Who benefits from support?
The heterogeneous effects of supporters on athletes' performance by skin color

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Abstract

This paper investigates the effect of supporters on the performance of soccer players by skin color using objective player performance data and an automated skin color recognition algorithm. Due to the COVID-19 restrictions, one third of the games of the highest Italian soccer league 2019/2020 season were played in closed stadiums. I identify a significant increase in the performance of non-white players, relative to white players, when supporters are banned from the stadium. The effect does not differ between home and away games, and players playing in top versus minor teams, while weaker players are impacted more than others.

JEL: J15, J71, Z22.

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1 INTRODUCTION

Racism at the workplace can have an impact on workers' wellbeing, which in turn affect their performance.[1] Productivity at work is often altered by the influence an individual receives from others (Kinlaw, 1999; Albrecht et al., 2014). Most companies condemn racist behaviors and pledge their commitment toward corporate social responsibility and social justice.[2] Despite the relevance of the phenomenon, research on the effect of racism on worker performance is limited. Racist episodes have been studied in some working environments, such as hospitals (Shields and Price, 2002) and the army (Antecol and Cobb-Clark, 2009). However, it is challenging to provide robust empirical evidence because of the difficulty to find an exogenous source of variation in exposure to racism.

The COVID-19 pandemic generated an important discontinuity in the way workers interact among them and with the external environment. Due to the COVID-19 restrictions, the main European leagues soccer games were played without fans in stadiums, which affects athletes behavior. Soccer has been shown to suit well for studying moral support as well as psychological, and social pressure generated from fans on athletes.[3] In soccer, racism is a widespread phenomenon and manifests mainly through discriminatory behaviors of supporter against non-white players.[4] The empty-seats shock reduces the positive effect of support from fans, but at the same time takes away the negative effect of racism on discriminated players. The availability of detailed data on soccer player performance

[1]Oswald et al. (2015) show a link between happiness and productivity at work. Pagán-Castaño et al. (2020) provide an extensive literature review on the factors influencing employee wellbeing. Job satisfaction has been shown to be a good predictor of future stock market performance (Edmans, 2012), and increases value added (Bockerman and Ilmakunnas, 2012).

[2]Many private and public institutions fight against racism and try to increase awareness of the phenomenon among people. Several organizations seek to help workers and firms to detect racism harassment at the workplace and contribute to a more inclusive company culture. Examples are "Great Place to Work" in the US, "Pearn Kandola" in the UK and "Embrace Difference" in Europe.

[3]See Colella et al. (2021); Gómez and Pollard (2011); Liardi and Carron (2011); Apesteguia and Palacios-Huerta (2010); Feri et al. (2013); Garicano et al. (2005) for pre-COVID-19 papers and Cross and Uhrig (2020); Dilger and Vischer (2020); Ferraresi and Gucciardi (2020); Fischer and Haucap (2020); Reade et al. (2020a); Sors et al. (2020); Bryson et al. (2021); Cueva (2020); Endrich and Gesche (2020); Scoppa (2021); Reade et al. (2020b) for research exploiting the "empty seats" discontinuity due to the COVID-19 pandemic.

[4]Thanks to new technology and an increasing awareness of the phenomenon, most of the racist episodes around soccer at an highly professional level are recorded. All the most important European leagues show an increasing pattern in racist episodes.

and the prevalence of racism at stadiums make soccer a perfect environment to study the potential effects of racial offenses on individual performance at the workplace.

In this paper, I provide evidence that supporters have heterogeneous effects on soccer players performance by skin color in the highest Italian soccer league, Serie A. I exploit the sudden and unexpected change in the presence of supporters due to the COVID-19 restrictions. Soccer leagues discontinued the game schedule in March 2020 and restarted a few months later with one major change: the so called "closed stadium" rule, which forbids all individuals that are not directly involved in the game from entering stadiums. I generate and apply a skin color recognition algorithm to athlete pictures and classify more than 500 players into white and non-white categories. Using an objective performance measure from fantasy-sports competition, I compile individual performance scores in every game of the 2019/2020 season. I compare how each player fared in games played when supporters are allowed in the stadium against performance in empty stadiums.[5]

I find that performance of non-white players, relative to white players, increases by 1.5% on average, when fans are absent. The effects are similar in home and away games, and between players playing in top clubs and in other players. Defenders and midfielders, as well as less-skilled players, suffer more than others. Results are robust to the inclusion of several controls, such as turn, team and player fixed effects, game characteristics indicators and to potential confounders, such as player nationality. I also implement a placebo exercise using only 240 games played in front of fans: I generate a placebo ban, taking place after the first 120 games and replicate the main analysis. The placebo-ban has no significant effects on player performance score.

To the best of my knowledge, this is the first paper providing empirical evidence on the causal effect of supporters on individual performance by player skin color in a highly competitive environment.

This paper contributes to several strands of the literature. First, it relates to the literature connecting racism, wellbeing, and performance at work. Shields and Price (2002) document how nurses suffering racial harassment from patients report lower job satisfaction and are more intent on leaving their job, while Antecol and Cobb-Clark (2009) show

[5]Technically, the strategy is identical to a difference-in-differences methodology. However, in this setting there is no real control group as both "types" of players are affected by the absence of supporters, but in an heterogenous way.

that offensive racial behaviors toward military personnel heighten their intentions to leave the military profession. More recently, Stoermer et al. (2019) finds that black workers that experience racial harassment in the South African labor market have a lower job satisfaction and display a lower productivity. Turning to a firm level analysis, Corritore et al. (2020) show how workplaces with greater intrapersonal cultural heterogeneity between employees have greater expectations for future growth and innovation.[6] Given the difficulty to find an exogenous variation in racial harassment, research in this field is limited to descriptive evidence or survey studies. This paper contributes to this literature by producing new insights on the effect of external support, or pressure, on individual performance in a competitive working environment, by exploiting a natural experiment.

Second, this paper contributes to the economic research strand that uses soccer data to investigate human behavior.[7] Apesteguia and Palacios-Huerta (2010) collect data on penalty shoot-outs to show that being the first-mover increases the probability of winning, as a consequence of the psychological pressure suffered by second shooters. Dohmen (2008) provides additional evidence on the effect of pressure on penalty score probability. Analyzing an exogenous shock in the presence of away team supporters in the Argentinean soccer league, Colella et al. (2021) identify an overall positive average effect of supporters on team performance. Previous research shows how home advantage, which consists in the greater probability of winning a game when playing at the local stadium, is present in team sports (Gómez and Pollard, 2011; Liardi and Carron, 2011; Carron et al., 2005; Pettersson-Lidbom and Priks, 2010; Pollard, 2006) as well as in individual competitions (Koning, 2011). It has been also shown that, in addition to directly affecting players, supporters exert social pressure on referees, biasing their decisions (Garicano et al., 2005; Dohmen and Sauermann, 2016). Recently, several studies have exploited the COVID-19 pandemic to provide additional evidence on home advantage (Cross and Uhrig, 2020; Dilger and Vischer, 2020; Ferraresi and Gucciardi, 2020; Fischer and Haucap, 2020; Reade et al., 2020a; Sors et al., 2020) and referee bias (Bryson et al., 2021; Cueva, 2020; Endrich and Gesche, 2020; Scoppa, 2021; Reade et al., 2020b;).[8] The literature on home advantage and

[6] A closely related strand of the literature explores racial discrimination among workers and its impact on wages (Brown, 1984; Card and Krueger, 1993; Hersch and Shinall, 2015).

[7] The book *"Beautiful game theory: How soccer can help economics"* by Palacios-Huerta (2014) provides a review of previous research in economics using soccer data.

[8] An article featured in The Economist (2020) under the headline "Home Comforts" (July 2020) provides a powerful graphical description of the changes in home advantage for the major European leagues.

the importance of supporters for performance looks mainly at team level effects, analyzing the total number of goals or cards given to each team as outcomes. This paper adds to this literature by providing evidence on the heterogeneous effect of supporters on individual player performance, skin color.

Third, this paper contributes to the literature on racism among supporters. Previous research in this field qualitatively documents the presence of racism among soccer fans by describing racist traits of supporters (Arnold and Veth, 2018; Hylton, 2020), or assessing their perception of xenophobic behavior of fans and media from the player prospective (Garland and Rowe, 2001). The book "European Football in Black and White" by Kassimeris (2007) describes the link between racism in soccer arenas and politics, and shows how the escalating violence, especially against ethnic and religious minorities, constitutes a threat to the emerging multicultural nature of European soccer. While these studies point toward a substantial presence of racism among fans, there is no evidence that supporters can affect player performance through racist behaviors. This paper fills this gap by showing empirically the negative causal effect of supporters on the performance of non-white players.

The most closely related research to this paper is a working paper by Caselli et al. (2021). They study how the absence of supporters during soccer games impacts the performance of African Serie A players. Their approach presents two main limitations compared to this study. First, they analyze the heterogeneous impact of supporters by player continent of origin. As result, their treatment group includes all white african players that might not be targeted by the crowd and, importantly, it excludes all non-white players with a European passport who are also victims of racism abuse.[9] Second, because of their citizenship based classification, their main result is based on a treatment group accounting for only 6.7% of the sample. I overcome these limitations by implementing a rigorous and objective classification of players following their skin color, resulting in a treatment group that accounts for 15.4% of the sample.

[9]Recent examples are racist abuse suffered by the English national team players Marcus Rashford, Jadon Sancho and Bukayo Sako after the Euro 2020 tournament final and by Italian player Mario Balotelli during a serie A game. A recent article on The Guardian (2021) stressed how the last Euro 2020 tournament, a competition played among national European teams, is a "barometer of diversity" due to the diverse composition of teams in terms of skin color. Romelu Lukaku, a Belgian serie A non-white player decleared in an interview:"*if it's going well, they call me a Belgian striker. If it's not, a Congolese descent*".

2 Background

Racism is present in many sports. In soccer, it manifests mainly through discriminatory behaviors and verbal abuse against non-white players. Most European soccer leagues have witnessed racist incidents in stadiums in the past, and the phenomenon is growing.[10] In recent years, awareness of the problems associated with racism has increased tremendously. Consequently, sports federations have moved jointly to fight racism: FIFA president Gianni Infantino has urged for "harsh sanctions" against clubs, while UEFA President Aleksander Ceferin has invited referees to stop games if a racist incident occurs. The idea of campaigning against racism in soccer is now rooted in many European countries. Since 2016 an ad of the "NO TO RACISM" campaign, which contains the most famous soccer players and managers as testimonials, has been shown before the start of any European league game.

The greatest portion of racist incidents in soccer concerns episodes of racial discriminatory behaviors from in stadiums. In general, supporters are an integral part of the sport. They perceive themselves as part of the team and go to the stadium to boost players performance and to help the team to win games. They express their appreciation for or criticism against both own and opponent team players. Unfortunately, when a non-white player is targeted, fans behavior takes the form of racial harassment. Many professional players report having been victims of racist chants or verbal abuses by supporters during soccer games in recent years.[11]

Racist behaviors from supporters are unfortunately very common in Italy, where about 250 thousands supporters watch games live in stadiums every week. A report from the Italian soccer players association detected more than 600 racist incidents during the 2018/2019 season, 66% of them happened in stadiums. The victims are always non-white players, independent of their nationality. During a game of the 2019/2020 season, analyzed by this study, an Italian black soccer player, Mario Balotelli, stopped playing and threw the ball towards the supporter stands as a form of protest against the continuous insults he was receiving due to his skin color.

[10] Figures published by the UK government show a 50% increase in the number of incidents involving racist abuse during soccer games reported to the British police (The Guardian).

[11] Some examples are: Antonio Rüdiger and Raheem Sterling in the English Premier League, Moussa Diaby in the German Bundesliga and Ousmane Dembele in the Spanish La Liga.

The current COVID-19 pandemic, has had a great impact on soccer. The most important soccer leagues discontinued the game schedule in March 2020 and restarted a few months later with one major change: the absence of supporters in stadiums. More than two thousand games, in the professional European leagues, were played with the closed stadium rule, which forbids all individuals that are not directly involved in the game, that is, players, managers, and staff from entering stadiums. The Italian Serie A resumed on June 20, 2020, until August 2, 2020. In total, 130 games, out of 380, were played in closed stadiums.

3 Data

3.1 Data Sources

The main source of data is *Fantacalcio.it* (last accessed: August 8, 2021), a platform for playing fantasy soccer in the Italian first league. Fantasy soccer is a fantasy sport game in which participants assemble imaginary or virtual teams of real professional soccer players, and compete based on real player performance. After every Serie A game, Fantacalcio assigns a score between 0 and 10 to each player based on individual performance. The score is fully objective, as it is computed by the algorithm "Alvin482", which examines several components of player behavior during the games including the position on the field, the share of successful passes, shoots, dribbles and tackles, as well as game specific characteristics such as the ranking of teams and the difficulty of the game. Each fantasy soccer team aims at getting the highest "Alvin482" total score. Fantacalcio also provides additional information on Serie A teams and players, such as age, weight, nationality, and position on the field, as well as results for every game played.

The second input concerns football players close-up photos downloaded from two websites: *Soccerwiki.org* and *Transfermarkt.com*. Soccerwiki is a free soccer-orientated wiki containing information on players, clubs, stadiums, managers, referees, leagues, and other data related to the world of soccer. Transfermarkt is a popular website collecting scores, results, and rankings of numerous leagues globally, as well as information on companies, players' careers, and transfers. I downloaded more than 90% of the pictures from Soccerwiki. However, being a collaborative database where anyone can create and edit data, some of the photos are missing or "awaiting approval". When one of these two events occurs, I downloaded the picture from the second source: Transfermarkt. At the end of this process I am able to obtain a picture for 557 Serie A players, accounting for 99.5% of the observations in the sample.

The last source of data is the website *Diretta.it*, a website collecting results, goals, and statistics of every game, as well as an indicator stating whether fans were allowed in the stadium when the game was played. I used this information to classify the sample into games with supporters and games without supporters.

3.2 Classification

After having downloaded every player photo, the algorithm classifies players into white and non-white.[12] To do that, I implement a three steps procedure. Figure (1) shows each step of the procedure for two players in the sample.

First, I isolate all the pixels in a figure that identifies the player's skin. To this extent, I implement the novel *"skin detection using HSV & YCbCr color space"* method created by Dahmani et al. (2020).[13] Starting from an reed-green-blue (RGB) image, each pixel is converted into two color-composition scales: Hue Saturation Value (HSV) and Luma-Chroma-blue-Chroma-red (YCbCr). Then the value of each pixel is compared with standard values of a skin pixel and classified as skin and non-skin using a combination scheme.[14] This scheme exploits the weakness of each of the two skin detectors scales and improves the skin region segmentation by taking the best of each of the two classifiers. As shown in Figure (1), panel (b), on average between one third and half of the pixels are preserved.

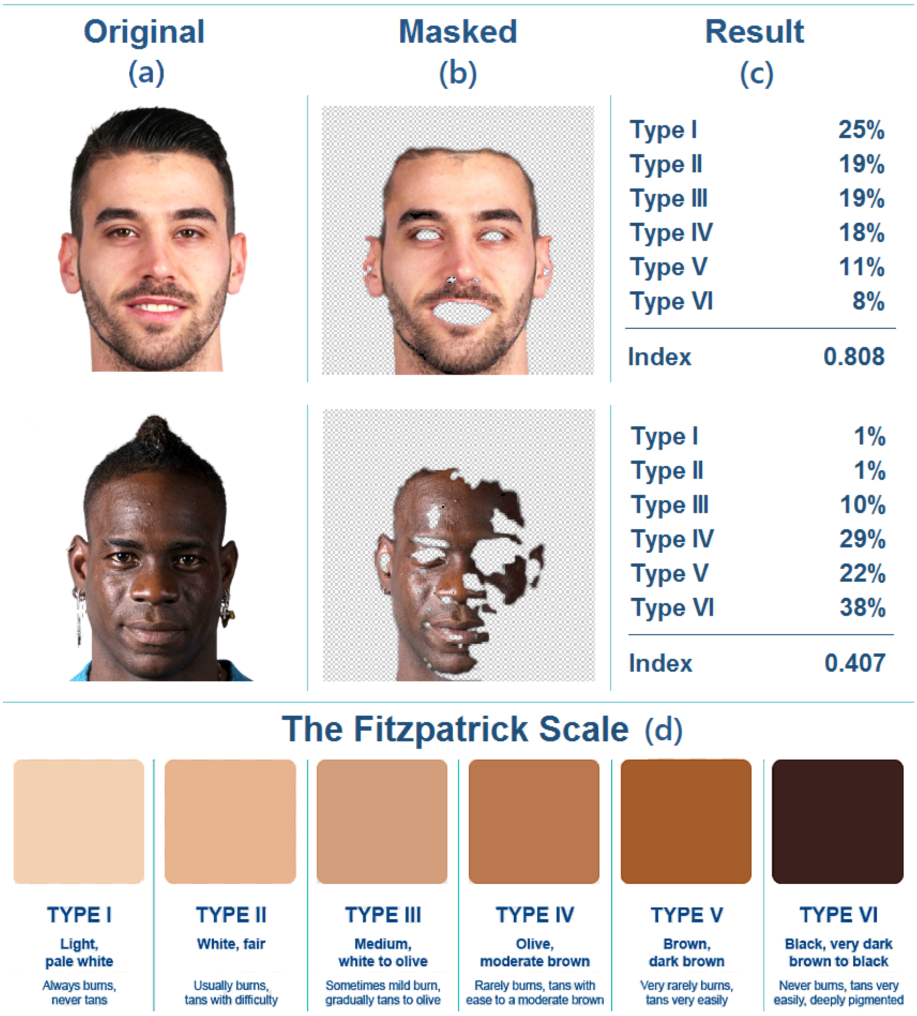
Second, I classify each pixel in the figure in one of the 6 colors of the Fitzpatrick (1975) photo-typing scheme, presented in Figure (1) - panel (d). This is a numerical classification for human skin color commonly used in dermatology research. I use a color detection technique based on *OpenCV*, a library for image processing techniques implemented by

[12]The first category is supposed to contain all players from a light to an olive skin color, while the second includes players with a dark brown or black skin color.

[13]They propose a novel skin segmentation method based on a zero-sum game theory model, which improves the detection efficiency of some usual skin descriptors. The algorithm used in this paper is freely accessible at the following address: https://github.com/CHEREF-Mehdi/SkinDetection. The website also contains an illustration on how the algorithm operates and several tests on its performance.

[14]The ranges are [$0 <= H <= 17$, $15 <= S <= 170$ and $0 <= V <= 255$] for the HSV scale and [$0 <= Y <= 255$, $135 <= Cr <= 180$ and $85 <= Cb <= 135$] for the YCbCr scale.

Figure 1: Classification Examples



This Figure shows the three steps of the skin color classification algorithm for two Italian players in the sample. Panel (a) shows the picture downloaded from the website soccerwiki.com; panel (b) shows the figure after the mask, that isolates the skin, is applied; panel (c) shows the share of skin-pixels for each category of the Fitzpatrick scale and the skin-color-index generated; panel (d) plots the skin color categories in the Fitzpatrick scale - source: Fitzpatrick (1975).

Intel Corporation. The algorithm detects RGB coordinates for each pixel, computes the distance between the pixel coordinates and the coordinates of each of the 6 colors in the scheme, and selects the one having the smallest distance.[15] Panel (c) of Figure (1) shows the results of this procedure in terms of share of pixels for two players. As expected, the largest proportion of pixels for the first picture resides in the lighter categories, while the opposite happens in the case of the second picture.

The third and last step concerns the classification of players into one of the two categories: white and non-white. Given that many of the Italian or Mediterranean players have

[15] The distance formula used is $[d_{pixel,i} = abs(Red_{pixel} - Red_{Fi}) + (Green_{pixel} - Green_{Fi}) + (Blue_{pixel} - Blue_{Fi})]$, where x_{pixel} refers to the color x coordinate of the pixel image and x_{Fi} refers to the color x coordinate of the i color in the Fitzpatrick scale.

an “olive” skin color, I consider types I-IV for the white category and construct a skin color index that equals the share of pixels in these first four categories. As shown in Figure (1), the index for the first player is 0.8 while for the second it is 0.4. I classify as non-white all the players with an index value above 0.6 and as white all the others.[16] At the end of this procedure 86 of the 557 analyzed players in the sample were categorized as non-white; this accounts for 15.4% of the players and 14.2% of the observations.

3.3 SAMPLE

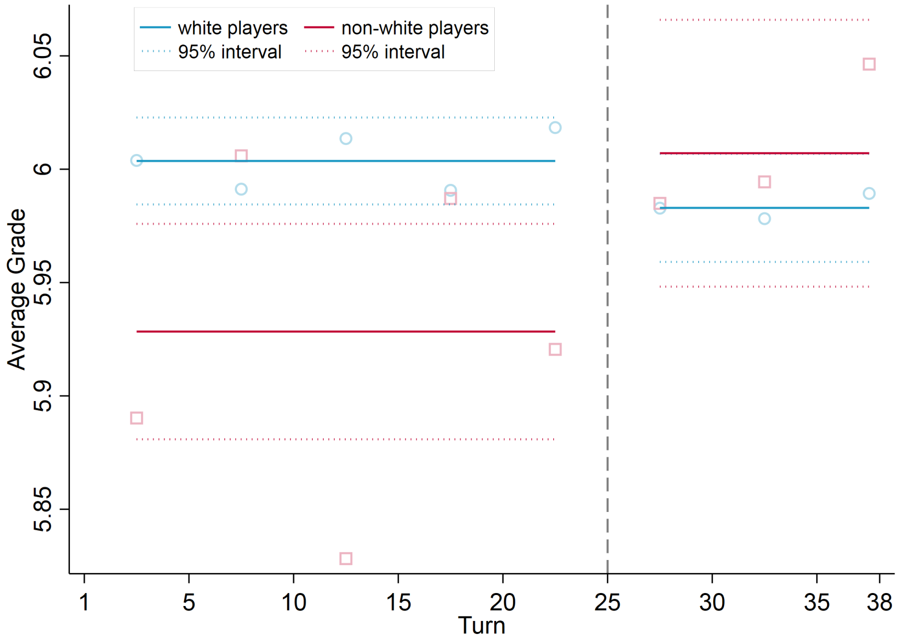
Using the information provided by Fantacalcio for the entire 2019/2020 season of Serie A, and the skin color classification, I construct a panel database containing: (i) the score that each player received after each game, as well as (ii) baseline player characteristics, such as age, weight, height, nationality, team, and position on the field, and (iii) the assigned skin color. The database contains 20 teams, 557 players, and 380 games, for a total of 10,898 observations. The presence of non-white players is quite stable between home (14.3) and away games (14.0). The presence of non-white players is slightly greater in the top 6 teams (17.4%) than it is in others (14.4%). 73% of all the African players, 19% of the Latin Americans and only 9% of the European players are classified as non-white. Even though there is a substantial correlation between the skin color index and the continent of origin, only 32% of the non-white players in the sample have an African state as first nationality, while almost 50% of them are Europeans.

The goal of the analysis is to understand whether the lack of supporters has different effects on player performance according to skin color. I divide games in the database into two groups: games played in normal circumstances and games played in a closed stadium. Non-white players account for 13.8% of the observations in the first group and 14.8% of the observations in the second group. To avoid biased and volatile estimations due to a low number of observations, I include in the sample only players with more than 3 appearances in each of the two groups, reducing the sample to 9,495 observations. Figure (2) plots the average score that every player received by skin color and whether support-

[16] The distribution of the index presents a big jump after the cutoff of 0.6, with the majority of players almost equally distributed above it. I run a non-parametric regression of the grade on 9 indicators, one for each 0.1 increment of the skin color index, and find that the effect picks up at the cutoff of 0.6. These results are available upon request.

ers were present or not in the stadium. If a game is played with supporters, white players get, on average, a score of 0.076 higher than non-white players, equals to an increase of 1.3%. On the other hand, if supporters are not present in the stadium during the game, non-white players get 0.03 points more than white players, indicating a potential heterogeneity in the effect of supporters on players performance related to skin color.

Figure 2: Average Individual Score



This Figure presents the average score received by white players (in blue) and non-white players (in red) in the 2019/2020 serie A season. The left side concerns the period in which games were played with supporters and the right one the period in which supporters were banned from stadium. The circles and the squares plot the averages by bins of 5 turns, 50 games. Source: Fantacalcio.it, own calculation.

4 Impact Estimates

4.1 Empirical Strategy

In order to causally identify the effect of (the lack of) supporters on the performance of white and non-white players, I estimate the following equation:

$$Y_{ikjt} = \alpha + \beta\, NW_i + \gamma\, NS_{jt} + \lambda\, NW_i \times NS_{jt} + \gamma\, X_{itkm} + \rho_i + \nu_t + \epsilon_{ikjt} \tag{1}$$

Where Y_{ikjt} refers to the score attributed to player i in team k during game j played for the Serie A turn t; NW_i is a dummy indicating whether player i is categorized as non-white and NS_{jt} indicates whether the game j was played without supporters in the stadium. Depending on the specification used, X_{itm} contains several controls, such as indicators for home games, team fixed effects, number of goals scored by team k in game j, a quadratic time control and the nationality of player i. ρ_i and ν_t are individual and time fixed effects, respectively.[17] The main coefficient of interest is the interaction term λ, which represents the average change in the performance score of a non-white player when there are no-supporters to when there are supporters in the stadium, relative to the same average change for white players.

Identification relies on two assumptions. The first is the absence of other factors that could affect the performance of non-white players, over that of white players, contemporaneously with the closed stadium policy. The second is a common trend assumption between the performance score of white and non-white players: I assume that if the closed stadium policy would have never been implemented, the difference in score between the two groups of players would have remained constant. Figure (2) doesn't show any particular trends in the two distributions. However, one might think that other unobserved individual characteristics of players, correlated with the skin color, might affect their performance and bias the results. I address potential concerns by running several robustness checks. In particular, in a double interaction model, I show that if the skin color is taken into account, the continent of origin does not significantly affect player performance. In addition, I run a placebo experiment on a subsample of games played with supporters in the stadium and do not find any significant result of the placebo ban implemented after 12 games, out of 24, in this hypothetical scenario.

4.2 Main Result: Effect on Player Performance

Table (1) shows the estimation results. In the most plain-vanilla specification, column (1), the non-white coefficient is always negative, indicating that non-white players receive, on average, a lower score with respect to white players. This difference can be due to a baseline disparity in skills and strengths between players in the two categories. The interaction

[17] In all the specifications where a player fixed effect is included, the variable NW_i, as well as the player time invariant controls are omitted, while the variable NS_{jt} also appears in the specification including turn fixed effects because at the very beginning of the restrictions a few games of the same turn were played without supporters.

term between the non-white and the no-supporters dummy is instead positive, suggesting that, without supporters, the average score of non-white players increases compared with the change that white players had. I consider a few different specifications. Column (2) controls for a quadratic time trend.[18] Then, I control for game characteristics, by adding the home game dummy and the number of goals scored by the team, in column (3), and team fixed effects, in column (4). To reduce potential bias from player time-invariant characteristics, I include player nationality fixed effects in column (6) and player fixed effects in column (7). Finally, I control for potential time non-parametric effects in column (8) by adding a turn fixed effect. In column 6 to 8, I also cluster standard errors at the player level, to obtain robust inference to potential unobserved correlation between different games played by the same player (Cameron and Miller, 2015).

Table 1: Effect of supporters on players performance

OLS Estimation								
Dependent Variable: *Player performance score*								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
No Supporters	-0.021	-0.049	-0.050*	-0.055*	-0.059**	-0.059*	-0.053*	0.053
	(0.015)	(0.032)	(0.030)	(0.030)	(0.030)	(0.032)	(0.032)	(0.068)
Non-white player	-0.072**	-0.072**	-0.089***	-0.100***	-0.102***	-0.102**		
	(0.028)	(0.028)	(0.026)	(0.027)	(0.034)	(0.052)		
No Supporters × Non-white player	0.096**	0.095**	0.093**	0.088**	0.087**	0.087*	0.090*	0.089*
	(0.044)	(0.044)	(0.040)	(0.040)	(0.040)	(0.047)	(0.047)	(0.047)
Turn Quadratic Trend		✓	✓	✓	✓	✓	✓	
Home Games Dummy			✓	✓	✓	✓	✓	✓
Team Goals			✓	✓	✓	✓	✓	✓
Team FE				✓	✓	✓	✓	✓
Player's Nationality FE					✓	✓		
Player FE							✓	✓
Turn FE								✓
Observations	8952	8952	8952	8952	8952	8952	8952	8952
Cluster SE - player						✓	✓	✓

OLS estimation of the effect of no supporters on player performance by skin color. No Supporters is a dummy taking value 1 for all games played in empty stadiums. Non-white player is a dummy taking value 1 for all players classified as non-white. Beta coefficients reported and robust standard errors in parentheses. Standard errors are clustered by player in Columns (6), (7) and (8). *** significant at 1%, ** significant at 5%, * significant at 10%.

Independently of the specification, the interaction term between the no-supporters and the non-white indicator is always positive, statistically significant, and stable in terms of magnitude, ranging between 0.087 and 0.096. In the most conservative specification,

[18] By time, in this setting, I refer to turn, an indicator of the chronological order of the games.

column (8), the coefficient is 0.089, indicating a 1.5% increment in the average score.[19] This result is consistent withe the hypothesis that non-white players suffer from the presence of supporters in the stadium. The COVID-19 pandemic may not only affect the presence of fans in stadiums, it could also have a direct effect on team performance in other ways. However, it is unlikely that other potential factors, other than racist behaviors from supporters, would impact differently the performance of players by skin color.

4.3 ROBUSTNESS

In this section, I present the additional robustness checks. The first set of checks concerns sample selection. In the main analysis, I consider only players playing more than 3 games in each part of the season. In table (2), I replicate the most conservative specification, including time and player fixed effects, using all the players in the sample, column (1), and only players making at least 10 appearances per period, column (2). I then exclude the goalkeepers from the sample as they are all categorized as white, column (3). The interaction coefficient is always positive, statistically significant and quite stable in terms of magnitude, indicating that the result is not due to sample selection.

As a second check, I exclude the possibility that the result is due to potential unobserved characteristics of the players related to the origin country that are, at the same time, correlated with the impact of the closed stadium and the skin color. For this reason, I use the nationality to divide players into four subgroups according to their continent of origin.[20] In column (4), I replicate the main specification by including the interaction terms between the no-supporters indicator and each continent dummy, and the double interaction no-supporters, non-white and continent. While the main treatment effect remains positive and significant, none of the coefficients of the interactions with the continent indicators is significant, showing that, once the skin color is taken into account, the continent has no treatment effect on performance. In addition, the double interaction terms are not significant, demonstrating the absence of heterogeneous effects of the treatment by player continent. This evidence reinforces the theory that racist supporters target play-

[19] The pre-ban average score was 5.93 for non-white players and 6.01 for white players.

[20] The sample contains a small amount of players with more than one nationality, in this case I consider only the first nationality mentioned as is intended to be the one players refer to as “first". As shown in the online appendix table A1, 76% of players are European, 16% are from Latin America, 6.7% are Africans and 1.3% Asiatic.

Table 2: Effect of supporters on player performance - Robustness Checks

	OLS Estimation				
Dependent Variable: *Player performance score*					
	Sample Selection			Continent	Placebo
	(1)	(2)	(3)	(4)	(5)
No Supporters ×Non-white player	0.077* (0.046)	0.090* (0.049)	0.081* (0.047)	0.124** (0.062)	
No Supporters×Africa				0.062 (0.057)	
No Supporters×America				0.037 (0.047)	
No Supporters×Asia				0.200 (0.129)	
No Supporters×Africa×Non-white player				-0.116 (0.117)	
No Supporters×America×Non-white player				-0.096 (0.117)	
No Supporters - Placebo×Non-white player					-0.009 (0.053)
Controls	✓	✓	✓	✓	✓
Player FE	✓	✓	✓	✓	✓
Turn FE	✓	✓	✓	✓	✓
Observations	9642	7751	8332	8332	5435
Cluster SE - player	✓	✓	✓	✓	✓
Sample	All	> 10 Games	No GK	Main	No Covid

OLS estimation of the effect of no supporters on player performance by skin color of the players. No Supporters is a dummy taking value 1 for all games played in empty stadiums. Non-white player is a dummy taking value 1 for all players classified as non-white. The sample in column (1) includes all players, in column (2) only players playing at least 10 games per period and in column (3) all players but goalkeepers. In column (5) only games played from turn 1 to turn 24 are included. The reference category for Continent is Europe (category with the highest number of observations). All players from Asia are classified as white so the interaction term with non-white is omitted. No Supporters - Placebo is a dummy taking value 1 for all games played from turn 13 to turn 24. Controls include Home games dummy, Team goals, Team FE, and Turn FE in all the specifications. It also includes No supporters dummy in columns (1)-(4) and No Supporters - Placebo in column (5). Beta coefficients reported and standard errors clustered by player in parentheses. *** significant at 1%, ** significant at 5%, * significant at 10%.

ers because of their skin color, rather than their citizenship.

The last check deals with a placebo test to exclude that non-white players exhibit any difference in performance due to time rather than the closed stadium policy. I consider only games played from turn 1 to turn 24.[21] I create a placebo-ban variable taking value 1 only for games played after turn 13 and I replicate the main analysis. Column (5) displays the results. As expected the placebo-ban coefficient is null, providing supportive evidence that there was no differential trend between white and non-white players before the closed stadium policy.

[21] About half of the games in turns 25 and 26 were played without supporters, while all games form turn 27 on were played in closed stadiums.

4.4 HETEROGENEOUS EFFECTS

In this section, I investigate potential heterogeneous effects of the supporters on non-white players by characteristics of the game or the players. To this extent, I construct binary indicators for each characteristic and I replicate the main specification by including: (i) the indicator, (ii) the interaction term between indicator and the no-supporters dummy, (iii) the interaction term between indicator and the non-white dummy and (iv) the double interaction indicator, no-supporters, non-white. Table (3) displays the results.

To explore eventual heterogeneity of the effect with respect to the characteristics of the game, I consider indicators for home games and top teams. Previous research shows the existence of the home advantage and that it persists also when supporters are not in the stadium. Top teams is a dummy taking value 1 if the player plays in one of the top 6 teams.[22] As shown in columns (1-3), there is no statistically significant heterogeneous treatment with respect to game characteristics, signaling that non-white players suffer from supporters more than others independently of the difficulty of the game characteristics.

Finally, I investigate heterogeneous treatment effects by player role and player distribution. Results in columns (4) show that, in comparison with other players, strikers are not affected by the absence of supporters. Column (5) indicates that players in the third quartile of the pre-ban score distribution are significantly less affected than the one in the first quartile. In terms of magnitude, this completely offsets the baseline negative effect. While not significant, also coefficients for the second and fourth quartile are negative, signaling that the positive and statistically significant effect found in the main analysis is coming form the bottom quartile of of the player strength distribution.

5 CONCLUSION

In this paper, I investigate the effect of supporters in stadiums on the performance of soccer players by skin color, in the highest Italian soccer league, Serie A. I evaluate player performance using an objective score and classify players in white and non-white implementing an automated skin color recognition algorithm. Identification comes from an excep-

[22] Top 6 teams are decided following popularity, number of supporters and recent years performance. They are: Juventus, Milan, Inter, Napoli, Roma and Lazio.

Table 3: Heterogeneous effects of supporters on player performance

	OLS Estimation				
Dependent Variable: *Player performance score*					
	Game characteristics			Player's role	Player's strength
	(1)	(2)	(3)	(4)	(5)
No Supporters ×Non-white player	0.097*	0.113**	0.111*	0.157**	0.138**
	(0.055)	(0.049)	(0.059)	(0.064)	(0.060)
Home game×No Supporters×Non-white player	-0.014		0.004		
	(0.065)		(0.082)		
Top team×No Supporters×Non-white player		-0.079	-0.046		
		(0.116)	(0.131)		
Top team×Home game×No Supporters×Non-white player			-0.065		
			(0.115)		
Defender ×No Supporters×Non-white player				0.018	
				(0.092)	
Striker×No Supporters×Non-white player				-0.225**	
				(0.111)	
2nd Quartile×No Supporters×Non-white player					-0.071
					(0.086)
3rd Quartile×No Supporters×Non-white player					-0.198*
					(0.101)
4th Quartile×No Supporters×Non-white player					-0.060
					(0.127)
Controls	✓	✓	✓	✓	✓
Player FE	✓	✓	✓	✓	✓
Turn FE	✓	✓	✓	✓	✓
Observations	8952	8952	8952	8952	8944
Cluster SE - player	✓	✓	✓	✓	✓

OLS estimation of the effect of no supporters on players performance by skin color of the players. No Supporters is a dummy taking value 1 for all games played in empty stadiums. Non-white player is a dummy taking value 1 for all players classified as non-white. Top team is a dummy taking value 1 for all players playing for Juventus, Inter Milan, A.C. Milan, Napoli, Rome and Lazio. The reference category for role is midfielder (category with the highest number of observations) and for quartiles is the first quartile. All goalkeepers are classified as white so the interaction term with non-white is omitted. Controls include Home games dummy, Team goals, Team FE, and Turn FE in all the specifications. It also includes No supporters dummy and Home game × No supporters in columns (1) and (3), Top team × No supporters in columns (1) and (3), Home game × Top team in column (3), dummy for each role × No supporters in column (4), and dummy for each quartile × No supporters in column (5). Beta coefficients reported and standard errors clustered by player in parentheses. *** significant at 1%, ** significant at 5%, * significant at 10%.

tional change in access to stadiums: due to the COVID-19 restrictions, Serie A 2019/2020 season interrupted in March 2020 and restarted in June 2020 allowing access to stadium only to players, managers and staff. As a result, one third of the games were played without fans. I find a significant increase by 1.5% in the performance of non-white players, relative to white players, when fans are not in the stadium. Given the absence of factors other than racist chants and verbal abuse from supporters that could impact differently players by skin color, this result suggest that racial discrimination faced by non-white players affects their performance. This study provides the first evidence on the heterogeneous effects of supporters on performance by player skin color. It complements the literature on moral support and performance and provides insights on the effect of racist behavior on performance, contributing to the labor economics literature connecting racist episodes, wellbeing and individual behavior at work.

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Online Appendix

Descriptive statistics

Table A1: Descriptive Statistics

	Total	**By skin color**		
		White	**Non-white**	**Share**
	(1)	(2)	(3)	(4)
Players				
Number of Players	557	471	86	15.4%
By Continent of Origin (Passport)				
Africa	37	10	27	73.0%
America	89	72	17	19.1%
Europe	423	381	42	9.9%
Asia	8	8	0	0.0%
By Team				
Top 6 teams	172	142	30	17.4%
All other teams	389	333	56	14.4%
Observations - player X game				
Games with supporters	6,936	5,982	954	13.8%
Games without supporters	3,962	3,375	587	14.8%
Home Games	5,449	4,669	780	14.3%
Away Games	5,449	4,688	761	14.0%

This table reports the number of players in total, by continent of origin and by team and the number of observations in the sample for games played with supporters and with empty stadiums and for home and away games in column (1). Columns (2) and (3) reports the same statistics by the skin color of the Player and column (4) the share of non-white players or observations.