Hostile Work Environments and Task-Specific Productivity of Racial Minorities

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Abstract

Racial harassment is highly prevalent in the workplace. Extensive medical literature suggests that this type of harassment has considerable impacts on cognitive abilities and risk preferences of subjects. Yet, virtually no work has evaluated the impact of racial harassment on the task-specific productivity of racial minorities outside of controlled experiments. To evaluate this relationship we make use of a natural experiment that decreased racial harassment in football stadiums and a novel dataset with more than 40 different measures of task-specific productivity of football players. Our results show that in the absence of discrimination African players do not experience any increase in productivity measures associated with efficiency relative to other players. We also rule out any differences in the risk profile of plays between both groups. However, we observe significant increases in measures associated with in-game participation, implying that the overall increase in performance of African players in this context is linked to increases in participation. Put together, our results have broad implications for minorities on labor markets, suggesting that a decrease in racial hostilities in work environments can lead to gains in participation of racial minorities.

Keywords: Discrimination, Racial Minorities, Productivity, Pandemic

JEL Codes: J15, J24, Z22

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1 Introduction

Racial harassment is highly prevalent at the workplace, with 31 % of young black workers in the U.S. reporting having experienced discrimination at work in 2019 (Lloyd, 2021). Consequences of racial harassment for worker's health are well understood: racial trauma can result in symptoms similar to post-traumatic stress disorder and lead to mental health issues (Cheng and Mallinckrodt 2015, Sibrava et al. 2019). Deteriorated health conditions, in turn, can affect the labor market outcomes of workers (Oswald et al. 2015; Stephens and Toohey 2022). However, virtually nothing is known about how discrimination affects task-specific productivity - are workers less efficient when facing harassment? Are they less likely to take risks? This lack of evidence is concerning since racial discrimination is highly prevalent and productivity is the main driver for increasing standards of living (Goldin et al., 2024).

Professional football is the perfect setting to understand how discrimination affects productivity. In an environment in which fans attempt to intimidate and distract opponents through insults, it is easy to see how insults may quickly spill over into racial harassment and discriminatory behavior. As a matter of fact, racism is highly prevalent in European football, with officials of professional football leagues being criticized for inadequate response to racist incidents (Schulteis, 2024). Additionally, extensive data on measures of players' performance in each game can be used to obtain task-specific efficiency and participation, which is difficult to observe in other occupations. Yet, in this context, little is known about the impact of these discrimination incidents on players' task specific performances.

From the theoretical perspective, medical literature has provided ample support for the possibility that discrimination incidents influence task specific performance of workers. Studies have suggested that acute racial harassment episodes lead to an increase in cortisol levels (Paradies et al. 2015, Nam et al. 2022). Cortisol levels, in turn, are associ-

ated with a decrease in cognitive abilities (Shields et al. 2016, Henckens et al. 2012, Bendahan et al. 2017, Shields 2020), hence, it is possible, if not likely, that racial harassment influence cognitive performance of workers. Moreover, cortisol levels have also been associated with different preferences for risk taking (Porcelli and Delgado 2009, Reynolds et al. 2013, von Helversen and Rieskamp 2020, Buckert et al. 2014) allowing once again for the possibility that racial harassment affects workers behavior. Unfortunately, no study has yet evaluated the impact of racial harassment on both cognitive tasks and risk taking.

To fill this gap in the literature, we use a unique data set that includes detailed task-specific productivity measures and exploit the sudden absence of supporters in Italian stadiums caused by the COVID-19 pandemic. In early 2020, the main Italian football championship - also known as "Serie A" - was interrupted in an effort to prevent the spread of the virus. Months later, Italian authorities allowed the competition to be resumed if matches were played without fans in the stadiums. Since racist intimidation from supporters against minority players is frequent in European competitions, this natural experiment allows us to test the impact of discrimination on the task-specific productivity of frequently discriminated groups.

First, following Caselli et al. (2023) we show that the overall performance of African players significantly increases relative to the baseline mean when supporters are absent. Next, we present novel analysis in the context of this important result. Following the literature that suggests that acute racial harassment episodes lead to an increase in cortisol levels , and that cortisol levels are associated with a decrease in cognitive abilities we evaluate the impact of the absence of supporters on measures of players' efficiency and participation. We find no evidence that the absence of supporters improves the performance of African players compared to non-African players in more than six different measures of efficiency (% targets received, % passes completed, % successful take-on, % shots on target, % goals), suggesting no statistically detectable decrease in performance of tasks associated with cognitive abilities.

In contrast, we do find evidence that African players display significantly higher levels of participation during matches - when fans are absent, African players have significantly more passes targeted at them, receptions, touches, carries, and attempted passes in magnitudes that range from 0.1 to 0.18 standard deviations. This result is robust to different definitions of minority groups and to different falsification tests. Since we do not observe any gains in efficiency, we believe that this increase in participation is a direct consequence of the absence of fans in stadiums rather than a consequence of any changes in efficiency.[1]

Next, following the large theoretical literature that links stress to risk taking preferences (Porcelli and Delgado 2009, Reynolds et al. 2013, von Helversen and Rieskamp 2020, Buckert et al. 2014) , we analyze if African players attempt riskier plays when fans are absent. We find no evidence that African players are more willing to try riskier plays when compared to their non-African counterparts. Finally, we also examine if the affected task-specific productivity of African players translates into better performance of the team, but find no effects of supporter's absence on the probability that the team is winning, drawing, or losing.

These results suggest that the only significant gains of performance of African players in Italy during the 2019-2020 season were improvements in non-cognitive abilities, namely participation. While further research is needed to confirm the external validity of these findings, it is possible that under the presence of a hostile and discriminatory environments minority workers will have worse performance because they participate less, not because their cognitive abilities are affected. For example, during a business meeting, minority workers may offer input less frequently or during a presentation, they may choose to speak less.

[1]Carries are defined as number of times a player controls the ball with their feet. Touches are defined as number of times a player touches the ball. Note, receiving a ball, then dribbling, and then sending a pass counts as one touch. Take-on is defined as dribbling past a defending player. Unsuccessful take-ons include attempts where the dribbler retained possession of the ball but was not able to get past the defending player.

This paper contributes to three strains of literature. First, our study advances the body of work that studies the effects of racial discrimination on labor market outcomes (as surveyed by Lang and Kahn-Lang Spitzer 2020). Most studies analyze descriptively or structurally the earnings and labor supply disparities due to discrimination thereby omitting the important effects on productivity (Shields and Price 2002; Antecol and Cobb-Clark 2009; Deery et al. 2011; Aizer et al. 2020). An exception is the seminal work by Caselli et al. (2023) that use COVID-19 as a natural experiment and estimate the effect of discrimination on overall performance of football players in Italy. We contribute to this literature by replicating the original main results presented in that study and then analyzing the impact of racial harassment on various measures of efficiency, participation and risk taking. We caution the reader to not interpret our results as a simple mechanism of the aforementioned study as we believe that our analysis serves as a compliment to it.

Second, this paper complements the literature on productivity and the COVID-19 pandemic (e.g., Bloom et al. 2020; Etheridge et al. 2020; Künn et al. 2021; Morikawa 2021, 2022; Barrero et al. 2021). These studies find ambiguous effects - ranging from negative to positive - of the pandemic on worker and firm productivity. Potential explanations for the contrasting effects of the pandemic could be different countries, sectors, and empirical approaches. Using a uniform approach and analyzing different team members and the overall team performance simultaneously, we show that productivity depends on team-specific responsibilities. This result suggests that the implementation of public interventions such as social distancing, working from home, or exclusion of audience should take into account the differential effects on each individual in the same working environment.

Third, we add to a large strand of literature that uses sports data to document economic findings which otherwise would remain uncovered (e.g., Kahn and Sherer 1988; Chiappori et al. 2002; Bhaskar 2008 Apesteguia and Palacios-Huerta 2010; Parsons et al. 2011; Kleven et al. 2013; Lichter et al. 2017; Bar-Eli et al. 2020; Fischer et al. 2022;

Principe and van Ours 2022; Hoey et al. 2023). Professional sports are governed by many of the same microeconomic foundations as other labor markets, which makes sports an outstanding setting to study many empirical questions (Rosen and Sanderson, 2001). Therefore, the sports environment was used to address important economic questions for the first time (González-Díaz and Palacios-Huerta, 2016). Without using data on task-specific productivity of football players, we would not be able to analyze the relationship between racial discrimination and productivity of high-income workers because individual-level productivity in most high-wage jobs is rarely observed (Burke et al., 2023).

The remainder of the paper proceeds as follows. Section 2 provides information about the institutional setting and explains the relationship between discrimination and productivity. The dataset is described in section 3 and the empirical approach is presented in section 4. Section 5 discusses the results and section 6 concludes.

2 Background

2.1 Serie A and COVID-19

Serie A is the top-tier division in Italian football and it is considered one of the top 3 most competitive leagues in the world. The league is composed of 20 teams from different parts of the country that play each other twice in a season. Like many other European leagues, the season starts in August and has its final fixture played in May of the following year with matches played almost every weekend during this period.

The 2019-2020 Serie A season was originally scheduled to run from the 24th August 2019 to 24th May 2020. On 22 February 2020, however, Italian Prime Minister, Ciuseppe Conte suspended all three matches that were supposed to be played in the regions of Lombardy, Veneto, and Piedmont, due to the COVID-19 pandemic in the country. The following week, six matches were initially to be played behind closed doors due to scare of the outbreak, however, all were later outright suspended. On March 9th, the government ruled that all sporting events in Italy to be suspended until April 3rd. Serie A or-

ganizers, however, decided not to resume activities stating that the competition would only resume once "health conditions allow it". On May 28th, Italian Minister for Sport, Vincenzo Spadafora, announced that Serie A would resume starting June 20th under a strict protocol. This protocol required testing for COVID-19 of the entire squad during days before a match, the quarantining of individuals who test positive, as well as the prohibition of ticket sales for all subsequent matches.

2.2 Discrimination and Task Performance

To the beast of our knowledge, no study has evaluated the link between discrimination and performance at specific tasks. Nonetheless, current medical literature has analyzed mechanisms associated with this relationship, allowing us to conjecture about the impact of discriminatory events on task performance at work. The first of these mechanism is the connection between discrimination and cortisol. Cortisol is a corticosteroid hormone produced by the adrenal cortex and the body's main stress hormone. Studies have suggested that cortisol level is the mechanism behind the well-established relationship of discrimination and depression or anxiety (see Paradies et al. (2015) for a survey). More recently, Nam et al. (2022) has exposed the direct link between discriminatory events and stress, showing that even microaggressions can lead to spikes of cortisol levels. Crucially, the authors show that the timing of this response is almost immediate, with cortisol peaks being detected on the same day of racial abuse.

The effects of cortisol levels on both cognitive and non-cognitive task performance are well documented. In terms of cognitive outcomes, stress has been linked to impact all four areas of cognitive processes: executive functions, episodic memory, fear conditioning, and decision making (Shields et al., 2016). For example, stress impairs the ability to adapt one's thinking and behavior to new, changing, or unplanned events, also known as cognitive flexibility, (Shields et al., 2016). Stress also decreases interference control or the ability to ignore distracting or irrelevant information while focusing on a target (Henck-

ens et al., 2012). Finally, stress alters risk taking on a time dependent manner leading to less or more risk taking after the event (Bendahan et al., 2017).

The impacts of stress are not limited to cognitive outcomes. Research linking behavioral responses to stress has shown that stress reduces the creation of new communication ties between individuals (Kalish et al., 2015), speech fluency (Buchanan et al., 2014), and increases preferences for interpersonal distance (Long et al., 1980). Furthermore, studies evaluating impacts of stress in team dynamics suggest that members under acute stress search for and share less information, tend to neglect social and interpersonal cues, and fail to recognize situations that require interpersonal interaction (Dismukes et al. 2015, Cohen 1980).

3 Data

We obtain the task-specific performance measures and player-level characteristics (height, country of birth, weight, etc.) from Sports Reference data base (Forman et al., 2024). Our data set includes player-match level performance in four different categories - passing, possession, shooting, and defending - for all players in Serie A in all matches of the 2019-2020 season. For reference, table A.1 shows the mean and standard deviation of all task-specific measures available at the Sports Reference data base. The overall performance of players and weather conditions are obtained from Caselli et al. (2023).

To construct our final sample, we exclude goalkeepers as well as players listed on match day squads that have not played.[2] Then, we create our own measure of ethnic groups by

[2]Goalkeepers perform tasks of very different nature when compared to other field players. Moreover we do not have data for goalkeeping specific tasks.

by combining country of birth and presence on the national team.[3] Finally, we define matches without supporters as all matches taking place after March 4th of 2020, the date when Italian authorities determined that matches in the country would be played with closed doors.

Table 1 shows characteristics of players in the analysis sample. The majority of players is from Europe (72%), followed by players from Americas (18%), players from Africa (7%), and players from rest of the world (2%). In contrast to players from other continents, African players are more likely to play as midfielders and less likely to play as attackers or defenders. The number of years of experience is also different among players from different continents. European and American players are most experienced, followed by players from African and the rest of the world. Other observable characteristics such as pre-season weight and height as well as overall performance of players from different continents are very similar. The difference of the player's performance before and after the lockdown, however, is strikingly different between the racial and ethnic groups. Figure 1 shows the raw difference in overall performance before and after the lockdown. Only players from Africa show a positive and statistically significant increase in performance after the stadiums become silent.

4 Empirical Approach

We estimate the impact of discrimination on overall performance, efficiency-based measures (e.g., % targets received, % passes completed, % successful take-on, % shots on target, % goals), and attempt-based measures (e.g., passes targeted at, receptions,

[3]Africa: Algeria, Angola, Benin Burkina Faso, Cabo Verde, Cameroon, Congo DR, Côte d'Ivoire, Egypt, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Liberia, Mali, Mauritania, Morocco, Nigeria, São Tomé and Príncipe, Senegal, Sierra Leone, Tanzania, Togo, Tunisia, Uganda, Zimbabwe. Americas: Argentina, Brazil, Chile, Colombia, Costa Rica, Curaçao, Ecuador, Guadeloupe, Guiana, Jamaica, Mexico, Nicaragua, Paraguay, Peru, Uruguay, Venezuela. Europe: Albania, Austria, Belgium, Bosnia and Herzegovina, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Norway, Northern Ireland, Germany, Greece, Iceland, Ireland, Italy, Hungary, Kosovo, Lithuania, Luxembourg, Macedonia, Moldova, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, Wales, England, Scotland. Rest of the world: Armenia, Australia, Canada, China, Georgia, Indonesia, Iran, Israel, Japan, Korea, New Zealand, Syria, Türkiye, United States.

touches, carries, attempted passes) of players from Africa. In particular, we estimate the following model:

$$y_{itm} = \beta_0 + \beta_1 F_m + \beta_2 F_m \times D_i + \gamma_i + X'_{itm}\beta_4 + Z'_m\beta_5 + \varepsilon_{itm} \quad (1)$$

where y_{itm} is the outcome of interest of player i from team t during match m. D_i is an indicator that equals to one if the player i is from Africa and F_m is an indicator that equals to one if match m takes place in a stadium without fans. The model also contains player fixed effects (γ_i). The coefficient of interest is therefore β_2 and captures the effect of an empty stadium on outcome of player from Africa relative to a player from other continents. The vector X_{imt} contains player-specific variables such as team fixed effect as well as the number of minutes and the position (e.g. attack, midfield, defense) a player plays. We include the number of minutes and the position a player plays in a game as control variables to compare performance of players playing the same position and for the same amount of time since the position and time crucially affects how much a player can participate in a game.[4] To account for time-invariant and player-team-specific characteristics that are correlated with performance and mental resilience of player i we also include player-team fixed effects in some specifications. Z_m is vector containing match-specific variables such as weather conditions on matchday (minimum, maximum, and average temperature as well as humidity, wind, fog, rain, and snow), opponent team fixed effects, matchday fixed effects, and an indicator for a home game.[5] This vector controls for match-specific omitted variables that are correlated with players' outcomes and perceived discrimination. This empirical model therefore exploits within-player changes in the outcomes of interest, net of any unobserved player-team-specific characteristics.

[4] Minutes played and position of a player can, however, respond to an empty stadium. To test whether these control variables are endogenous, we estimate the effect of an empty stadium on minutes played and position of a player using the baseline model and find no effects (see columns (2)-(5) in table A.2).

[5] In some models instead of matchday fixed effects we include team-matchday fixed effects to account for omitted team-matchday-specific characteristics that might affect players' outcomes of interest and discrimination.

The standard errors are clustered at the team-matchday level. We test, however, alternative clustering choices and show the results in section 5.7.

The causal estimate of the reduced discrimination on outcomes of players relies on two main identifying assumptions. First, we assume that changes in player's productivity have not affected the government to allow football games only without spectators. Given that this decision was solely based on the the spread of the coronavirus we feel confident that this assumption is satisfied. The second assumption requires that the players from Africa have similar trends in outcomes of interest to players from other continents absent the COVID-19 pandemic. To test the parallel trend assumption and analyze the pre-pandemic trends, we estimate equation 1 using an event study framework. Figure 2 shows the event study estimates of the effect of empty stadium on overall performance of African players. Before the lockdown the difference in the overall performance between African and non-African players is quite similar in magnitude and in most matchweeks not statistically different. After the lockdown the overall performance of players from Africa increases with the biggest impacts five matchweeks after the onset of the pandemic, suggesting that African players need some time to adapt to the new environment.

5 Results

5.1 Overall Performance

To evaluate the effect of an empty stadium on productivity of players, we begin by estimating the model shown in equation 1 using different sets of control variables. This exercise is similar to the main analysis performed in Caselli et al. (2023), however our sample differs slightly in the definition of origin country. Column 1 in Table 2 shows results using a baseline model that only controls for minutes played, column 2 shows results using an empirical model that adds player controls, and column 3 shows results using a model that adds match controls. The coefficient of interest stays remarkably stable across different specifications in terms of magnitude and statistical significance. Relative to the baseline

mean, model with player and match controls shows that supporter's absence improve the overall performance of African players by 2.6%, statistically significant at 5% level.

Given the descriptive evidence shown in Figure 1, we also formally analyze how players from other continents respond to missing crowds in the stadiums. Table 3 shows results from the specification in Equation 1 for different racial and ethnic groups. We estimate a baseline model (Column 1), a model that adds player controls (Column 2), and a model that adds player and match controls (column 3). None of the estimates for players from Europe, America, and rest of the world are statistically significant at conventional levels suggesting that racial discrimination could be a potential channel for the improved performance since in contrast to other racial groups, players with African decent face racism more common in the Italian football league (Romani and Poli, 2019). [6]

5.2 Efficiency vs. Attempt-Based Measures

Before analyzing the impact of fan absence on player task specific performance it is important to discuss the interpretation of this analysis in the face of the overall performance results. The goal of our analysis is to understand the impact of fan absence on task specific performance of African players, not necessarily to "uncover the mechanisms" of the increase in overall performance. While these two analysis may be related, the latter depends on a series of variables weighted by an algorithm from which very little is known about. It is not our goal to cast light on how this algorithm is constructed. It is possible that increases in the performance of certain tasks do no translate into increases in overall performance. Hence, any increase in task-specific performance, although correlated, cannot be interpreted as a direct driver of increases in overall performance.

We analyze various measures of task-specific performance, which are grouped into

[6] We also perform several analysis of different hypotheses such as psychological pressure or referee bias that could explain the improvement of performance of African players in contrast to other nationalities. We are able to replicate the original results by Caselli et al. (2023) that these mechanisms do not explain the main differences in performance between African players and non African players (see table A.3 and A.4.

two categories: attempt-based measures and efficiency-based measures. These measures capture most actions a player can carry out during the game. We hypothesize that efficiency-based measures tend to be more highly associated with cognitive measures. Consider, for example, % targets received or % total passes completed; these are measures usually directly associated with visual processing and processing speed of players. An improvement in cognitive abilities derived from an increase in these two cognitive dimensions will likely generate an increase in the share of total passes completed and the share of receptions. Alternatively, attempt-based measures may be affected despite no changes in cognitive skills. For example, imagine that a players feels more self-confident and participates more when in possession of the ball by showing up to receive the ball more frequently. Even if there are no changes in cognitive abilities, this could lead to a higher total number of passes targeted at and a higher number of total passes attempted by African players.[7] Hence, we think that these measures are less directly associated with cognitive abilities.

To emphasize the difference between efficiency- and attempt-based measures, figure 3 shows the effect of empty stadiums on standardized efficiency-based measures and their attempt-based counterparts (when a counterpart is available). We also present point estimates for this analysis in tables 4 and 5. Interestingly, while efficiency-based measures are not affected, most attempt-based measures are positively affected when fans are absent.[8] Point estimates for the effects of lockdown on efficiency-based measures of African Players - % targets received, % total passes completed, % successful take-on, % shots on target, % goals - are close to zero and not statistically significant at conventional levels, suggesting that players are not being more efficient in the performance of tasks.

[7] The absence of supporters also leads to an increase in number of passes completed by African players (see figure A.1).

[8] See figure A.1 for the full analysis of all available measures of players' performance. We show the task-specific indexes based on four groups: possession, passing, goal and shot creation, and defense.

It is important to remind the reader that failing to reject the null hypothesis does not necessarily imply a that the true impact of fan absence on outcomes for African players is zero. Hence, we cannot claim that there are no impacts on efficiency-based outcomes. However, two variables help us argue that if these effects exist they are most likely of very small magnitude. First, % of targets received is a variable of particular interest because given its high frequency, precision is likely high. For this variable, we see a negative point estimate with, as expected, tight confidence intervals. These confidence intervals rule out effects larger than 0.1 standard deviations. Next, we also pay particular close attention to % of shots on target. The main advantage of this variable is that shots on target is independent of any teammate or opposition action. That is, hitting a target with a shot depend almost exclusively on the player. While here confidence intervals are slightly wider, we can rule out statistically significant effects larger than 0.12 standard deviations, leading us to conclude, once again that if an effect exists on efficiency-based measures, it is likely of very small magnitude.

In contrast, many attempt-based measures of African players see an increase of around 0.15 S.D. as a result of supporter's absence in the stadiums - passes targeted at, passes received, touches, total carries, total passes - all display a significant increase of similar magnitude (see table 4). While these measures tend to be correlated, for example, a player that has more passes received will also attempt more passes, this is not always the case. As a matter of fact, African players are targeted more often and convert these targets into more receptions, carries and pass attempts but do not attempt more shots or take-ons. This increase is consistent with a mechanism in which African players are participating more in the offensive phase of the game and do so in a way that displays higher levels of teamwork since shots and take-ons do not involve interaction with a teammate while passes do.

There are two competing theories for the drivers of this increase. First, African players may feel more confident or have their non-cognitive abilities affected in a way that they

put themselves in a position to be targeted at more often. Second, teammates may be targeting them more often because African players are playing more efficiently. A priori, both of these theories are equally likely to explain the increase in passes target at African players under the absence of fans. Given the conclusion that the effects on efficiency-based measures are economically non-significant, we believe the increase in passes targeted at is driven mainly by African players themselves. However, we cannot rule out small residual effects on passes targeted at arising from players passing the ball more often to African players. Altogether, regardless of drivers, our main analysis suggests that other than overall performance, volume (attempts) rather than efficiency of play is the dimension through which supporter's absence affects task performance.

5.3 Risk Preferences

Given the vast medical evidence linking cortisol levels to risk preferences we analyze whether African players attempt riskier plays when fans are absent. It is important to acknowledge that a limitation of this analysis is that it is possible that our natural experiment could be affecting risk in many dimensions (i.e., risk aversion and payoffs) at the same time. Hence results here must be interpreted with caution.

We choose various attempt-based measures (carries, take-ons, shots, tackles, and passes) that differ in terms of risk. For comparability purposes, each measure is divided by number of touches a player accomplishes per game . We derive the risk of each attempt-based measure by using the variance of the efficiency-based counterpart. We assume that the success of an attempt-based measure follows a Bernoulli distribution, hence the variance is given by $p * (1 - p)$ where p is the average efficiency-based counterpart. We then divide our outcomes into higher-risk (high variance) outcomes and lower-risk (low variance) outcomes.

This definition of risk being based on variance leads to an initial counter-intuitive classification of some variables. For example, shots-on target are classified as a lower-risk

outcome despite a very low probability of success. The reason for this counter-intuitive classification is that our definition of risk is derived from variance, not necessarily the success rate and low probability outcomes will have a low variance. This definition can be justified in practice since fans tend to have lower expectations about the performance of a task when an outcome has a lower probability of success. Given the previous example, this would mean that shots are lower risk because fans already expect to see players fail on that task anyway, hence trying a shot is a "safe" play.

Table 6 shows the results of this analysis by ranking the attempt-based measures from low to high risk. All estimates are close to zero and not statistically significant at conventional levels suggesting that African players are not attempting riskier plays. This result is consistent with ambiguous evidence in experimental literature on stress and risk taking. While studies document a change of risk taking under stress (Buckert et al., 2014), some studies report no relationship between stress and risk taking (Lempert et al., 2012). In addition, existing work also shows that the direction of the effect of stress on risk taking depends on risk of the decision and psychological components such as affective valence, cortisol reactivity, and social anxiety (Porcelli and Delgado 2009, Reynolds et al. 2013, von Helversen and Rieskamp 2020).

5.4 High-impact Sample

In order to further understand if the impacts are indeed driven by discrimination we analyze the performance of players in a context in which we believe that African players are impacted the most. [9]To perform this analysis we identify the regions with the highest number of racism incidents in professional soccer stadiums according to the Italian Soccer Player Association (*Associazione Italiana Calciatori, A.I.C.*). AIC has spend considerable resources documenting racial discrimination in stadiums in Italy. At the end of each season AIC publishes a report with statistics and insights about racism cases in Italy.

[9] A high impact sample has also been conducted by Caselli et al. (2023). Authors conclude that discrimination is the main driver of increase in player performance.

We use this report to construct a measure for the most discriminatory regions in Serie A. Making use of this measure, we then construct an indicator variable for playing a game away in those regions. We then make use of a triple interaction between our measure of discriminatory regions, African player and no-fans in the stadium to estimate the impact on our high-impact sample.

Results for this analysis are shown in figure 4. Looking at the the results for attempt-based measures in panel (a), we see a pattern similar to our main results. African players are targeted more, receive more passes and have more touches. This suggests that African players, playing in high-discriminatory stadiums, when fans are absent are more likely to participate in the game compared to African players post-pandemic in low-discriminatory stadiums. Nonetheless, due to large standard errors it is not possible to rule out that these point estimates are different than zero. Estimates for the efficiency-based measures are in panel (b) of figure 4. We see that most coefficients for efficiency-based measures have statistically non-significant point estimates that are close to zero in magnitude. The percentage of total passes completed is the only variable that displays a point estimate with a considerable magnitude. Nonetheless, given that all other measures of efficiency display non-statistically significant point estimates that are close to zero in magnitude, we conclude that there is no evidence of increase in efficiency of African players in highly discriminatory stadiums when fans are absent.

5.5 Endurance-Based Measures

To understand if a change in the style of play after the lockdown due to a potential COVID-19 infection could also be a reason for unaffected efficiency, we analyze the physical ability of African players. If players suffer from a COVID-19 infection and in turn have a lower physical endurance, the efficiency of the task-specific performance could deteriorate. Hence, we test if various endurance-based measures such as carrying distance and tackles of African players are affected during the lockdown. For comparability we focus

on total carrying distance divided by total carries, progressive carrying distance divided by progressive carries, fraction of successful tackles, and fraction of successful dribbler tackles. Shown in table 7 none of the effects on endurance-based outcomes are statistically significant at conventional levels suggesting that physical condition is not driving the efficiency of African players.

5.6 Success of the Team

We complement our analysis by analyzing if changes in performance of African players affect team performance. Using our empirical model, we estimate the effect of fan absence in stadiums on the probability of a team of African players win, lose, or draw (see table 8). We find that the absence of the supporters does not significantly affects the probability of a team winning, losing, or drawing . This result is also supported by one of the most important metrics of team's success - goals scored. The non-significant effect on number of goals African players are scoring after the onset of the pandemic shown in figure A.1 is in line with the team's success not being affected.

5.7 Robustness

We evaluate the robustness of our results using falsification and sensitivity tests. First, as a falsification analysis, we limit our sample to games played before the lockdown when supporters were still present in the stadiums and define treatment if the game was played during matchweek 13 and 26.[10] If the absence of the supporters in stadiums is truly the driving force for the improved performance of African players we should not expect to see any statistically significant effects during match weeks before the lockdown. As expected we find no statistically significant relationship between placebo treatment and performance of African players using empirical models with different placebo cutoffs (see figure A.2 and table A.5). Second, we use season 2018-2019 as a placebo sample since attendance to matches never faced any restriction during that season. Similarly to the

[10]This is the the halfway point of the match weeks prior to the lockdown.

previous analysis, if our main analysis can be interpreted as causal, we should not expect to see effects on performance of African players. Figures 5 and 6 show the results of this placebo test where the treatment is assigned using different match weeks. We find no effects of the placebo treatment during the 2018-2019 season supporting the main effects of empty stadiums on performance of African players.[11] Both of these results increase our confidence in the causal interpretation of our results.

We also analyze if the effects are different using alternative definitions of race such as Sub-Saharan nationality, African origin as identified by having parents from Africa, and skin color.[12] It is possible that while we use African as the definition of minority group for the study, considerable heterogeneities exist within this group. For example, we may observe stronger impacts for players from Sub-Saharan Africa and no impacts for other African players. We present results for different definitions of racial minorities in figure 7 and 8 for task-specific outcomes and in table A.7 for overall performance. The results are in line with estimates for all African players, but smaller for players whose origin might be less salient or who might be better prepared to overcome racial harassment (skin color, African origin). In contrast to players arriving directly from Africa, black players and players of African origin born in Europe are more likely to adapt to racial abuse and perform better under discrimination. Therefore we expect to see smaller effects when the games take place without supporters for black players and players with African parents.

Finally, shown in table A.8, we also perform additional robustness checks such as clustering the standard errors are at the individual level, restricting the sample to players that played at least 20 minutes in each game or at least 30 games per season, and add controls for baseline athleticism - indicator for a runner (player runs above median dis-

[11] The corresponding effects of empty stadiums on overall performance can be seen in Table A.6.

[12] We observe players from the following Sub-Saharan countries in our sample: Angola, Benin, Burkina Faso, Cameroon, D.R. Congo, Côte d'Ivoire, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Mali, Mauritania, Nigeria, Senegal. Players from these countries represent 5% of all players and 70% of African players. Roughly 16% of the players are black and 9% of the players have parents from Africa. African origin and skin color definition according to the Fitzpatrick scale are obtained from Caselli et al. (2023)

tance), young player (age less than the median age), tall player (height above the median height), frequency of substitutions (above median of substitutions), as well as number of days since the last match throughout the season. All these corroborate the conclusion that the effect of absence of fans in the stadiums on performance of African players is truly causal.

6 Conclusion

This paper analyzes the effects of discrimination on the productivity of racial minorities in professional football. The effects are identified using a unique data set that contains several task-specific productivity measures and a natural experiment during the COVID-19 pandemic that resulted in ghost stadiums. The absence of supporters in the stadiums proxies the elimination of racial harassment during the games.

We analyze various task-specific productivity statistics and find that only measures of participation and not efficiency increase as a result of the COVID-19 lockdown. The results show that only players from Africa improve their performance when the fans are absent from the stadiums. In the absence of supporters, African players had more passes targeted at, more receptions, and more touches compared to their non-African counterparts while not having statistically higher rates of completion of passes, take-ons, or shots. These results suggest that the channel through which hostile environments affect minorities is of non-cognitive nature, in particular, participation in the game. While these results are obtained in the context of a competitive professional sport, we believe that they can have implications for labor markets more broadly: discriminated groups could participating less in group tasks when these take place in environments that are hostile to minorities.

While we think that our results present novel and interesting findings to the literature, we also feel that it is crucial to highlight the limitations of our study. Football is a highly competitive team sport with an environment and dynamics that are unique and different

from the average work environment in the economy. Despite our belief that our findings have implications for workers elsewhere, we believe more research is needed to confirm these findings in other environments. Next, while our main results suggest that African players are participating more due to a change in their own behavior, it is also possible that a small part of this increase in participation also comes from teammate actions. Finally, while we do not find any impacts on the risk profile of the choice of plays, we acknowledge that our natural experiment could be affecting risk in many dimensions (i.e., risk aversion and payoffs) at the same time. Study designs that tackle these limitations are avenues for future research.

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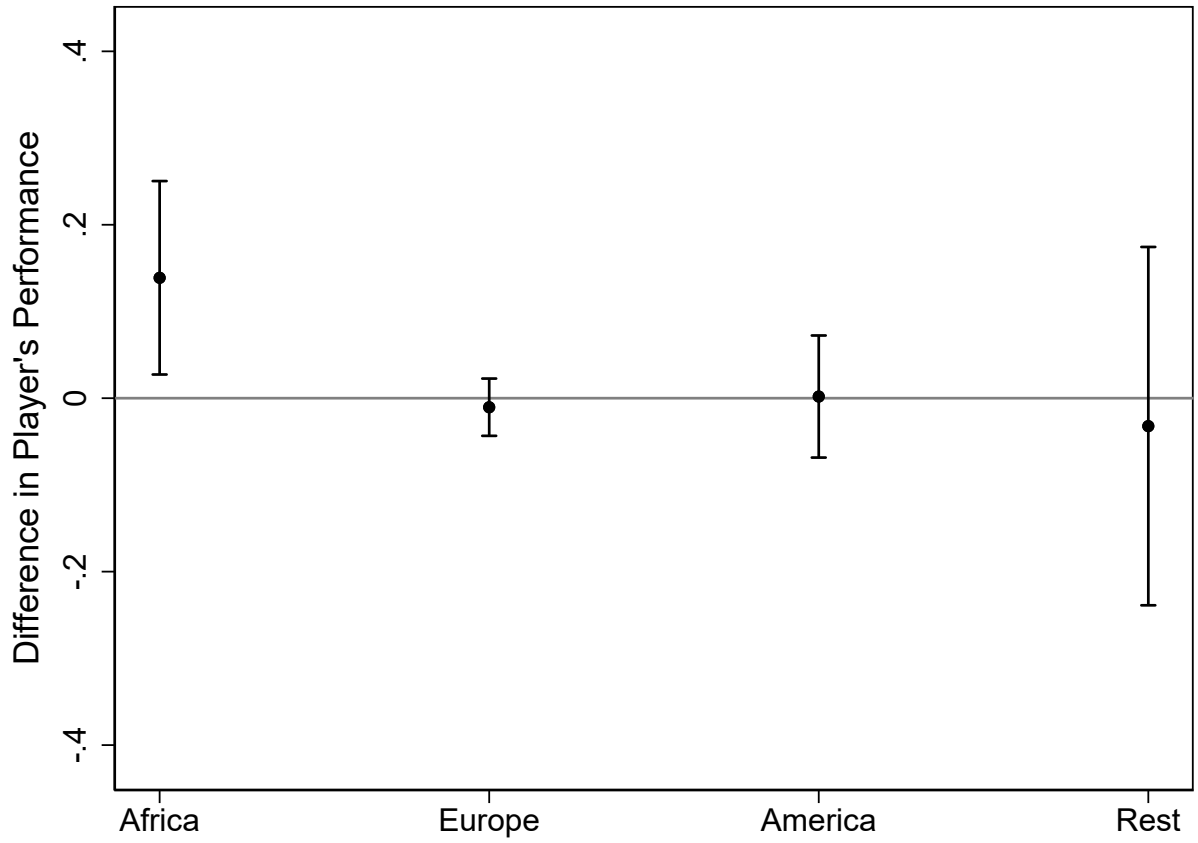
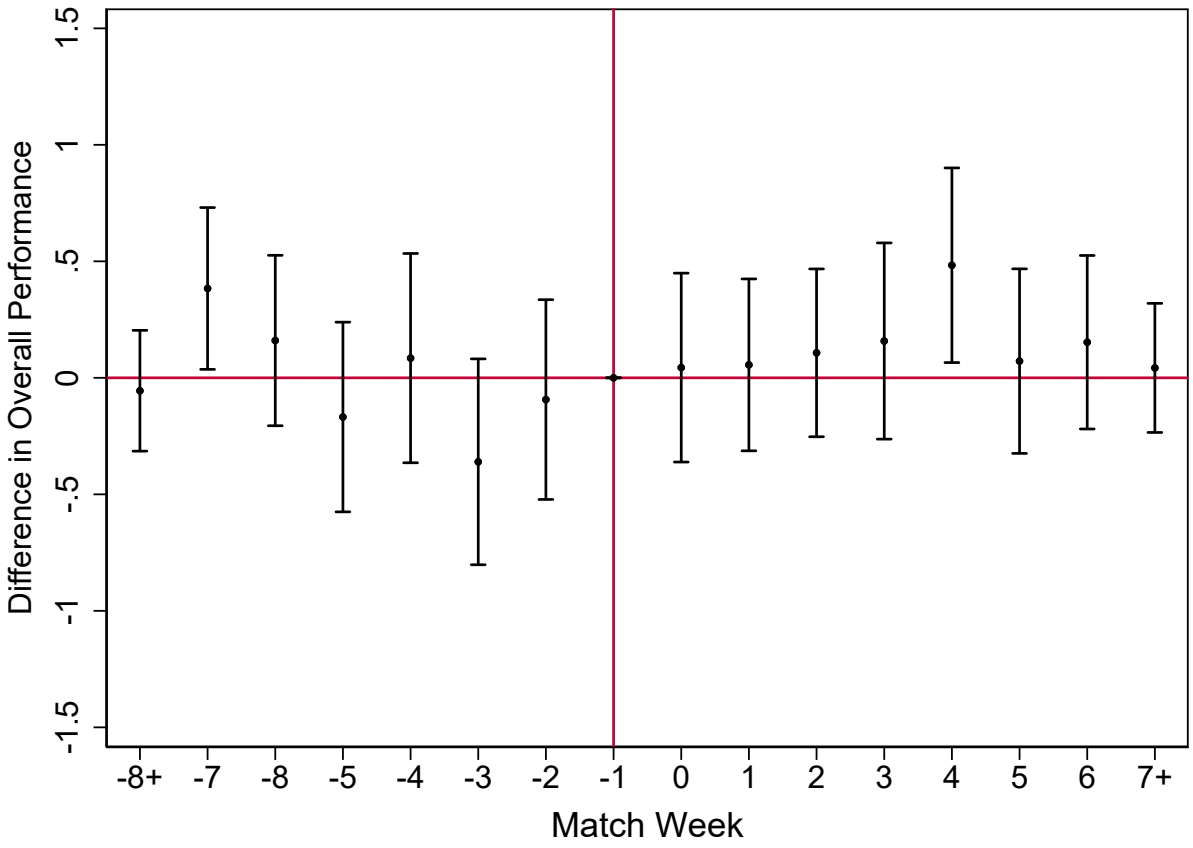
Figures and Tables

Figure 1:
Difference in Player's Performance before and after Lockdown



Notes: This figure shows coefficients and 95% confidence intervals from regressions estimating the effect of an empty stadium on player's overall score by continent of origin. The data is from Sports Reference data base. The sample is restricted to the 2019-2020 season.

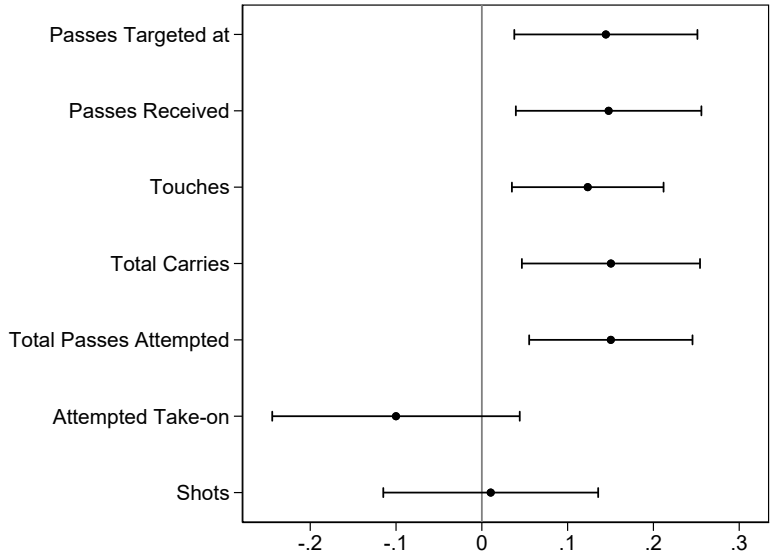
Figure 2:
Effect of Empty Stadium on Player's Overall Score



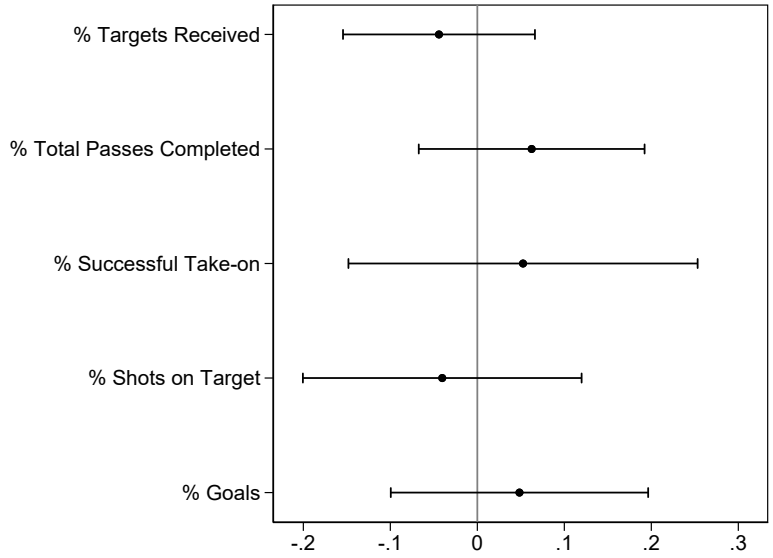
Notes: This figure shows the coefficients and 95% confidence intervals event study estimating the effect of an empty stadium on overall score of players. The regression includes player controls (minutes played, position of player, individual and team fixed effects) and match controls (opponent and matchweek fixed effects, an indicator for a home game, and weather conditions). Standard errors are clustered at the team-by-matchweek level. The data is from Sports Reference data base. The sample is restricted to the 2019-2020 season.

Figure 3:
Effect of Empty Stadium on Player's Standardized Attempt- and Efficiency-Based Measures

(a) Attempt-Based Measures

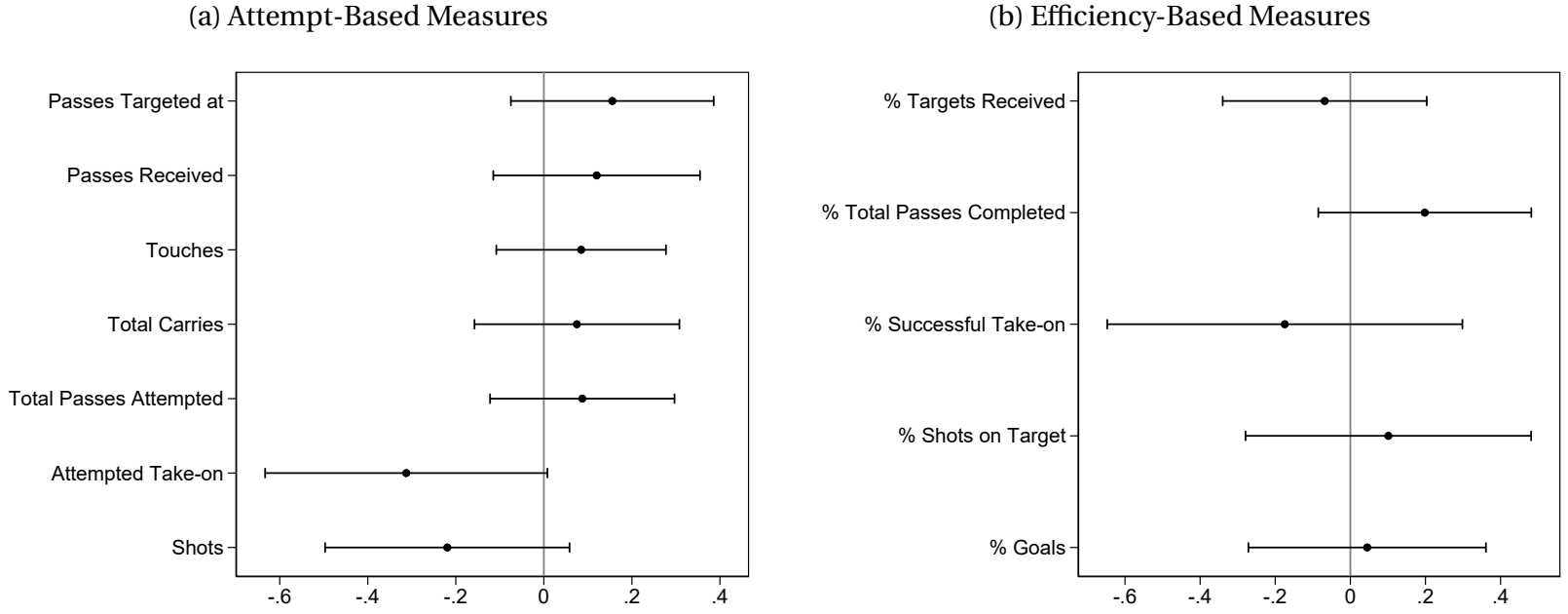


(b) Efficiency-Based Measures



Notes: This figure shows point estimates and 95% confidence intervals from regressions estimating the effect of an empty stadium on standardized attempt- and efficiency-based Measures. All regressions include player controls (minutes played, position of player, individual and team fixed effects) and match controls (opponent and matchweek fixed effects, an indicator for a home game, and weather conditions). Standard errors are clustered at the team-by-matchweek level. The data is from Sports Reference data base. The sample is restricted to the 2019-2020 season.

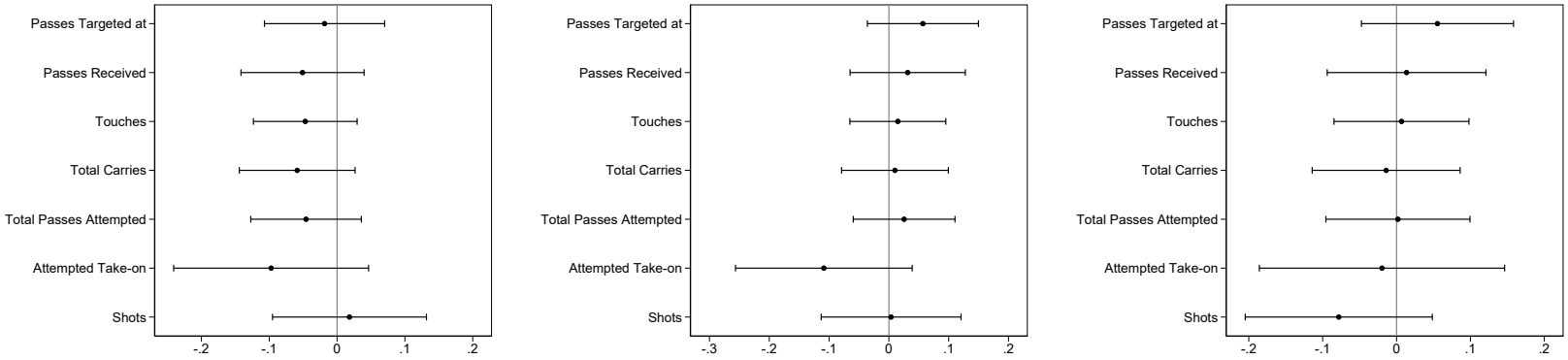
Figure 4:
Effect of Empty Stadium on Player's Standardized Attempt- and Efficiency-Based Measures
Robustness - Previous Racial Abuse



Notes: This figure shows point estimates and 95% confidence intervals from regressions estimating the effect of an empty stadium on standardized attempt- and efficiency-based Measures. All regressions include player controls (minutes played, position of player, individual and team fixed effects) and match controls (opponent and matchweek fixed effects, an indicator for a home game, and weather conditions). Standard errors are clustered at the team-by-matchweek level. The data is from Sports Reference data base. The sample is restricted to the 2019-2020 season.

Figure 5:
Effect of Empty Stadium on Player's Standardized Attempt-Based Measures
Robustness - Season 2018-2019

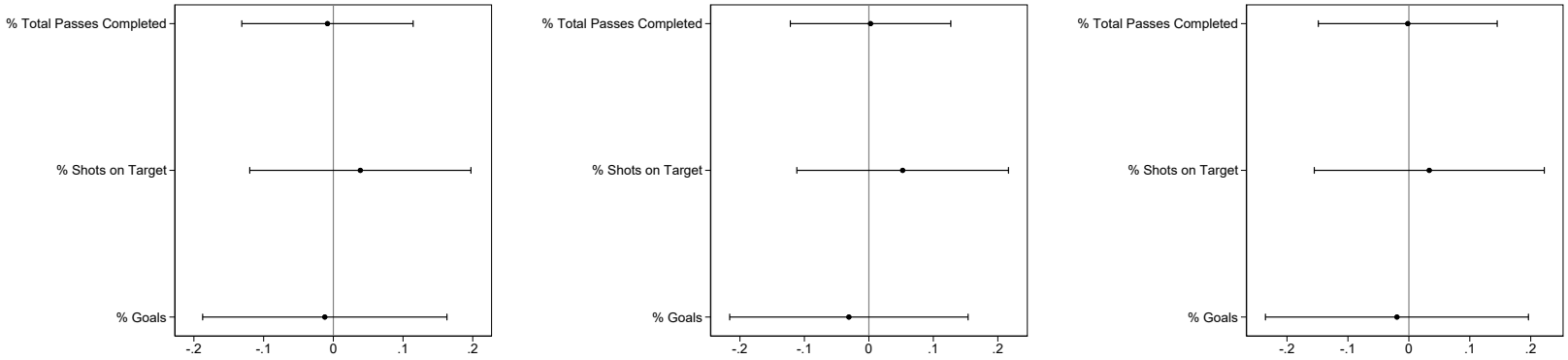
(a) Week 20-38 (b) Week 25-38 (c) Week 30-38



Notes: This figure shows point estimates and 95% confidence intervals from regressions estimating the effect of an empty stadium on standardized attempt-based measures. All regressions include player controls (minutes played, position of player, individual and team fixed effects) and match controls (opponent and matchweek fixed effects, an indicator for a home game, and weather conditions). Standard errors are clustered at the team-by-matchweek level. The data is from Sports Reference data base. The sample is restricted to the 2018-2019 season.

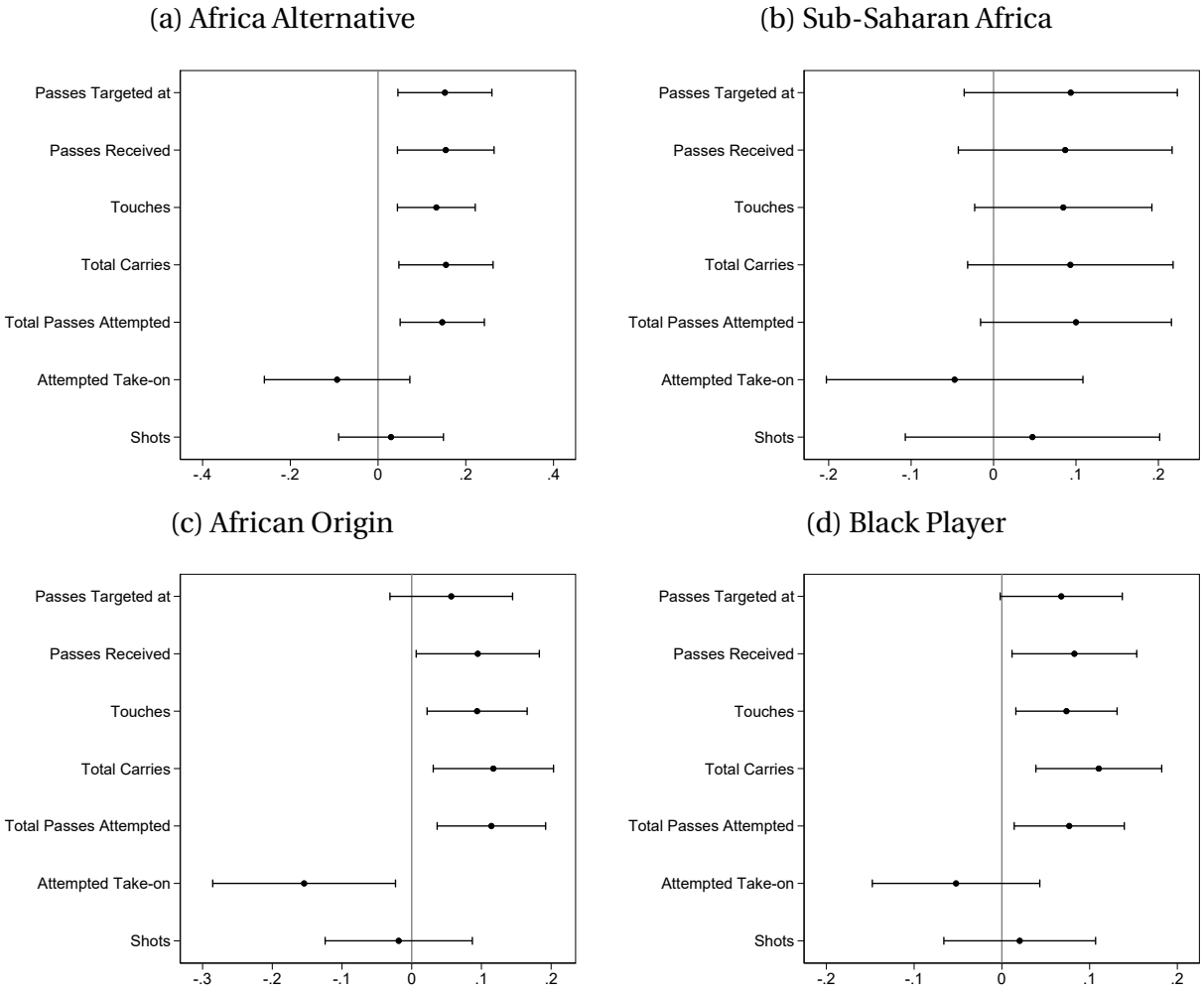
Figure 6:
Effect of Empty Stadium on Player's Standardized Efficiency-Based Measures
Robustness - Season 2018-2019

(a) Week 20-38 (b) Week 25-38 (c) Week 30-38



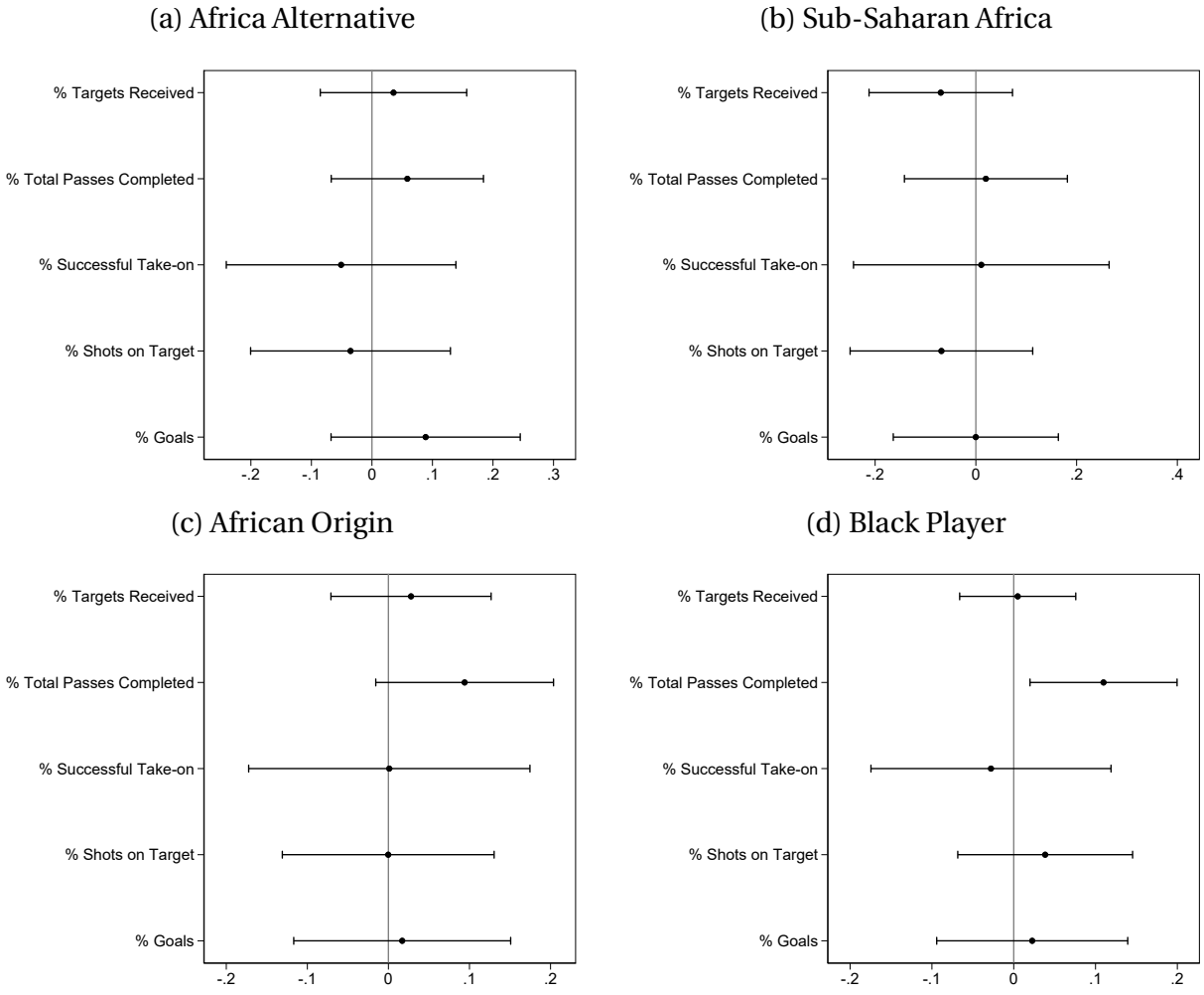
Notes: This figure shows point estimates and 95% confidence intervals from regressions estimating the effect of an empty stadium on standardized efficiency-based measures. All regressions include player controls (minutes played, position of player, individual and team fixed effects) and match controls (opponent and matchweek fixed effects, an indicator for a home game, and weather conditions). Standard errors are clustered at the team-by-matchweek level. The data is from Sports Reference data base. The sample is restricted to the 2018-2019 season.

Figure 7:
Effect of Empty Stadium on Player's Standardized Attempt-Based Measures
Robustness - Alternative Race Definition



Notes: This figure shows point estimates and 95% confidence intervals from regressions estimating the effect of an empty stadium on standardized attempt-based measures using alternative definition of race. Africa Alternative is the definition of race used in Caselli et al. (2023). Sub-Saharan Africa, African Origin, Black player identifies players from Sub-Saharan Africa, African origin, and black players, respectively. All regressions include player controls (minutes played, position of player, individual and team fixed effects) and match controls (opponent and matchweek fixed effects, an indicator for a home game, and weather conditions). Standard errors are clustered at the team-by-matchweek level. The data is from Sports Reference data base. The sample is restricted to the 2019-2020 season.

Figure 8:
Effect of Empty Stadium on Player's Standardized Efficiency-Based Measures
Robustness - Alternative Race Definition



Notes: This figure shows point estimates and 95% confidence intervals from regressions estimating the effect of an empty stadium on standardized efficiency-based measures using alternative definition of race. Africa Alternative is the definition of race used in Caselli et al. (2023). Sub-Saharan Africa, African Origin, Black player identifies players from Sub-Saharan Africa, African origin, and black players, respectively. All regressions include player controls (minutes played, position of player, individual and team fixed effects) and match controls (opponent and matchweek fixed effects, an indicator for a home game, and weather conditions). Standard errors are clustered at the team-by-matchweek level. The data is from Sports Reference data base. The sample is restricted to the 2019-2020 season.

Table 1:
Characteristics of Players

	Africa	Europe	America	Rest
Share of Players	0.06	0.73	0.18	0.02
	(0.25)	(0.44)	(0.38)	(0.13)
Performance of Players	5.90	5.95	5.98	5.88
	(0.67)	(0.66)	(0.67)	(0.63)
Experience of Players	3.11	3.50	3.48	1.75
	(1.45)	(1.58)	(1.59)	(0.88)
Position of Players: Attack	0.20	0.25	0.25	0.14
	(0.40)	(0.43)	(0.43)	(0.35)
Position of Players: Midfield	0.45	0.34	0.33	0.36
	(0.50)	(0.47)	(0.47)	(0.48)
Position of Players: Defense	0.32	0.39	0.39	0.45
	(0.47)	(0.49)	(0.49)	(0.50)
Position of Players: Other	0.02	0.03	0.04	0.04
	(0.15)	(0.18)	(0.18)	(0.21)
Weight of Players	75.05	75.98	75.67	77.12
	(5.49)	(6.32)	(5.76)	(5.65)
Height of Players	182.39	183.01	181.47	183.72
	(5.78)	(5.67)	(6.10)	(5.09)
Number of Players		428		

Notes: The table shows summary statistics of players from different continents of origin. Standard deviations are shown in parenthesis. The data is from Opta and Sports Reference data base. The sample is restricted to the 2019-2020 season.

Table 2:
Effect of Empty Stadium on Player's Overall Performance

	(1)	(2)	(3)
Africa	-0.119		
	(0.039)		
No Fans	-0.005	-0.002	0.003
	(0.029)	(0.027)	(0.123)
Africa x No Fans	0.160***	0.159**	0.151**
	(0.060)	(0.063)	(0.062)
Player Controls	NO	YES	YES
Match Controls	NO	NO	YES
Mean Y - Baseline	5.952	5.952	5.952
Adjusted R^2	0.005	0.101	0.119
Observations	8,859	8,854	8,854

Notes: This table shows results from regressions estimating the effect of an empty stadium on player's overall performance. Africa is a dummy equal to one if the player is from Africa. No Fans is a dummy equal to one if the game was played without fans. Africa x No Fans is the interaction between Africa and No Fans. All models control for number of minutes played. Player controls include position of player, as well as individual and team fixed effects. Match controls include opponent and matchweek fixed effects as well as an indicator for a home game and weather conditions. Standard errors in parentheses are clustered at the team-by-matchweek level. The data is from Opta data base. The sample is restricted to the 2019-2020 season.

Table 3:
Effect of Empty Stadium on Player's Overall Performance

	(1)	(2)	(3)
	Treatment: Player from Africa		
Africa x No Fans	0.160***	0.159**	0.151**
	(0.060)	(0.063)	(0.062)
Mean Y - Baseline	5.952	5.952	5.952
Adjusted R^2	0.005	0.101	0.119
Observations	8,859	8,854	8,854
	Treatment: Player from Europe		
Europe x No Fans	-0.013	-0.002	0.000
	(0.033)	(0.034)	(0.034)
Mean Y - Baseline	5.952	5.952	5.952
Adjusted R^2	0.004	0.100	0.118
Observations	8,859	8,854	8,854
	Treatment: Player from Central/South America		
America x No Fans	0.001	-0.041	-0.039
	(0.040)	(0.041)	(0.041)
Mean Y - Baseline	5.952	5.952	5.952
Adjusted R^2	0.004	0.100	0.118
Observations	8,859	8,854	8,854
	Treatment: Player from Rest of the World		
Rest x No Fans	-0.044	-0.107	-0.109
	(0.107)	(0.122)	(0.115)
Mean Y - Baseline	5.952	5.952	5.952
Adjusted R^2	0.004	0.100	0.118
Observations	8,859	8,854	8,854
Player Controls	NO	YES	YES
Match Controls	NO	NO	YES

Notes: This table shows results from regressions estimating the effect of an empty stadium on player's overall performance. Africa x No Fans is the interaction between a dummy equal to one if the player is from Africa and an indicator for an empty stadium. Europe x No Fans is the interaction between a dummy equal to one if the player is from Europe and an indicator for an empty stadium. America x No Fans is the interaction between a dummy equal to one if the player is from Central/South America and an indicator for an empty stadium. Rest x No Fans is the interaction between a dummy equal to one if the player is from rest of the world and an indicator for an empty stadium. All models control for number of minutes played. Player controls include position of player, as well as individual and team fixed effects. Match controls include opponent and matchweek fixed effects as well as an indicator for a home game and weather conditions. Standard errors in parentheses are clustered at the team-by-matchweek level. The data is from Opta data base. The sample is restricted to the 2019-2020 season.

Table 4:
Effect of Empty Stadium on Player's Player's Attempt-Based Measures

	(1)	(2)	(3)
	Passes Targeted at		
Africa	-0.097		
	(0.041)		
No Fans	0.014	0.028	0.015
	(0.032)	(0.025)	(0.106)
Africa x No Fans	0.175***	0.147***	0.149***
	(0.061)	(0.056)	(0.054)
Adjusted R^2	0.510	0.665	0.699
Observations	9,497	9,493	9,493
	Passes Received		
Africa	-0.055**		
	(0.041)		
No Fans	0.071**	0.082***	0.029
	(0.034)	(0.026)	(0.107)
Africa x No Fans	0.172***	0.151***	0.151***
	(0.063)	(0.057)	(0.055)
Adjusted R^2	0.461	0.644	0.685
Observations	9,497	9,493	9,493
	Touches		
Africa	-0.036		
	(0.035)		
No Fans	0.004	0.006	0.029
	(0.025)	(0.020)	(0.077)
Africa x No Fans	0.124**	0.124***	0.125***
	(0.055)	(0.046)	(0.045)
Adjusted R^2	0.589	0.757	0.780
Observations	9,497	9,493	9,493
	Total Carries		
Africa	0.021		
	(0.040)		
No Fans	-0.009	-0.002	0.000
	(0.032)	(0.025)	(0.104)
Africa x No Fans	0.178***	0.157***	0.156***
	(0.062)	(0.055)	(0.052)
Adjusted R^2	0.461	0.648	0.686
Observations	9,497	9,493	9,493
Player Controls	NO	YES	YES
Match Controls	NO	NO	YES

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Table 4:
Effect of Empty Stadium on Player's Player's Attempt-Based Measures (Continued)

	(1)	(2)	(3)
	Total Passes Attempted		
Africa	-0.047*		
	(0.039)		
No Fans	0.051*	0.049**	0.040
	(0.028)	(0.022)	(0.091)
Africa x No Fans	0.142**	0.151***	0.152***
	(0.061)	(0.050)	(0.048)
Adjusted R^2	0.485	0.711	0.739
Observations	9,497	9,493	9,493
	Attempted Take-on		
Africa	0.206***		
	(0.061)		
No Fans	-0.115***	-0.099***	0.104
	(0.021)	(0.021)	(0.071)
Africa x No Fans	-0.004	-0.099	-0.096
	(0.086)	(0.073)	(0.073)
Adjusted R^2	0.059	0.377	0.385
Observations	9,497	9,493	9,493
	Shots		
Africa	-0.166**		
	(0.046)		
No Fans	-0.053**	-0.018	-0.039
	(0.024)	(0.023)	(0.074)
Africa x No Fans	0.078	0.011	0.011
	(0.072)	(0.063)	(0.063)
Adjusted R^2	0.059	0.411	0.429
Observations	9,498	9,494	9,494
Player Controls	NO	YES	YES
Match Controls	NO	NO	YES

Notes: This table shows results from regressions estimating the effect of an empty stadium on player's standardized attempt-based measures. Africa is a dummy equal to one if the player is from Africa. No Fans is a dummy equal to one if the game was played without fans. Africa x No Fans is the interaction between Africa and No Fans. All models control for number of minutes played. Player controls include position of player, as well as individual and team fixed effects. Match controls include opponent and matchweek fixed effects as well as an indicator for a home game and weather conditions. Standard errors in parentheses are clustered at the team-by-matchweek level. The data is from Sports Reference data base. The sample is restricted to the 2019-2020 season.

Table 5:
Effect of Empty Stadium on Player's Player's Efficiency-Based Measures

	(1)	(2)	(3)
	% Targets Received		
Africa	0.159***		
	(0.053)		
No Fans	0.202***	0.172***	-0.046
	(0.023)	(0.020)	(0.063)
Africa x No Fans	-0.118	-0.057	-0.063
	(0.085)	(0.058)	(0.059)
Adjusted R^2	0.044	0.604	0.614
Observations	9,442	9,438	9,438
	% Total Passes Completed		
Africa	0.239***		
	(0.045)		
No Fans	0.136***	0.127***	-0.146
	(0.031)	(0.026)	(0.094)
Africa x No Fans	-0.039	0.061	0.055
	(0.080)	(0.068)	(0.067)
Adjusted R^2	0.023	0.254	0.279
Observations	9,441	9,437	9,437
	% Successful Take-on		
Africa	0.187		
	(0.063)		
No Fans	0.008	0.008	-0.016
	(0.030)	(0.032)	(0.116)
Africa x No Fans	0.071	0.077	0.057
	(0.099)	(0.102)	(0.102)
Adjusted R^2	0.003	0.042	0.044
Observations	5,395	5,375	5,375
	% Shots on Target		
Africa	-0.061		
	(0.052)		
No Fans	0.015	0.028	-0.008
	(0.023)	(0.024)	(0.099)
Africa x No Fans	-0.027	-0.038	-0.035
	(0.079)	(0.081)	(0.081)
Adjusted R^2	0.008	0.091	0.094
Observations	9,498	9,494	9,494
	% Goals		
Africa	-0.123		
	(0.042)		
No Fans	0.033	0.043*	-0.062
	(0.023)	(0.024)	(0.080)
Africa x No Fans	0.055	0.039	0.047
	(0.074)	(0.075)	(0.075)
Adjusted R^2	0.004	0.059	0.060
Observations	9,498	9,494	9,494
Player Controls	NO	YES	YES
Match Controls	NO	NO	YES

Notes: This table shows results from regressions estimating the effect of an empty stadium on player's standardized efficiency-based measures. Africa is a dummy equal to one if the player is from Africa. No Fans is a dummy equal to one if the game was played without fans. Africa x No Fans is the interaction between Africa and No Fans. All models control for number of minutes played. Player controls include position of player, as well as individual and team fixed effects. Match controls include opponent and matchweek fixed effects as well as an indicator for a home game and weather conditions. Standard errors in parentheses are clustered at the team-by-matchweek level. The data is from Sports Reference data base. The sample is restricted to the 2019-2020 season.

Table 6:
Effect of Empty Stadium on Player's Risk-Based Outcomes

	Lower-Risk Outcomes			
	Carries	Short Passes	Medium Passes	Shots
No Fans	-0.007	0.001	0.020*	-0.004
	(0.019)	(0.011)	(0.012)	(0.004)
Africa x No Fans	0.008	0.014	-0.012	0.000
	(0.011)	(0.010)	(0.011)	(0.003)
Mean Y - Baseline	0.660	0.302	0.297	0.032
Variance	0.109	0.110	0.140	0.217
Success Rate	0.124	0.874	0.831	0.317
Adjusted R^2	0.294	0.286	0.344	0.301
Observations	9,461	9,461	9,461	9,461
	Higher-Risk Outcomes			
	Take-Ons	Long Passes	Dribbler Tackles	Any Tackles
No Fans	0.004	-0.006	0.002	-0.001
	(0.004)	(0.008)	(0.004)	(0.003)
Africa x No Fans	-0.002	-0.004	-0.001	-0.005
	(0.004)	(0.008)	(0.004)	(0.004)
Mean Y - Baseline	0.038	0.128	0.031	0.029
Variance	0.234	0.235	0.236	0.224
Success Rate	0.626	0.624	0.381	0.338
Adjusted R^2	0.258	0.357	0.089	0.093
Observations	9,461	9,461	9,434	9,434

Notes: This table shows results from regressions estimating the effect of an empty stadium on risk-based outcomes. Success rate is the the average efficiency-based counterpart and risk rate is the variance of the efficiency-based counterpart assuming a Bernoulli distribution. Africa is a dummy equal to one if the player is from Africa. No Fans is a dummy equal to one if the game was played without fans. Africa x No Fans is the interaction between Africa and No Fans. All regressions include player controls (minutes played, position of player, individual and team fixed effects) and match controls (opponent and matchweek fixed effects, an indicator for a home game, temperature, rainfall, snowfall, and wind speed). Standard errors in parentheses are clustered at the team-by-matchweek level. The data is from Sports Reference data base. The sample is restricted to the 2019-2020 season.

Table 7:
Effect of Empty Stadium on Player's Endurance-Based Outcomes

	(1)	(2)	(3)	(4)
No Fans	-0.261	-3.836*	-0.016	0.050
	(0.280)	(2.218)	(0.032)	(0.052)
Africa x No Fans	-0.153	1.485	0.002	0.015
	(0.238)	(1.830)	(0.038)	(0.051)
Mean Y - Baseline	5.397	28.243	0.356	0.383
Adjusted R^2	0.160	0.258	0.098	0.099
Observations	9,409	7,882	9,486	5,662
Player Controls	YES	YES	YES	YES
Match Controls	YES	YES	YES	YES

Notes: This table shows results from regressions estimating the effect of an empty stadium on endurance-based outcomes. In model (1) the outcome is total carrying distance divided by total carries. In model (2) the outcome is progressive carrying distance divided by progressive carries. In model (3) the outcome is fraction of successful tackles. In model (4) the outcome is fraction of successful dribler tackles. Africa is a dummy equal to one if the player is from Africa. No Fans is a dummy equal to one if the game was played without fans. Africa x No Fans is the interaction between Africa and No Fans. All regressions include player controls (minutes played, position of player, individual and team fixed effects) and match controls (opponent and matchweek fixed effects, an indicator for a home game, temperature, rainfall, snowfall, and wind speed). Standard errors in parentheses are clustered at the team-by-matchweek level. The data is from Sports Reference data base. The sample is restricted to the 2019-2020 season.

Table 8:
Effect of Empty Stadium on Team's Performance

	(1)	(2)	(3)
	Win	Draw	Loss
No Fans	0.049	-0.012	-0.037
	(0.134)	(0.140)	(0.139)
Africa x No Fans	0.025	-0.026	0.001
	(0.033)	(0.036)	(0.037)
Player Controls	YES	YES	YES
Match Controls	YES	YES	YES
Mean Y - Baseline	0.226	0.384	0.389
Adjusted R^2	0.110	0.210	0.204
Observations	9,486	9,486	9,486

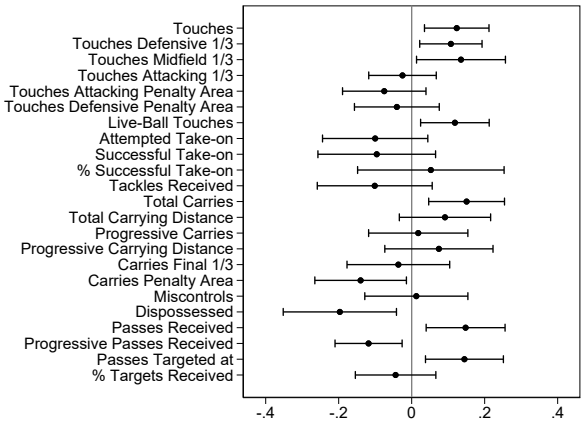
Notes: This table shows results from regressions estimating the effect of an empty stadium on probability of player's team winning, loosing, or drawing. Africa is a dummy equal to one if the player is from Africa. No Fans is a dummy equal to one if the game was played without fans. Africa x No Fans is the interaction between Africa and No Fans. Player controls include number of minutes played, position of player, as well as individual and team fixed effects. Match controls include opponent and matchweek fixed effects as well as an indicator for a home game and weather conditions. Standard errors in parentheses are clustered at the team-by-matchweek level. The data is from Opta data base. The sample is restricted to the 2019-2020 season.

Appendix

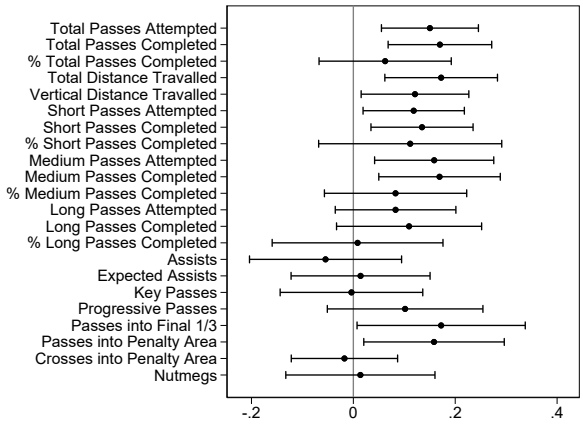
A Supplemental Figures and Tables

Figure A.1:
Effect of Empty Stadium on Player's Standardized Outcomes

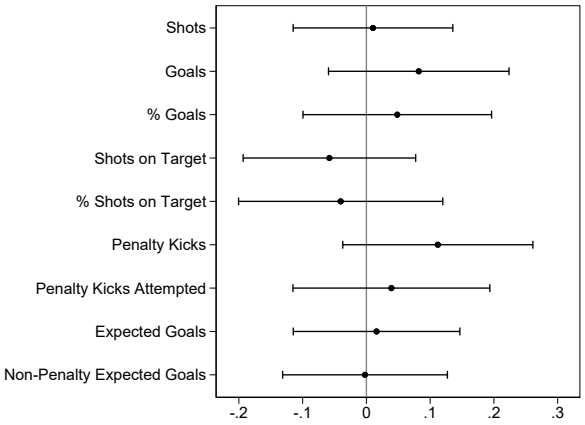
(a) Possession Measures



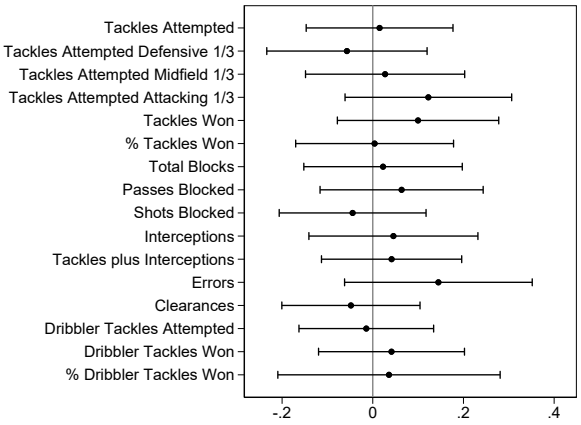
(b) Passing Measures



(c) Goal and Shot Measures



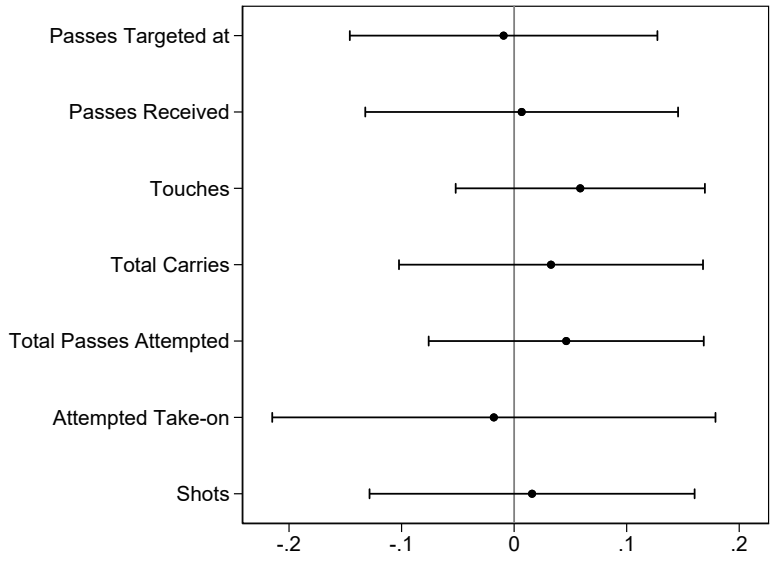
(d) Defense Measures



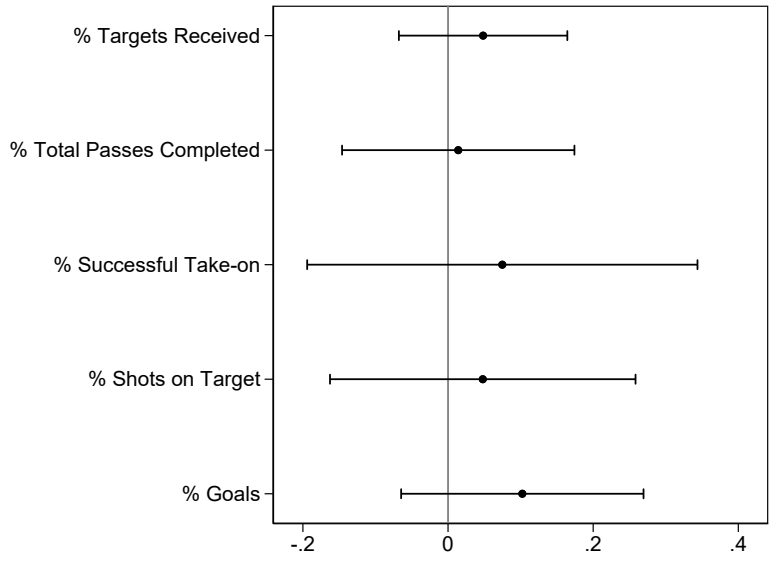
Notes: This figure shows point estimates and 95% confidence intervals from regressions estimating the effect of an empty stadium on standardized performance measures. All regressions include player controls (minutes played, position of player, individual and team fixed effects) and match controls (opponent and matchweek fixed effects, an indicator for a home game, and weather conditions). Standard errors are clustered at the team-by-matchweek level. The data is from Sports Reference data base. The sample is restricted to the 2019-2020 season.

Figure A.2:
Effect of Empty Stadium on Player's Standardized Attempt- and Efficiency-Based Measures
Robustness - Placebo Treatment

(a) Attempt-Based Measures



(b) Efficiency-Based Measures



Notes: This figure shows point estimates and 95% confidence intervals from regressions estimating the effect of an empty stadium on standardized attempt- and efficiency-based Measures. The treatment indicator equals to one if the game was played between matchweek 13 and 26. All regressions include player controls (minutes played, position of player, individual and team fixed effects) and match controls (opponent fixed effects, an indicator for a home game interacted with an indicator for no fans, and weather conditions). Standard errors clustered at the team-by-matchweek level. The data is from Sports Reference data base. The sample is restricted 2019-2020 season when matches were played with supporters in stadiums.

Table A.1:
Summary Statistics of Player's Performance

	Africa		America		Europe		Rest	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
				Passing				
Total Passes Attempted	35.41	22.45	35.10	22.28	34.64	21.81	34.57	19.40
Total Passes Completed	30.13	20.67	28.93	19.93	28.21	19.43	28.31	16.93
% Total Passes Completed	82.27	12.35	79.80	12.69	78.92	13.77	80.04	11.41
Total Distance Travalled	580.88	427.14	557.02	404.07	531.28	399.29	536.42	341.53
Vertical Distance Travalled	162.48	138.83	169.91	141.39	162.89	138.95	180.66	130.72
Short Passes Attempted	13.27	9.25	12.90	8.94	13.38	9.16	13.01	8.67
Short Passes Completed	11.96	8.76	11.55	8.45	11.88	8.59	11.56	8.08
% Short Passes Completed	87.92	15.05	87.84	13.99	87.19	14.70	87.16	16.19
Medium Passes Attempted	14.95	11.02	14.58	11.01	13.98	10.56	14.59	9.60
Medium Passes Completed	13.41	10.47	12.78	10.41	12.04	9.95	12.63	8.79
% Medium Passes Completed	86.59	15.27	83.93	17.99	82.52	18.14	85.21	15.70
Long Passes Attempted	6.06	5.27	6.22	5.17	5.86	5.21	5.66	4.34
Long Passes Completed	4.24	4.27	4.04	3.77	3.75	3.90	3.64	3.41
% Long Passes Completed	66.66	28.47	63.09	28.61	61.83	29.38	62.82	27.33
Assists	0.07	0.28	0.08	0.30	0.07	0.28	0.08	0.27
Expected Assists	0.05	0.11	0.07	0.14	0.07	0.15	0.07	0.14
Key Passes	0.65	1.04	0.82	1.19	0.80	1.13	0.71	1.01
Progressive Passes	2.57	2.61	2.51	2.49	2.58	2.57	2.75	2.51
Passes into Final 1/3	2.46	2.87	2.20	2.41	2.16	2.47	2.21	2.32
Passes into Penalty Area	0.55	0.90	0.65	1.10	0.68	1.06	0.55	0.87
Crosses into Penalty Area	0.08	0.31	0.18	0.52	0.19	0.51	0.15	0.45
Nutmegs	0.04	0.19	0.05	0.23	0.05	0.23	0.04	0.19
				Defense				
Tackles Attempted	1.12	1.32	1.23	1.40	1.06	1.26	1.06	1.27
Tackles Attempted Defensive 1/3	0.55	0.88	0.61	0.93	0.51	0.83	0.59	0.90
Tackles Attempted Midfield 1/3	0.44	0.75	0.47	0.79	0.41	0.72	0.36	0.72
Tackles Attempted Attacking 1/3	0.13	0.40	0.16	0.41	0.14	0.39	0.11	0.35
Tackles Won	0.70	0.98	0.71	0.99	0.61	0.89	0.64	0.98
% Tackles Won	0.35	0.43	0.35	0.42	0.33	0.42	0.34	0.43
Total Blocks	0.75	1.01	0.88	1.10	0.74	0.99	1.02	1.06
Passes Blocked	0.49	0.78	0.58	0.87	0.48	0.77	0.67	0.87
Shots Blocked	0.26	0.62	0.31	0.67	0.26	0.60	0.35	0.67
Interceptions	0.87	1.22	0.89	1.20	0.71	1.04	0.96	1.15
Tackles plus Interceptions	1.99	1.96	2.12	2.10	1.78	1.80	2.02	1.80
Errors	0.02	0.15	0.03	0.17	0.02	0.14	0.04	0.19
Clearances	1.51	2.19	1.48	1.98	1.37	1.86	1.91	2.41
Dribbler Tackles Attempted	1.03	1.23	1.29	1.48	1.14	1.33	1.26	1.49
Dribbler Tackles Won	0.39	0.69	0.49	0.82	0.44	0.75	0.49	0.91

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Table A.1:
Summary Statistics of Player's Performance (Continued)

	Africa		America		Europe		Rest	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
				Possession				
Touches	43.96	24.63	44.05	24.56	42.94	23.98	43.52	22.54
Touches Defensive 1/3	13.10	11.65	13.10	12.38	11.98	11.56	14.93	12.08
Touches Midfield 1/3	24.43	17.22	22.24	15.01	21.57	14.55	20.89	13.06
Touches Attacking 1/3	9.79	8.34	11.95	11.09	12.42	10.20	11.06	8.95
Touches Attacking Penalty Area	1.48	2.05	1.85	2.42	1.85	2.31	1.48	1.82
Touches Defensive Penalty Area	3.01	3.92	3.15	4.16	2.76	3.74	3.69	4.70
Live-Ball Touches	42.05	23.76	41.34	22.92	40.02	22.43	40.33	20.46
Attempted Take-on	1.61	1.94	1.31	1.66	1.25	1.65	1.23	1.55
Successful Take-on	1.09	1.43	0.83	1.17	0.77	1.16	0.82	1.13
% Successful Take-on	70.58	34.44	62.92	39.05	61.51	39.35	69.31	37.16
Tackles Received	1.15	1.47	0.89	1.23	0.82	1.22	0.84	1.13
Total Carries	30.56	18.57	29.33	18.10	28.42	17.52	27.04	15.04
Total Carrying Distance	170.29	117.37	164.36	121.10	153.81	110.45	171.36	111.66
Progressive Carries	3.45	3.29	3.67	3.72	3.56	3.43	3.73	3.35
Progressive Carrying Distance	89.93	74.38	92.05	81.69	85.44	72.16	97.67	74.76
Carries Final 1/3	1.03	1.36	1.18	1.64	1.14	1.50	1.26	1.51
Carries Penalty Area	0.29	0.68	0.33	0.76	0.33	0.71	0.24	0.54
Miscontrols	0.84	1.23	0.86	1.20	0.85	1.21	0.74	1.07
Dispossessed	0.88	1.15	0.86	1.17	0.79	1.12	0.69	1.00
Passes Received	29.88	18.73	29.71	18.48	29.12	17.92	27.59	15.61
Progressive Passes Received	2.30	2.87	3.23	4.15	3.10	3.60	2.42	3.06
Passes Targeted at	33.82	19.47	34.26	19.50	33.92	18.89	30.82	16.90
% Targets Received	86.79	16.36	85.84	15.87	84.39	16.23	88.81	12.22
				Goal and Shot Creation				
Shots	0.89	1.19	1.04	1.42	1.09	1.44	1.04	1.39
Goals	0.07	0.27	0.12	0.38	0.12	0.36	0.09	0.28
Expected Goals	0.08	0.18	0.12	0.24	0.11	0.23	0.08	0.16
Non-Penalty Expected Goals	0.07	0.15	0.10	0.20	0.10	0.19	0.08	0.16
% Goals	0.04	0.16	0.06	0.21	0.06	0.20	0.05	0.19
Shots on Target	0.28	0.56	0.37	0.73	0.35	0.68	0.34	0.62
% Shots on Target	0.15	0.31	0.17	0.33	0.17	0.32	0.19	0.35
Attempted Penalty Kicks	0.01	0.12	0.02	0.16	0.02	0.15	0.00	0.00
Penalty Kicks	0.01	0.09	0.02	0.15	0.02	0.14	0.00	0.00

Notes: The table shows all available performance measures of players from different continents of origin. The data is from Sports Reference data base. The sample is restricted to the 2019-2020 season.

Table A.2:
Effect of Empty Stadium on Total Cards Received, Minutes Played, and Position

	(1)	(2)	(3)	(4)	(5)
	Cards	Minutes	Attack	Midfield	Defense
No Fans	-0.018	-2.467*	0.033	-0.004	0.000
	(0.032)	(1.308)	(0.032)	(0.026)	(0.017)
Africa x No Fans	-0.030	0.542	0.006	0.021	-0.014
	(0.034)	(2.231)	(0.018)	(0.015)	(0.011)
Mean Y - Baseline	0.206	70.308	0.237	0.349	0.381
Adjusted R^2	0.047	0.308	0.714	0.742	0.892
Observations	9,486	9,486	9,486	9,486	9,486
Player Controls	YES	YES	YES	YES	YES
Match Controls	YES	YES	YES	YES	YES

Notes: This table shows results from regressions estimating the effect of an empty stadium on total cards received, minutes played, and postion. Africa is a dummy equal to one if the player is from Africa. No Fans is a dummy equal to one if the game was played without fans. Africa x No Fans is the interaction between Africa and No Fans. All regressions include player controls (minutes played except in models with minutes as outcome, position of player, individual and team fixed effects) and match controls (opponent and matchweek fixed effects, an indicator for a home game, temperature, rainfall, snowfall, and wind speed). Standard errors in parentheses are clustered at the team-by-matchweek level. The data is from Opta data base. The sample is restricted to the 2019-2020 season.

Table A.3:
Effect of Empty Stadium on Player's Overall Performance
Robustness - Intensity of Treatment

	(1)	(2)	(3)
No Fans	0.020	0.011	0.007
	(0.122)	(0.123)	(0.123)
Intentisity	-0.035	-0.001	-0.111***
	(0.055)	(0.054)	(0.021)
No Fans x Intensity	-0.037	-0.032	-0.035
	(0.062)	(0.061)	(0.038)
Africa x No Fans	0.117*	0.122*	0.112*
	(0.070)	(0.070)	(0.068)
Africa x Intensity	-0.138	-0.001	-0.072
	(0.090)	(0.109)	(0.086)
Africa x No Fans x Intensity	0.135	0.134	0.162
	(0.142)	(0.143)	(0.156)
Mean Y - Baseline	5.952	5.952	5.952
Adjusted R^2	0.119	0.118	0.124
Observations	8,854	8,854	8,854
Player Controls	YES	YES	YES
Match Controls	YES	YES	YES

Notes: This table shows results from regressions estimating the effect of an empty stadium on player's overall performance. Africa is a dummy equal to one if the player is from Africa. No Fans is a dummy equal to one if the game was played without fans. Intensity is in model (1) a dummy equal to one if the team of the player experienced racial abuse before lockdown, in model (2) a dummy equal one if the away game took place in a stadium with above-median attendance before lockdown, in model (3) an indicator equals to one if a player receives at least one yellow or one red card. No Fans x Intensity is the interaction between No Fans and Intensity. Africa x No Fans is the interaction between Africa and No Fans. Africa x Intensity is the interaction between Africa and Intensity. Africa x No Fans x Intensity is the interaction between Africa, No Fans, and Intensity. All regressions include player controls (minutes played, position of player, individual and team fixed effects) and match controls (opponent and matchweek fixed effects, an indicator for a home game, and weather conditions). Standard errors in parentheses are clustered at the team-by-matchweek level. The data is from Sports Reference data base. The sample is restricted to the 2019-2020 season.

Table A.4:
Effect of Empty Stadium on Player's Overall Performance
Robustness - Intensity of Treatment

	(1)	(2)	(3)
No Fans	-0.002	0.017	0.014
	(0.123)	(0.123)	(0.123)
No Fans x Intensity	0.007	-0.061	-0.000
	(0.030)	(0.056)	(0.000)
Africa x No Fans	0.178**	0.148**	0.168**
	(0.073)	(0.067)	(0.068)
Africa x No Fans x Intensity	-0.089	-0.033	-0.001
	(0.136)	(0.163)	(0.000)
Mean Y - Baseline	5.952	5.952	5.953
Adjusted R^2	0.119	0.119	0.119
Observations	8,849	8,849	8,832
Player Controls	YES	YES	YES
Match Controls	YES	YES	YES

Notes: This table shows results from regressions estimating the effect of an empty stadium on player's overall performance. Africa is a dummy equal to one if the player is from Africa. No Fans is a dummy equal to one if the game was played without fans. Intensity is in model (1) a dummy equal one if the player has at least five years of experience in Serie A, in model (2) a dummy equal to one if the player has international experience playing Champions League or Europa League, in model (3) the number of COVID-19 deaths per million inhabitants in home country of the player from the beginning of the pandemic up to June 20, 2020. No Fans x Intensity is the interaction between No Fans and Intensity. Africa x No Fans is the interaction between Africa and No Fans. Africa x Intensity is the interaction between Africa and Intensity. Africa x No Fans x Intensity is the interaction between Africa, No Fans, and Intensity. All regressions include player controls (minutes played, position of player, individual and team fixed effects) and match controls (opponent and matchweek fixed effects, an indicator for a home game, and weather conditions). Standard errors in parentheses are clustered at the team-by-matchweek level. The data is from Sports Reference data base. The sample is restricted to the 2019-2020 season.

Table A.5:
Effect of Empty Stadium on Player's Overall Performance
Robustness - Placebo Treatment

	(1)	(2)	(3)
Africa	-0.145		
	(0.058)		
No Fans	0.003	-0.012	0.008
	(0.033)	(0.032)	(0.052)
Africa x No Fans	0.051	0.102	0.098
	(0.077)	(0.079)	(0.079)
Player Controls	NO	YES	YES
Match Controls	NO	NO	YES
Mean Y - Baseline	5.952	5.952	5.952
Adjusted R^2	0.006	0.106	0.106
Observations	5,805	5,791	5,791

Notes: This table shows results from regressions estimating the effect of an empty stadium on player's overall performance. Africa is a dummy equal to one if the player is from Africa. No Fans is a dummy equal to one if the game was played between week 13 and 26. Africa x No Fans is the interaction between Africa and No Fans. All models control for number of minutes played. Player controls include position of player, as well as individual and team fixed effects. Match controls include opponent and matchweek fixed effects as well as an indicator for a home game and weather conditions. Standard errors in parentheses are clustered at the team-by-matchweek level. The data is from Opta data base. The sample is restricted 2019-2020 season when matches were played with supporters in stadiums.

Table A.6:
Effect of Empty Stadium on Player's Overall Performance
Robustness - Season 2018-2019

	(1)	(2)	(3)
No Fans	-0.010	-0.025	-0.008
	(0.041)	(0.030)	(0.032)
Africa x No Fans	-0.043	-0.086	-0.057
	(0.053)	(0.054)	(0.059)
Player Controls	YES	YES	YES
Match Controls	YES	YES	YES
Mean Y - Baseline	5.937	5.937	5.937
Adjusted R^2	0.082	0.074	0.074
Observations	8,273	8,273	8,273

Notes: This table shows results from regressions estimating the effect of an empty stadium on player's overall performance. Africa is a dummy equal to one if the player is from Africa. In model (1), (2), (3) No Fans is a dummy equal to one if the game was played during matchweek 20 and 38, 25 and 38, 30 and 38 respectively. Africa x No Fans is the interaction between Africa and No Fans. Player controls include number of minutes played, position of player, as well as individual and team fixed effects. Match controls include opponent fixed effects, an indicator for a home game interacted with an indicator for no fans, and weather conditions. Standard errors in parentheses are clustered at the team-by-matchweek level. The data is from Opta data base. The sample is restricted to the 2018-2019 season.

Table A.7:
Effect of Empty Stadium on Player's Overall Performance
Robustness - Alternative Race Measures

	(1)	(2)	(3)
		Africa Alternative	
No Fans	-0.021	-0.006	0.003
	(0.027)	(0.026)	(0.120)
Africa Alternative x No Fans	0.171***	0.177***	0.177***
	(0.057)	(0.060)	(0.059)
Adjusted R^2	0.001	0.106	0.121
Observations	9,570	9,569	9,569
		Sub-Saharan Africa	
No Fans	-0.018	-0.001	0.008
	(0.027)	(0.026)	(0.120)
Sub-Saharan Africa x No Fans	0.180**	0.138*	0.137*
	(0.071)	(0.076)	(0.075)
Adjusted R^2	0.001	0.105	0.120
Observations	9,574	9,569	9,569
		Africa Origin	
No Fans	-0.017	-0.003	0.005
	(0.027)	(0.026)	(0.120)
African Origin x No Fans	0.082*	0.083	0.083
	(0.050)	(0.052)	(0.051)
Adjusted R^2	0.001	0.105	0.120
Observations	9,570	9,569	9,569
		Black Player	
No Fans	-0.023	-0.005	0.004
	(0.028)	(0.026)	(0.121)
Black Player x No Fans	0.071*	0.056	0.058
	(0.040)	(0.041)	(0.040)
Mean Y - Baseline	5.972	5.972	5.972
Adjusted R^2	0.001	0.105	0.120
Observations	9,511	9,510	9,510
Mean Y - Baseline	5.971	5.971	5.971
Player Controls	NO	YES	YES
Match Controls	NO	NO	YES

Notes: This table shows results from regressions estimating the effect of an empty stadium on player's overall performance. Africa Alternative is a dummy equal to one if the player is from Africa using the definition of Caselli et al. (2023). Sub-Saharan Africa is a dummy equal to one if the player is from Sub-Saharan Africa. African Origin is a dummy equal to one if the player is from African origin. Black Player is a dummy equal to one if the player is black. No Fans is a dummy equal to one if the game was played without fans. Africa Alternative x No Fans is the interaction between Africa Alternative and No Fans. Sub-Saharan Africa x No Fans is the interaction between Sub-Saharan Africa and No Fans. African Origin x No Fans is the interaction between African Origin and No Fans. Black Player x No Fans is the interaction between Black Player and No Fans. Player controls include number of minutes played, position of player, as well as individual and team fixed effects. Match controls include opponent and matchweek fixed effects as well as an indicator for a home game and weather conditions. Standard errors in parentheses are clustered at the team-by-matchweek level. The data is from Opta data base. The sample is restricted to the 2019-2020 season.

Table A.8:
Effect of Empty Stadium on Player's Overall Performance
Robustness - Alternative Specifications

	(1)	(2)	(3)	(4)
No Fans	0.001	0.025	-0.029	0.001
	(0.068)	(0.128)	(0.154)	(0.123)
Africa x No Fans	0.152**	0.146**	0.217**	0.152**
	(0.073)	(0.067)	(0.099)	(0.062)
Mean Y - Baseline	5.952	5.949	6.061	5.952
Adjusted R^2	0.118	0.131	0.103	0.119
Observations	8,849	8,329	3,272	8,849
Player Controls	YES	YES	YES	YES
Match Controls	YES	YES	YES	YES

Notes: This table shows results from regressions estimating the effect of an empty stadium on player's overall performance. In model (1) standard errors are clustered at the individual level. In model (2) the sample is restricted to players that played at least 20 minutes in each game. In model (3) the sample is restricted to players that played at least 30 games per season. Model (4) controls for baseline athleticism - indicator for a runner (player runs above median distance), young player (age less than the median age), tall player (height above the median height), frequency of substitutions (above median of substitutions), as well as number of days since the last match throughout the season. Africa is a dummy equal to one if the player is from Africa. No Fans is a dummy equal to one if the game was played without fans. Africa x No Fans is the interaction between Africa and No Fans. All regressions include player controls (minutes played, position of player, individual and team fixed effects) and match controls (opponent and matchweek fixed effects, an indicator for a home game, and weather conditions). Standard errors in parentheses are clustered at the at individual level in model (1) and team-by-matchweek level in models (2)-(4). The data is from Sports Reference data base. The sample is restricted to the 2019-2020 season.