence of a wage penalty against Black players in general, or for Black quarterbacks specifically. There is only some evidence, pre-retention adjustments, that players classified as Non Black and Non White earn less than White players. However, in keeping with our motivating conjecture – i.e., that if retention rates vary by races, the ex-ante option value of an NFL career will vary by race even if the observed wage distribution is equal – we find an approximately 3 percentage point difference in retention likelihood between black and non-black players, conditional on observables and fixed effects. This difference in retention affects wages in our selection corrected estimates. After adjusting for selection, Black players earn 0.17 fewer log points and Non Black/Non White players earn 0.15 fewer log points, under our preferred specification. Larger wage gaps are reported with respect to Black Quarterbacks (up to 0.93 log points). As veteran Quarterbacks are the highest paid players in league, the retention disparity between Black and White players has the highest potential to impact earnings at the Quarterback position. Relatedly, we find that neither unequal injury rates between black and non-black players or playing in 'outside the frame' positional stereotypes are the sources of this retention disparity.

A fair question is to what extent the results herein generalise to labour markets in the macroeconomy? Our principal lesson for regression based empirical work on wage gaps is to also consider the retention process. We see no reason why this wouldn't be important in the labour market at large. Most firms in the economy are not under the same spotlight as an NFL Franchise and the absence of public scrutiny is likely to further increase the exercise of discretion against minority employees in the retention decision. While the contractual distinction between restricted rookies and highly paid free-agents is not as rigid outside of a professional sports context, the practice of backloading wages is commonplace in many occupations. There are good reasons to suspect that unequal retention rates impact career earnings for professional workers. At the time of writing, there are only 8 S&P 500 CEOs who are Black. To become CEO of a S&P 500 company requires several successful years of retention and promotion. To what extent this under-representation is a result of discrimination, and the consequences for career earnings, remain open questions.

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Appendix: Additional tables and figures

Table A.1: Summary Statistics (Part 1: Wages)

	Mean (SD)	Count (%)	Observations
Matched wages, race, player and team characteristics			
Drafted players 2005-2023. One observation per player			
Used in Figure 1, Table 7 and Table 8			
Ln(Annualized total pay)	13.86 (1.39)	–	2,750
Ln(Veteran total pay)	15.85 (1.76)	–	1,189
Black	–	3,497 (72.30%)	4,837
White	–	1,172 (24.23%)	4,837
Non-Black Non White	–	163 (3.37%)	4,837
Draft pick	128.06 (73.78)	–	4,837
Free agent	–	1,444 (52.51%)	2,750
Productivity (AV)	2.29 (2.34)	–	2,750
Player lasts 10+ years	–	281 (10.22%)	2,750
Prior 3-year win rate	0.50 (0.14)	–	3,319
Year 1 salary cap hit	810.67 (862.92)	–	4,837
Years in league	5.14 (3.21)	–	2,750
Games played	54.55 (47.36)	–	2,750
Games started	1.82 (2.74)	–	2,750
Height (inches)	73.82 (2.65)	–	2,750
Weight (lbs)	244.21 (45.30)	–	2,750
40-yard dash (sec)	4.74 (0.30)	–	2,750
Panel wages 2011-2023			
All players 2011-2023. One observation per player-season			
Used in Figure 2			
Annualised Contract Value ($M)	2.64 (4.01)	–	20,960
Draft round 1	–	2,913 (13.90%)	20,960
Draft round 2	–	2,312 (11.03%)	20,960
Draft round 3	–	2,128 (10.15%)	20,960
Draft round 4	–	2,098 (10.01%)	20,960
Draft round 5	–	1,722 (8.22%)	20,960
Draft round 6	–	1,637 (7.81%)	20,960
Draft round 7	–	1,427 (6.81%)	20,960
Drafted	–	14,237 (67.92%)	20,960
Undrafted	–	6,723 (32.08%)	20,960
Height (inches)	74.12 (2.64)	–	11,288
Weight (lbs)	248.33 (45.39)	–	11,288
40-yard dash time (sec)	4.75 (0.30)	–	11,031

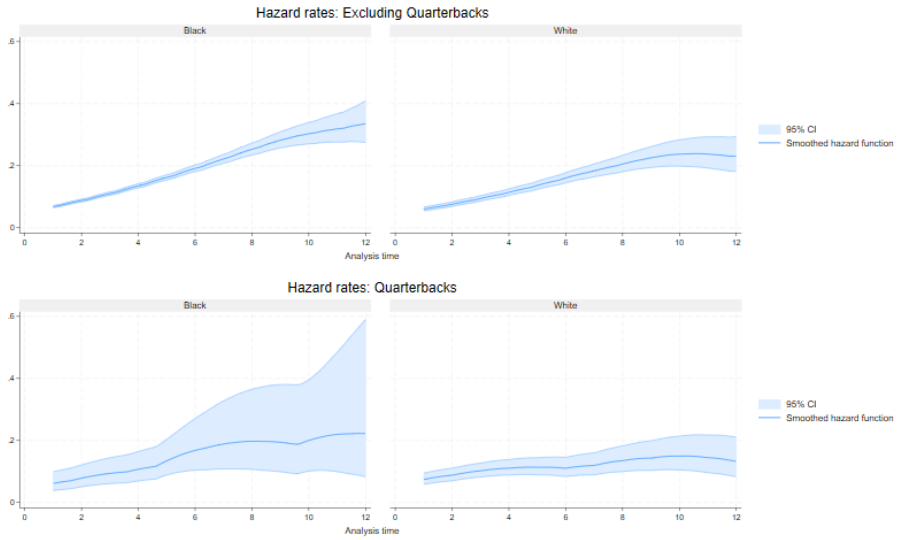
Notes: 1. The main results on wage gaps in the paper are established with the matched data on wages, race, player and team characteristics. The number of observations on annualised total pay is restricted to the estimation sample. 2. Panel wages are necessary to establish figure 2, which shows the sharp increase in annualised contract values after the rookie period has concluded.

Table A.1: Summary Statistics (Part 2: Retention)

Variable	Mean (SD)	Count (%)	Observations
Drafted & Race Matched Panel 2000-2023			
Drafted players 2000-2023. One observation per player-season			
Used in Tables 2-4 and Table 6			
Black	–	17,469 (71.11%)	24,566
White	–	6,137 (24.98%)	24,566
Non Black Non White	–	960 (3.91%)	24,566
Defensive Coverage	–	4,680 (19.05%)	24,564
Defensive Line	–	4,137 (16.84%)	24,564
Linebacker	–	3,453 (14.06%)	24,564
Offensive Line	–	5,635 (22.94%)	24,564
Quarterback	–	1,173 (4.78%)	24,564
Rookie release	–	13,908 (56.61%)	24,566
Running Back	–	2,159 (8.79%)	24,564
Special Teams	–	480 (1.95%)	24,564
Wide Receiver	–	2,847 (11.59%)	24,564
Retained (outcome 1)	–	14,793 (63.85%)	23,168
Released & rehired (outcome 2)	–	4,899 (21.15%)	23,168
Released & exits league (outcome 3)	–	3,476 (15.00%)	23,168
% Veterans released	48.61 (13.37)	–	23,168
% Veterans same position released	10.16 (11.32)	–	23,166
Age	25.97 (3.03)	–	24,566
Average Value (Productivity)	3.98 (3.68)	–	24,566
Games played	12.16 (4.75)	–	24,566
Games started	7.02 (6.35)	–	24,566
Veterans	–	9,573 (38.97%)	24,566
NFL Roster Panel 2000-2023			
All NFL squad players 2000-2023. One observation per player-season			
Used in Table 5			
% Veterans released	48.14 (13.35)	–	44,886
% Veterans same position released	17.19 (13.09)	–	44,886
Age	26.54 (3.37)	–	44,886
Games played	11.68 (5.05)	–	44,886
Games started	5.78 (6.25)	–	44,886
Released	–	18,564 (41.36%)	44,886
Retained	–	26,322 (58.64%)	44,886

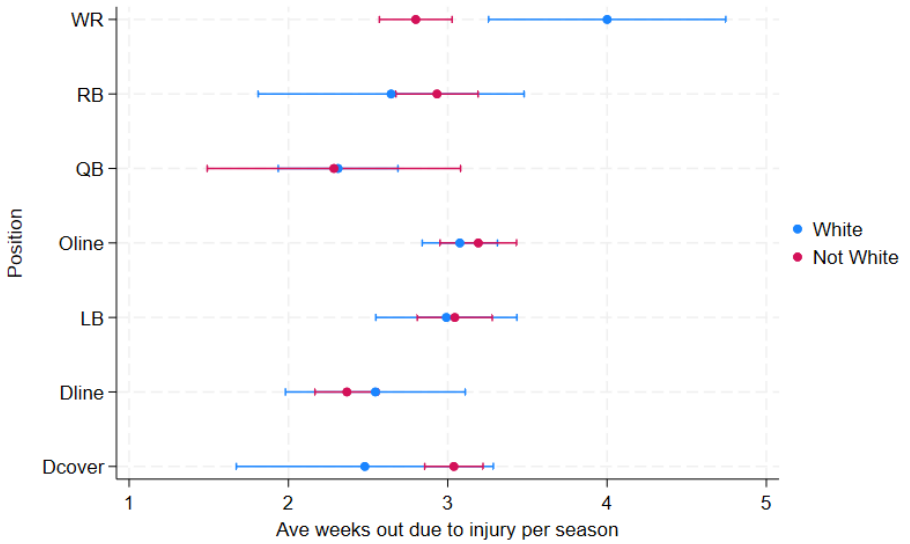
Notes: 1. The main results on retention decisions in the paper are established with the matched race and drafted players panel. 2. We additionally make use of the full rosters of NFL teams to calculate the % of Veterans released and % of Veterans released in the same position in each team-season and merge these into our matched drafted and race sample. These are the most appropriate percentages to use because the space on the roster is the relevant determinant. However, to keep retention decisions comparable, we restrict the main estimating sample to drafted players.

Figure A.1: Hazard rates



The sample comprises drafted players between 2000-2023. The wide confidence interval for Black QBs is a reflection of their small numbers in the league.

Figure A.2: Weeks lost to injury by position



The sample merges injury data with data on player's race for the seasons 2009-2020, excluding the 2019, which was not collected by the data provider due to Covid. Special teams players are omitted due to the very few numbers of non-white players. The plot returns the estimated margins, controlling for the player's age.

Table A.2: Survivor Tables for NFL Players

Year	N	Exits	Surv.	SE	Year	N	Exits	Surv.	SE
Black					Black QB				
1	3497	659	0.812	0.007	1	48	15	0.688	0.067
2	2838	448	0.683	0.008	2	33	5	0.583	0.071
3	2390	426	0.562	0.008	3	28	3	0.521	0.072
4	1964	412	0.444	0.008	4	25	4	0.438	0.072
5	1552	345	0.345	0.008	5	21	3	0.375	0.070
6	1207	289	0.263	0.007	6	18	2	0.333	0.068
7	918	256	0.189	0.007	7	16	3	0.271	0.064
8	662	227	0.124	0.006	8	13	2	0.229	0.061
9	435	169	0.076	0.005	9	11	2	0.188	0.056
10	266	106	0.046	0.004	10	9	3	0.125	0.048
11	160	75	0.024	0.003	11	6	3	0.063	0.035
12	85	36	0.014	0.002	12	3	1	0.042	0.029
13	49	25	0.007	0.001	13	2	1	0.021	0.021
14	24	13	0.003	0.001	14	1	0	0.021	0.021
15	11	5	0.002	0.001	15	1	1	0.000	-
White					White QB				
1	1172	243	0.793	0.012	1	171	55	0.678	0.036
2	929	132	0.680	0.014	2	116	14	0.597	0.038
3	797	109	0.587	0.014	3	102	17	0.497	0.038
4	688	114	0.490	0.015	4	85	9	0.444	0.038
5	574	108	0.398	0.014	5	76	10	0.386	0.037
6	466	111	0.303	0.013	6	66	16	0.292	0.035
7	355	89	0.227	0.012	7	50	14	0.211	0.031
8	266	73	0.165	0.011	8	36	5	0.181	0.030
9	193	56	0.117	0.009	9	31	5	0.152	0.028
10	137	36	0.086	0.008	10	26	5	0.123	0.025
11	101	44	0.049	0.006	11	21	5	0.094	0.022
12	57	21	0.031	0.005	12	16	4	0.070	0.020
13	36	12	0.021	0.004	13	12	3	0.053	0.017
14	24	6	0.015	0.004	14	9	2	0.041	0.015
15	18	6	0.010	0.003	15	7	3	0.023	0.012
Non Black, Non White									
1	163	27	0.834	0.029					
2	136	19	0.718	0.035					
3	117	24	0.571	0.039					
4	93	18	0.460	0.039					
5	75	7	0.417	0.039					
6	68	18	0.307	0.036					
7	50	14	0.221	0.033					
8	36	13	0.141	0.027					
9	23	10	0.080	0.021					
10	13	6	0.043	0.016					
11	7	2	0.031	0.014					
12	5	1	0.025	0.012					
13	4	2	0.012	0.009					
14	2	1	0.006	0.006					
15	1	1	0.000	.					

Notes: Notes here The table shows the unconditional survival rates of NFL players for the first fifteen seasons. Survival tables for Non Black, Non White QBs cannot be calculated as there were only 6 players in the sample period, 5 of whom did not survive beyond year 1.

Table A.3: Outside the Frame Position

	Position								
	Dcover	Dline	LB	Oline	QB	RB	Special	WR	Total
Stereotype	Black	Black	Black	White	White	Black	White	Black	-
In Frame (N)	4,361	3,274	2,592	2,876	911	1,933	466	2,580	18,993
In Frame (%)	93.2%	79.1%	75.1%	51.0%	77.7%	89.5%	97.1%	90.6%	77.3%
Out Frame (N)	319	863	861	2,759	262	226	14	267	5,571
Out Frame (%)	6.8%	20.9%	24.9%	49.0%	22.3%	10.5%	2.9%	9.4%	22.7%
Total	4,680	4,137	3,453	5,635	1,173	2,159	480	2,847	24,564

Notes: This table shows the number and percentage of players who are in (out) of the frame in terms of the sterotypical skin colour of the playing position. The Offensive line is arguably not a 'white' position but whether or not this position is included does not affect the subsequent analysis.

Table A.4: Rookie Retention: Outside the Frame

	(1)	(2)	(3)	(4)
Out Frame	0.0079	0.0073	-0.017	-0.051
	(0.91)	(0.83)	(-0.60)	(-1.13)
Non White		-0.039***	-0.061**	-0.095**
		(-4.15)	(-2.41)	(-2.16)
Out Frame & Non White			0.041	0.074
			(0.91)	(1.28)
% Veterans released in position	0.12***	0.12***	0.12***	0.13***
	(3.41)	(3.39)	(3.41)	(3.22)
% Veterans released	-0.27***	-0.27***	-0.27***	-0.27***
	(-8.58)	(-8.55)	(-8.55)	(-7.60)
Age	-0.085***	-0.086***	-0.086***	-0.088***
	(-35.1)	(-35.4)	(-35.4)	(-32.0)
Games	0.020***	0.020***	0.020***	0.021***
	(22.1)	(22.0)	(22.0)	(20.5)
Games Started	0.00081	0.00080	0.00079	0.00043
	(0.75)	(0.74)	(0.74)	(0.36)
AV	0.016***	0.016***	0.016***	0.017***
	(8.25)	(8.36)	(8.36)	(7.66)
Draft round	Yes	Yes	Yes	Yes
Season FE	Yes	Yes	Yes	Yes
Position FE	Yes	Yes	Yes	Yes
Team FE	Yes	Yes	Yes	Yes
Observations	14,179	14,179	14,179	11,107
R-squared	0.215	0.216	0.216	0.222

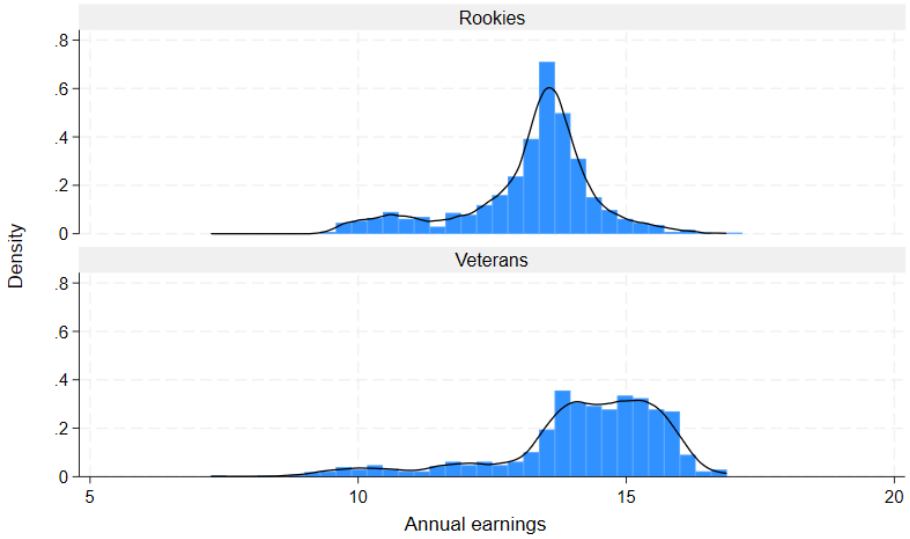
Notes: The table presents the impact of being out of the frame with respect to the sterotype of that playing position upon Rookie retention for drafted NFL players 2000-2023. Each column is a linear probability model. Column 4 excludes the Offensive Line which is marginally majority white.

Table A.5: Injuries by playing position

		Weeks Out		
Position	Injuries	Mean	Std. Dev.	% Black
QB	324	2.28	4.53	23.8%
Oline	2,130	3.16	5.10	47.3%
RB	940	2.81	4.78	90.3%
WR	1,220	2.85	4.86	92.1%
Dcover	2,068	2.86	4.85	95.7%
Dline	1,346	2.41	4.63	84.9%
LB	1,395	2.81	4.89	78.9%
Special	136	1.01	3.37	3.9%

Notes: The table provides the count of injuries by playing position, alongside the average number of weeks a player from that position misses on average from an injury (of any type). The final column % Black gives the proportion of players by position who are Black, excluding Non Black, Non White players.

Figure A.3: Earnings Backloading



Natural log of annual earnings in 2023 prices. Drafted players 2005-2023 with completed careers.

Table A.6: Retention bias channels: Coaches and metropolitan demographics

	All Players			Quarterbacks		
	(1)	(2)	(3)	(4)	(5)	(6)
Black player	-0.043*	-0.052***	-0.047	-0.14	-0.072	-0.61
	(-1.83)	(-2.81)	(-0.59)	(-1.31)	(-0.84)	(-1.39)
White Head Coach	0.0012			-0.018		
	(0.057)			(-0.26)		
Black player × White Coach	0.00084			0.10		
	(0.033)			(0.79)		
All White Staff		-0.016			-0.012	
		(-0.86)			(-0.20)	
Black player × All White Staff		0.018			-0.0058	
		(0.83)			(-0.048)	
Metro White Share			-0.00093			-0.0054*
			(-0.98)			(-1.78)
Black player × Metro White Share			0.000067			0.0073
			(0.061)			(1.23)
Other	-0.052**	-0.052**	-0.053**			
	(-2.02)	(-2.03)	(-2.07)			
% Veterans in same position released	0.15***	0.15***	0.15***	-0.13	-0.12	-0.056
	(2.97)	(2.99)	(2.89)	(-0.41)	(-0.38)	(-0.18)
% Veterans released	-0.35***	-0.35***	-0.36***	-0.29	-0.30	-0.33
	(-8.66)	(-8.66)	(-8.80)	(-1.32)	(-1.40)	(-1.50)
Age	-0.088***	-0.088***	-0.089***	-0.081***	-0.080***	-0.083***
	(-26.3)	(-26.3)	(-26.4)	(-4.95)	(-4.84)	(-5.09)
Games Played	0.019***	0.019***	0.019***	0.029**	0.028**	0.030**
	(14.5)	(14.5)	(14.5)	(2.31)	(2.24)	(2.41)
Games Started	0.0023	0.0023	0.0023	-0.031**	-0.030**	-0.031**
	(1.51)	(1.50)	(1.53)	(-2.29)	(-2.22)	(-2.33)
Player Productivity	0.021***	0.021***	0.021***	0.040***	0.040***	0.039***
	(7.93)	(7.95)	(7.92)	(3.40)	(3.44)	(3.35)
Observations	7,123	7,123	7,123	279	279	279
R-squared	0.213	0.213	0.213	0.275	0.274	0.283

Notes: Sample size is 2008-2017. Linear probability model (OLS) on player retention. The interaction terms between Black player and White Coach, White Staff, and Metro White Share test whether Black players under these conditions face a greater retention penalty as might be expected if the unobserved level of Franchise predjuice was correlated with these variables. However, none of these interactions are statistically significant. Columns (1)-(3) include position and season fixed effects. Columns (4)-(6) restrict the sample to Quarterbacks and include only season fixed effects.

Table A.7: Annual Earnings and Oaxaca-Blinder Decomposition

	Panel A: Regression Results		
	Pooled	White	Black
	(1)	(2)	(3)
Black	0.027		
	(0.55)		
QB	0.780***	0.647***	0.679***
	(6.40)	(2.79)	(3.33)
Black.QB	-0.162		
	(-0.72)		
Other	-0.054		
	(-0.56)		
NFL Games	0.007***	0.010***	0.005***
	(7.19)	(5.30)	(4.56)
NFL Games Started	0.073***	0.036	0.096***
	(4.91)	(1.12)	(5.51)
FA	-0.163***	-0.204*	-0.144**
	(-2.92)	(-1.70)	(-2.21)
Tenure	0.245***	0.359**	0.173*
	(3.00)	(2.15)	(1.78)
Productivity (AV)	0.093***	0.051	0.109***
	(5.84)	(1.42)	(5.79)
Draft Pick	-0.007***	-0.007***	-0.006***
	(-22.18)	(-10.25)	(-19.45)
Height	0.021*	0.036	0.009
	(1.84)	(1.38)	(0.73)
Weight	0.002*	0.002	0.003*
	(1.89)	(0.52)	(1.71)
Yards	-0.554***	0.061	-0.748***
	(-3.90)	(0.21)	(-4.40)
Observations	2,750	646	1,992
R-squared	0.581	0.570	0.596

Panel B: Oaxaca-Blinder Decomposition				
	Overall	Endowments	Coefficients	Interaction
	(1)	(2)	(3)	(4)
White Mean	13.856***			
	(243.77)			
Black Mean	13.854***			
	(450.89)			
Total Difference	0.002			
	(0.02)			
Decomposition				
Due to Endowments	0.021			
	(0.29)			
Due to Coefficients	-0.044			
	(-0.60)			
Due to Interaction	0.024			
	(0.29)			
Variable Detail				
QB		0.093***	-0.000	-0.004
		(2.98)	(-0.09)	(-0.09)
FA		-0.003	-0.061	-0.002
		(-0.75)	(-0.84)	(-0.58)
Tenure		0.008	0.013	0.006
		(1.48)	(0.69)	(0.67)
NFL Games		0.007	0.258**	0.006
		(0.55)	(2.02)	(0.53)
NFL Games Started		0.018	-0.129*	-0.014
		(1.36)	(-1.94)	(-1.14)
Productivity (AV)		-0.009	-0.067	0.002
		(-0.73)	(-0.71)	(0.51)
Draft Pick		-0.089***	-0.018	-0.002
		(-4.05)	(-0.19)	(-0.19)
Height		-0.024	3.780*	0.112*
		(-0.81)	(1.72)	(1.72)
Weight		0.097**	-0.730	-0.075
		(2.50)	(-0.92)	(-0.92)
Yards		-0.183***	3.673**	0.176**
		(-4.46)	(2.30)	(2.28)

Notes: Panel A reports coefficients from OLS regressions of Ln annual earnings. Column (1) includes players with race interactions, Columns (2) and (3) estimate seperately for White and Black players. Panel B reports the Oaxaca-Blinder decomposition results comparing White and Black players. The decomposition breaks down the total earnings difference into components due to different characteristics (endowments), different returns to characteristics (coefficients), and their interaction. t-statistics in parentheses for Panel A, z-statistics in parentheses for Panel B. * p<0.10, ** p<0.05, *** p<0.01.

Table A.8: Earnings gaps with Heckman twostep

	Veteran Earnings	Selection	Veteran Earnings	Selection	Veteran Earnings	Selection	Veteran Earnings	Selection
Black	-0.18	-0.069	-0.21*		-0.19	-0.058	-0.22**	
	(-1.43)	(-0.72)	(-1.92)		(-1.53)	(-0.59)	(-1.97)	
Non Black Non White	-0.11	-0.18	-0.21		-0.13	-0.16	-0.22	
	(-0.50)	(-1.08)	(-1.08)		(-0.60)	(-0.91)	(-1.12)	
QB	0.66**	0.67***	0.73**	0.53***	0.58*	0.72***	0.66**	0.56***
	(2.23)	(2.81)	(2.52)	(2.60)	(1.96)	(3.00)	(2.29)	(2.71)
Black QB	-0.55	-0.81*	-0.93*		-0.49	-0.87**	-0.90*	
	(-1.04)	(-1.95)	(-1.87)		(-0.93)	(-2.07)	(-1.82)	
% Veterans released in same position		1.63***		1.60***		1.72***		1.70***
		(5.34)		(5.29)		(5.71)		(5.68)
% Veterans Released		0.32		0.34				
		(1.07)		(1.15)				
3 year WR		-0.025		0.0052		-0.20		-0.17
		(-0.11)		(0.023)		(-0.58)		(-0.50)
lambda		-1.27***		-1.28***		-1.29***		-1.29***
		(-6.56)		(-6.58)		(-6.79)		(-6.81)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Position FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Team FE	No	No	No	No	Yes	Yes	Yes	Yes
Observations	2,235		2,235		2,235		2,235	
Selected		1,062		1,062		1,062		1,062

Notes: 1. Replicates table 8 but with estimates from the two-step version of the Heckman Selection model. The maximum likelihood version is more efficient and allows for joint hypothesis testing across both equations, but requires stronger distributional assumptions and can be sensitive to misspecification. The two-step version is more robust to distributional violations.