

Effect of pass and shoot efficiency: Analysis of Italian first league ranking

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ABSTRACT

Season rankings in football leagues are affected by the number of goals scored, shots, effective shots, and passes. Extant studies have examined the factors that affect a team's win or lose, including fewer passes, number of successful passes, more shots, passes in opposition half, scoring efficiency, and pass efficiency. However, the factors that predict and directly affect success in football are diverse and lack consistency. This study thus investigated the factors affecting league rankings in the Italian professional football league, Serie A, and analysed them considering the efficiency of pass and shoot. The analysis confirmed that pass and shoot efficiency significantly affects victory points. Therefore, efficiency can be used as a factor that affects season rankings.

Keywords: Performance analysis of sport, Football, Italian league, Ranking, Efficiency.

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INTRODUCTION

Italian professional football is one of the most famous football leagues globally. Football leagues range from the first to fourth divisions. Serie A, the first division, has currently 20 clubs. Each club plays against another club twice a season, with 38 matches per club, on a home-and-away basis. The top four clubs in the league receive a direct spot in the group stage of the UEFA Champions League and the bottom three clubs are relegated to Serie B. Thus, it is necessary to keep the rankings as stable as possible by managing points during each season, which results in the importance of each club running games and managing points efficiently throughout the season.

Football requires an analysis of player and team performance, and many previous studies have focused on the factors that affect success in football. Studies on efficiency analysis for attack indicators focus on shooting and effective shots and passes. These defence indicators focus on tackles, clearance, and so on, and studies on the analysis of league rankings based on points scored and conceded have also been conducted. However, there is a limit to explaining the indicators for performance analysis by teams using points, possession, and number of passes. For example, possession and points do not necessarily coincide (Harrop & Nevill, 2014).

In the Qatar World Cup final qualifier playoffs, Italy played against North Macedonia. Italy had 28 more shots, 66:34 possession, and 254 passes, and still lost that match 1:0. Studies have found that successful passes, more shots, and passes in the opposition half are factors that affect a team's win. However, it is difficult to explain a game's result and consider its success factors because the factors that affect a team's wins in football lack consistency.

In this study, we present the possibility of analysing matches using pass and shoot efficiency for Serie A clubs and compare and contrast these factors in consideration of season rankings.

The structure of this paper is as follows. The following section summarizes existing research and the theoretical background. Then, the analysis method of efficiency analysis are explained in the research method section. The descriptive statistics and efficiency analysis results are summarized in the results section, while the implications of this study are discussed in the discussion and conclusion.

Literature review

This study analyses Italian football clubs that affect the victory and ranking of existing clubs. Similar, although limited, research has also been conducted on football clubs in England, Spain, and Germany.

Oberstone (2009) asserted that, as a factor influencing season rankings, fewer shots to make a goal are an important predictor in the English first division. Lago-Ballesteros and Lago-Peñas (2010) noted that the top teams in the Spanish first division had more goals, shots, and shots on goal. Collet (2013) presented the efficiency of the pass leading to a goal, while Harrop and Nevill (2014) found that fewer passes and passes in opposition half were important factors in winning a game in League 1, England. Broich et al. (2014) stated that goal efficiency was important for team victory in the German first division. Hwang (2022) noted that game efficiency can bring positive results to a season's performance in the Korean professional soccer.

Existing studies have also found that success factors in football are diverse, although these analyses were limited to specific leagues. This study thus aims to narrow down the number of performance indicators of efficiency pass and shoot in football. The efficiency analysis was conducted from the efficiency viewpoint, a

factor influencing each team's points.

There are several ways in which this study differs from existing research. First, it analysed the rankings using pass and shoot efficiency as performance indicators that affect the match. Second, efficiency was analysed as a factor that significantly affects the season ranking, so that the actual league ranking and victory points can be explained more accurately. Football is relatively behind in terms of the development and utilization of these indicators. If the various indicators from the viewpoint of game efficiency in this study are developed further, they could be used to improve team performance and create a better understanding of football.

DATA AND METHODS

Data

This study analysed 20 clubs in Serie A League 1 (first division) in the 2020–21 and 2021–22 seasons, based on data provided by the WhoScored portal service, the world's largest online football statistics portal. The detailed data for 2020–21 are shown in Table 1. The MaxDea commercial program was used for efficiency analysis. The number of decision-making units (DMUs) varies from researcher to researcher, and it is worth noting that it is recommended to set it to at least $(\text{input} + \text{output}) \times 3$ or more than $\text{input} \times \text{output}$ (Cooper et al., 2007). Considering that the discriminative power of efficiency analysis is lower when there are many input and output factors compared to DMU, an analysis of 20 DMUs reflecting four input factors and one output factor can be considered appropriate.

Table 1. 2020/2021 Italian first league team data.

Year	Name of club	Input variable (number)			Output variable	
		Shots	Effective shots	Passes	Offensive passes	Points
2020	Inter	348	204	12.377	5.056	91
	AC Milan	351	206	10.656	4.353	79
	Atalanta	389	232	11.301	5.822	78
	Juventus	379	216	13.437	5.489	78
	Napoli	419	226	12.557	5.382	77
	Lazio	338	186	11.546	4.490	68
	Roma	345	200	11.407	4.659	62
	Sassuolo	350	180	13.882	5.670	62
	Sampdoria	287	141	8.837	3.609	52
	Verona	278	125	8.867	3.448	45
	Genoa	216	126	9.944	3.140	42
	Bologna	319	180	9.912	3.855	41
	Fiorentina	248	124	8.866	3.622	40
	Udinese	283	131	9.647	3.390	40
	Spezia	251	136	10.340	4.223	39
	Cagliari	303	131	8.848	3.272	37
	Torino	312	151	9.274	3.258	37
	Benevento	284	134	8.027	2.676	33
	Crotone	240	122	9.673	3.055	23
	Parma Calcio 1913	267	130	10.578	3.341	20

2021	AC Milan	404	196	10.198	4.581	86
	Inter	424	254	12.005	5.394	84
	Napoli	378	201	13.228	5.403	79
	Juventus	351	172	11.510	4.044	70
	Lazio	259	195	13.524	5.260	64
	Roma	403	198	10.088	4.121	63
	Fiorentina	327	186	11.322	5.086	62
	Atalanta	427	177	10.732	5.286	59
	Verona	303	160	8.725	3.393	53
	Torino	322	154	8.991	4.039	50
	Sassuolo	363	213	11.800	4.364	50
	Udinese	322	187	7.839	3.049	47
	Bologna	290	149	10.003	3.514	46
	Empoli	333	164	8.331	3.403	41
	Sampdoria	266	125	8.870	3.116	36
	Spezia	251	135	8.042	2.681	36
	Salernitana	291	140	7.206	2.665	31
	Cagliari	300	124	7.746	2.865	30
	Genoa	289	115	7.519	2.781	28
	Venezia	235	120	8.098	2.557	27

In this study, shot, effective shot, pass, and the number of passes to the attacking side were selected as input elements and directly related indicators. The input factors were considered in previous studies. A lower pass-to-shots-on-goal ratio (Collet, 2013) and fewer passes and passes in opposition half were found to affect the season ranking (Harrop & Nevill, 2014), and the offensive pass was effective in scoring efficiency (Tenga & Sigmundstad, 2011). Winning football teams recorded significantly higher numbers of shooting and shooting on target (Lago-Peñas et al., 2011).

A game begins with a pass and ends with a shot. Table 3 shows that the pass rate for the 2021 season was 28% of all passes made. The process of deploying the opposition third is an important factor in winning or losing. A high pass success rate to the opponent's attacking side means a higher possibility of scoring. Therefore, efficient game operation through passing is necessary. Generally, shots and effective shots are used as the most important attack indicators. The scoring success rate was 35%, while the effective shooting success rate was only 35%. Broich et al. (2014) found that goal efficiency is an important factor in league standings.

Table 2. Italian first league data summary, 2020/2021.

Year	Division	Average	Standard deviation	Minimum value	Maximum value
2020	Shooting	310	54.1	216	419
	Effective shot	164	39	122	232
	Number of passes	10.499	1.638	8.027	13.882
	Attack pass	4.091	971	2.676	5.822
2021	Shooting	327	57.9	235	427
	Effective shot	168	36.4	115	254
	Number of passes	9.789	1.942	7.206	13.524
	Attack pass	3.880	1.942	2.557	5.403

Efficient game strategies that continue the flow of offense through passes to the opposition third can lead to a win. In terms of efficiency, if a team takes many passes with a small number of attacks, the team's game efficiency can be interpreted as high.

The number of shots, number of shots on target, number of passes, and number of passes in the opposition third were used as input factors. An analysis was conducted to confirm the possibility that clubs with high efficiency could rank high in a season by developing the arguments in existing studies.

Table 3. Goal, target shooting, and final third pass efficiency.

Year	Scoring success rate	Effective shooting success rate	Offensive pass rate
	(Scores/Number of shots on target)	(Number of effective shots/ Number of total shots)	(Number of passes in the attacking camp/ Number of total passes)
2020	35%	35%	28%
2021	32%	34%	28%

Methods

Data envelopment analysis (DEA) can be defined as input versus output because efficiency is measured with input and output factors. It is possible to measure whether a DMU is efficient or inefficient by comparing the efficiency of input versus output. We measure the relative efficiency of individual DMUs by measuring their distances using linear programming. Previous research has also used DEA to analyse the efficiency of football clubs (Barros & Leach, 2006; Espitia-Escuer & García-Cebrián, 2004; Espitia-Escuer & García-Cebrián, 2010; García-Sánchez, 2007; Haas et al., 2004; Haas, 2003; Rossi et al., 2019; Tenga et al., 2010).

Efficiency can be calculated as a value between 0 and 1 and relative efficiency can be compared based on a DMU with high efficiency; an inefficient DMU that has the advantage of being able to calculate what needs to be improved among input or output factors. The CCR model, which assumes constant returns to scale, and the BCC model, which assumes variable returns to scale, are most commonly used. The CCR and BCC analytical models can be distinguished depending on the relationship between input and output. In this study the input-oriented model of the CCR was used, as we aimed to improve efficiency by minimizing input with a fixed output. Inefficient DMUs are classified based on the DMU standard, with an efficiency score of 1, and the relative comparison of each DMU seeks to find its efficiency ranking through super-efficiency analysis. The equation below is an input-oriented model, where θ^{k*} is the efficiency of a DMU (Charnes et al., 1978):

$$\begin{aligned}\theta^{k*} &= \text{Min } \theta - \epsilon \left(\sum_{i=1}^M s_i^- + \sum_{r=1}^s s_r^+ \right) \\ x_{ki}\theta - \sum_{j=1}^n x_{ji}\lambda_j &= s_i^- (i = 1, 2, \dots, M) \\ \sum_{j=1}^n y_{jr}\lambda_j - y_{kr} &= s_r^+ (r = 1, 2, \dots, s) \\ \lambda_j &\geq 0 (j = 1, 2, \dots, J) \\ s_i^- &\geq 0 (i = 1, 2, \dots, M) \\ s_r^+ &\geq 0 (r = 1, 2, \dots, N)\end{aligned}$$

RESULTS AND DISCUSSION

Efficiency results

The results of the efficiency analysis of clubs in the 2020–21 season are shown in Table 4. The winning team, Inter Milan, had the highest game efficiency score, while Parma Calcio had the lowest efficiency score. The league rankings are also ranked in order of efficiency points from first to fifth. In other words, as a result of the efficiency analysis, the top five teams were ranked in terms of season performance.

The team rankings and efficiency results for the 2021–22 season are shown in Table 5. The winning team, AC Milan, had the highest game efficiency score, while the three relegated teams (Cagliari, Genoa, and Venezia) had the lowest efficiency scores.

The analysis of the two seasons' efficiency scores indicates that efficiency score can be a factor in determining the league champion and runner-up team. The relegated team was also analysed as having the lowest efficiency score.

Table 4. Efficiency results in the Italian league, 2020/2021.

Year	Ranking	Club name	Efficiency	Points
2020	1	Inter	1.1	91
	2	AC Milan	1	79
	3	Atalanta	0.9	78
	4	Juventus	0.8	78
	5	Napoli	0.8	77
	6	Lazio	0.8	68
	7	Roma	0.7	62
	8	Sassuolo	0.7	62
	9	Sampdoria	0.8	52
	10	Verona	0.8	45
	11	Genoa	0.7	42
	12	Bologna	0.5	41
	13	Udinese	0.6	40
	14	Fiorentina	0.7	40
	15	Spezia	0.6	39
	16	Torino	0.6	37
	17	Cagliari	0.6	37
	18	Benevento	0.6	33
	19	Crotone	0.4	23
	20	Parma Calcio 1913	0.3	20
2021	1	AC Milan	1.2	86
	2	Inter	0.9	84
	3	Napoli	0.9	79
	4	Juventus	0.9	70
	5	Lazio	1.1	64
	6	Roma	0.8	63
	7	Fiorentina	0.8	62
	8	Atalanta	0.7	59
	9	Verona	0.8	53

10	Torino	0.7	50
11	Sassuolo	0.6	50
12	Udinese	0.8	47
13	Bologna	0.7	46
14	Empoli	0.6	41
15	Sampdoria	0.6	36
16	Spezia	0.7	36
17	Salernitana	0.6	31
18	Cagliari	0.5	30
19	Genoa	0.5	28
20	Venezia	0.5	27

Data comparison

The analysis of team statistics in the 2020–21 season in Table 5 shows the same results as in Table 4. Atlanta had the highest effective shot and attack pass, and Napoli had the highest shooting, but champion team Inter Milan had the highest efficiency. The lowest ranked team Parma Calcio 1913, which had the lowest efficiency. In the 2021–22 season showed that AC Milan, as the winning team, had the highest efficiency. By contrast, Venezia had the lowest efficiency.

As factors influencing season rankings, more shots and attack passes are important predictors. However, the top team in the Italian league had the highest efficiency. By contrast, the lowest ranked team had the lowest efficiency. In other words, efficiency was important for team victory in the Italian league. From the efficiency scores of the two seasons, we can conclude that pass and shoot efficiency can be a factor in determining the league champion.

Table 5. Team comparison.

Year	Division	Minimum team (ranking)	Maximum team (ranking)
2020	Shooting	Genoa (11th)	Napoli (5th)
	Effective shot	Crotone (19th)	Atalanta (3rd)
	Number of passes	Benevento (18th)	Sassuolo (7th)
	Attack pass	Benevento (18th)	Atalanta (3rd)
	Efficiency of pass and shoot	Parma Calcio 1913 (20th)	Inter Milan (1st)
2021	Shooting	Venezia (20th)	Atalanta (8th)
	Effective shot	Genoa (19th)	Inter Milan (2nd)
	Number of passes	Salernitana (17th)	Lazio (5th)
	Attack pass	Venezia (20th)	Napoli (3rd)
	Efficiency of pass and shoot	Venezia/Genoa/Cagliari (20th)/(19th)/(18th)	AC Milan (1st)

CONCLUSIONS

In this study, the efficiency score was used as a factor that affects the season ranking of the Italian Serie A League. We confirmed that the season rankings are directly affected by game efficiency.

The main results of this study are as follows. First, the champion team during the 2020–21 and 2021–22 season was the club with the highest pass and shoot efficiency. The efficiency score was calculated by selected indicators such as the number of shots, number of shots on target, number of passes, and number

of passes in the opposition third. Second, the demoted team was analysed to be at the lowest level in the league in terms of efficiency score. Third, in terms of statistics, in general, it can be thought that a large number of shots and passes will have a positive effect on the outcome of a game, but this high number does not affect the outcome of league ranking. Considering the schedule for the European Champions League, in which the top four teams qualify, efficient game management should be a priority for the top teams.

In summary, to achieve positive performance results during the season, clubs must operate the match strategically in terms of pass and shoot efficiency. In this context, this study shows that game efficiency affects seasonal performance. Efficiently completing an attack sequence can be crucial, and the Italian league plays with the shortest attack sequence compared to other leagues (Mitrotasios et al., 2019). Therefore, rather than running a game to increase possession, teams must focus on the build-up for the attack, which relates to a pass and is finished with a goal. The Italian league analysed that defence is more important than offense as a success factor (Boscc et al., 2009). Thus, this research may be of interest to football club coaches, football analysts, and football fans.

This study has several limitations that provide directions for future research. First, the offensive and defensive factors may affect the results, as we only used pass and shoot as performance indicators. Second, we focused only on one football league, meaning the results may not be generalizable to other leagues. Future studies could aim to include more European leagues in their analysis and also consider using various performance indicators.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author.

REFERENCES

- Barros, C. P., & Leach, S. (2006). Performance evaluation of the English Premier Football League with data envelopment analysis. *Appl Econ*, 38(12), 1449-1458. <https://doi.org/10.1080/00036840500396574>
- Boscá, J. E., Liern, V., Martínez, A., & Sala, R. (2009). Increasing offensive or defensive efficiency? An analysis of Italian and Spanish football. *Omega*, 37(1), 63-78. <https://doi.org/10.1016/j.omega.2006.08.002>
- Broich, H., Mester, J., Seifriz, F., & Yue, Z. (2014). Statistical analysis for the First Bundesliga in the current soccer season. *Prog App Math*, 7(2), 1-8.
- Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *Eu J Oper Res*, 2(6), 429-444. [https://doi.org/10.1016/0377-2217\(78\)90138-8](https://doi.org/10.1016/0377-2217(78)90138-8)
- Collet, C. (2013). The possession game? A comparative analysis of ball retention and team success in European and international football, 2007-2010. *J Sports Sci*, 31(2), 123-136. <https://doi.org/10.1080/02640414.2012.727455>
- Cooper, W. W., Seiford, L. M., & Tone, K. (2007). *Data envelopment analysis: A comprehensive text with models, applications, references and DEA-solver software* (Vol. 2). Springer. <https://doi.org/10.1007/978-0-387-45283-8>

- Espitia-Escuer, M., & Garcia-Cebrián, L. I. (2004). Measuring the efficiency of Spanish first-division soccer teams. *J Sports Econ*, 5(4), 329-346. <https://doi.org/10.1177/1527002503258047>
- Espitia-Escuer, M., & García-Cebrián, L. I. (2010). Measurement of the efficiency of football teams in the Champions League. *Manag Decis Econ*, 31(6), 373-386. <https://doi.org/10.1002/mde.1491>
- García-Sánchez, I. M. (2007). Efficiency and effectiveness of Spanish football teams: A three-stage-DEA approach. *Cent Eur J Oper*, 15, 21-45. <https://doi.org/10.1007/s10100-006-0017-4>
- Haas, D. J. (2003). Productive efficiency of English football teams-A data envelopment analysis approach. *Manag Decis Econ*, 24(5), 403-410. <https://doi.org/10.1002/mde.1105>
- Haas, D., Kocher, M. G., & Sutter, M. (2004). Measuring efficiency of German football teams by data envelopment analysis. *Cent Eu J Oper*, 12(3), 251-268.
- Harrop, K., & Nevill, A. (2014). Performance indicators that predict success in an English professional League One soccer team. *Int J Perform Anal Spor*, 14(3), 907-920. <https://doi.org/10.1080/24748668.2014.11868767>
- Hwang, H. C. (2022). Analysis of the effect of game efficiency of Korean professional soccer club on season performance. *Korean Society for Sport Management*, 27(6), 55-67. <https://doi.org/10.31308/KSSM.27.6.55>
- Lago-Ballesteros, J., & Lago-Peñas, C. (2010). Performance in team sports: Identifying the keys to success in soccer. *J Hum Kinet*, 25(1), 85-91. <https://doi.org/10.2478/v10078-010-0035-0>
- Lago-Peñas, C., Lago-Ballesteros, J., & Rey, E. (2011). Differences in performance indicators between winning and losing teams in the UEFA Champions League. *J Hum Kinet*, 27(1), 135-146. <https://doi.org/10.2478/v10078-011-0011-3>
- Mitrotasios, M., Gonzalez-Rodenas, J., Armatas, V., & Aranda, R. (2019). The creation of goal scoring opportunities in professional soccer. tactical differences between Spanish la Liga, English Premier League, German Bundesliga and Italian Serie A. *Int J Perform Anal Sport*, 19(3), 452-465. <https://doi.org/10.1080/24748668.2019.1618568>
- Oberstone, J. (2009). Differentiating the top English premier league football clubs from the rest of the pack: Identifying the keys to success. *J Quant Anal Sports*, 5(3), 10. <https://doi.org/10.2202/1559-0410.1183>
- Rossi, G., Goossens, D., Di Tanna, G. L., & Addesa, F. (2019). Football team performance efficiency and effectiveness in a corruptive context: The Calciopoli case. *Eur Sport Manag Quart*, 19(5), 583-604. <https://doi.org/10.1080/16184742.2018.1553056>
- Tenga, A., & Sigmundstad, E. (2011). Characteristics of goal-scoring possessions in open play: Comparing the top, in-between and bottom teams from professional soccer league. *Int J Perform Anal Sport*, 11(3), 545-552. <https://doi.org/10.1080/24748668.2011.11868572>
- Tenga, A., Ronglan, L.T., and Bahr, R. (2010). Measuring the effectiveness of offensive match-play in professional soccer. *Eur J Sport Sci*, 10(4), 269-277. <https://doi.org/10.1080/17461390903515170>

