ASSESSING THE RELATIVE EFFICIENCY OF SPORTS ORGANIZATIONS: A CASE STUDY OF THE KOREAN PROFESSIONAL TEAMS

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─Abstract ─

The Korean professional sports industry is experiencing immense competitive pressure. Thus, it is imperative for sports organization in Korea to improve the cost efficiency and organizational efficiency in order to gain a competitive edge. The purpose of this study is to assess the relative efficiency of the sports organizations' performance. To do this end, we use the data gathered from the Korean baseball organization (KBO) and Korean Basketball League (KBL).

This study proposes full results of DEA analysis such as efficiency score, slacks in inputs and outputs of inefficient organizations, window analysis. We also analyze the productivity changes of the organizations over time using the Malmquist Index method. Malmquist Index is used to separate the changes over time in the efficiency of each organization individually, from the shift of the best practice frontier over time typically due to changes in technology.

Key Words: *Korean Sports Organizations, Data Envelopment Analysis, Performance Evaluation, Window analysis, Malmquist Index*

JEL Classification: L83

1. INTRODUCTION

According to sports white paper published in 2010, sports business in Korea is developing significantly and the scale of sports business reaches to 33.4 trillion Korean Won. (Korean Ministry of Culture, 2010:1) This amount, compared to that of 2009, is increased by 27% and also the absolute scale of Korean sports business is expected to increase gradually as Korean economy grows hereafter. Especially, professional sports industry is considered as a very prospective industry since it is heavily associated with the Korean people's leisure life.

Recently, the Korean professional sports industry is experiencing immerse competitive pressure. The professional sports organization operating in Korea can be divided into five main categories; professional baseball was first launched in 1982, and since then, professional football league in 1983, professional basketball league in 1997, professional Volleyball in 2005, was launched. During the last 30 years in Korea, due to the competition between the various professional sports leagues, only a few professional sports organizations are operating the teams on its own, without the support of the mother corporations such as Samsung Group or Hyundai Group. Thus, to remain competitive, it is imperative for the sports organizations to continuously improve their efficiency by removing the inefficiencies of the organizations.

Practically, data envelopment analysis (DEA) has become one of the preferred bench-marking methods. A major advantage is that it is not required to know the production function of the decision making units (DMU). In this paper we present the result of the performance analysis of the 18 organizations, belonged to 2 major professional sports leagues such as the Korean baseball organization (KBO) and Korean Basketball League (KBL). Unlike previous researches, that have used single sports organizations in the assessment process, this study uses both pro-baseball organizations and pro-basketball organizations in order to provide a meaningful overall measure of efficiency. Until now in Korea, no study is conducted to propose the difference in relative efficiency of cross-professional sports organizations.

This study is conducted with the following three directions in order to overcome the main limitations of the efficiency analysis in Korean professional sports industry. Firstly, we use DEA models to measure the efficiency of professional sport organizations. This study not only propose the difference in operating efficiency of two major professional sports organizations, but also other

professional sports organizations gain deeper insights into their organizations performance. Secondly, while two previous studies examine relative efficiency of Korean Professional baseball teams by using CCR model, we fully utilize the DEA analysis to investigate Korean professional sports organizations' operating problem.(Lee, 2005:2, Kang, 2010:5) Thus, this study proposes full results of DEA analysis such as efficiency score, slacks in inputs and outputs of inefficient organizations, window analysis. Finally, we analyze the productivity changes of the organizations over time using the Malmquist Index method. Malmquist Index is used to separate the changes over time in the efficiency of each organization individually, from the shift of the best practice frontier over time typically due to changes in technology.

The rest of this paper is organized as follows. Section 2 describes the data used in this study. Section 3 comprises the results of the analyses based on DEA analysis and productivity Malmquist index, and finally Section 4 concludes this study.

2. DATA

The data for this study was collected from the homepage of two major sports league in Korea such as Korean Baseball Organization (KBO) and Korean Basketball League (KBL). We collected the data for 18 organizations for the years 2009-2011. In this study, the sport organizations are viewed as DMUs. With DEA analysis, choosing the right input/output variables is an important step in measuring the organizational performance. The reason is that selecting wrong variables might devaluate the results. We choose the input and output variables used in DEA analysis based on the literature review of previous studies. Input variables included are the total yearly salary ($x1$), the ratio of high-paid players ($x2$). Two output variables are selected such as winning ratio ($y1$), number of spectators per game ($y2$). Since the data was not completely compatible with the information required, transformation was performed to obtain the information required for the analysis. This was done for the input variable the ratio of high-paid players ($x2$) and it was calculated that the amounts of the players' annual salary that is at least 2 times bigger than average organization's yearly salary level was divided by the total yearly salary. The data and descriptive statistics of the variables used in the study are given in Table 1.

Table 1: The gathered information to assess sports organizations in Korea, years for 2009-2011

Sports Organization	total salary			the ratio of high-paid players			winning ratio			number of spectators/game		
	2009	2010	2011	2009	2010	2011	2009	2010	2011	2009	2010	2011
SK Wyverns	541300	559700	592900	0.5579	0.4994	0.6325	0.602	0.632	0.546	12556	14907	14905
samsung Lions	470000	500465	460700	0.5532	0.4716	0.4558	0.481	0.594	0.612	5782	6898	7592
Dosan Bears	359600	405200	454900	0.3871	0.4139	0.5091	0.534	0.549	0.466	15731	16222	18712
Lotte Giants	357000	410500	476500	0.3751	0.4263	0.5750	0.496	0.519	0.563	20597	17813	20273
KIA Tigers	372400	446800	463800	0.4041	0.4711	0.5207	0.609	0.444	0.526	8818	6512	8980
LG Twins	474900	567900	490700	0.4927	0.5864	0.5706	0.406	0.429	0.450	14778	15076	18056
Nexen Heroes	353000	284140	325500	0.3782	0.2991	0.1536	0.451	0.391	0.389	4996	5963	6688
Hanhwa Eagles	396400	265200	268800	0.5323	0.1772	0.2232	0.346	0.368	0.450	5691	5930	7044
Wonju Dongbu	167100	179600	176200	0.5446	0.5401	0.6527	0.611	0.611	0.574	3239	2649	3529
Ulsan Mobis	124400	143900	139000	0.6029	0.4183	0.5396	0.648	0.741	0.370	3519	4837	2843
Seoul Samsung	156700	176100	163000	0.7211	0.6133	0.5706	0.556	0.481	0.500	6453	4004	4628
Seoul SK	180800	180000	189000	0.5144	0.5111	0.6508	0.444	0.296	0.370	6505	5583	5655
Changwon LG	140300	168000	146500	0.4027	0.4286	0.3618	0.537	0.630	0.519	5542	4923	4762
Goyang Orions	149600	96600	111700	0.5281	0.1967	0.2686	0.333	0.278	0.278	3633	2188	1755
Inchon Etland	150500	180000	182600	0.5648	0.6417	0.4359	0.537	0.278	0.704	3706	3706	5288
Jeonju KCC	148500	180000	188500	0.4108	0.5083	0.6578	0.574	0.648	0.630	5650	5593	5465
Anyang KGC	119000	135700	131500	0.6134	0.5380	0.4715	0.537	0.296	0.296	3111	2378	2343
Pusan KT	149100	165600	182750	0.4024	0.4831	0.4544	0.222	0.741	0.759	2365	5604	5784

3. RESULTS

3.1. DEA efficiency analyses

The relative efficiencies of each DMU in the period 2009-2011 are calculated under the CCR DEA model. (Charnes et al., 1978:3) The efficiencies for DMUs are presented in the table 2. In table 2, the organization that has efficiency score of 1.0 are said to be an efficient organization. We have 5 organizations that are efficient in 2009, 3 organizations in 2010, and 5 organizations in 2011. In the period 2009-2011, the average efficiency score of all organization is first slightly decreased and then increased.

The efficient DMUs can be utilized as benchmarks for improving the inefficient DMU. Thus, we can compute the necessary improvements required in the inefficient DMU's inputs and outputs to make it efficient. DEA analysis allows for calculating slacks which specify the amount by which an input or output must be improved. The nonzero slacks identify the amounts of inefficiency in each input and output of the DMU. Since the DEA-based benchmarking approach

considers inefficiency as the results of heavy investment on higher paid (star) players, efficiency improvements might be achieved if the inefficient organization is able to spend less money on star players.

Table 2: The Efficiency for DMUs in 2009-2011 years

Organization	Efficiency 2009	Frequency in Reserence Set	Efficiency 2010	Frequency in Reserence Set	Efficiency 2011	Frequency in Reserence Set
SK Wyverns	0.740		0.809		0.685	
samsung Lions	0.582		0.642		0.683	
Dosan Bears	0.988		0.997		1.000	1
Lotte Giants	1.000	8	1.000	12	1.000	9
KIA Tigers	1.000	6	0.523		0.620	
LG Twins	0.609		0.615		0.879	
Nexen Heroes	0.791		0.736		1.000	4
Hanhwa Eagles	0.450		1.000	7	1.000	3
Wonju Dongbu	0.874		0.661		0.784	
Ulsan Mobis	1.000	3	1.000	14	0.645	
Seoul Samsung	0.994		0.636		0.846	
Seoul SK	0.798		0.755		0.791	
Changwon LG	1.000	5	0.845		0.971	
Goyang Orions	0.601		0.781		0.617	
Inchon Etland	0.792		0.526		0.962	
Jeonju KCC	1.000	6	0.862		0.880	
Anyang KGC	0.889		0.494		0.556	
Pusan KT	0.401		0.968		1.000	11
Average	0.806		0.769		0.829	

3.2. DEA window analyses

The efficiency scores reported are from panel data analyses, where the observations for the organizations in different years are treated as separate observations. However, if we make the comparison of DMU in different years separately, it is difficult to consider dynamic trend of DMU's efficiency due to environmental change. (Cooper et al, 2007:4) In addition, we could not identify the technological improvement during 3 year periods. Thus, to deal with this problem, we suggest DEA window model, with a window width of 2 years in order to compare the trend of efficiency levels and stability of the changes. This means that observations are only compared to other observations within a 2-year time span.

Table 4 shows the average efficiency score for the different sports organizations for each window. In table 4, we can identify that the efficiency trend is continuously improvement from year 2009 to 2011 with 0.739 -> 0.742->0.779. And we also see how individual organization performs in different years against the same window. For example, the performance of 8 organizations such as Kia tigers, Wonju Dongbu, Ulsan Mobis, Seoul Samsung, Changwon LG, Goyang Orions, Jeonju KCC, Anyang KGC are decreased, but the performance of remaining 10 organizations are increased. Furthermore, we see that the Lotte Giants is the best performer and Anyang KGC the worst.

Table 3: Results from window analyses for 2009-2011

Organization	2009-2010	2010-2011	Average
SK Wyverns	0.687	0.708	0.697
samsung Lions	0.553	0.636	0.594
Dosan Bears	0.891	0.969	0.930
Lotte Giants	0.924	0.990	0.957
KIA Tigers	0.663	0.549	0.606
LG Twins	0.550	0.732	0.641
Nexen Heroes	0.665	0.856	0.761
Hanhwa Eagles	0.690	0.975	0.833
Wonju Dongbu	0.684	0.647	0.666
Ulsan Mobis	1.000	0.792	0.896
Seoul Samsung	0.782	0.706	0.744
Seoul SK	0.700	0.752	0.726
Changwon LG	0.898	0.867	0.883
Goyang Orions	0.680	0.674	0.677
Inchon Etland	0.585	0.715	0.650
Jeonju KCC	0.878	0.832	0.855
Anyang KGC	0.671	0.499	0.585
Pusan KT	0.660	0.958	0.809
Average	0.731	0.770	0.750

year 2009 average	0.739
year 2010 average	0.742
year 2011 average	0.779

3.3. Malmquist index

The Malmquist index measures productivity changes of DMUs between two time periods using input or output orientated distance functions. It can be defined into product of Catch-up and Frontier-shift terms. The catch-up (recovery) analyzes the degree to which the DMU improves or worsens its efficiency over time change. In addition, frontier-shift (innovation) reflects the change in the efficiency between the two time periods.

The Malmquist, Catching up, frontier shift indices are summarized in Table 5. In Table 5, we can see that the average Malmquist index for the 2009-2011 is 1.089, indicating productivity growth on average for the 3 year perods. By decomposing this index into an average catching up effect of 1.081 and a frontier shift of 1.008 reveals that Korean sports organizations, on average, have increased in their efficiency relative to the best practice frontier, and sports industry has not experienced technological progress. However, looking at the indices between adjacent years it is clear that frontier shift is decreasing and smaller than 1, indicating technological disimprovements, and at the same time the catching up index is greater than 1 and increasing, showing that the organizations are keeping up with the progress.

In comparing the productivity change for the two separate sports league, we find that the average Malmquist index of pro- baseball league is greater than that of pro-basketball leagues. It indicates that total productivity growth in pro- baseball league is greater than toal productivity growth in pro-basketball league. But the total productivity growth rate in both leagues are clearly decreasing. The decomposition of 2009-2010 malmquiest index shows that a positive catching up (1.112) in pro- baseball league and a small negative catching up (0.998) in pro basketball leaque is observed. Thus, we can say that organizations belonged in KBO are well keeping up with the progress compared to organizations in KBL. At the same time period, the frontier shift indices in both leagues are greater than 1, indicating technological improvements. The decomposition of 2010-2011 malmquiest index shows that a positive catching up (1.111) in pro- baseball league and a small negative catching up (1.116) in pro basketball leaque is observed. Thus, we can say that both organizations belonged in KBO and in KBL are well keeping up with the progress. But, at the same time period, the frontier shift indices in both leagues (0.989 of KBO, 0.907 of KBL) are smaller than 1, indicating that ogranizations in KBL are much struggling to keep up with technological improvements compared to the organizations in KBO.

Table 4: Catching up, frontier shift, and Malmquist indices for 2011-2011 years

Catch-up	2009=>2010	2010=>2011	Average	Frontier	2009=>2010	2010=>2011	Average
SK Wyverns	1.093	0.847	0.970	SK Wyverns	1.083	0.940	1.011
samsung Lions	1.103	1.063	1.083	samsung Lions	1.273	1.015	1.144
Dosan Bears	1.009	1.003	1.006	Dosan Bears	0.944	0.928	0.936
Lotte Giants	1.000	1.000	1.000	Lotte Giants	0.818	0.928	0.873
KIA Tigers	0.523	1.185	0.854	KIA Tigers	1.193	0.995	1.094
LG Twins	1.011	1.429	1.220	LG Twins	0.860	0.923	0.892
Nexen Heroes	0.930	1.359	1.144	Nexen Heroes	1.230	1.131	1.181
Hanhwa Eagles	2.225	1.000	1.612	Hanhwa Eagles	1.240	1.052	1.146
Wonju Dongbu	0.756	1.187	0.972	Wonju Dongbu	1.255	0.807	1.031
Ulsan Mobis	1.000	0.645	0.822	Ulsan Mobis	1.134	0.854	0.994
Seoul Samsung	0.640	1.330	0.985	Seoul Samsung	0.963	0.913	0.938
Seoul SK	0.946	1.048	0.997	Seoul SK	0.862	0.950	0.906
Changwon LG	0.845	1.149	0.997	Changwon LG	1.084	0.918	1.001
Goyang Orions	1.299	0.790	1.045	Goyang Orions	1.091	0.942	1.017
Inchon Etland	0.663	1.831	1.247	Inchon Etland	0.993	0.942	0.967
Jeonju KCC	0.862	1.021	0.941	Jeonju KCC	1.022	0.913	0.967
Anyang KGC	0.556	1.126	0.841	Anyang KGC	1.013	0.907	0.960
Pusan KT	2.416	1.033	1.724	Pusan KT	1.054	0.924	0.989
Average	1.049	1.114	1.081	Average	1.062	0.943	1.003
Max	2.416	1.831	1.724	Max	1.273	1.131	1.181
Min	0.523	0.645	0.822	Min	0.818	0.807	0.873
SD	0.506	0.264	0.243	SD	0.141	0.071	0.089

Malmquist	2009=>2010	2010=>2011	Average
SK Wyverns	1.184	0.797	0.990
samsung Lions	1.404	1.079	1.241
Dosan Bears	0.953	0.931	0.942
Lotte Giants	0.818	0.928	0.873
KIA Tigers	0.624	1.179	0.902
LG Twins	0.870	1.319	1.094
Nexen Heroes	1.144	1.537	1.340
Hanhwa Eagles	2.758	1.052	1.905
Wonju Dongbu	0.949	0.958	0.953
Ulsan Mobis	1.134	0.551	0.842
Seoul Samsung	0.616	1.215	0.916
Seoul SK	0.815	0.996	0.906
Changwon LG	0.916	1.055	0.985
Goyang Orions	1.418	0.745	1.082
Inchon Etland	0.659	1.724	1.191
Jeonju KCC	0.880	0.932	0.906
Anyang KGC	0.563	1.021	0.792
Pusan KT	2.546	0.954	1.750
Average	1.125	1.054	1.089
Max	2.758	1.724	1.905
Min	0.563	0.551	0.792
SD	0.610	0.274	0.306

4. CONCLUSION

This paper presented the efficiency level and the evolution of productivity of the Korean sports organizations operating in the two professional sports leagues for the period 2009-2011. Also, in this study we discussed efficiency improvement by using full results of DEA analysis such as slacks in inputs and outputs of inefficient organizations. Furthermore, in order to capture the variations of efficiency over time, we presented the result of window analysis and Malmquist productivity index.

The findings of this paper are that (1) inefficiency of organizations are due to the heavy investment of higher paid players, (2) the efficiency trend is continuously improved from year 2009 to 2011 with 0.739 -> 0.742->0.779, (3) productivity of all organization, on average for the 3 year periods, are increased.

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