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Abstract

We examine the effect of labor mobility constraints on racial wage discrimination. We show that when monopsony power is low because of relaxed labor mobility constraints, firms cannot act on their prejudice and discrimination disappears. This prediction is taken to the data by using an exogenous mobility shock on the European football labor market. The Bosman ruling lifted restrictions on player mobility in 1995. Using a panel of top English clubs, we compare the pre- and post-Bosman ruling market. We find evidence that wage discrimination disappears only for workers whose mobility constraints have been lifted. (JEL J15, J31, J6, J71)

1 Introduction

We examine the effects of labor mobility constraints on racial wage discrimination. Taste-based discrimination cannot survive in a competitive market (Becker, 1957), but can be explained by market failures. We show theoretically that racial wage gaps could persist in a monopsonistic labor market with limited job-to-job mobility. In contrast, when constraints on job-to-job mobility are reduced, we show that the monopsony power of prejudiced firms is low and discrimination disappears.

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Our contribution is to bring the predictions on job-to-job mobility and racial wage discrimination to the data. To this end, we study an environment with a clear change in labor mobility constraints: the European football labor market. In 1995, the Bosman ruling by the European Court of Justice lifted restrictions on player mobility in the European Union (EU).[1] Exploiting this shock we find that racial wage discrimination is economically significant before the Bosman ruling, but disappears afterwards, as theory would predict.

This investigation is important for public policy reasons. Removing constraints on worker mobility, such as quotas, work permits, or non-compete rules,[2] may improve the capacity of workers to move from prejudiced to unprejudiced firms and reduce discrimination.[3] In contrast, when job-to-job mobility is constrained, a firm is able to act on its prejudice because of the low cost of doing so.

Investigating the effect of monopsony power on discrimination raises many challenges. First, we need a credible shock to job-to-job mobility. The *pre*-Bosman era was characterized by two important restrictions on mobility: (1) transfer fees needed to be paid for out-of-contract players,[4] and (2) the number of foreigners per club was restricted to 5 by a quota. The Bosman ruling removed the quota for EU nationals and the transfer fee for out-of-contract players. This policy change creates a compelling quasi-experimental variation.

Second, we need to measure wage discrimination. Player wages are not publicly available. However, the features of the football market are used to design a market

[1]Specifically, in June 1990, at the end of his contract, the Belgian player Jean-Marc Bosman refused Liege's offer of a contract extension at only 25% of his last wage, and accepted a contract from the French club Dunkirk instead. Because Dunkirk refused to meet the transfer fee demand, Liege refused to let him go. Bosman decided to take his case to the courts and won. As a result, the European Commission applied European law on worker mobility to the football labor market.

[2]Non-compete rules between firms tend to restrain labor competition. One recent example is the "Techtopus" case, where major Silicon Valley firms such as Google, Apple or Intel stand accused of passing tacit agreements not to hire each other's employees (see NY Times, April 24th 2014). Another worrying development is the rise of non-compete clauses in all types of jobs, such as summer camp counselors or hair stylists (see NY Times, June 8th 2014). Alan Krueger describes non-competes rules as part of a 'rigged' labor market in which employers "undoubtedly restrict worker mobility" (see also Krueger and Ashenfelter, 2018; Starr et al., 2015).

[3]Recent papers find that the incidence of non-compete clauses falls disproportionately on women and black workers (Lipsitz and Starr, 2019; Johnson et al., 2019)

[4]This restriction was similar to the "reserve clause", frequent in North American sports, that bound players to the clubs that held their contracts, irrespective of whether their contract had expired. This meant the player was not free to enter into another contract with another club. The reserve clause was abolished in baseball in 1975.

test for racial discrimination in salary setting (Szymanski, 2000). Football is an efficient market, where club success depends on their wage bills, which reward player talent.[5] Discrimination can then be said to exist if, for a given wage bill, clubs fielding an above-average proportion of black players systematically outperform clubs with a below-average proportion of black players. This implies that black players are being paid less than their talent would warrant.

Third, we need a credible identification strategy. The main challenge is that the Bosman ruling applies to all EU countries, while non-EU countries have very few black players in their League before and after 1995, which rules out using these countries as control groups. However, the ruling did not apply equally to all players within EU countries. Before exploiting within-country variation across players, we first exploit variation over time. Using a panel of top English clubs from 1981 to 2008, we run the market-test at the match level. We test whether clubs that field more black players in a given match outperform their rivals, while controlling for wage bill differences, and including club-pair fixed effects. We find significant discrimination before Bosman.[6] Hiring one additional black player gave a goal advantage equivalent to increasing the wage bill by 300,000£. However, we show this advantage disappears *after* Bosman, when labor mobility constraints subside.

We then exploit variation across players and use a falsification test that mimics a difference-in-differences approach. We compare, after the ruling, black and white English players to black and white non-EU players, who face higher mobility constraints. If prejudice had been significantly reduced since the Bosman ruling, then black players who do not benefit from the ruling should not be discriminated against today, but this is not what we find. We find evidence that only black *non-EU* players face wage discrimination in the post-Bosman era, while white non-EU players, and black and white EU players are not discriminated against. Alternative theories which explain the drop in discrimination in the middle of 1990s with a decline in prejudice also have to explain why black players who face labor mobility constraints

[5]Unlike professional sport labor markets in the US, there are no collective bargaining agreements, salary caps, or draft picks to maintain a competitive balance between clubs.

[6]Using a more aggregated version of the market test, Szymanski (2000) confirms racial discrimination in professional English clubs between 1978 and 1993, before the Bosman ruling.

post-Bosman are still discriminated against. We therefore feel confident in ascribing the decrease in wage discrimination to the Bosman ruling.

We also face challenges to rule out alternative explanations for the decrease in wage discrimination. First, we test the relevance of an alternative hypothesis: that the emergence of a market for corporate control of English professional clubs has increased competition, which would have driven discriminating firms out of the market (Palacios-Huerta, 2014). However, the market for corporate control emerged before the Bosman ruling. Moreover, only a third of the Premier League clubs during the post-Bosman period have been listed on the stock market, and few of the best ones. We nevertheless test for the corporate control effect and find no evidence that clubs on the stock market discriminate less than privately owned-clubs.

Second, could the decrease in wage discrimination simply be due to a decrease in prejudice? Unfortunately, racist incidents in football, whether from fellow players, owners, managers or supporters still continue to make the headlines of English newspapers.[7] As a consequence, in July 2019, the international governing body of football (FIFA) updated their disciplinary code to fight all kinds of racism and discriminatory behavior. Even if the data reject the idea of a general reduction in prejudiced views concomitant to the Bosman ruling, we explicitly address this possibility. First, we run our estimation on 5-year windows, before and after the ruling, and show that the decrease in discrimination is faster than would imply a slow downward trend in prejudice. Moreover, yearly estimates of the effect of black players on performance show no secular trend leading to a decrease in discrimination.[8]

The results of this paper are related to a large theoretical literature on how labor market frictions enable firms to discriminate against their employees. However, there is little empirical work on this question. Biddle and Hamermesh (2013) and Baert et al. (2014) are exceptions showing that employers discriminate less in labor markets with a small number of job seekers relative to vacancies. Our perspective is different but the Bosman mobility shock, by offering more job opportunities, could

[7]See the online appendix for evidence of racism in English football before and after the ruling.

[8]In addition, the Bosman ruling modified managers' incentives. As expected from theory, managers who hire many black players outperform competitors with the same wage budget before the Bosman ruling, but not so afterwards.

be interpreted as a decrease in the ratio of employed job seekers to job offers. This situation discourages employers from indulging in discriminatory tendencies. This paper also contributes to the literature on the effects of labor mobility constraints on wages. For instance, Naidu (2010) and Naidu et al. (2016)) document that wages rise when labor mobility constraints decrease. We show that decreasing these frictions also reduces racial wage discrimination.[9]

The paper is organized as follows. Section 2 describes the context of our analysis and the competitive football market. Section 3 outlines what our search model with prejudice would predict about the effects of labor mobility constraints on discrimination. Section 4 presents our identification strategy and the specifications of the market test for discrimination. Our empirical results on discrimination in the English football league are presented in section 5. The most important result is that discrimination disappears when constraints on worker mobility are lowered. Section 6 concludes.

2 The Football Market

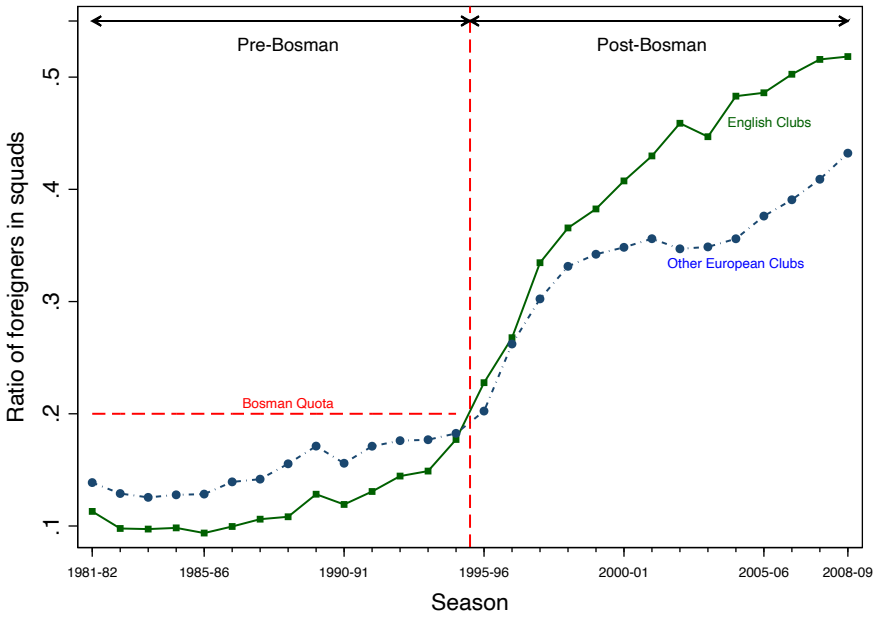
We have already discussed two important advantages that the football market can offer to answer the challenges in linking labor mobility to discrimination: an exogenous change in mobility, and a simple test for racial wage discrimination in absence of individual wages. Another advantage is the opportunity to collect data on teamsheets and skin color of professional players that we have matched with their career paths.[10] We now document five facts about the football market that guide our empirical and theoretical analysis.

Fact 1. Intensified mobility. The Bosman ruling was decided on December 15, 1995, by the European Court of Justice. This important decision lifted restrictions on football player mobility based on the European Community Treaty of the free movement of labor (article 39). This decision had a profound effect on transfers in the European football market by banning restrictions on EU players in the EU's

[9]We also contribute to a long literature that uses sport as a laboratory to explore economic mechanisms (see (Depetris-Chauvin et al., 2020; Gauriot and Page, 2019) for recent examples.)

[10]See Appendix A for further information on variable definitions and data sources.

Figure 1: Share of foreigners in European clubs (1981-2008)



Notes: English clubs are part of the Premier League. The other European clubs are also top league clubs from Denmark, France, Germany, Greece, Italy, the Netherlands and Spain. Given that the average club size in top leagues is around 25 players, the dashed horizontal line represents the quota constraint of 5 foreign players per club per season before the Bosman ruling. The vertical dashed line separates the pre-Bosman and post-Bosman ruling.

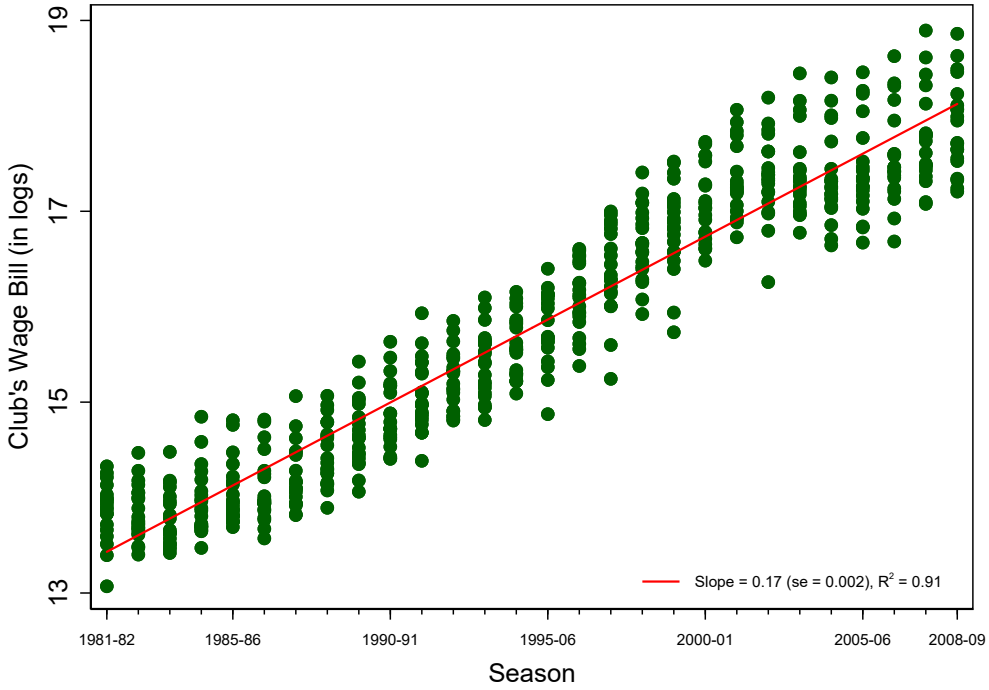
national leagues and by allowing players in the EU to move to another club at the end of their contract without a transfer fee being paid. Figure 1 illustrates the intensified mobility of the European football market in the wake of the Bosman ruling. After 1995, the ratio of foreigners in clubs skyrocketed. Before 1995, the quota of five foreign players per club in England was binding but not fulfilled.

Fact 2. League competition is hierarchical. Each season or year,[11] approximately 20 clubs compete in the English first league. Competition is focused on league rankings without play-offs. Clubs are ranked by total points, then goal difference, and then goals scored. At the end of each season the worst-performing clubs swap places with the highest-ranked clubs in the second league. There are no collective bargaining agreements, salary caps, or draft picks to maintain a competitive balance between clubs.

Fact 3. Clubs are heterogeneous in wage bills. Figure 2 reports the log of the

[11] We use the terms season and year interchangeably to indicate the part of the year during which football matches are held, usually from August to June.

Figure 2: Club Wage Bills for the English First league



Notes: Each dot stands for one club from 1981 to 2008. The elasticity coefficient from the OLS regression of the log-club's wage bill on a year trend is reported with standard error in parenthesis.

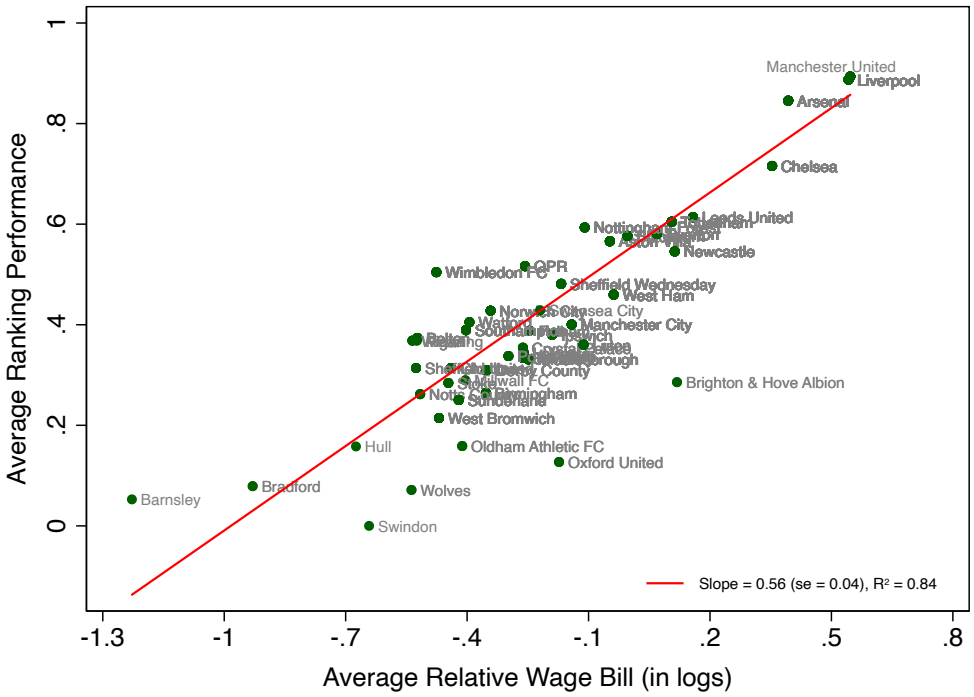
clubs' wage bills in the English first league from 1981 to 2008. Each year, we observe a dispersion of wage bills supporting club heterogeneity. Over the years, wage bills are linearly increasing for all clubs, without being affected by the Bosman ruling shock. A common explanation for the increasing trend in wage bills is the increasing price of talent. Players earn wages proportional to their talent and demand for talent is increasing, which raises its price.

Fact 4. Clubs success depends on sporting talent. A club's sporting talent is highly correlated with its success and performance. Thus, the higher the club's sporting talent, the higher its wage bill, and the higher its ranking.[12] In Figure 3, we observe that wage expenditures and success are heavily correlated in the English Premier League between 1981 and 2008.

Fact 5. Football is not immune to prejudice. Racial wage gaps persist in many occupations, and evidence suggests that at least some of this is due to discrimination

[12]In Appendix B, we construct a proxy for a club's sporting talent, based on a crude measure of players' quality. Figure 6 depicts a clear linear correlation between wage bill and club quality, with an r-squared of 0.78.

Figure 3: Average Wage Bill and Club Success in the English First League



Notes: The figure covers the period from 1981 to 2008. The average performance of club i is computed in a given season t as $[(Ranking_{it} - min_t)/(max_t - min_t)]$, where min and max are the lowest and highest possible rankings in t. The club's average relative wage bill is computed as the log difference to the annual average.

from prejudiced firms.[13] English football is no exception. Racist incidents, such as the English national team captain aiming a racial slur at another player, continue to occur with alarming regularity.[14] In August 2014, it came to light that Malky Mackay, the manager of Premier League club Cardiff City, shared racist e-mails and texts with the director in charge of transfers, Iain Moody, such as: "[This agent] needs to rename his agency the All Blacks;" or "Not many white faces amongst that lot but worth considering". As a consequence of repeated racism and discriminatory behaviors, and after almost 15 years without any major changes, the FIFA has decided to update their disciplinary code. Thus, "content-wise, topics like racism and discrimination have been updated, putting FIFA at the forefront of the fight against this appalling attack on the fundamental human rights of individuals." Following the same goal, the Premier League association launched on October 2019 a "No Room

[13]See Lang and Lehmann (2012) or Charles and Guryan (2011) for recent literature reviews documenting the persistence of racial wage gaps in the US.

[14]See our online appendix for a more detailed compendium.

For Racism" campaign with the possibility to report racism by using a website reporting form or a dedicated smartphone application.

3 Theoretical Predictions from a Search Model of Discrimination

To link racial wage discrimination and labor mobility, we build a simple labor market search model in the style of Burdett and Mortensen (1998) and Bowlus and Eckstein (2002). This model, developed in Appendix C, presents three features. First, it is specific to the economics of football, relying on the stylized facts that emerge from Section 2. Second, it links race-based wage discrimination to job-to-job mobility constraints. Finally, it offers a micro-foundation for the discrimination market test. Given that sporting success depends on the quantity of sporting talent, the model generates the following predictions:[15]

- When job-to-job mobility is constrained,
  - the club's sporting talent depends on the club's wage bill and its share of black players;
  - disliked players change club less often than preferred ones.
- When job-to-job mobility is unconstrained,
  - the club's sporting talent depends on the club's wage bill *but not* on its share of black players;
  - disliked players move *more often* than preferred ones.

The story behind the model is straightforward.[16] Clubs face a trade-off between offering individual wages that perfectly reward players' talent, ensuring they do not search on the job, or alternatively offering lower wages, but facing costly turnovers

[15]These predictions correspond to Propositions C.2 and C.3 shown in the Appendix.

[16]Note that our model does not distinguish consumer from employer discrimination. However, previous research shows that discrimination in football is unlikely to be consumer-driven. Preston and Szymanski (2000) find no evidence that having more black players decreases attendance or club revenue, and no correlation between measures of prejudice at the local level and the number of black players hired.

if their players are poached by another club. If job-to-job mobility is constrained, and clubs can set wages to some degree, then clubs exhibiting racial biases can persist, since discriminated players find it hard to find new employers. By contrast, when constraints on job-to-job mobility are low, players can relocate or credibly threaten to leave, which weakens the monopsony power of prejudiced firms. The club's sporting talent is then independent of the club's share of black players.

4 Empirical Design

4.1 The Market-Based Test for Discrimination

Our empirical analysis uses Szymanski's (2000) market test for discrimination. This test is a clever way out of the omitted variable bias that plagued conventional approaches to testing for racial discrimination using earning functions (Palacios-Huerta, 2014). A conventional approach would be to run a Mincerian individual wage equation, controlling for individual ability and adding a dummy for the player's skin color. However, controlling for individual ability/productivity has proven difficult when output is produced as a team, as in football. Moreover, individual wage data for football players are not publicly available on a large time-scale.

The intuition behind the market test is simple: if all individual talent is perfectly rewarded, the club's performance (a function of talent) should be perfectly explained by the club's wage bill. Crucially, this performance should be independent of the club's racial composition. By contrast, for a given wage bill, if clubs fielding an above-average proportion of black players systematically outperform clubs with a below-average proportion of black players, then the labor market may be unfair towards black players, i.e., their talent is not fully rewarded and they face wage discrimination (see subsection C.2 for a theoretical foundation).

4.2 The Bosman Shock as a Source of Identification

In moving from theory to estimation we face the challenge that the levels of mobility constraints in the European football market are unfortunately not readily quantifi-

Table 1: Individual Differences in Means: Black vs White English Players

	Pre-Bosman (1990-1994)			Post-Bosman (1995-1999)			Overall
Variable	Black	White	Diff.	Black	White	Diff.	Diff. across periods
Player's number of matches	21.0	19.7	1.28^c	19.7	17.8	1.87^a	-1.74^a
	[13.4]	[13.4]	(0.72)	[11.9]	[12.0]	(12.1)	(0.30)
Player's quality level	2.64	2.28	0.36^a	2.92	2.67	0.24^a	0.4^a
	[2.1]	[2.1]	(0.11)	[2.1]	[2.0]	(0.1)	(0.06)
Age of players	25.2	25.6	-0.39^c	25.8	25.7	0.08	0.24^c
	[4.1]	[4.6]	(0.22)	[4.5]	[5.0]	(0.26)	(0.14)
Tenure in years	2.79	2.90	-0.11	2.92	3.29	-0.35^a	0.32^a
	[2.1]	[2.3]	(0.12)	[2.0]	[2.8]	(0.13)	(0.7)
Observations	417	2,049		357	1,643		

Notes: This table reports average characteristics for black and white English players in the first league. Observations are at the player-season level, meaning some players can appear multiple times in this dataset. 'Diff.' means difference in means between blacks and whites; Standard deviations are in brackets; standard errors are reported in parentheses, with ^{a}, ^{b} and ^{c} denoting significance at the 1%, 5% and 10% level, respectively.

able. In lieu of quantifiable measures, we use the Bosman ruling as an exogenous mobility shock. We then apply the market test for discrimination to a panel of all English Premier League clubs on narrow time-windows from 1990 to 1999, i.e., 5 years before and 5 year after the Bosman ruling.[17]

Exploiting the ruling and using our extensive player data, we construct informative descriptive statistics (see Appendices A and B for data details). From 1990 to 1999, we have information on 1,714 first league players of which 77% are English.[18] In particular, 11.8% of players are English and black; this number is fairly stable before (14.1%) and after (11.2%) Bosman. However, the number of black non-English players has increased from 1% before the ruling to 5.6% after it.

To avoid comparing players with different nationalities, we focus only on English players and report their average individual characteristics in Table 1. We thus compare black to white English players during the 1990 to 1999 seasons. We observe in the pre- and post-Bosman periods that black players on average played more matches, were slightly more qualified, and slightly less tenured. Interestingly, the data point to significant differences across the two periods (see last column of Table 1): In the post-Bosman era, all players on average played less matches, are qualitatively better, about 3 months older and more tenured.

[17] We focus here on narrow 5-year windows, before and after the ruling, although we have data from 1981 to 2008 that we use for robustness checks.

[18] We use the term English but a minority of those players are Irish, Scottish or Welsh. Considering these players as English players makes sense in our context because they were not considered foreigners in the English football market and thus were not subject to the foreign quotas.

Table 2: Mean Match Statistics

Variable	Pre-Bosman (1990-1994)	Post-Bosman (1995-1999)	Differences across periods
Mean number of players (Home)	12.20	12.80	0.59[a]
	[0.7]	[0.9]	(0.02)
Goals scored (Home)	1.52	1.54	0.15
	[1.3]	[1.3]	(0.04)
Goals scored (Away)	1.10	1.09	-0.01
	[1.1]	[1.1]	(0.03)
Minutes played by	157.30	143.70	-13.57 [a]
black English players (Home)	[128.7]	[119.4]	(3.87)
Minutes played by	164.50	185.90	21.38[a]
black players (Home)	[128.5]	[120.4]	(3.88)
Observations	2,228	1,900	

Notes: This table reports average characteristics for Premier league matches. 'Difference' means difference in means between and post- and pre-Bosman period. Standard deviations are in brackets; standard errors are reported in parentheses, with [a] denoting significance at the 1% level.

Table 2 reports descriptive statistics on matches before and after the ruling, given that our market test is based on match-level variation (see below). Black English players are less selected on average after Bosman, but the total number of black players goes up because of the influx of black EU and non-EU players. There are no differences in the mean number of goals scored before and after the Bosman ruling.

4.3 Main Specification

To apply the market test, relating a club's success to its wage bill and share of black English players, we use a novel measure of team success: the difference in the number of goals in a match between two teams.[19] This disaggregated measure has some advantages relative to Szymanski's measure of performance, which was based on the final rankings of clubs. It allows us to control more finely for performance, to exploit a larger source of variation, and to explore the role of managers, which cannot be done using the ranking of the club since managers often change within a season.[20]

[19]The terms "team" and "club" are often used interchangeably, but they represent here two different things. The "team" is the individual unit that's playing a particular match and the club is the organization behind the team.

[20]A previous version of the paper included results that used Szymanski's method with qualitatively equivalent results. Results are available upon request.

The main specification is as follows

$$\text{Goal Difference}_{ijt} = \xi_{ij} + \boldsymbol{\beta}\mathbf{D}_{ijt} + \boldsymbol{\delta}\text{Bosman}_t \cdot \mathbf{D}_{ijt} + \epsilon_{ijt}, \tag{1}$$

where $\text{Goal Difference}_{ijt}$ is the goal difference between the home team i and the away team j in t, ξ_{ij} is a team pair or match-up fixed effect,[21] which absorbs all unobserved and fixed match characteristics.[22] ϵ_{ijt} is the usual error term and the vector $\mathbf{D}$ represents differences between home team i and away team j, that we will interact with a Bosman ruling dummy, which is equal to 0 from 1990 to 1994, and one from 1995 to 1999:

$$\begin{aligned}\mathbf{D}_{ijt} = &(\text{Minblack}_{it} - \text{Minblack}_{jt}) + \log(\text{WageBill}_{it}/\text{WageBill}_{jt}) \\ &+ (\text{PlayersNb}_{it} - \text{PlayersNb}_{jt}) + (\text{Teammatch}_{it} - \text{Teammatch}_{jt}) \\ &+ (\text{MeanAge}_{it} - \text{MeanAge}_{jt}) + (\text{Subs}_{it} - \text{Subs}_{jt}).\end{aligned} \tag{2}$$

We run the market test for discrimination based on the difference in the number of minutes played by black English players during the match, $\text{Minblack}_{it} - \text{Minblack}_{jt}$.[23] This variable can thus be interpreted as the difference in the number of black English players on the pitch between the two teams.[24] We are interested in the effect of having more black players on the goal difference. We expect the β of the difference in minutes played by English black players, before Bosman, to be positive. By contrast, we expect δ to be negative if lowering mobility constraints, post-Bosman, lowers wage discrimination.

Beyond the team pair fixed effects, we expect time-varying team or match differences to affect the difference in goals scored. For instance, we expect that the larger the log difference in wage bills, the larger the goal difference.[25] Ad-

[21] Note that the fixed effects take into account the teams at home and away, hence a match Arsenal - Manchester United will have a different fixed effect than Manchester United - Arsenal.

[22] Here we do not add time fixed effects, which only capture differences in home advantage over time and are always insignificant. Results are available upon request.

[23] This measure is normalized by dividing the number of minutes played by 90, the official duration of a football match.

[24] For matches before 1992, we know whether the player was substituted or not, but not his time on the pitch. We therefore give each sub before 1992 the median time played by substitutes in the period 1992-1995, 20 minutes.

[25] The log difference in wage bills variable, $\log\left(\text{WageBill}_{it}/\text{WageBill}_{jt}\right)$, is aggregated at the

ditionally, to control for differences in injuries and rotation, we create and add three team-level variables. First, we sum for each team-match the total number of matches played during a season by the players who start the game. The higher this sum is for a given match, the closer the team gets to the best team or the "best eleven" players. We then take the log and the difference between the two teams to create $\text{Teammatch}_{it} - \text{Teammatch}_{jt}$. Second, we compute the difference in the number of players used over the season, as in Szymanski's original specification, $\text{PlayersNb}_{it} - \text{PlayersNb}_{jt}$. Third, we calculate the difference in the number of substitutes during a game, $\text{Subs}_{it} - \text{Subs}_{jt}$. We also add as a control the difference in the minutes-weighted mean age of the team at the match level, $\text{MeanAge}_{it} - \text{MeanAge}_{jt}$. All these variables are interacted with a dummy equal to 1 if the season takes place after the Bosman ruling.

5 Empirical Results

5.1 Discrimination Market-test

In order to pinpoint the effect of the Bosman ruling, we run the market test (equation 1) on 5-year time periods before and after the Bosman ruling.[26] We measure the effect of a difference in racial composition on the success of two teams competing against each other, conditioning on a team-pair fixed effect. Standard errors are clustered at the team-pair level.

We identify discrimination through the simple idea that if black players' talent is underpaid, the club's wage bill does not fully explain team success. The results are presented in Table 3. Columns 1 and 2 show the results using the OLS and the Within estimators, i.e., without and with a team-pair fixed-effect, respectively.[27] In

season level since no individual-level wage data exists.

[26]The seasons 1990-91 to 1994-95 are considered as the pre-Bosman years, and the seasons 1995-96 to 1999-00 as the post-Bosman years. The results using the longer pre-Bosman (1981 to 1994) and post-Bosman (1995 to 2008) periods are reported in Table 11 in Appendix D.4. We also run similar regressions looking at club performance instead of match performance in Section D.3 of the Appendix. The results are very similar to those presented here; clubs that hired more black players over-performed before Bosman and lose their edge after the Bosman ruling.

[27]The goal difference follows a Skellam distribution, i.e., the difference between two Poisson distributions. We see whether this is likely to affect our OLS results in column 1 by using Poisson

Table 3: Match Performance and Discrimination

Dependent Variable:	Goal Difference: Home vs Away Teams			
Sample Period:	1990-1999			
Estimator:	OLS	Within	Within-IV	Arellano Bond
	(1)	(2)	(3)	(4)
(β_1) **Difference in number of black English players**	**0.050**^{a} (0.02)	**0.069**^{a} (0.02)	**0.079**^{a} (0.02)	**0.054**^{b} (0.02)
(δ_1) **Bosman × Difference in number of black English players**	**-0.099**^{a} (0.02)	**-0.075**^{a} (0.03)	**-0.110**^{a} (0.04)	**-0.111**^{a} (0.03)
(β_2) Difference in log wage bill	0.857^a (0.08)	0.425^a (0.16)	0.868 (0.68)	0.593^a (0.22)
(δ_2) Bosman × Difference in log wage bill	0.060 (0.10)	0.140 (0.12)	-1.163 (0.88)	0.185 (0.11)
(β_3) Difference in number of players used	0.004 (0.01)	-0.000 (0.01)	0.015 (0.02)	0.001 (0.01)
(δ_3) Bosman × Difference in number of players used	-0.004 (0.01)	0.001 (0.01)	-0.039 (0.03)	-0.005 (0.01)
(β_4) Difference in number of matches by team	1.799^a (0.21)	2.124^a (0.23)	2.274^a (0.27)	2.216^a (0.23)
(δ_4) Bosman × Difference in number of matches by team	0.240 (0.32)	-0.078 (0.36)	-0.378 (0.40)	-0.225 (0.33)
(β_5) Difference in number of substitutions	-0.338^a (0.05)	-0.353^a (0.07)	-0.396^a (0.08)	-0.354^a (0.06)
(δ_5) Bosman × Difference in number of substitutions	0.142^b (0.07)	0.128 (0.09)	0.168^c (0.10)	0.176^b (0.08)
(β_6) Difference in age of team	-0.013 (0.02)	-0.001 (0.03)	-0.023 (0.03)	-0.006 (0.03)
(δ_6) Bosman × Difference in age of team	0.012 (0.03)	-0.011 (0.04)	0.015 (0.04)	0.004 (0.03)
Home advantage	0.428^a (0.03)			
$\beta_1 + \delta_1$	-0.049^b (0.02)	-0.006 (0.02)	-0.029 (0.03)	-0.056^c (0.03)
Observations	4048	3746	3508	3700
Team-pair fixed effect	No	Yes	Yes	Yes
Number of instruments			3	68
AR1 p-value				0.0
AR2 p-value				0.236
Hansen p-value			0.62	0.46

Notes: the dependent variable is the goal difference in the match. Robust standard errors in parentheses with ^{a}, ^{b}, and ^{c} denoting significance at the 1%, 5%, and 10% percent level, respectively. Standard errors are clustered at the club-pair level (see text for details).

the pre-Bosman era, we find that success depends significantly on the team's racial composition (β_1). Teams fielding an above-average proportion of black players outperform teams with a below-average proportion of black players. This suggests race-based wage discrimination: because the talent of black English players is underpaid, the club's wage bill does not fully explain team success. In other words,

regressions on the number of goals for the away and home teams. The results are essentially unchanged (see Table 12 of Appendix D.5).

the club's wage bill does not fully account for the team's talent. In contrast, after Bosman, we find that discrimination is essentially eliminated (δ_1). The sum of the coefficients, β_1 and δ_1, is not statistically different from 0 for both the Within and Within-IV cases, and negative and significant for the OLS and Arellano-Bond cases, which would imply that black English players are now overpaid relative to performance. This could be due to the arrival of players from other countries, which we discuss in Section 5.2.

How beneficial is discrimination to teams that employ black players? The coefficient on the number of black English players (β_1) is statistically and economically significant. To quantify the monetary advantage of employing black English players, we compare β_1 to the effect on the difference in wage bills, which is statistically significant during the whole period. The larger the difference in wage bills, the larger the goal difference. Playing with one more black English player gives the same goal advantage as increasing the wage bill by 300000£.[28] This result is consistent with our theoretical predictions on the effect of mobility constraints on wage discrimination. By decreasing frictions, the ruling allows players to escape discrimination by relocating or threatening to leave, whatever their position on the pitch.[29]

The change in discrimination is remarkable when we consider that contracts for football players last on average around 3 to 4 years. Some players were thus not able to leave immediately after the Bosman ruling. However, an alternative to changing clubs is to renegotiate the contract, to avoid the player being poached by other clubs. This renegotiation is quite frequent post-Bosman and typically leads to wage increases that may have favored discriminated players.

Two of the controls we use to capture variation at the match-level are significant:

[28]This monetary advantage is found by computing the variation in wage bill equivalent to the effect of playing with one more black player, so that $\beta_2 \times \Delta \ln(WB) = \beta_1$. Solving the equation we obtain $\Delta WB = \exp(\beta_1/\beta_2 + \ln(\overline{WB})) - \overline{WB}$. Plugging in the values from column 1 and $\overline{WB} = 4.56$ million pounds, the average wage bill in the Premier League between 1990 and 1994 (before the ruling), we find $\Delta WB \approx 300000$£.

[29]A challenge is that black and white players could play in different positions. Black players are less likely to be goalkeepers and more likely to be forwards. We could thus be picking up unconditional differences in wages between different positions. We run the same test as in equation 1 using the number of minutes played by black goalkeepers, defenders, midfielders or forwards. We find similar results. Having more black players as defenders, midfielders or forwards increases team performance before Bosman. However, after Bosman, there is no effect of having more black players in any position. Hence our results do not seem to be caused by relative positional differences between black and white players. These tests are available upon request.

the difference in the number of substitutions during a game, and the difference in the number of matches by team. The effect of substitutions is negative, but probably not causal, since managers could make more substitutions when they are losing a game.[30] The difference in the number of matches has a positive effect on performance, as expected: teams score more goals when they are able to play with their best team.[31]

The results from the first two columns point to a reduction in wage discrimination with relaxed mobility constraints. However, two possible concerns are worth mentioning: (1) the potential mismeasurement of the wage bills, and (2) the fact that bonuses could provoke reverse causality since a higher performance may induce higher bonuses and thus a higher wage bill (if salary is incentive based). As a result one might be worried that the extent of discrimination could be potentially biased in case of a systematic mismeasurement of wage bills in prejudiced clubs. Even if such a systematic pattern is unlikely, we address this concern first with an instrumental variable (IV) estimator. We instrument the difference in wage bills with the lagged difference in performance in cups, lagged difference in stadium attendance, and the difference in relative record transfer fees. The key identifying assumption is that these variables do not affect team success in the league, except through their effect on the club's wage bill. None of these variables have a significant effect on performance when included in our main specification. We discuss the relevance of our three excluded instruments and the way they are constructed in Appendix E.

The second-stage results of the within-IV approach are presented in column 3 of Table 3.[32] They confirm the Bosman ruling effect on wage discrimination. Whereas the coefficient for the share of black players employed is positive and significant before the Bosman ruling (β_1), it becomes insignificant post-Bosman (δ_1). The IV results do not appear to be affected by a weak instrument problem. The first stage F-statistics on the excluded instruments are above the recommended threshold of

[30] One could be worried that having this potentially endogenous variable could bias our results. In fact, most of the control variables could be considered endogenous, since teams doing badly could be tempted to play older players, or change their starting line-ups. Removing these variables however, does not change the significance of the coefficient on the the difference of black players, and makes the estimated effects larger if anything. These tests are available upon request.

[31] The "Home advantage" estimate is significant and represents the constant of the OLS regression.

[32] The first-stage results document that the instruments have a significant effect on the relative log wage bill (See Table 13 in Appendix E).

10 (see Table 13 in Appendix E). It is also reassuring that the standard errors on the second-stage estimates of column 3 are not much larger than those in the within model of column 2. Moreover, the instruments pass standard validity assessments. The F-test of joint significance of the excluded exogenous variables is rejected at the 1% level. The test of overidentifying restrictions for the excluded instruments is also passed and the Angrist-Pischke first-stage chi-squared statistics reject the null of underidentification (Angrist and Pischke, 2009).

In column 4 of Table 3, we use the Arellano and Bond's (1991) two-step GMM approach. This estimator differences away time-invariant team specific effects using orthogonal deviations. It relies on the dynamic structure of the model for identification by using lagged levels of the independent variables as instruments for current differences. We instrument both the wage difference, and the difference in the share of black English players in this way. Following Roodman's (2009) rule of thumb, we use a number of instruments that is strictly lower than the number of matches (groups) in the sample.[33] This strikes a balance between estimate consistency and test validity. The diagnostic tests (Hansen and first and second order autocorrelation) presented at the bottom of the table reveal no evidence against the validity of the instruments used by the GMM estimator.

The GMM estimates of the share of black English players employed confirm our main results: wage discrimination is significant before the ruling (β_1) but not afterwards (δ_1). Again, these findings are consistent with our theoretical predictions on the effect of relaxed mobility constraints on racial wage discrimination.

5.2 Are non-EU Black Players Discriminated post-Bosman?

After having exploited variation over time, we now exploit variation across players. Although the ruling lifted constraints on EU players, non-EU players in the English Premier League are still subject to restrictive contracting conditions. For instance, to obtain a UK work permit, non-EU players must fulfill a set of stringent

[33]Validity of GMM estimators is subordinate to the number of instruments. A large number generates implausibly low values of Hansen tests of instruments exogeneity (Roodman, 2009), while using too few instruments is likely to generate a weak instrument problem and to deliver inaccurate estimates.

conditions.[34] As a consequence, despite a general decrease in frictions, mobility is relatively more constrained for non-EU players, even after the Bosman ruling. If prejudiced attitudes persist over time, black non-EU players could thus face wage discrimination. Some firms may take advantage of the mobility constraints to exert their monopsony power and act on their prejudice. This test relies on the heterogeneous impact of the Bosman ruling on different groups of players.[35]

We find evidence of wage discrimination against black non-EU players by performing the market test after Bosman. Results are reported in Table 4, where we decompose the effect of different shares of players: black English, black EU, black non-EU, and white non-EU.[36] In order to to investigate the effect of the ruling over time, the sample is split into two equally long time periods: first from 1995 to 2001, and then from 2002 to 2008.

We find that the estimates of the share of *non-EU black* players are positive and significant after Bosman, in the first (1995-2001) and the second period (2002-2008) though the point estimates in the second period are lower. It is worth noting that none of the other groups have a significant effect on performance. These estimates suggest that wage discrimination could still be present in the English Premier League post-Bosman, but only for players who face both prejudiced owners and mobility constraints, i.e., for black non-EU players.

5.3 Trend in Discrimination

We explore the trend in discrimination in this section. Discrimination could be decreasing linearly during the 5-year pre-Bosman period, with no break in trend that a regression would interpret as a sharp break. We therefore interact the difference in the number of minutes played by black English and EU players, who are both

[34]The conditions are such that a non-EU player must have played at least 75% of his national team's competitive matches over the last two years and his national team must be in the top 70 countries in the world. The appeals process allows for some flexibility in the rules, but the non-EU nationals playing in the Premier League are still expected to be of high quality.

[35]Unfortunately, this test cannot rely on temporal variation before the Bosman ruling because there are almost no black EU or non-EU players in the Premier League before 1995.

[36]Non-EU players are non-member players of the common market or the European free trade association zone. We do not report results for the pre-Bosman period, as there were only 8 (only 0.18% of matches played) non-English black players playing in England (see section 4.2).

Table 4: *Post*-Bosman: Are non-EU Black Players Discriminated?

Dependent Variable:	Goal Difference: Home vs Away Teams			
Sample Period:	1995-2001		2002-2008	
Estimator:	Within	Within-IV	Within	Within-IV
	(1)	(2)	(3)	(4)
Difference in number of black English players	0.003	0.010	0.022	0.032
	(0.03)	(0.03)	(0.03)	(0.03)
Difference in number of black non-EU players	0.152^{b}	0.170^{b}	0.072^{b}	0.071^{c}
	(0.08)	(0.08)	(0.04)	(0.04)
Difference in number of black EU players	0.072	0.069	0.012	0.023
	(0.05)	(0.05)	(0.03)	(0.03)
Difference in number of white non-EU players	0.061	0.065	0.039	0.044
	(0.04)	(0.04)	(0.04)	(0.04)
Difference in number of white EU players	0.018	0.022	0.029	0.027
	(0.02)	(0.02)	(0.02)	(0.02)
Difference in log wage bill	0.234	-0.193	0.451^{a}	0.857^{b}
	(0.16)	(0.38)	(0.16)	(0.38)
Difference in number of matches played by team	2.185^{a}	2.196^{a}	2.088^{a}	2.097^{a}
	(0.23)	(0.24)	(0.22)	(0.22)
Difference in age of team	-0.011	-0.009	-0.004	-0.015
	(0.03)	(0.03)	(0.03)	(0.03)
Difference in number of players used	0.006	0.005	0.018^{c}	0.014
	(0.01)	(0.01)	(0.01)	(0.01)
Difference in number of substitutions	-0.189^{a}	-0.188^{a}	-0.068	-0.080
	(0.06)	(0.06)	(0.06)	(0.06)
Observations	2384	2224	2308	2164
Team-pair fixed effect	Yes	Yes	Yes	Yes

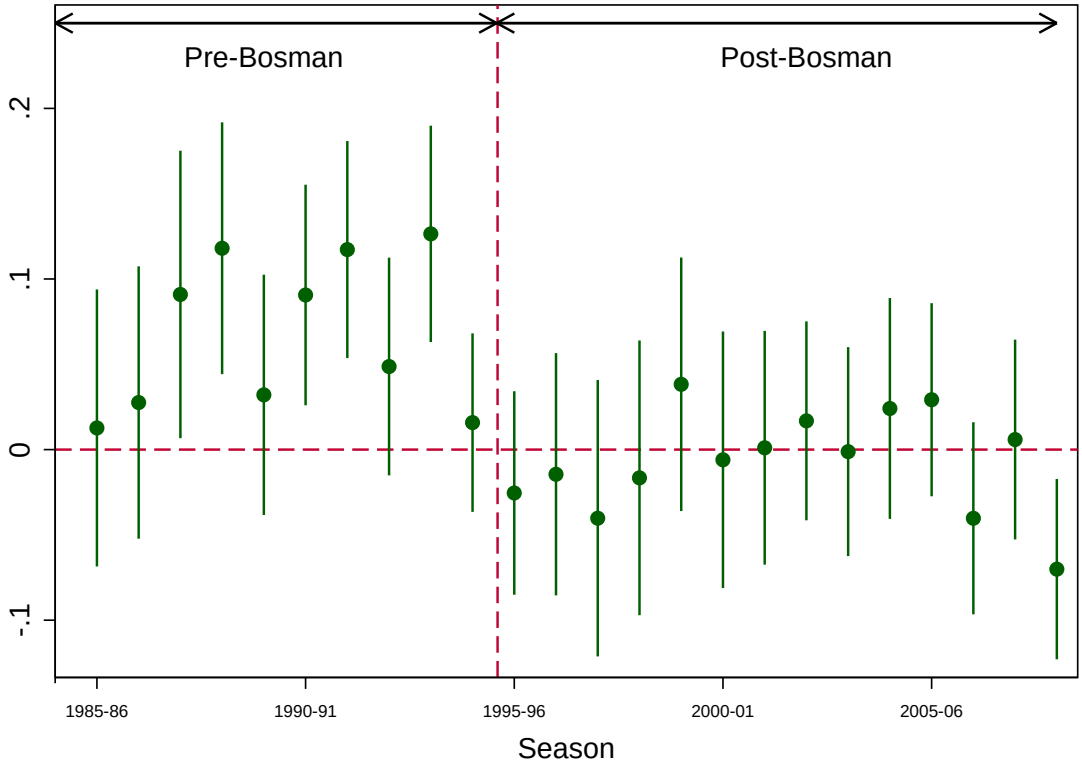
Notes: the dependent variable is the goal difference in the match. Robust standard errors in parentheses with ^{a}, ^{b}, and ^{c} denoting significance at the 1%, 5%, and 10% percent level, respectively. Standard errors are clustered at the team-pair level (see text for details).

affected by the ruling, with a year dummy, to see if discrimination decreases linearly over time, while controlling for the wage bill of clubs and the number of players used, as in Szymanski's original specification. Given the limited amount of data available on a yearly basis, we make no claim on the relevance of lack or presence of discrimination in a specific year, but we are interested in seeing if a trend exists over the Bosman pre-period.[37]

The coefficients are plotted in Figure 4, with 90% confident intervals. There does not seem to be a downward linear trend in discrimination before the Bosman ruling, and no time trend afterwards. This lack of time-trend and the drop in discrimination

[37] We actually see a slight drop in discrimination for the season 1994-95, but that seems consistent with the variation in the years beforehand. One thing to bear in mind is that although the Bosman Ruling came into force in December 1995, it could have been anticipated. Indeed, the Bosman case had been submitted to the Court two years before, on October 6, 1993. Thus, in December 1993, the European Union of Football Associations amended the regulations governing the *Status and Transfer of Football Players*. This amendment provided that a player may enter into a contract with a new club when the contract between him and his club has expired, has been rescinded or will expire within six months. However, the two clubs were still forced to agree on a transfer fee with a specific action in case of disagreement.

Figure 4: Yearly estimates of the effect of black English and EU players on goals



Notes: Points are plotted coefficients from an OLS regression of goal difference on the difference in the number of black English and EU players. Lines represent 90% confidence intervals

with the Bosman ruling make us confident that the results we see are indeed driven by changes in labor mobility constraints.

5.4 The Role of Managers

In this subsection we analyze the role of managers who may be the source of discrimination. They may behave in a racist manner (see Fact 5 in section 2) or benefit from market discrimination. To explore this idea we use data at the match level because managers change during the course of the season. For each match, we know the identity of both home and away managers. If better managers recruit more black players,[38] then this could explain why teams with more black players have better results. We can estimate this hypothesis by including home and away manager

[38]Contrary to other sports, managers in English football have always been involved in player hiring.

fixed effects in equation 1. The results of Table 3 remain mostly unchanged when adding home and away manager fixed effects.[39] If anything the point estimates for discrimination are higher.[40]

We can also estimate more directly whether the Bosman ruling affected the success of managers whose strategy relied on hiring black players. We should expect managers who selected more black players than the norm to have over-performed before Bosman, and to regress to the mean following the Bosman ruling. To explore this idea, we run equation 1 but restrict our attention to a smaller vector $\mathbf{D}_{ijt}$. We remove from the estimation all the variables that rely on manager choice (mean age of team, share of black players, total number of matches played by team, number of players used over the season), since coaches can directly choose these variables, which could make them endogenous.[41] We simply control for the difference in wage bills and add a new variable called "High black share managers". This variable is equal to 1 if a manager selected black players above a threshold more than 10 times in the pre-Bosman period, and 0 otherwise. We set the threshold at 3 black players, which seems reasonable given that it only occurs 15% of the time before Bosman in our dataset.

Managers that hired more black players were successful before Bosman, but that advantage vanished in the post-Bosman period, which is consistent with our initial hypothesis.

5.5 Are Black English Players more Mobile post-Bosman?

As emphasized in our theory (see Proposition C.2 in the Appendix), we should expect a racially differentiated change in job turnover to accompany a change in job-to-job mobility. In our empirical context, we define job turnover as club transfers, i.e., moving from one club to another during a given season. Figure 5 contrasts the turnover of black (B) and white (A) English players by comparing their share in the total number of transfers per year with respect to their share in the total population.

[39] See Table 9 in Appendix D.1.

[40] Peeters et al. (2017) use a similar specification to estimate manager fixed effects. They are interested in the career trajectories of managers based on their value added.

[41] Including these variables however makes little difference to the results.

Table 5: Match specification - Manager Performance

Dependent Variable:	Goal Difference: Home vs Away Teams		
Sample Period:	1990-1999		
Estimator:	OLS	Within	Within-IV
	(1)	(2)	(3)
Difference in log wage bill	0.940[a]	0.479[a]	1.567[b]
	(0.07)	(0.16)	(0.72)
Bosman × difference in log wage bill	0.019	0.132	-1.583[c]
	(0.10)	(0.13)	(0.87)
Difference in high black share manager	0.154[a]	0.220[a]	0.413[a]
	(0.06)	(0.08)	(0.13)
Bosman × Difference in high black share manager	-0.303[a]	-0.328[a]	-0.646[a]
	(0.09)	(0.11)	(0.20)
Observations	4048	3746	3508
Team-pair fixed effect	No	Yes	Yes

Notes: the dependent variable is the goal difference in the match. Robust standard errors in parentheses with [a], [b], and [c] denoting significance at the 1%, 5%, and 10% percent level, respectively. Standard errors are clustered at the club-pair level (see text for details). The high black share managers are Alan Smith, Brian Little, Gerry Francis, Glenn Hoddle, Howard Wilkinson, Joe Kinnear, Phil Neal, Ray Harford, Ray Wilkins, Ron Atkinson, Steve Coppell and Trevor Francis. These managers are selected since they frequently (more than 10 times) played more than 3 black players (which is the 15% cut-off for appearances) in a first division game between 1990 and 1995.

The turnover variable is defined as follows for a given year:

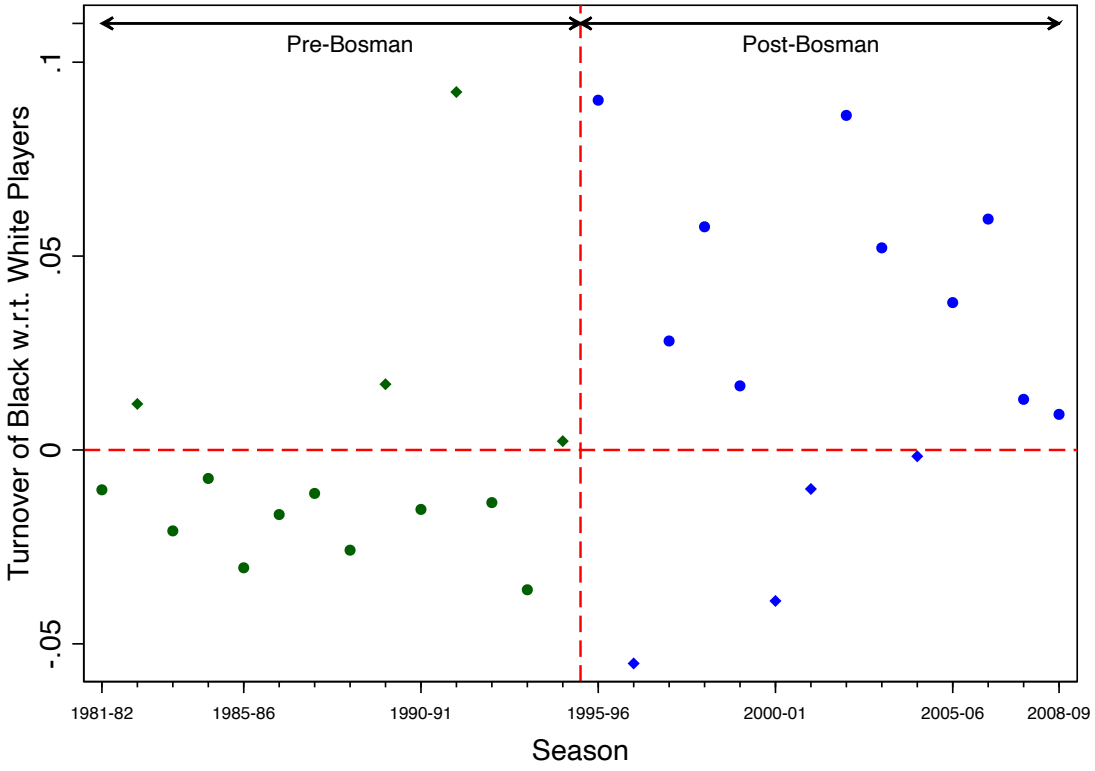
$$\text{Turnover} = \frac{\text{Share in transfers}_B}{\text{Share in population}_B} - \frac{\text{Share in transfers}_A}{\text{Share in population}_A}.$$

The turnover variable is positive if black players change clubs more often in a given year than their white colleagues. The variable is negative if they do not change more often. We analyze the turnover changes over the whole period from 1981 to 2008.

As shown in Figure 5, before the Bosman ruling (on the left of the vertical line), white players tended to change clubs more often than black players. A large number of turnover values are negative before the Bosman ruling; ten out of fourteen values are below zero. This tendency is reversed after Bosman; ten out of fourteen values are *above* zero. Regressing the turnover variable on a dummy equal to 1 for the Bosman ruling period gives a positive and significant coefficient equal to 0.03.[42] This reversed trend suggests that black players "voted with their feet" when mobility constraints

[42]It is unclear, however, when precisely this trend reversed. This may be because we imperfectly observe club transfers. We have data on the first division only, so what we are measuring are transfers within the first division.

Figure 5: Relative Turnover of Black English Players



Notes: Each observation represents relative mobility of black vs. white players in a given season. Dots represent points that correspond to our model-driven hypothesis: black players move more than white players with lower mobility constraints. Diamonds represent points that do not correspond to our hypothesis.

were removed. This is in line with the reduction in job tenure observed for black players in Table 8 after the ruling. We also find evidence, presented in Appendix (D.2), that young black players took advantage of the new ruling to change clubs when they could have been discriminated against.

5.6 Does Corporate Control Decrease Discrimination?

The rise of a market for corporate control of English professional clubs could potentially affect clubs' discriminatory behavior by increasing the competitiveness of English football (Palacios-Huerta, 2014). In a competitive market, discrimination would be competed away since nondiscriminatory clubs would employ more black players, given their lower cost at any given level of talent. We would then expect Arrow's (1973) predictions to be realized. Black players' wages would increase until

they become independent of race and discriminating clubs would be driven out of the market since they make lower profits than nondiscriminating clubs.

Some issues regarding the impact of this insightful hypothesis on discrimination in the Premier League could be raised, however. First, the emergence of a market for corporate control of English clubs started in the early 1980s, i.e., ten to fifteen years *before* the Bosman ruling. This implies that we should have observed a decrease in wage discrimination before the ruling. The second concern is that a club experiencing very poor performance simply moves down from one division to another and is not necessarily driven out of the market. Relegation can lead to promotion the following season. So, competition *per se* may not necessarily discipline discriminatory behavior in our context.

The third concern is that there is no clear evidence that the market for corporate control has increased the competitiveness of English football. Only a third of the Premier League clubs during the post-Bosman period have been listed on the stock market.[43] Among the "Big Four", singled out in the upper right corner of Figure 6, only Chelsea[44] and Manchester United have been listed but not Arsenal and Liverpool. Interestingly enough, most clubs floated on the English stock exchange were unprofitable and all were eventually delisted, which would lead to an increase in discrimination today if corporate control is the causal mechanism driving the decrease in racial discrimination.

Despite these concerns, we benefit from the early listings on the stock market to directly test the impact of corporate control on the share of black players employed, as well as on club's performance and racial discrimination. First, we check whether listed clubs, which could face relatively more competitive pressure, employ more black players when they are discriminated against by the market, i.e., before 1995. To verify this assumption, we regress the relative share of black players employed on a corporate control dummy, which is equal to one if the club is listed on the stock

[43]See Andreff (2015) for the detailed list of English clubs that have been floated on the stock market, as well as their initial public offering and delisting date. Furthermore, Andreff states that governance changes very little with stock market control, emphasizing that there is "no way to consider public trade of shares as a tool for improving listed clubs' governance and profitability."

[44]Note that Chelsea's ascension to the "Big Four" followed its removal from the stock market, after its shares were bought by a billionaire.

Table 6: Share of Black English Players and Corporate Control

Dependent Variable:	Relative share of black players employed	
Sample:	*Pre*-Bosman (1980-1994)	*Post*-Bosman (1995-2008)
	(1)	(2)
Corporate Control	-0.059^{c}	0.005
	(0.03)	(0.02)
Relative wage bill	0.045	-0.001
	(0.03)	(0.03)
Observations	308	270
Club-fixed effect	Yes	Yes

Notes: the dependent variable is relative share of black players employed. Robust standard errors are in parentheses, clustered by club, with ^{a}, ^{b}, and ^{c} denoting significance at the 1%, 5%, and 10% percent level, respectively.

market. The results are reported in Table 6. Over the whole period, from 1981 and 2008, we do not not find any positive relationship between corporate control and the share of black players employed. Before the Bosman ruling, if anything, listed clubs hire less black players, while after Bosman, there is no significant difference in hiring between clubs under corporate control and those that are not.

In Table 7, we explore whether corporate control affects club performance and wage discrimination. We introduce the difference in the corporate control dummy as an additional regressor in equation 1 . In columns 1 and 3, we find no significant effect of being a club floated on the stock exchange on club's performance, before or after Bosman. Finally, we present a direct test of whether the rise of corporate control had an effect on wage discrimination by interacting the difference in corporate control with the difference in the relative share of black players. We expect a negative estimate of the interaction term if corporate control reduces the gap between white and black player wages. We find however that the coefficients on the interaction term are positive and insignificant before or after Bosman. The non negative estimate before Bosman does not come as a surprise given that Arrow's (1973) prediction relies on an increase in the demand for Black players, which is not what we find (see Table 6).

A cautious interpretation of these results is that corporate control of football clubs does not reduce discrimination, or at least not enough to be detected by differences between clubs on the stock market and under private ownership. Hence

Table 7: Discrimination Market-test: Effect of Corporate Control

Dependent Variable:	Goal Difference: Home vs Away Teams			
Sample:	*Pre*-Bosman (1990-1994)		*Post*-Bosman (1995-1999)	
Estimator:	Within			
	(1)	(2)	(3)	(4)
Difference in corporate control	0.263	0.263	-0.020	-0.020
	(0.17)	(0.17)	(0.13)	(0.13)
Difference in number of black English players	0.070^{b}	0.070^{b}	-0.027	-0.027
	(0.03)	(0.03)	(0.03)	(0.03)
Difference in corporate control × Difference in number of black players		0.007		0.000
		(0.06)		(0.04)
Difference in log wage bill	0.659^{a}	0.659^{a}	0.243	0.243
	(0.24)	(0.24)	(0.27)	(0.27)
Difference in number of players used	0.004	0.004	0.007	0.007
	(0.01)	(0.01)	(0.01)	(0.01)
Difference in number of matches played by team	2.034^{a}	2.034^{a}	2.218^{a}	2.218^{a}
	(0.25)	(0.25)	(0.30)	(0.30)
Difference in age of team	0.039	0.039	-0.022	-0.022
	(0.03)	(0.03)	(0.03)	(0.03)
Difference in number of substitutions	-0.277^{a}	-0.277^{a}	-0.229^{a}	-0.229^{a}
	(0.08)	(0.08)	(0.07)	(0.07)
Observations	1930	1930	1628	1628
Team-pair fixed effect	Yes	Yes	Yes	Yes

Notes: the dependent variable is computed in relative terms as $\left(\frac{Ranking_{it}-min_t}{max_t-min_t}\right)$, where $Ranking_{it}$ is the final ranking of team i at the end of season t; and min and max are the lowest and highest possible rankings each season. Robust standard errors are in parentheses, clustered at the match level, with ^{a}, ^{b}, and ^{c} denoting significance at the 1%, 5%, and 10% percent level, respectively.

we believe that the mechanism causing the decrease in wage discrimination is the Bosman ruling, and not the rise of corporate control of football clubs.

6 Conclusion

In this paper, we find evidence that wage discrimination has been eliminated following a decrease in labor market frictions. As shown in our model, which fits the major empirical facts of the market, an increase in job-to-job mobility can erode the monopsony power of firms, leading to an eradication of the racial wage gap.

A heartening interpretation of our results is that creating the right labor market conditions can cause wage differentials between white and black employees to disappear even if racist attitudes remain. Otherwise, firms can act on their prejudice, as seems to be the case for black non-EU players.

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A Data Appendix

Our dataset contains all professional football players, regardless of nationality, from the first English league from 1981 to 2008 and comes from Kleven et al. (2013). We then merge this data on the nationality of players to extensive teamsheet data that we scraped from www.weltfussball.de. Our dataset is similar to Szymanski (2000) but differs in scope and time. In terms of time, Szymanski focuses only on the pre-Bosman period, i.e., from 1978 to 1993. In terms of scope, Szymanski uses a panel of 39 clubs from four divisions in the English football league, we have information on all players and matches from the first division in England. Despite our focus on elite players, our number of clubs in the pre-Bosman period is fairly similar to Szymanski: 41 teams from 1981 to 1993 against 39. In terms of time, we cover the pre- and post-Bosman eras, from 1981 to 2008. To this dataset we add the following variables.

Wage bills. We use wage bills from the Companies House website, a British government agency that collects annual reports from registered companies. Wage data are provided for almost all the English clubs in our sample. We are missing some data from clubs who

went bankrupt during the season, such as Crystal Palace in 1998 or Leicester City in 2001, and some data from a few clubs that did not report wage bills in their financial accounts.

These wage data are considered as reliable because they are obtained from audited annual accounts. There are some issues however. First, the reports are not homogeneous over the 30-year period. Some clubs changed the ending date on their company accounts and reported annual results over thirteen months or more, in which case the data were adjusted on a pro rata annual basis. Then, we do not know what proportion of the pay is incentive related (e.g., bonuses for performing well in a cup competition) and what proportion is fixed. Finally, the wage bill is given for all staff, including salaries for scouts, statisticians, physiotherapists, and coaches. However, there are two reasons why it is unlikely to be a significant problem for our analysis. One is that the pay for most of the non-player employees is relatively small compared with the total wages of players; and the other reason is that the share of the pay for non-player employees likely accounts for a similar share of the wage bills in all clubs.

Racial information. The race information was coded from an examination of players' photographs into categories of either black or not black (which we refer to as white).[45] This method might sound arbitrary because we code players as "black" if they appear to be "black". However, this method is actually a good way to model the potential for discrimination because discriminators prejudge an individual based on appearances (Palacios-Huerta, 2014).[46] These pictures were obtained primarily from the reputable website `transfermarkt.de`, and when pictures from that site were not available, we conducted Internet searches. We obtained pictures for nearly all the players in our sample. The players whose photos were missing were primarily youth team players who had had little game time and could thus be discarded from our analysis.

Control variables. In addition to information on race and wage bill, we have precise data on nationality, age, the number of matches played, the number of goals scored, national team selections (and their level - youth, A, ...), and whether a player participated in the

[45] Our full coding protocol is available upon request.

[46] For an explanation of why this appearance-based method is appropriate, Palacios-Huerta (2014) considers the case of the legendary Manchester United player Ryan Giggs. He appears to be Caucasian, and it was unlikely that he faced discrimination as a professional player during his career because discriminators prejudge an individual based on appearance. However, after he became famous, he publicly revealed that he had been victim of racism as a child because of his father's skin color. This revelation came as a surprise to his fans.

World Cup. We use part of this information to create an objective, albeit imperfect, measure of player's sporting quality (see Appendix B). Moreover, we added information on team's ranking and attendance from the European football statistics website.

Pre- and post-Bosman club differences Table 8 presents club differences in terms of wage bill, transfer fee record and stadium attendance, which are significant both economically and statistically. The only notable exception is the share of black English players, which is constant in both eras.

Table 8: Club Differences in Means

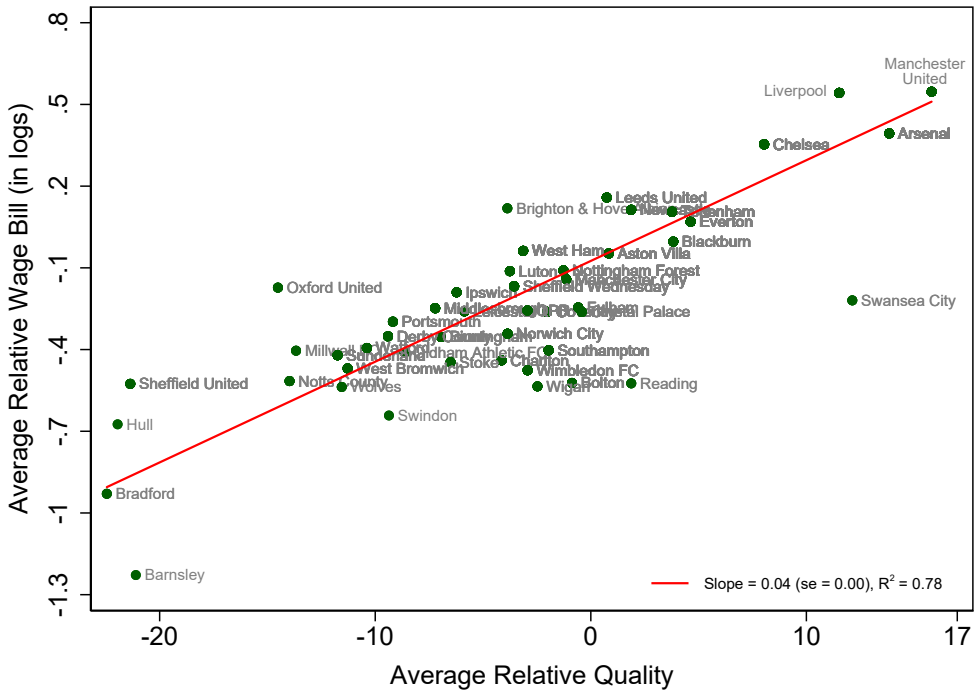
Variable	Pre-Bosman (1990-1994)	Post-Bosman (1995-1999)	Difference across periods
Wage bill (in millions of pounds)	4.56	14.70	9.40^a
	[1.93]	[8.20]	(0.50)
Transfer fee record (in millions)	1,76	5.33	3.57^a
	[0.95]	[3.30]	(0,33)
Stadium attendance (in thousands)	22.60	29.40	6.78^a
	[8.8]	[9.70]	(1.30)
Share of black English players	0.16	0.14	-0.02
	[0.10]	[0.10]	(0.02)
Observations	106	99	

Notes: This table reports average characteristics for English first league clubs. 'Difference' means difference in means between post- and pre-Bosman period. Standard deviations are in brackets; standard errors are reported in parentheses, with ^{a} denoting significance at the 1% level. Wage bills and transfer fee records are in nominal values.

B Sporting Talent and Wage Bill

In order to check whether sporting talent is well approximated by wage bills, we created a team specific talent index that sums the talent of each team's players. This index is computed for each club based on the experience of their players (i.e., their total number of matches played in the Premier League), the age of their players, and whether they are selected by their national team, and at what level (youth team, B team, A team). This variable is a crude measure for the team's sporting talent, but gives a rather sensible proxy for the quality of the team. As an example, the best performers, identified in Figure 3, which are Arsenal, Chelsea, Liverpool and Manchester United, are also the best teams in terms of quality with the highest wage bills. A regression of the average team's quality on average wage bill gives a R-squared of 0.78. The wage bill does approximate quite precisely for the team's sporting talent.

Figure 6: Average Wage Bill and Team's Quality



Notes: The figure covers the period from 1981 to 2008. The club's average relative quality and wage bill in a given season are both computed as differences to their annual average.

C A Search Model of Discrimination in football

This simple model presents three features. First, it is specific to the economics of football, relying on the four stylized facts that emerge from Section 2. Second, it links race-based wage discrimination to job-to-job mobility constraints. Finally, it offers a micro-foundation for our discrimination market-based test.

We first present player and club behavior, as well as the individual wage setting (C.1) before introducing the role of taste discrimination (C.2).

C.1 Clubs, Players and Individual Wage Setting

Clubs. Clubs are heterogeneous in their wage bill (fact #3 presented in Section 2) but homogeneous in size because the number of players per team is fairly rigid. Team success is measured by league position (fact #2) and depends on the quantity of sporting talent (fact #4). Clubs maximize team success simply by minimizing the total cost of talent given total resources.[47] We assume, for simplicity, that total resources, R, are exogenously

[47]Clubs may also care about profits and not only about success. Considering that teams are profit maximizers is "an assumption with which sports economists have been quite comfortable in the United States, but which often seems less appropriate in the case of European football" (Szy-

given when the hiring decisions are made. We consider the production function to be linear in talent, so we abstract from analyzing diversity, talent distribution across players and spillover effects within clubs to focus on the role of prejudice. Following our fact #4, we assume that some clubs hold a 'taste' for racial discrimination.[48] For the sake of simplicity we are agnostic in the model about whether the club's prejudice comes from fellow players, owners, managers or supporters. However, in our context, it seems more likely that discrimination is driven by employers rather than by consumers.[49]

Players. The mass L of players is divided into two types according to their appearance, A and B. Type B could be discriminated against by clubs. All players are heterogeneous in talent independent of their type, and each type has the same distribution of talent. Talent is thus not differentiated by race or color. The decision problem faced by a player is the following. He maximizes utility over an infinite horizon in continuous time. He receives, at random time intervals, information about new or alternative jobs. This information is encapsulated in the parameter of the Poisson arrival process, λ, which denotes the arrival rate of job offers. This parameter reflects the general state of the labor market, including contracting rules, institutional constraints and barriers to mobility. Job-player matches are destroyed at an exogenous positive rate, δ, when players retire. Players are assumed to be risk neutral, with discount rate r, and must respond to offers as soon as they arrive.

Individual wage setting. In general there will be many causes explaining individual wage setting, such as the role of appearance that will be considered below. We abstract from this complexity and assume that a club offers to a player two types of contracts: perfect and imperfect. In both cases, the wage (ω) players receive is function of their talent, t. The contract is considered to be "perfect" when the player receives a wage that perfectly rewards his talent ($\omega = t$), and "imperfect" when the player earns only a fraction of what his talent is worth ($\omega = kt$, where $0 < k \leq 1$). In any case, the player accepts the

manski (2003): 1170). Garcia-del-Barrio and Szymanski (2009) confirm empirically that football club choices in England and Spain "are more closely approximated by win maximization than by profit maximization in both the short term and the long term".

[48] Altonji and Blank (1999) reviews the pioneering works introducing search into taste-based theories of discrimination. Note that statistical discrimination, based on stereotypes and made possible by imperfect information, is less of an issue in our setting since clubs easily observe the performance of football players.

[49] Previous research shows that discrimination in football is unlikely to be consumer-driven. Preston and Szymanski (2000) find no evidence that having more black players decreases attendance or club revenue, and no correlation between measures of prejudice at the local level and the number of black players hired.

job offer if it pays a higher wage while employed or if the instantaneous utility of being unemployed is lower than that of being employed. Although this is obviously a simplified wage setting, we view it as a useful benchmark that leads to a simple job offer trade-off and will help us to shed some light on the role of prejudice.

The club faces a trade-off when offering an imperfect contract. It diverts a share $(1-k)t$ of the player's talent but takes the risk of seeing the player poached by a rival since the player continues to search on the job. A player is poached with probability $\lambda\gamma$, where γ is the probability of receiving a perfect contract. Once the player is poached, the club incurs a turnover cost $c(t)$, which accounts for the leaving, replacement and transitions costs, such as the administrative costs involved with processing a separation, any payroll costs relating to filling the vacant position or time taken to select and recruit a replacement, among others. We assume turnover costs to be club specific, since clubs may differ in their capacity to recruit new players. For instance, London-based teams may find it easier to attract new players.

The club's value of offering an imperfect contract (J_I) is based on the trade-off between the gain from diverting part of the talent $(1-k)t$ and the loss that occurs when the player retires (δ) or is poached ($\lambda\gamma$):

$$\begin{aligned} rJ_I &= (1-k)t - \delta J_I - \lambda\gamma(J_I + c(t)), \\ &\Leftrightarrow \quad J_I = \frac{(1-k)t - \lambda\gamma c(t)}{r+\delta+\lambda\gamma}. \end{aligned} \tag{3}$$

The club's wage setting for a talent t depends on the comparison of J_I versus J_P, the club's value of the perfect job offer, which is null because $\omega = t$:

$$rJ_P = t - \omega - \delta(J_P) \Leftrightarrow J_P = 0. \tag{4}$$

The club offers a perfect contract if:

$$\begin{aligned} J_P > J_I \quad &\Leftrightarrow \quad 0 > \frac{(1-k)t - \lambda\gamma c(t))}{r+\delta+\lambda\gamma}, \\ &\Leftrightarrow \quad c(t) > \frac{(1-k)t}{\lambda\gamma}. \end{aligned} \tag{5}$$

Equation (5) states that the club offers a perfect contract to the player if the turnover cost is higher than the rent extracted from the player weighted by the probability of being

poached by a rival. To get a simple closed-form solution for the probability γ of offering a perfect contract, we assume that c follows a Pareto distribution with a lower turnover cost bound $\tilde{c}$ and shape parameter $\alpha \geq 0$. This assumption implies a distribution of turnover cost draws given by

$$G(c) = \left(\frac{c}{\tilde{c}}\right)^{-\alpha}, \qquad c \in [\tilde{c}, \infty],$$

where the shape parameter α indexes the dispersion of turnover cost draws. The Pareto parametrization of c is intuitive because most turnover costs are low, but as α decreases, the relative number of high turnover costs increases, and the cost distribution becomes more concentrated at these higher cost levels. Since teams with low turnover costs have their players poached more often, they will offer most of the jobs. Based on the inequality (5) and assuming that c is distributed Pareto and linear in talent, such that $c(t) = ct$, yields a closed-form solution for γ:

$$\gamma(t) = \left(\frac{\tilde{c}\lambda\gamma}{1-k}\right)^{\alpha} = \left(\frac{\tilde{c}\lambda}{1-k}\right)^{\frac{\alpha}{1-\alpha}}. \tag{6}$$

The probability of offering a perfect contract (γ) depends primarily on two important variables, λ and k (see Eq. 6). First, everything else being equal, the arrival rate of job offers, λ, determines the strength of the club's monopsony power. The lower the value of λ, the lower the job-to-job transition, and thus the higher the club probability of offering an imperfect contract to their employees. Second, as k decreases, clubs divert a larger share of the monetary value of a player's talent; therefore offering an imperfect contract to a player is more attractive.

C.2 Club's Prejudice and Monopsony

Now that we have worked out the endogenous probability of a player receiving a "perfect" job offer, we introduce discrimination into our model. Similarly to most search models with discrimination, such as Bowlus and Eckstein (2002), Bowlus et al. (2001) and Black (1995), we introduce discrimination by supposing that there is hiring discrimination. We are agnostic about whether discrimination comes from all or a subset of clubs, who would be less willing to hire a B-type player. This discrimination is represented in our model by a lower arrival rate of job offers for B-type players, $\lambda\theta$, with $0 \leq \theta \leq 1$. This implies that they are less likely to find a club that wants to offer them a perfect contract. Clubs know

that B-types are less likely to be poached, and endogenously offer them lower wages. $\theta < 1$ leads to differences in γ, the probability of receiving a perfect contract. Note that for a given θ, from the Bosman ruling and the associated increase in λ, we expect more B-type players to be poached, and discrimination to decrease.

The intuitive reason is that monopsony power is reduced when job-to-job transition is less constrained, i.e., when the value of job offer arrivals (λ) is high. Clubs should thus offer *perfect* contracts to retain their players and avoid costly turnovers. As a consequence, for sufficiently high λ, preferred and disliked players receive the same talent-adjusted wage. The next proposition sums up our discussion:

Proposition C.1. *The higher the rate of job offer arrivals (λ), the higher the probability of obtaining a perfect contract (γ). Thus, for a sufficiently high λ, race-based wage differentials disappear despite club prejudice.*

If we interpret labor mobility in our model as the transition from imperfect to perfect contracts, then we can also derive a second testable proposition:

Proposition C.2. *A decrease in job-to-job mobility constraints causes a racially differentiated change in job turnover.*

C.3 Wage Discrimination Market Test

From the assumption on clubs' prejudice and the probability of obtaining a perfect contract γ (Eq. 6), we can ground Szymanski's discrimination market-based test. The test is simple: discrimination can be said to exist if, for a given wage bill, clubs fielding an above-average proportion of B players systematically outperform clubs with a below-average proportion of B players. This test requires specifying the share of B players in a club, which we derive below based on a very stylized recruitment process.

This stylized hiring process is subject to a zero profit condition such that the club's resources (R) are equal to the club's wage bill (Ω) plus the sum of realized turnover costs (C). We assume each club knows its individual turnover costs c, and fields a fixed number of players, n. Sporting success depends on the quantity of sporting talent, T, hired by the club:

$$T \equiv (n-1)t + \tilde{t}.$$

Clubs thus hire $n-1$ players with the same individual talent t, and one marginal player

with a potentially different talent $\tilde{t}$. The share ϕ of imperfect contracts offered to the $n-1$ players depends on labor market conditions (λ), player type (A or B), and the associated turnover costs. It appears readily that the higher the share of imperfect contracts offered to the $n-1$ players, the higher the rents extracted from these players, the more talented the marginal player, and the higher the team's sporting talent, T. We assume for simplification that the marginal player cannot be underpaid and his talent $\tilde{t}$ is such that the zero profit condition holds:

$$\begin{aligned} R = \Omega + C &= (n-1)[\phi k t + (1-\phi)t] + \tilde{t} + (n-1)\phi\lambda(\theta\mu\gamma_B + (1-\mu)\gamma_A)ct \\ &= (n-1)t[\phi(k + c\lambda(\theta\mu\gamma_B + (1-\mu)\gamma_A)) + 1 - \phi] + \tilde{t}, \end{aligned} \tag{7}$$

where ϕ is the share of players that are not paid their marginal product ($\omega < t$) and μ the share of B-type players in the team.

Armed with this framework, we illustrate how the share ϕ depends on the value of turnover costs c by focusing on two interesting cases. We view them as useful benchmarks that can shed light on the role of labor mobility on wage discrimination.[50]

Case 1 If turnover costs are high, such that $c \geq \frac{(1-k)}{\lambda\theta\gamma_B}$, all players are paid the monetary value of their talent t to avoid being poached, so that $\phi = 0$. No player is underpaid and clubs do not earn any rent.

Case 2 If turnover costs are such that $\frac{(1-k)}{\lambda\gamma_A} \leq c \leq \frac{(1-k)}{\lambda\theta\gamma_B}$, clubs underpay all B-type players, while paying each A-type player its marginal product. Thus, the share of imperfect contracts ϕ is equal to μ. The talent of the marginal player is now

$$\tilde{t} = R - \mu t \times (n-1)(k + \lambda\theta\gamma_B c_B) - (1-\mu)t \times (n-1). \tag{8}$$

These two cases depend crucially on labor market conditions, which affect the turnover costs. Our perspective is that the Bosman ruling modifies the general state of the labor market. It lowers the constraints on labor mobility and thus increases the arrival rate of job offers, λ.[51] Indeed, the end of transfer fees for out-of-contract players and of quotas

[50]Note that a third case is such that if $c \leq \frac{(1-k)}{\lambda\gamma_A}$ all players are underpaid so that $\phi = 1$, and clubs get rents from all players. The marginal player's talent is $\tilde{t} = R - (n-1)t[k - 1 + \lambda c(\theta\mu\gamma_B + (1-\mu)\gamma_A)]$.

[51]We are not the first to consider that changes in λ may reflect changes in the state of the labor market. As stated in Manning (2003) "in the model of Burdett and Mortensen (1998), the extent

within the EU dramatically reduced mobility constraints. EU players, independent of their race, now receive a higher number of job offers, from a larger number of firms, compared to the pre-Bosman ruling period. It is thus reasonable to assume that λ is higher after the ruling than before.[52]

In Case 1, differences in sporting talent T across clubs only depend on differences in wage bills and not on the share of black players. This case corresponds to a post-Bosman ruling type situation with high turnover costs due to high λs. This situation discourages clubs from indulging in discriminatory tendencies and team success does not depend on μ, the club's share of black players. Case 2 can be interpreted as the pre-Bosman ruling situation with different types of contracts due to a taste for discrimination. We view the Bosman ruling as a move from case 2 to case 1. By combining Eqs. (8), (7), and $R = \Omega + (n-1)t\mu\lambda\theta\gamma_B c$, we get an interesting testable proposition:

$$\begin{cases} T = \Omega & \text{Case 1} \\ T = \Omega + \mu t(N-1) * (1-k) & \text{Case 2} \end{cases}$$

If follows that

Proposition C.3. *When λ is high (case 1), the team's sporting talent and success only depend on the club's wage bill Ω. When λ is low (case 2), the team's sporting talent and success depends on both the club's wage bill Ω and the share of B-type players μ.*

In Case 2, the reason why the share of black players matters is that by diverting part of the wage devoted to B-type players the club earns some rents that are used to increase its overall talent T. This is the essence of the discrimination market test.

Table 9: Match specification - Manager Fixed Effects

Dependent Variable:	Goal Difference: Home vs Away Teams		
Estimator:	OLS	Within	Within-IV
Sample:	(1990-1999)	(1990-1999)	(1990-1999)
	(1)	(2)	(3)
Difference in log wage bill	0.202	-0.206	-0.605
	(0.13)	(0.24)	(0.70)
Bosman × difference in log wage bill	0.418[a]	0.644[a]	0.084
	(0.16)	(0.19)	(0.97)
Difference in number of black English players	0.065[a]	0.107[a]	0.114[a]
	(0.02)	(0.03)	(0.03)
Bosman × difference in number of black English players	-0.083[a]	-0.107[a]	-0.121[b]
	(0.03)	(0.04)	(0.05)
Difference in number of players used	0.009	0.010	0.011
	(0.01)	(0.01)	(0.01)
Bosman × difference in number of players used	-0.000	-0.004	-0.010
	(0.02)	(0.02)	(0.02)
Difference in total number of matches played by team	2.089[a]	2.194[a]	2.114[a]
	(0.22)	(0.25)	(0.30)
Bosman × difference	0.112	0.134	0.153
in total number of matches played by team	(0.33)	(0.38)	(0.41)
Difference in age of team	0.014	0.005	-0.004
	(0.03)	(0.03)	(0.03)
Bosman × difference in mean age of team	-0.006	-0.023	-0.006
	(0.04)	(0.05)	(0.05)
Difference in number of substitutions	-0.329[a]	-0.350[a]	-0.357[a]
	(0.06)	(0.08)	(0.08)
Bosman × difference in number of substitutions	0.114	0.091	0.103
	(0.09)	(0.10)	(0.11)
Observations	4048	3746	3508
Team-pair fixed effect	No	Yes	Yes
Home and away manager fixed effect	Yes	Yes	Yes

Notes: the dependent variable is the goal difference in the match. Robust standard errors in parentheses with [a] and [b] denoting significance at the 1% and 5% percent level, respectively. Standard errors are clustered at the team-pair level (see text for details).

D Further Evidence of Discrimination

D.1 Manager Fixed Effects

D.2 Evidence on Age Profiles of Players

The age profile of black players before and after the Bosman ruling also presents some evidence of discrimination. Figures (7) and (8) depict the age density of black players in "discriminating" and "non-discriminating" teams before and after the Bosman ruling, respectively. We define, although imperfectly, "discriminating" teams as the ones whose proportions of black players in the team is lower than 25% of the other teams, and "non-

of club market power is determined by the rate at which job opportunities arrive relative to the job destruction rate: the lower the arrival rate of job offers, the more market power clubs will have."

[52]Note that while it is reasonable to assume that λ is on average higher after the ruling, due to much lower mobility constraints, some (less talented) players could have received lower offers after the ruling due to increased competition from abroad. It may be interesting for future research to study the individual heterogeneous effect of the Bosman ruling on job opportunities.

discriminating" teams as those where the proportions of black players is higher than 75% of the other teams. Of course, this way of selecting discriminating and non-discriminating teams is far from perfect, but it is consistent with our empirical strategy and model. In the model, firms that discriminate are more likely to have their black players poached by rival firms. We should therefore expect these firms to have less older black players.

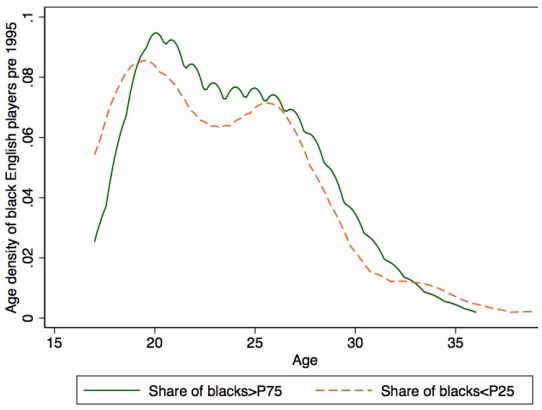


Figure 7: Pre-Bosman

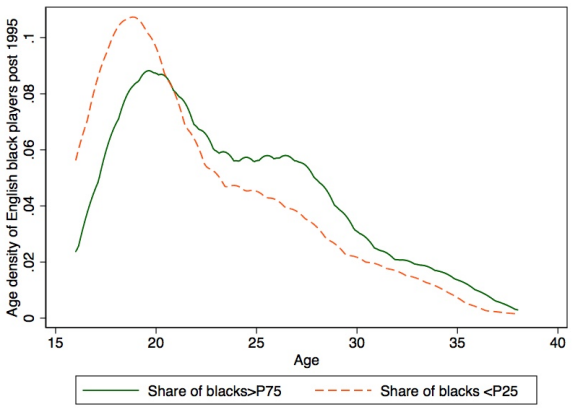


Figure 8: Post-Bosman

Notes: This graph represents the age density of black players at clubs with low and high share of black players.

In Figure 7, we observe that the age densities of black players in pre-Bosman are quite similar in discriminating and non-discriminating clubs, but there is a huge change post-Bosman (Figure 8): the age density of black players is more right-skewed in discriminating clubs. These differences could be explained by job-to-job mobility constraints. When players are young, they tend to play for their local clubs or for any club that wants them, whether these discriminate or not. Then, when labor mobility is low, as is the case pre-Bosman, black players employed in discriminating clubs can not move. This explains the similar age profiles depicted in Figure 7 between discriminating and non-discriminating clubs. By contrast, when job-to-job mobility is high, as was the case post-Bosman, black players in discriminating clubs are mostly youngsters since older players leave as soon as they can. This explains why the age density of black players is more right-skewed in discriminating clubs in the post-Bosman era (Figure 8).

D.3 Heterogeneity in discrimination

The results in the main part of the article show that discrimination decreases following the Bosman ruling. We argue that clubs took advantage of the institutional constraints on

player mobility to discriminate against their black English players. Three other hypotheses could make us more confident about the validity of our story:

1. Clubs that have a large share of black players *pre*-Bosman should see a decrease in league performance after Bosman.

2. Clubs that have a large share of black players *pre*-Bosman should see an increase in their relative wage bills after Bosman.

3. Clubs that have a large share of black players *pre*-Bosman should see some black players leave after Bosman.

To investigate these three hypotheses, we select a subsample of clubs who, before the Bosman ruling, seem to base their strategy on recruiting black players. These clubs are in the top 20% of clubs in terms of hiring black English players in any given year in the 5 years before the Bosman ruling. The three hypotheses are explored in Table 10 below.

Table 10: Discrimination Market-test: Heterogeneity of clubs

Dependent Variable:	Goal Difference	Share of Black English Players	Relative Wage Bill
Sample:		(1990-1999)	
	(1)	(2)	(3)
Relative wage bill	0.893^{a}	0.033	
	(0.08)	(0.03)	
Relative wage bill × Bosman ruling	0.037	-0.03	
	(0.10)	(0.08)	
Clubs with high share of black players pre-Bosman	0.111^{b}	0.180^{a}	-0.166
	(0.05)	(0.03)	(0.10)
Clubs with high share of black players × Bosman ruling	-0.147^{b}	-0.092^{b}	0.037
	(0.07)	(0.04)	(0.14)
Number of players used	0.01	-0.005^{b}	-0.028^{a}
	(0.01)	(0.00)	(0.01)
Bosman ruling		0.024	-0.036
		(0.02)	(0.06)
Additional Controls	Yes	No	No
Observations	4048	206	206
Match or Club fixed effect	Yes	No	No

Notes: the dependent variable is the goal difference between the two teams. The OLS estimator is used here. Controls for the match level specifications include the difference in the relative wage bill of clubs, the difference in the mean age of teams and the number of matches played, and the number of substitutions, as well as their interaction with a Bosman ruling dummy. Robust standard errors are in parentheses, clustered by club for columns 2 and 3, and match for column 1, with ^{a} and ^{b} denoting significance at the 1% and 5% percent level, respectively. Clubs with a high share of black players pre-Bosman are Aston Villa, Sheffield Wednesday, Chelsea, Coventry, QPR, Wimbledon and Crystal Palace.

The point estimates all seem to concord with the above hypotheses. Clubs that hire many black players before Bosman do better than other clubs before Bosman, but not

afterwards. They decrease their share of black players significantly post Bosman, and their relative wage bill is lower before Bosman but increases slightly after Bosman. These results all concord with our original hypotheses, though the coefficient in the last column is not statistically significant.

D.4 Additional Results on Long-time Windows

We present additional results using long-time windows with match-level data and the IV strategy. Our results can be interpreted as follows. Before Bosman (columns 1 and 2), a team that increased its number of black players by 1 could expect to score an additional 0.03 goals per game. In other words, because of wage discrimination, the club with more black players can hire more talented players. This can be compared to the size of the effect for the difference in wage bills. However this effect disappears after the Bosman ruling. Please note that with this specification the instruments do not pass the test of overidentifying restrictions, both for the Arellano-Bond and the IV specification, though redoing the estimation separately for pre-Bosman and post-Bosman fixes this problem.

D.5 Additional Results with Poisson regressions

One potential problem with the main specification in the paper is that we use OLS on count data. Unfortunately, we cannot use Poisson regression on goal difference since this variable is negative whenever the away team wins the game. However, we can rerun the main specifications from the paper and see whether our variables have an effect on the goals for the home and away teams. The results are presented in Table 12. The conclusions are identical to those presented in the main part of the article. Notice that the signs are inverted for the effect on the away team goals. This is because all the variables are defined as the difference between the home and away team. Having more English black players than the opposite team increases the number of goals you score before Bosman, but this effect disappears with the Bosman ruling.

Table 11: Discrimination Market-test: Match Success and Long Span

Dependent Variable:	Goal Difference: Home vs Away Teams			
Sample:	1981-2008			
Estimator:	OLS	Within	Within-IV	Arellano-Bond
	(1)	(2)	(3)	(4)
Difference in log wage bill	0.879[a]	0.588[a]	1.102[a]	0.529[a]
	(0.05)	(0.08)	(0.35)	(0.13)
Bosman × difference in log wage bill	0.173[a]	0.232[a]	-0.206	0.177[b]
	(0.06)	(0.07)	(0.45)	(0.08)
Difference in number of black English players	0.033[a]	0.036[a]	0.040[a]	0.016
	(0.01)	(0.01)	(0.02)	(0.02)
Bosman × difference in number of black English players	-0.071[a]	-0.053[a]	-0.065[a]	-0.063[b]
	(0.02)	(0.02)	(0.02)	(0.02)
Difference in number of players used	0.004	0.003	0.007	0.003
	(0.01)	(0.01)	(0.01)	(0.01)
Bosman × difference in number of players used	-0.001	-0.001	-0.011	-0.003
	(0.01)	(0.01)	(0.01)	(0.01)
Difference in total number of matches played by team	2.217[a]	2.234[a]	2.256[a]	2.237[a]
	(0.14)	(0.15)	(0.17)	(0.15)
Bosman × difference in total number of matches played by team	-0.148	-0.184	-0.226	-0.199
	(0.20)	(0.21)	(0.23)	(0.21)
Difference in age of team	-0.010	-0.009	-0.019	-0.010
	(0.01)	(0.01)	(0.02)	(0.01)
Bosman × difference in mean age of team	0.016	0.008	0.005	0.009
	(0.02)	(0.02)	(0.02)	(0.02)
Difference in number of substitutions	-0.410[a]	-0.437[a]	-0.449[a]	-0.441[a]
	(0.03)	(0.04)	(0.04)	(0.04)
Bosman × difference in number of substitutions	0.320[a]	0.311[a]	0.303[a]	0.311[a]
	(0.04)	(0.05)	(0.06)	(0.05)
Observations	11404	11070	9528	9770
Team-pair fixed effect	No	Yes	Yes	Yes

Notes: the dependent variable is the goal difference in the match. Robust standard errors in parentheses with [a] and [b] denoting significance at the 1% and 5% percent level, respectively. Standard errors are clustered at the team-pair level (see text for details).

Table 12: Match specification - Poisson regression

Dependent Variable:	Goals - Home Team	Goals - Away Team
Estimator:	Poisson	
Sample:	1990-2000	
	(1)	(2)
Difference in log wage bill	0.327^{a}	-0.329^{a}
	(0.04)	(0.05)
Bosman × difference in log wage bill	0.042	0.010
	(0.05)	(0.06)
Difference in number of black English players	0.020^{b}	-0.017^{c}
	(0.01)	(0.01)
Bosman × difference in number of black English players	-0.037^{a}	0.038^{b}
	(0.01)	(0.02)
Difference in number of players used	-0.001	-0.005
	(0.00)	(0.01)
Bosman × difference in number of players used	-0.000	0.003
	(0.01)	(0.01)
Difference in total number of matches played by team	0.669^{a}	-0.712^{a}
	(0.12)	(0.14)
Bosman × difference in total number of matches played by team	-0.070	-0.319
	(0.16)	(0.20)
Difference in age of team	-0.006	0.002
	(0.01)	(0.01)
Bosman × difference in mean age of team	0.012	0.008
	(0.02)	(0.02)
Difference in number of substitutions	-0.138^{a}	0.120^{a}
	(0.03)	(0.03)
Bosman × difference in number of substitutions	0.069^{c}	-0.033
	(0.04)	(0.05)
Observations	4048	4048
Team-pair fixed effect	Yes	Yes

Notes: the dependent variable is the goal for the home or away team. Robust standard errors in parentheses with ^{a}, ^{b}, and ^{c} denoting significance at the 1%, 5%, and 10% percent level, respectively. Standard errors are clustered at the **team**-pair level.

E Instrumental Variable Approach and First Stage Results

E.1 Relevance and constructing of the instruments

We briefly discuss here the relevance of our three excluded instruments and the way they are constructed. Regarding our first two instruments (performance in cups, and stadium attendance), we know that wages are set by clubs before the season starts. Higher attendances and better performance in cups in the previous season generate higher revenues, which allow clubs to recruit better players in the following season, and increases the wage bill. A detailed breakdown of club revenues is not usually available in the audited accounts from which we build our dataset. One exception is the analysis of data from the 1981/82 season, in which we find that match revenues coming from attendance made up 62% of total revenues. Nottingham Forest's accounts in that season provides a more precise picture. Reaching the quarter finals of the League Cup increased their turnover by about 10% compared to an early elimination. In 1982, most of the clubs' revenue came from stadium attendance, and performances in cups. This has changed in the intervening years, as the revenue generated by broadcasting and merchandising has increased. However, match revenues still accounted for 37% of total revenues in the season 2006/07 (a more recent season where we also observe a partial breakdown of club revenues).[53] Regarding the third instrument, we use record transfer fees to capture potential buyouts by rich owners. When buying out a club, new owners often break the club's transfer fee record, which increases the team's wage bill because of a positive correlation between transfer fees and wages. However, many record purchases prove to be poor value for money with on average very little effect on the final team performance. These three variables are then differenced between clubs to create our three instruments for the wage bill difference.[54]

The instruments are constructed for each season as follows.[55] The difference in lagged stadium attendance in thousands of people is measured as the one-year lag of the difference between the home and away clubs' log attendance. Performance in cups is measured as the difference in club performance in the Football Association Challenge Cup and the League

[53]Note that a good performance in cups also boosts merchandising and broadcasting revenues.

[54]It is worth noting that conditional on wage bill difference, record transfer fees are not related to performance in the Premier League. A reason could be that most of the club's owners in the English Premier League are rich billionaires.

[55]See Appendix (A) for data sources.

Cup, using a linear performance index for each additional round reached. The relative transfer fee record variable is measured as the difference in the home club's transfer fee record relative to the away club.

E.2 First stage results

Table 13: First Stages: Goal Difference: Short and Long Span

Dependent Variable:	Difference in log wage bill	Difference in wage bill×Bosman	Difference in log wage bill	Difference in log wage bill×Bosman
Sample:	1990-2000		1981-2008	
	(1)	(2)	(3)	(4)
Lagged difference in cup performance	0.054^a	0.013	0.101^a	0.063^a
	(0.01)	(0.01)	(0.01)	(0.01)
Difference in relative transfer fees	0.170^a	0.187^a	0.215^a	0.227^a
	(0.01)	(0.02)	(0.01)	(0.01)
Lagged difference in average attendance	0.305^a	0.062	0.393^a	0.128^a
	(0.02)	(0.05)	(0.02)	(0.02)
Difference in number of black English players	0.014^a	0.012^b	-0.000	0.003
	(0.00)	(0.01)	(0.00)	(0.00)
Bosman × difference	-0.018^a	-0.037^a	-0.014^a	-0.040^a
in number of black English players	(0.00)	(0.01)	(0.00)	(0.01)
Difference in number of players used	0.005^a	0.014^a	0.009^a	0.016^a
	(0.00)	(0.00)	(0.00)	(0.00)
Bosman × difference in number of players used	-0.009^a	-0.032^a	-0.011^a	-0.030^a
	(0.00)	(0.00)	(0.00)	(0.00)
Difference in total number of matches played	0.100^a	0.138^a	0.010	0.061^b
by team	(0.03)	(0.04)	(0.02)	(0.03)
Bosman × difference	-0.294^a	-0.294^a	-0.088^a	-0.195^a
in total number of matches played by team	(0.05)	(0.06)	(0.03)	(0.04)
Difference in age of team	0.016^a	0.002	-0.010^a	-0.020^a
	(0.00)	(0.01)	(0.00)	(0.00)
Bosman × difference in mean age of team	0.005	0.005	0.015^a	0.012^b
	(0.01)	(0.01)	(0.00)	(0.01)
Difference in number of substitutions	0.036^a	-0.001	-0.025^a	-0.049^a
	(0.01)	(0.01)	(0.01)	(0.01)
Bosman × difference in number of substitutions	0.002	0.009	0.033^a	0.030^a
	(0.01)	(0.02)	(0.01)	(0.01)
Observations	3508	3508	9528	9528
Team-pair fixed effects	Yes	Yes	Yes	Yes
F test of excluded instruments	180.16^a	45.48^a	477.65^a	133.22^a
Angrist-Pischke underidentification $\chi^2(3)$	49.21^a	50.32^a	137.50^a	124.01^a
Test of overidentifying restrictions		0.234		6.602^b
$\chi^2(1)$ p-value		0.629		0.01

Notes: robust standard errors in parentheses, clustered at the team-pair level, with ^{a} and ^{b} denoting significance at the 1% and 5% level respectively.

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