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Measuring Efficiency of Professional Football Club in Contemporary Researches

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Abstract: In this paper we analyze modern approaches which are used to measure efficiency of professional football clubs. We have made a brief survey of current scientific researches over last few years devoted to the football clubs' efficiency. The results of our research show that the most popular object of study is football clubs from Great Britain. It can be explained due to the high information transparency and business activity on the stock market. The most popular method of analysis used in modern researches is the method of data envelopment analysis (DEA). On the base of analyzed studies it is possible to sum up that sports performance of football club depends primarily on the human capital of players and coaches and staff costs. The financial efficiency of the football clubs mainly depends on the sports efficiency.

Key words: Efficiency · Football clubs · Financial efficiency · Sports efficiency · Data Envelopment Analysis (DEA) · Regression analysis

INTRODUCTION

Nowadays the topic of football economy is becoming more and more urgent. In the economic literature many papers are devoted to the analysis of the efficiency of professional football club as business unit. The variety of tools of economic analysis provides the assessment of the clubs' efficiency from different points of view.

While Russian scientists in researching of football clubs usually used standard ratio analysis of financial stability, liquidity and solvency, foreign practice has accumulated positive experience of using economic and statistical methods for analyzing and predicting the performance of football clubs.

This is a summary survey of contemporary studies of football clubs' efficiency. On the base of analysis of international researches over last few years we have classified all works in groups according to the several criteria:

- The object of study;
- The subject of study;
- The method used for the study.

Most researches are devoted to the analysis of English football clubs [1-8]. There are also rare studies of football clubs from Germany [9-11] and France [12, 13]. Such countries as Brazil [14], Denmark [15], Greece [16], Iran [17], Japan [18], Portugal [16], Spain [19] and Turkey [20] are represented in scientific researches, but only once.

In many ways, it is due to the fact that English clubs were among the first clubs floated on the stock market. For example, N. Rowbottom [21] has written that the first information about listed English football clubs dated back to 1996. In contrast to this football clubs of other European countries are represented in the stock market very poor. As a result, information transparency and accessibility of information have led to the popularity of English football clubs as a convenient object of study.

General Review of the Literature: Generally all variety of methods used to analyze the efficiency of football club can be divided into two large groups:

- Parametric methods;
- Non-parametric methods.

Parametric methods are a group of methods, which use the tools of deterministic correlation and regression analysis. These methods include linear and non-linear regression models, simple and multiple regression, the

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Cobb-Douglas function etc. This approach can identify and define the type of relationship between the studied variables, it also allows to identify the functional dependence.

Non-parametric methods are focused primarily on the overall assessment of the efficiency. This assessment is based on the analysis of set of inputs and outputs which characterize the activity of the object under review. In this case, the establishment of a functional connection is not critical, because the performance evaluation is performed using weighted indices and weights for all variables. For example, typical non-parametric methods are stochastic frontier model and data envelopment analysis (DEA). It should be noted that the most popular method of analysis of clubs' efficiency is the method of data envelopment analysis (DEA).

The idea of DEA belongs to Farrell [22]. He has tried to measure the effectiveness of one unit of final product in example of one input factor and one output parameter. Farrell applied this model to measure the performance of agriculture in the USA compared to other countries. But he could not find a way to combine all the various inputs and outputs into a single virtual input and output respectively. This idea was further developed by Charnes, Cooper and Rhodes, who reformulated it in a mathematical programming problem.

First DEA-model has been developed and offered by Charnes, Cooper and Rhodes (CCR-model). The model is based on the method of Farrell for measuring the effectiveness of each decision making unit (DMU) with the functions of production capacity, or production functions.

Later in the model of Charnes, Cooper and Rhodes multiple input and output parameters of each DMU are combined in all sorts of scalar input and output parameters (under constant returns of scale-CRS).

DEA identifies the efficient DMU among other involved units by constructing the efficiency frontier, but for everyone else-a measure of their inefficiency.

Evaluation of units is made by using principal of optimization. The criterion for the detection of DEA efficiency is to achieve a Pareto optimum, or Pareto efficiency. According to the theory the economic situation is Pareto efficient if in a given time for a given technology and resources it is impossible to produce larger quantities of at least one product with producing the same amount of other products. This means that combination of used manufacturing processes is optimal.

According to Charnes, Cooper and Rhodes efficiency is determined as follow:

DMU is 100% Effective if:

- None of outputs can be increased without an increase of one or more input factors or reducing other outputs;
- None of inputs can be reduced without reducing one or more outputs or enhancing other inputs.

Performance measurement in the CCR-model uses optimal generalized correspondence between the participating outputs and inputs. This method determines an estimation of the parameters in such a way that the observed DMU was on a scale from 0 (lowest efficiency) to 1 (maximum efficiency) and has taken efficiency value e_o, as high as possible in given ratio of inputs and outputs of all observed units under review.

The evaluation of all involved in the research DMUs is made in order to maximize the efficiency of the DMU but in limits not exceeding a value of 1. Formally, this task consists of solving the following maximization problem [22]:

$$e_o = \frac{\sum_{j=1}^{s} u_j y_{jo}}{\sum_{i=1}^{r} v_i x_{io}} \to \max$$

subject to:

$$\frac{\sum_{j=1}^{s} u_j y_{jm}}{\sum_{i=1}^{r} v_i x_{im}} \le 1 \quad ; \text{m} = 1, 2, \ldots, \text{n}$$

$$u_j v_i \ge 0 \; ; \text{j} = 1, 2, \ldots, \text{s}; \text{i} = 1, 2, \ldots, \text{r}$$

where x_{im}, y_{jm} are amount of inputs and outputs of the DMU j; and u_j, $v_i \ge 0$ are the weight given to outputs and inputs.

Thus, DEA provides an answer to the question of whether analyzed business unit is effective or not and how its current performance differs from the ideal. In this case DEA method shows the reasons of inefficiency, which provide basic ways to improve the current level of efficiency-by improving the inefficient management (pure technical efficiency) or adverse conditions (technical efficiency). However, this method of analysis doesn't allow to identify and assess the impact of factors which are expected to influence on the efficiency of the object.

Non-parametric methods were used by different authors such as Barros, C.P. and J. Douvis [16], Barros, C.P. and P. Garcia-del-Barrio [1], Dawson, P. and S. Dobson [2], Frick, B. and R. Simmons [9],

Garcia-Sanchez, I.M. [19], Guzman, I. and S. Morrow [3], Haas, D.J. [4], Halkos, G. and N. Tzeremes [23], Jardin, M. [12], Kern, M. and B. Süssmuth [10], Soleimani-Damaneh, J., M. Hamidi and N. Sajadi [17].

In contrast to nonparametric methods traditional methods of correlation and regression analysis seem to be more informative. Correlation analysis usually establishes the existence of relationship between the studied variables and regression analysis estimates the impact of these factors on the dependent variable. Thus, correlation and regression analysis not only find out the relationship between the factors and the dependent variable, but also allows estimating the impact of the studied factors on the efficiency of football club.

Correlation and regression analysis was the basis of the research works of Aglietta, M., W. Andreff and B. Drut [13], Baur, D.G. and C. McKeating [24], Beck, N. and M. Meyer [11], Carmichael, F., I. McHale and T. Dennis [5], Forker J. [6], Jørgensen, C.W., M.R. Moritzen and G. Stadtmann [15], McNamara, P., S. Peck and A. Sasson [7], Samagaio, A., E. Couto and J. Caiado [8].

However, except for difference in the tools used to analyze, there is also difference in the understanding of the football club efficiency. Researchers consider the efficiency of football club from different points of view- according to the foreground aims of football clubs. In the scientific literature two approaches are developed to study the efficiency of professional football club:

- Evaluation of economic efficiency;
- Assessment of sports efficiency.

Analysis of Professional Football Club Efficiency in Terms of Sports Results: In terms of sports performance the subject of study, as a rule, is considered as the indicators of play performance-the number of points for the season, goal difference, goals scored, the number of trophies won in the international tournaments, etc. The most remarkable scientific works belong to Beck, N. and M. Meyer [11], Dawson, P. and S. Dobson [2], Frick, B. and R. Simmons [9], Garcaa-Sanchez, I.M. [19], Halkos, G. and N. Tzeremes [23], Karaca, O. [25], Yamamura, E. [18] etc.

Most authors associate sports performance of football club with a number of points scored in a season. Among them are the Baur, D.G. and C. McKeating [24], Barros, C.P. and J. Douvis [16], Frick, B. and R. Simmons [9], Garcia-Sanchez, I.M. [19], Guzman, I. and S. Morrow [3], Haas, D.J. [4], Jardin, M. [12], Kern, M. and B. Süssmuth [10], McNamara, P., S. Peck and A. Sasson [7], Soleimani-Damaneh, J., M. Hamidi and N. Sajadi [17].

Thus, Frick, B. and R. Simmons [9] with the DEA method have analyzed a number of points for season as a sports efficiency on the base of 39 German football clubs which played in the "Bundesliga" during the period of 1981-2003. The results of their work show that coach's wage growth affects the sports performance of the club.

Garcia-Sanchez, I.M. [19] using the DEA method has analyzed the activity of 20 Spanish football clubs who performed in the first division of the Spanish Football League during the season of 2004-2005. He found out that the achievement of high points at the end of the season was largely driven by defense and attack efficiency, which in turn depended on the talent of the players and team size.

Guzmőn, I., S. Morrow [3] and Haas, D.J. [4] have evaluated the sports performance of English football clubs using the same method of analysis (DEA) and the same independent variables (staff costs for players and coaches). However, they obtained different results.

For example, in 2003 Haas, D.J. [4] has analyzed 20 English football clubs which played in the English Football Premier League during the season 2000-2001. He points out that improvement of sports performance requires not only reduction of inputs-player's and coach's salary, but it is also necessary to increase output-the number of points scored.

The study of English football clubs conducted by Guzmőn I. and S. Morrow [3] later in 2007 has showed that the reduction of inputs (salary of players and coaches) to 20% would lead to the growth of sports efficiency.

Jardin, M. [12] in his research work based on the analysis of 14 French clubs during the period of 2004-2007 has used the same methodology and independent variables, like Guzman, I., S. Morrow [3] and Haas, D.J. [4]. The results of his studies showed that the efficiency of football club in general and sports efficiency in particular were decreasing primarily due to the return of scale. Most clubs overinvested in players at the beginning of the season. According to DEA sports and financial leaders of France were not efficient because of too little return on too large investment.

Soleimani-Damaneh, J., M. Hamidi and N. Sajadi [17] have also used the DEA method and wages as independent variable in assessing the efficiency of Iranian football clubs. The results of their study highlight that there is a statistically significant relationship between the sports efficiency of football club and salaries of players and coaches. However, a too high salary increase is a factor of reducing the efficiency of football club.

Kern, M., B. Süssmuth [10] and McNamara, P., S. Peck, A. Sasson [7] have chosen talent of players as a factor influencing the sports efficiency. For example,

according to the study of 21 German football clubs of "Bundesliga" for the period of 1999-2001 which was conducted by Kern M., B. Süssmuth [10], the player talent constitution of teams was found to be of paramount importance for success on and off the pitch.

In their turn McNamara, P., S. Peck and A. Sasson [7] on the example of the English clubs acting in the English Football Premier League for more than 12 years have showed that the acquisition of high potential talent wasn't sufficient condition of sports efficiency. Thus, the most important thing is the selection of a manager with experience who is able to make right evaluation of player's talent and to integrate that talent into the current team.

Carmichael, F., I. McHale and T. Dennis [5] have developed a unique indicator of sports efficiency on the base of points scored by team - the club's percentage share of the total points achieved by all clubs during the season. Such calculation is created to reflect competitive balance of distribution of league success. It provides an indication of the degree of competitive balance among football clubs - club's share of total output in the league. By means of the correlation and regression analysis on the base of English football clubs played in the English Football Premier League during the seasons 1998-1999 and 2004-2005, authors have established statistically significant relationship between sports efficiency, salary and talent of players.

Beck, N. and M. Meyer [11] have used goal differences, defined as goals scored by home teams minus goals scored by away teams as indicator of sports efficiency. The correlation and regression analysis on the base of 3366 matches of the German clubs for the period of 1992-2003 showed that sports efficiency of clubs depended primarily on individual characteristics of players-tenure, nationality, age, experience, etc.

Dawson, P. and S. Dobson [2] have considered quantity of victories as sports efficiency of football clubs. They have proposed 3 different indicators for assessing of sports efficiency:

- Total wins divided by total number of games played;
- The total number of wins plus one-third the number of draws divided by the total number of games played;
- The total number of wins plus one half the number of draws divided by the total number of games played.

This approach is used because except wins there are drawn matches in football. In order to reflect this fact two other measures of output are also considered-the total number of wins plus one-third the number of draws divided by the total number of games played and the total number of wins plus one half the number of draws divided by the total number of games played. The results of the research show that essential impact on sports efficiency is provided by characteristics of coach human capital-quality of its play experience and prior affiliation with the current club.

Halkos, G. and N. Tzeremes [23] have considered sports efficiency of football club as quantity of the won trophies. By means of DEA they have analyzed results of 25 largest European football clubs during the period of 2009-2011. Income, current cost of club and size of the loan capital were proposed as independent variables explaining sports efficiency. Nevertheless, results of their analysis showed that sports efficiency of football club wasn't based on the high income or other financial indicators. Thus, researchers stress that money not always guarantees success.

Yamamura, E. [18] has used rate of wins as measure of sports efficiency. Using correlation and regression analysis of Japanese football clubs for the period of 1993-2006 researcher has estimated the influence of salary on sports efficiency. He established that wage disparity within a team reduced team performance during the developing stage but didn't affect it during the developed stage (when endogeneity bias and the unobservable team fixed effects are controlled).

Baur, D.G., C. McKeating [24] and Karaca, O. [25] have analyzed different ranks, which, in their opinion, were able to reflect sports efficiency of football clubs.

For example, Karaca, O. [25] has analyzed influence of foreign players on sports efficiency of football clubs from 36 countries during the period of 2003-2007. For this purpose he has used correlation and regression analysis. Two indicators of sports efficiency were used as dependent variable:

- For assessment at the international level – UEFA Country Ranking points;
- For assessment of national team efficiency-FIFA/Coca-Cola World Ranking points.

The results of the analysis showed that the countries with higher share of legionaries were more successful in international tournaments. However foreign players didn't influence on sports efficiency of national teams.

Analysis of Professional Football Club Efficiency as Business Unit: From financial point of view financial efficiency of football club is usually considered in two aspects:

- The efficiency of the club as business unit which is seeking to maximize total revenues for maintaining its financial stability and solvency;
- The efficiency of the club as an issuer of listed securities which is seeking to maximize the market value of shares or income from market transactions with securities.

The ability to generate income as a feature of club's effective work was analyzed in works of Aglietta, M., W. Andreff and B. Drut [13], Barros, C.P., A.G. Assaf and A.F. de Araujo Jr. [14], Barros, C.P. and J. Douvis [16], Barros, C.P. and P. Garcia-del-Barrio [1], Carmichael, F., I. McHale and T. Dennis [5], Forker, J. [6], Guzman, I. and S. Morrow [3], Haas, D.J. [4], Jardin, M. [12], Kern, M. and B. Süssmuth [10], McNamara, P., S. Peck and A. Sasson [7], Soleimani-Damaneh, J., M. Hamidi and N. Sajadi [17].

Most authors use traditional financial indicators like:

- Total revenue (Guzman, I., Morrow, S.; Haas, D.J.; Kern, M., Süssmuth, B.; Soleimani-Damaneh, J., Hamidi, M., Sajadi, N.);
- Sales (Barros, C.P., Douvis, J.; Forker, J.; Jardin, M.);
- TV rights revenues (Aglietta, M., Andreff, W., Drut, B.);
- Operating profit before depreciation and amortization (Forker, J.);
- Cash flow (Forker, J.);
- Operational cost (Barros, C.P., Garcia-del-Barrio, P.);
- Gross wages (Aglietta, M. andreff, W., Drut, B.).

Some authors use the relative indicators: the total variable cost divided by the price of capital (which is derived by dividing amortizations + depreciations by total assets) (Barros, C. P., A.G. Assaf and A.F. de Araujo Jr.), clubs' share of revenue earned within the league in the season and wage expenditure by the club as a percentage share of total Premiership expenditures (Carmichael, F., McHale, I., Dennis, T.), return on sales (McNamara, P., Peck, S., Sasson, A.).

Guzman, I., S. Morrow [3] and Haas, D.J. [4] using the same DEA method have estimated the influence of participation in the Champions League on financial efficiency of English football clubs.

According to the study of Guzman, I. and S. Morrow [3] participation in the Champions League has a positive impact on the financial success of football club. In contrast to them Haas, D.J. [4] has found that participation in the Champions League did not affect the financial results of the football club.

Kern, M. and B. Süssmuth [10] have also analyzed the total income as an indicator of financial performance of German football clubs played in the "Bundesliga" during the period of 1999-2001 using the Stochastic Frontier Analysis. They found that the fan potential variable and participation in international competitions showed a positive, highly significant impact on revenues.

Barros, C.P. and J. Douvis [16] have used only sales revenue as an indicator of financial efficiency. They have conducted a comparative analysis of the efficiency of Greek and Portuguese clubs who played during the period of 1999-2003. They used method of the Malmquist productivity index based on data envelopment analysis (DEA). The results indicated that the majority of the Greek clubs faced severe problems in terms of their productivity gains, while all Portuguese clubs experienced gains in total productivity in the period under investigation.

Aglietta M., Andreff W., Drut B. [13] have used income from the sale of TV broadcasting rights as an indicator of financial efficiency. They used regression analysis in order to evaluate the impact of several factors:

- Gross wages;
- The population of the town where the club is based;
- Distance that TV channels must cover in order to reach the club's stadium for broadcasting;
- The ranking used by the French league to redistribute 20% of TV rights revenues according to media performance.

In all specifications link between TV rights revenues and payroll is significant. TV broadcasting rights strongly impact on clubs' overall revenues. It means that with important revenues derived from TV rights clubs are able to pay high players' wages in order to gather an efficient team which is the way for winning many games, getting higher revenues from these wins and resulting higher TV rights in the future.

Forker, J. [6] has considered financial efficiency of English football clubs by means of several financial indicators like: sales; operating profit before depreciation and amortization; cash flows from operations; equity market value of listed football clubs. Using correlation and regression analysis he has established positive relationship between operating profit and transfers of the current and last period. However influence of transfers which were made two year before isn't established that's why author, calls into question the received results.

Analysis of professional football club efficiency as participant of stock market

Football club as a full participant of the stock market has been studied in the works of Baur, D.G. an C. McKeating [24], Berument, H., N.B. Ceylan and E. Gozpinar [20], Jørgensen, C.W., M.R. Moritzen and G. Stadtmann [15], Samagaio, A., E. Couto and J. Caiado [8].

For example, Jørgensen, C.W., M.R. Moritzen and G. Stadtmann [15] have conducted the study of stock price of the Danish football club "Brøndby". They have estimated multiple regression model in which dependent variable was the percentage change in the stock price. Jørgensen, C.W., M.R. Moritzen and G. Stadtmann [15] have suggested that dynamics of share price could be influenced by such factors as results of a match with participation of "Brøndby" in the national championship and in the European cup tournaments, win in the Danish cup competition. The results of the correlation and regression analysis show that each point gained has a positive impact on the stock price of football club. Thus, sports efficiency of football club in a certain degree may affect the financial success of club.

Berument, H., N.B. Ceylan and E. Gozpinar [20] have studied average return of the shares of three leading Turkish football clubs-"Besiktaa", "Fenerbahce" and "Galatasaray". The model of time series analysis-autoregressive conditional heteroskedasticity-was used as a method of research. The indicators of sports efficiency were chosen as independent variables: wins in the national cup competitions, wins over foreign competitors. The results of the work show that only for football club "Besiktas" relationship between the return of the shares and sports results is statistically significant and positive. It should be noted that away victory has a greater effect on the dependent variable than a victory on home field.

Another study of the financial efficiency in terms of market evaluation was carried by Samagaio, A., E. Couto and J. Caiado [8]. Using regression analysis they have estimated the financial and non-financial indicators of English football clubs which played in the English Football Premier League during the period of 1995-2007. They have elaborated factor models for two indicators of football club's market efficiency:

- Annual average return of the shares of the various clubs calculated from daily returns:
- The equity risk of the various clubs represented by the standard deviation of return.

Regression analysis allowed them to assess the impact of income, wages, club staff, transfer costs, amortization of players, net profit from the sale of players and other expenses on the dependent variables. The results of the analysis confirmed the hypothesis that the growth of financial efficiency had a positive impact on the market value of the football club's shares.

Baur, D.G. and C. McKeating [24] have conducted a study of 27 European football clubs listed on global stock exchanges and included in the calculation of Dow Jones stoxx football index. Using regression analysis they have found that the stock price of football club depended on current sports efficiency - the number of points scored per game (for the national games), UEFA club rankings (for international games) and a number of related characteristics of the club (the sizes of club, League, the financial market). This relationship is positive and statistically significant.

The results show that in general football clubs do not benefit from a stock market listing. IPO (listing) has a positive impact for the success in the home league only for football clubs playing in smaller leagues or lower division football clubs that belong to large leagues. However, the current stock price does not predict the future success of a football club.

CONCLUSION

Summing up the results of our research we would like to point out several moments.

All variety of methods used to analyze the efficiency of football club in modern studies can be divided into two large groups:

- Parametric methods;
- Non-parametric methods.

Parametric methods are a group of methods, which use the tools of deterministic correlation and regression analysis. These methods include linear and non-linear regression models, simple and multiple regressions, the Cobb-Douglas function etc. This approach can identify and define the type of relationship between the studied variables, it also allows to identify the functional dependence.

Non-parametric methods are focused primarily on the overall assessment of the efficiency. This assessment is based on the analysis of set of inputs and outputs which characterize the activity of the object under review.

Table 1: The most popular factors influencing efficiency of football club

	Financial efficiency	
Sports efficiency	Profit maximization	Stock price maximization
- human capital of player (tenure, age, nationality, experience, success etc)	- sports success	- sports success
- human capital of coach (the length of the manager's playing career, playing position of manager in the playing career, total months managing before the present job, total number of months managing the current club, a prior affiliation with the current club etc)	- size of club	×
- wage sums of players	×	×
- wage sums of coaches	×	×

In this case, the establishment of a functional connection is not critical, because the performance evaluation is performed using weighted indices and weights for all variables. For example, typical non-parametric methods are stochastic frontier model and data envelopment analysis (DEA).

The most popular method of analysis used in contemporary researches is the method of data envelopment analysis (DEA).

We allocated factors which according to researches most often affected the efficiency of football club and had the greatest impact. These factors are represented in the table 1 according to the type of a dependent variable:

As the table 1 shows, sports efficiency of football club depends primarily on the human capital of players and coaches and staff costs. Players' talent to show qualitative game and the coach's ability to put together a team of talents provide the success of the football club on the pitch. In this case, a worthy reward for the work of both players and coaches stimulates to achieve further success on the pitch.

Financial success of the club, seeking to maximize the income, is caused, as a rule, by the sizes of club and sports efficiency. Many large football clubs which take leading positions in the national championship are economically inefficient because of providing too small return on big investments. From this point of view small clubs have significant advantage. Sports successes result in clubs' higher situation in a national rank that allows to participate in the international tournaments and to get access to the new markets of TV broadcasting rights, sponsors' contracts, sales of clubs' symbolic etc.

The financial efficiency of the football clubs, seeking to maximize the market value of their stocks, mainly depends on the sports efficiency. Investors evaluate the investment attractiveness of the club in terms of its current and expected wins, because the relationship between the indicators of sports and financial success is obvious, although is not always straightforward.

Thus, it is possible to tell that in contemporary studies of football clubs' efficiency certain techniques of assessment are already established. All these methods are tested on the big samples representing football club from different countries, including Brazil, Denmark, Germany, Great Britain, Greece, France, Iran, Japan, Portugal, Spain and Turkey.

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Appendix 1

Author	Method of analysis	Subject of research	Dependent variable	Independent variable
Aglietta, M., Andreff, W., Drut, B.	Regression methodology	Financial efficiency	1. TV rights revenues 2. Gross wages	1. Population of the town where the club is based 2. Distance that TV channels must cover in order to reach the club's stadium for broadcasting 3. The ranking used by the French league to redistribute 20% of TV rights revenues according to media performance
Baur, D.G., McKeating, C.	Regression methodology	Sportive and financial efficiency	1. Points per game 2. UEFA club coefficient 3. Share price of a football club	1. Size of club (small or large clubs) 2. Size of league (small or large leagues) 3. The market return given by the equally-weighted average of all clubs for each year 4. Size of financial market
Barros, C.P., Assaf, A.G., de Araujo Jr., A.F.	Bayesian Varying Efficiency Distribution (VED) model	Financial efficiency	The total variable cost / the price of capital derived by dividing amortizations+ depreciations by total assets	1. The price of labor calculated by dividing the total labor expenses by the number of full time equivalent employees / the price of capital derived by dividing amortizations+depreciations by total assets 2. The price of capital derived by dividing amortizations + depreciations by total assets 3. Total attendance 4. Total receipt 5. Total points in league, 6. Time trend to capture any missing dynamics 7. City location
Barros, C.P., Douvis, J.	The Malmquist productivity index based on data envelopment analysis (DEA)	Sportive and financial efficiency	1. Total Receipt 2. Championship points won 3. Number of attendances measured by the total number of tickets sold	1. Number of players 2. Total costs
Barros, C.P., Garcia-del-Barrio, P.	The random stochastic frontier model	Financial efficiency	Operational cost	1. Sales 2. Points 3. Attendance 4. The price of labour, 5. The price of capitalpremises 6. The price of capitalinvestment
Beck, N., Meyer, M.	Regression methodology	Sportive efficiency	Goal differences, defined as goals scored by home teams minus goals scored by away teams	1. Players' characteristics (tenure, overall tenure, age, nationality, experience and success) 3. Current league position of the home/away team (before the actual match has been played) 4. Points accumulated by the home/away team over the last 3/5 fixtures of the current season 5. Goal difference accumulated by the home / away team over the last 3/5 fixtures of the current season 3. Match significance 4. Geographical distance between the grounds of two competing teams 5. Lasting participation in the national cup competition
Berument, H., Ceylan, N.B., Gozpinar, E.	The generalized autoregressive conditional heteroscedasticity (GARCH) model	Financial efficiency	The daily ISE 100 index	1. Dummy variable for the day of the week effect 2. Dummy variable for the location of wins (home and guest win effect) 3. Dummy variable for the Win against foreign rivals effect 4. Time lag of the daily ISE 100 index

Appendix 1: Continued

Author	Method of analysis	Subject of research	Dependent variable	Independent variable
Carmichael, F., McHale, I., Dennis, T.	Regression methodology	Sportive and financial efficiency	1. The club's percentage share of the total points achieved by all clubs during the season 2. Club's share of revenue earned within the league in the season 3. Wage expenditure by the club (as a percentage share of total Premiership expenditure)	1. Tenure in years at the current club at the start of the season 2. Managerial change in the current season 3. Player's range of skills and abilities 4. Season ratio of points won at home to points won away 5. Dummy variables indicating participation in European competitions
Dawson, P., Dobson, S.	Production frontier analysis	Sportive efficiency	1. Total wins divided by total number of games played 2. The total number of wins plus one-third the number of draws divided by the total number of games played 3. The total number of wins plus one half the number of draws divided by the total number of games played	1. The length of the manager's playing career-total of number league games played 2. The length of the manager's playing career-total number of clubs played for 3. Playing position of manager in the playing career 4. Total months managing before the present job 5. Total number of months managing the current club 6. A prior affiliation with the current club 7. Age of manager
Forker, J.	Regression methodology	Financial efficiency	1. Sales 2. Operating profit before depreciation and amortization 3. Cash flows from operations 4. Equity market value of listed football clubs	1. Net cash investment in player contracts 2. Tangible fixed assets 3. Players' wages 4. The book values of equity 5. Net income
Frick, B., Simmons, R.	Stochastic production frontier analysis	Sportive efficiency	Team points (as proportion of maximum attainable in a given season)	1. Team wage bill 2. Coach salary 3. Coach career points from Bundesliga games as proportion of maximum possible 4. Number of Bundesliga seasons experienced by coaches 5. length of tenure in Bundesliga 1 since 1981/82 or most recent promotion 6. Dummy variable for the fact of firing team head coach during the season in question
García-Sanchez, I.M.	DEA	Sportive efficiency	1. The points obtained by a team at the end of the season 2. The number of spectators for the whole season	1. Attacking moves 2. Passes to the penalty area 3. Shots at goal 4. Ball recovery 5. Goalkeeper's actions 6. Goals scored 7. Goals let in 8. Stadium capacity 9. Population of the province

Appendix 1: Continued

Author	Method of analysis	Subject of research	Dependent variable	Independent variable
Guzman, I., Morrow, S.	DEA + Canonical Correlation Analysis (CCA)	Sportive and financial efficiency	1. Points won in a season 2. Total revenue for the corresponding financial year	1. Staff costs 2. Directors' remuneration 3. Other operating expenses
Haas, D.J.	DEA	Sportive and financial efficiency	1. Points awarded during the season 2. The season total revenue	1. Clubs total wages and salaries reduced by the amount paid to the head coach and the salary of the head coach 2. Salary of the head-coach 3. Population of the clubs' home town
Halkos, G., Tzeremes, N.	DEA	Sportive efficiency	1. The sum of the number of European and domestic trophies 2. The DEA model efficiency scores	1. Revenues 2. Current Value of FC 3. Debt level
Jørgensen, C.W., Moritzen, M.R., Stadtmann, G.	Regression methodology	Financial efficiency	The percentage change in the stock price	1. OMCX Smallcap index 2. Actual number of points scored (point) 3. The expected number of points scored (expected) 4. The coefficient related to the national and European matches
Jardin, M.	DEA + Assurance region method	Sportive and financial efficiency	1. Number of points at the end of the season 2. Turnover	1. Club total wage 2. Population size of the club city
Karaca, O.	A modified version of the model presented in Hoffmann	Sportive efficiency	1. UEFA Country Ranking points 2. FIFA/Coca-Cola World Ranking points	1. Population 2. Per capita GNI 3. Yearly average temperature data of each country 4. Percentage of foreign players
Kern, M., Süssmuth, B.	Stochastic Frontier Analysis	Sportive and financial efficiency	1. Total revenues 2. Points received by winning the domestic league and cup competition	1. Participation in the European cups 2. Wage sums of players 3. Wage sums of coaches 4. Fan potential according to the recent UFA study 5. Net intra-seasonal transfers of players 6. Intra-seasonal signing up of a new coach
McNamara, P., Peck, S., Sasson, A.	Regression methodology	Sportive and financial efficiency	1. Points at the end of the season 2. Return on sales	1. Players Value 2. Shared Team Experience 3. Business Model Typologies 4. Dummy variable, if a club was promoted from the lower league
Samagaio, A., Couto, E., Caiado J.	Regression analysis + structural equation modeling (SEM)	Financial efficiency	1. Annual average return of the shares of the various clubs calculated from daily returns 2. The equity risk of the various clubs represented by the standard deviation of return	1. Turnover 2. Wages and Salaries 3. Other operational costs before player trading 4. Net transfer fees 5. Amortizations of players registration 6. Net profit related with sale of player registrations 7. Other net income. 8. Mean score obtained by the club in all official competitions in which it participated over a season 9. Importance of the competition 10. Classification obtained by the club in competitions
Soleimani-Damaneh, J., Hamidi, M., Sajadi, N.	DEA + Ana-lytical Hierarchy Process (AHP) technique	Sportive and financial efficiency	1. Points received by the team 2. Number of spectators watching the team's matches 3. The team's income at the end of the season	1. Fixed assets 2. Player wages 3. Coach wages 4. Staff wages
Yamamura, E.	Dynamic panel model	Sportive efficiency	Rate of wins	1. Average annual salary of players 2. Inter-team annual salary; Herfindahl index