What makes Elite Leagues Professional?

¿Qué hace diferentes a las grandes ligas profesionales?

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Abstract

Elite professional sport leagues are a global social-economical phenomenon. The fact that only few leagues achieve the elite category does not occur by chance. Four leagues from North America and five are European (NFL, MLB, NHL, NBA, EPL, Bundesliga, LaLiga, Serie A y Ligue 1) were evaluated. In order to demonstrate that are these leagues, and no other, the most significant ones, we have utilised non-linear methodologies (Power Laws, Entropy and probability of success) which allow us to go deep in the aspects that we understand as the most relevant ones: access to economic resources, competitive format, and competitive balance. All these nine leagues have access to more economical resources (Total Revenue: €45.712 M mill/season 2015) than the rest of the leagues in the world, constitute huge social transcendence, accumulate the best players worldwide and their components are confronted under different competition formats (closed or open leagues), but are highly competitive (Normalised Entropy: 0.976-0.998 – Performance Differential: 0.0159-0.0611). We can affirm that the main professional sport leagues present specific profiles, compared to the rest of the leagues in the world. The availability of economical resources, the competition format, and the uncertainty related to the match and league results are the factors that determine if a professional sport leagues can obtain global relevance, attracting millions of supporters worldwide and significant economical resources.

Key words: Resources, competitive format, competitive balance, uncertainty, power law.

Resumen

Las ligas deportivas profesionales son un fenómeno socioeconómico global. El hecho de que solo unas pocas ligas alcancen la categoría de élite no ocurre por casualidad. Se evaluaron cuatro ligas de Norteamérica y cinco europeas (NFL, MLB, NHL, NBA, EPL, Bundesliga, LaLiga, Serie A y Ligue 1). Para demostrar que son estas ligas, y no otras, las más importantes, se han utilizado metodologías no lineales (Leyes de potencia, Entropía y probabilidad de éxito) que nos permiten profundizar en los aspectos más relevantes: acceso a recursos económicos, formato competitivo y equilibrio competitivo. Todas ligas analizadas tienen acceso a recursos más económicos (ingresos totales: 45.712 millones de euros/temporada 2015) que el resto de las ligas del mundo, tienen una gran trascendencia social, acumulan a los mejores jugadores del mundo y sus componentes se enfrentan en diferentes formatos de competición (ligas cerradas o abiertas), pero son altamente competitivos (Entropía normalizada: 0.976-0.998-Diferencial de rendimiento: 0.0159-0.0611). Podemos afirmar que las principales ligas deportivas profesionales presentan perfiles específicos en comparación con el resto de las ligas del mundo. La disponibilidad de recursos económicos, el formato de competición y la incertidumbre relacionada con los resultados del partido y la liga son los factores que determinan si las ligas deportivas profesionales pueden obtener relevancia global, atrayendo a millones de seguidores en todo el mundo y recursos económicos significativos.

Palabras clave: Recursos, formatos de competición, balance competitivo, incertidumbre, ley de potencia.

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Introduction

Sport is the most popular mass phenomenon of our time, with a permanently growing number of practitioners and followers worldwide. Considerable part of this popularity is due that sport is a multi-factorial sociological construct comprising relevant elements of life itself, as entertainment, overcoming, and the search for the excellency. A key instrument for the expression of sport is the competition. Sport, in the context of a competitive game, configures, with the victories and defeats, a sort of representation of the society, with the difference relying in not tragic consequences, which is frequently the case in other aspects of life. Some of the most attractive and demanded competitions are those in which success depends directly of co-operation-opposition strategies between two or more players. These sport modalities (Szymanski, 2003) are those that we know as team sports or association sports (e.g. American football, basketball, hockey, soccer, rugby, etc.). Each modality organises regulated competitions (leagues) at local, national, regional or supranational level, which allow to determine the best club or franchise on that sport. In order for these competitions to result attractive to sportsmen, spectators, sponsors, and media, among other agents, they must gather several features which identify them and make them interesting to consumers (Zimbalist, 2002) .

Today, among the huge number of existing competitions worldwide (more than 300 professional leagues), very few achieve to arouse enough interest and popularity to become a global success phenomenon, demanded and consumed almost worldwide by millions of people. There is a large number of aspects, both financial and non-financial (Pawlowski, Nalvantis & Coates, 2018), that can be used to compare those leagues. Several cultural, sociological, economical, and organisational aspects will determine if the product is successful, mediocre, or simply, a failure. In order to understand the whole process, we analyse those aspects which we consider as the most relevant and distinctive of the main, and most prestigious, professional sport leagues (PSL) in the world.

Methodology

Sample

Initially we start our analysis evaluating the 62 leagues with highest revenues in season 2015 (*List of professional sports leagues by revenue, 2015*), from a universe of the more than 300 professional leagues.

These were the PSL with incomes over 50 million euros per year on their last season. This availability of resources behaves in the form of a power law in which an important difference in access to economical resources can be observed between the first nine leagues and the rest of competitions. According to this criterion, the main PSL are the four north-American leagues popularly known as the *Big-4* (National Football League (NFL), Major League Baseball (MLS), National Basketball Association (NBA), and National Hockey League (NHL)), and five European leagues (Barclays Premier League (EPL), Fußball-Bundesliga, Primera División Española (LaLiga), Lega Nazionale Professionisti Serie A (Serie A) y Ligue de Football Professionnel (Ligue 1)).

Procedures

In order to evaluate the key factors which make an PSL a social-economical global phenomenon which differentiates from the rest of professional leagues, basic statistics, and non-linear analysis were utilised (power laws and Shannon's entropy), which are now described.

Power laws (PL)

The PL reflect an organisation pattern which is typical in adaptive complex systems. They manifest in many life phenomena in which a significant number of elements interact in a non-linear fashion to produce a different structure. These systems evolve far from balance and they are frequently highly dissipative. They are described through mathematical expressions of the type: $Y = c\,X^{b}$; where X and Y are two variables, c is a constant (normalisation constant), and b is the scale exponent. An expression of this type has two fundamental properties. First, if we apply the logarithm to both variables, we obtain a linear equation with slope b: $log\,(Y) = log\,(c) + b\,log\,(X)$. Secondly, the power laws are invariant to scaling (scale free).

Entropy

A magnitude which has proven to be specially useful for analysing complex systems is the entropy. In information theory, the entropy is a measure of the uncertainty of a random variable. In this work, we utilise Shannon's entropy (S), which allow us to quantify the expected value of the information contained in a data series (e.g. team score, position, etc.). More specifically, the entropy will be utilised to measure the mean unpredictability of a random variable, which is

equivalent to its information content. That is to say, when the probability set p_i, $i=1,..., N$; of a known system, the mean uncertainty can be determined and, in consequence, a reference can be performed to the mean amount of information contained in the selected PSL or participating teams. Numerically, Shannon's entropy is defined as:

$$S = \sum_{i=1}^{N} (p_i \log 1/p_i)$$

with the maximum uncertainty achieved when all p_i values are equal. The value of S changes according to the value of N, and (in our case, the number of participant teams in a league), and then, if N changes the value of S would not be comparable. In order to resolve this problem we utilise the normalised Shannon's entropy

$$S_N): \quad S_n = \frac{s}{\log(N)}$$

with $S_N \in [0; 1]$, where a value of 1 corresponds to the maximum uncertainty; with every equal p_i value.

Competitiveness.

In order to evaluate this parameter, the normalised entropy values for each team competing in each league on season 2015, were utilised. For obtaining this entropy, we first calculate the probability of success in a confrontation as the team score over the accumulated score for all the competing teams, as:

$$P_n = \frac{Points\ at\ the\ end\ of\ the\ season}{Total\ number\ of\ points\ of\ all\ teams\ in\ the\ season}$$

Then, team entropy is calculated as

$$S = Pn - \log (P_n)$$

The value of Equation adjusts to the way of organising and distributing of all the teams at the end of the season, and the utilised distribution is the uncertainty (Shannon's entropy) $(S_1, S_2,..., S_n)$ of these teams in 2015, for each league.

The maximum competitiveness of each league, or the maximum performance differential (D_R) corresponds to the entropy difference between the first (S_p) and last (S_u) classified team of each league, independently from the number of teams participating in the corresponding league:

In order to understand each league characteristics, we start from a theoretical model of extreme situations, from a hierarchical distribution (high D_R), to a totally equilibrated situation (low D_R) with every team showing the same performance (de Sáa et al., 2012).

Results and discussion

As previously stated, the analysis is based on the criterion that a series of factors exist (economical and organizational) which influence the aforementioned competitions to become the main PSL in the world. For easier analysis, these factors can be grouped in the following manner: access to economical resources; competition format; and competitiveness.

Access to economical resources. We start our analysis from the criterion of economical resources availability. The reason is sustained in the certainty that only having access to a significant amount of economical resources, the sport phenomenon is capable of creating structures sufficiently attractive for the sportsmen, crowd, investors, and media. The problem arises when the incomes are accumulated by some few leagues, leaving less resources for the remaining ones, which leads to the risk of producing the *Matthew Effect* (Merton, 1968). If a correct distribution of the economical resources is achieved, the access to the best players is balanced, the most attractive competition format is found, and the competitiveness, rivalry, and uncertainty are incremented, a successful competition will be achieved with high certainty (Noll, 2013).

If we accept the fact that a professional competition can be understood as an enterprise with its own features and dynamics in which the sport objectives are mixed with the financial objectives (Késenne, 2014; Neale, 1964), we could affirm that the main PSL always will be those which have access to significant amounts of economical resources. We can observe how this criterion behaves in reality in Figure 1. In this figure, the distribution of economical revenues for the 62 main PSL in the world, are presented. In the figure, the adjusted distribution curve, corresponding to a well defined PL, can be observed, too, which relates the revenues with the position of a league between the most wealthy PSL in the world (*Revenue=25540xRanking* [-1,419]).

Always, the main PSL belong to countries with high human resource potential (high population), highly developed economies, and high attachment with the sport modality. All these parameters are manifested in the analysed PLS.
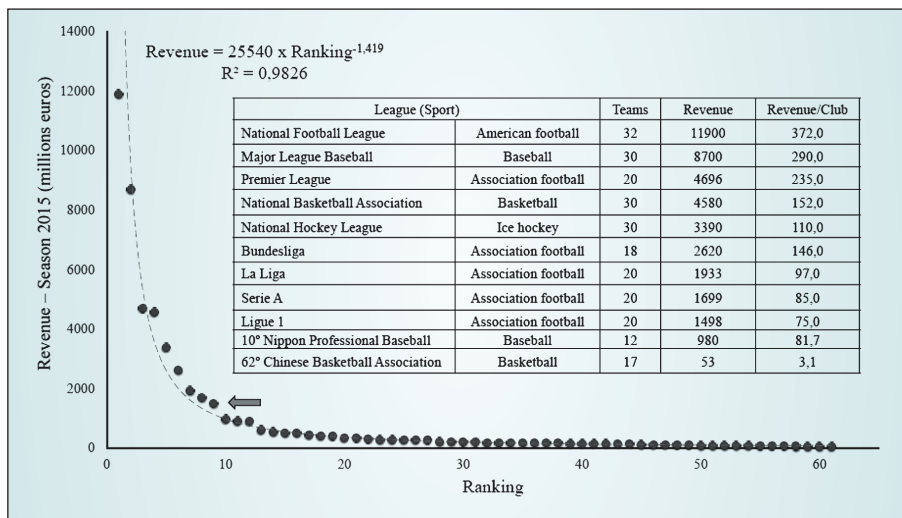
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$$\text{Revenue} = 25540 \times \text{Ranking}^{-1,419}$$
$$R^2 = 0,9826$$

League (Sport)		Teams	Revenue	Revenue/Club
National Football League	American football	32	11900	372,0
Major League Baseball	Baseball	30	8700	290,0
Premier League	Association football	20	4696	235,0
National Basketball Association	Basketball	30	4580	152,0
National Hockey League	Ice hockey	30	3390	110,0
Bundesliga	Association football	18	2620	146,0
La Liga	Association football	20	1933	97,0
Serie A	Association football	20	1699	85,0
Ligue 1	Association football	20	1498	75,0
10° Nippon Professional Baseball	Baseball	12	980	81,7
62° Chinese Basketball Association	Basketball	17	53	3,1

Figure 1. Economical Revenue Distribution of most wealthy PSL. The total revenue table is included, also by club, for the nine main PSL, 10th and 62th (List of professional sports leagues by revenue, 2015).

Currently, the available economical resources in sports are significant, but they have to also be distributed among a big and increasing number of sport modalities (Matheson, 2002). Also, it is a fact that most of these resources are concentrated in a limited number of sports, clubs, or sportsmen.

In sportsmen, the concentration of resources is evident (SportingIntelligence, 2015). It is interesting to note that, among the sportsmen with highest incomes are practitioners from individual modalities. In the season subject of this study, the two sportsmen with highest overall revenues are boxers, who have far surpassed the US$100 million (Mayweather: US$300 million; Pacquiao: US$160 million). This situation corresponds to what is known as the *Louis-Schmeling paradox* (Neale, 1964). This is more frequent in individual sports and can be observed in different modalities during the season 2015 with the cases: Djokovic-Federer, Hamilton-Alonso, Mickelson-Woods-McIlroy. It would be interesting to verify if this behaviour can be also found in team competitions. It is relevant to consider that, in team sports, the available resources must be shared among the teams participating in a league, and these clubs must redistribute these resources among their players in their squad and the team staff. A priori, it could be thought that this behaviour would induce an attenuator effect on the potential unbalances in the revenues of teams and players, but this is not the case. In practice, we can observe that, despite the utilisation of different financial support sources and redistribution methods, the phenomenon repeats, essentially in the european leagues. In fact, among the 200 players with higher income in the world (Forbes, 2015), a 61% of them belongs to the *Big-4*, and only 33% to the top five European leagues. However, two players from European soccer (Ronaldo and Messi) achieve year revenues wich are highky superior compared to the players of highest income in the North-American PSL (LeBron, Rothlisberger, Lester, Pujols, Weber, etc.). This shows an exemple of an unbalanced distribution among the participating teams (Annual Review of Football Finance, 2016).

For every PSL, the financial sources are basically the same (television incomes, marketing, and merchandising, publicity, match-day, season tickets, player transfers, and, occasionally, stock exchange, among others), but the contributed amount of income from each different source significantly changes between competitions and, specially, between continents. The north-American leagues are those that generate the highest amount of resources (north-American PSL: €33.266 Mm vs. European PSL: €12.446 Mm). This means that the *Big-4* obtains almost three times more revenues, compared to the European leagues. Moreover, one only league (NFL: €11.900 Mm) achieves almost the same amount of resources as the five European competitions together.

Currently, everything seems to indicate that the PSL have started a rampant race in search of resources. It even seems, in occasions, that the interest in sport passes to background, prevailing the economical interests. These clubs have become enterprises of global interest, where sports are a mere instrument for generating economical resources. Nevertheless, in order to guarantee the robustness, or even the survival, of these huge sport competitions, it is compulsory to balance both objectives. Aiming to this objective, these big professional leagues have developed organisational strategies (*salary cap*, *financial fair-play*, etc.) trying to soften undesirable situations and to prevent the development of sport monopolies, which could, at mid-term, decrease the interest in these competitions.

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Other objective is to prevent an unbalanced economical overgrowth of the competition, which could lead to a less equitable distribution of the resources. This could result in a financial default, that could collapse the competition. In North America, the utilised strategies were centred in the creation of different models. One of the most interesting models was the establishment of financial limits (*salary cap* or *wage cap*, *soft cap*, *hard cap*), individually or collectively bounding the financial resources that the clubs can expend in the salary of players. This initiative has not always been without controversy and conflict, but its implantation seems positive and it has been exported to several sport modalities on different continents.

In Europe, other strategy has been utilised. In June 2012, UEFA Executive Comitee approved the formation of the *Club Financial Control Body*. The function of this organism is to veil for the application of the *UEFA Fair Play Rules*, document approved in September 2009 which establishes economical control mechanisms for the clubs belonging to this organisation to prevent untenable economical situations which could compromise the viability of the sport projects of the clubs. In any case, the economical parity has not been achieved (Figure 2).

The figure shows the high differences between different leagues and the unequal performance shown by the teams in each league, specially European leagues. In this case, the average salary of some teams largelly surpass the rest of the teams in the league (e.g. Real Madrid, PSG, Barcelona, Juventus). Certainly, this influences the redistribution of resources. Eleven teams of the Big-4 are at the Top-20 among the teams which payed highest salaries in 2015. Nevertheless, only two of them (Los Angeles Dodgers and New York Yankees) are at the Top-10. The rest are soccer teams with less numerous squads.

The consequence is that a higher availability of economical resources allows teams of the main LPD to hire the best players in the world, in a totally globalised market. A priori, this situation leads to a high risk, as an inadmissible unbalance can be produced, resulting in a less attractive competition.

Nowadays, and with more emphasis in the analysed leagues, the sports have developed a complex labour market at global scale, where players are permanently transferred among clubs, and the players can even be exploited with the aim of maximising the revenues. Nevertheless, the players can also be benefited and, in occasions, help to improve the financial situation of less wealthy clubs. Certainly, the possibility of a PSL to have available a high number of local players is unlikely. This forces the PSL to look for players abroad, cre-
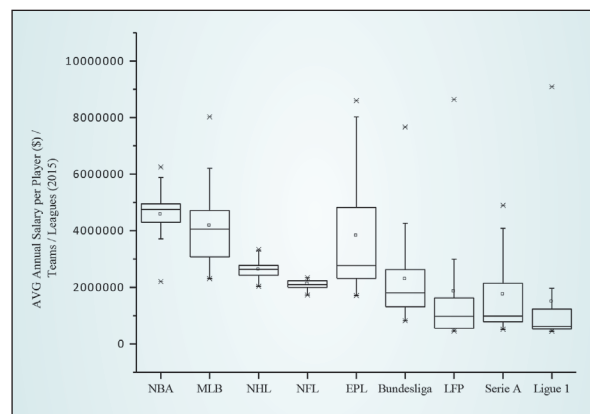

Figure 2. Box-plot of average team salary expenses performed in the season 2015 by clubs and franchises competing in the NBA, MLB, NHL, NFL (left) and EPL, Bundesliga, LaLiga, Serie A, and Ligue 1 (right).

ating a globalised player transfer market and a significant immigratory flux of sportsmen, which also has social-economical consequences. In this sense, in the new labour organization, the increasing role of the intermediaries, the arrival of new economical-financial figures (e.g. free agents), the establishment of spatially fragmented comercial circuits, would be the base for the creation of a sports market which can overcome the national frontiers (Poli, 2010). It is a fact that the internationalisation of professional sports is a phenomenon derived from the globalisation. However, the number of foreign players is different on every continent. In north-American leagues is considerably inferior comparing with the big European leagues. While the *Big-4* only had 994 foreign players (MLB: 202-26%; NHL: 589-22%; NBA: 62-14%; NFL: 41-2,4%), in Europe more than the 50% (1.462 players) are foreigners (LaLiga: 229-36%; EPL: 360-69%; Serie A: 293-56%; Bundesliga: 256-50%; Ligue 1: 324- 49%).

In order to try to balance the squad level, north-American leagues utilise another interesting model, creating an original system for having access to the players available in the market: the *draft* or *player selection meeting*. In this model there is no limitation on the number of foreign players, which existed as model in USA until the mid-70s (*reserve clause* or *reservation system*). With this strategy the franchises choose the players in an order inverse to the performance obtained in the last season in their respective leagues. That is to say, the best players in the *draft*, depending on the utilised *draft* model (*classic draft*, *expansion draft*, *dispersion draft*, *lottery*, etc.), shall be selected by the teams of worst performance in the last season.

The acquisition model for players in European leagues is totally different. There is no concession to the rivals, and the club with more resources can get

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more and better players. In these leagues, which belong to the European Union (EU), the participation of foreign players was initially limited with the objective of favouring, at least a priori, the respective national teams. Nevertheless, the allowed participation of foreign and communitary players has been progressively incrementing, significantly opening this scenario. We can find an inflection point in the *Bossman case*: in this legal-sport episode, the Tribunal of Justice of the EU on December 15th, 1955, dictated the elimination of the player retention clauses and allowed teams to contract any available player in the market, with certain limitations. Basically, the limitation consisted in that each club could utilise a limited number of non-communitary (EU) players.

Competition format

There are a lot of different competitive formats in the world. Currently, in the major PSL only two competition formats are utilised: open and closed league formats.

Open format

Format in which the competing teams can change on the next season, giving the opportunity of participating to minor league clubs (hierarchical organization). This implies that, each season, a number of teams must leave their place due to low sport performance or because a federative sanction (non-payment to players, irregularities, etc.), to the best clubs of the following league of inferior category. This ascent and descent format has been utilised in 2015 by the five studied European soccer leagues.

The competition is performed in the model *all against all*, in two rounds (local and visitor). Each match gives the possibility of winning a maximum of three points in case of victory, 1 point in case of tied match, or zero points in case of loss. The points accumulate until completing all the matches of the season and this score determines the final position in the classification table.

What is interesting about this format is that, besides the final victory, two factors also motivate the teams in the competition: the possibility of playing in international competitions and the struggle for not descending from the category. This three main objectives are the incentives which guide the development of the competition on each season. Positive or negative performance has a high social, economical, and sport impact for the participating teams (Noll, 2003). The difficulty on achieving these objectives depends

on how balanced are the contenders, which is strongly dependant of the availability of resources and the number of participating teams (Owen & King, 2013).

A peculiarity of the big European soccer leagues is that not all of them have the same number of places to enter in the international competitions (UEFA Champions League and Europe League). The number of teams which could loss the category in a season can also be different among these leagues (Table 1). In the first case, the number of available places for a league depends on the international performance achieved by the clubs of the league in previous seasons. For the category descent criterion, two strategies are commonly used, which are occasionally modified according to the season: direct descent, or promotion phase where the potentially descending teams play against teams of the inferior category. This model frequently tends to create a competitive hierarchy generating club sub-categories according to clearly defined economical, organisational, and competitive differences. Goossens et al, (2012) establish four team categories: big traditional clubs; the teams aiming to play international competitions; those teams which hang on to the category (*small six*), and those which struggle to avoid the descent. The clubs included in each category are not always the same and the clubs try to evolve through the category they aspire. This results in a constant regeneration of a permanent race in the league, for achieving their objectives, which recalls the evolutive hypothesis known as the *Red Queen* (Van Valen, 1973).

Closed Leagues

The case of the four north-American leagues is totally different. The franchises do not have any risk on losing the category. For this reason, the way of facing a season significantly changes among the different teams (leading teams vs low performance teams). This format also includes two phases: regular league and playoffs for the title.

The regular league is different compared with the big European leagues. In this case, the teams are organised in two conferences, and each conference in divisions. In this format, even if the number of matches as local and visitor are the same, the number of confrontations between two teams changes if these teams are in the same league or not, and if they belong to the same conference or not. This, by itself, is a relevant factor which conditions the score of a team at the end of the regular phase, taking into account that different leagues and conferences have not always a proper competitive balance. This factor forces to reorganise

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the confrontations in the next phase according to the position in the division and the victory coefficient. However, the teams which obtain a higher number of victories and those teams which obtain a best coefficient will be those teams which will pass to the next phase (playoffs). Besides, in occasions, the final winners are not those which obtain the best victory coefficient in the regular phase (e.g. three of the NBA rings obtained by the Chicago Bulls with Michael Jordan).

The north-American leagues employ a closed competition format, highly professionalised and privatised, with a marked entrepreneurial philosophy of the organisation, participants, and sportsmen. The economical balance between teams acquires an even more relevant importance than in the European leagues. This organisational model pivots on the concept of franchise, in which the organisational entity of the competition leaves the participation of the teams subject to accomplishing specific economical aspects (*economical canon*), and where each team is a commercial brand which can be sold and even change its name if it was necessary (e.g. Seattle SuperSonics to the Oklahoma Thunders in 2008). This is a dual system in which the teams act as franchisee and franchised of the leagues (Martínez-Cañellas, 2012), without any dependance on the high official entities (e.g. national or international federations, governments, etc.). This is funded in the concession provided by the organisers of each franchise, on allowing the exploit of a team which could participate, binding it to a concrete territorial context (*home territory*). Each franchised owns the exclusiveness over the rights of the franchise, with the aim of ensuring the economical viability of its entrepreneurial project (Pérez-Serrabona, 2015).

Competitiveness

The confrontations between teams of very dissimilar forces rarely result interesting. What is transcendent in high competition sports is the struggle among equals in a context in which the final result can never be known a priori. In this context, the competitive balance and the uncertainty in the competitions increase and become key elements to warranty the success of the competition.

The competitiveness, or competitive balance, must be understood as a confrontational behaviour which marks the levels of equality between contenders. In the specific case of collective sports, the ideal competition model would be the one in which any team would be as strong as the rest of the contenders; that is to say, those competitions where the best clubs are not excessively superior to their rivals, and where the
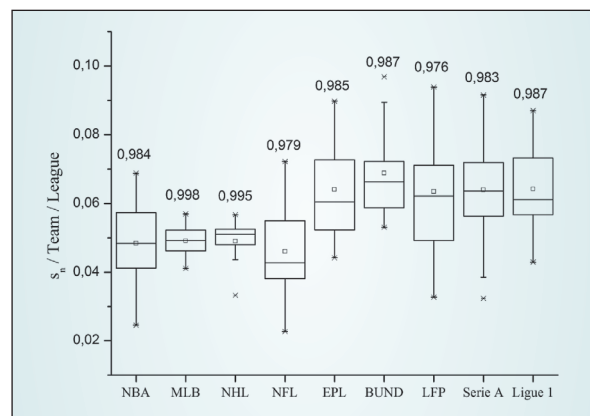

Figure 3. Box-Plot with the normalised Shannon's entropy values (S_n) for the nine main PSL in the season 2015. Each box shows the distribution of the normalised entropy for the teams which are part of the league. The mean value and possible outliers are included. In the top of each box, the global values of each league can be observed (left: 5 European soccer leagues; right: 4 north-American leagues).

rivalry between the teams transcends the match to the whole surrounding sport and social-economical environment (e.g. Lakers vs Celtics; Red Sox vs Yankees; Bruins vs Canadiens; or Real Madrid vs Barcelona). The more equal are the contenders, more difficult will be to predict the result of each match, and in consequence, to predict the final result of a competition. Nevertheless, sometimes a surprise can occur: for instance, when against all odds the theoretically weak team beats the favourite. The fallibility of players, teams, coaches and even referees, leads to the possibility of surprising results. In these occasions the uncertainty degree increases.

The success in elevated uncertainty conditions is a desirable objective, and it has become relevant for the main PSL. The uncertainty is not a parameter controllable through the classic logic and frequently leads to errors in the interpretation of the internal structure of the competition. This does not mean that the results in sports could be totally random, as always will exist an internal logic evidenced in a dominant tendency (underlying order), showing the chaotic behaviour of these leagues (*butterfly effect;* Lorenz, 2000). From the point of view of the complexity theory, every chaotic behaviour leads to implicit uncertainty and, in the organised systems, is governed by a mixture of order and disorder. In this sense, the competition is related, at least in part, with the randomness (Morin, 1998).

As previously mentioned in the methodology, the uncertainty level will be evaluated calculating the normalised Shannon's entropy level (S_n). The higher the value of the entropy is, the higher the uncertainty level. In all the evaluated cases, the entropy is very high and approximates to the maximum level (1) on the nine analysed leagues. However (Figure 3), the dif-

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Table 1. Normalised team entropy (S_p: maximum; S_u: minimum) and maximum performance differential (D_R), for each analysed league.

Ligue	S_p- Maximun	S_u- Minimun	D_R
NBA	0.0688	0.0245	0,0443
MLB	0.0570	0.0411	0,0159
NHL	0.0567	0.0334	0,0233
NFL	0.0722	0.0227	0,0495
EPL	0.0898	0.0442	0,0456
Bundesliga	0.0968	0.0531	0,0437
LaLiga	0.0939	0.0328	0,0611
Serie A	0.0916	0.0324	0,0592
Ligue 1	0.0870	0.0430	0,0440

ferences are clear in some cases for both competition formats (e.g. LaLiga vs Bundesliga, NFL vs MLB).

As can be observed, are the MLB and NHL which show a higher uncertainty value, with clear differences with respect to the NFL, NBA and the LaLiga. However, in no case these differences were statistically significant.

The entropy values for each club show how the competition formats (open or closed leagues) are a determinant factor on the level of competitiveness of the league. Those leagues of the *Big-4* fluctuate (Table 1) between what we could understand as a random competition, as is the case of the MLB (D_R: 0,0159), and other competitions which are *deterministic dynasties*, as is the case of the three other north-American leagues (D_R-NHL: 0,0233; D_R-NBA: 0,0443; D_R-NFL: 0,0495) and mostly the five European leagues (D_R: 0.0437 to 0.0611). Table 1. Normalised team entropy (S_p: maximum; S_u: minimum) and maximum performance differential (D_R), for each analysed league.

Curiously, the most relevant league in economical terms (NFL), is the one with the highest differences of performance between its teams (D_R: 0.0722 to 0.0227). An hypothesis which explains this situation is that American football is a local sport with low access to relevant players worldwide and with a high number of players per team, which results in difficulties for organising competitive squads for every participant. A similar situation occurs (DR: 0.0898 to 0.0442) with the most economically relevant European soccer league (EPL). However, it is also true that the second league with the highest revenues, the MLB, is the most competitive and balanced among the nine evaluated leagues. The NFL presents the lowest global uncertainty level (0.979), among the north-American leagues. This could be explained by the low performance that the franchises on the last positions had shown, in 2015. Maybe, the low number of matches performed by each team during the season should be also considered in the analysis. A different situation occurs with the NHL (0.995) and the MLB (0.998), in which three levels of

franchises could be observed. The most performing, those obtaining the ten best victory coefficients, showing a moderate unpredictability level. A second group is integrated by those franchises struggling until the end to enter to the playoffs (positions 10 to 20). The rest corresponds to the group of the weakest teams or those which prematurely abandon the race for entering the playoffs, possibly trying to achieve a privileged position in the *draft* of the next season.

In the case of European soccer PSL is different. In all these leagues the competitiveness is moderately lower, specially in the case of the Spanish (D_R-LaLiga: 0.0611) and Italian (D_R-SerieA: 0.0592) leagues. In both, one or two teams (Juventus, or Real Madrid and Barcelona FC) shown very high predictability levels in the confrontations with the rest of the teams. Their dominion is evident, both in score and number of goals.

Every European league presents three clearly differentiable performance levels. In the first level (positions 1st to approximately 6th) we can find the teams struggling for the title or for achieving a position to have access to the international competitions (UEFA Champions League and Europe League) on the next season. In a second level are the mid-board teams (positions 7th to approximately 14th), which are those competing without many options of having access to the first level, but which are also pretty far from the descent zone. The third group (positions 15th to the last) is composed of the teams fighting for keeping the category.

In the evaluated season, a special case is present with the Serie A. In this league we can find two teams which an entropy level (performance) excessively low (Cesena: 24 points; Parma: 19 points). However, in one of the cases its low performance does not respond to sport reasons. It must be taken into account that Parma received a discount of one point for not paying the taxes of the previous season, and later, the team received two more sanctions of two and four points because they did not pay the players, and administrative irregularities.

Conclusion

We can affirm that the main PSL present specific profiles, compared to the rest of the leagues in the world. The availability of economical resources, the competition format, and the uncertainty related to the match and league results are the factors that determine if a PSL can obtain global relevance, attracting millions of supporters worldwide and significant economical resources.

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