# THE SOCCER WORLD CUP IS BACK AGAIN: CAN YOU GUESS WHO WINS?

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# RESUMEN

El siguiente estudio analiza las variables que explican el rendimiento de un equipo nacional de fútbol. Las variables se clasifican en los tres siguientes grupos: macroeconómicos, demográficos y deportivo-culturales. Encontramos que el deporte-cultura es una variable relevante en cuanto a su posición.

Los resultados contrastan con estudios previos que no consideran nuestra medición sobre el rendimiento del participante en torneos. La posición del equipo se evalúa aplicando *Data Envelopment Analysis* (*DEA*) para obtener el puntaje de eficiencia de los participantes basado sobre la idea de maximización de puntos con el número de intentos para marcar mediante corner, fuera de línea, tiro abierto y gol.

**Palabras claves:** eficiencia, variables macroeconómicas, *ranking*, FIFA.

# ABSTRACT

The following study analyzes the variables that explain a nation's soccer team performance. The variables are classified in three groups: macroeconomic, demographic and cultural-sport. We find that cultural-sport is a relevant variable to its standing.

The result contrasts previous studies that do not consider our tournament participant's performance measurement. Team standing is assessed employing Data Envelopment Analysis (DEA) to obtain participants' scores of efficiency based on the idea of maximization of points given the attempts to score by corner, off side, shooting wide and goal.



**Keywords:** Efficiency, macroeconomic variables, ranking, FIFA.

## CONTENT

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## Executive summary

This paper is different than earlier studies because our sample has not been taken before and the technique (DEA) used here is singular in the economic of sport literature. We employ this technique as a primary step to find the determinants of efficiency.

In particular, we find that both macroeconomic and demographic variables are not significant in explaining a nation's performance, but what we call cultural-sport is a relevant variable to its standing.

Our result is also an addition to the existing literature because it employs a sophisticated technique to rank team efficiency called Data Envelopment Analysis which we find more reliable than the actual FIFA rankings.

DEA is a non-parametric method that does not need to consider a specific functional form of the frontier. It estimates the frontier with linear programming. It is enveloped because it makes an envelope around the observed values. Thus, the particular nation representative performance is assessed relative to others and gets a score of efficiency that varies between cero and one. This means that a team can be very efficient within a sample, but is not the best if it is considered in another sample. In our case, we evaluate the performance of the best national representatives that qualify to the FIFA world cup and play for being the world champion.

We use four inputs in the DEA estimation: the number corner, off side, shooting wide and goals. We also consider one output: the points that a tournament participant can achieve in the World Cup Championship. In order to guarantee confidence in our indicators, we run a test of difference in quartiles and we verify that there is a significant difference between quartiles.

This study is relevant for business because soccer is the most popular sport that handles millions of dollars every year. Measuring a team performance correctly and evaluate its determinants may influence a correct sport manager's decision making.

## Introduction

Soccer is one of the most popular sports in the world. We are able to identify the last statement by looking at the significant number of countries members attached to the Federation Internationale de Football Association (FIFA)[1], the world body governing body of this sport. Therefore, there is not doubt that soccer should be considered as one of the favorite sports played worldwide.

According to the FIFA statistics, during the past century there have been eighteen different soccer champions since 1930, where half of them come from South America or CONMEBOL Federation and the other half comes from the European side or UEFA Federation[2].

CONMEBOL federation has ten countries as members, while UEFA has fifty one participants during the preliminary World Cup Tournament. In addition, European Countries has a GDP per capita of US$ 19,500 while South American hits US$ 7,500[3] (World Fact book, 2005). Despite the higher number of participants and per capita GDP in Europe in comparison to South America, the latter region is as successful as the former in the FIFA tournaments.

Our study tries to explore what are the determinants that can explain an outstanding performance of national participants in the FIFA world cups. According to the literature, there are several variables that may affect the standing of a soccer team. In particular, Hoffman, Ging and Ramasamy (2002b) reveal that economic, demographic, cultural and climatic factors are relevant. They test FIFA World Cup

[1] FIFA which is an association governed by Swiss law founded in 1904 and based in Zurich. It has 208 member associations and its goal is to preserve its Statutes (see FIFA website: www.fifa.com).
[2] CONMEBOL stands for South American Football Confederation while UEFA is the Union of European Football Associations.
[3] This estimation was made for 2005.

rankings against different variables that may explain a team's ranking[4]. Also, Hoffman, Ging and Ramasamy (2002a) conclude how many inherent national characteristics such as geographical, demographic and cultural factors have a significant impact on an Olympic contestant's success.

Our paper intends to explore the determinants of a tournament participants' performance, based on an indicator of efficiency widely used in the literature of banking and health but not deeply used in sports. We used Data Envelopment Analysis[5] to estimate efficiency of a nation soccer team and evaluate its determinants[6].

In the sport field, there are some applications of efficiency indicators to assess the standing of different national sport representatives. For example, Andersons and Sharp (1997) measure efficiency of baseball batter by Data Envelopment Analysis Technique (DEA). Soccer is not alienated from this estimation under this approach. Pestana, Del Corral and Garcia del Barrio (2008) provide estimates of technical efficiency for a panel of managers in Spanish soccer's Premier League for the period 1994 to 2006[7].

Pestana, Del Corral and Garcia del Barrio (2008) implemented a stochastic frontier latent class model, a procedure that also permits them to analyze the efficiency of the clubs with respect to their own frontiers. The results reveal that some of the clubs could improve their efficiency levels substantially. Also, Espitia-Escuer, Garcia-Cebrián (2006) evaluate the performance of Spanish First Division comparing the result that they should have obtained on the basis of their potential and propose a future course of action to improve their performance.

[4] FIFA World Cup rankings bias the study because the methodology used by this institution is arbitrary. They assign different weight to the points according to the importance of the match and the opponent's strength.

[5] See Barr, Killgo and Siems (1999), as well as Berger and De Young (1999), for insights in application of efficiency indicators to the financial system. Also, Chirikos and Sear (2000) have a similar estimation applied to hospitals.

[6] Condon et al. (2003) used Neuretical Networks for the same purpose.

[7] English Premier League performance has also been subject of study by Carmichael, Thomas and Ward (2001).

Our paper complements latter research by attempting to find a relationship between efficiency scores of national soccer teams and the macroeconomic, demographic and cultural-sport variables. This paper is different than earlier studies because our sample has not been taken before and the technique (DEA) used here is singular in the economic of sport literature. We employ this technique as a primary input to find out the determinants of a participant's performance in the FIFA world cup tournaments.

Soccer is a popular sport that is able to transact millions of dollars[8] in broadcasting, tickets and merchandising (Dobson and Goddar 2001d). Therefore, the performance of a national team will influence the increasing transfer of funds toward itself and the related industries. In some countries, soccer is seen as a vehicle of nationalism and the performance of a national team reinforces the impact in the economy (Hoffman, Ging and Ramasamy, 2002b). Our study is relevant to asses the influence of a team performance because it is related to economic issues.

## 1. Indicators of efficiency

Our research uses as a primary input the indicator of a team efficiency estimated with Data Envelopment Analysis (DEA). There is some previous literature that has estimated efficiency of soccer teams. For example Dawson et. al. (2000a and 2000b) developed indicators of efficiency following stochastic frontier methods. Espitia and Garcia-Cebrián (2006) have developed DEA scores of the Spanish First Division soccer teams for 1998-2005. The latter technique will be used here because DEA does not need a functional form and a vector of prices that is not available in our database.

[8] Soccer is a current topic in sport literature from an economic point of view. According to Cairns et al. (1986), this could be explained by widespread interest and the data available allows some exploration in the discipline.

DEA is a non-parametric method that does not need to consider a specific functional form of the frontier but estimates it with linear programming solved in R program. It is enveloped because it makes an envelope around the observed values from the sample. The particular nation representative performance is assessed relative to others and gets a score of efficiency that varies between cero and one. This means that a team can be very efficient within a sample, but is not the best if it is considered in another sample. In our case, we evaluate the performance of the best national representatives that qualify to the FIFA World Cup and strive to become the world champion.

The following equation is solved in order to get the indicators of efficiency:

$$\begin{aligned} &\text{Max } \theta_1 \text{ subject to:} \\ &\quad \theta_1 \mathrm{u} \leq zU \\ &x \geq zX \text{ , } \mathbf{z} \in R_+^K \ldots \end{aligned} \qquad (1)$$

Where $\theta_1$ is the scalar technical efficiency from the output oriented approach, u is the vector of size m of products produced by the team under evaluation. U is the matrix kxm, with k teams under study, and m products obtained by them. The variable x is the vector of n inputs processed by the team. In addition, X has a size of kxn and z is a vector of scale which determines the optimal combination of n inputs and m outputs used in the frontier.

When $\theta_1$=1, the team under analysis lies exactly on the optimal frontier and therefore is efficient, while if $\theta_1 < 1$, it means that is possible to obtain a radial increase in the output using the same input quantities. Figure 1 explains this idea for two outputs and one input:

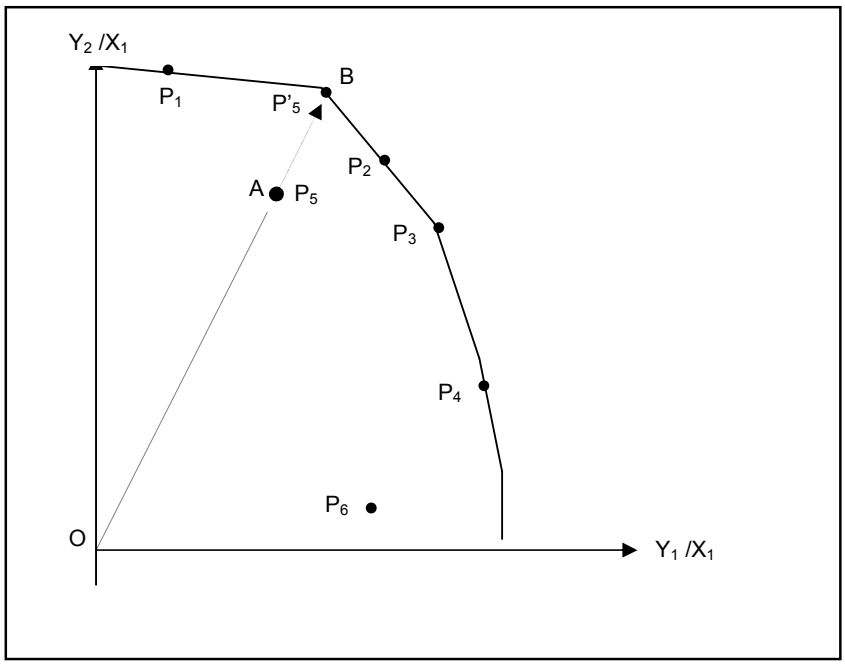


*Figure 1.* A graphical explanation of the DEA
Note: The teams P1, P2, P3 and P4 are efficient while, P5 and P6 are inefficient.

This figure represents six teams: $P_1$, $P_2$, $P_3$, $P_4$, $P_5$ and $P_6$ where they have one input $X_1$ to produce two outputs $Y_1$ and $Y_2$. The frontier is constructed as a concave shaped, as it is shown above, and the teams $P_1$, $P_2$, $P_3$, and $P_4$ are efficient (score of $\theta_1$=1) but $P_5$ and $P_6$ are inefficient (score of $\theta_1$<1). Team $P_5$ is located at A and needs a radial increase to be located in B.

We run (1) with four inputs: the number corner, off side, shooting wide and goal. There is one output: the points that a tournament participant can achieve in the World Cup Championship. Espitia and Garcia-Cebrián (2006) consider similar inputs and outputs, but for lack of information, we were not able to use exactly the same inputs.

In order to guarantee confidence in our indicators, we run a test of difference in quartiles and we verify that there is a significant difference between quartiles.

Figure 2 shows the difference between quartiles[9]. Therefore, we can rely on the estimations made for the soccer teams.

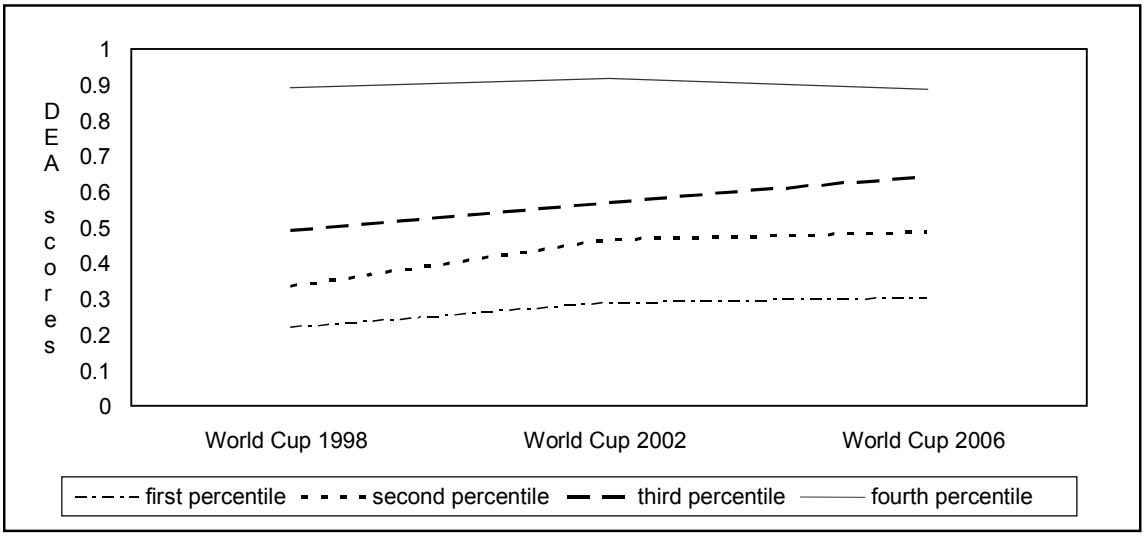


*Figure 2.* Percentiles

In addition, we run a Bootstrapping (see Table 1), which is based on the idea of repeatedly simulating Data Generating Process (DGP), by re-sampling and plugging the original estimator to each simulated sample, so that the resulting estimates mimic the sampling distribution of the original estimator. We follow the Bootstrap commands posted by Wilson (2005). Then, we verify that the ranking of the estimated scores do not differ with the simulated DEA scores[10]. Therefore, our efficient indicators can respond to sampling variations of the estimated frontier. Once we establish our estimations of efficiency consistent, the next section explains the data and model used to test our hypothesis.

[9] The test of difference in means shows statistically a significant difference between quartiles of our estimation. It means that our result is not biased toward one quartile

[10] A Spearman Test permitted to verify that the rankings between the simulated and the original DEA scores are not different. The statistics test of Spearman was -3.73, -4.85 and -5.06 for each world cup; then, the null hypothesis was rejected at 99%, which means that the ranks of the original DEA do not covary with the ranks of the simulated variable.

Table 1. *Bootstrap of DEA scores*[11]

| Country | World Cup 1998 | | | | World Cup 2002 | | | | World Cup 2006 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DEA | Ranking DEA | Boot-strap | Ranking Bootstrap | DEA | Ranking DEA | Boot-strap | Ranking Bootstrap | DEA | Ranking DEA | Boot-strap | Ranking Bootstrap |
| Angola | n.d. | | n.d. | | n.d. | | n.d. | | 0.68 | 14.00 | 0.64 | 16.00 |
| Argentina | 0.44 | 10.00 | 0.37 | 17.00 | 0.58 | 11.00 | 0.55 | 14.00 | 0.98 | 2.00 | 0.90 | 3.00 |
| Australia | n.d. | | n.d. | | n.d. | | n.d. | | 0.46 | 25.00 | 0.44 | |
| Austria | 0.33 | 12.00 | 0.29 | 19.00 | n.d. | | n.d. | | n.d. | | n.d. | 27.00 |
| Belgium | 0.33 | 12.00 | 0.28 | 21.00 | 0.55 | 14.00 | 0.50 | 17.00 | n.d. | | n.d. | |
| Brazil | 0.51 | 6.00 | 0.40 | 14.00 | 1.00 | 1.00 | 0.73 | 6.00 | 0.86 | 5.00 | 0.77 | 6.00 |
| Bulgaria | 1.00 | 1.00 | 0.90 | 1.00 | n.d. | | n.d. | | n.d. | | n.d. | |
| Cameroon | 0.50 | 7.00 | 0.44 | 12.00 | 0.75 | 6.00 | 0.70 | 7.00 | n.d. | | n.d. | |
| Chile | 0.20 | 15.00 | 0.17 | 24.00 | n.d. | | n.d. | | n.d. | | n.d. | |
| China | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | |
| Colombia | 1.00 | 1.00 | 0.83 | 3.00 | n.d. | | n.d. | | n.d. | | n.d. | |
| Costa Rica | 1.00 | 1.00 | 0.72 | 5.00 | 0.58 | 11.00 | 0.55 | 14.00 | n.d. | | n.d. | |
| Cote d'Ivoire | n.d. | | n.d. | | n.d. | | n.d. | | 0.43 | 26.00 | 0.41 | 28.00 |
| Croatia | n.d. | | n.d. | | 0.56 | 13.00 | 0.52 | 15.00 | 0.62 | 18.00 | 0.58 | 19.00 |
| Czech Republic | n.d. | | n.d. | | 0.53 | 16.00 | 0.47 | 20.00 | 0.58 | 21.00 | 0.55 | 22.00 |
| Denmark | 0.44 | 9.00 | 0.38 | 16.00 | 1.00 | 1.00 | 0.89 | 1.00 | n.d. | | n.d. | |
| Ecuador | n.d. | | n.d. | | 0.69 | 8.00 | 0.64 | 11.00 | 0.95 | 3.00 | 0.91 | 2.00 |
| France | 1.00 | 1.00 | 0.68 | 7.00 | 0.23 | 22.00 | 0.19 | 26.00 | 1.00 | 1.00 | 0.83 | 4.00 |
| Germany | 0.83 | 3.00 | 0.70 | 6.00 | 1.00 | 1.00 | 0.81 | 4.00 | 0.84 | 6.00 | 0.69 | 13.00 |
| Ghana | n.d. | | n.d. | | n.d. | | n.d. | | 0.75 | 11.00 | 0.71 | 12.00 |
| Iran | 0.50 | 7.00 | 0.42 | 13.00 | n.d. | | n.d. | | 0.26 | 27.00 | 0.24 | 29.00 |
| Ireland | n.d. | | n.d. | | 0.54 | 15.00 | 0.49 | 19.00 | n.d. | | n.d. | |
| Italy | 0.58 | 4.00 | 0.48 | 8.00 | 0.40 | 21.00 | 0.38 | 24.00 | 1.00 | 1.00 | 0.76 | 7.00 |
| Jamaica | 0.33 | 12.00 | 0.28 | 21.00 | n.d. | | n.d. | | n.d. | | n.d. | |
| Japan | n.d. | | n.d. | | 0.88 | 3.00 | 0.78 | 5.00 | 0.50 | 24.00 | 0.45 | 26.00 |
| Korea, Rep. | 0.50 | 7.00 | 0.45 | 10.00 | n.d. | | n.d. | | 0.77 | 8.00 | 0.73 | 9.00 |
| Mexico | 0.31 | 13.00 | 0.28 | 22.00 | 0.79 | 4.00 | 0.70 | 8.00 | 0.56 | 22.00 | 0.53 | 24.00 |
| Morocco | 0.35 | 11.00 | 0.30 | 18.00 | n.d. | | n.d. | | n.d. | | n.d. | |
| Netherlands | 0.49 | 8.00 | 0.40 | 15.00 | n.d. | | n.d. | | 0.75 | 10.00 | 0.71 | 11.00 |
| Nigeria | 0.54 | 5.00 | 0.47 | 9.00 | 0.55 | 14.00 | 0.46 | 21.00 | n.d. | | n.d. | |
| Norway | 0.50 | 7.00 | 0.44 | 11.00 | n.d. | | n.d. | | n.d. | | n.d. | |
| Paraguay | 0.83 | 2.00 | 0.73 | 4.00 | 0.42 | 19.00 | 0.39 | 23.00 | 0.66 | 15.00 | 0.63 | 17.00 |
| Poland | n.d. | | n.d. | | 0.64 | 9.00 | 0.60 | 12.00 | 0.76 | 9.00 | 0.72 | 10.00 |
| Portugal | n.d. | | n.d. | | 0.53 | 17.00 | 0.49 | 18.00 | 0.61 | 19.00 | 0.54 | 23.00 |
| Romania | 1.00 | 1.00 | 0.86 | 2.00 | n.d. | | n.d. | | n.d. | | n.d. | |
| Russian Fed. | n.d. | | n.d. | | 0.53 | 17.00 | 0.49 | 18.00 | n.d. | | n.d. | |
| Saudi Arabia | 0.50 | 7.00 | 0.45 | 10.00 | n.d. | | n.d. | | 0.56 | 23.00 | 0.50 | 25.00 |
| Senegal | n.d. | | n.d. | | 0.77 | 5.00 | 0.69 | 9.00 | n.d. | | n.d. | |
| Serbia | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | |
| Slovenia | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | |
| South Africa | 0.33 | 12.00 | 0.29 | 19.00 | 0.62 | 10.00 | 0.58 | 13.00 | n.d. | | n.d. | |
| Spain | 0.22 | 14.00 | 0.19 | 23.00 | 0.58 | 12.00 | 0.51 | 16.00 | 0.70 | 13.00 | 0.65 | 14.00 |
| Sweden | n.d. | | n.d. | | 0.55 | 14.00 | 0.50 | 17.00 | 0.59 | 20.00 | 0.56 | 21.00 |
| Switzerland | n.d. | | n.d. | | n.d. | | n.d. | | 0.79 | 7.00 | 0.74 | 8.00 |
| Togo | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | | n.d. | |
| Trinidad & Tobago | n.d. | | n.d. | | n.d. | | n.d. | | 0.71 | 12.00 | 0.65 | 15.00 |
| Tunisia | 1.00 | 1.00 | 0.90 | 1.00 | 1.00 | 1.00 | 0.83 | 3.00 | 0.63 | 17.00 | 0.57 | 20.00 |
| Turkey | n.d. | | n.d. | | 0.99 | 2.00 | 0.84 | 2.00 | n.d. | | n.d. | |
| Ukraine | n.d. | | n.d. | | n.d. | | n.d. | | 0.65 | 16.00 | 0.62 | 18.00 |
| United Kingdom | 0.33 | 12.00 | 0.29 | 20.00 | 0.74 | 7.00 | 0.66 | 10.00 | 0.86 | 4.00 | 0.79 | 5.00 |
| United States | n.d. | | n.d. | | 0.48 | 18.00 | 0.43 | 22.00 | 1.00 | 1.00 | 0.91 | 1.00 |
| Uruguay | n.d. | | n.d. | | 0.42 | 20.00 | 0.37 | 25.00 | n.d. | | n.d. | |

[11] "n.d." means that either we were not able to estimate efficiency or the country does not participate in the World Cup Championship. We can see that the DEA and the ranking that comes after this efficiency estimation are similar to the bootstraped.

## 2. Model and data

In order to figure out the determinants of a team performance, we start from different studies in the macro level work done by Bernard and Busse, (2000), Condon et al. (2003), as starting point. There are not many studies focusing on soccer; as a result, we had to reach out studies on other disciplines. The authors find a relationship between gold Olympic medals explained by GDP, population size as geographical, macroeconomic and political variables. We can use these variables as Hoffman, Lee and Ramasamy (2002a/b) did to explore the determinants of a team's standing.

Therefore, the model specification will be:

$$\begin{aligned} DEA_{it} &= \beta_0 + \beta_1 PERCGDP_{it} + \beta_2 PERCGDP^2{}_{it} + \beta_3 DEBTGDP_{it} \\ &+ \beta_4 INVGDP_{it} + \beta_5 POP_{it} + \beta_6 CONMEBOL_i + \beta_7 UEFA_i + \beta_8 CAF_i \\ &+ \beta_9 CONCACAF_i + \beta_{10} FINALIST_{it} + \beta_{11} HOME_{it} \end{aligned} \qquad (2)$$

The sub indexes "i", and "t" refer to a particular country and time period. The exogenous variable (DEA) is the efficiency measure by Data Envelopment Analysis Technique.

We control for macroeconomic variables where PERCGDP is the per capita Gross Domestic Product (GDP) for a particular country. We expect that this variable gives a positive sign because higher per capita GDP means that in average the people have covered their main necessities and are willing to practice[12] soccer in a competitive level. However, soccer is a relative low capital intensive sport and there is a possibility that people with just some resources practice this discipline. Then, we add $PERCGDP^2$, which controls for non linearity in the per capita GDP. The increase of income can not impact the performance in soccer at the same rate[13], and some times this relationship between per capita GDP and soccer efficiency is negative.

[12] Basically, people are free to avoid any economic pressures and have some available time for leisure.
[13] Hoffman (2002a) finds in an earlier study for Olympic Games that there is diminishing return between per capita GDP and sport standings.

The latter variable is classified by Hoffman, Ging and Ramasamy (2002b) as initial development of soccer talent because early development depends on the soccer physical organization infrastructure. In order to control better for initial development of soccer talent, we also have included Investment and Government debt as percentage of GDP. We may expect the sign of these variables to be positive. Our macroeconomic variables, per capita GDP, Investment and Government debt as percentage of GDP, come from the World Bank Database (see Table 2 for statistics).

The next variable is the control for demographic effects: Population Size. Mainly, populated countries are able to perform better than countries with a small proportion of people devoted to practice sport activities.

Our next independent group of variables concern cultural-sport settings. The dummy variables South American Football Confederation (CONMEBOL), Union of European Football Associations (UEFA), Confederation of African Football (CAF) and the Confederation of North, Central American and Caribbean Association (CONCACAF) control for influence of FIFA's confederations in the soccer performance[14].

We have included Home and Finalist as variables that set the influence of world cup hosting and standing in the tournament. We may expect that a hosting country stands better in a FIFA World Cup tournament and could end between the four best teams here (finalist) then it may pressure some positive effect in the team efficiency. According to FIFA records, in twelve out of eighteen editions of the championship the host came up among the top four finalists. There should be some sympathy pressures that make this result to happen. Hoffman, Ging and Ramasamy (2002b) consider that the hosting activity is an indicator of sporting cultural affinity toward soccer and it requires infrastructure in addition to the public support.

[14] There is also de Asian Football Confederation (AFC), which has been dropped to avoid the problem of singular matrix.

Table 2. *Statistics (average for the three World Cups)*

| Country | Export (%GDP) | Outstanding Debt (% GDP) | Investment (% GDP) | GDP (Anual variation) | Population (millions) | Shooting on goal | Shooting wide | Off side | Corners | Points | DEA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Angola | 68.06 | 88.34 | 10.61 | 13.29 | 14.85 | 11.00 | 23.00 | 14.00 | 13.00 | 2.00 | 0.47 |
| Argentina | 20.94 | 83.06 | 2.27 | 0.47 | 37.63 | 21.00 | 18.00 | 13.00 | 20.33 | 8.33 | 0.62 |
| Australia | 20.49 | n.d. | 3.20 | 3.68 | 19.69 | 27.00 | 27.00 | 9.00 | 20.00 | 4.00 | 0.39 |
| Austria | 49.38 | n.d. | 0.79 | 2.51 | 8.12 | 3.00 | 0.00 | 0.00 | 0.00 | 2.00 | 0.22 |
| Belgium | 81.65 | n.d. | 10.60 | 2.12 | 10.36 | 12.50 | 13.00 | 3.50 | 13.50 | 4.00 | 0.41 |
| Brazil | 11.89 | 30.81 | 2.94 | 2.11 | 179.22 | 36.33 | 23.33 | 13.67 | 21.67 | 15.33 | 0.79 |
| Bulgaria | 54.09 | 76.41 | 8.78 | 4.93 | 7.94 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.33 |
| Cameroon | 21.46 | 72.85 | 3.16 | 4.09 | 16.64 | 8.00 | 8.00 | 5.50 | 10.00 | 3.00 | 0.47 |
| Chile | 35.19 | 45.50 | 5.02 | 3.25 | 15.75 | 5.00 | 0.00 | 0.00 | 0.00 | 3.00 | 0.20 |
| China | 28.47 | 13.03 | 3.54 | 9.50 | 1278.04 | 10.00 | 9.00 | 5.00 | 16.00 | 0.00 | n.d. |
| Colombia | 18.94 | 34.57 | 3.42 | 3.12 | 42.97 | 1.00 | 0.00 | 0.00 | 0.00 | 3.00 | 1.00 |
| Costa Rica | 46.49 | 29.17 | 4.96 | 6.48 | 4.08 | 13.33 | 14.00 | 8.33 | 9.33 | 6.33 | 0.74 |
| Cote d'Ivoire | 47.20 | 99.66 | 2.22 | 1.02 | 17.63 | 23.00 | 26.00 | 11.00 | 23.00 | 3.00 | 0.34 |
| Croatia | 44.29 | 70.86 | 5.69 | 4.29 | 4.46 | 14.00 | 16.50 | 11.50 | 22.50 | 2.50 | 0.42 |
| Czech Republic | 63.40 | n.d. | 7.16 | 2.40 | 10.26 | 33.00 | 31.50 | 13.00 | 34.00 | 7.00 | 0.50 |
| Denmark | 45.80 | n.d. | 2.54 | 1.94 | 5.37 | 12.00 | 7.00 | 4.50 | 9.50 | 7.00 | 0.72 |
| Ecuador | 26.81 | 57.75 | 3.17 | 3.42 | 12.60 | 15.50 | 17.00 | 8.50 | 16.00 | 4.50 | 0.68 |
| France | 26.74 | n.d. | 3.00 | 2.17 | 59.78 | 28.33 | 19.33 | 12.67 | 21.67 | 11.67 | 0.69 |
| Germany | 36.48 | n.d. | 1.75 | 1.60 | 82.31 | 34.33 | 41.00 | 12.33 | 27.33 | 14.00 | 0.89 |
| Ghana | 38.77 | 74.19 | 2.20 | 5.20 | 21.11 | 23.00 | 38.00 | 25.00 | 17.00 | 6.00 | 0.68 |
| Iran, Islamic Rep. | 26.94 | 10.14 | 0.30 | 5.38 | 65.99 | 10.50 | 5.50 | 3.50 | 4.50 | 2.00 | 0.32 |
| Ireland | 90.20 | n.d. | 12.07 | 6.75 | 3.97 | 25.00 | 25.00 | 7.00 | 21.00 | 6.00 | 0.51 |
| Italy | 26.25 | n.d. | 1.17 | 1.22 | 57.67 | 30.67 | 19.00 | 18.00 | 23.00 | 10.67 | 0.64 |
| Jamaica | 40.39 | 64.48 | 6.37 | 1.17 | 2.61 | 3.00 | 0.00 | 0.00 | 0.00 | 3.00 | 0.33 |
| Japan | 11.13 | n.d. | 0.05 | 0.14 | 127.20 | 9.33 | 12.33 | 4.00 | 10.33 | 2.67 | 0.57 |
| Korea, Rep. | 41.47 | n.d. | 0.80 | 1.75 | 47.44 | 9.00 | 10.00 | 3.00 | 5.50 | 2.50 | 0.41 |
| Mexico | 29.80 | 27.42 | 2.83 | 3.51 | 99.82 | 16.33 | 14.33 | 6.33 | 12.67 | 5.33 | 0.52 |
| Morocco | 29.11 | 44.31 | 1.45 | 6.32 | 29.12 | 5.00 | 0.00 | 0.00 | 0.00 | 4.00 | 0.35 |
| Netherlands | 66.96 | n.d. | 5.41 | 2.28 | 16.06 | 21.50 | 12.00 | 6.00 | 9.50 | 9.50 | 0.60 |
| Nigeria | 36.18 | 50.35 | 3.38 | 3.21 | 131.47 | 8.50 | 10.00 | 3.50 | 5.50 | 3.50 | 0.37 |
| Norway | 41.73 | n.d. | 1.54 | 2.36 | 4.54 | 5.00 | 0.00 | 0.00 | 0.00 | 5.00 | 0.50 |
| Paraguay | 47.76 | 43.88 | 2.18 | 1.60 | 5.57 | 14.33 | 17.00 | 6.67 | 9.33 | 4.00 | 0.57 |
| Poland | 31.63 | 36.17 | 3.80 | 4.22 | 38.34 | 13.50 | 13.50 | 9.00 | 19.00 | 3.00 | 0.53 |
| Portugal | 29.36 | n.d. | 2.57 | 2.28 | 10.36 | 36.50 | 32.50 | 13.00 | 28.00 | 8.00 | 0.49 |
| Romania | 30.69 | 35.25 | 5.56 | 2.67 | 21.96 | 4.00 | 0.00 | 0.00 | 0.00 | 7.00 | 1.00 |
| Russian Federation | 33.41 | 44.54 | 1.71 | 2.28 | 144.90 | 17.00 | 24.00 | 10.00 | 10.00 | 3.00 | 0.38 |
| Saudi Arabia | 44.51 | n.d. | 0.93 | 2.04 | 21.73 | 7.00 | 11.00 | 4.67 | 4.67 | 0.67 | 0.23 |
| Senegal | 27.20 | 59.70 | 1.16 | 2.96 | 10.92 | 23.00 | 31.00 | 21.00 | 22.00 | 8.00 | 0.77 |
| Serbia | 22.78 | 61.42 | 5.90 | 4.98 | 7.49 | 8.00 | 13.00 | 3.00 | 11.00 | 0.00 | n.d. |
| Slovenia | 58.55 | n.d. | 3.34 | 4.32 | 1.99 | 17.00 | 16.00 | 3.00 | 12.00 | 0.00 | n.d. |
| South Africa | 29.50 | 18.34 | 0.34 | 3.06 | 44.85 | 10.00 | 7.50 | 2.50 | 6.00 | 3.00 | 0.36 |
| Spain | 26.70 | n.d. | 3.28 | 3.67 | 41.72 | 29.33 | 22.67 | 9.33 | 21.67 | 8.00 | 0.49 |
| Sweden | 45.87 | n.d. | 6.56 | 3.28 | 8.95 | 23.50 | 20.50 | 8.50 | 23.50 | 5.00 | 0.50 |
| Switzerland | 41.94 | n.d. | 4.40 | 2.10 | 7.29 | 28.00 | 21.00 | 8.00 | 22.00 | 8.00 | 0.74 |
| Togo | 31.73 | 93.56 | 2.70 | 1.98 | 5.73 | 12.00 | 15.00 | 13.00 | 9.00 | 0.00 | n.d. |
| Trinidad and Tobago | 49.37 | n.d. | 10.43 | 9.26 | 1.31 | 7.00 | 15.00 | 6.00 | 5.00 | 1.00 | 0.37 |
| Tunisia | 47.17 | 62.63 | 5.87 | 4.03 | 9.75 | 5.00 | 9.00 | 6.00 | 8.00 | 1.00 | 0.34 |
| Turkey | 23.07 | 43.87 | 1.54 | 5.12 | 69.25 | 32.00 | 30.00 | 21.00 | 39.00 | 13.00 | 0.99 |
| Ukraine | 47.87 | 42.91 | 2.87 | 3.53 | 48.38 | 30.00 | 30.00 | 13.00 | 19.00 | 7.00 | 0.61 |
| United Kingdom | 27.34 | n.d. | 4.25 | 2.72 | 59.47 | 23.33 | 22.00 | 7.00 | 16.67 | 8.67 | 0.64 |
| United States | 10.32 | n.d. | 1.41 | 2.91 | 287.79 | 12.33 | 13.67 | 7.00 | 11.00 | 2.67 | 0.50 |
| Uruguay | 23.89 | 57.04 | 3.05 | 0.17 | 3.30 | 18.00 | 16.00 | 6.00 | 19.00 | 2.00 | 0.24 |

In addition, in the literature of endogenous preference Akerlof (1980) and Becker and Murphy (2000) analyzed how social environment can affect the individual behavior. For these authors the different behaviors respond to social approval and other forms of social interdependences. These social tests are difficult to find (Durlauf and Brock, 2000), but our study attempts to capture the social interaction of groups with the HOME and CONMMEBOL, UEFA, CAF, AFC and CONCACAF. The latter variables have been taken from FIFA records[15].

Our analysis considers the last three World Cups: 1998, 2002 and 2006, because before these dates there is not enough information to construct the scores of efficiency.

## 3. Results

Table 3. *Correlation matrix of variables*

| | DEA | Export (% GDP) | Debt (% GDP) | Invest-ment (% GDP) | GDP | GDP per capita | GDP (Anual Var.) |
|---|---|---|---|---|---|---|---|
| Export (%GDP) | -0.2300 | | | | | | |
| | 0.0376 | | | | | | |
| Outstanding Debt (%GDP) | -0.2057 | 0.0187 | | | | | |
| | 0.1752 | 0.7262 | | | | | |
| Investment (%GDP) | -0.0024 | 0.2003 | 0.1914 | | | | |
| | 0.9826 | 0.0001 | 0.0003 | | | | |
| GDP | 0.2017 | 0.4408 | -0.3897 | -0.1153 | | | |
| | 0.0626 | 0.0001 | 0.0001 | 0.0040 | | | |
| GDP per capita | 0.0396 | 0.1153 | -0.2290 | 0.2466 | 0.5285 | | |
| | 0.7173 | 0.0043 | 0.0001 | 0.0001 | 0.0001 | | |
| GDP (Anual variation) | 0.0675 | 0.4033 | -0.3595 | 0.0128 | 0.0256 | 0.1114 | |
| | 0.5418 | 0.0001 | 0.0001 | 0.7512 | 0.5256 | 0.0056 | |
| Population (millions) | 0.1547 | 0.4690 | -0.2766 | -0.1985 | 0.7995 | 0.1403 | -0.0121 |
| | 0.1550 | 0.0001 | 0.0001 | 0.0001 | 0.0001 | 0.0004 | 0.7642 |

P-values are shown below the correlation coefficients.

The above table shows some pair wise correlations between efficiency (DEA) and some macroeconomic variables: Export, Investment Outstanding debt as percentage of GDP, variations of GDP, per-capita and the nominal GDP and population. Our

[15] Beyond the economic literature on corruption, the use of sports data to find determinants of sport games has gone under a significant development. The areas of study include discrimination (Szymanski, 2000), the effects of police on crime (McCornick & Tollison, 1998) and others.

variable of study (DEA) is not significantly correlated to theses set of macroeconomic variables. Therefore, we can infer that there is not an endogeneity problem within the set of variables. Our next step was to run a pool regression to find out the determinants of efficiency.

Table 4. *Pooled regression analysis*

| Variables | Dependent Variable: DEA | | |
|---|---|---|---|
| | Model 1 | Model 2 | Model 3 |
| PERCGDP | 0.000004 | 0.000027 | 0.000008 |
| | (0.000553) | (0.000033) | (0.000058) |
| $PERCGDP^2$ | -2.63E-09 | -1.73E-10 | -3.26E-09 |
| | (5.65e-09) | (4.75E-10) | (6.10e-09) |
| DEBTGDP | -0.001726 | | -0.001453 |
| | (0.001543) | | (0.001704) |
| INVGDP | 0.004523 | -0.009677 | 0.002965 |
| | (0.019650) | (0.020741) | (0.020514) |
| POP | 0.000772 | 0.008765 | |
| | (0.000767) | (0.014577) | |
| CONMEBOL | 0.689421 *** | | 0.698378 *** |
| | (0.173780) | | (0.180669) |
| CONCACAF | 0.655997 *** | | 0.678326 *** |
| | (0.200900) | | (0.214333) |
| CAF | 0.489705 *** | | 0.496562 *** |
| | (0.150187) | | (0.156913) |
| UEFA | 0.677904 *** | | 0.694898 *** |
| | (0.184636) | | (0.193912) |
| FINALIST | | 0.276495 ** | |
| | | (0.126193) | |
| HOME | | 0.203268 | |
| | | (0.185488) | |
| Control for years | No | Yes | Yes |
| Observations | 45 | 85 | 45 |
| $R^2$ | 0.7163 | 0.6785 | 0.6675 |

*** Significant at 1%
** Significant at 5%
* Significant at 10%

We can see from Table 4 that the cultural-sport variables are relevant in the model. Therefore, being part of CAF, CONMEBOL, UEFA or CONCACAF affects positively the efficiency of a soccer team in World Cups Championships. However, AFC is not significant in the estimation. The latter result can be explained by the outstanding performance of Central American (Basically Mexican and Americans), South

Americans, emerging African nations and European teams in the championships (see Table 5).

Table 5. *Historical world cup statistics*

| Year | Host | 1st place | 2nd place | 3rd place | 4th place |
|---|---|---|---|---|---|
| 1930 | Uruguay | Uruguay | Argentina | USA | Yugoslavia |
| 1934 | Italy | Italy | Czechoslovakia | Germany | Austria |
| 1938 | France | Italy | Hungary | Brazil | Sweden |
| 1950 | Brazil | Uruguay | Brazil | Sweden | Spain |
| 1954 | Switzerland | W. Germany | Hungary | Austria | Uruguay |
| 1958 | Sweden | Brazil | Sweden | France | W. Germany |
| 1962 | Chile | Brazil | Czechoslovakia | Chile | Yugoslavia |
| 1966 | England | England | W Germany | Portugal | U.S.S.R |
| 1970 | Mexico | Brazil | Italy | W. Germany | Uruguay |
| 1974 | W. Germany | W. Germany | Holland | Poland | Brazil |
| 1978 | Argentina | Argentina | Holland | Brazil | Italy |
| 1982 | Spain | Italy | W. Germany | Poland | France |
| 1986 | Mexico | Argentina | W. Germany | France | Belgium |
| 1990 | Italy | Germany | Argentina | Italy | England |
| 1994 | USA | Brazil | Italy | Sweden | Bulgaria |
| 1998 | France | France | Brazil | Croatia | Holland |
| 2002 | Korea/Japan | Brazil | Germany | Turkey | South Korea |
| 2006 | Germany | Italia | France | Germany | Portugal |

Source: FIFA

Being part of CONMEBOL increases efficiency of the team in the World Cup by 68.94%, while being part of CONCACAF and UEFA increases the team performance by 65.59% and 67.79% respectively. That means that federation setting has a big impact on a team effectiveness. This result contrasts the contribution of CAF (48.97%) to the team standing.

The standing of African teams in the championships support their performance in the U20 and U17 tournaments where they are able to usually reach the final stages. These young teams are the base of adult generations, which has permitted them to be noted as outstanding teams in the World Cup.

This result means that being part of certain confederation helps the efficiency of a team. In particular, Garicano, Palacios-Huerta and Prendergast (2005) show a sample in the first division of Spanish soccer on how the referee may exert an

influence in the result by biasing his judgment toward the home team[16]. This conclusion may help to interpret our result because, whenever a team country belongs to certain federation, it may influence its performance independently of the team's abilities to score[17].

The macroeconomic variables are not significant, that is: Per-capita GDP, Shares of Investment and Debt. This means that performance in soccer of a country does not depend on the infrastructure that it may undertake. We may see why South Americans are as good as European even though GDPs Per-capita of the former countries are significantly lower than the latter. The result differs from Hoffman, Ging and Ramasamy (2002b)[18] who tested the ranking of FIFA against socioeconomic variables. FIFA's ranking is biased because it does not measure objectively. The construction of this index depends on some subjective weight that may bias the result.

Table 6 shows our DEA scores and the ranking that we can build up after estimating efficiency of the 2006 soccer world cup participants. The table shows how our ranking that comes from efficiency estimation is very similar to the position achieved by these teams after the world cup. For example, the USA team ended up 25$^{th}$, which is similar to the DEA ranking (18$^{th}$), but it contrasts with the place that they were seeded before the competition (7$^{th}$).

The variable Host resulted with a positive but not significantly sign, which means that the performance of a soccer team does not depend on audience sympathetic influence. The result contrasts Hoffman, Ging and Ramasamy (2002b) who show that there is a cultural influence behind the interaction between team performance and hosting activity.

[16] Also Duggan and Levitt (2002) studied how preferences of crowd affect referee behavior.
[17] This explanation of results goes along the line of Special Interest Group (SIG). See Olson (1971) and Salisbury (1969) for a detailed elucidation of the theory behind SIG.
[18] Hoffman (2002b) found a significant interaction between FIFA world cup ranking and GDP, but for certain lower levels. Above a level of GDP, there is not a relationship.

Table 6. *Comparison of rankings*[19]

| Country | DEA | DEA Ranking | FIFA Ranking | World Cup Ranking |
|---|---|---|---|---|
| Angola | 0.47 | 19 | 63 | 23 |
| Argentina | 0.95 | 3 | 4 | 6 |
| Australia | 0.39 | 23 | 48 | 16 |
| Brazil | 0.84 | 5 | 1 | 5 |
| Costa Rica | n.d. | n.d. | 21 | 31 |
| Cote d'Ivoire | 0.34 | 25 | 42 | 19 |
| Croatia | 0.43 | 22 | 20 | 22 |
| Czech Republic | 0.46 | 21 | 2 | 20 |
| Ecuador | 0.87 | 4 | 38 | 12 |
| France | 1.00 | 2 | 5 | 2 |
| Germany | 0.84 | 7 | 17 | 3 |
| Ghana | 0.68 | 10 | 50 | 13 |
| Iran, Islamic Rep. | 0.14 | 29 | 19 | 25 |
| Italy | 1.00 | 1 | 12 | 1 |
| Japan | 0.26 | 28 | 15 | 28 |
| Korea, Rep. | 0.65 | 12 | 29 | 17 |
| Mexico | 0.47 | 20 | 7 | 15 |
| Netherlands | 0.70 | 9 | 3 | 11 |
| Paraguay | 0.52 | 16 | 30 | 18 |
| Poland | 0.60 | 15 | 22 | 21 |
| Portugal | 0.60 | 14 | 10 | 4 |
| Saudi Arabia | 0.29 | 27 | 33 | 28 |
| Serbia | n.d. | n.d. | 47 | 32 |
| Spain | 0.67 | 11 | 5 | 9 |
| Sweden | 0.52 | 17 | 14 | 14 |
| Switzerland | 0.74 | 8 | 36 | 10 |
| Togo | n.d. | n.d. | 56 | 30 |
| Trinidad and Tobago | 0.37 | 24 | 50 | 27 |
| Tunisia | 0.33 | 26 | 28 | 24 |
| Ukraine | 0.61 | 13 | 40 | 8 |
| United Kingdom | 0.84 | 6 | 9 | 7 |
| United States | 0.52 | 18 | 7 | 25 |

The variable Finalist was positive as well, which confirms the consistency of our estimation given that a team between the four finalists is equivalent to be very efficient.

The variable Population has the right sign but it is not significant. This result goes along the line of Archetti (1999), Giulianotti (1999), Lever (1995) and Hoffman, Ging

[19] If it says “n.d.” means that we were not able to estimate the DEA for this country.

and Ramasamy (2002b)[20], and it implies that population size has no impact in soccer performance. For these authors, culture dominates the size of population. We can verify this by comparing the soccer performance of Latin cultures[21] against any other culture[22]. The benefit of an increase in the population comes if the new people devote their effort to this sport. Therefore, culture has an important effect in the performance of a team. Some countries with a high population do not typically engage in soccer; the new generations participate in alternative activities that are more popular than soccer in their culture.

## Conclusions

This paper examines the determinants of efficiency in a soccer team. The result differs from previous studies because demographic and macroeconomic variables are not significant while cultural-sport variables are relevant to explain a team standing. The significant cultural-sport variables considered include team's federation and hosting.

This conclusion contributes to the literature of how social interaction and environment may influence a tournament participants' behavior. These results have been analyzed previously in the literature of sport economics, but without an empirical team performance assessment.

Our result is also an addition to the existing literature because it employs a sophisticated technique to rank team efficiency called Data Envelopment Analysis (DEA), which is more reliable than the actual FIFA rankings. Conversely, FIFA's ranking is biased according to the methodology of the soccer ruler.

[20] They also attribute physical condition as a factor that influences the team performance. They also find religion and nationalism as main factors that express rivalry among nations and determine the country efforts in a game.

[21] FIFA's record show that Italy, Brazil, Argentina, France are four soccer Latin champions out of six.

[22] We mean countries that speak languages with Latin origin such as Italian, French, Spanish and Portuguese.

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