Efficiency measurement of professional football clubs: a non-parametric approach

Lidiya Ivanovna Kulikova, Anna Valeryevna Goshunova

Institute of Finance and Economics, Kazan (Volga Region) Federal University. Butlerov str., 4, Kazan, 420012, Russian Federation

Abstract. In this article the efficiency of professional football clubs from Australia, Brazil, England, France, Germany, Italy, Netherlands, Portugal, Russia, Scotland and Spain was investigated using data envelopment analysis (DEA). In order to assess impact of accounting policies on players' registrations on football clubs efficiency, football clubs not recognizing professional players' registrations as assets were added in data. The results of analysis show that capitalization of purchased players' registrations influences efficiency of football club, but it isn't a crucial factor. Another important factors affecting on efficiency of football clubs are size of club and its capital structure.
[Kulikova L.I., Goshunova A.V. **Efficiency measurement of professional football clubs: a non-parametric approach.** *Life Sci J* 2014;11(11s):117-122] (ISSN:1097-8135). http://www.lifesciencesite.com. 27

Keywords. Efficiency; Football clubs; Financial efficiency; Sports efficiency; Data Envelopment Analysis (DEA); Regression analysis.

Introduction

A lot of studies are devoted to the analysis of professional football clubs efficiency [1]. Various researchers differently evaluate efficiency of clubs – from economic [2-13] and sports [6-15] points of view. In our research we continue tradition of evaluating football clubs efficiency by using non-parametric methods of analysis, but at the first time we take into account football clubs which don't recognize professional players' registrations as assets. These clubs are from Russia and Australia. It is done in order to assess whether capitalization of purchased players' registrations can affect on efficiency of football clubs. Structure of work includes introduction, methodology, data, results and conclusions.

Methodology.

Generally all variety of methods used to analyze 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 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 type of relationship between the studied variables; it also allows identifying the functional dependence.

Non-parametric methods are focused primarily on the overall assessment of the efficiency. This assessment is based on the analysis of a 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 performance evaluation is made using weighted indices and weights for all variables. For example, typical non-parametric methods are stochastic frontier model and DEA. It should be noted that the most popular method of analysis of clubs' efficiency is DEA.

The idea of DEA belongs to Farrell [16]. 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 various inputs and outputs into a single virtual input and output respectively [16].

First DEA-model developed by Charnes, Cooper and Rhodes was 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.

According to Charnes, Cooper and Rhodes 100% efficiency is determined as follow:

- None of outputs can be enhanced without increasing of one or more inputs or reducing other outputs;
- None of inputs can be reduced without reducing one or more outputs or increasing other inputs.

Performance measurement in the model of Charnes, Cooper and Rhodes is realized on the base of optimal weighted ratio between participating outputs and inputs. This method determines estimation of parameters in such a way that the observed DMU lies on scale from 0 (lowest efficiency) to 1 (maximum efficiency) and takes efficiency value e_o, as high as possible in given

ratio of inputs and outputs of all observed units. Formally, this task consists of solving the following maximization problem [16]:

$$e_0 = \frac{\sum_{j=1}^{s} u_j \, y_{j0}}{\sum_{i=1}^{r} v_i x_{i0}} \to \max!$$

subject to:

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

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

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

Thus, DEA gives an answer to the question whether analyzed business unit is effective or not and how much its current efficiency differs from the ideal. At the same time DEA points out sources of inefficiency, which lead to the two general ways of improvement of current efficiency level - by improving inefficient work of business unit (pure technical efficiency) or by eliminating unfavorable conditions (scale effect). However, DEA method cannot identify and quantify the impact of factors involved in calculation of efficiency mark.

According to constant returns to scale output is changing in the same proportion as input. Changing input on condition of variable returns to scale can result in disproportionate variation of output. This definition has an impact on the efficiency values - more businesses may be recognized as effective on condition of variable returns of scale.

Mathematical representation of variable scale effect can be made by addition of new variable u_o to the initial function of efficiency model (the equation 2) [16]:

$$e_0 = \frac{\sum_{j=1}^{s} u_j \, y_{j0} + u_0}{\sum_{i=1}^{r} v_i x_{i0}} \to \max!$$

subject to:

$$\frac{\sum_{j=1}^{s} u_j \, y_{jm} + u_0}{\sum_{i=1}^{r} v_i x_{im}} \le 1 \quad ; m = 1,2, \ldots, n$$

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

While: If $u_0 \langle 0 \to$ decreasing returns to scale;

If $u_0 \rangle 0 \to$ increasing returns to scale;

If $u_0 = 0 \to$ constant returns to scale.

Certainly, establishment of form which better describes reality has an impact on the assessment of efficiency. In contrast to models with constant returns to scale, acceptance of variable scale allows to estimate both general efficiency of DMU and efficiency of its decisions, while differences in resource base "are neutralized".

Data.

Data was collected from financial reports of football clubs for 2008 year and football statistics reviews. The sample for the investigation comprises 51 professional football clubs from Australia, Brazil, England, France, Germany, Italy, Netherlands, Portugal, Russia, Scotland and Spain.

Generally, researchers consider efficiency of football club from different points of view. In scientific literature two approaches are already developed to study efficiency of professional football club [1]:

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

The ability to generate income as a feature of club's effective work was analyzed in works of Aglietta et al., 2010 [2]; Barros et al., 2011 [3]; Barros and Garcia-del-Barrio, 2008 [4]; Carmichael et al., 2011 [8]; Forker, 2005 [5]; Guzman and Morrow, 2007 [9]; Haas, 2003 [10]; Jardin, 2009 [11]; Kern and Sussmuth, 2003 [12]; McNamara et al., 2011 [13].

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 Baur and McKeating, 2009 [6]; Barros and Douvis, 2009 [7]; Frick and Simmons, 2007 [14]; Garcia-Sanchez, 2007 [15]; Guzman and Morrow, 2007

[9]; Haas, 2003[10]; Jardin, 2009 [11]; Kern and Sussmuth, 2003[12]; McNamara et al., 2011 [13].

In our research we consider both types of efficiency. We suppose joint assessment of football clubs efficiency from financial and sports points of view will allow us to estimate general efficiency of club and also its ability to reach optimum results both in business and on field.

Two outputs were used to build efficiency score:

- Turnover which reflects financial efficiency of football clubs;
- Rank of club in the national championship which characterizes quality of club's team, efficiency of its sports activity.

Several inputs were used: Total costs; Intangible assets (players' registrations); Borrowed capital; Purchases of players' registrations; Personnel costs; Average number of playing staff; Number of points scored in national championship for the season 2007/2008.

We suppose that indicators of total expenses and borrowed capital have impact on efficiency of football club as business unit while intangible assets (players' registrations), purchases of players' registrations and personnel costs promote achievement of high sports results. Number of points scored in national championship for a sports season directly reflects sports efficiency because it is a standard way of club's success measurement in national championship which influences on distribution of prize-winning income. Average number of playing staff is used in order to take in account clubs' wellbeing on which depends the opportunity "to contain a long bench". Descriptive statistics of all variables are given in table 1.

Table 1. Data descriptive statistics (number of observations 51)

Variable	Mean	Std. Dev.	Min	Max
Turnover, MEUR	90.483	99.906	0.384	381.257
Rang of club in the national championship for the season 2007/2008	0.736	0.252	0	1
Costs, MEUR	98.776	103.864	0.529	386.480
Intangible assets (players' registrations), MEUR	40.047	57.687	0	291.807
Borrowed capital, MEUR	151.114	231.001	0	1069.644
Number of points scored in national championship for the season 2007/2008	59.647	18.865	12	96
Playing staff	71.157	82.654	25	448
Personnel costs, MEUR	53.630	58.317	0.649	220.266
Purchases of players' registrations, MEUR	22.830	48.283	0	305.592

For the purpose of DEA-model determination we used graphical analysis which showed that outputs "Turnover" and "Rank" have disproportionate dependence on inputs "Intangible assets (players' registrations)", "Borrowed capital", "Points" etc. (Fig. 1, 2 and 3).

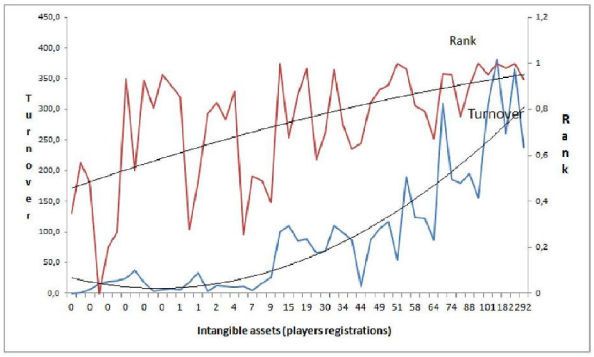

Fig. 1. Dependence of Turnover and Rank on Intangible assets (players' registrations)

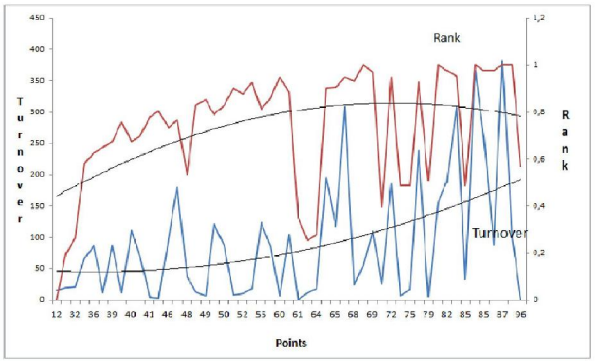

Fig. 2. Dependence of Turnover and Rank on Points

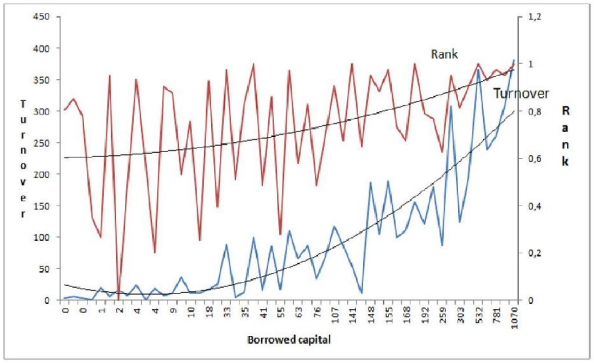

Fig. 3. Dependence of Turnover and Rank on Borrowed capital

From figures 1, 2 and 3 we can see that in all cases variation of inputs changes value of outputs in disproportionate ratio. Thus, for the purposes of DEA we will rely on the output-oriented DEA-model with variable returns to scale.

Results.

As a result of calculation we have got efficiency estimates for 51 football clubs of Asia, America and Europe. Results of calculations are provided in Table 2.

Table 2. DEA efficiency results

Football club	Country	GE	PTE	SE
Arsenal	England	0.830	1.000	0.830
Chelsea	England	0.463	0.727	0.636
Aston Villa	England	0.487	0.821	0.593
Birmingham city	England	0.646	0.663	0.975
Blackburn	England	0.956	1.000	0.956
Bolton wanderers	England	0.120	0.154	0.782
Burnley	England	0.507	0.536	0.946
Everton	England	0.930	1.000	0.930
Fulham	England	0.446	0.558	0.799
Hull city	England	0.354	0.356	0.994
Liverpool	England	0.535	0.718	0.746
Manchester city	England	0.727	0.784	0.928
Manchester United	England	1.000	1.000	1.000
Stoke city	England	0.097	0.086	1.120
Sunderland	England	0.108	0.568	0.190
Tottenham	England	0.947	1.000	0.947
West ham united	England	0.439	0.566	0.775
Wigan	England	0.740	0.780	0.949
Wolverhampton	England	0.477	0.485	0.985
Cardiff	England	0.616	0.619	0.994
Barcelona	Spain	0.760	1.000	0.760
Real Madrid	Spain	0.991	1.000	0.991
Roma	Italy	0.760	1.000	0.760
Napoli	Italy	0.655	1.000	0.655
Milan	Italy	0.570	1.000	0.570
Lazio	Italy	0.966	1.000	0.966
Juventus	Italy	0.780	1.000	0.780
Olympique Lyonnais	France	0.992	1.000	0.992
Aberdeen	Scotland	1.000	1.000	1.000
Celtic	Scotland	1.000	1.000	1.000
Dundee United	Scotland	0.778	0.865	0.900
Falkirk	Scotland	1.000	1.000	1.000
Heart of Midlothian	Scotland	0.355	0.370	0.959
Hibernian	Scotland	0.539	0.568	0.949
Inverness CT	Scotland	1.000	1.000	1.000
Kilmarnock	Scotland	0.889	1.000	0.889
Motherwell	Scotland	0.894	1.000	0.894
Rangers	Scotland	0.605	1.000	0.605
St Mirren	Scotland	1.000	1.000	1.000
Porto	Portugal	1.000	1.000	1.000
Essendon	Australia	1.000	1.000	1.000
Collingwood	Australia	0.843	1.000	0.843
Hawthorn	Australia	1.000	1.000	1.000
Melbourne	Australia	1.000	1.000	1.000
Port Adelaide	Australia	1.000	1.000	1.000
Rostov	Russia	0.127	1.000	0.127
Ural	Russia	0.686	0.793	0.865
Chernomorets	Russia	1.000	1.000	1.000
Borussia Dortmund	Germany	0.892	1.000	0.892
Corinthians Paulista	Brazil	0.794	0.898	0.884
Ayax	Netherlands	0.979	1.000	0.979
Mean	x	0.731	0.841	0.869

In output-oriented model purpose of optimization is maximization of outputs without changing set of inputs. Decomposition of general efficiency on pure technical efficiency and efficiency depending on the size of scale allows to find out inefficiency sources: whether the inefficiency was caused by inefficient work of DMU (PTE) or unfavorable conditions (SE), or both reasons together [17].

Table 3 shows football clubs which have maximum scores both in general efficiency and its components – pure technical efficiency and scale efficiency.

On the base of results shown in table 2 we can make a conclusion that DEA-effective clubs use both accounting policies as capitalization of purchased players' registrations as intangible assets and writing off to the current expenses. However most of effective clubs prefer accounting policy on capitalization. Therefore, recognition of players' registration as separate asset influences efficiency of football club, but it isn't a crucial factor.

Table 3. Football clubs efficiency scores

Football club	Country	GE	PTE	SE	Share in total turnover of all studied clubs from the same country,%	Rank of club in the national championship for the season 2007/2008	Accounting policies on players' registrations
Essendon	Australia	1	1	1	17,58	0,2667	writing off to the expenses
Hawthorn	Australia	1	1	1	20,51	0,9333	writing off to the expenses
Melbourne	Australia	1	1	1	13,65	0	writing off to the expenses
Port Adelaide	Australia	1	1	1	16,47	0,2000	writing off to the expenses
Manchester United	England	1	1	1	16,42	1	capitalization as intangible asset
Porto	Portugal	1	1	1	100,00	1	capitalization as intangible asset
Chernomorets	Russia	1	1	1	4,78	0,3514	writing off to the expenses
Aberdeen	Scotland	1	1	1	6,55	0,7273	capitalization as intangible asset
Celtic	Scotland	1	1	1	37,13	1	capitalization as intangible asset
Falkirk	Scotland	1	1	1	2,29	0,4545	capitalization as intangible asset
Inverness CT	Scotland	1	1	1	1,21	0,2727	capitalization as intangible asset
St Mirren	Scotland	1	1	1	1,50	0,1818	capitalization as intangible asset

Absolute efficiency of football clubs Manchester United (England), Porto (Portugal) and Celtic (Scotland) is caused by their high sports performance during the season 2007/2008 at the end of which they became champions of their countries. Furthermore, additional calculations show that these clubs have the maximum share in total turnover within country sample. Thus, FC Manchester United has 16,42% of total turnover of all 20 English clubs included in sample. The Scottish FC Celtic represents more than 37% of total turnover of studied Scottish clubs. Thus, these clubs are effective both from sports and financial points of view.

The Scottish FC Aberdeen was not far from FC Celtic, champion of the Scottish Premier league of 2008, occupying the fourth place in national championship. The club demonstrated high financial results, having closed year with net profit. Moreover, return on sales (ROS) in FC Aberdeen was 8,60% that was almost 3% higher, than in FC Celtic at the same period.

Absolute DEA-efficiency of other clubs may be also logically explained. Despite the low incomes and low position in the national championship, these clubs demonstrate good results on conditions of limited resource base. Thus, the Russian FC Chernomorets has the smallest amount of total assets among researched clubs but it achieved a high return on assets (ROA) at the end of 2008 (table 3). In particular, in terms of return on equity (ROE) Chernomorets occupies second place among football clubs under review.

Similarly, football clubs from Australia Port Adelaide, Essendon and Hawthorn were able to generate profit in 2008 without big assets. In

particular, FC Port Adelaide is ranked third according to return on assets (ROA) and the twelfth according to return to sales (ROS) among studied clubs. Moreover, FC Hawthorn made great success in terms of sports efficiency by taking second place in the national championship (table 4).

Table 4. Financial coefficients of football clubs

Football club	Country	Return On Equity (ROE), %	Return On Assets (ROA), %	Return On Sales (ROS), %
Port Adelaide	Australia	40,30	20,94	11,04
Essendon	Australia	3,76	3,43	2,18
Hawthorn	Australia	29,76	19,32	10,04
Chernomorets	Russia	306,70	3,63	8,85
St Mirren	Scotland	108,54	106,97	371,04

Efficiency of Scottish clubs Falkirk and Inverness CT can be explained by the fact that despite the absence of net profit in 2008 they are the only clubs in Scotland, which were able to provide 100% of equity without borrowed capital. Thus, possessing small assets fully secured by owner's equity, these clubs showed high efficiency. Scottish FC St Mirren also has high concentration of equity (98,56%). Despite the low sports scores club closed 2008 year with high rates of profitability (ROE, ROA, and ROS).

Unfortunately, absolute efficiency of the Australian FC Melbourne doesn't have logical explanation. This club took last place in the standings of Australian championship of 2008, was unprofitable, with high concentration of borrowed capital. Thus, DEA-efficiency of this club can be considered as a calculation error.

Conclusion.

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

Absolute efficiency for football clubs is rather rare phenomenon. Among 51 studied clubs only 12 clubs are effective both in terms of pure technical efficiency and scale efficiency. Among them there are world known football clubs like Manchester United (England), Porto (Portugal) and Celtic (Scotland), which are the most successful clubs in financial and sporting terms. However, our research shows that absolute efficiency is not privilege of the football giants.

The results of analysis show that DEA-effective clubs use both accounting policies as capitalization of purchased players' registrations as intangible assets and writing off to the current expenses. However most of effective clubs prefer accounting policy on capitalization. Therefore, recognition of players' registrations as separate asset influences efficiency of football club, but it isn't a crucial factor.

Efficiency of club, seeking to maximize revenue and rank in the national championship, is to a large extent driven by the size of club. Many big football clubs which take leading positions in the national championship are economically inefficient because of too low return on large investments. From this point of view small clubs have significant advantage. For example, Russian and Australian clubs.

Another important factor of efficiency is capital structure of football club. In particular, the high concentration of equity, independence from external funding contributed to the efficiency of Scottish clubs, despite of the low position in the national standing and lack of income.

Corresponding Author:
Dr.Kulikova, Institute of Finance and Economics.
Kazan (Volga Region) Federal University.
Butlerov str., 4, Kazan, 420012, Russian Federation.

References

1. Kulikova, L.I. and A.V. Goshunova, 2013. Measuring efficiency of professional football club in contemporary researches. World Applied Sciences Journal, 25(2). Date Views 06.03.2014 www.idosi.org/wasj/wasj25(2)13/12.pdf.
2. Aglietta, M., W. Andreff and B. Drut, 2010. Floating European football clubs in the stock market. EconomiX Working Papers, 24. Date Views 06.03.2014 economix.fr/pdf/dt/2010/WP_EcoX_2010-24.pdf.
3. Barros, C. P., A.G. Assaf and A.F. de Araujo Jr., 2011. Cost performance of Brazilian soccer clubs: A Bayesian varying efficiency distribution model. Economic Modelling, 28(6): 2730-2735.
4. Barros, C.P. and P. Garcia-del-Barrio, 2008. Efficiency Measurement of the English Football Premier League with a Random Frontier Model. Economic Modelling, 25(5): 994–1002.
5. Forker, J., 2005. Discussion of Accounting, Valuation and Duration of Football Player Contracts. Journal of Business Finance and Accounting, 32(3-4): 587-598.
6. Baur, D.G. and C. McKeating, 2009. The Benefits of Financial Markets: A Case Study of European Football Clubs. The Institute for International Integration Studies Discussion Paper Series. Date Views 06.03.2014 www.tcd.ie/iiis/documents/discussion/pdfs/iiisdp283.pdf.

7. Barros, C.P. and J. Douvis, 2009. Comparative analysis of football efficiency among two small European countries: Portugal and Greece. International Journal of Sport Management and Marketing, 6(2): 183-199.
8. Carmichael, F., I. McHale and T. Dennis, 2011. Maintaining market position: team performance, revenue and wage expenditure in the English premier league. Bulletin of Economic Research, 63 (4): 464-497.
9. Guzmán, I. and S. Morrow, 2007. Measuring efficiency and productivity in professional football teams: evidence from the English Premier League. Central European Journal of Operations Research, 15 (4): 309-328.
10. Haas, D.J., 2003. Productive efficiency of English football teams-a data envelopment analysis approach. Managerial and Decision Economics, 24(5): 403-410.
11. Jardin, M., 2009. Efficiency of French football clubs and its dynamics. Munich Personal RePEc Archive. Date Views 06.03.2014 mpra.ub.uni-muenchen.de/19828.
12. Kern, M. and B. Süssmuth, 2003. Managerial Effiency in German Top League Soccer. Munich Discussion Paper, 3. Date Views 06.03.2014 epub.ub.uni-muenchen.de/5/.
13. McNamara, P., S. Peck and A. Sasson, 2011. Competing Business Models, Value Creation and Appropriation in English Football. Long Range Planning. Date Views 06.03.2014 dx.doi.org/10.1016/j.lrp.2011.10.002.
14. Frick, B. and R. Simmons, 2007. The Impact of Managerial Quality on Organizational Performance: Evidence from German Soccer. Working Paper Series, 07-08: 1-20.
15. García-Sánchez, I.M., 2007. Efficiency and effectiveness of Spanish football teams: a three-stage-DEA approach. Central European Journal of Operations Research, 15(1): 21-45.
16. Lissitsa, A. and T. Babiéceva, 2003. Data envelopment analysis (DEA) –
Shell data analysis (DEA) - a modern technique for determining the efficiency of production. Institute of Agricultural Development in Central and Eastern Europe, 50. Date Views 06.03.2014 hdl.handle.net/10419/28581.
17. Coelli, T., 1996. A Guide to Deap Version 2.1: a Data Envelopment Analysis. CEPA Working Paper 8/96: 3-50.

6/27/2014