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Home-Team Response to the Three-Point Victory Rule: New Evidence Using Double and Triple Differences

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Abstract

Recent findings in sports economics have provided both theoretical and empirical support for the hypothesis that the three-point victory rule leads home teams to choose a more defensive playing style. The main aim of this paper is to test this hypothesis by analyzing line-ups, as well as yellow and red cards. To do so, we used a difference-in-differences approach in which the Italian and French leagues were the treatment group, and the German and Spanish leagues were the control group. In addition, we used a triple-difference model to analyze whether home teams responded differently from visiting teams to the three-point victory rule. Unlike previous results, we provide evidence supporting that home teams increased their aggressiveness. We found that both home and away teams increased the forwards/defenders ratio in the starting lineups, with no indication of significant differences between them. Moreover, home teams increased the actions penalized via red and yellow cards more than did the away teams.

Keywords: Football, difference-in-differences, three-point victory rule.

JEL Classifications: C93, L83

Introduction

First introduced in English football in 1981 and widely adopted during the 1990s, the three-point victory rule (3PVR) was one of the major regulatory changes implemented by the football association during its history. The driving force behind this change was the alarming reduction of goals since the 1950s. An example was the 1990 Football World Cup in Italy, which had the lowest number of goals in history (2.2 per game), and its infamous Group F (England, Ireland, the Netherlands, and Egypt), which has the record for ties (five out of six matches). Based on the assumption that a higher value for a win would encourage attacking play, regulators increased the victory points from 2 to 3, with the draws and defeats being similarly awarded with 1 and 0 points, respectively. As Joseph Blatter, general secretary of FIFA, said: “the idea is to make sure the essence of soccer, which is goals, can be maintained” (as cited in Hersh, 1993).

During the last fifteen years, researchers have found the so-called three-point victory rule to be a useful natural experiment to study the effect of higher rewards in competitive environments. Most studies have focused on analyzing the impact on competition as a whole, while paying less attention to the effect on teams that play in unequal conditions because of different qualities or the places in which they play. Our paper focuses on analyzing this second source of asymmetry—the home advantage. According to the literature, teams have a greater chance of winning when they play on their own field compared to when they play away. Table 1, calculated from data provided by Pollard and Gómez (2014), shows this asymmetry in the six continental confederations: Asia (AFC), Africa (CAF), North and Central America (CONCACAF), South America (CONMEBOL), Oceania (OFC), and Europe (UEFA). As can be seen, on average, the hosts won about 46% of the matches, tied in about 26%, and only lost 28% during the period 2006–2012.

Table 1. Percentage of wins and draws in 157 National Football Leagues, 2006–2012

	Home teams win	Draw	Away teams win	Countries analyzed	Number of games analyzed
Asia (AFC)	45.68%	25.32%	29.00%	32 out of 46	28,494
Africa (CAF)	45.32%	28.94%	25.74%	38 out of 54	38,631
North and Central America (CONCACAF)	45.77%	26.80%	27.42%	22 out of 35	18,010
South America (CONMEBOL)	47.98%	26.25%	25.77%	10 out of 10	16,843
Oceania (OFC)	45.39%	16.85%	37.77%	5 out of 11	1,745
Europe (UEFA)	46.85%	24.45%	28.70%	50 out of 53	66,029
Overall	46.29%	25.96%	27.74%	157 out of 209	169,752

Source: Own elaboration based on data from Pollard and Gómez (2014).

Dewenter and Namini (2013) provided theoretical arguments and empirical evidence that the 3PVR could have reduced home-team offensiveness. They argued that home teams usually incur a bias that induces them to please their supporters in a more offensive playing style than they should employ. In this scenario, when the reward for victory increases, the opportunity cost of playing too offensively should also increase, thus leading home teams to choose a more defensive style.

Dewenter and Namini’s (2013) results could have significant policy implications, as prizes, patents, grants, and tax incentives are the main tools used by regulators to encourage innovation (Hemel & Ouellette, 2013). For example, following the

Schumpeterian idea that large firms are a more stable platform for research and development than smaller firms (as cited in Gilbert, 2006), large firms can afford a bias in favor of innovation that leads them to cover a wide range of research and development projects—some of which have a very low likelihood of success. According to this perspective, increasing the reward could increase the opportunity cost of exploring new paths, thus harming innovation in the long term. In this regard, confirming whether a higher prize reduces the assumption of risks among those who are particularly prone to taking them could be relevant in order to design incentives correctly.

Our aim is to test the response of home teams using a different empirical approach. First, we do not use indirect measures of risk taking, such as goals and relative victories. Instead, we analyze the selection of the starting lineups by the coaches, and the players' actions punished via yellow and red cards. Second, we use data from the Italian and French leagues, which introduced the 3PVR in the 1994–95 season, from the 1993–94 and 1994–95 seasons. These competitions and seasons have the advantage that the introduction of the 3PVR did not coincide with other important events that transformed football in the 1990s (e.g., the increase in the number of substitutions, the Bosman ruling, and the automatic dismissal for a tackle from behind). Third, we use a difference-in-differences (DD) approach whereby we compare the average change over time for the group that introduced the rule (treatment group) and the group that did not (control group). Unlike previous studies, we did not use cup competitions as a control group (see Dilger & Geyer, 2009; Garicano & Palacios-Huerta, 2014), but rather the Spanish and German leagues, which introduced the 3PVR one year later. This allows us to avoid the problem that the lineups of cup tournaments may have been influenced indirectly by the introduction of the new rule in the league (i.e., if coaches placed different importance on cup and league matches, the distribution of players between both tournaments could be changed). Moreover, we avoid the problem that cup tournaments are also played by clubs from minor leagues, which may experience different trends compared to those from the first division. Finally, to test whether the 3PVR affected home teams differently from away teams, we used a difference-in-difference-in-differences (DDD) strategy using two control groups: Spanish/German leagues and visiting teams.

The rest of the paper is organized as follows. The next two sections present the literature review and the theoretical considerations. Following this, the methodology is described, and the results are discussed. The last section provides the conclusion.

Literature Review

The effects of the three-point victory rule (3PVR) on competition have been widely analyzed with mixed results. On one hand, the new reward scheme seems to have guided teams to take more risks in the pursuit of victory. This evidence has been found through four kinds of measures: (1) more offensive moves (Guedes & Machado, 2002); (2) more shots, shots on goal, and corner kicks (Garicano & Palacios-Huerta, 2014); (3) more dirty play (del Corral, Prieto-Rodríguez, & Simmons, 2010; Garicano & Palacios-Huerta, 2014); and (4) a higher number of attackers in the starting eleven (Garicano & Palacios-Huerta, 2014).[1] On the other hand, the rule seems to have encouraged a more conservative playing style when teams were ahead in the score, adding more defenders during the substitutions (Garicano & Palacios-Huerta, 2014). This mixed behavior has resulted in a decrease in the number of ties, with the number of goals

Table 2. Some Empirical Studies of the 3PVR Effect on Competitions

Author	Measures	Database	Conclusions
Guedes & Machado (2002)	Offensive moves, ties, relative wins, and goals.	Portuguese league. Seasons: 1994–95 and 1995–96.	No variation in draws or victories. Underdogs reduced offensive moves in asymmetric matches in which score was tied for at least 75 of the 90 minutes.
Fernandez-Cantelli & Meeden (2003)	Goals and ties.	10 leading leagues. 36 seasons.	Little evidence of an increase in annual goals or of a reduction in draws.
Palacios-Huerta (2004)	Relative wins, ties and goals.	English leagues. Period: 1888–1996.	Structural changes in ties, relative wins, goal differences, and the variability of goals, but not in the average of goals.
Shepotylo (2005)	Relative wins, ties and goals.	Ukrainian (1980–1991, 1995–2003) and Italian (1993–2003) leagues.	Collusion between weaker teams to reduce ties in the Ukrainian league but not in the Italian league.
Aylott & Aylott (2007)	Decided matches and goals.	7 leagues. 13 seasons.	Football became more exciting, but the rule needed between four and five years to take full effect.
Haugen (2008)	Competitive balance.	Norway (1972–1994), Romania (1981–1999), the UK (1947–2004).	Reduction of competitive balance.
Dilger & Geyer (2009)	Ties, goal difference and scoreless games.	German league and cup competitions. Period: From 1985–86 to 2004–05.	Evidence of a reduction in draws and goal differences, but no of variation in scoreless games using a difference-in-differences approach.
Moschini (2010)	Draws and goals.	35 countries. Period: 1978–2007.	Increase of goals and a decrease in the probability of draw.
del Corral, Prieto-Rodríguez, & Simmons (2010)	Red cards.	Spanish league. Seasons: 1994–95 and 1995–96.	Increase of red cards at the end of the match and when teams were ahead in the score.
Dewenter & Namini (2013)	Relative wins and goals.	German league. Seasons: From 1982–83 to 2007–08.	Reduction (increase) of goals and wins for home (away) teams. No significant variation for the aggregate values.
Garicano & Palacios-Huerta (2014)	Lineups, shots, corner kicks, substitutions, yellow cards, faults, extra time, attendance.	Spanish league (1994–95 and 1998–99) and Spanish cup (1993–95 and 1997–99).	More attackers and defenders in lineups. Use of substitutions to reduce attackers and increase defenders when the team was leading the match. Increase in faults and extra time, and a decrease in attendance. No change in goals, ties, and yellow cards.
Riedl, Heuer, & Strauss (2015)	Goals and draws.	24 countries and 20 seasons.	Draws were reduced but, in conformity with loss aversion, they were still high with respect to the statistical expectation values.
Hon & Parinduri (2016)	Goals, goal differences, and decided matches.	German league. Seasons: 1980–2010.	No evidence of variation of decisive games, N. of goals and goal difference using a regression discontinuity design.

remaining unchanged (Palacios-Huerta, 2004; Dilger & Geyer, 2009). However, the results are not unanimous; Table 2 provides a short summary of the main findings.

However, the effects of the 3PVR on teams with different chances of winning has received less attention in the literature. The analysis has involved three aspects: quality differences between teams, corruption, and offensive bias. Guedes and Machado (2002) provided a model with asymmetric teams, in which offensive efforts were strategic substitutes for underdogs (i.e., the more offensive a favorite is, the less offensive the underdog is) and strategic complements for favorites (i.e., the more offensive an underdog is, the more offensive the favorite is). According to their model, the 3PVR causes favorites to increase their offensive effort while underdogs respond more defensively. Guedes and Machado (2002) offered empirical support for this result in the Portuguese league, as they reported a decrease in the weakest teams' offensive moves in those matches in which the score remained tied for at least 75 of the 90 minutes.

Shepotylo (2005) analyzed whether the 3PVR created incentives to collude among teams of similar strength and lower quality in leagues with higher levels of corruption and less control by the media. By analyzing the introduction of the 3PVR in the Ukrainian league in 1995, Shepotylo (2005) uncovered a cooperation scheme that involved winning at home and losing away (thus contributing to increasing the home advantage) in order to increase the number of points. Similarly, Elaad, Krumer, and Kantor (2018) reported a significant scheme of collusion between teams of different quality in more corrupt countries. According to their findings, teams in danger of relegation on the last day of the season had a higher probability of achieving the desired result when they played against teams (usually better) for which the result was irrelevant. By contrast, the following year, the team had a greater likelihood of losing against the same rival, thus showing evidence of quid pro quo behavior.

Dewenter and Namini (2013) provided a model with symmetrical teams in which the offensiveness of both teams was a resource that could be either strategic substitutes or complements. The main assumption of the model is that the existence of a home bias leads home teams to allocate more offensive resources in the field to the detriment of their defensive capacity in order to satisfy followers. The authors argued that, when there is a higher reward, the opportunity costs of being too offensive increase. Consequently, home teams become more defensive. The model provided three scenarios in which the results depended on whether the levels of offensiveness were strategic substitutes or complements, and whether there was a strong home bias or not. Table 3 shows both the hypotheses of these scenarios and the expected consequences.

Dewenter and Namini's (2013) panel data analysis of the German league showed that the 3PVR reduced the number of goals and the likelihood of winning for home teams, whereas it increased the goals scored and the likelihood of winning for the visitors. These findings would suggest evidence in favor of the second scenario in their model in which the home bias was sufficiently strong and the offensive effort was a strategic substitute.

Table 3. Scenarios of the Model of Dewenter and Namini (2013)

Hypotheses	Consequences
Scenario 1	
Home bias is weak or absent.	Home team plays more offensively.
Level of offensiveness is a	Visitor plays more offensively.
strategic substitute for both teams or	Home team scores more goals.
strategic complement for both teams.	Visitor scores more goals.
	No. of matches which end with a draw decreases.
Scenario 2	
Home bias is sufficiently strong.	Home team plays less offensively.
Level of offensiveness is a strategic	Visitor plays more offensively.
substitute for both teams.	Home team scores less goals.
	Visitor scores more goals.
	No. of matches which end with a draw may increased or decrease.
Scenario 3	
Home bias is sufficiently strong.	Home team plays less offensively.
Level of offensiveness is a strategic	Visitor plays less offensively.
complement for both teams.	Home team scores less goals.
	Visitor scores less goals.
	No. of matches which end with a draw increases.

Theoretical Considerations and Hypotheses

The model by Dewenter and Namini (2013) assumed that home and away teams were completely symmetrical, with the main discrepancy being the different number of offensive players due to the home bias. It is possible this assumption is not appropriate when taking the fact that the home advantage can also be a result of supporters' pressure on players and referees into account (see Nevill, Balmer, & Williams, 2002; Dohmen, 2005; Garicano, Palacios-Huerta, & Prendergast, 2005), which leads to a higher probability of victory for the hosts. In this way, the consideration of asymmetries can be relevant for home and away teams. If, similarly to Guedes and Machado (2002), we allow that offensive efforts can be strategic substitutes for away teams and strategic complements for the hosts, the result could be the complete opposite to that suggested by Dewenter and Namini (2013)—namely an increase in the aggressiveness of home teams and a decrease in the aggressiveness of the guests.

In order to confirm the results of Dewenter and Namini's (2013) study, we used the initial lineups and dirty play. Accordingly, we tested the following null hypotheses:

H1: *The 3PVR did not have any significant impact on the number of offensive players in the initial lineups.*

H2: *The 3PVR did not have any significantly different impact on home and away teams' initial lineups.*

H3: *The 3PVR did not have any significant impact on the number of red and yellow cards (dirty play).*

H4: *The 3PVR did not have a significantly different impact on home and away teams' dirty play.*

It is important to emphasize that we use the term aggressiveness instead of offensiveness, as this term allows the inclusion not only of offensive play (more forwards in the starting eleven), but also of dirty play in games (more yellow and red cards). Although it might be argued that red and yellow cards correspond to defensive actions, our point of view is that dirty play is risky behavior in which a conservative team would not engage. The link between incentives, starting squads, and dirty play has been analyzed previously in the literature. Using a difference-in-differences approach, Garicano and Palacios-Huerta (2014) found that the 3PVR increased the number of defenders and attackers in the Spanish league significantly, as well as the number of fouls. Del Corral et al. (2010) reported a positive impact of the 3PVR on red cards. More recently, Rohde and Breuer (2017) used the value of the starting squads to analyze how managers save efforts in the absence of financial incentives or ahead of more important games.

Methodology

Empirical Analysis

To test whether the introduction of the three-point victory rule (3PVR) affected the variables in our study, we used (DD) and (DDD) strategies. The DD estimator calculates the effect of the new rule by comparing the average change in the dependent variable for the group that introduced the rule (treatment group) and that which did not (control group) over time. In our case, the introduction of the 3PVR in season 1994–95 was the treatment, teams playing in the first division in Italy and France during the seasons 1993–94 and 1994–95 were the treatment group, and teams from the first division in Spain and Germany were the control group during the same period. The model from which we obtained the DD estimator can be written as:

$$y = a_1 \cdot Treat + a_2 \cdot Post + a_3 \cdot (Treat \cdot Post) + X'\beta + \gamma + \varepsilon$$

where *Treat* is a dummy variable that takes the value of 1 for the teams belonging to the treatment group (the Italian and French leagues) and 0 otherwise. *Post* is a dummy variable that identifies the season in which the treatment was introduced (the 1994–95 season), (*Treat* · *Post*) is a dummy interaction variable that identifies the treatment teams (home teams from Italian and French leagues playing in 1994–95), γ represents dummies to control for unobserved heterogeneity, and ε is the error term. This model may be estimated by OLS, with the coefficient a_3 as the DD estimator that measures the treatment effect.

To test whether the 3PVR affected home teams differently from away teams, we used a DDD strategy with two control groups: Spanish/German leagues and visiting teams. In this case, the equation is as follows:

$$\gamma = b_1 \cdot Treat + b_2 \cdot Home + b_3 \cdot Post + b_4 \cdot (Treat \cdot Post) + b_5 \cdot (Treat \cdot Home) + b_6 \cdot (Home \cdot Post) + b_7 \cdot (Treat \cdot Home \cdot Post) + \beta X + \gamma + \varepsilon$$

where *Home* is a dummy variable that takes the value of 1 for teams playing at home and 0 otherwise, (*Treat . Home . Post)* is the interaction variable that identifies the treatment home teams, and b_7 is the coefficient of interest that measures the effect of the 3PVR on the hosts.

The (DD) and (DDD) strategies allow for the control of unobserved but fixed omitted variables; however, they require the trend in both groups to be the same in the absence of treatment (Angrist & Pischke, 2009). Accordingly, in our model, we included a vector of exogenous variables, *X'*, which contains the evolution of the team's ability, a linear time trend denoting the match day (week 1, week 2, …), and dummies for the weekday (Monday, Tuesday…). Weekday dummies were included to take into account that lineups and players' motivation can change when teams play on a workday instead of on a weekend. The trend variable was used to test whether teams' behavior was not constant over the season.[2] Ability was estimated by adding the percentage of wins and draws during the previous two seasons, with victories being valued twice as much as ties. The incoming teams in the category received a value that was 15% higher than that of the last team in the ranking (in other words, we presumed that promoted teams were better than were relegated ones). In addition, the unobserved presumably constant heterogeneity was controlled for in a fixed-effects model using dummies for the home and the away teams. Finally, due to the presence of serial correlation in long time series (Bertrand, Duflo, & Mullainathan, 2004), we used the cluster option for teams to correct standard errors.

With regard to our dependent variable *y* we were interested in studying the aggressiveness employed by teams in order to win. Therefore, we analyzed the players chosen by coaches for the starting lineup and the extreme actions taken by the players, which we could identify as the players were punished via yellow and red cards.

For our analysis of the initial lineups, we classified the players as goalkeepers, defenders, midfielders, and forwards, according to their roles within the team. Placed near the goal line, the main role of the goalkeeper (the only player who can use hands) and the defenders is to prevent the scoring of a goal. Midfielders, situated around the center of the field, have the dual function of recovering the ball from the opposing team and creating opportunities for the forwards. Finally, located near to the opposing net, the main objective of forwards is to score a goal. Our unit of analysis was the starting eleven of a team, and the dependent variables were the number of defenders, the number of midfielders, the number of forwards, and the forwards/defenders ratio.[3] The value of these variables indicated the style of play chosen by the coach: fewer defenders and more forwards create a more offensive-minded game, while the opposite creates a more defensive style of play, which would be less attractive to supporters.

Ranging from the lesser to the greater seriousness of the action, the referee may punish a player's misconduct with a caution (a yellow card) or by dismissal (a red card). Players punished with two yellow cards automatically receive the red card and are expelled. Therefore, an increase in the number of actions punished via yellow and red cards would be an indicator of the greater aggressiveness of players during a game. Our unit of analysis was the team playing a particular match, and the dependent variables were the number of red and the number of yellow cards. We also used two dummies as dependent variables, which measured whether the team had been punished with at least one yellow or red card during the match.[4]

Data Collection

Our database consisted of 2,744 matches collected from the Italian, French, German, and Spanish leagues during the 1993–94 and 1994–95 seasons. The Italian and French leagues, which introduced the 3PVR in 1994–95, were the treatment group. The German and Spanish leagues were the control group because they applied the old rule during the same period. Both groups have 1,372 matches each, providing a total of 5,488 lineups, 9,054 yellow cards, and 866 red cards.[5]

The selected leagues belonged to the four most competitive countries in European football during the years studied according to UEFA Country Ranking.[6] All of them used a round-robin format in which each team played against all the others twice throughout the season—once in their own stadium and once as a visitor on the rival's pitch.[7] Teams are awarded points if they win or draw. The classification at the end of the season is used to proclaim the champion of the competition, to select the teams for the European tournaments (Champions League and UEFA Cup), and to replace the worst teams with the best from the respective second division.

The choice of these seasons and leagues requires some additional clarification. The first is that most of the leagues introduced the 3-1-0 award system in the 1995–96 season, along with another regulatory change, namely the third substitution. The Italian and French federations were some of the few exceptions that introduced the new point award system in the 1994–95 season, and the third substitution a year later. This provides an advantage over other studies, as these regulatory changes did not occur at the same time, thus allowing us to analyze the 3PVR effect without the influence of the modification in substitutions. This choice is particularly relevant as we are interested in studying how coaches selected the players under the sole influence of the 3PVR.

Second, the (DD) and (DDD) strategies require the use of a control group that did not receive treatment during the studied seasons. This group consisted of the German "Bundesliga" and the Spanish "La Liga," which applied the old rule. This creates a difference from studies that used cup tournaments as a control group in their DD strategies. Although using teams from the same country competing in tournaments with distinct reward rules (league and cup) reduces the risk of having different trends in the control and treatment groups, these competitions may not be independent. The 3PVR can influence both cup and league tournaments if the perception of coaches regarding the importance of league matches changes. When this occurs, the selection of players may be different in both tournaments because of the new rule. In addition, cup tournaments include teams from lower divisions that may suffer different shocks from those experienced by the top teams.

Third, our database spans two consecutive seasons, thus providing a sample with similar teams, coaches, referees, players, and spectators. This decreases the possibility of different trends arising within national leagues.

Results

Descriptive Analysis

In this section, we present a previous analysis of Italian and French leagues before and after the introduction of the three-point victory rule (3PVR) using two-tailed t-tests to evaluate the differences. Only those with p-values of less than 0.10 are considered statistically significant. The results are shown in Table 4.

Table 4. Starting Line-Ups, Yellow and Red Cards in the Italian and French Leagues under the 2PVR and the 3PVR

	2PVR 1993–94 (n=686)	3PVR 1994–95 (n=686)	Diff.	p-value	N
Starting line-ups					
Home teams					
Number of defenders per match	3.99	4.08	0.09 *	0.052	1,372
Number of midfielders per match	4.10	3.83	-0.27 ***	0.000	1,372
Number of forwards per match	1.91	2.09	0.18 ***	0.000	1,372
Forwards / defenders ratio	0.51	0.55	0.04 ***	0.006	1,372
Away teams					
Number of defenders per match	4.15	4.21	0.06	0.254	1,372
Number of midfielders per match	4.10	3.83	-0.28 ***	0.000	1,372
Number of forwards per match	1.75	1.97	0.22 ***	0.000	1,372
Forwards / defenders ratio	0.45	0.51	0.06 ***	0.000	1,372
Yellow and red cards					
Home teams					
Number of yellow cards per match	0.95	1.14	0.20 ***	0.002	1,372
Percentage of matches with yellow cards	52.6%	58.5%	5.8% **	0.030	1,372
Number of red cards per match	0.07	0.11	0.05 ***	0.007	1,372
Percentage of matches with red cards	5.7%	10.5%	4.8% ***	0.001	1,372
Away teams					
Number of yellow cards per match	1.30	1.43	0.13 *	0.074	1,372
Percentage of matches with yellow cards	62.0%	62.1%	0.1%	0.956	1,372
Number of red cards per match	0.17	0.19	0.02	0.419	1,372
Percentage of matches with red cards	16.0%	17.2%	1.2%	0.562	1,372

Note: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table 4 displays the two measures of aggressiveness of play we used, namely composition of the starting lineups and dirty play. The results show the initial differences between the home and away teams. First, the hosts began the match with a greater number of forwards and a lower number of defenders than did the visitors.[8] This could be related to overconfidence and the coaches' desire to please fans, which is characteristic of the home advantage. By contrast, the second measure of aggressiveness, the number of activities punished via red and yellow cards, was higher among away teams.[9] These findings have also been reported in English and German football (see Thomas, Reeves, & Smith, 2006; Boyko, Boyko, & Boyko, 2007; Buraimo, Forrest, & Simmons, 2010), and have been associated with the referee's favoritism towards home teams induced by crowd pressure, and to more aggressive behavior on the part of teams that are behind in the score, usually the visitors.

By analyzing the changes in both seasons, it can be appreciated that both home and away teams modified the composition of their starting eleven, reducing the number of midfielders and increasing the number of forwards, with the difference being significant at the 1% level. Although the home teams also increased the number of defenders (0.09, $p < 0.1$), the "forwards/defenders" ratio shows that the starting eleven became more offensive under the new rule in both the hosts' and the visitors' teams. The two-tailed t-test did not find any significant difference in the variation of the forwards/defenders ratio between home and away teams. These initial results allow for the rejection of H1, but not of H2.

Moreover, cautions and dismissals increased under the 3PVR, which is in line with previous studies in the literature. This phenomenon seems to be particularly relevant for home teams, as significant differences in the number of red and yellow cards, as well as in the percentage of matches with sanctions, were found. These results allow the rejection of both H3 and H4.

Econometric Analysis

The results from the difference-in-differences (DD) and difference-in-difference-in-differences (DDD) models are shown in Table 5 and Table 6. "Treat" is the dummy variable used to signal the French and Italian competitions; "Post" identifies the season 1994–95; "Home" identifies home teams; "Matchday" is the week on which teams played; "DD estimator" is the interacting variable that measures the impact of the 3PVR on the dependent variable; and the "DDD estimator" measures the different impact of the rule on home teams. In addition, we used the ability of the team ("Own ability") and that of its opponent ("Opponent's ability") to control trends that were not due to the treatment.[10] As has been explained, ability was measured using the teams' historical outcomes in the previous two seasons. All the models included dummies for the weekday on which the team played, and for home-team and away-team fixed effects.

Table 5 analyzes the effect of the 3PVR on the initial lineups. The DD estimates showed that coaches reacted by reducing the number of midfielders (0.292) and increasing the number of defenders (0.118) and forwards (0.164). The positive impact on the forwards/defenders ratio (0.069, $p < 0.01$) would allow for the rejection of the null hypothesis H1. By contrast, none of the DDD estimates were significant; thus, the null hypothesis H2 could not be rejected.

The effects of the 3PVR on dirty play are shown in Table 6. The DD estimates showed that the rule increased the likelihood of teams having at least one red card per match (0.061, $p < 0.01$), as well as the number of yellow cards (0.113, $p < 0.15$). The results suggest that we can reject H3. With regard to the home teams, the DDD estimates provide evidence that allow for the rejection of hypothesis H4. Thus, compared to the visitors, the home teams increased their number of red cards (0.100, $p < 0.05$), their number of yellow cards (0.274, $p < 0.05$), and their likelihood of being punished by at least one dismissal (0.089, $p < 0.05$) or one caution (0.093, $p < 0.01$).

Table 5. DD and DDD Estimates of the Effect of the 3PVR on the Initial Line-Ups (OLS Models)

	Difference-in-Differences estimates				Difference-in-Difference-in-Differences estimates			
	Defenders	Midfielders	Forwards	Forwards / Defenders	Defenders	Midfielders	Forwards	Forwards / Defenders
Constant	3.97708***	4.70617***	2.09389***	0.98420***	3.70023***	3.97792 ***	1.96187***	0.65283***
	(0.69192)	(0.88435)	(0.6089)	(0.2119)	(0.69248)***	(0.88483)	(0.60746)	(0.21193)
Own ability	0.00690***	-0.00202	-0.00706***	-0.00390***	0.00862	-0.00266	-0.00693***	-0.00421***
	(0.00171)	(0.0019)	(0.00135)	(0.00057)	(0.00171)	(0.0019)	(0.00133)	(0.00056)
Opponent's ability	-0.00187	0.00014	0.00074	-0.00050	-0.00017	-0.00098	0.00082	-0.00009
	(0.00164)	(0.00183)	(0.00127)	(0.00062)	(0.00164)	(0.00183)	(0.00127)	(0.00062)
Matchday	0.00024	0.00095	-0.00022	-0.00101***	0.00202**	-0.00022	-0.00025	-0.00049
	(0.00095)	(0.0011)	(0.00078)	(0.00035)	(0.00095)	(0.0011)	(0.00078)	(0.00035)
Treat	-0.14783	-0.80310	0.10535	-0.23736	-0.98410	0.90980	0.12672	0.21039
	(0.9984)	(1.08553)	(0.64325)	(0.2676)	(0.9988)	(1.0883)	(0.64343)	(0.26737)
Post	0.03750	-0.11678***	0.02868	-0.02025	0.07322	-0.15325***	0.07231**	-0.00904
	(0.03504)	(0.04139)	(0.02788)	(0.01399)	(0.04608)	(0.05344)	(0.03596)	(0.01868)
DD estimator	0.11819**	-0.29285***	0.16405***	0.06963***	0.01040	-0.23476***	0.15333***	0.06241***
	(0.04903)	(0.05716)	(0.03964)	(0.01766)	(0.06371)	(0.07351)	(0.05067)	(0.02312)
Home					-0.16612***	-0.06564	0.18262***	0.04432***
					(0.04202)	(0.04812)	(0.03231)	(0.01729)
Treat*Home					-0.05329	0.05079	-0.02976	0.01423
					(0.05558)	(0.06389)	(0.04484)	(0.02041)
Home*Post					-0.00193	0.05910	-0.08811*	-0.01398
					(0.0577)	(0.06685)	(0.04573)	(0.02271)
DDD estimator					0.06242	-0.04081	0.01674	-0.02539
					(0.07771)	(0.09012)	(0.06248)	(0.02776)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	5,488	5,488	5,488	5,488	5,488	5,488	5,488	5,488
R^2	0.4796	0.4821	0.3974	0.3267	0.4940	0.4764	0.4060	0.3567

Note: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. The unit of analysis is the team in the match. "Defenders," "Midfielders," and "Forwards" are the number of defenders, midfielders, and forwards in the initial line-up respectively. "Forwards / Defenders" is the quotient of the number of forwards over the number defenders in the starting eleven. All models include home-team and away-team fixed effects as well as dummies about the weekday the team is playing. S.E. clustered on teams using bootstrap method (10,000 replications) are reported in parentheses.

Table 6. DD and DDD Estimates of the Effect of the 3PVR on Cautions and Dismissals (OLS Models)

	Difference-in-Differences estimates				Difference-in-Difference-in-Differences estimates			
	No. of red cards	No. of yellow cards	Matches with red cards	Matches with yellow cards	No. of red cards	No. of yellow cards	Matches with red cards	Matches with yellow cards
Constant	-0.04338	3.79040***	0.12643	1.09693***	0.21933	2.77826***	0.05004	1.14124***
	(0.21695)	(0.61881)	(0.17433)	(0.14317)	(0.21665)	(0.61373)	(0.17417)	(0.14296)
Own ability	0.00021	-0.00742***	-0.00100	-0.00094	-0.00095	-0.00672***	0.00027	-0.00101
	(0.00084)	(0.00247)	(0.00071)	(0.00068)	(0.00083)	(0.00243)	(0.00071)	(0.00067)
Opponent's ability	-0.00066	-0.00462*	-0.00073	-0.00070	-0.00015	-0.00406	0.00123	-0.00072
	(0.00088)	(0.0025)	(0.00078)	(0.00069)	(0.00087)	(0.00247)	(0.00077)	(0.00069)
Matchday	-0.00125**	-0.01320***	-0.00100**	-0.00325***	-0.00097*	-0.01069***	-0.00196***	-0.00324***
	(0.00052)	(0.0015)	(0.00045)	(0.00042)	(0.00052)	(0.00148)	(0.00045)	(0.00041)
Treat	0.13455	0.10109	0.18814	0.08429	0.07133	1.24529	-0.06654	0.10324
	(0.23835)	(1.3143)	(0.19174)	(0.43548)	(0.23823)	(1.31203)	(0.19172)	(0.4351)
Post	-0.00231	0.06853	-0.03126*	-0.01050	-0.02245	-0.03135	0.04403*	0.00338
	(0.02013)	(0.06)	(0.01686)	(0.01438)	(0.0283)	(0.07444)	(0.02337)	(0.01698)
DD estimator	0.03557	0.11339	0.06102***	0.02200	0.03346	0.11981	-0.02902	-0.02332
	(0.02691)	(0.07799)	(0.02295)	(0.02148)	(0.03793)	(0.09818)	(0.03194)	(0.02504)
Home					-0.07705***	-0.24290***	-0.03767*	-0.06053***
					(0.02333)	(0.06898)	(0.01938)	(0.01715)
Treat*Home					-0.03785	-0.09882	-0.07622***	-0.02995
					(0.03016)	(0.08524)	(0.02549)	(0.02441)
Home*Post					-0.03377	-0.16625*	-0.06700**	-0.02787
					(0.03299)	(0.0972)	(0.02758)	(0.02357)
DDD estimator					0.10097**	0.27428**	0.08905**	0.09326***
					(0.04373)	(0.12276)	(0.03715)	(0.03385)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	5,488	5,488	5,488	5,488	5,488	5,488	5,488	5,488
R^2	0.0902	0.3664	0.0812	0.4983	0.0955	0.3642	0.1029	0.5047

Note: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. The unit of analysis is the team in the match. "Matches with red cards" and "Matches with yellow cards" are dichotomous variables that take value 1 if the team in the match was punished with a red card or yellow card respectively, and zero otherwise. All models include home-team and away-team fixed effects as well as dummies about the weekday the team is playing. S.E. clustered on teams using bootstrap method (10,000 replications) are reported in parentheses.

It is interesting that the coefficient of the match day was correlated negatively with the forward/defender ratio and dirty play, indicating that the teams reduced their risk-taking behavior as the end of the season approached.

As Bertrand et al. (2004) highlighted in their widely cited paper, the DD approach may provide biased standard errors because of a serious serial correlation problem in long time series. This could lead to the over-rejection of a true null hypothesis. In order to address this issue, we clustered standard errors at the team level using the bootstrap method with 10,000 replications. The number of groups (89 teams) is considered sufficiently large to resolve serial correlation problems.

Placebo Tests

To ensure that standard errors had been estimated correctly, we performed placebo tests based on the notion of Bertrand et al. (2004), as these are being used increasingly in the literature (Cheng & Hoekstra, 2013; Huber, Newman & LaFave, 2016; Gardeazabal & Polo, 2018). Accordingly, we dropped the period in which the 3PVR was applied (season 1994–95), and assigned the status of the treatment group randomly to half of the teams in the season 1993–1994, being a false 3PVR applied in the second part of the season. The placebo tests for the DDD estimates followed the same idea; the only difference was that we also randomized the home and away teams. By repeating this simulation 10,000 times, we obtained a distribution of the DD and DDD estimates of a phantom intervention. Since the 3PVR was fictitious, the null hypothesis of no effect should be rejected at the 5% percent level not more than 5% of the time (and at the 10% percent level only 10% of the time). Table 7 shows the real DD and DDD coefficients reported in Tables 5 and 6, the average of the 10,000 simulations, and the rejection rates at the 5% and 10% levels. As can be seen, the rejection rates were quite close to the theoretical ones; thus, the standard errors were approximately correct, lending internal validity to our estimates.

Following Abadie, Diamond, and Hainmueller (2010), we performed an inference exercise in which we examined whether the estimated effect of the 3PVR was expected to be abnormal in the placebo distribution. In this regard, our inferential procedure was similar to that implemented by Cheng and Hoekstra (2013) and Huber et al. (2016). Accordingly, we calculated the proportion of the simulated coefficients that were larger, in absolute terms, than was the coefficient we obtained in our baseline model.[11] If this proportion were high, the estimated effect would be drawn from the placebo distribution and not from the 3PVR. Table 7 shows that most of the significant coefficients from the baseline models had proportions below 10%, lending support to the robustness of our results; the exceptions were the DD coefficient of the number of defenders, as 10.9% of the placebo estimates were above the true coefficient (0.11819).

Figure 1 plots the placebo distributions of the DD and DDD estimates for the forwards/defenders ratio, and for matches with at least one red card. The real estimate is marked with a dashed vertical line. As can be seen, the histograms are centered on zero and are approximately normally distributed. Except for the DDD estimates of the forwards/defenders ratio, the vertical lines are far from the center of the distribution, showing that our estimates were extreme outliers in the placebo distributions.

Finally, in addition to this randomization inference, we performed a placebo test in which we dropped the season 1994–95, and compared the treatment group (France and Italy) and the control group (Germany and Spain). Once again, we applied the

Table 7. Placebo Tests

	Dependent variables:							
	No. of defenders	No. of midfielders	No. of forwards	Forwards / Defenders ratio	No. of red cards	No. of yellow cards	Matches with red cards	Matches with yellow cards
DD estimates								
Coefficient from baseline model	0.11819**	-0.29285***	0.16405***	0.06963***	0.03557	0.11339	0.06102***	0.02200
Mean of the random placebo intervention	-0.00119	-0.00101	0.00019	-0.00027	0.00010	0.00242	-0.00002	0.00022
Rejection rate at the 5% level	0.04360	0.04480	0.04620	0.04350	0.04870	0.04320	0.04570	0.04150
Rejection rate at the 10% level	0.08900	0.09250	0.09380	0.09430	0.09640	0.09150	0.09770	0.08910
Tests above the reference estimate	0.10900	0.00530	0.02570	0.02140	0.12430	0.13610	0.00870	0.19070
False intervention on the treated group	-0.11367	0.19949*	-0.08583	0.01870	-0.03948	-0.10499	-0.02038	-0.04067
	(0.09969)	(0.11484)	(0.08726)	(0.0365)	(0.03161)	(0.10211)	(0.02716)	(0.02555)
DDD estimates								
Coefficient from baseline model	0.06242	-0.04081	0.01674	-0.02539	0.10097**	0.27428**	0.08905**	0.09326***
Mean of placebo tests	0.00022	-0.00061	-0.00188	0.00046	0.00056	-0.00110	0.00039	-0.00017
Rejection rate at the 5% level	0.05170	0.05150	0.05640	0.04730	0.05430	0.05120	0.05470	0.04730
Rejection rate at the 10% level	0.10460	0.10410	0.10720	0.10280	0.10710	0.10130	0.10310	0.09540
Tests above the reference estimate	0.27330	0.49930	0.41380	0.38010	0.05300	0.06000	0.04910	0.02630
False intervention on the treated group	0.02871	0.00534	-0.03405	-0.02627	-0.04044	-0.19889	-0.02799	-0.01958
	(0.08003)	(0.08378)	(0.05909)	(0.03166)	(0.05316)	(0.15146)	(0.04827)	(0.04216)

Note: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. "Coefficient from baseline model" are the DD and DDD estimates from equations reported in Table 5 and Table 6. "Mean of the random placebo intervention" represents the average of the DD and DDD coefficients obtained from 10,000 simulations where the treated teams were randomly assigned. Rows below shows the rejection rate of the null hypothesis of no effect of the false intervention (3PVR) at the 5% and 10% significance levels. "Tests above the reference estimate" are the percentage of the simulations that are larger, in absolute terms, than the coefficient from our baseline model. "False intervention on the treated group" shows the DD and DDD estimates and their S.E. when a fictitious 3PVR is applied to the treated group (France and Italy) in the second part of season 1993–94.

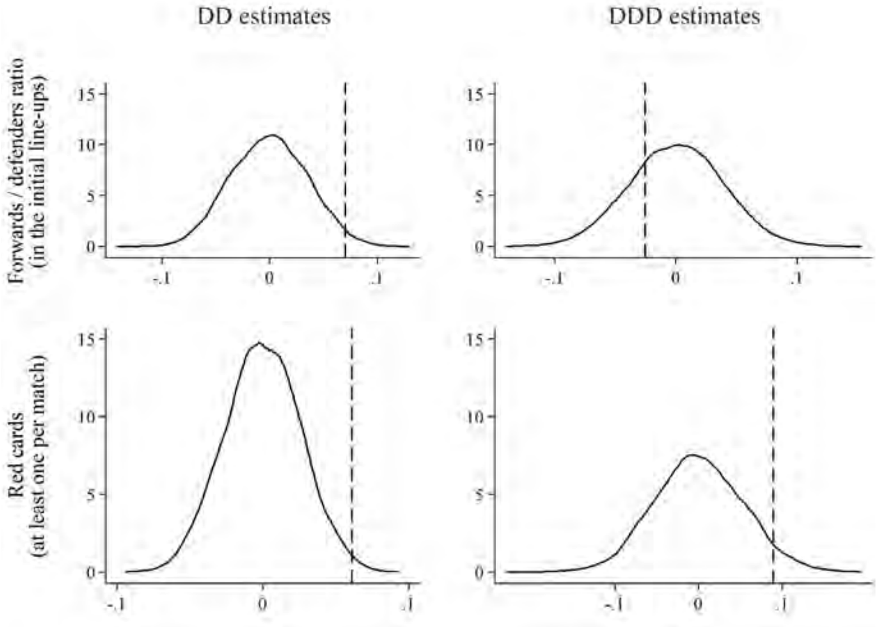

Figure 1.

Empirical distributions of the DD and DDD estimates (for the forwards/defenders ratio and for red cards) in a placebo intervention. The vertical dashed lines represent the estimates from the baseline models.

false 3PVR in the second part of the season. Table 7 shows the DD and DDD coefficients and the standard errors in parentheses. As can be seen, except for the midfielders, the impact of the fictitious 3PVR was not significant in the remainder of the placebo models, thus showing the robustness of the DD and DDD estimates.

Discussion

The difference-in-differences (DD) estimates support the idea that the 3PVR increased risky play by increasing the proportion of forwards in relation to defenders, as well as the matches in which at least one red card was issued. These findings are in line with the literature. The increase in dirty play following the introduction of the 3PVR was reported by del Corral et al. (2010), as well as by Garicano and Palacios-Huerta (2014). Similarly, Garicano and Palacios-Huerta (2014) reported an increase in defenders, as well as forwards. In addition, our paper provides the first evidence of an increase in the offensiveness of the starting eleven measured via the forwards/defenders ratio.

With regard to the difference-in-difference-in-differences (DDD) analysis, our results led to the rejection of Dewenter and Namini's (2013) hypothesis that home teams became more conservative under the 3PVR. On one hand, we did not find any significant evidence that home coaches selected their starting eleven differently from the way coaches selected the starting eleven for the away teams. On the other hand, we found strong evidence that home teams reacted by engaging in more dirty play than did the away teams. One possible explanation for the different response of hosts and visitors to a same incentive is their different starting point in their dirty play and lineups previously to the introduction of the 3PVR. As can be seen in Table 4, the initial lineups of home teams had a significantly greater number of forwards and a significantly lower number of defenders than had those of away teams, thus providing fewer possibilities to exploit this way.[8] By contrast, the home teams started from a low base of red and yellow cards as a result of a possible referee bias.[9] This gave them the opportunity to increase dirty play to win when the reward increased.

These conclusions should, however, be considered with caution. First, lineups are limited to the first minute, and coaches can change them during the match according to the score. Garicano and Palacios-Huerta (2014) found that, under the 3PVR, the team that was ahead used substitutions to remove attackers and increase the number of defenders in order to protect their advantage. The model by Brocas and Carrillo (2004) showed that, in tie situations, the new rule induced teams to play more defensively in the first half and more offensively in the second half. Second, the direction of causality between 3PVR, dirty play, and referee's punishment could be questioned. If national football associations anticipated more unfairness due to the increased rewards for winning and instructed referees to punish rule violations more severely than previously, the increase of cautions and dismissals could be a result not of a change in the style of play, but in the style of evaluating certain actions by referees.[12] From our point of view, we find it unlikely that instructions to referees have changed with the introduction of the 3PVR. As far as we know, FIFA did not show any public concern about dirty play before the introduction of the rule. Moreover, if there had been stricter refereeing, it would have affected both teams; however, as seen, the increase of yellow and red cards occurred especially among home teams (obviously, we consider improbable that the 3PVR could counteract the social pressure in the stadium that was generating a referee bias in favor of home teams). Future research may extend our findings by analyzing the lineups during the game, taking the score into account.

Conclusion

In this article, the impact of the three-point victory (3PVR) rule on the risk-taking behavior of home teams was analyzed. We investigated this behavior by analyzing the responses of coaches when selecting their initial lineups, and the reaction of players committing actions punishable via yellow and red cards. Furthermore, we used a difference-in-differences (DD) strategy to evaluate the impact of the rule on entire teams and a difference-in-difference-in-differences (DDD) strategy to evaluate the impact on home teams.

We provided evidence that, in general, coaches increased the proportion of forwards/defenders in their starting eleven, and referees increased the number of times they punished a team with at least one red card.

With regard to home teams, our findings did not provide support for the hypothesis that home teams became more conservative under the 3PVR. Thus, the hosts' starting eleven did not vary significantly from those of visitors. In addition, we found strong evidence that home teams increased actions punishable via red and yellow cards more than did away teams. The latter could have been the result of an increase in real dirty play, or of greater diligence on the part of referees in punishing these actions.

Endnotes

[1] The authors also reported an increase in the number of defenders.

[2] We thank the anonymous referee for this suggestion.

[3] We removed goalkeepers from the study because teams always maintain one player in this position.

[4] We used a linear probability model estimated via OLS instead of a Probit model, as the straightforward interpretation of interaction terms in nonlinear models is different from that in linear models (Karaca, Mandic, Norton, & Dowd, 2012), and nonlinear models do not fulfil the common trend assumption (Lechner, 2011). The OLS estimates are close to the marginal effects induced by nonlinear models (Angrist & Pischke, 2009), and are appropriate to calculate the effect of a treatment clustering standard error to correct both heteroscedasticity and serial correlation (Bertrand et al., 2004). Moreover, Deke (2014) found that a linear probability model could estimate impacts on binary outcomes in randomized controlled trials while logistic models could not, as its standard errors are essentially the same as the true standard errors in a Monte Carlo simulation.

[5] The sources of these data were http://www.footballdatabase.ue and http://www.worldfootball.net.

[6] The Italian federation had the best-ranked clubs in the years 1993, 1994, and 1995, followed in second and third place by the French and German federations. Spain was positioned in fourth place in 1993 and 1995 and was in fifth place in 1994. See http://kassiesa.home.xs4all.nl/bert/uefa/data/method1/crank1994.html.

[7] In the Italian and French leagues, 18 teams face other rivals in 34 rounds; in France and Spain, 20 teams play each other during 38 rounds.

[8] The number of forwards (defenders) initially deployed by coaches was higher (fewer) in home teams than it was in visiting teams at the one-percent level in two-tailed t-tests.

[9] Differences in the number of red and yellow cards, as well as in the percentage of matches with at least a caution or dismissal, were significant at the one-percent level in two-tailed t-tests.

[10] For example, Olympique de Marseille, second in the French championship in 1993–94, was demoted to the second division in the 1994–95 season because of a bribery scandal during the 1992–93 season.

[11] Note that we are speaking in absolute terms. If the coefficient of the reference model were negative, as is the case for the midfielders, we calculated what proportion of the simulated coefficients was below it.

[12] We thank the anonymous referee for this suggestion.

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