

Study on the “Hot Match” Effect in Professional Football Leagues

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Abstract. This study takes match outcomes of European eight leagues, China Super League (CSL) and Japan J1 League (J1) in 20 seasons (1996–2015) as samples, and proposes UNIANOVA (multi-factors: home or away game, results of the previous games, combination of the two) to explore the Hot Match Effect in professional football leagues. The results show that (1) “Home advantage” phenomenon is significant in professional football leagues; (2) Hot Match Effect exist in professional football leagues, and is obvious in Home matches; (3) the interaction effect between the two factors (home or away, results of the previous games) is significant in terms of winning percentage.

Keywords: Professional football leagues · Hot match effect · Hot hand

1 Introduction

In sports a widespread belief exists that success breeds success and failure breeds failure. One major example is the “hot hand” or “streak shooting”—terms referring to the belief that the performance of a player during a particular period is significantly better than could be expected on the basis of the player’s overall record (Gilovich et al. 1985). The related research on “hot hand” or “cold hand” has mainly focused on basketball, volleyball, baseball, tennis and golf. Those sports have two common characteristics: 1. Two possible outcomes (Hit or Miss, Win or Lose); 2. A large number of shoots or scores in one game. Compared with those, football is a sport with three possible outcomes (win, draw or lose) and fewer shoots or scores in one game. As far as we are concerned, no study has yet been conducted on Momentum effect in football matches.

In professional football leagues, each team competes with its opponents in succession according to the fixtures, and the outcomes form a natural time series. In the light of principles concerning Momentum Effect, the study propose UNIANOVA (multi-factors: home or away, result of the previous games, combination of the two) to explore the Hot Match Effect in professional football leagues.

2 Method

In this paper, the “Hot Match” Effect is defined as the phenomenon that as the winning streak increases, the winning percentage of the next game grows as well.

2.1 Subjects

This study takes match outcomes of European eight leagues, China Super League (CSL) and Japan J1 League (J1) in 20 seasons (1996–2015) as samples. Information about the leagues is shown in the following Table 1 in detail.

Table 1. Schedule of 10 leagues.

Abbreviation	Name of the League	Begin	End
England1	English Premier League	1996–1997	2015–2016
Spain1	Spanish la Liga	1996–1997	2015–2016
German1	German Bundesliga	1996–1997	2015–2016
Italy1	Italian Serie A	1996–1997	2015–2016
French1	French Ligue 1	1996–1997	2015–2016
Holland1	Netherlands Eredivisie	1996–1997	2015–2016
Portugal1	Portugal Primeira Divisão	1996–1997	1998–1999
	Portugal Primeira Liga	1999–2000	2015–2016
England2	English First Division	1996–1997	2003–2004
	English League Championship	2004–2005	2015–2016
Japan1	Japan J1 League	1997	2015
China1	C League	1996	2003
	Chinese Super League	2004	2016

Data are collected from <http://wildstat.com/> and <http://data.j-league.or.jp/>. The study only focuses on the regular season’s data (Holland1, England2). The matches don’t include the over-time and penalties (Japan1). As Wuhan Guang-gu’s withdrawal from CSL (China Super League) tournament in 2008, CFA judged its outcomes in 2008 season to be loses. For this reason, the data concerning the CSL2008 are not included in the study. The study conducts UNIANOVA (multi-factors: home or away, results of the previous games, combination of the two) with the help of SPSS19.0.

2.2 Procedures

As our statistics are defined in terms of streaks, defining the term “streak” should be the first step. Let G be a set of games indices and $\{X_g\}_{g \in G}$ be the sequence of match outcomes, where $X_g = 3$ if the outcome is win, $X_g = 1$ if the outcome is draw, $X_g = 0$ if the outcome is lose. A streak occurs in game g if a team has just completed k or more games with the same outcome, i.e. if $X_{g-1} = X_{g-2} = \dots = X_{g-k} = 3$. For the analysis we report below, we set $k = 3, 2, 1$ based on evidence that the intuitive sense of the emergence of a streak generally begins at the third successive event (Carlson and Shu 2007),

and previous studies have focused on streaks of at least three hits as indicative of hot hand shooting (Koehler and Conley 2003; Rao 2003).

$$W_k^i = \frac{|G_w^k|}{\|G_w^{k-1}\|} G_w^k := \{g \in G : X_{g-1} = X_{g-2} = \dots = X_{g-k} = 3\} \quad (1)$$

In the above formula, $|\cdot|$ counts the number of wins in a set of games, $\|\cdot\|$ counts the number of elements in a set of games and G_w^k for the subset of games g immediately follow a streak of k wins, $X_{g-1} = X_{g-2} = \dots = X_{g-k} = 3$. W_k^i indicates the team i 's conditional probability (to win game immediately after streak of k wins).

$$P_W^k = \sum_{i=1}^n (W_k^i)/n \quad (2)$$

P_W^k is the mean value among n team in one season. The calculation only takes the non-zero value in W_k^i into account. Using those indicators, the study conducted UNIANOVA (multi-factors: home or away game, results of the previous games, combination of the two) with the help of SPSS19.0.

3 Results

3.1 Analysis of the Winning Percentage of Home and Away

Table 2 shows that the mean of 10 leagues' home winning percentage is 0.427, and the mean of away winning percentage is 0.261. In term of home winning percentage, German1 has the highest (0.486), followed by Holland1 (0.485), Japan1 has the lowest (0.425); and with regard to away winning percentage, Japan1 has the highest (0.347), followed by Holland1 (0.284), China1 hits the lowest (0.213). The overall mean of winning percentage was 0.366. Japan1 hits the highest (0.386), with the second being Holland1 (0.385) and the lowest being China1 (0.344).

3.2 Analysis of Winning Percentage with Conditional Probability (Previous Match Outcomes)

From Table 3, as the winning streak increases, the winning percentage of the next game grows as well. Under the condition that previous game was won, the mean of winning percentage of the next game is 0.356; under the condition of two games winning streak, the mean of winning percentage of the next game is 0.461; under the condition that three games winning streak, the mean of winning percentage of the next game is 0.543.

Table 2. Winning percentage of home and away games

	N	Home		Away		Total	
		\bar{X}	SD	\bar{X}	SD	\bar{X}	SD
England1	20	0.463	0.006	0.268	0.005	0.366	0.004
Spain1	20	0.484	0.004	0.254	0.009	0.369	0.004
German1	20	0.486	0.015	0.264	0.01	0.375	0.008
Italy1	20	0.472	0.008	0.231	0.014	0.351	0.007
French1	20	0.483	0.01	0.233	0.006	0.358	0.003
Holland1	20	0.485	0.003	0.284	0.005	0.385	0.003
Portugal1	20	0.483	0.013	0.249	0.013	0.366	0.002
England2	20	0.46	0.014	0.267	0.007	0.364	0.006
Japan1	20	0.425	0.013	0.347	0.026	0.386	0.008
China1	20	0.475	0.009	0.213	0.014	0.344	0.009
Total	200	0.472	0.021	0.261	0.03	0.366	0.014

Table 3. Winning percentage with conditional probability (pervious match outcomes)

	N	$P(W 1W)$		$P(W 2W)$		$P(W 3W)$	
		\bar{X}	SD	\bar{X}	SD	\bar{X}	SD
England1	20	0.364	0.035	0.464	0.036	0.522	0.07
Spain1	20	0.347	0.038	0.448	0.048	0.575	0.055
German1	20	0.354	0.035	0.463	0.054	0.532	0.074
Italy1	20	0.345	0.034	0.460	0.042	0.540	0.075
French1	20	0.335	0.034	0.446	0.051	0.510	0.089
Holland1	20	0.385	0.031	0.487	0.051	0.583	0.06
Portugal1	20	0.350	0.036	0.499	0.059	0.588	0.079
England2	20	0.351	0.023	0.405	0.031	0.494	0.05
Japan1	20	0.387	0.036	0.449	0.06	0.518	0.071
China1	20	0.341	0.046	0.484	0.072	0.564	0.105
Total	200	0.356	0.038	0.461	0.057	0.543	0.079

3.3 Analysis of the Winning Percentage with Conditional Probability (Home or Away Games and Previous Match Outcomes)

From Table 4, under the condition of the same winning streak, the winning percentage of the next home game is higher than that of the next away game. Winning percentage with conditional probability of home games increases monotonically with the number of pervious wins. But the same phenomenon doesn't exist in the away games of German1, French1, England2 or China1.

Table 4. Analysis of winning percentage

	N	Home			Away		
		P(W 1W)	P(W 2W)	P(W 3W)	P(W 1W)	P(W 2W)	P(W 3W)
		$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$
England1	20	0.463 \pm 0.043	0.550 \pm 0.067	0.611 \pm 0.064	0.381 \pm 0.065	0.508 \pm 0.094	0.530 \pm 0.215
Spain1	20	0.484 \pm 0.040	0.565 \pm 0.060	0.622 \pm 0.067	0.372 \pm 0.046	0.523 \pm 0.090	0.584 \pm 0.247
German1	20	0.492 \pm 0.037	0.575 \pm 0.061	0.658 \pm 0.090	0.396 \pm 0.035	0.498 \pm 0.087	0.478 \pm 0.308
Italy1	20	0.478 \pm 0.050	0.576 \pm 0.058	0.634 \pm 0.061	0.389 \pm 0.041	0.532 \pm 0.098	0.581 \pm 0.242
French1	20	0.471 \pm 0.040	0.536 \pm 0.044	0.585 \pm 0.066	0.364 \pm 0.035	0.548 \pm 0.089	0.525 \pm 0.231
Holland1	20	0.502 \pm 0.028	0.590 \pm 0.061	0.631 \pm 0.076	0.425 \pm 0.043	0.552 \pm 0.078	0.620 \pm 0.200
Portugal1	20	0.489 \pm 0.040	0.584 \pm 0.068	0.646 \pm 0.102	0.420 \pm 0.051	0.561 \pm 0.095	0.590 \pm 0.178
England2	20	0.440 \pm 0.023	0.508 \pm 0.037	0.561 \pm 0.066	0.338 \pm 0.035	0.464 \pm 0.069	0.446 \pm 0.172
Japan1	20	0.461 \pm 0.049	0.531 \pm 0.072	0.586 \pm 0.091	0.392 \pm 0.032	0.516 \pm 0.058	0.528 \pm 0.210
China1	20	0.498 \pm 0.052	0.572 \pm 0.079	0.638 \pm 0.151	0.440 \pm 0.077	0.575 \pm 0.196	0.396 \pm 0.350
Total	200	0.478 \pm 0.044	0.559 \pm 0.065	0.617 \pm 0.090	0.392 \pm 0.055	0.528 \pm 0.104	0.528 \pm 0.245

3.4 UNIAOVA of Winning Percentage

In Table 5, there is a very significant difference in the winning percentage between home and away games ($P < 0.001$), and the effect size is great, which imply that the phenomenon of Home Game Advantage is widespread and obvious in professional football leagues.

There is a very significant difference in the winning percentage among different winning streak groups ($P < 0.01$). It indicates that there is “Hot Match” Effect in professional football leagues, especially in home games. Winning percentage with conditional probability of home games increases monotonically with the number of pervious wins.

In the analysis of the factor (home or away and winning streak), there is a very significant difference in Italy1 ($F = 8.341$, $P < 0.001$, $\eta_p^2 = 0.141$), French1 ($F = 13.977$, $P < 0.001$, $\eta_p^2 = 0.216$), Holland1 ($F = 9.726$, $P < 0.001$, $\eta_p^2 = 0.161$) and Portugal1 ($F = 11.789$, $P < 0.001$, $\eta_p^2 = 0.189$), and all the effect sizes are great. There is also a very significant difference in England1 ($F = 3.165$, $P < 0.01$, $\eta_p^2 = 0.089$), Spain1 ($F = 7.923$, $P < 0.001$, $\eta_p^2 = 0.135$), England2 ($F = 7.119$, $P < 0.001$, $\eta_p^2 = 0.123$) and China1 ($F = 7.018$, $P < 0.001$, $\eta_p^2 = 0.123$), while all the effect sizes are medium. There is a significant difference in the German1 ($F = 3.206$, $P < 0.05$, $\eta_p^2 = 0.06$), and the effect size is medium, but there is no significant difference in Japan1. All the results suggest that there is an interactive effect between home or away games and the number of previous wins.

Table 5. The UNIANOVA of winning percentage

	England1	Spain1	German1	Italy1	French1	Holland1	Portugal1	England2	Japan1	China1
Home or Away F	23.032	44.059	56.608	45.800	46.796	37.064	48.801	97.952	15.106	31.283
Home or Away P	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**
Home or Away η_p^2	0.234	0.225	0.271	0.232	0.235	0.196	0.243	0.392	0.090	0.171
Streak of wins F	40.104	45.004	21.086	53.846	42.115	64.127	69.399	36.779	31.634	15.294
Streak of wins P	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**
Streak of wins η_p^2	0.443	0.470	0.294	0.515	0.454	0.559	0.578	0.421	0.384	0.232
Home or Away \times Streak of wins F	4.905	7.923	3.206	8.341	13.977	9.726	11.789	7.119	0.945	7.018
Home or Away \times Streak of wins P	<0.01 **	<0.001**	0.025 *	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**	0.421	<0.001**
Home or Away \times Streak of wins η_p^2	0.089	0.135	0.060	0.141	0.216	0.161	0.189	0.123	0.018	0.122

3.5 UNIANOVA of Winning Percentage (Overall Data)

Taken together, the 10 leagues’ overall data paint a picture of how “League” as a factor was introduced in the UNIANOVA.

In Table 6, there is a very significant difference in the winning percentage among different leagues ($P < 0.001$), but the effect size is small.

A very significant difference exists both in the winning percentage between home or away games ($P < 0.001$) and in the winning percentage among different winning streak groups ($P < 0.01$), which implies that the phenomenon of Home Game Advantage and “Hot Match” Effect is widespread and obvious in professional football leagues.

Table 6. The UNIANOVA of winning percentage (overall data)

	F	P	η_p^2
League	7.010	<0.001**	.040
Home or Away	403.214	<0.001**	.210
Streak of wins	374.965	<0.001**	.425
League * Home or Away	1.856	0.055	.011
League * Streak of wins	2.010	0.002*	.034
Home or Away * Streak of wins	65.576	<0.001**	.115
League * Home or Away * Streak of wins	2.003	0.002*	.034

4 Conclusion

Hot Match Effect exists in professional football leagues, and is particularly obvious in home games. The Hot Match Effect is more significance with the increase of the winning streak in home games. The interaction effect between the two factors (home or away, results of the previous games) is significant in terms of winning percentage.

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