The red card cliché

Is it harder to play against 10 men? **Adam Greenberg** analyses four seasons' worth of Premier League data to test the idea that soccer teams are tougher to beat when they are a man down

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In soccer, as in other competitive sports, a lot rides on victory. There is pride, of course, and there are bragging rights; trophies and championship titles. Of more consequence, perhaps, is money: the win bonuses for players and clubs, and the betting stakes placed by hopeful fans.

The pressure to win can sometimes push players to take rash decisions – whether it be delivering a crunching, sliding tackle on a threatening opponent, a "theatrical" dive to earn a penalty kick, or a few harsh words directed at the match officials. If the transgression is serious enough, a player will be shown the red card by the referee and told to leave the pitch – upsetting the balance of the 11-a-side game.

Does this mean certain defeat for the 10-man team? Some pundits would argue not. One of the more popular footballing clichés is the classic "It's always harder to play against 10 men" – the rationale being that when a team has a player sent off, the manager pushes the remaining players back down the field to focus on defending their goal. This should make it harder for the opposition team to attack, and

hence reduce the likelihood of them scoring, thus hindering their chances of winning the game (if they are not already ahead, that is). This cliché clearly contradicts the more logical explanation that when a team is reduced to 10 men, there will be relatively more space for the opposition team to exploit, and attacking should become more straightforward.

We set out to test which theory better explains the observed outcomes, and to estimate the magnitude of the effect of a sending off on the goals scored and points obtained by both teams. Three points are awarded for a win, one for a draw, and none for losing, and it is the total of these points over a season that determine league rankings.

For our analysis, we used a panel data set with 1520 matches spanning the Premier League seasons 2009/10, 2010/11, 2011/12, and 2012/13, with data sourced from Sky Sports match reports at bit.ly/1GktRrO (a complete list of variables present in the data set can be found online at significancemagazine.com/redcards).

The results presented here were found from a series of econometric regressions,

ranging from ordinary least squares (OLS), to more robust methods such as fixed effects (FE) and random effects (RE) estimation (see box below for more detail).

Past performance

Several past papers have put the 10-man cliché to the test, with most obtaining results that contradict it – instead siding with the more logical explanation. Caliendo and Radic[1] looked at matches from quadrennial World Cup championships from 1930 to 2002. They found that scoring intensity rises for both teams after a red card, but more so for the 11-man team, which creates a net negative impact on the 10-man team's scoring intensity. This evidence is clearly contrary to the cliché and instead suggests that it is *not* harder to play against 10 men.

Vecer et al.[2] used betting data from the FIFA World Cup 2006 and Euro 2008. They also found that a red card increases the scoring intensity of the 11-man team, but unlike Caliendo and Radic, the Vecer analysis suggests that a 10-man team's scoring

Regressions explained

A regression tries to explain the relationship between a set of variables by fitting a model to the data. This entails specifying a form for the model (an equation which connects the variables), and then estimating the coefficients on each explanatory (or "predictor") variable to quantify the effects each has on the dependent variable of interest (the "response" variable).

Depending on the structure of the relationship, different regression techniques provide different levels of accuracy.

Ordinary least squares (OLS)
OLS is one of the simplest forms of regression because it allows the relationship to be specified as a linear model. An OLS regression attempts to find a line of best fit that most closely approximates the data. This is done by finding the best-fit line that minimises the sum of the squared vertical distances between this line and the actual observations.

Fixed effects (FE) and random effects (RE)
This study estimates the effect of a red card, and does so by including as many explanatory variables as is possible (the time of the red card, the position of the player who was sent off, etc.). However, it is possible that there are other factors that affect the outcome which are not observed or cannot be measured, and are therefore absent from the data set. This includes influencers such as the effort levels of the players, which may be linked to the importance of the match (for example, if a match is a 'derby' between local rivals, this may boost the

players' performances). With these unobserved factors present in the data, the results can be misleading and incorrect relationships between the variables can be inferred.

It is possible to eliminate the effects of these unobserved factors using FE estimation. By subtracting the mean from each variable, these time-invariant unobservables (the fixed effects) will be eliminated because *they do not vary over time*. Note that this is an assumption that, for example, the match Arsenal vs. Tottenham is a derby each year, and the effect this has on the teams' performance should not be drastically different from one year to the next.

The problem with FE is that the regression will exclude any observation which appears only once in the four seasons. For example, the 1520 matches are made up from 676 different pairs of teams, with one, two, three or four observations for each. There are 248 team pairings for which only one observation exists in the data (due to the annual relegation of three teams). Using FE means that these observations are not included in the regression, and only data from the remaining 428 pairs (which make up 1272 matches) are used.

RE estimation circumvents this problem by only partially de-meaning the variables (that is, only subtracting from the variables the necessary amount in order to remove the effects of the unobservables). RE is therefore more efficient than FE because it uses more of the variance in the data set. However, whilst FE eliminates the possibility of omitted variable bias, it is still possible under RE and so care needs to be taken when analysing the results.

intensity actually falls "to about 2/3 of the original intensity, whereas the intensity of the opposing team increases by a factor of about 5/4". This study therefore provides further support against the cliché, though the international matches that both the Caliendo and Vecer studies focus on are likely to have different dynamics from domestic games.

Indeed, the only study to have offered moderate support to the 10-man cliché is one based on domestic matches: the 2010 investigation of German Bundesliga matches from 1999 to 2009, by Mechtel et al.[3] While they concluded that "a sending-off imposed against the home team worsens the final score … (from the home team's perspective)", they were unable to find such clear results when considering the effect of a red card for the away team. They conclude that a red card for the away team only has a negative effect on their points when it is issued early enough in the game, and that away-team dismissals later than the 70th minute actually lower the home team's points.

The authors provided some discussion of the dynamics that could explain this finding, focusing on "team role theory" which suggests "a team becomes weaker after a sending off", and "social impact theory" which concerns some "counteracting effects, e.g. motivational effects, that lead to a better performance for the penalized team". They concluded that when red cards are issued early enough, the motivational effect is insufficient "to overcompensate for being shorthanded for a long time". However, when the sending-off is late in the game, the motivational effects "seem to be able to overcompensate for the negative effects derived from team role theory", and this is why away teams can do better if they have a player dismissed later on. This potential ability for motivational effects to overpower the negative effect of the red card may be what commentators have in mind when stating that "it's always harder to play against 10 men".

Our analysis is more up to date than any of these papers, and is the first to examine matches from the English Premier League. It therefore attempted to provide further robustness for the past findings (or, indeed, to find opposing results).

The latest results

During the four Premier League seasons for which data were collected, there were 238

Table 1. Red cards, average points and average goals scored in the four English Premier League seasons 2009/13

	Home team	Away team
Red cards	100	138
Average points	1.67	1.06
Average goals scored	1.62	1.18

red cards issued: 100 were given to teams while playing at their home ground, and 138 were given to teams playing away from home. Across all games (with and without red cards) home teams obtained an average of 1.67 points and scored an average of 1.62 goals per game, compared with just 1.06 points and 1.18 goals for away teams. A series of t-tests show that these differences are all statistically significant – that is, away teams received significantly more red cards, but scored fewer goals and obtained fewer points than home teams (see Table 1).

On average, after a red card, the number of points fell by 0.25 for the 10-man team, but increased by 0.36 for the 11-man team. So on an unconditional level, the data reject the cliché, suggesting instead that it is in fact easier to play against 10 men.

Next, several regressions were run which provided a series of strong results that further refuted the cliché. On average, having a home-team player sent off was found to reduce the points the 10-man home team obtained from the game by 0.8631. Similarly, having an away-team player sent off increases the points of the 11-man home team by an average of 0.3529. Note the former number is over twice as large as the latter. This suggests that the negative impact on the home team's points from having one of their own players sent off is more than twice as large as the positive impact from having a player from the opposition team dismissed. In other words, a home team suffers a lot more from having a player expelled than it gains from having an extra man.

Why might this be? Perhaps because the home team has home advantage anyway (as seen in Table 1), gaining an extra man has a smaller marginal effect on the confidence of the players – and the fans in the crowd – and the manager does not have to change strategy. But losing a player might seriously dent the confidence of players (and fans) and force a drastic change in tactics.

At this point it should be noted that due to time constraints we were unable to control for the current league positions of the two teams involved in the game. It seems safe to assume that if a weaker team (as measured by league points/ranking) has a player sent off, this is likely to have a bigger impact than when the stronger team loses a man.

In all, there were 27 matches that involved multiple red cards (either both the home team and away team received a red card, or one of the two teams received multiple red cards). The results show that a sending-off for the home team does not simply "cancel out" the effects of a red card for the away team. In fact, the results suggest that even if both teams have a player dismissed, there is an overall negative effect on the home team's points.

Table 2 shows the home team's expected points following several different combinations of home-team and away-team red cards. The home team is expected to get the most points (2.0454) if only the away team has a player sent off. The next best option (1.6925) is for neither team to have a player sent off, because both teams being reduced to 10 men actually reduces the home team's expected points (to 1.1823). The home team is expected to get the fewest points (0.8294) when it is one man light.

In terms of goals scored, if the away team has a player sent off, the home team is expected to score an average of 0.6017 more goals as a result, and this finding is statistically significant. It is worth noting that one possible explanation behind the footballing cliché in question is that when a team has a player sent off, it tends to prioritise defending, and as such it should be more difficult to score against it. The results here clearly provide evidence against this theory.

Another set of regressions followed which included the position of the dismissed player as an additional explanatory variable. The coefficients suggest that, for a home team,

Table 2. Home team's expected points

		Away team	
		11 men	10 men
Home team	11 men	1.6925	2.0454
	10 men	0.8294	1.1823

having a defender dismissed has the largest negative impact on the home team's points (an average loss of 1.0425 points), followed by an attacker (a fall of 0.9126 points). The position that causes the least impact when dismissed is a midfielder, which would cause the home team on average to drop 0.6333 points. The results did not highlight any significant difference in outcome depending on the position of the dismissed player when it is the away team that receives the red card.

A series of FE and RE models were also used. These controlled for season and bilateral team pairing fixed effects by including 676 team-pair dummy variables in the regression. Under both these models, the sign and significance of the estimated coefficients remained stable, with similar values. As such, the results discussed above are robust and continue to reject the cliché.

Extra time

Several auxiliary regressions were run to test some additional theories relating to other hot topics in football. The results reported are only from the primary OLS estimations, intended to give an idea of potential relationships. Further studies are necessary to confirm any possible effects and provide some robustness to the results.

It is often said that "big" teams – those in the upper echelons of the Premier League – have decisions go their way and tend to receive fewer red cards. When using the team's position in the final league table as a measure of quality, there does appear to be a relationship, albeit fairly weak. It appears, with a few exceptions, that the lower a team's final position, the higher its number of red cards. The line of best fit in Figure 1 has a moderate positive slope.

An OLS regression was run to test this relationship, and the results suggest that "better" home teams are less likely to receive red cards than teams in lower positions in the league. Similarly, home teams are more likely to receive red cards themselves when playing "better" away teams. However, this regression merely demonstrates correlation. There is a potential for causation to work in the opposite way (or in both ways). For example, it may be that teams finish lower down the table *because* they receive more red cards.

Interestingly, the results also show that an away-team red card raises the probability

of a home-team dismissal by 0.087, and the result is statistically significant (albeit the coefficient is rather small, and therefore this effect is minimal). Assuming most red cards are issued following bad tackles, this result suggests that reckless challenges by one team may lead to retaliatory fouls by the other. Often in reality – especially in high-pressure games of heightened importance – foul play does spark tit-for-tat challenges and causes the contest to turn ugly. In our dataset, there are 218 matches involving red cards, of which 20 saw a sending off for both teams – this equates to almost one in every 10 matches.

The final word?

The findings clearly reject the cliché, and this decision is independent of the method used: OLS, FE and RE all point to the same conclusion. The results show that having a player sent off significantly reduces the goals scored and the points obtained by the 10-man team, but increases both when the red card is instead issued to the opposition. A home team suffers a lot more from having a player dismissed than it gains from having an extra man, and even if both teams have a player sent off, there is an overall negative effect on the home team's points.

Further analysis on this topic could consider additional variables such as

possession statistics, corners, shots, tackles, weather conditions, crowd attendance, etc. Of course, it will always be helpful to include even more seasons in the data set as well, to increase the power of the tests. However, this study provides a good start and clearly rejects the commonly used cliché that "it's always harder to play against 10 men", and concludes that it may in fact be easier.

References

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3. Mechtel, M., Brändle, T., Stribeck, A. and Vetter, K. (2010) Red cards: Not such bad news for penalized guest teams. MPRA Paper 21430, Munich University Library, Germany. bit.ly/1QUKqxc

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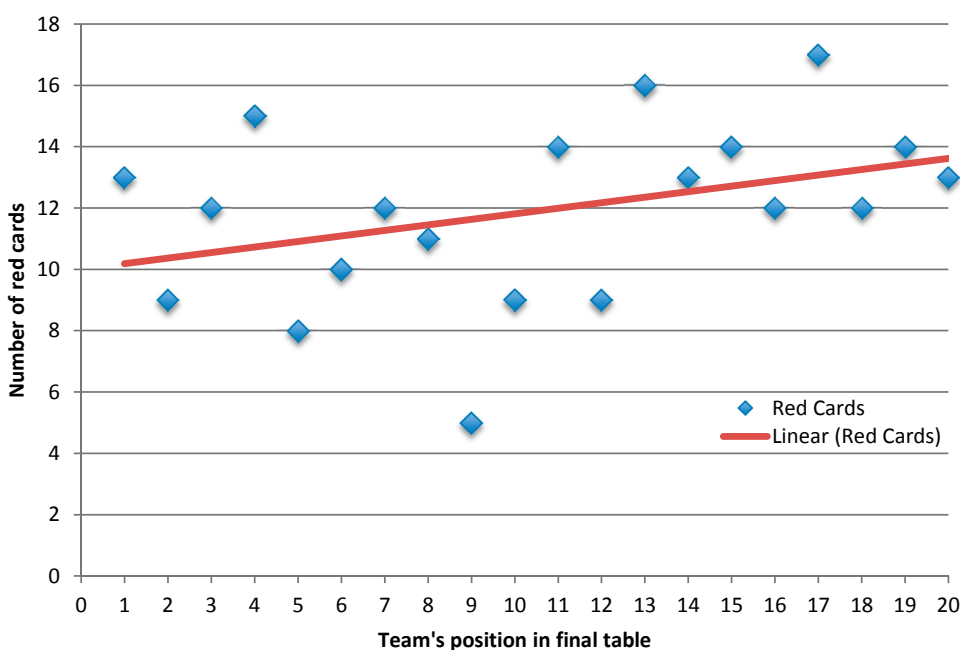
Figure 1. Number of red cards by team's end-of-season position