Universitat Autònoma de Barcelona

BEYOND THE GAME:
Three essays on how economics links to the industry of basketball

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BEYOND THE GAME: THREE ESSAYS ON HOW ECONOMICS LINKS TO THE INDUSTRY OF BASKETBALL

by

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To Rodrigo

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Six year ago I decided to start a long and not easy way with a clear intention: to have the opportunity of some day become a professor. What I never imagine was the huge amount of things that the research was going to provide me in many senses. For this reason I want to say thank you in general to all the people who work everyday for the PhD students, giving us their time and knowledge without expecting anything in return. I have always felt a deep admiration for this profession, which has grown during this stage of my life.

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MARTA BROSED LÁZARO

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INTRODUCTION

"I've missed more than 9000 shots in my career. I've lost almost 300 games. 26 times, I've trusted to take the game winning shot and missed. I've failed over and over and over again in my life. And that is why I succeed"

-Michael Jordan-

Sport is one of the most important industries in the world because of the huge amount of people, factors, stakeholders, governmental institutions and money that involves. However it is unusual to find studies, which deal with sport as an economic sector and business, being guided just by the passion of the game.

This thesis is made up of three essays on sports economics, basing on basketball as a scientific laboratory, where some of the most important issues about competition and management of teams are studied. The main goal is to provide useful conclusions and policy implications that eventually improve the functioning of the industry.

Motivation

Sports Economics is a rather novel discipline, compared to other branches of Economics, whose results have a growing consideration within the academic world, sparking the interest of many researchers since the appearance of Simon Rottemberg's seminal paper on baseball player's labor market (1956). The wide availability of data set, both of individual or collective performance, is one of the keys that explain the inclusion of sports as an empirical laboratory and the rapid increase of the literature on the economics of professional team sports. The complexity of the sports labor market, transfers or the link between demand and competitiveness or salaries and performance have motivated a great amount of studies. Not to mention the peculiarities of the sport as an industry, where the existence of competitors in necessary and required for achieving success and the maximization of the utility depends not only on financial healthy but also on sports outcomes.

However, even though it is true that the cost-benefit analysis of the relationship between doing sport and wellness-health are usually accomplished, there are fewer contributions about the economic impact of sport as a relevant industry, in spite of its inclusion in the market is an indisputable evidence. Therefore, the main objective of the present work is to delve into the theoretical and empirical analysis of some of the most relevant questions of the competitive field, relying on one of the team sports with the biggest market such as basketball.

Professional sport occupies a public position. Around the world there are hundreds of thousands of people supporting a team (whether football, basketball or baseball) buying shirts and merchandising products, as well as tickets for the games or the rights for private broadcasts. According to Deloitte the Big Four Leagues of EEUU generates an annual benefit of 17.000 millions of dollars and or even in Spain the Professional Football League represents the 1.7% of the national GDP, creates 85.000 direct jobs and provides 9.000 millions to the economy, without adding the business around the sports bets. This relevance fosters the growth of sports economics as a discipline that, although being relatively recent, has an important production of papers over the last 60 years.

Considering these figures, as Cairns, Jennett and Sloane (1986) relate, it seems evident that the management of sport and the decision-making of the sports institutions need to be subjected to economic analysis, whether relating to capital acquisitions (such as certain sign up), design of the competition system (whose improvements rely on the increase of the competitive balance) or determining the features of the member of the team according to the institutional objectives. Very often the goals of the organizations are misleading between the economic and sports ones, since they should be efficient in economic terms but at the same time to reach sporting success, giving prestige to the owners. In other words, maximizing the utility, either profit or wealth (Neale, 1964). This fact encourages a decision-making without a clear objective or motivation, which could be dealt by using the typical instruments of the economic theory. This need of applying the economic knowledge to the sports management is more intense when it comes to face budgetary restrictions.

WHY BASKETBALL?

Among all the collective sports, we focus on basketball. The main reason is the statistical richness since every single movement and action is counted and analyzed by experts working in the sector. This fact makes easier the empirical stage and the application of the methodology. The amount of data increases remarkably when we talk about National Basketball Association (from now NBA) stats, where we find and endless range of data, what explains the changes that the original project of this dissertation suffers from. The first idea was to focus the whole work on European basketball, comparing different leagues but analyzing in detail the Spanish Professional League (ACB). This objective is especially interesting because of the viability problems lived by the league nowadays, not only in financial terms but also in terms of competition design and competitive balance. It is worth remembering that the main financial resource of basketball clubs until the crisis had been the money invested by construction companies, banks, insurance companies and public institutions, conveying instability to the structure of the league and being even more important to get and efficient return from the scarce resources.

However the lack of data referred to demand and quality variables of the European leagues caused a change in the analytical objective of the empirical part of this dissertation in such a way that chapters 2 and 3 it are focused on NBA, where the contractual arrangements induce team owners to monitor players, and the statistical tradition is wider.

The final motivation of the three chapters presented in this work is to delve into some crucial aspects of sports such as production function, efficiency, competitive balance and heterogeneity of the inputs included in the team, from an economic perspective. In all of them this dissertation tries to contribute to the literature on the sports economics with new variables and experiments, as well as to debate about the most spread theories and assumptions.

Objectives, methodology and main results

The first chapter analysis the efficiency and the evolution of the Total Productivity in Spanish First division Basketball teams during their productive process, just considering the performance on the field. The discussion about what is the production function and the inputs and outputs of the sports teams is widely spread among researchers. There is a growing literature on the production function of the sports teams where two ways of measuring the output are found: output measured by team performance or by contrast the game in itself weighted by revenues derived from it, idea supported by Rottenberg (1956) and Neale (1964) among others. This paper is in line with the first theory, where the team is a technical unit whose performance is the output of the productive process and the differences appear in terms of inputs used.

In the empirical part we will use the non-parametric techniques of optimization, measuring efficiency with respect to the best observations of the sample through a data envelopment analysis (DEA). This technique is the more suitable for sports given that it does not consider a specific functional form for the frontier as well as the absence of errors. The results provide not only the efficiency indexes, but also the potential output in terms of wins achieved seasonally, which could be compared to the real outcome of the teams. In a second stage, the Malmquist Index based on DEA results, assesses the existence of movements of the efficiency frontier or which is the same, the existence of technical progress.

Our findings show that the more efficient is the team, the best sports outcomes. We also find that there is a linkage between the use of resources and the qualification at the end of the season. Given the resources used by the inefficient teams, the number of wins should have been higher and therefore not all the teams finish qualified where expected according to their availability of resources. So the main conclusion would be that team's final position depends more on its efficient use of resources than on its potential.

The second part addresses the issue of the competitive balance comparing the two conferences in which are divided the NBA teams, and its relationship with demand, which is not clear in the literature. This is one of the issues more discussed among researchers since there are a great amount of rules that modify the market in order to ensure certain level of demand. Therefore this paper is divided in two parts. The first part seeks to identify the level of competitive balance of the whole basketball league by comparing both conferences[1] with the aim of determining if the division of teams fosters the competition. The main contribution of this part of the work is the use of the Number of Relevant Competitors (NRC) as indicator of competitive balance substituting the traditional indexes of concentration. This NRC is inspired by the outcomes achieved on the market's natural structure and derived from the application of Gibrat's Law (1931) made by Buzzel (1981), which recognizes a correlation between the sizes or which is the same, between the market shares of the firms, taking the leader firms as reference. There are many advantages in using NRC as indicator of competitive balance instead of the typical ones when it comes to sports competitions since it avoids problems generated by the zero-sum nature of the league. The main result in this part is the high level of competitiveness presented by the NBA, an expected result considering the set of regulatory rules adopted by the league. However the distribution of teams between conferences is not optimal whose main consequence is a higher difficulty to reach the play-off stage in the Eastern conference than in Western.

The relationship between competitive balance and demand is conducted in the second part of the chapter II, or which is the same, it is proved not only the correlation between uncertainty of the outcome and willingness to attend the sports event, well known as Rottenberg's hypothesis, but also the sense of this correlation by using the Granger causality test. This is a relevant issue,

[1]There are 30 teams competing in the NBA but the number of games played against each other depends on the Conference where they belong. This system was designed to avoid the big distances among cities making the league more dynamic.

whose research is very spread among academics, since there are many rules adopted by the league, which alter the market conditions, justified in terms of competitive balance and increase of the demand. The first finding is the lack of variability of the attendance along the time series, being very common the sold-out in almost every game. The immediate conclusion is the level of attendance is not explained by sporting arguments. We also show that, contrary to the expected, it is the attendance what determines the level of competitiveness.

Finally, chapter 3 tackles the configuration of the teams in terms of optimal level of diversification providing experimental evidence on the relationship between outcomes achieved and heterogeneity of the inputs, that is, players of the team. Generally speaking, there are two philosophies widely spread about the design of sports teams, especially basketball teams: all the players are ready and able to perform every task during the game or otherwise, there are as many specialists in the team as tasks which means that every member plays an accurate role. The objective in this part of the dissertation is to determine what is the most effective of them since it can be an underlying factor of success. The achievement of a reliable answer of this topic would provide configuration rules to the general managers. Once again this paper is divided in two parts. Firstly we focus on the assessment of the diversification level taking the Gollop and Monahan index (1991) as reference but adapted to the case of NBA teams. Its three components (number of players used, the distribution of the time played among players and the level of effort or responsibility of each player in every task) provide much more information with respect to sporting strategies.

The second part of the chapter III approaches the effects of the diversification on the outcomes measured by two alternatives: the probability of playing the play-off stage and the efficiency achieved by the teams. In both cases we test the fulfillment of three hypothesis, which enclose the vast majority of the information required to draw conclusions, by using binary and panel data techniques respectively.

The main findings are related to the sign of the impact of each component. The number of players has a negative effect over the probability of playing play-off and the level of efficiency considering that its increase responds normally to injuries or bad results. The asymmetry of time performed by each member improves the sports outcome and the effect of the heterogeneity is in the same line, which means that the specialization of the players is relevant to achieve the best qualification according to the institutional objectives of the teams.

All in all, the three pieces contained in this dissertation address the relationship between economy and sports, but every paper can be read independently considering the different analysis accomplished in each of them.

Policy implications

In conclusion, this dissertation tries to contribute to the sports economics researchwith regard to some of the most debated issues: efficiency in sports teams, competitive balance and optimal level of heterogeneity in teams' design by using basketball as reference. Based on our empirical results we consider have found some interesting lessons to take into account.

The media, experts, fans and even owners and stakeholders tend to focus only in sports results to assess the success of a team in a certain season. But we show how a deeper knowledge of the reason behind teams' sports results provide a more realistic evaluation, helping to improve them in the future by a better management of the resources. Considering the Total Factor Productivity, in a long run it is advisable to experience a technical progress that allows operating with a less utilization of resources.

Regarding the relationship between competitive balance and attendance, contrary to what has been forecasted, this is unclear and not totally proved, in such a way that we recommend to review many of the rules adopted for the sake of the demand, seeking new variables that represents in a better way the reality of the current sports industry whose dimension has grown remarkably.

Finally our findings in chapter III allow us to make some recommendations with respect to the shaping of the teams and their management of it, or which is the same, with respect to the general managers and coaches tasks. The more diversifier is the team, the better qualification it achieves. Therefore in NBA, as far as we have analyzed, regarding the general manager decisions it is advisable to design teams basing on specialist players who will perform almost exclusively the most suitable actions for them. In the same line, with relation to coaches decisions they should propose an unbalanced distribution of the time played among the members of the team as well as to draw movements where the specialists eventually perform the action to which are the more appropriated players on the court.

Chapter 1

PRODUCTIVITY IN PROFESSIONAL SPANISH BASKETBALL

ABSTRACT

The aim of this article is to study the efficiency and the evolution of the Total Factor Productivity in the Spanish First division basketball teams, taking into account only the performance on the field, which will allow us to link sporting performance to business management. To that purpose we estimate both, efficiency and Malmquist Indexes, based on teams productive activity and their ability to win. The methodology presented is a Data Envelopment Analysis (DEA) applied to the timeline of four seasons (2008/09, 2009/10, 2010/11 and 2011/12). The potential output of each team is also obtained. In order to make a better use of scarce resources, this paper provides recommendations and policy implications.

JEL: L83, L20

Keywords: basketball; efficiency; data envelopment analysis; Malmquist Index

1.1. INTRODUCTION

Most frequently sports firms mislead the two major objectives that they have to fulfill, since they need financial health and at the same time sporting success, maximizing the utility of the firm (Neale, 1964). In many occasions this duality incites a decision making without a clear aim and motivation, not to mention the special way of looking at the professional sports firms in a competitive market. By using the tools that economic theory puts at business world disposal ,these inefficiencies could be solved.

Considering the framework of the sports firms, it would be justified to provide them with an economic analysis to determine their productive aspects. However, terms such as production, production frontier or efficiency have an ambiguous meaning relative to sports management, since there is no agreement about the final objectives and the available means of production.

In order to clarify the operating system of the sports bodies, this paper follows the portrayal model of the firm suggested by Fandel (1991) and adapted by Espitia-Escuer and García-Cebrián (2004) for the case of football, in which the market supplies with several inputs and resources to the firm, in shape of physical and human capital. The physical capital is found in facilities and technical progress, through the development of training techniques and the improvement of the physical qualities. However, the biggest expenditures are assigned to hire players and coaches. These resources are converted into sports results thanks to the productive process carried out during weekly workouts and games. The more efficient the team is, the less resources are used to obtain satisfactory results. Sportive results coming from the productive activity are useful to obtain revenues shaped in sales of sports entertainment. According to Guzman (2006), by correctly organizing resources and adapting the financial structure, sports clubs achieve good levels of efficiency and a sustainable growth.

Taking the Spanish basketball case as reference, this study tries to give an answer to questions such as teams perform in their potential limit or otherwise they should obtain a bigger number of wins; there is technological progress in basketball; what aspects of the game deserve the attention of the mangers to organize the staff in a efficient manner.

The motivation behind this sports discipline and this league is firstly the availability of data, since statistics play an important role in sporting and management decisions. And secondly, the troubling financial situation in the Spanish industry. The existing empirical studies make reference to NBA basketball mainly, so there is a gap in the application to European basketball, which works in a very different manner in many aspects.

This article is organized as follow. The next section covers a review of the reference literature about efficiency in sports and the theoretical framework in which is developed this work. The third section is related to methodological aspects, that is, the specification of a production function, measurements of efficiency and a brief presentation of the Malmquist Index. The fourth and fifth sections describe the database and the obtained results respectively. Finally, the last section emphasizes the most important conclusions.

1.2. THEORETICAL FRAMEWORK

Sports economics is a relatively recent yet growing discipline and during the last 60 years has generated an important flow of articles, sparking interest among academics. The professional teams, even satisfying the required features to be treated as any other entity, present a number of peculiarities, which motivate an especial literature. This is considered in several articles such as Neale (1964), El-Hodiri and Quirk (1971), Cairns, Jennett and Sloane (1986).

After Rottenberg, several studies have estimated the impact of the play factors in the final outcome of the game and the efficiency for a wide range of sports; Carmichael, Thomas and Ward (2001) and Carmichael y Thomas (1995) formulate a production function and obtain the production frontier of soccer and rugby respectively; Mazur (1994) and Ruggiero, Handley and Gustafson (1996) evaluate technical efficiency in baseball; Hadley, Poitras; Ruggiero and Knowles (2000) analyse the performance of American football teams with regard to their potential.; Schofiel (1998) estimates a production function of cricket; Dawson, Dobson and Gerrard (2000), Espitia-Escuer, and García-Cebrián (2004), Boscá et al. (2006) and Haas (2003) in relation to soccer.

There are also many works that deal with the efficiency of basketball teams, normally focused on NBA team's performances and the impacts of the game features in the American league. The literature presents a wide disparity of approaches depending on the time interval (during either one season or several of them), the technical unit analysed (teams or players) or the selected output (wins, % of wins, probability of winning). The pioneering article in the NBA production frontier was written by Zak et al. (1979), where inputs are ratios measuring performance of one team, dependent on their rival's, over final outcome. Teams are efficient when they achieve their maximum potential taking into account the rival´s potential. The documents of Hofler and Payne (1997 and 2001) take a step by increasing the sample until 29 teams, generating a panel data for 7 seasons, therefore inputs and outputs are absolute value, with no ratios, this way avoiding multicolineality problems. This work not only manages to estimate the impact of the features of the game in the final result, but also adjusts to the impact of the coaches and player quality, which supposed a innovation to that moment. Berri (1999) introduces fixed effects in a two steps model, which links player´s statistics to total wins, and subsequently measure the marginal product of the players instead of marginal product of the inputs as Zak et al. (1979) and Hofler and Payne (2001) had already made.

The innovations provided by this article are the use of a different methodology and a different analysis unit. It uses European basketball, specifically the Spanish league, which is considered the most powerful league after NBA and whose connection with academic studies is quite limited to date. It has to be noted that, despite being the same sport, there are considerable differences between American and European basketball, in terms of rules or in the way the spectacle is conceived. Finally we try to incorporate the play-off stage, which is not an easy task but really interesting because of the importance of this stageof the competition.

Spanish professional basketball is going through a worrisome situation from a financial point of view. Many teams are involved in financial problems, with an added danger of insolvency. During past economic growth, the development of the market and the power of the teams with bigger economic capacity, pushed modest teams to assume investments whose incomes were not able to bear. Hence, during the seasons 2008/09, 2009/10 and 2010/11 F.C. Barcelona and Real Madrid concentrated 33%, 35% and 37% of the expenses in sports staff respectively. If the sample is expanded with Baskonia and Unicaja, the four teams accumulate 52%, 54% and 55%. Considering the assumption that the income of a basketball club depends on obtained results, the best way to improve the financial situation is through a better utilization of resources detected by calculating the efficiency levels.

1.3. SPECIFYING THE PRODUCTION FUNCTION

The features and statistic richness of basketball allow to analyze it as any other productive activity, for which a production function is required. Rottenberg (1956) was pioneer on shaping the production function of a sports activity. After that, the first empirical estimations came from the hand of Scully (1974), Medoff (1976), Zech (1981) and specifically with Zak et al. (1979) what was the first attempt to consider the production function in professional basketball.

A basketball team is a technical unit that produces output from a combination of inputs. Let the productive process in basketball be specified as:

$$Y_i = f(X_i), \quad i = 1,2,\ldots,n, \qquad (1)$$

Where Y_i is the team $i$output (generally % of wins, probability of win or, as in this case, number of total wins) and X_i is our vector of inputs. These inputs are responsible for measuring the activities produced by the players and coaching staff during the competition.

According to Førsund, Lovell and Schmidt (1980) and Esteban-García and Coll-Serrano (2003), there are two estimation methods implemented to build a production frontier, depending on the functional form, thus requiring the link of inputs and outputs; parametric or non-parametric methods. The former provides information on the relative importance of each one of the inputs in obtaining output and being necessary to establish how the error term distributes itself.

This work assumes that every team have access to homogeneous technology and all the professionals of the industry know it. This technology refers to strategies, technical resources, physical training, sports planning, etc. For this reason, the use of non-parametric techniques of optimization - specifically the model known as DEA- suits this study more effectively. The main reasons are its larger flexibility and the absence of specification errors, since the adoption of a specific functional form in the relation between outputs and inputs is not necessary, nor a distribution of the efficiency.

Another advantage presented by this methodology is the possibility to manage multi-output or multi-input situations, even expressing them in different units. Deterministic frontiers assess the efficiency with regard to the best observations of the sample, which corresponds to optimization process. Those organizations situated on the frontier are considered efficient, while distances between observations and this isoquant are a measure of inefficiency of the corresponding firm. In both processes -regular phase and play off- the proposed linear programming problem is the following:

$$Min\ \phi_i^t\ (y_i^t, x_i^t) \quad (2)$$

$$s.t$$

$$\lambda X_t \leq \phi x_i^t \quad i = 1, \dots, m$$

$$\lambda Y_t \geq y_i^t$$

$$\lambda \geq 0$$

wherex_i^t and y_i^t represent the vector of inputs used and outputs produced respectively by the unit i whose efficiency is being measured, while $X_t$is the matrix of the n productive factors used by all the teams in the sample and $Y_t$is the matrix of products obtained by them. The weights of the optimum combination are represented by the vector of parameters λ, and finally ϕ is the efficiency level for the team under analysis in period *t* taking into account the optimum weights, so that when ϕ=1, the analysed firm is on the isoquant and such is its efficiency that it results impossible to achieve a bigger quantity of output given the inputs. Or dually, it is impossible to obtain the same volume of production decreasing all resources. In the same way when $\phi < 1$ the firm is operating under inefficiency equal to (1-ϕ) since it could be possible to attain the same output quantity by reducing the consumption of all the resources in that proportion.

The DEA model proposed considers constant returns to scale, since the whole competition is analysed and not game-by-game, so the compensation factor exists in order to eliminate punctual differences in terms of required inputs, which appear in certain games. For instance, when a team plays against another offensive-minded team, that style of play gives you considerably more time on attack and, as a result, more possibilities of scoring. However, the contrary occurs when a team meets a defensive-minded one. This model is characterized by an input orientation, in such a way that, given a level of output, efficiency firms will be those that are able to obtain the same output decreasing the level of input. The adoption of one orientation or another is irrelevant for the task of identifying inefficiencies but our choice will determine the interpretation of the results. Otherwise, the output orientation will help us to obtain the potential output given such level of inputs, allowing us to compare the real results with those that should have been achieved by each inefficient team in order to clarify the results.

With the aim of assessing trends in Total Factor Productivity of Spanish basketball teams, we will use the Malmquist Index also based on DEA results, taking advantage of the available information from several years. This study will allow us to draw conclusions about the existence of technical progress, or which is the same, the existence of increasing returns to scale and some movement of the efficient frontier. There are several productivity index decompositions in the literature, but among all of them in this paper we will use the proposal of Grosskopf(1993) and Coelli, Rao and Battese (1998). Both define The Malmquist Index by using distance functions between two data points and two different periods (t and t+1) that describe a multi-input and multi-output production technology without the need to specify a behavioural objective:

$$M_i\left(y_i^t, x_i^t, y_i^{t+1}, x_i^{t+1}\right) = \left[\frac{\phi_i^t(y_i^{t+1}, x_i^{t+1})}{\phi_i^t(y_i^t, x_i^t)} * \frac{\phi_i^{t+1}(y_i^{t+1}, x_i^{t+1})}{\phi_i^{t+1}(y_i^t, x_i^t)}\right]^{1/2} \qquad (3)$$

where$\phi_i^t(y_i^{t+1}, x_i^{t+1})$ represents the distance or technical efficiency for the period t+1 with regard to the period t technology. In other words, is the distance of an observation (of input vector and output vector) in period t+1 to the frontier in period t. A value of $M_i$greater than one will indicate positive TFP growth from period t to t+1, while a value less than one indicates a TFP decline. Note that, similarly to Coelli et al. (1998), Malmquist Indexes calculated by this way are in reality a geometric mean of two productivity measures, coming from one of two periods as a benchmark.

Equation 3 could be rewritten as two components: technological change and technical efficiency change:

$$M_i\left(y_i^t, x_i^t, y_i^{t+1}, x_i^{t+1}\right) = \left[\frac{\phi_i^{t+1}(y_i^{t+1}, x_i^{t+1})}{\phi_i^t(y_i^t, x_i^t)}\right]\left[\frac{\phi_i^t(y_i^{t+1}, x_i^{t+1})}{\phi_i^{t+1}(y_i^{t+1}, x_i^{t+1})} * \frac{\phi_i^t(y_i^t, x_i^t)}{\phi_i^{t+1}(y_i^t, x_i^t)}\right]^{1/2} \quad (4)$$

where the first term refers to the technical efficiency change and compares the relative change in technical efficiency between *t* and *t+1* with respect to the efficiency frontier of the analysed unit. A value greater than 1 indicates proximity to the production frontier, whereas a value less than 1 implies divergence. The second term is a measure of technological change or production frontier variation between two periods (t, t+1), being a value greater than 1 an indication of technological progress and a value less than 1 a sign of technological recession. This way, the technical change of the sector is reflected.

1.4. DATA

With the objective of evaluating the efficiency and productivity, it has been built a panel data for 18 teams[1] taking part in ACB during the seasons 2008/09, 2009/10, 2010/11 and 2011/12. The reference database have been ACB data Statistics Services which is the official website for experts, completing with others tools of European and American scouting[2]

The calculation of the Frontier assumes that every team try to maximize their production given the available inputs. The objective is to analyse the efficiency of the teams in their task of obtaining wins, therefore the output will be the total number of wins achieved according to Hofler and Payne (1997). Unlike the aforementioned authors which do not consider the play-

[1]In Season 2008/09 the total number of team contestants was 17, so that some of the total and average results have to be compeered carefully.

[2] Scouting4u and Draftexpress, website of the scouting company NBA Draft Prospects, which makes tracking of all the players in European and American leagues.

off, we take notice of, during this process, not all the teams play the same number of games and there are teams that, without varying their human capital, have the possibility of achieving a larger number of wins. Given that we need to analyse both stages as a different and complementary output, it is made the decision of using multioutput. However, the fact that one team plays play-off, which represents undoubtedly a sports success, does not entail necessary an increase in its output, butsimultaneously it wastes inputs. This fact definitely would penalize, from the point of view of the efficiency, teams that have achieved to complete a remarkable regular phase qualifying between the 8 firsts. In the interest of providing consistency to the study, it has been decided to increase in 2 the number of wins of the 8 teams in play-off, which is exactly the minimum number of extra games they might play, avoiding this way the penalization in case of not achieving any win. This same procedure is applied in the following qualifying rounds until the finals.

The selection process of inputs turns out to be the most delicate stage and at the same time, it provides richness to the study, since they have to be consistent with the own nature of the game and simultaneously, as any economic analysis based on production frontiers, they should help in finding reliable indicators of production flows. This selection requires a deep discussion since to there is no agreement about quantitative and qualitative indicators of the basketball skills of the human capital. As most of the sports, basketball is made of endless aspects that have influence upon the outcome, but they might not be reflected statistically. But a common aspect of all collective sports is that the only productive factor is a group of players organized under a style of playing and other strategies introduced by a technical staff. Those players develop a series of activities needed to achieve wins. To determine those relevant activities it has been required theoretical foundations about the sports discipline, which contribute to specify the final production function.

Apart from any proxy of the human capital (total number of player used throughout the season), which is a production resource present in all activity, we consider that inputs in basketball are the total possessions and those factors that allow the teams to increase them, that is, offensive and defensive rebounds. From a statistical point of view, what coaches understand by possessions is the addition of field throws (scored or missed), received faults and turnovers. In productive terms, a possession is the opportunity used by each team to make one basket, taking into account that the maximum time allowed by the regulations is 24 seconds. Some of these possessions finish into scored points, and those that are not scored, are considered defective product, which decreases the efficiency level since it consumes inputs. Otherwise, if two teams have achieved the same number of wins using a different amount of possessions means that the team which develops more possessions, did not obtain the same return from their productive process, maybe because the % of success or the defense performance were not good enough. Moreover, this productive factor takes charge of specifying the way teams play, their style and their strategies of performing, in such a way that it could be considered as a qualitative element. A team that chooses a productive strategy based on speed, is going to generate more chances of achieving basket, and depending on its % of success, the scores of its games will be higher, because at the same time this offensive team is going to force adversaries to play a larger number of possessions and more opportunities to score a basket.

Similarly, an offensive rebound gives the team a new opportunity to score, that is, a new possession. But if the rebound is defensive, it has double information in most cases: it means that the rival's shoot has been defective due to a good and powerful defense, and at the same time, that the rebound provides another chance to score. Therefore, with these three factors we achieve to gather offensive and defensive aspects, the later indirectly, but also strategy of game. Descriptive statistics of variables are reported in Table 1.1.

It should be noted that we contemplate several arguments to discount the inclusion of defensive factors as inputs following Espitia and García (2004, 2006). Mainly we consider that defensive plays are the result of tactical and technical weekly work. This is one possible way of organization in order to obtain the best outcome from the real inputs. An effective defense involves both, tactical work through the scouting of the rival's offensive plays, and physical training with the aim of pushing through the physical exhaustion of the defence moves. In other words, if the analysed team has good defense, it will achieve a larger return of the available possessions by obtaining a positive balance in the rate scored /surrendered baskets. Moreover, there is not yet a reliable assessment method of defensive moves because they are not recorded in the statistics of each game, and the only proposal would be the use of reverse inputs, following Lewis and Sexton (2004). However this methodology is not suitable because in our case an increase in quality does not suppose a reduction in the quantity of product obtained, rather on the contrary. It has been dismissed also others inputs which are not directly bound to the production process of the team and however are influenced by random factors, as referee decisions; favour/against personal fouls, which is used as a proxy of a good offensive or bad defence, are an example of this influence.

TABLE1.1 Descriptive statistics by seasons

SEASON 2008/09

Variable	Obs	Mean	Std. Dev.	Min	Max
Wins	17	18.94118	10.73819	8	40
Possessions	17	3282.882	305.6875	2965	3878
Players	17	12.88235	1.69124	11	17
Offensive rebounds	17	357.2941	56.21584	270	503
Defensive rebounds	17	769.7059	87.67323	665	982

SEASON 2009/10

Variable	Obs	Mean	Std. Dev.	Min	Max
Wins	18	19.27778	10.27164	5	43
Possessions	18	3385.278	271.7604	3098	4009
Players	18	13.55556	2.064325	11	18
Offensive rebounds	18	354.1667	44.14581	279	424
Defensive rebounds	18	801.5556	105.5837	675	1056

SEASON 2010/11

Variable	Obs	Mean	Std. Dev.	Min	Max
Wins	18	19.88889	10.2377	7	43
Possessions	18	3399.056	296.4828	3072	4180
Players	18	13.11111	1.843554	10	17
Offensive rebounds	18	373.0556	49.98526	301	511
Defensive rebounds	18	836.6667	104.5326	707	1072

SEASON 2011/12

Variable	Obs	Mean	Std. Dev.	Min	Max
Wins	18	20.11111	10.2262	8	45
Possessions	18	3266.833	370.746	3076	4475
Players	18	13.55556	2.12055	10	17
Offensive rebounds	18	380.5556	61.2413	285	498
Defensive rebounds	18	870.7222	119.216	755	1228

By using the actions during the game as inputs, we cover not only sporting aspects but also economic. Following the Fandel's functional model of the firms (1991) and adapting it to sports firms, we must consider that the income of a basketball club is based on season tickets sales, match attendance and advertising and all these things are fundamentally dependent on previously obtained results. Therefore, in order to maximize profits it is required to minimize costs. One way to do this is through the elimination of wasted resources.

1.5. RESULTS AND DISCUSSION

The results obtained from the solution of the linear programming problem applied to data of our sample for each season, are showed separately in tables 1.2, 1.3, 1.4 and 1.5. The above-mentioned results are presented ordered from bigger to lower Global Technical Efficiency within each season. This efficiency is split into two factors: Purely Technical Efficiency, which shows how well the productive unit analyzed is removing the maximum return from the available physical resources, and Scale Efficiency which calculates the size effect over the efficiency.

It could be observed that the team with a major number of wins, which is FC. Barcelona, is efficient during the four seasons analyzed, independently of the results gap between them. In the same way it could be asserted that the aforementioned pattern is carried out inversely regarding those teams situated on the bottom of the rank and therefore those who lose the category. The last teams are also who perform farther away from their maximum potential during the total year

TABLE1.2. Efficiency and potential output for season 2008/09

Team	Global Efficiency	Pure Efficiency	Scale Efficiency	Actual Wins	Potential wins
FC.Barcelona	1	1	1	42	42
Baskonia	1	1	1	42	42
Unicaja	1	1	1	33	33
Joventut	0.9	1	0.9	25	27.78
Real Madrid	0.845	0.949	0.891	32	37.87
Gran Canaria	0.841	1	0.841	23	27.35
Fuenlabrada	0.806	1	0.806	15	18.62
Valencia	0.703	0.996	0.706	18	25.6
Bilbao	0.671	1	0.671	17	25.34
Manresa	0.647	0.998	0.648	14	21.65
CB. Granada	0.608	1	0.608	12	19.75
Estudiantes	0.516	0.993	0.519	11	21.34
San Sebastian	0.504	1	0.504	11	21.85
Sevilla	0.454	1	0.454	10	22.05
Murcia	0.421	1	0.421	9	21.4
Menorca	0.368	0.982	0.375	8	21.77
Cai Zaragoza	0.367	0.978	0.375	8	21.83
Average	**0.685**	**0.994**	**0.689**	**19.41**	**26.54**

However, it could be detected in some occasions, sporting results do not correspond with the efficiency ranking. For instance, in the season 2008/09, Real Madrid beat Joventut in the number of wins but nevertheless the last one presents a better result in terms of efficiency. The same case is applicable to Fuenlabrada who beats Bilbao and Valencia in efficiency obtaining a smaller number of wins[3]. Valencia in season 2009/10, despite of winning 25 games, which qualifies it in the fifth position, does not achieve a utilization of the resources according to its potential, in light of its efficiency index.

[3]Bilbao is one of the eight teams competing in the play-off while Manresa or Fuenlabrada were not qualified

TABLE1.3. Efficiency and potential output for season 2009/10

Team	Global Efficiency	Pure Efficiency	Scale Efficiency	Actual wins	Potential wins
FC.Barcelona	1	1	1	44	44
Baskonia	1	1	1	43	43
Real Madrid	0.96	0.998	0.962	36	37.5
Unicaja	0.95	1	0.95	26	26.32
Sevilla	0.826	0.997	0.828	22	26.63
Estudiantes	0.785	0.969	0.81	21	26.75
Gran Canaria	0.774	1	0.774	19	20.68
Joventut	0.759	1	0.759	15	34.26
Valencia	0.709	1	0.709	25	26.8
Bilbao	0.701	0.982	0.714	16	21.41
CB. Granada	0.685	1	0.685	15	20.45
San Sebastian	0.64	1	0.64	13	23.45
Manresa	0.579	1	0.579	14	22.47
Fuenlabrada	0.558	0.977	0.572	12	23.32
Alicante	0.528	0.987	0.535	13	24.64
Valladolid	0.524	0.979	0.535	13	22.92
Obradoiro	0.38	1	0.38	8	21.08
Murcia	0.203	0.952	0.213	5	24.68
Average	**0.698**	**0.991**	**0.703**	**20**	**27.24**

Nonetheless, we find that sometimes an efficient team is exceeded in terms of games wined by less efficient teams. In season 2010/11 Valencia managed to beefficient in spite of being the fifth considering the number of wins, which is due to Valencia completed such an excellent regular stage that it gives margin to maintain the levels of efficiency even without wining any game during the play-off. Contrarily, Unicaja and Bilbao in the same season are beaten by Valladolid in terms of efficiency, but achieving three wins more and competing for the play-off. Season 2011/12 presents the most worried case since Real Madrid, the second team in terms of wins, is overcome by Cai Zaragoza, which achieved 25 games less, of course without playing play-off. It should be emphasized that those teams, which behave in an inefficient way,

TABLE1.4. Efficiency and potential output for season 2010/11

Team	Global Efficiency	Pure Efficiency	Scale Efficiency	Wins	Potential Wins
FC.Barcelona	1	1	1	43	43
Real Madrid	1	1	1	34	34
Valencia	1	1	1	26	26
Baskonia	0.941	1	0.941	30	31.88
Gran Canaria	0.918	0.995	0.923	23	25.05
Fuenlabrada	0.907	1	0.907	22	24.26
Valladolid	0.867	1	0.867	18	20.77
Unicaja	0.865	0.987	0.877	21	24.28
Bilbao	0.851	0.985	0.863	34	39.95
Sevilla	0.84	1	0.84	16	19.06
Cai Zaragoza	0.774	1	0.774	16	20.68
Average	0.756	0.935	0.812	19.89	25.17
Estudiantes	0.745	0.971	0.768	16	21.49
Joventut	0.691	1	0.691	14	20.3
San Sebastian	0.575	0.988	0.582	12	20.89
Manresa	0.505	1	0.505	10	19.82
Alicante	0.459	1	0.459	9	19.63
Menorca	0.338	1	0.338	7	20.74
CB. Granada	0.329	0.944	0.384	7	21.31
Average	**0.756**	**0.990**	**0.765**	**19.889**	**25.173**

used to be repeated in different seasons. For instance, Valencia is inefficient again in the last season, according to the behaviour of the first two seasons.

Another pattern repeated during the three seasons is the fact that purely efficiency takes value 1 in more than the 50% of the teams, resulting the scale efficiency the key to determine differences in efficiency. Moreover, both Obradoiro (2009/10) and Menorca (2010/11), loose the category being efficient, from the purely point of view. Although it is true that efficiency scale is not always responsible for the imbalances in the connection between number of wins and efficiency levels. The most clarifying case is Real Madrid

TABLE1.5. Efficiency and potential output for season 2011/12

Team	Global Efficiency	Pure Efficiency	Scale Efficiency	Wins	Potential Wins
FC.Barcelona	1	1	1	45	45
Baskonia	0.952	1	0.952	32	33.61
Bilbao	0.938	1	0.938	21	22.39
San Sebastian	0.93	1	0.93	22	23.66
Cai Zaragoza	0.896	1	0.896	16	17.86
Real Madrid	0.892	0.928	0.961	41	45.96
Alicante	0.886	1	0.886	20	22.57
Manresa	0.86	1	0.86	15	17.44
Sevilla	0.847	1	0.847	20	23.61
Valencia	0.838	1	0.838	28	33.41
Unicaja	0.834	0.969	0.861	17	20.38
Joventut	0.764	0.976	0.783	16	20.94
Obradoiro	0.654	1	0.654	13	19.88
Gran Canaria	0.597	1	0.597	13	21.78
Murcia	0.589	0.954	0.617	13	22.07
Fuenlabrada	0.554	0.972	0.57	12	21.66
Estudiantes	0.523	0.972	0.539	11	21.03
Valladolid	0.387	0.985	0.393	8	20.67
Average	**0.775**	**0.986**	**0.785**	**20.17**	**25.22**

(2011/12)who is beaten by four teams with less wins but which register total pure efficiency, while Real Madrid shows inefficiency.

Regarding averages, it is remarkable that during season 2011/12 teams perform nearer from the frontier, which fits in a major number of average wins. Among all the inputs, possessions would have the greatest impact on the efficiency indexes, since the most efficient season (2011/12) records the fewer number of possessions on average but the larger figure in the rest of inputs. The standard deviation of the wins has been decreasing progressively over the analysed period, being in the last season noticeably lower, which makes us think that budgetary reductions are leading to an homogenization and to an increase of the competitive balance.

We also calculated the potential wins, i.e. the amount of wins each team could have achieved each season with an efficient use of its actual resources. From a first analysis of these results we deduce that, except season 2011/12, the champion (FC. Barcelona) is always the team with the highest potential. However, at the bottom of the table, none of the teams relegated should have been the lowest ranked taking into account their potential. In contrast, we also see teams that avoid the relegation by making a more efficient use of their resources than opponents.

Table 1.6 describes the decomposition of Malmquist Index into efficiency change and technical change, and reports the change in total factor productivity for each unit from one year to the next. It can be seen that only in season 2009/10 Malmquist Index is more than the unit; in the last two seasons studied the value is inferior to the unit, which means that the total factor productivity of ACB teams is decreasing although the fall is smaller from one period to another. With regard to the evolution of efficiency and technical change, it is observed that on average, only in the second term the efficiency change increases, happening the same with technical change for the first season. The best team in terms of technological progress always plays play-off without expecting it, that is, without being one of the favourite teams for playing this stage of the championship. That is the case of Estudiantes, Fuenlabrada and San Sebastian. Otherwise, teams at the bottom of the ranking or teams that come from playing play-off and do not achieve such success in the next season, suffer the biggest decrease in the Malmquist Index. But in every case, teams relegated to the second division present a Malmquist Index, a technical change and efficiency change inferior to the average.

The main result is the fact that productivity change does not present a pattern in its behaviour concerning the movement of its components, which indicates that no component predominates in the TFP variations.

Nevertheless, several individual cases should behighlighted , which deserve a deeper analysis. For instance, in seasons 2010/11 and 2011/12 there are teams undergoing a positive change in efficiency simultaneously with a greater technical decline, leading to a fall in TPF (FC.Barcelona and Sevilla in both seasons, Real Madrid, Valencia, and San Sebastian in 2010/11). Moreover, in season 2010/11 there is an increase in efficiency average and all the teams showed a negative technical change. Given that during the time period studied, TFP showed no clear evolution, both on average and by teams, it is worth taking the sample as a whole, and analysing the evolution from 2008/09 to 2011/12. The values for only those teams that played all the seasons in ACB are showed in Table 1.7.

The Malmquist index is smaller than the unit; therefore, there is a productivity decrease despite the efficiency progress observed in the same period. Six teams present Total Factor Productivity growths (FC.Barcelona, Valencia, Sevilla, Manresa, Bilbao and san Sebastian), but only FC. Barcelona achieves also a positive technical change. In the light of these results, we could conclude that, in the time horizon analyzed, the impact of efficiency over the productivity evolution is not so important as the impact of technical change.

TABLE 1.6. Malmquist Index. Values and components for Spanish Basketball league

TEAM	CHANGES FROM SEASON 2008/09 TO 2009/10			CHANGES FROM SEASON 2009/10 TO 2010/11			CHANGES FROM SEASON 2010/11 TO 2011/12		
	Efficiency Change	Technical Change	Malmquist Index	Efficiency Change	Technical Change	Malmquist Index	Efficiency Change	Technical Change	Malmquist Index
BARÇA	1	1.058	1.058	1	0.98	0.98	1	0.993	0.993
MADRID	1.136	0.986	1.12	1.042	0.887	0.924	0.892	0.982	0.876
VITORIA	1	1.085	1.085	0.941	0.885	0.833	1.011	1.031	1.043
MÁLAGA	0.759	1.036	0.786	1.14	0.883	1.007	0.964	0.947	0.913
VALENCIA	1.351	1.032	1.394	1.053	0.87	0.917	0.838	0.964	0.808
ESTUDIANTES	1.521	0.993	1.511	0.95	0.89	0.845	0.702	0.978	0.687
JOVENTUT	0.779	0.942	0.733	0.986	0.869	0.857	1.106	1.004	1.11
SEVILLA	1.82	0.921	1.675	1.017	0.89	0.905	1.008	0.99	0.998
MANRESA	1.059	0.953	1.009	0.738	0.888	0.655	1.702	0.931	1.584
CANARIAS	0.843	1.033	0.871	1.295	0.882	1.143	0.65	0.994	0.646
FUENLABRADA	0.65	1.12	0.728	1,733	0.889	1.541	0.611	0.978	0.597
GRANADA	1.052	1.153	1.213	0.514	0.873	0.449			
BILBAO	1.154	0.928	1.071	1.099	0.99	1.089	1.103	0.942	1.039
S.SEBASTIAN	1.047	1.057	1.107	1.089	0.886	0.965	1.616	0.944	1.525
MURCIA	0.482	1.061	0.512						
VALLADOLID				1.553	0.884	1.474	0.808	0.96	0.776
ALICANTE				0.792	0.859	0.681	1.289	0.958	1.234
CAI							1.158	0.948	1.097
Average	**0.993**	**1.022**	**1.014**	**1.021**	**0.894**	**0.913**	**0.98**	**0.971**	**0.96**

TABLE 1.7. Malmquist Index and its components from season 2008/09 to 2011/12

Team	Efficiency change	Technical change	Malmquist Index
FC.Barcelona	1	1.01	1.01
Real Madrid	1.018	0.951	0.968
Baskonia	0.984	0.0997	0.98
Unicaja	0.941	0.953	0.897
Valencia	1.06	0.953	1.011
Estudiantes	1.005	0.953	0.957
Joventut	0.947	0.937	0.887
Sevilla	1.231	0.932	1.148
Manresa	1.1	0.924	1.016
Canarias	0.892	0.968	0.863
Fuenlabrada	0.883	0.991	0.875
Bilbao	1.118	0.953	1.066
San Sebastian	1.226	0.96	1.177
Average	**1.031**	**0.891**	**0.989**

1.6. CONCLUSIONS AND POLICY IMPLICATIONS

In any sport, basketball in particular, the achievement of objectives without wasting resources, is essential for the sustainability of any organization, particularly when the economic situation is as discouraging as theSpanish current one. Performing on the field efficiently is the best way to increase the profits by generating savings, which minimize costs. Therefore, this study has measured the efficiency of the basketball Spanish first division (ACB) teams developing their productive activity for the achievement of wins and also the evolution of Total Factor productivity, between the seasons 2008/09 and 2011/12.

The analysis is based on the calculation of the Malmquist Index. The efficiency values (split into global technical efficiency, purely technical efficiency and scale efficiency) have been calculated through the use of Data Envelopment Analysis (DEA), which allows us to make a series of observations, comments and conclusions with regard to the management of the budgets and the relationship between efficiency and sports performance.

We can conclude that generally speaking the efficient teams are those achieving the best sports outcomes, and those teams that are not efficient could have achieved the same amount of wins using fewer resources. Otherwise, given the resources used by the inefficient teams, the number of wins should have been higher, as shows the potential output calculated.

Another remarkable result is that efficiency is linked with a larger number of wins on average and fewer amount of possessions used, since season 2011/12 is the best in terms of efficiency but records the least amount of possessions in comparison to the rest of the seasons. Therefore, we can conclude that, in order to obtain an effective use of the available resources, anadvisable strategy would be to develop a style of playing defined by a slow pace. Fewer possessions played will result in a higher level of efficiency.

Between 2008/09 and 2009/10 seasons there is an increase in Total Factor Productivity, while between 2010/11 and 2011/12 the productivity falls. Throughout the two first terms, changes in the Malmquist Index can be attributed to technical change, whereas in the last period the decrease is due to both, efficiency and technical change. The fact that there is not a pattern in the evolution of TFP and its components, led to the conclusion that neither efficiency changes nor technical changes predominate in the TFP variations, which could be a consequence of the fact that the isoquants referring to the different periods are cut. This explains also that the technical change experienced by all the analysed units is different for the same period.

The results of this study are useful not only to improve teams' economy, but also to analyse and make recommendations in regards to sporting performance. We have checked that all the relegated teams presents efficiency and Malmquist indexes under the average of the competition, and in most cases they presents the worse results. Contrary, those teams that unexpectedly compete in the play-off, always accomplish efficient results, making a quality improvement in different dimensions.

Considering the evolution of the Total Factor Productivity between 2008 and 2012 as a whole, we observe a decline in productivity on average despite the improvements in efficiency. Only six teams present a Mamquist Index superior to the unit. Which is more, only the leader in terms of wins and championships achieved, i.e. FC. Barcelona, accomplishes a positive technical change. Therefore, the achievement of a positive shift in the production frontier appears to be vitally important for staying efficient during a long period. In a long run, teams should work with the aim of experiencing technical progress and reaching frontiers that represent less utilization of resources.

After taking into account our findings we would recommend to pay attention of the use of possessions, to stress the importance of rebounds in the configuration of the team and do not use a large number of players (it should be pointed that most of the relegated teams used a number of players above average, supposedly making changes in order to improve the situation).

Chapter 2

MEASURING THE COMPETITIVE BALANCE IN THE NBA AND ITS CAUSALITIES

ABSTRACT

The aim of this paper is to approach properly the way of measuring the competitive intensity, comparing both conferences of the NBA through 25 seasons, in order to analyze the causality between Competitive Balance and demand. The tools, coming from the industrial economics, are used to detect domain positions or oligopolistic structures. This work adds the NRC indicator (number of relevant competitors), inspired by the outcomes achieved on the market's natural structure. The results show that both Conferences present a high level of competitive intensity being the Eastern Conference slightly more competitive, in spite of the regulation applied is identical. The second part consists in testing the causality between Competitive Balance and venues attendance by using the Granger Causality test methodology, proving that Competitive Balance is not an exogenous regressor of the NBA demand function estimation, while it is the attendance which has an impact on the competitive balance, contrary to the literature's assumption, calling into a question the measures adopted by the NBA as institution to keep a high level of competitive balance for the sake of demand. Additional arguments are reported in the text.

JEL: L83, L20

Keywords: basketball; competitive balance; number of relevant competitors; Granger Causality Test.

2.1. INTRODUCTION

The level of competitiveness is frequently discussed in different countries and social spheres, from media to sport professionals and supporters. However, these groups normally draw conclusions on the basis of perceptions and partial indicators. For this reason, Competitive Balance is also one of the most long-standing propositions in the Sports economics scope. In addition to this fact, it creates an uncertainty of outcome, which is a factor widely accepted as determinant of the sporting events demand, generating many policies focused on fostering and improving the Competitive Balance (Rottenberg, 1956; El-Hodiri& Quirk, 1971). Therefore, there is a collective interest in maintaining reasonable quality in playing strength to stimulate the willingness to pay the admission ticket.

By using tools coming from Economic Theory, in particular fromindustrial economics, it is possible to conduct a comparison exercise between competitive levels of different competitions. Some of the popular indicators used to explain inequalities are concentration ratios, Herfindahl Index or Gini Coefficient. However the interest of this paper is focused on building a new indicator, which is called NRC or Number of Relevant Competitors derived from the application of Gibrat's Law. In industrial economics empirical tests of Gibrat's Law show whether the smaller firms within an industry grow faster than the larger firms. The NRC is based on the independency of firm size and its growth.

Once the results have been analyzed, they will be used to check the direction of the correlation between Competitive balance and Demand, estimated by literature. A possible endogeneity will be proved as well, setting alternative methods of estimation to increase the accuracy of the results.

This paper is focused on Basketball, particularly American Basketball, whose competitive structure and regulation are very different from European basketball leagues, as usually happens with all the american sports. Therefore, it is aimed to submit an study of the competitive level in which both conferences (Eastern and Western) are developed trying to give an answer to the historical debate about the balance in the distribution of teams between both conferences.

This work is in line with studies such as Michie and Oughton (2004), Brandes and Frank (2007) among others, from a methodological perspective. The rest of the article is structured as follows. The next section provides a review of the previous literature in the topic. Section 3 describes the NBA system of competition and organization. Section 4 and 5 explain the methodology used to measure the competitive balance as well as the results and conclusions. Causality theory and results from Granger Causality test are shown in section 6, as well as some explanatory arguments of the obtained results. The final section provides a summary and conclusions.

2.2. LITERATURE REVIEW

The Competitive Balance refers to the balance in sport capabilities of teams and their possibilities to win any game (Michie et al, 2004). Simultaneously, Competitive Balance means uncertainty of predicting results. Generally speaking, the competitive balance allows thinking about two fundamental topics (Fort, 20013): firstly, it gives the chance to measure the impact of different competition policies and secondly, it permits to evaluate its relationship with fan demand. Szymanski (2003) examined the Competitive Balance from three different perspectives: a) match uncertainty which refers to the uncertainty about the result of a special game (between two teams), b) season uncertainty which refers to uncertainty about games of a season c) championship uncertainty which refers to the dominance of a limited number of teams over the league. The core index presented in this work is the Number of Relevant Competitors is based on this last approach.

As Rottenberg (1956) established through the Louis-Schmeling Paradox, being the first statement in this sense, the greater the level of Competitive Balance of the league is, the harder to predict the result of games and then the competition becomes more attractive from the demand point of view. His statement, also known as the Uncertainty of Outcome Hypothesis, said that " *uncertainty of outcome is necessary if the consumer is to be willing to pay admission to the game"*. If there is a progressive decrease in the Competitive Balance, then the number of spectators attending to the venues and also the TV viewers will diminish. Needless to say, this Competitive Balance depends on the distribution of talent among competitors or which is the same, depends on the quality of the teams and the sports events. Therefore both institutions and academics try to design mechanisms that force the creation of uncertainty as well as to investigate their real effects on competitiveness and demand, in different sports, countries and teams. Teams control the merchandising; leagues have attempted to transfer resources from stronger, more successful teams to smaller to incentive the overall benefit of the league as a whole. Concepts such as gate revenue sharing, centralized TV rights, cap salary, Drafts or luxury tax are in the core of the debate, having been accepted by American Sports Institutions as essential to enhance the survival of the competitions. However this agreement does not exist in European competitions due to the fact that most of the teams are involved in playing two competitions, domestic and continental. As long as there is not a common framework, the adoption of some regulatory measures in the National League could create unbalance in the European Competitions.

Perhaps this is one of the reasons why academics cannot agree regarding some of the toolsavailable to aid competitive balance. For instance, Fort and Quirk (1995) conclude that neither draft nor revenue sharing improve the Competitive Balance contrary to Vrooman (1995) and Kesenne (2000) who accept the hypothesis of revenue sharing increases competitive intensity.

Another issue of debate is if the Szymanski (2003) assumptions reflect the reality or some contradictions could happen in specifics frameworks. The efficiency of the regulatory rules in increasing competitive balance is under debate. For example, attendance has been growing during the last two decades in most European football leagues despite the fact that competitive balance did not significantly change (Brandes and Frank, 2007). The institutions and teams hold that if there is not a clear relationship between Competitive Balance and demand then no regulatory mechanism will be justified. Therefore, it seems undeniably interesting for the sports industry to analyze the relationship between competitive balance and fan attendance in more detail and how these variables interact with each other. In this paper the NBA is used as a laboratory due to the fact that it has absorbed almost all the regulating policies.

2.3. NBA COMPETITION SYSTEM AND ORGANIZATION

Due to its complexity and the relevant differences regarding European competitions, first of all it is necessary to typify briefly the competition system of the NBA and the way in which the Institution is organized.

Currently 30 teams compete in the league, but along the time series of data analyzed it is found seasons with 27 or 28 teams. In order to organize efficiently the league, minimizing as much as possible the amount of journeys and the distance covered, the league is divided into two Conferences, which work as independent competitions in terms of ranking: Eastern and Western, with 15 teams in each one. Within each Conference, in turn, 3 divisions are set out with 5 teams in each one: Atlantic, Central and Southwest in Eastern, Northwest, Pacific and Southwest in Western Conference.

Each team plays four times against teams of its same division, between 3 and 4 times against teams of the other two divisions of its own conference and finally 2 times against teams of the other conference (home and away). Therefore, each team along the regular season plays 82 games. The NBA is the only competition in the EEUU where all the teams meet in direct competition at least twice,which means that the yearly season ticket ensures the fans have an opportunity of watching every team of the league at least once.

At Institutional level, the NBA operates like a cooperative where the 30 teams are owners of the competition. The league in itself contains control and regulating elements in order to keep a genuine balance of the competition. This way, even though there are teams in small markets (Oklahoma, Milwaukee, Portland,…) they theoretically should have the same capability to compete as other teams belonging to bigger markets (Los Angeles, New York, Miami,…). This entails to assume several regulatory policies (cap salary from 1983, Draft, luxury tax) as well as a specific organizational model. One of the most important rules of the NBA is every franchise operates for themselves in a 75-mile radius around the venue. Beyond this distance the incomes are shared equally among all the teams.

2.4. MEASURING COMPETITIVE BALANCE

A structure that fosters competitiveness shall be a structure in which it is difficult for an agent to capture differential results towards the rest and, as a consequence, the gap in the results of the agents will be diminished. There are many ways to measure competitive balance in sports competitions, or which is the same, to measure uncertainty of outcome, all of them based on a set of indicators commonly used in the industrial economics literature, following the line proposed by Rottenberg (1956). The choice of the most appropriate measure should be done considering the time horizons: match, season and long-run (Quirk and Fort, 1997). This paper is focused on the seasonal horizon and in order to give robustness to the results making possible to interpret the economic consequences, several measures of competitive balance are presented in the empirical analysis.

2.4.1. THE CONCENTRATION RATIO

As an initial approach, it is customary to use a concentration index. This concentration index assesses the cumulative market fraction attributable to the top *m* agents in a particular industry, allowing for a comparison between teams.

$$C = \sum_{i=1}^{m} s_i \qquad (1)$$

where s_i is a ranked vector of the market share of the top m agents.

This index could be indicative of the existence of both, dominant positions and oligopolistic structures, in a particular market, when its value is close to one. This kind of index could be used to measure the fraction of the industry's total production that is accounted for by a given number of agents in the sector. This way, for example, C_1 represents the market share of the leader, C_4 is the concentration ratio accounted for by the top four firms, and C_8 would be a measure of the dominance of the teams qualifying for the play offs, etc. In such a way that the leader ratio could be calculated as a method of expressing its capability as regards others agents of the sector. It is usual to compare the leader share with the share corresponding to a homogeneous distribution of the market 1/m. Similarly, it is appropriate to compare the concentration ratio of the top four firms C_4 with the distribution in case of a homogeneous market, that is 4/m. However, for several authors, such as Utt and Fort (2002), these measures generate problems in terms of usefulness when it comes to sports outcomes.

2.4.2. THE HERFINDAHL- HIRSCHMAN INDEX

The Herfindahl-Hirschman Index is a measure of concentration defined as the sum of the squares of the market shares of all the agents in the industry. This index was developed with the aim of analyzing inequalities between firms in a specific sector. In analytical terms, this index is expressed as follows,

$$H = \sum_{i=1}^{N} s_i^2 \qquad (2)$$

where*N* denotes the number of participating teams and s the share of wins during a season. The possible values of the index are bounded between 0 and

1. Its maximum value H= 1 corresponds to a monopoly situation, and it tends toward zero in the case of an infinite number of agents. Generally speaking, the larger the coefficient (closer to 1), the lower the number of agents supplying the market and/or the bigger the differences in size. While the lower the index value, the lower the degree of market concentration and more agents of similar size supplying the market. When an homogeneous distribution of the market between agents happens, the index value end up being 1/n. Since sports competitions have a fixed number of contestants, the value of H will be indicative of the difference in their size, that is, in their ability to capture market share.

2.4.3. THE GINI COEFFICIENT

The Gini coefficient is a measure of inequality typically used as an indicator of the income distribution among the population, but it could be used to assess any kind of unequal distribution. The Gini coefficient ranges from 0 to 1, where 0 corresponds to complete equality (the income is distributed homogeneously), and 1 corresponds to complete inequality (a total asymmetric distribution). The proposal of Deaton (1997) is taken as the expression of Gini Index,

$$G = \frac{N+1}{N-1} + \frac{2}{N(N-1)u} + \sum\nolimits_{i=1}^{n} P_i X_i \qquad (3)$$

where*u* is the average value of the reference variable, $P_i$is the rank *P* of person *i,* with variable X, which represents a vector ranked from the highest to the lowest income of N people.

2.4.4. NUMBER OF RELEVANT COMPETITORS

Some authors have discussed the indicators presented up to here when it comes to be applied to sports industries, due to the zero-sum nature of the leagues. In other words, one team can win all the games it plays but not the total games played in the league (Utt and Fort, 2002). There is an alternative measure of the concentration based on the theory of natural structure of the markets.

In a market where a particular number of agents exist with different market shares, it is possible to establish the number of relevant competitors taking as a reference the market shares of each one of the teams, in a sports context. The market power arises in any process where the competitors grow at a rate, independently of their resources, that is, the growth of firms over time could be represented as a simple stochastic model in which the probability of a change in the size of the firm by a given percentage is independent of its own size (Buzzel, 1981). This process, known as Gibrat's Law (1931), recognizes the empirical fact that there is a correlation between the sizes, or between the market shares of the firms operating in a particular business sector. The underlying assumption is that the relation between the market share of the i-th firm and the market share of the 2i-th firm is a constant proportion (or "size ratio"). This hypothesis inspires what some authors name as natural market structures, Ijiri and Simon(1971), Buzzell (1981), and in analytical terms could be characterized by,

$$f = s_{2i}/s_i \qquad \text{being f constant for each i.}$$

By establishing the relation in reference to the leader firm, it is obtained that,

$$s_1 f^0 = s_1$$
$$s_1 f^1 = s_2$$

$$s_1 f^2 = s_4$$

...

hence it could be deduced a general expression, $s_1 f^{\ln i/\ln 2} = s_i$, or similarly in terms of the rank achieved by the firm i, R_i, it is obtained, $s_1 R_i^{\beta} = s_i$

This expression could be written in the semi-logarithmic model proposed by Buzzell (1981), which enables an empirical contrast. The semi-logarithmic distribution expresses the relative sizes of firms in a market as a function of each firm's size rank as follows:

$$\text{Ln } S_i = \alpha + \beta R_i + \varepsilon_I \qquad (3)$$

Where $-\beta = \ln i/\ln 2$; Ln S_i is the dependent variable and represents the logarithm of the market share of the firm in the i-th position of the rank; Ln R_i is the independent variable which is calculated as the logarithm of the rank position; and finally ε_I is the error term. The interpretation of the results allows identifying the market share of the leader as $e^{\alpha+\beta}$.

Cooke and Cox (1977) suggest that the size ratio is a useful summary measure of the structure of a given market because there is a close and direct relationship between the value of the ratio and the number of "significant" competitors in a market (Buzzell, 1981). From the parameter β it could be derived the number of relevant competitors, or which is the same in a sports context, the number of competitors with a relevant market share in relation to the leader share. The value of β is an estimation of the concentration fraction. Its interpretation in sports competitions is the greater the fraction, the lower the level of competitiveness. On the other hand, in general terms, the stability throughout of this parameter means that the growth rate of the sector is independent of the size of its market shares. This fact would make more difficult that a team which is not a relevant competitor in one season changes its nature in following seasons.

Since the beginning of the season implies a reset to zero in the scores and all the teams start the competitive term in the same conditions, the outcome of this analysis establishes the number of relevant competitors each season. Gibrat's effect only happens in the course of one season considering that the share obtained from previous competitions has no impact in the current competition. This proposal has been considered by classics as the determination of natural market structure. The National Leagues are competitions where the number of contestants remains constant, and the results of one season come from the competitive process developed between all the teams by playing the games corresponding to the number of total teams (N-1)*N. The systematic repetition of this effect season by season emphasizes the role of the regulatory body as a Competitive Moderator. Dobson, Goddart and Ramlogan (2001) argue about the convergence of the incomes using temporal models, which analyze the convergence of incomes. This convergence is detected when a balance in the competition exists. Furthermore, it is argued about the high correlation between economic and competitive inequality.

The natural structure models consider that is the market itself, which, thanks to its dynamics, generates the asymmetries finally observed, contrary to the market efficiency hypothesis, in which some of the economic theories are based. The asymmetry seems to be determined by the behavior of the agents in the market, when the regulatory body does not act imposing balancing mechanism between agents.

Once all the coefficients have been estimated through the regression, the next step is to calculate the Number of relevant competitors by applying the following expression,

$$NRC = (\text{Ln } S_{av} - \alpha)/\beta \qquad (4)$$

where S_{av} is the average share of each season. It seems reasonable to take the average share of the season or the value corresponding to an homogeneous distribution, that is 1/n, in order to obtain those teams that have possibilities of winning the championship, considering the leader share. This result has a lot of meaning in itself and a plausible interpretation. As much teams involved in the competition with possibilities of becoming champion, the more supporters will join to the event and the bigger the market demand will be.

2.5. DATA AND COMPETITIVE INTENSITY

In order to obtain the indexes and the number of relevant competitors it has been analyzed 25 NBA seasons, from 1990/91 to 2014/15, considering the number of wins achieved by each team and their relative positions in the final ranking. It should be noted that 2 of these 25 seasons have a smaller number of games due to the lockout[2], having been played only 47 games in the 1998/99 season and 66 in 2011/12, instead of 82 games. There is another important organization change in the structure of the competition since in season 2004/05 the number of divisions in each conference changed from two to three. As explained before, both conferences work independently. Giving the existence of two different rankings, one for each conference, it is misleading to analyze the NBA as an only competition.

[2]The lock out is a streak that happens when the NBA owner and Player's association cannot make an agreement on how much players and the organization get paid. The BRi (Basket related income) plays a crucial role in this issue. There have been four lockouts in the history of the NBA.

TABLE2.1. Descriptive statistics of Eastern Conference

	Attendance	H-H	Gini	C_8	NRC
Mean	16915.56	0.0702	0.1789	0.6461	7.1758
Median	16973.96	0.0674	0.1781	0.6373	7.5036
Max	17752.01	0.0829	0.2142	0.7166	8.38
Min	15644.67	0.0596	0.125	0.587	5.4098
Std. Dev.	528.71	0.0072	0.0246	0.0391	0.8362

TABLE2.2. Descriptive statistics of Western Conference

	Attendance	H-H	Gini	C_8	NRC
Mean	16954.596	0.0815	0.1894	0.7113	6.8297
Median	16978.44	0.0817	0.1849	0.7089	7.0183
Max	17851.73	0.0933	0.2879	0.7955	9.8223
Min	1402.87	0.0498	0.1311	0.535	5.4754
Std.Dev.	662.81	0.0083	0.0344	0.048	0.8839

Instead, we have used a balanced panel with all the teams that were present in each conference during the 25 seasons analyzed, in such a way that the study has at its disposal 50 observations. A summary of the data is presented in tables 2.1 and 2.2 whence it could be deduced that the variability of the attendance is lower compared to the rest of competitive balance indicators.

The most representative concentration measures of each conference are shown in tables2.3 and 2.4, from which an exercise of comparative statistics could be drawn with the aim of measuring the within-season inequality. In particular, table 2.3 contains a detail of the Herfindahl-Hirschman indexes reached by each season in the first column, the hypothetical values in case of perfect homogeneity in the second column and finally in the third column the

TABLE 2.3. Herfindahl-Hirschman and distance to the homogeneous distribution

	HERFINNDHAL-HIRSCHMAN		H.D.[3]		H-H - H.D	
SEASON	EASTERN	WESTERN	EASTERN	WESTERN	EASTERN	WESTERN
1990-91	0.0794	0.0825	0.0385	0.0385	0.0409	0.0440
1991-92	0.0775	0.0855	0.0385	0.0385	0.0390	0.0470
1992-93	0.0786	0.084	0.0385	0.0385	0.0401	0.0455
1993-94	0.0757	0.0913	0.0385	0.0385	0.0372	0.0528
1994-95	0.071	0.0934	0.0385	0.0385	0.0325	0.0549
1995-96	0.0753	0.0783	0.0444	0.0357	0.0309	0.0426
1996-97	0.0828	0.0737	0.0444	0.0357	0.0384	0.0380
1997-98	0.079	0.0778	0.0444	0.0357	0.0346	0.0421
1998-99	0.083	0.0795	0.0444	0.0357	0.0386	0.0438
1999-20	0.0674	0.0904	0.0444	0.0357	0.0230	0.0547
2000-01	0.0624	0.0904	0.0444	0.0357	0.0180	0.0547
2001-02	0.0647	0.0846	0.0444	0.0357	0.0203	0.0489
2002-03	0.0622	0.0884	0.0444	0.0357	0.0178	0.0527
2003-04	0.0597	0.09	0.0444	0.0357	0.0153	0.0543
2004-05	0.0657	0.08	0.0345	0.0345	0.0312	0.0455
2005-06	0.0657	0.0772	0.0345	0.0345	0.0312	0.0427
2006-07	0.0627	0.0797	0.0345	0.0345	0.0282	0.0452
2007-08	0.0663	0.0817	0.0345	0.0345	0.0318	0.0472
2009-10	0.0693	0.0778	0.0345	0.0345	0.0348	0.0433
2010-11	0.0662	0.0805	0.0345	0.0345	0.0317	0.0460
2011-12	0.0791	0.0499	0.0345	0.0345	0.0446	0.0154
2012-13	0.065	0.0805	0.0345	0.0345	0.0305	0.0460
2013-14	0.0605	0.0857	0.0345	0.0345	0.0260	0.0512
2014-15	0.0643	0.0822	0.0345	0.0345	0.0298	0.0477

distance between the real value and the balanced one. Regardless of the structural changes of the competition, in general terms, the data show stability through the time series analyzed, appreciating the biggest values in the H-H of the teams playing in the Western Conference, as well as the biggest

[3]H.D. : Homogeneous distribution. For the case of the NBA where not all the teams play each other the same number of times, that is, Total wins ≠ n*wins , the shares should be compared to the number of games played, instead of the number of teams: $n = \frac{games\ 5}{5} + \frac{games\ 4}{4} + \frac{games\ 3}{3} + \frac{games\ 2}{2}$; where games 5 is the number of games where the teams plays 5 times each other , games 4 number of games where teams plays 4 times and so on.

differences with regard to the perfect competitive balance, as shows the graphical analysis of the figure 2.1.

The average of C_8, which is the market share of the teams qualified for playing the play-off, ranges from 5,8% to 7,1% in Eastern and from 5,3% to 7,9% in Western, showing a slight inequality considering that the share in the case of a equitable distribution of the market would be 5,3% in leagues with 15 teams, 5,7% for 14 teams and 6,1% for 13 teams.

Finally the table presents the Gini coefficients, whose use is quite spread to measure the competitive balance of the league playoff outcomes (Quirk & Fort, 1992) and within-season inequality as well. (Schmidt, 2001; Schmidt and Berri, 2001). They show information in the same line of the aforementioned indicators, that is, the West Conference is slightly more unequal compared to the East Conference. This conclusion is easy to check observing Figure 2.2, where complete equality of winning is the 45-degree line and the area between this line and the Lorenz curve represents the inequality of the conferences.

As the main principle drawn from the results we could point out that both NBA Conferences show high levels of competitive intensity, that is to say, high level of Competitive Balance with a low concentration of the market.

By testing the significance of the differences on the averages[4] (see the appendix, table 1A), it is observed that both conferences are significant different from the C_8 and H-H point of view. In other words, the Western Conference demonstrates a lower competitive intensity. Therefore, the interpretation of the C_8 leads to the conclusion that teams playing in Eastern

[4] See appendix for further information [table 2. A1]

FIGURE 2.1.Herfindahl-Hirschman indexes and the gap regarding the homogeneous distribution

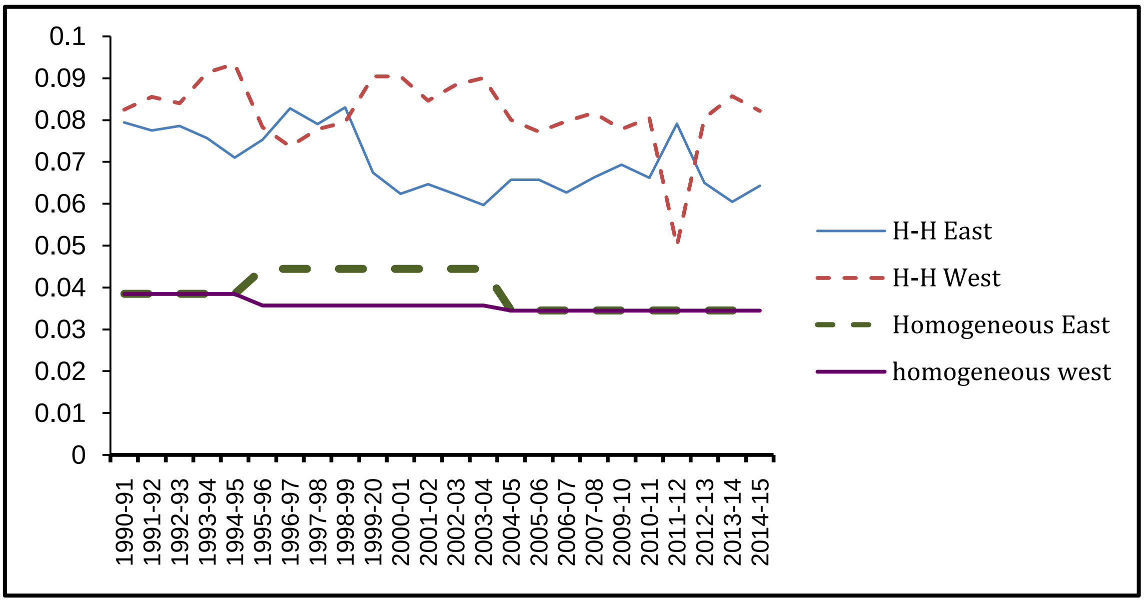


FIGURE 2.2. Lorenz curve for East and West conferences

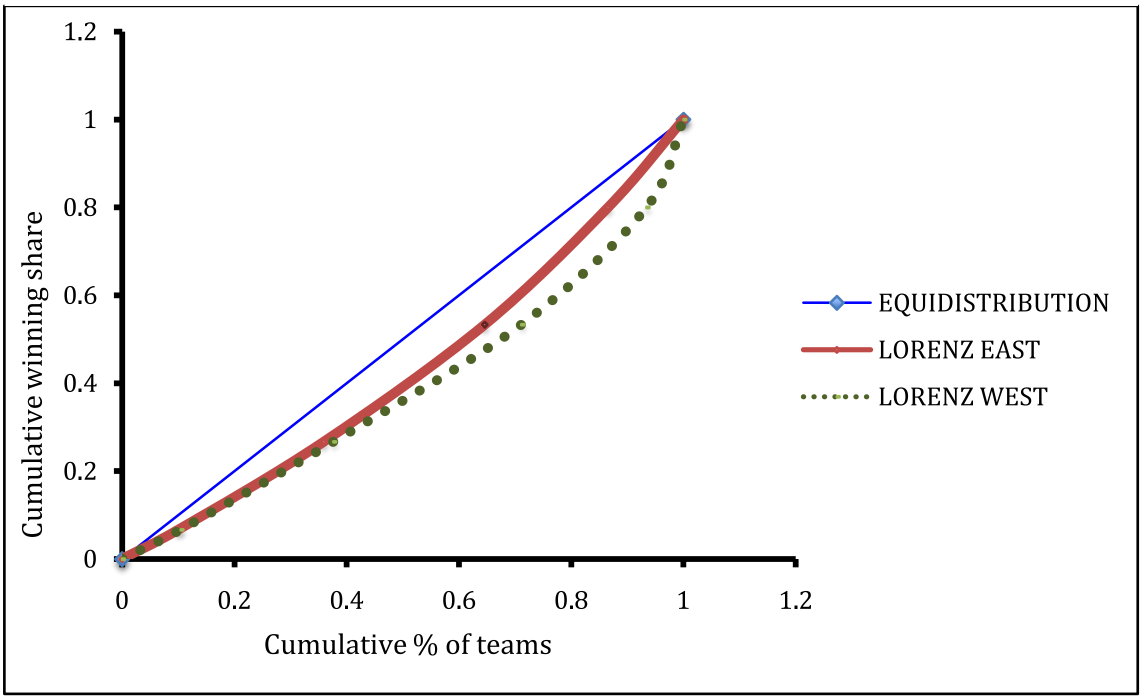


TABLE 2.4. Main indicators of concentration

	C8		GINI		NCR		TEAMS	
SEASON	EASTERN	WESTERN	EASTERN	WESTERN	EASTERN	WESTERN	EASTERN	WESTERN
1990-91	0.7167	0.7352	0.1753	0.1998	5.4098	6.6958	13	14
1991-92	0.6829	0.7542	0.1803	0.1957	6.1226	6.0312	14	13
1992-93	0.6794	0.7486	0.1558	0.2198	5.878	6.2075	14	13
1993-94	0.6969	0.7955	0.1968	0.2248	6.378	5.7365	14	13
1994-95	0.6638	0.7842	0.1782	0.2047	6.6721	5.4754	14	13
1995-96	0.6699	0.7021	0.2022	0.2051	6.9419	6.9754	15	14
1996-97	0.7154	0.6951	0.2135	0.2444	6.339	7.5792	15	14
1997-98	0.665	0.7456	0.1523	0.2879	6.318	7.6013	15	14
1998-99	0.6914	0.7143	0.15	0.2259	5.9455	7.0294	15	14
1999-20	0.626	0.7369	0.1591	0.1567	7.4122	5.9098	15	14
2000-01	0.6228	0.7369	0.1979	0.1567	8.1617	5.9098	15	14
2001-02	0.5951	0.7352	0.125	0.192	7.5266	6.4408	15	14
2002-03	0.6016	0.7334	0.1548	0.1711	7.9467	6.0842	15	14
2003-04	0.587	0.7247	0.1728	0.1311	8.3313	5.7758	15	14
2004-05	0.6163	0.6927	0.1771	0.1802	7.7351	7.1291	15	15
2005-06	0.6163	0.6602	0.1679	0.1469	7.642	7.2036	15	15
2006-07	0.5935	0.6797	0.1316	0.1705	7.7584	7.1106	15	15
2007-08	0.6228	0.7057	0.1971	0.185	7.7818	7.0921	15	15
2009-10	0.652	0.6862	0.2042	0.1765	7.5037	7.3161	15	15
2010-11	0.6374	0.6829	0.2117	0.1666	7.8522	7.0367	15	15
2011-12	0.7035	0.535	0.2143	0.1525	6.6808	9.8224	15	15
2012-13	0.6276	0.6894	0.1981	0.1663	7.8994	7.0183	15	15
2013-14	0.6098	0.7089	0.2022	0.1598	8.3801	6.6727	15	15
2014-15	0.613	0.7073	0.1864	0.193	7.8822	7.0531	15	15

TABLE 2.5. Estimation of the semi-logarithmic model

	α	β	L Sav
Eastern	-2.184873	0.0744662	-2.7187776
Western	-2.061286	0.0831986	-2.633199

conference have more difficulties to reach the play off positions not having this way the opportunity of winning the championship.

The results provided by the estimation of the semi-logarithmic model are shown in table 2..5. These results prove that the coefficients α and β are significant, both at a global level. Slight differences between Eastern and Western are perceived in the estimated model, considering that the addition of α and β determines the market share of the leader and β itself is an estimation of the concentration fraction.

The estimated values are in the line of the conclusions obtained with the statistics analysis, making clear that the Eastern is the conference with the lowest β coefficient corresponding to the situation of greater competitiveness between teams, when it comes to win games.

The numbers of relevant competitors are shown jointly with the rest of indexes in table 2.4, as another indicator of the concentration. Onceα and β have been obtained by estimating the expression 3, thesecoefficients are applied to expression 4, obtaining the NRC. In spite of finding slight

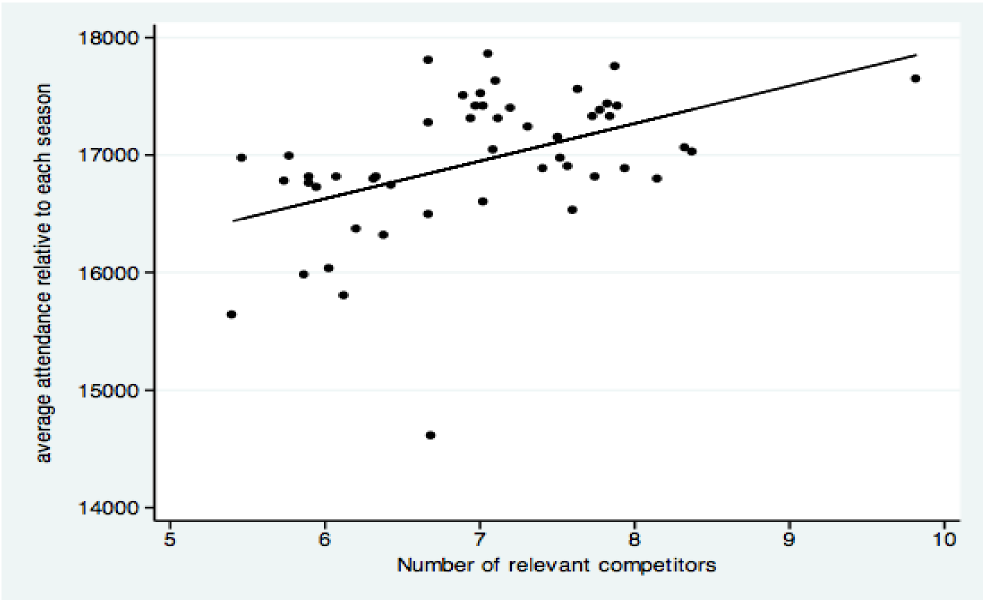
TABLE 2.6. OLS Estimation results for panel for different concentration indexes

	NCR	HH	C8	GINI
IC coefficient	0.1381***	-1.6394**	-0.4084***	-0.1485
	(0.0372)	(0.635)	(0.1053)	(0.1759)
Constant	9.4695***	9.8817***	10.0145***	9.7646***
	(0.0723)	(0.048)	(0.0716)	(0.0328)

NOTE: results present the estimation of the expression $Log(Attendance) = \alpha + \beta * IC_t + \varepsilon_t$
t-statistics in parentheses
*significant at 10%, **significant at 5%, ***significant at 1%

variations from one season to another in both conferences, on average the Eastern Conference shows a higher number of relevant competitors or, in other words, there are more teams powerful enough to win the competition (7.2 in East against 6.8 in West). Summarizing, all the results and analysis made so far, independently of the concentration index considered, lead to a consistent conclusion in terms of competitive balance, that is, the competition with the lower level of concentration has a higher number of relevant competitors. However the estimation results regarding the impact of the aforementioned indexes over the attendance to the NBA venues present considerable differences. This fact gives relevance and justifies the decision of taking the Number of Relevant Competitors as main indicator of competitiveness in following sections. This estimation results are shown in table 2.6.

FIGURE 2.3. Average attendance and NRC by conferences



2.6. CAUSALITY BETWEEN COMPETITIVE BALANCE AND DEMAND

The link between competitive balance and attendance plays a central role within the theory of sports economics, where it has been generally assumed that the relationship runs from competitive balance (exogenous variable) to attendance (endogenous variable). As Engle and Granger (1987) explain, when the experiment is not controlled, the demonstration of the cause-effect relation is not an easy task. Under the traditional approach, which is based on a regression model, the only conclusion that could be drawn is the quantification of the correlation, but the existence and the nature of the relation is not disputed. However, as Brandes and Frank (2007) argue, this distinction seems to be arbitrary, being necessary to find evidences for proving the sense of the causality, in spite ofthe statement 'the more equitable the distribution of fan attendances is, the better the competitive balance' seems to be straightforward. Additionally, it is required to check the existence of simultaneity between both variables that would lead to endogeneity problems, in order to accomplish a better quantification of theimpact. To that aim the number of relevant competitors from both conferences is taken as an indicator of competitive balance and the average attendance to the venues of each season as the measure of demand (using the logarithmic transformation to decrease the scale), which allows us to work with a panel data of 50 observations. Although there are some outliers, the graphical analysis showed in figure 2.3 leads to the conclusion of the existence of a overall positive correlation between attendance and Number of relevant competitors, which clearly means that both variables moves together in the same direction. The objective of this section is to prove the endogeneity of demand and the exogeneity of competitive balance in the classical demand function, or in other words, to examine for causal links:

$$Log(Attendance) = \alpha + \beta * NRC_t + \varepsilon_t \qquad (5)$$

The identification of economic causality from data series, under a general agreement, is a pending task in econometrics, given that the influence of the future over the past is ambiguous. Linking to Hall, Szymanski and Zimbalist (2002) and Brandes and Franck (2007) this article proposes the Granger causality test, a widely used tool in applied economics, which seems to be ideal to predict the direction of the relationship between competitive balance and fan attendance. That way the Granger causality test will help to determine not only whether one variable is useful in forecasting another, but also adding the advantage of determining the direction of interaction. Granger (1969) proposed a definition of causality between two or more variables taking into account the influence of one variable on another: a stationary time series Y is said to cause another stationary time series X if the inclusion of past values of Y significantly reduces the predictive error variance of X. In practice, Granger causality test is carried out by regressing X on its own lags and on lags of Y. If the lags of Y are jointly statistically significant, then the null hypothesis that Y does not Granger cause X, can be rejected. In the context of this paper this means that if the lagged NRC were found to be significantly positive, then there would be evidence of having an impact over the attendance, which implies thatit plays the role of exogenous variable.

Originally the notion of Granger causality was thought to solve causality problems between time series. However, in sports, as in the vast majority of industrial organizations, the reality is better represented by panel data. For this reason many authors have been involved in developing this technique for panel econometrics from the beginning of the new millennium. The first papers were focused on investigating the nexus between growth and mainly investment, among others variables[5].

The VAR model proposed by the Granger causality test takes the following general shape adapted to a panel context:

$$X_{it} = \alpha_i + \sum_{l=1}^{m} \beta_1 X_{i,t-l} + \sum_{l=1}^{m} \beta_2 Y_{i,t-l} + \mu_{it} \quad (6)$$
$$Y_{it} = \theta_i + \sum_{l=1}^{m} \gamma_1 Y_{i,t-l} + \sum_{l=1}^{m} \gamma_2 X_{i,t-l} + v_{it} \quad (7)$$

The specification of the corresponding VAR system within the context of this work could be expressed as:

[5] Some of those first papers which studied the causality in the sense of Granger applied to a panel data were Attanasio et al.,2000; Podrecca and Carmeci, 2001; Nar-Reichert and Weinhold, 2001; Laakson-Craig, 2004; Hsiao and Hsiao, 2006.

$$Attendance_{it} = \alpha_i + \sum_{l=1}^{m} \beta_1 Attendance_{i,t-l} + \sum_{l=1}^{m} \beta_2 NRC_{i,t-l} + \mu_{it} \quad (8)$$

$$NRC_{it} = \theta_i + \sum_{l=1}^{m} \gamma_1 NRC_{i,t-l} + \sum_{l=1}^{m} \gamma_2 Attendance_{i,t-l} + v_{it} \quad (9)$$

whereα_i and θ_i are random and fixed effects[6] respectively, i denotes each conference (East and West) observed over t = 1, 2, …, 25 periods. Finally μ_{it} and v_{it}represent the disturbances independently distributed with mean equal to zero. Once estimated the coefficients, it is possible to draw a conclusion regarding the causality by running Wald tests on the β_2 and γ_2 coefficients, which allows us to check if they are statistically different from zero. Both models need to be estimated in order to prove the existence of endogeneity in case of both variables cause each other simultaneously. In addition to this the reduce form of VAR model includes the contemporaneous effect of the exogenous variable.

The Grange causality test requires checking the stationarity of the data as a previous step, and therefore,before accomplishing the estimation, the time series should be tested for the presence of unit roots by applyingthe conventional test of stationarity Dickey- Fuller. The regression equation in our panel data context would be:

$$\Delta y_{i,t} = \alpha_i + \rho y_{i,t-1} + \varepsilon_{i,t} \quad (10)$$
$$i = 1, 2, t = 1,2, \ldots, T$$

[6]Random effects for equation 6 and fixed effects for equation 7 are taken as the most suitable model according to Hausman test. See appendix [Table 2.A2 and 2. A3] for further information .

TABLE 2.7. Unit Root Test results

	ATTENDANCE		NCR	
H0: panel contain unit roots	Stat	Prob	Stat	Prob
Harris-Tzavalis	0.3136	0.0005	0.2942	0.0003
ADF-Fisher Chi-square	1.7238	0.0424	2.6735	0.0038
PP-Fisher Chi-square	11.2781	0.0000	3.0289	0.0012

TABLE 2.8. Optimal lag length

lag	AIC	HQIC	SBIC
0	-8.83251	-8.82277	-8.73449
1	-9.37041*	-9.34118*	-9.07634*
2	-9.15389	-9.10517	-8.66376
3	-8.95021	-8.882	-8.26404
4	-9.01766	-8.92996	-8.13543

Given that our sample is considered small, it would be more appropriate to fix a standard Dickey-Fuller distribution (instead of the asymptotically normal), assuming a critical value close to 3. Table 2.7 establishes that the variables considered in this work appear to be stationary.

Since Granger causality test is sensitive to the lag length of the VAR model it is an important task to determine the maximum lag order, decision that will be based on different information criteria with the aim of avoiding the inclusion of irrelevant lags. The most spread information criteria are Akaike criterion (AIC), Hannan-Quinn criterion (HQC) and Schwarz criterion (SC). In this paper, in case of conflict between the conclusions reached by each test, the Schwarz criterion will prevail over the others, due to the length of our sample[7].Table 2.8 shows that all the criterion lead to the conclusion that the optimal lag length is 1.

Tables 2.9 and 2.10 provide the results of the Granger Causality tests, based on the average attendance to the venues during each season and the number of relevant competitors, with OLS, with the Arellano-Bond one-step system GMM estimator and with Arellano-Bover/Blundell-Bond estimator[8]. Following the previous argument, both variables are used in their logarithmic form in order to reduce the effect of the different scale. The OLS specification includes random effects in table 2.9 and fixed effects in table 2.10 according to the result provided by the Hausman test for correlated random effects, while the GMM specifications include period-specific effects as generally recommended by the literature. The lags of the dependent variable from at least two periods earlier, as well as lags of the explanatory variable, serve as GMM-style instruments.

The bottom of the table reports specification test results for the GMM estimations. In the case of the Sargan test by no rejecting its null hypothesis we are accepting the over-identification of the instruments as valid. In this kind of model it is advisable to estimate over-identified equations. In fact the GMM estimator could be interpreted as a lineal combination of all the possible estimations of an over-identified model. Tables 2.9 and 2.10 show that the null hypothesis of the Sargan test is always accepted with a p-value bigger than 0.05. In order to detect first-order autocorrelation in the underlying level variables, we use the Arellano-Bond test of no second-order autocorrelation in the disturbances of the first difference equation. The

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[7]In small samples it is met $\rho(SC) \leq \rho(HQC) \leq \rho(AIC)$ being these coefficients the orders selected by each criterion.

[8]This method assumes that there is no autocorrelation in the idiosyncratic errors and requires the initial condition that the panel-level effects be uncorrelated with the first difference of the first observation of the dependent variable.

TABLE 2.9. Estimation results for VAR model.

Dependent variable:Attendance

	OLS	Arellano-Bond one-step GMM	Arellano-Bover Blundell-Bond
ATTENDANCE (-1)	0.3312***	0.4715**	0.4834***
	(0.578)	(0.2185)	(0.1734)
ATTENDANCE (-2)	0.2686***	0.1751	0.1734**
	(0.016)	(0.093)	(0.083)
NCR (-1)	-0.0243	0.0055	0.0028
	(0.078)	(0.037)	(0.0176)
Observations	50	50	50
Wald test (p-level)Attendance	0.0001	-	-
Wald test (p-level) NRC	0.7549	0.8832	0.8729
AB test(p-level)	-	0.8454	-
Sargan Test (p-level)	-	0.4862	0.6258

Standard errors are in parenthesis. AB test = Arellano-Bond test for AR(2) in first differences
Estimates for constant terms not shown
* Significance at the 10% level.** Significance at the 5% level. *** Significance at the 1% level.

TABLE 2.10. Estimation results for VAR model.

Dependent variable: NRC

	OLS	Arellano-Bond one-step GMM	Arellano-Bover Blundell-Bond
NCR (-1)	0.4443***	0.4150***	0.3984***
	(0.103)	(0.119)	(0.115)
NRC (-2)	-0.0339	-0.0449	-0.0305
	(0.044)	(0.032)	(0.108)
ATTENDANCE (-1)	0.9574***	1.5656***	1.3729**
	(0.181)	(0.510)	(0.492)
Observations	50	50	50
Wald test (p-level)Attendance	0.0001	0.0022	0.0001
Wald test (p-level) NRC	0.0001	-	-
AB test(p-level)	-	0.1872	-
Sargan Test (p-level)	-	0.6349	0.6258

Standard errors are in parenthesis. AB test = Arellano-Bond test for AR(2) in first differences
Estimates for constant terms not shown
* Significance at the 10% level.** Significance at the 5% level. *** Significance at the 1% level.

existence of first order correlation in first differences is recommended, since otherwise there would be no dynamic effects and GMM estimator would not be appropriate. The null hypothesis of no autocorrelation is accepted in one-step GMM model for both cases.

The upper part of the tables reports the estimated coefficients, which enclose information about the causality between both variables. By finding significant positive coefficients of the NRC in table 2.9 would support the idea that the higher the level of competitiveness is, the bigger impact over the attendance. Contrary to the expected assumption, the NRC has no impact over the attendance in none of the estimations, conclusion supported by the Wald test as well, which never rejects the null hypothesis of coefficient equal to zero. However some effects are found in table 2.10 thanks to the analyze of the relationship between both variables in contrary sense, that is, letting NRC be the endogenous variable, which could be partially explained by the level of attendance. In the three proposed models the attendance is positive and statistically significant, and the Wald test clearly rejects the null hypothesis. Considering all these results we can conclude that the level of competitiveness does not Granger cause attendance but attendance Granger cause the balance of the competition analyzed.

From an Economic point of view, the first implication would be related to the appropriateness of undertaking regulatory measures in order to improve the balance of the NBA. Generally this battery of measures[9] has been justified on behalf of the competitiveness, considered as the main determinant of sport demand in terms of attendance. However, in the light of the results provided by this study, this assumption widely spread in the literature should be tested for the case of each competition. The absence of impact of the

[9]NBA is considered a pioneer competition in implementing measures as drafts, salary cap, luxury tax and revenue sharing.

competitive balance over the attendance could be due to the complexity of the business of basketball NBA. The large amount of elements that turn a NBA game into an appealing spectacle (food, lights, cheerleaders, mascots, live music, etc.) leads one to the foregone conclusion that the competitive balance or even the on-court productivity, traditionally used in these kind of studies, are not enough to explain the demand.

In our model the only other explanatory variable is past attendance, which is positive and significant, so the success of one season has an impact over the following season when it comes to venues attendance. The random effects are also significant, so the statistical interpretation is that improvements on basketball demand happen unexpectedly and independently of variables typically used to explain the demand such as the size of the potential market, the price of the tickets or the arena capacity. Contrary to the expected premise we find that the level of attendance in one season improves the balance of the competition during the next term, an outcome that could be interpreted in terms of revenues, or rather, in terms of revenue sharing. The scale reached by the NBA as a business is so significant that we need a wider vision of the industry to explain properly its operating. This way attendance works as a proxy[10] of what happens with the totaldemand and therefore with the revenues generated by the league[11], which are shared among all the teams under the revenue sharing agreement. For this reason an increase of the attendance reflects simultaneously an increase of the revenues of the league, which are shared among all the teams increasing this way their available budgets and eventually, the competitiveness of the league.

[10]The correlation between attendance and revenues (BRI) over the 25 seasons is 0.8542

[11]BRI is the basketball related incomes, which includes ticket sales, tv contracts, concessions, parking temporary Stadium advertising, merchandising and a proportion of the revenues generated by stadium.

2.7. CONCLUDING OBSERVATIONS

In order to analyze the level of concentration, apart from the indicators widely used by the industrial economics, this study presents the number of relevant competitors as an alternative indicator of the competitive intensity, which is based on the theory of natural structure of the markets and inspired by Gibrat's law. This fact represents the main contribution of the present study since this indicator avoids the pitfalls presented by the typical indicators due to the zero-sum nature of the league being more suitable to sports industries. In the light of the results two conclusions can be drawn. Firstly, both conferences, and the NBA as a whole, show a high level of competitiveness where the uncertainty of the outcome is plausible. However, there is reliable evidence that the distribution of the teams between both conferences is not so balanced as expected since the Eastern conference shows systematically higher levels of competitive balance being more difficult to reach the play-off phase by any team in Eastern than in Western.

Once the competitive balance indicator is defined, it raises the question of why the competitive balance has to be measured. The answer comes from the Rottenberg's hypothesis where the uncertainty of the outcome is a requirement to increase the willingness to pay admission to a game on the behalf of the potential fans. As long as this statement is valid and the competitive balance causes attendance, the regulatory mechanisms applied by institutions, specifically the NBA, will be justified under the theoretical terms.

Reality places some surprising observations, which call into question the aforementioned assumption in the scope of the current sports business. We use the Granger Causality test to check the way of interaction between competitive balance and fan attendance. The results present no evidence of Granger causality from competitive balance to attendance, being in line with other works such as Fort & Quirk (1992), Sanderson (2002) and Rascher (2002). However there is evidence that the causality between competitive balance and attendance runs in the contrary direction, and it is the attendance that determines in some way the competitive level of the NBA.

The explanation of these unexpected results is based on the complexity of the NBA as an spectacle and on the institutional rules that govern the NBA, especially the practice of the revenue sharing and finally on the dimension reached by the business of American basketball, not only in EEUU but also in the rest of the world. In those competitions where the revenue sharing is applied, the existence of starts as Michael Jordan, nowadays Stephen Curry, Lebron James or legendary teams is of benefit to all the teams.

On the other hand the attendance presents a limited variability, that is, the arenas are almost sold-out in every game day, independently of the teams playing, which leads to the conclusion that the level of attendance is not explained by sporting arguments, greatly due to the big amounts of activities organized around the game. This fact could be the reason of the lack of ability of the NRC to explain the level of attendance.

Finally, considering the reported results, an interesting further research might try to find a variable, which represents in a better way the whole demand of basketball, determining what elements enhance it, apart from the attendance, which it has been demonstrated that is not enough. This previous study will lead us to quantify the scale and the direction of the relationship between basketballs related incomes (BRI), demand and competitive balance. In addition to this, another interesting line of research in the future would be the analysis of new arguments, of greater richness than the sporting ones, to explain the demand of a sport that has reached a high level of complexity such as modern basketball. We have learnt that sport industry, as we know it today, is far away from the vision of the first theorists and it would be advisable to update their hypothesis.

APPENDIX
COMPLEMENTARY TABLES

TABLE 2.A1. Significance of the differences on average

H-H		C_8		GINI		NCR	
EASTERN	WESTERN	EASTERN	WESTERN	EASTERN	WESTERN	EASTERN	WESTERN
0.070262	0.08114	0.6443	0.70851	0.17759	0.1899	7.2192	6.871
0.000125		5.35 e-0.5		0.231		0.2	

TABLE 2.A2. Hausman test for equation 6

	COEFFICIENTS		
	Fixed Effects	Random Effects	Difference
ATTENDANCE (-1)	0.3400873	0.3312631	0.0088242
ATTENDANCE (-2)	0.2847377	0.2686617	0.016076
NRC (-1)	-0.033448	-0.024376	-0.009072

Fixed effect coefficient = consistent under Ho and Ha; obtained from xtreg
Random effect coefficient= inconsistent under Ha, efficient under Ho; obtained from xtreg

Ho: difference in coefficients not systematic
chi 2 = 0.41
Prob> chi2 = 0.9382

TABLE 2.A3. Hausman test for equation 7

	COEFFICIENTS		
	Fixed Effects	Random Effects	Difference
NRC (-1)	0.3812437	0.4443316	-0.0630878
NRC (-2)	-0.028401	-0.0339504	0.0055493
ATTENDANCE (-1)	1.1069489	0.9574774	0.1120118

Fixed effect coefficient = consistent under Ho and Ha; obtained from xtreg
Random effect coefficient= inconsistent under Ha, efficient under Ho; obtained from xtreg

Ho: difference in coefficients not systematic
chi 2 = 8.86
Prob> chi2 = 0.0312

Chapter 3

DIVERSIFICATION STRATEGIES IN NBA TEAMS

ABSTRACT

This paper analyzes the relationship between diversification and effectiveness in the process of achievement of objectives within a sporting framework testing the hypothesis that the sign and the magnitude of this relationship, added to the goals established by the club, could play a crucial role in the configuration and design of sports teams. The assessment of the diversification level is based on the Gollop and Monahan index, whose components are used as explanatory variables in a model where the dependent variable is the results obtained by the teams in terms of efficiency and ranking position. This analysis is focused on the National Basketball Association (NBA). The database is configured for all the franchises, which have contested the league for 18 seasons, from 1996-97 to 2013-14.

JEL: L83, L20, L25, J24

Keywords: Team Sport Diversification, Diversification Index, Basketball Teams, NBA.

3.1. INTRODUCTION

It is widely accepted among researchers that professional sport is a suitable laboratory to prove several hypotheses which assess not only economic aspects such as profitability or management (El-Hodiri, M., & Quirk, J. ,1971; Rottenberg, 1956; Szymansky,S., 2003) but also the sportive performance in itself by measuring the efficiency, the outcomes obtained or the level of competitiveness (Espitia, M., and García,L. 2004; Berri, D.J. 1999; Carmichael, F. Thomas, D. & Ward, R. 2001) or analyzing the assignment of players on the court during the game as well as the strategic behavior (Palacios-Huerta, 2003; Moschini, 2003; Boon and Sierksma, 2003). Sports Institutions works like any conventional company which has its own economic activity and market and where large sums of money and a high level of expectations get involved, having to fulfill simultaneously two requirements: economic and sporting success. However it is the availability of data and statistics, which makes sports industry so interesting and useful. It is the only context where the performance and the efficiency of the labor could be analyzed immediately, and what is more, where the most sophisticated technology is applied to improve these statistics, generating more data. TV broadcasts inform us about the percentage of ball possession, the number of home runs, the percentage of aces or the number of offensive rebounds (Klaassen, Magnus, 2003).

Many models of optimizing strategic behavior have been developed in the literature and one of the most analyzed factors is the level of diversification within the companies (Ansoff H.I., 1957; Berger, P.G., Ofek, E., 1995; Chandler A.D., 1962; Gort M., 1962). In recent years this kind of study has been introduced in the sports economics framework as well (Dobson, S., Goddard, J., 2003; Boon, B.H., Sierksma, G., 2003), trying to give a reliable answer to those questions that many supporters discuss in informal terms such as; should the team play an attacking strategy or otherwise focus on defensive tasks? Or what kind of players should be signed every season according to the sports objectives?

Basketball is a constant succession of strategies since it is allowed to introduce as many changes of players as coaches consider, stop the game to explain a new tactic and the defense is studied depending on every attacking movement of the adversary. The purpose is not only to minimize the power of the adversary but also to organize your own inputs (or which is the same, players) as efficient as possible, which gives the opportunity of achieving the goals set by the Institution. To that aim there is a previous work made during every preseason by coaches and technical managers who are responsible for shaping a team with complementary players who fit into the group in order to develop all the relevant tasks required during the game.

The crucial question is: What would be the optimal distribution of the task among the players of the team? It is more advisable to design a team with a high level of heterogeneity? First of all, we refer to heterogeneous team as a team where all the players have a defined roll being specialized in a few tasks. Thus, each activity would be concentrated in the most qualified players to each case.

That has been the most spread philosophy among basketball experts as coaches design movements where all the players perform generating advantages for the shooters or playing pick and roll for the fastest ones. However, in modern basketball there is a change of trend, growing the number of supports for diversification of the teams, where everybody is able to develop any task; centers are ready to made a three-point shot and guards are placed on the court to get rebounds among other kind of actions. The main argument is those teams with a larger number of versatile players would have more strategic alternatives. Hence, a controversial debate has been set recently.

This paper tries to answer the aforementioned questions by using economic tools and data provided by the NBA (National Basketball Association). The sample has been compiled for the 29 franchises divided into two conferences (Eastern and Western) that have taken part in the competition throughout the last 18 seasons from 1996-97 to 2013-14. Firstly it is indispensable to calculate the value of a diversification index, which defines the configuration of the team. Next we establish a relationship between this index and the sportive results achieved with the aim of detecting possible impacts of the teams design on the success.

The scientific method proposed in this work is based on the use of Gollop and Monahan (1991) index (from now on GM), which provides both, an added value of the diversification level of the teams but also its breakdown into the three components, or which is the same, the number of products, the balanced distribution of the activity and the heterogeneity of the product, giving more information of the relevant aspects of the sporting strategy. Since the paper of Gollop and Monahan (1991) is focused on manufacturing industry, it is necessary to adapt it to the case of basketball teams. The next step will be to prove the existence of a relationship between different configuration models of team and the outcomes achieved along the competition by relying on the values obtained during the first stage, that is; the components of the GM index will be the explanatory variables of the effectiveness and efficiency level performed by the teams.

The remainder of the paper is structured as follows: In section 2 we present the main antecedents provided by specialized literature and the basis of the GM index. Section 3 explains the adaptation of the index to the case of NBA basketball teams and its results. In section 4 we present a set of models in order to test the impact of the diversification over the sports results, as well as the main results from these models. Finally section 5 contains the main conclusions and the policy suggested.

3.2. MEASURING THE DIVERSIFICATION

Generally speaking firms are considered diversified if they concurrently are active in more than one business. Contemporary measures of diversification strategies, therefore, attempt to reflect the extent of the firm diversity. Since the work of Rumelt (1974) economists have been investigating not only the diversification, but also the relationship between product diversity and performance. These studies include the analysis of the diversification strategies properties, suggesting reliable and generalized measures of the level of diversification. In general terms diversification is related to the supply of products having been approached by two lines. The first one has the aim of defining correctly the term diversification and a measure that fulfills the requirements to be reliable and comparable among companies from different sectors and features. Many works belong to this line such as Hoskisson, R. et al. (1993), Troutt, M.D. and Acar, M. (2005), Gollop, F. M. and Monahan, J.L. (1991) or Pehrsson, A. (2006). There is another group of works analyzing the relationship between diversification and company results whose recommendations do not become widespread, not having reach an agreement about the conclusions. Graham, J.R., Lemmon, M., and Wolf, J., (2002), Jacquemine, A., and Berry, Ch., (1971), Markides, C.C., and Willimanson, P.J., (1994) y Rajan,R., Servae, H., and Zingales, L.,(2000) are some examples of this line. Given that there is no formal model of production that leads to a unique index of diversification (Gollop and Monahan, 1991), the literature has proposed a set of indexes, which allows approaching the features of the diversification strategies developed by the companies. Considering them, the literature exhibits a consensus about what is considered the properties that every well-designed index should fulfill:

(i) it should vary directly with the number of different products produced;

(ii) it should vary inversely with the increasingly unequal distribution of products across product lines;

(iii) it should vary directly with the dissimilarity or heterogeneity of products.

For a long time none of the diversification measures presented in economics literature simultaneously satisfies all the properties. Gort (1962), Berry (1971) or Pomfret and Shapiro (1980) are some examples. But all those attempts were useful to approach the development of an index that does achieve it.

Gollop and Monahan (from now GM) suggest a complex index based on the generalization of the Herfindahl concentration index making it sensitive to product heterogeneity for the case of US Manufacturing. In its application for productive plant and industrial enterprises, GM index is specified as:

$$GM = \frac{1}{2}\left(\left(1-\frac{1}{n}\right)\right) + \frac{1}{2}\sum_i \left(\frac{1}{n^2} - s_i^2\right) + \frac{1}{2}\sum_i \sum_k s_i s_k \sigma_{ik} \qquad (1)$$

where n is the number of distinct products produced by the company, s_i is the share of the i^{th} product in establishment, firm or industry shipments, and

σ_{ik} is a continuous variable which provides information about product dissimilarity. This term deserves a detail of its way of calculating:

$$\sigma_{ik} \equiv \left(\sum_j \frac{|w_{kj} - w_{ij}|}{2}\right)^{1/2} \tag{2}$$

where $0 \leq \sigma_{ik} \leq 1$ and w_{kj} and w_{ij} are the input cost share of the j^{th} input in the product k^{th} and the input cost share of the j^{th} input in the product i^{th} respectively.

The GM index takes a zero value when the analyzed entity produces only one product, contrary to the situation where the diversification is perfect and the GM takes the value 1. The decomposition of the index in three components could be deduced from expression (1) whose meanings and applications spark the academic interest:

$$GM = N + S + H \tag{3}$$

Where:

$$N = \frac{1}{2}(1 - 1/n)\,, with \quad 0 \leq N \leq 0.5 \tag{4}$$

$$S = \frac{1}{2}\sum_i \left(\frac{1}{n^2} - s_i^2\right), with \quad -\frac{1}{2}\left(1 - \frac{1}{n}\right) < S \leq 0 \tag{5}$$

$$H = \frac{1}{2}\sum_i \sum_k s_i s_k \sigma_{ik}, \text{ with} -\frac{1}{2}\left(1 - \sum_i s_i^2\right) \leq H \leq 1/2\left(1 - \sum_i s_i^2\right) \tag{6}$$

The three components increase with the number of products and by increasing the equality of the distribution and product dissimilarity.

The first component (N) identifies the number of products of the firm, in such a way that the larger is the number of products the closer to 0,5 will be the N component.

The S component is called by the authors the *distribution component* since it reflects the distribution of the business among the activities. It is the result of the subtraction between the value of the Herfindahl index with an homogeneous distribution and the Herfindahl index of the real distribution. The bigger the S value in absolute terms is, the bigger the asymmetry of the company. In other words, the closer to 0 the term is, the larger the homogeneity of the distribution.

And finally the H component identifies the heterogeneity of the firm under the premise that two productsare homogeneous if they require the same amount of the same inputs.

3.3. DIVERSIFICATION INDEX FOR NBA TEAMS

Considering the theory developed in the previous section, the strategy of diversification in the configuration of a sports team, and specifically in the case of basketball, could be interpreted as the design of teams where there are dissimilar players with features suitable for developing different tasks during the games. Therefore the strategy of the sports managers and coaches is essential for the proper working of the team.

In order to achieve the objective of this work, the variables taking part in the GM index should be adapted to the case of the analyzed basketball competition. Thus, the term related to the number of products, ***N***, would be the total number of players which have taken part of the competition in each team. Relevant differences in this number are not observed at the beginning of the seasons, basically because the maximum number of players is restricted to 15 each game, which could determine N; however its fluctuation depends on the number of players signed throughout the season, according to unexpected events such as injuries, transfers or bad results. For the distribution component, **S,** s_i is the share of each player in terms of time played during the games regarding the total.

For the purpose of applying this measure, w_{kj} represents the effort instead of the monetary costs, that is, the responsibility in developing each of the tasks, necessary for winning the game, which are established by the coaches' strategy. The component σ_{ik} is calculated considering a vector of variables (w_{kj}) measured in total terms, which are considered as indispensable by basketball experts, and represents the differences of the number of actions performed by one player in relation to the rest of the team. Some of these variables belong to the attacking strategies such as the field goals made, the field goals attempted, 3 point field goals made, 3 point field goals attempted, free throws made, free throws attempted and assists, while others have a defensive nature; offensive and defensive rebounds, steals, blocks and personal faults committed[12]. Specifically the GM index is calculated from the difference between the statistics of each player and all the rest of the teammates, comparing one by one. Those players developing a larger number of a specific kind of actions of the game contribute to the heterogeneity of the team and therefore H becomes an added measure of the team's heterogeneity.

[12]See appendix for further information [Table 3.A1]

The sample contains information of the variables selected from season 1996-97 to 2013-14, including the 29 NBA franchises that have contested stably during the period under study. We talk in franchises terms because it is not unusual to find cases where the team moves to another city but the organization and the players are the same. The data were collected from the official web site NBA.stats. The descriptive statistics of the GM and its components (N, S, H) for the whole league are shown in Table 3.1 where it is proved that there is a moderate level of diversification in NBA teams, with a GM index slightly higher than 0.5 on average and fluctuating from 0.47 to 0.52. Tables3.2 and 3.3 summarize the descriptive statistics of the GM and its components by conferences, East and West respectively. By comparing both conferences it is found that the GM index in Western is slightly lower than in Eastern (0.502 against 0.503) but considering that there is one less team in West conference, this dissimilarity could be due to the difference in the number of players. The analysis of the following section will clarify this hypothesis.

Therefore, in the light of the descriptive statistics we conclude that the level of diversification is quite similar in both conferences, being necessary a deeper analysis for reaching reliable conclusions. The components of the index are homogeneous and they barely fluctuate between teams (the standard deviation are close to 0.005 for the three components), being the H component where we observe the largest differences. It is also outstanding the disparity between the minimum and maximum number of players which leads to the conclusion that there is a remarkable difference in the configuration of teams, possibly due to the unexpected circumstances faced by each team along the season.

TABLE 3.1. NBA total values of the Gollop and Monahan index

	Wins	Players	GM	N	S	H
Mean	9.72	14.96	0.5031105	0.4662318	-0.046698	0.0835767
Std. Dev.	9.51	1.83	0.0078899	0.0040932	0.0048779	0.0066524
Min	1	10	0.4702665	0.45	-0.0660267	0.0563596
Max	69	24	0.5220062	0.479	-0.0313363	0.1003197

TABLE 3.2. East Conference values of the Gollop and Monahan index

	Wins	Players	GM	N	S	H
Mean	10.02	15.13	0.503614278	0.466588889	-0.046389772	0.083415161
Std. Dev.	10.00	1.87	0.007796622	0.004054172	0.005103006	0.006891289
Min	1	11	0.480730465	0.455	-0.060217854	0.056359556
Max	69	21	0.522006177	0.476	-0.032476094	0.099958643

TABLE 3.3. West Conference values of the Gollop and Monahan index

	Wins	Players	GM	N	S	H
Mean	9.42	14.79	0.502570736	0.465849206	-0.04702822	0.083749749
Std. Dev.	8.98	1.79	0.007968815	0.004108232	0.004611838	0.006395738
Min	1	10	0.470266525	0.45	-0.066026717	0.068591237
Max	64	24	0.521085997	0.479	-0.031336293	0.100319699

3.4. MEASURING DIVERSIFICATION EFFECTS

In order to fulfill the final objective of this work, we propose a model which establishes a relationship between the sports outcomes and the components of the GM index, being the latter the explanatory variables of the model. The dependent variable could be measured in two different ways, depending on the institutional goals of each team. Given the difficulty of controlling this information for every season and every team[13], two alternative dependent variables are proposed: the probability of playing the play-off phase and a measure of efficiency during the games.

3. 4.1. PROBABILITY OF PLAY-OFF

Since NBA competition has two stages, the regular season and the play offs, the first objective for those candidate teams to win the championship should be to achieve the qualification for the play-offs, that is, to be one of the eight top ranked teams. Following the aforementioned arguments, those diversification strategies that increase the probabilities of playing the play off would be the most recommendable. Therefore, a dummy variable called "playoff" is created to account for the final ranking, where $y_i = 1$ if team is one of the top eight of the ranking and $y_i = 0$ otherwise, then the aimed probability is $P\ (y_i = 1|x_i)$.

[13]It should be considered that NBA is a competition where the favorite teams to win the championship vary considerably from one season to another thanks to the competitive balance mechanisms adopted by the league.

We propose to use the general framework of binary dependent models, which generally speaking suppose that $y_i = 1 \;\; if \; y_i^* > 0$ and $y_i = 0$ otherwise, being y_i^* a not observed latent variable which verifies $y_i^* = \beta' x_i + \varepsilon_i$, where β is a vector of parameters and ε_i is a continuous and unobserved random variable. Then $P\,(y_i = 1|x_i) = P(\varepsilon_i > -\beta' x_i) = G(X\beta)$ being the latest function bounded between 0 and 1.

The case of the widely used logit model assumes a simple logistic distribution function:

$$P\,(y_i = 1|x_i) = \frac{e^{\beta' x_i}}{1+e^{\beta' x_i}} \qquad (7)$$

McFadden, D., (1974, 1981), Ben-Akiva and Lerman (1985) and Train (1986) all have used the logit model to relate the probabilityof making a choice to a set of variables reflecting decision-maker preferences.

On the other hand the probability in a probit model is given by a standardize normal distribution function:

$$P\,(y_i = 1|x_i) = \int \frac{1}{\sqrt{2\pi}}\, exp\left(-\frac{1}{2}z^2\right) dz = \frac{1}{\sqrt{2\pi}} e^{\frac{1}{2}-z^2} \qquad (8)$$

In both models the technical and most relevant features are the same and the results provided never show an outstanding difference. One of the main problems of this kind of models is the missed information, considering that the dependent variable adopts 15 possible values but it is limited to only two values. For this reason we also include an ordered probit estimation where the dependent variable is divided in three different groups of teams with the same reward after the regular season: $y_i = 1$ if the team does not qualify for the play-offs, $y_i = 2$ if the team plays the playoffs but without the advantage of playing more matches on the team's home ground and $y_i = 3$ if the team is one of the fourth top having the aforementioned advantage.

Summarizing, the hypotheses to be tested in this empirical part are:

H1: The number of players taking part in the team during a season has a negative impact over the probability of qualifying for the playoff stage[14].

With regard to the distribution of the time played among the members of the team, there are two points of view widely extended among the experts of the sport. On the one hand those who support a balanced distribution or symmetry considering that the more qualified players capable to play keeping a high level, the greater the opportunities of winning. On the other hand there are coaches who trust on designing teams with 5 or 6 stars (spending the most part of the budget on them) in such a way that these players would play the biggest part of game time comparing to the others. The later philosophy is the most extended in NBA being the former closer to the European one. Therefore:

H2: The heterogeneous distribution of the time played by the member of the team increases the probability of qualifying for the playoff stage.

H3: The diversification in terms of who develops the most part of the actions during the game, determines the probability of qualifying for the playoff stage.

The model to test the formulated hypotheses has the following general form:

[14] This is due to the hiring of players throughout the season usually responds to injuries or bad results.

$$y_t^* = \beta_0 + \beta_1 N_{it} + \beta_2 S_{it} + \beta_3 H_{it} + \mu_{it} \qquad (9)$$

being N, S and H the components of the GM index which allow to identify the impact of the number of players, the distribution of played time among them and the heterogeneity of the rolls played by players.

The results of the estimations are shown in Table3.4. In all cases the signs of the independent variables are identical, and although all the components are significant, the significance levels of the coefficients are slightly lower in the Probit model, especially for the heterogeneity variable. The probability of playing the play-off stage decreases with the number of players while it increases with the heterogeneity and with the distribution of time played. Despite the S coefficient having a negative sign it should be taken into account that the nature of the variable is negative by construction, having therefore a positive impact over the probability.

In the last row of the Table 3.4, the accuracy of logit and probit models in the approximation to the observed data is introduced. The ability of the model to predict is almost 69%, that is, about 69 of each 100 teams qualifies according to models forecasts taking 0.5 as a reference point, which makes them significantly reliable.

The interpretation of the estimated coefficients is complicated because they do not refer directly to the partial endogenous variance. Table 3.5 shows the elasticity of each GM component with regard to the probability of playing the playoffs. In other words, the variation on average of the probability of being one of the eight best teams when one of the explanatory variables increases in 1%.

The direction of the impact is similar to those specified in the estimation process; being observed that the most influential component is the number of players. That is, the probability of playing playoffs decreases in about 9,4% when the number of players of the team increases in 1%. On the other hand, when the heterogeneity increases in 1%, the possibilities of playoff also increase in 1,26% according to the logit estimation. This outcome lead us to state that specifying the roles into the team and designing strategies where the most qualified players for each task perform them as a first option, help to achieve the aim of ranking among the first eight teams contenders to the championship.

Given the features of the competition system during the regular season, where not all the teams interact with the same intensity, it is always advisable to carry out the analyse for each conference separately in order to prove the existence of big differences in the behaviour of the components[15]. Considering the theory it seems that the logit model works better when it comes to conference terms, but the most remarkable point is some components are not significant and those whose impact are contrary to the forecasts of the hypothesis are not significant, which gives more relevance to the initial analysis with a complete sample, given that the conferences are partial.

[15]See appendix [Tables 3.A3, 3.A4, 3. A5, 3.A6]

TABLE 3.4. Probit and Logit estimations (dependent variable: playoff=1 if team qualifies among the 8 firsts, playoff=0 otherwise)

VARIABLE	STANDARD PROBIT	STANDARD LOGIT	ORDERED PROBIT
Intercept	17.735(8.671)**	29.871(14.411)**	
	(8.671)		
N	-48.038(18.137)***	-80.947(30.240)***	-53.11(16.03)***
	(18.137)		
S	-61.829(19.546)***	-101.701(32.454)***	-49.21(16.77)***
	(19.546)		
H	22.712(11.667)*	39.720(19.547)**	29.84(10.24)***
	(11.667)		
Nº obs	522	522	522
Log-Likelihood	-320.42404	-319.994	-511.242
p-value	0	0	0
Pseudo R2	0.109	0.1102	0.0824
Correctly Class	68.58%	68.77%	-

Standard errors are in parenthesis.
* Significance at the 10% level.** Significance at the 5% level.
*** Significance at the 1% level.

TABLE 3.5. Elasticity of each GM component

	Average Probability Variation		
	Probit Model	**Logit Model**	**Ordered Probit**
N	-9,4	-9,3	11.6
S	1.78	1,76	-1.73
H	1.19	1,26	-1.88

3.4.2. ANALYSIS IN TERMS OF EFFICIENCY

As a second via of analysis this paper proposes to check how the GM components affect the efficiency of the teams during the development of the games. In order to accomplish this task the first step is to obtain the efficiency index by considering a DEA model where every basketball team is a technical unit producing output from a combination of inputs, letting the productive process in basketball be specified as follows:

$$Y_i = f(X_i), \quad i = 1,2,\ldots,n, \qquad (10)$$

Where Y_i is the team $i$output, in our case the number of total wins, and X_i is our vector of inputs, that is, the tools used by a team during the game for scoring more points and winning the game. In the case of basketball we consider a variable called "pace" or which is the same, number of possessions played by the team during all the games, being each possession one opportunity for the team to score a basket.

The efficiency index is obtained using deterministic frontiers, which assess the efficiency with regard to the best observations of the sample corresponded to optimization process. Our variable is constructed by solving the following linear programming problem:

$$Min\ \phi_i^t\ (y_i^t, x_i^t) \quad (11)$$

$$s.t$$

$$\lambda X_t \leq \phi x_i^t \quad i = 1, \ldots, m$$

$$\lambda Y_t \geq y_i^t$$

$$\lambda \geq 0$$

whereϕ is the efficiency level for the team under analysis in period *t* taking into account the optimum weights, so that when ϕ=1 the analysed firm is on the isoquant and it is so efficient that it results impossible to achieve a bigger quantity of output given the inputs. The summary of the obtained efficiency indexes is shown in Table 3.A1 of the appendix.

Once constructed the dependent variable it is addressed the problem of measuring how the GM components affect the efficiency level in order to draw conclusions about the optimal design of the team. The hypothesis to be tested would be:

H1: the more players used to achieve results comparing to others teams, the lower the efficiency level.

Since the rules of basketball allow making changes between players as many times as the coach considers there is no influence of the physical fatigue. Therefore it could be expected that the returns increase with the asymmetry in distribution of the time played, in such a way that the minute shares of the best players of the team would be largest.

H2: The more asymmetrical is the distribution of the time played in favour of the starters, the biggest the contribution to the efficiency of the team.

H3: the heterogeneity during the development of the most relevant tasks of a basketball game has a significant impact over the efficiency of the team.

In order to check the formulated hypotheses it is estimated the following model:

$$Efficiency = \beta_0 + \beta_1 N_{it} + \beta_2 S_{it} + \beta_3 H_{it} + \mu_{it} \qquad (12)$$

In order to obtain an unbiased estimation of the causal effect, we need to check that the coefficient of the variable of interest does not suffer from omitted variable bias as well as the existence of spurious correlation. To that aim we include a set of control variables in the regression, which are supposed to affect the dependent variable since are correlated with omitted causal factors, in this case the experience level of the team. The more experienced is the team, the more efficient is supposed to be. In NBA basketball there two variables that keep a direct correlation with the experience: the number of Rockies, that is, players disputing their two first seasons in the league, and the number of all stars. The all stars are those players chosen as the most determining players of the league by the fans and coaches at the end of the first part of the season, considering their performances until that moment of the competition[16]. The number of Rockies is expected to have a negative impact on the efficiency level due to their lack of experience, while the number of all stars is expected to help the team to obtain better efficiency results. Taking all this information into account, the model estimated would be:

$$Efficiency = \beta_0 + \beta_1 N_{it} + \beta_2 S_{it} + \beta_3 H_{it} + \beta_4\ Allstar + \beta_5\, Rockies + \mu_{it} \qquad (13)$$

[16]We have built a database where an all star is qualified as all-star at least for 3 seasons more. Even if the player is not selected again in the following season, it is consistent to consider him as a high-qualified player in the context of the league.

TABLE 3.6. Dependent variable: Efficiency. Panel estimation results

VARIABLE	COEFFICIENT	P> [t]
Intercept	5.339*** (1.236)	0.000
N	-11.957*** (2.579)	0.000
S	-8.296*** (2.638)	0.002
H	5.876*** (1.599)	0.000
R2	0.225	
Nº of obs	522	
wald test (p-level)	0.000	

Standard errors are in parenthesis.
* Significance at the 10% level.** Significance at the 5% level.
*** Significance at the 1% level.

The results are reproduced in Table 3.6 and 3.7 respectively. For both equations 12 and 13, the sample is a balanced panel that includes 522 observations, therefore the estimation tool is a panel data specification and its corresponding techniques, such as the Breus-Pagan test suggests [17] . Additionally, considering that the extension of our study is the NBA league and all the teams that have taken part of the competition along the sample are included, we estimate a model of fixed effects, according to the results suggested by the Hausman test[18]. However, given the features of the

[17] The output of the test (Prob> chi2 = 0.0393< 0.05) implies the rejection of the null hypothesis and therefore the variance is different from 0.
[18] P-value of the Hausman test is 0.0002 and 0.0003 for equations 12 and 13, in such a way that we reject Ho: difference in coefficients not systematic. See appendix on further detail. [Tables 3.A7 and 3.A8]

TABLE 3.7. Panel estimation results with control variables. Dependent variable: efficiency

Variable	Coefficient	P> [t]
Intercept	4.07*** (1.080)	0.000
N	-8.6888*** (2.269)	0.000
S	-7.685*** (2.256)	0.002
H	2.636*** (1.387)	0.000
All-Star	0.05*** (0.005)	0.000
Rockie	-0.025*** (0.004)	0.000
R2	0.4364	
Nº of obs	522	
Wald Test (p-level)	0.000	

Standard errors are in parenthesis.
* Significance at the 10% level.** Significance at the 5% level.
*** Significance at the 1% level.

competition system during the regular season, where not all the teams interact with the same intensity, it is always advisable to analyse each conference separately in order to prove the existence of big differences in the behaviour of the components[19].

Consider the output of the estimation. The R^2 is equal to 0.225 for the first equation, which suggests as expected, that the model need more independent variables to explain strongly the efficiency of the teams. This coefficient improves remarkably in the second estimation (0.4364) by including variables of experience in the model, certifying the consistency of the results obtained over the rest of target variables. In both equations all the parameters are strongly statistically significant, which verifies the three hypotheses. On the

[19]See appendix [Tables 3.A9, 3.A10, 13.A11 and 3.A12]

one hand the number of players has a negative impact over the efficiency, bigger amount of inputs consumed, because an increase of the number of players meets injuries or bad performances of the teams. Contrary, the asymmetry in the minutes performed by all the players has a positive effect, which means that it is more advisable, in terms of efficiency, to shape a team with highly specialized players who play the biggest proportion of minutes and develop the most part of the task required to achieve a win. Finally, we also observe that the efficiency has a positive correlation with the level of heterogeneity of the team, which means that the performance of those teams made up of players specialized and focused in perform one task is more efficient, in sporting terms, than the teams where there are a set of players executing more tasks but with a lower level of specialization.

3.5. CONCLUSION

The study has proven the possibilities provided by the application of complex analytical techniques to professional sports. The relationship between product diversification and performance applied to the case of basketball teams has been the main subject of this paper, which is one of the topics more discussed in basketball environments.

On the basis of diversification tools and strategic analysis, this study has introduced the use of Gollop and Monahan Index together with different regression techniques in order to detect the impact of the heterogeneity of the teams over the sporting performance, applied to the NBA case throughout 18 seasons. The reference variables, corresponding to the GM components, are based on the number of players, the distribution of minutes played by each one of them and the actions performed on the court.

Our findings indicate that all the components are statistically significant when it comes to explain both, the probability of playing the play-off stage as well as the efficiency, which allows us to study in detail the advisable features of the NBA teams in terms of configuration and design, taking into account the institutional objective of each season.

The research concludes that the teams with very high diversification show a better performance. The number of members of the team has a negative impact over the sporting performance but considering the database it is observed that the biggest differences in this variable are due to injuries substitutions or transfers result of unexpected bad outcomes during the season. Therefore we do not consider it determinant when the team is designed, contrary to the asymmetric distribution of the minutes among players and the heterogeneity of the features of themselves. The former has a positive impact, which leads us to the conclusion that it is more efficient the design of a team where the starters play the biggest part of the game instead of looking for a balance between line-ups and reserves. The latter has also a positive effect, which means that the coaches and general managers might design a team with players specialized in particular tasks, practicing a playbook where the movements of all players are studied in order to achieve that the most qualifier player for each action is the one who performs it.

However, in the last seasons it might be possible a change of trend in the configuration of the team since the most successful outcomes have been achieved by teams with a large number of players capable of doing many different tasks and with a remarkable importance in the team. For this reason it is proposed a further research including breakpoints to check this possible change in the league.

APPENDIX
COMPLEMENTARY TABLES

TABLE 3.A1. Descriptive statistics of the variables used to calculate the GM index

VARIABLE	MEAN	STD.DEV.	MIN	MAX
PLAYERS	14.96551724	1.836597094	10	24
SI	0.066746676	0.046625313	0.001301125	0.19265575
Wij	0.033385666	0.028188235	0.00026	0.12245
σ	0.167415227	0.081445936	0.01624	0.34993
FGM(1)	191.4598828	169.2220251	2	978
FGA (2)	424.0491594	363.4999499	8	2173
3PM(3)	30.86283749	43.56051762	0	272
3PA(4)	86.66250637	114.9197522	0	653
FTM(5)	97.73127866	105.8491445	0	756
FTA(6)	129.8790117	135.1833021	0	972
OREB(7)	61.43530311	61.63168561	0	443
DREB(8)	158.5872389	138.4925324	2	894
AST(9)	113.2366276	130.9485983	0	925
STL(10)	40.32475802	34.61140403	0	225
BLK(11)	25.94740194	35.17012763	0	294
FAULTS(12)	112.6591951	71.96374815	3	371

(1) Field Goals made: this includes 2 pointers and 3 pointers successfully made
(2) Field Goals attempted. This includes 2 pointers and 3 pointers
(3) 3points field goals made
(4) 3point field goals attempted
(5) Free throws made
(6) Free throws attempted
(7) Offensive rebounds: the number of rebounds collected while they were on offense
(8) Defensive rebounds:: the number of rebounds collected while they were on defense.

(9) Assists: occurs when a player completes a pass to a teammate that directly leads to a made field goal.
(10) Steals: occurs when a defensive player takes the ball from a player on offense, causing a turnover.
(11) Blocks: occurs when a offensive player attempts a shot and the defense player tips the ball, blocking their chance to score.
(12) Personal faults committed

TABLE 3.A2. Descriptive statistics of the efficiency index by seasons

Season	obs	Mean	Std.Dev	Min	Max
1996-97	29	0.6077	0.2327	0.205	1
1997-98	29	0.6399	0.2495	0.177	1
1998-99	29	0.6053	0.2132	0.194	1
1999-00	29	0.5977	0.2015	0.224	1
2000-01	29	0.68	0.2198	0.259	1
2001-02	29	0.7008	0.1899	0.345	1
2002-03	29	0.6659	0.1941	0.271	1
2003-04	29	0.673	0.189	0.353	1
2004-05	29	0.7002	0.1987	0.214	1
2005-06	29	0.6249	0.1704	0.327	1
2006-07	29	0.617	0.16	0.311	1
2007-08	29	6363	0.2106	0.228	1
2008-09	29	0.6189	0.2157	0.241	1
2009-10	29	0.6633	0.2215	0.197	1
2010-11	29	0.6665	0.2174	0.258	1
2011-12	29	0.653	0.1804	0.388	1
2012-13	29	0.6176	0.1854	0.3	1
2013-14	29	0.6104	0.1937	0.263	1

TABLE 3.A3. Dichotomous model estimation results. Dependent variable: probability of playoff. EAST CONFERENCE

Variable	Standard Probit	Standard Logit	Panel Fixed Effects
Intercept	5.195(12.421)	9.291(20.60)	3.27(1.77)*
N	-19.514(25.852)	-33.89(42.96)	-7.34(3.69)**
S	-95.073(26.97)***	-155.96(45.23)***	-10.76(3.7)***
H	-4.921(15.78)	-6.75(26.48)	3.35(2.16)
Nºobs	270	270	270
Log-Likelihood	-166.692	-166.54	
F	-	-	20.01
p-value	0	0	0
Pseudo R2	0.1064	0.1072	0.169
Correctly Class	68.15%	68.52%	-

Standard error are in parenthesis

*Denotes significance at 10%**Denotes significance at 5%***Denotes significance at 10%

TABLE 3.A4. Elasticity of East Conference

	Average Probability Variation	
	Probit Model	***Logit Model***
N	-5.6	-5.8
S	2.73	2.7
H	-0.27	-0.22

TABLE 3.A5. Dichotomous model estimation results. Dependent variable: probability of playoff. WEST CONFERENCE

Variable	Standard Probit	Standard Logit	Panel Fixed Effects
Intercept	31.66(12.40)	52.97(20.83)*	6.32(1.73)***
N	-80.65(26.19)***	-134.70(44.21)***	-14.28(3.63)***
S	-27.07(28.84)	-45.47(48.08)	-6.075(3.89)
H	57.26(17.82)***	-94.42(29.72)***	8.51(2.41)***
Nºobs	252	252	252
Log-Likelihood	-149.91	-149.85	
F	-	-	24.74
p-value	0	0	0
Pseudo R2	0.1329	0.1332	0.225
Correctly Class	70.63%	70.24%	-

Standard error are in parenthesis
*Denotes significance at 10%
**Denotes significance at 5%
***Denotes significance at 10%

Table 3.A6. Elasticity of Western Conference

	Average Probability Variation	
	Probit Model	***Logit Model***
N	-9.98	-9.92
S	0.75	0.76
H	2.7	2.65

TABLE 3.A7. Hausman Test for equation 12

	CCOEFFICIENTS		
	Fixed Effects	Random Effects	Difference
N	-11.95757	-10.22262	-1.734948
S	-8.296322	-7.485231	-0.8110907
H	5.876821	5.702824	0.1739963

Fixed effect coefficient = consistent under Ho and Ha; obtained from xtreg
Random effect coefficient= inconsistent under Ha, efficient under Ho; obtained from xtreg

Ho: difference in coefficients not systematic

chi 2 = 19.37
Prob> chi2 = 0.0002

TABLE 3.A8. Hausman Test for equation 13

	CCOEFFICIENTS		
	Fixed Effects	Random Effects	Difference
N	-6.688899	-6.850484	-1.838416
S	-7.685655	-6.733711	-0.9519433
H	2.636276	2.423128	0.2131483
All Star	0.0505223	0.0502773	0.000245
Rockie	-0.0253817	-0.0261165	0.0007347

Fixed effect coefficient = consistent under Ho and Ha; obtained from xtreg
Random effect coefficient= inconsistent under Ha, efficient under Ho; obtained from xtreg

Ho: difference in coefficients not systematic
chi 2 = 22.97
Prob> chi2 = 0.0003

TABLE 3.A9. Panel estimation results. Dependent variable: efficiency. EAST CONFERENCE

Variable	FIXED EFFECTS	RANDOM EFFECTS
Intercept	3.270121**	2.725956*
	(1.775)	(1.655)
N	-7.341491**	-5.998886*
	(3.690)	(3.444)
S	-10.76463***	-9.016249***
	(3.701)	(3.495)
H	3.357251	3.3432
	(2.167)	(2.114)
R2	0.1952	0.1955
Nº of obs	270	270
wald test (p-level)	0.000	0
Hausman Test (p-level)	0.1953	

Standard error are in parenthesis
* Significance at the 10% level.** Significance at the 5% level.
*** Significance at the 1% level.
Test hausman Ho: difference in coefficients not systematic

TABLE 3.A10. Panel estimation results with control variables. Dependent variable: efficiency. EAST CONFERENCE

Variable	FIXED EFFECTS	RANDOM EFFECTS
Intercept	2.46411 (1.626)	1.858605* (1.517)
N	-5.080318 (3.409)	-3.602328 (3.148)
S	-9.395306*** (3.335)	-7.705862** (3.144)
H	0.9246206 (1.975)	0.9217901 (1.922)
All Star	0.0371517*** (0.007)	0.0368308*** (0.007)
Rockie	-0.0238645*** (1.626)	-0.0251686*** (0.005)
R2	0.4057	0.4074
Nº of obs	270	270
wald test (p-level)	0.000	0.000
Hausman Test (p-level)	0.1953	

Standard error are in parenthesis
* Significance at the 10% level.** Significance at the 5% level.
*** Significance at the 1% level.
Test hausman Ho: difference in coefficients not systematic

TABLE 3.A11. Panel estimation results. Dependent variable: efficiency. WEST CONFERENCE

Variable	FIXED EFFECTS	RANDOM EFFECTS
Intercept	7.026382*** (31.803)	6.321096*** (1.738)
N	-15.79383*** (3.780)	-514.28768**** (3.639)
S	-5.665544 (3.960)	-6.075265 (3.892)
H	8.699817*** (2.432)	8.513272*** (2.411)
R2	0.2258	0.2264
Nº of obs	252	252
wald test (p-level)	0.000	0.000
Hausman Test (p-level)	0.526	

Standard error are in parenthesis
* Significance at the 10% level.** Significance at the 5% level.
*** Significance at the 1% level.
Test hausman Ho: difference in coefficients not systematic

TABLE 3.A12. Panel estimation results with control variables. Dependent variable: efficiency. WEST CONFERENCE

Variable	FIXED EFFECTS	RANDOM EFFECTS
Intercept	4.706707*** (1.446)	4.408735*** (1.406)
N	-10.15314*** (3.047)	-9.505886*** (2.960)
S	-6.166955** (3.116)	-6.203599** (3.067)
H	3.894276** (1.947)	3.87355** (1.925)
All Star	0.0667338*** (0.005)	0.0661441*** (0.007)
Rockie	-0.280342*** (1.0.005)	-0.0286298*** (0.055)
R2	0.5065	0.5069
Nº of obs	252	252
wald test (p-level)	0.000	0.000
Hausman Test (p-level)	0.9431	

Standard error are in parenthesis
* Significance at the 10% level.** Significance at the 5% level.
*** Significance at the 1% level.
Test hausman Ho: difference in coefficients not systematic

REFERENCES

Aigner, D. et al. (1977). Formulation and Estimation of Stochastic Frontier Production Function models.*Journal of econometrics, 6, 21-37.*

Andreff W. and Rabanfald G. (2009) 'Is European Football Future to Become a Bothering Game? About Clubs' Loss MinimisingObjective'.*First European Conference in Sports Economics*, Paris, September, 2009.

Ansoff, H.I. (1957) Strategies for Diversification.*Harvard Business Review.*Vol35(5), pp. 113–124

Aslan A. (2008) 'Testing Gibrat's Law: Empirical Evidence From Panel Unit Root Tests Of Turkish Firms', *MPRA (Munich Personal RePEc Archive) Paper No. 10594.*

Attanasio, O.P., Picci, L., Scorcu, A.E., (2000). 'Saving, growth, and investment: a macroeconomic analysis using a panel of countries'. *Review of Economics and Statistics 82, 182–211.*

Ben-Akiva, M., Lerman, S., (1985). Discrete Choice Analysis: Theory and Application to Travel Demand. MIT Press, Cambridge, MA.

Berger, P.G., Ofek, E. (1995) Diversification's Effect on Firm Value. *Journal of Financial Economics.* Vol. 37(1), pp. 39–65

Berri, D.J. (1999). Who is Most Valuable? Measuring the Player´s Production of Wins in the national basketball Association. *Managerial and Decision Economics, 20:411-427.*

Berry, C.H., (1971). Corporate Growth and Diversification. *Journal of Law and Economics* vol. 14, pp. 371-383.

Boon, B.H. and Sierksma, G. (2003). Team formation: Matching quality supply and quality demand. *European Journal of Operational Research* , vol.148, nº2, pp. 277-292.

Boone, J. (2008) "A new way to measure competition." *The Economic Journal 118* (August)

Boscá, J.E., Liern, V., Martínez, A. &Sala, R. (2006). Increasing Offensive or Defensive Efficiency? An Analysis of Italian and Spanish Football.*Omega, doi:10.1016/j.omega.2006.08.002*

Brandes, L, Frank, E.(2007) Who Made Who? An Empirical Analysis Of Competitive Balance In European Soccer Leagues.*Eastern Economic Journal,* Vol. 33, No. 3, Summer 2007.

Buzzell, R.D. (1981) 'Are there "Natural" Market Structures?',*Journal of Marketing* vol. 45.

Cabral (2000) *Economía Industrial.*MacGraw Hill

Cairns, J., Jennett, N., & Sloane, P.J. (1986). The Economics of Professional Team Sports: a survey of theory and evidence. *Journal of economic Studies, 13, 3-80.*

Cameron and Trivedi (2005) ' Methods and Applications'. *Cambridge University Press*

Carmichael, F., Thomas, D. and Ward, R. (2001). Production and Efficiency in Association Football. *Journal of Sports economics*2001 vol. 2, pp.228-243.

Chandler, A.D. (1962). Strategy and Structure: Chapters in the History of the American Industrial Enterprise. *MIT Press, Cambridge, MA*

Coelli, T., et al. (1998).An introduction to efficiency and productivity Analysis. Norwell, *MA: Kluwer Academic Publishers.*

Deaton, A.(1997). Analysis of Household Surveys. Baltimore MD: Johns Hopkins University Press.

Dobson, S. And Goddard, J. (2001).' Revenue Convergence In the English Soccer League'.*Journal of Sports Economics, 2001 2-257*

Dobson, S. and Goddard, J. (2003). Persistence in sequences of football match results: A Monte Carlo analysis. *European Journal of Operational Research* , vol. 148, nº2, pp. 247-256.

Espitia-Escuer, M. &García-Cebrián, I. (2004).Measuring the Eficiency of Spanish First- Division Soccer Teams. *Journal of Sports Economics 2004 5:329-346.*

Espitia-Escuer, M. &García-Cebrián, I. (2008).Measuring the productivity of Spanish First Division Soccer Teams. *European Sport Management QQuarterly, 8:3, 229-246.*

El-Hodiri, M., and Quirk, J. (1971). An economic model of a professional sports League. *Journal of Political Economy,* vol. 79(6),pp. 1302-1319.

Engle, R.F. and Granger, C.W.J. (1987). 'Co-integration and Error Correction: *Representation, Estimation and Testing'.* Econometrica, 1987, 251 – 276.

Esteban-García, J. &Coll-Serrano, V. (2003).Competitividad y eficiencia.*Estudios de economía Aplicada, Vol.21-3, 2003, 423-450.*

Fandel, G. (1991).Theory of production and cost.*Berline: Springer-Verlag.*

Farrell, M.J. (1957). The measurement of productive Efficiency.*Journal of the Royal Statistical Society, 120, 253-281.*

Fort, R., & Quirk, J. (1995). 'Cross-subsidization, incentives, and outcomes in profesional team sports leagues'. *Journal of Economic Literature, 33(3), 1265-1299.*

Garcia, J., & Rodriguez, P. (2002). "The determinants of football match attendance revisited: Empirical evidence from the Spanish Football League". *Journal of Sports Economics, 3, 18-38.*

Gollop, F. M. and Monahan, J.L. (1991). A generalized index of diversification: Trends in U.S. Manufacturing. *The Review of Economics and Statistics* , vol. 73, nº 2, pp. 318-330.

Gort, M. (1962). Diversification and Integration in American Industry.*Princeton Princeton Univ. Press.*

Graham, J. R., Lemmon, M., and Wolf, J., (2002). Does Corporate Diversification Destroy Value?.*Journal of Finance* 57

Granger, C. (1969). "Investigating causal relations by econometric models and cross-spectral methods".*Econometrica, 37, 424-438.*

Guzmán, I. (2006). Measuring Efficiency and Sustainable Growth in Spanish Football teams. *European Sport Management Quarterly, 6, 267-287.*

Hall, S., Szymanski, S. and Zimbalist, A.S., (2002). "Testing Causality Between Team Performance and Payroll– The Cases of Major League Baseball and English Soccer". *Journal of Sports Economics, May 2002, 149–168.*

Hsiao, F.S.T., Hsiao, M.-C.W., (2006). 'FDI, exports, and GDP in East and Southeast Asia – Panel data versus time-series causality analyses'.*Journal of Asian Economics 17, 1082–1106.*

Hofler, R.A., & Payne, J.E. (1997). Measuring Efficiency in the National Basketball Association. *Economic Letters, 55, 296-299.*

Hofler, R.A., & Payne, J.E. (2006). Efficiency in the National Basketball Association: A Stochastic Frontier Approach with Panel Data. *Managerial and Decision Economics, 27:279-285.*

Hoskisson R., Hitt, M. A., Johnson, R. A., Moesel Douglas, D. (1993). Construct validity of an objective (entropy) categorical measure of diversification strategy. *Strategic Management Jour*nal, vol. 4, nº 3.

Jacquemine a. & berry Ch. (1979), "Entropy measurement of Diversification and Corporate Growth." The Journal of Industrial Ecomnomicsvol. 27, pp. 359-369 .

Ijiri Y. and Simon H. (1971), 'Effects of Mergers and Adquisitions on Business Firm Concentration', *Journal of Political Economy*, 79.

Késenne, S. (2000).'Revenue sharing and competitive balance in professional sports'.*Journalof Sports Economics, 1(1), 56-65.*

Laaksonen-Craig, S., (2004). 'Foreign direct investment in the forest sector: implications for sustainable forest management in developed and developing countries'. *ForestPolicy and Economics 6, 359–370.*

Lafuente A. and Salas V. (1983) 'Concentración y Resultados de las Empresas de la Economía Española' *Cuadernos Económicos del ICE* nº 22-23.

McFadden, D., 1974.The measurement of urban demand.*Journal of Public Economics*vol. 3, pp. 303–328.

McFadden, D., 1981.Econometric models of probabilistic choice. In: Manski, C., McFadden, D. (Eds.), Structural Analysis of Discrete Data with Econometric Applications. MIT Press, Cambridge, MA, pp. 13–29.

Markides, C. C. and Williamson, P. J., (1994). Related diversification, core competences and corporate performance.*Strategic Management Journal*, vol. 15.

Michie J. and Oughton C. (2004) 'Competitive Balance In Football: Trends And Effects.',*The Sport Nexus*.

Moschini, G.C. (2004). Nash equilibrium in strictly competitive games: live play in soccer. *Economics Letters* , vol. 85, nº 3, pp. 365-371.

Nair-Reichert, U., Weinhold, D., (2001). 'Causality tests for cross-country panels: a new look at FDI and economic growth in developing countries'. *Oxford Bulletin of Economics and Statistics 63, 153–171.*

Neale, W.C. (1964). The peculiar economics of professional Sports. A contribution to the Theory of the Firm in Sporting Competition and in market Competition. *The Quarterly Journal of Eeconomics, LXXVIII, 1-14.*

Owen, P.D., Ryan, M. and Weatherston R. (2006) 'Measuring Competitive Balance in Profesional Teams Sports Using the Herfindahl Hirschman Index' *University of Ontago, Ec. D.P. nº 0602.*

Palacios-Huerta I. (2004) 'Structural changes during a century of the world's most popular sport', *Statistical Methods & Applications*, 13: 241–258.

Pehrsson, A. (2006). Business relatedness measurements: State-of-the-art and a proposal. *European Business Review* . Vol. 18, n. 5, pg. 350 – 363

Piergiovanni, R., Santarelli, E., Klomp, L., Turik, A.R., (2002) 'Gibrat's Law and the Firm Size/Firm Growth Relationship in Italian Services' Tinbergen Institute Dicussion Paper TI-2002-080/3.

Podrecca, E., Carmeci, G., (2001). 'Fixed investment and economic growth: new results on causality'. *Applied Economics 33, 177–182.*

Pomfret, Richard, and Shapiro, D., (1980). Firm Size, Diversifi-cation, and Profitability of Large Corporations in Canada. *Journal of Economic Studies. Vol.* 7 , pp. 140-150

Quirk, J.,&Fort, R. D. (1992). 'Pay dirt: The business of professional team sports'. *Princeton, NJ: Princeton University Press.*

Rajan, R., Servaes, H., Zingales, L., (2000). The Cost of Diversity: The Diversification Discount and Inefficient Investment. *Journal of Finance vol 55*

Rascher, D. A. (2002).'Competitive balance on the field and in the courts'.*For the Record, 13(2), 3-6.*

Rottenberg S., (1956) The Baseball Player's Labor Market, *Journal of Political Economy*, Vol. 64, No. 3, pp 242-258.

Sanderson, A. R. (2002). 'The many dimensions of competitive balance'. *Journal of Sports Economics, 3(2), 204-228*

Schmidt, M. B. (2001). 'Competition in Major League Baseball: The impact of expansion'. Applied Economic Letters, 8, 21-26.

Schmidt, M. B., &Berri, D. J. (2001). 'Competitive balance and attendance: The case of Major League Baseball'. *Journal of Sports Economics, 2(2), 145-167.*

Simon, H.A., and Bonini, C.P. (1958). 'The size distribution of business firms'.*American Economic Review*, 48, 607-617.

Sloane, P. J. (1971). The economics of professional football: The football club as a utility maximize. *Scottish Journal of Political Economy, 17, 121-146.*

Sloane, P.J. (2006) 'Rottenberg and the Economics of Sport After 50 Years: An Evaluation.' *The Institute for the Study of Labor. Discussion Paper No. 217*

Szymanski, S. (2003). 'The Economic Design of Sporting Contests: A Review'. The Journal of Economic Literature, 1137–1187.

Train, K., (1986).Qualitative Choice Analysis.*MIT Press, Cambridge, MA.*

Troutt, M. D., Acar, M. (2005). A Lorenz–Pareto measure of pure diversification. *European Journal of Operational Research*, vol 167, nº 2

Utt, J. and Fort, R. (2002) 'Pitfalls To Measuring Competitive Balance With Gini Coefficients' *Journal Of Sports Economics*, Vol. 3 No. 4, November 367–373.

Vrooman, J. (1995).'Ageneral theory of professional sports leagues'. *Southern Economic Journal, 61(4), 971-99*

Zak, T.A., Huang, C.J., & Siegfried, J.J. (1979). Production Efficiency: the case of professional Basketball. *Journal of Business, 52, 379-392.*

Zech,C.E. (1981). An empirical estimation of a production function: The case of Major League Baseball. *American Economist, 25, 19-23*.

Zimbalist, A.S. (2002). 'Competitive Balance In Sports Leagues: An Introduction'. *Journal of Sports Economics 2002 3-111*