Social Media, Sports and Economic Indicators to Assess Premier League’s Efficiency using DEA

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Introduction

- Professional **football** has become a major business in Europe
- **Premier League** is the leading European football competition in terms of generated income
- Debate about **objectives** of football clubs is not new
- The presence of **non-financial objectives** also raises the question of **how to measure** the performance of football clubs
- Performance is a **relative** concept
Introduction

There are two broad types of method for arriving at measures of comparative efficiency: **parametric** and **non-parametric** methods

- **Parametric methods** typically hypothesise a functional form and use the data to estimate the parameters of that function. The estimated function is then used to arrive at estimates of the efficiencies of units

- **Non-parametric methods**, where no functional form is pre-established but one is calculated from the sample observations in an empirical way
  - best known as *Data Envelopment Analysis* (DEA), create virtual units to act as benchmarks for measuring comparative efficiency
Previous work

In the literature, many pieces of research can be found that assess the efficiency of sports (Dobson, & Gerrard, 2000; Debnath & Malhotra, 2015; Djordjević, 2015; Hausch & Ziemba, 1995; Meza, Valério, & Mello, 2015; Moreno & Lozano, 2014).

More specifically in football, research activities relating to data envelopment analysis (DEA) have grown in the last few years.
Previous work

Previous studies have evaluated performance in football through different approaches:

- some papers study the specific efficiency of **sports variables** like player or trainers (Espitia-Escuer & García-Cebrián, 2004; Torgler & Schmidt, 2007)

- while others analyze efficiency taking into account other **characteristics of the team** (Barros, Garcia-del-Barrio, & Leach, 2009; Dawson et al., 2000; Fizel & D’Itri, 1997)

- some include **other variables** as stadium facilities, stadium utilization rate or home town population (Barros & Leach, 2006; Haas, Kocher, & Sutter, 2004; Haas, 2003)
Our paper

The aim of this paper is to proposing the incorporation of social media indicators in the data envelopment analysis (DEA) methodology in order to analyze which ones are the most efficient teams of English football from three perspectives:

- Social media
- Economics
- Sports
Our paper

To assess if efficiency is somehow related to social media management of English Premier League’s clubs

We will employ an input-oriented DEA model
Sports and social media
Sports and social media

- Sport organizations need to interact with fans in a mutually beneficial way (Bühler & Nufer, 2009)
- As **social media** use has developed, sport companies have evolved practices to communicate with consumers. This has led to a **distinctive role for social media**, different from conventional media.
Sports and social media

Among other features, social media embraces **interactivity**; integrates communication and distribution channels; and delivers more **speed** to the delivery of information and feedback.

A specific review to sports and social media research (Filo, Lock, & Karg, 2014) reveals that these new information and communication technology has caused a **profound impact** in sports’ delivery and consumption.

This influence could generate **competitive advantage** if social media are managed from the perspective of organizational efficiency.
Methodology
Data envelopment analysis (DEA)

- Nonparametric method of measuring the efficiency of a **Decision Making Unit (DMU)** with multiple inputs and/or multiple outputs
- Used to measure the **relative efficiency** of a DMU by comparing it with other homogeneous units transforming the same group of measurable positive inputs into the same types of measurable positive outputs
Data envelopment analysis (DEA)

We can in 2 ways oriented:

- **Input oriented:**
  By how much can input quantities be proportionally reduced without changing the output quantities produced?

- **Output oriented:**
  By how much can output quantities be proportionally expanded without altering the input quantities used?

Number of DMUs > 3 * (inputs + outputs)
(Bowlin, 1998)
Input-output indicators of SES-DEA Model

Inputs
- Wages and salaries
- Total Assets
- Number of team’s posts in Facebook during the season 2013-2014

Outputs
- Season points
- Profit before taxes
- Number of Facebook fans

20 football clubs Premier League 2013-2014
Results
<table>
<thead>
<tr>
<th>DMU No.</th>
<th>DMU</th>
<th>Global Technical Efficiency CCR model</th>
<th>Purely Technical Efficiency BCC model</th>
<th>Scale Efficiency</th>
<th>Returns to Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Arsenal</td>
<td>0.79</td>
<td>1.00</td>
<td>0.79</td>
<td>Decreasing</td>
</tr>
<tr>
<td>2</td>
<td>Aston Villa</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>Constant</td>
</tr>
<tr>
<td>3</td>
<td>Cardiff City</td>
<td>0.35</td>
<td>0.52</td>
<td>0.68</td>
<td>Increasing</td>
</tr>
<tr>
<td>4</td>
<td>Chelsea</td>
<td>0.69</td>
<td>0.79</td>
<td>0.87</td>
<td>Decreasing</td>
</tr>
<tr>
<td>5</td>
<td>Crystal Palace</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>Constant</td>
</tr>
<tr>
<td>6</td>
<td>Manchester City</td>
<td>0.31</td>
<td>1.00</td>
<td>0.31</td>
<td>Decreasing</td>
</tr>
<tr>
<td>7</td>
<td>Manchester United</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>Constant</td>
</tr>
<tr>
<td>8</td>
<td>Everton</td>
<td>0.65</td>
<td>1.00</td>
<td>0.65</td>
<td>Increasing</td>
</tr>
<tr>
<td>9</td>
<td>Fulham</td>
<td>0.29</td>
<td>0.39</td>
<td>0.74</td>
<td>Increasing</td>
</tr>
<tr>
<td>10</td>
<td>Hull City</td>
<td>0.71</td>
<td>0.78</td>
<td>0.91</td>
<td>Increasing</td>
</tr>
<tr>
<td>11</td>
<td>Liverpool</td>
<td>0.88</td>
<td>1.00</td>
<td>0.88</td>
<td>Constant</td>
</tr>
<tr>
<td>12</td>
<td>Newcastle</td>
<td>0.51</td>
<td>0.53</td>
<td>0.96</td>
<td>Increasing</td>
</tr>
<tr>
<td>13</td>
<td>Norwich City</td>
<td>0.53</td>
<td>0.64</td>
<td>0.82</td>
<td>Increasing</td>
</tr>
<tr>
<td>14</td>
<td>Southampton</td>
<td>0.81</td>
<td>1.00</td>
<td>0.81</td>
<td>Constant</td>
</tr>
<tr>
<td>15</td>
<td>Stoke City</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>Constant</td>
</tr>
<tr>
<td>16</td>
<td>Sunderland</td>
<td>0.45</td>
<td>0.55</td>
<td>0.82</td>
<td>Increasing</td>
</tr>
<tr>
<td>17</td>
<td>Swansea City</td>
<td>0.65</td>
<td>1.00</td>
<td>0.65</td>
<td>Increasing</td>
</tr>
<tr>
<td>18</td>
<td>Tottenham</td>
<td>0.58</td>
<td>1.00</td>
<td>0.58</td>
<td>Constant</td>
</tr>
<tr>
<td>19</td>
<td>West Bromwich</td>
<td>0.43</td>
<td>0.47</td>
<td>0.91</td>
<td>Increasing</td>
</tr>
<tr>
<td>20</td>
<td>West Ham</td>
<td>0.31</td>
<td>0.39</td>
<td>0.80</td>
<td>Increasing</td>
</tr>
</tbody>
</table>
# Efficiency summary

<table>
<thead>
<tr>
<th>Nº DMUs</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>0.803</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.24</td>
</tr>
<tr>
<td>Minimun value</td>
<td>0.39</td>
</tr>
<tr>
<td>Maximun value</td>
<td>1</td>
</tr>
<tr>
<td>Nº efficient DMU</td>
<td>11</td>
</tr>
<tr>
<td>% DMU efficient rate</td>
<td>55 %</td>
</tr>
<tr>
<td></td>
<td>CCR</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Ranking 2013-14</td>
<td>0.337</td>
</tr>
</tbody>
</table>

**p<0.01  
*p<0.05
Conclusions
This study's results show that there is **significant acceptance** of **Social Media** as a technological resource among the teams in Premier League analysed.

Furthermore, it has found a **direct relationship** between position on the table, efficiency, turnover and the use of Social Media.

Only the teams capable of **integrating** these 2.0 technologies in their marketing plans obtained the largest efficiency gains.

This study provides a tool to assess the **strategic performance** of an organization regarding its presence and activity in Social Media.
Limitations
Limitations

- **Number of teams** in Premier League (20) limit the number of inputs, outputs considered.

- Furthermore the **influence** of environment variables and other **external data** have not been considered (home town population, sponsorship...)

- We don’t **compare traditional** social outputs as attendance vs social media
Future research lines
Future Research lines

- Another DEA models: including **additional variables** with other tools such as Twitter, Youtube, Instagram or Google+
- Enlarging the sample of clubs and countries in order to validate the model with **higher robustness**
Thanks
Non parametric, Return scale

- Nonparametric method of measuring the efficiency of a Decision Making Unit (DMU) with multiple inputs.

- The significance of scale inefficiencies induces that we are handling with an activity that gives rise to variable returns to scale and, consequently, the size of each team is an aspect to consider when evaluating its efficiency.
Some Informal Definitions

We begin by defining the **productivity** of a firm as the ratio of the output(s) that it produces to the input(s) that it uses:

\[
\text{productivity} = \frac{\text{outputs}}{\text{inputs}}
\]

When there is more than one input (and/or outputs) then a method for aggregating these inputs into a single index of inputs must be used to obtain a ratio measure of productivity.
The first model that has been applied in this study was the one initially proposed by Charnes et al (1978) and known by the authors' initials, **CCR**.

This model involves constant returns to scale and is input-oriented.

The input-oriented CCR model, assuming \(m\) inputs and \(s\) outputs would be formulated in its multiplier form (Cooper et al, 2000):

\[
\begin{align*}
\text{max } z &= \sum_{r=1}^{s} \mu_r y_{r0} \\
\text{subject to } & \sum_{r=1}^{s} \mu_r y_{rj} - \sum_{i=1}^{m} \nu_i x_{ij} \leq 0, \quad i = 1,2,\ldots,m; \quad r = 1,2,\ldots,s; \quad j = 1,2,\ldots,n.
\end{align*}
\]

\[\mu_r, \nu_i \geq 0\]
Data envelopment analysis (DEA): BCC model

Similarly, given the absence of information on the shape of the production frontier, we use a model like that shown in (1), but which has the property of allowing variable returns to scale.

This model is known, in honour of its authors, as BCC (Banker et al, 1984). When input - oriented, the multiplier form of the BCC Model becomes:

$$\begin{align*}
\max & \sum_{i=1}^{s} \mu_i y_{r0} + \mu_0 \\
\sum_{j=1}^{m} v_j x_{ij} - \sum_{j=1}^{m} v_j x_{ij} + \mu_c & \leq 0 \\
\sum_{i=1}^{m} v_i x_{ij} & = 1 \\
\mu_i, v_j & \geq 0
\end{align*}$$

\text{for } i = 1, 2, \ldots, m; \quad r = 1, 2, \ldots, s; \quad j = 1, 2, \ldots, n.