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The gold rush: Analysis of the performance of the Spanish Olympic federations

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Abstract: *Research question*: This study assesses the performance of the Spanish Sports Federations in the Olympic Games of Beijing 2008 and London 2012 from the point of view of their efficiency in the use of the available resources. The research aims to identify the possible existence of a behaviour pattern in the performance of these sports federations and, particularly, the influence of the different funding sources on the results. *Research methods*: The measurement of the relative efficiency of the 22 federations that participated in both editions is carried out by applying the Data Envelopment Analysis methodology. The Malmquist index is used to analyse the evolution of the efficiency and, a persistence study, to evaluate the consistency of the results. Finally, correlations are estimated to verify the possible links between the efficiency of the federations and their funding sources. *Results and findings*: The study captures the relative efficiency of the federations in the sample, a deceleration in the performance being observed between Beijing 2008 and London 2012. It finds little relation between the relative efficiency of the federations and their different funding sources. *Implications*: This study may be especially relevant in a context where an important amount of public resources is earmarked for elite sports, without clarifying the "value for money" of such investments. It hopes to contribute to the existing literature with regard to the measurement of efficiency in sports through the introduction of indicators which can capture the performance of sports federations more precisely.

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PUBLIC INTEREST STATEMENT

The Olympic Games are probably the most popular sporting event in the world. States allocate a great amount of public resources to sports federations to prepare athletes who take part in this competition, and citizens are interested in knowing the value for money of this investment. However, the measurement of high-level sport performance is very complex due to the diversity of the factors that determine sporting success. This paper creates a more sophisticated tool to evaluate the relative efficiency of Spanish Olympic federations in the Olympic Games (OG) of Beijing 2008 and London 2012. The results show a slight decrease in the efficiency of the Spanish Olympic team between the two Games. During this period, the Spanish federations received an increase in private revenues that compensated for the decrease in public funds, so these results contradict the belief that private funding leads to higher efficiency than public funding.

Subjects: Sports Management; Finance in Sport; Economics, Finance, Business & Industry; Public & Nonprofit Management

Keywords: Data Envelopment Analysis (DEA); efficiency; performance; sport federations; Olympic Games; sport funding

1. Introduction

Although sports economics literature agrees on the large economic and social impact of major sport events, there is no consensus about the convenience or value for money of public spending in these events (Crompton, 1995; Gratton, Shibli, & Coleman, 2006; Preuss, 2004). States allocate public resources to this sector through sports federations, and they have to invest them in the most efficient way to promote and develop their sports, as well as to prepare the athletes who take part in competitions. The Olympic Games (OG) are considered one of the most important competitions of the sporting world because their participants come from almost every country.

The Spanish sports system is articulated within a public structure whose governing body is the Supreme Council for Sports (*Consejo Superior de Deportes* or CSD) and a private structure whose governing body is the Spanish Olympic Committee (*Comité Olímpico Español* or COE) (CSD, http://www.csd.gob.es/).

Sports federations[1], along with the Autonomous Communities, are responsible for the development of high-level and high-performance sports. High-level sports are considered a matter of State interest (article 6 of the Sports Law 10/1990) and the State gives an important amount of public resources to an elite that represents a small section of the sports' universe. It has no guarantee of a return on this investment in terms of results, be it from a sporting, economic, or social point of view. Therefore, it is necessary to set limits to the aforementioned support and assess the use of these resources because they are required in other fields.

The object of this study is to analyse the efficiency of the Spanish sports federations in their participation in the OG of Beijing 2008 and London 2012. Efficiency can be defined as the relationship between the outputs achieved and the inputs consumed in the process (Intervención General de la Administración del Estado –IGAE, 1997). In this case, the efficiency of the federations will be determined by the scores achieved in both OG editions in comparison to the resources available to each. The periods of preparation of these Games (2005 to 2008 and 2009 to 2012) took place before and during the global financial crisis, so the country was in very different scenarios. This allows us to analyse the impact of the crisis on Spanish Olympic sport from the point of view of the results, as well as from the point of view of the funds received. To do so, we will identify the variables of inputs and outputs that describe the resources available and the results obtained with them. We will also analyse the different funding sources of the sports federations to determine the existence of a possible relationship between the relative efficiency of the federations and the way they are financed. We need to be aware of the fact that the study will provide a relative measurement of the efficiency within the sample. Therefore, the results will not imply that federations achieving the efficiency level are acting to the best of their abilities. Furthermore, it does not take into account the effect caused by federations whose teams did not qualify for one of the two OG.

The study is divided into the following sections. Section 2 provides the background and the literature related to the topics of efficiency and sports. Section 3 develops the methodology to be applied. Section 4 presents the results of the work, which are debated and commented on in Section 5. Finally, Section 6 contains the conclusions and describes future developments.

2. Background

2.1. Efficiency in Olympic Sports

Efficiency studies applied to the field of sports constitute a wide literature that can be classified into two main blocks, one focused on international multi-sports events and the other on case studies of specific sports. The present study belongs to the first block. The classification of the OG participant countries is usually based on the multi-criteria lexicographic method which considers, first, the total number of gold medals, followed by the silver medals and, finally, the bronze medals. So, if a country manages to win many silver and bronze medals, it will be below any country that only wins one gold medal, with the consequent bias of overestimating the latter. Furthermore, this classification does not take into account the resources consumed to achieve the results.

The efficiency studies that are focused on multi-sports events, generally the OG, look for alternatives to assess the performance of the participants. Most of them apply the Data Envelopment Analysis (DEA) or other similar non-parametric (linear programming) techniques such as the Free Disposal Hull. The crucial element in these methods is the selection of the inputs and outputs. Concerning the outputs, most of the studies have defined different systems of weightings considering exclusively the number of gold, silver and bronze medals (Lins, Gomes, Soares de Mello, & Soares de Mello, 2003; Lozano, Villa, Guerrero, & Cortés, 2002; Soares de Mello, Angulo, & Gomes, 2012; Soares de Mello, Angulo, Gonçalves, Biondi, & Gouvêia, 2004; Zhang, Li, Meng, & Liu, 2009). However, this strategy has been questioned for not being able to discriminate the results of athletes appropriately, in particular for those countries that win few medals (Santos, Angulo, & Soares de Mello, 2011). As the finalists that do not win medals obtain "diplomas", some recent studies suggest that the Olympic diplomas (4th to 8th positions) should be also considered as a relevant output in each competition (Shibli, De Bosscher, van Bottenburg, & Westerbeek, 2013, 2015). Another difficulty to evaluate performance in multi-sports events is the comparison of sports with different chances of winning a medal because of the number of participants or because of the number of competitions. (De Bosscher, 2007). For this reason, some studies take into account the proportion of medals won in each sport ("market share") instead of using absolute terms (Angulo, Pescarini, & Soares de Mello, 2015; De Bosscher, 2007).

As regards the inputs, much of the specialised literature seeks to relate the results of the elite sport systems with the human potential and the economic power of each country (Goldman Sachs, 2012). Consequently, the population and the GDP of each country are the most frequent inputs included in previous studies (Churilov & Flitman, 2006; Lins et al., 2003; Lozano et al., 2002; Wu, Liang, Wu, & Yang, 2008; Wu, Zhou, & Liang, 2010). According to De Bosscher (2007), these two variables explain more than half (53%) of the success of the nations in the OG. On the other hand, Vanegas and Vlachokyriakou (2012) point out that the traditional "population-GDP" approach is insufficient in explaining Olympic success on the basis of the number of medals won by the participating countries. Wu, Liang, and Chen (2009) introduce the GDP per capita as a more accurate indicator of the wealth of a country than the GDP expressed in absolute values. Furthermore, the greater wealth of a country does not necessarily imply a stronger investment in sports. Vanegas and Vlachokyriakou (2012) suggest that the Olympic team size is a good proxy for the investment in sports and, at the same time, a better indicator of the chances of winning a medal than any monetary indicator. For this reason, more recent studies use the number of athletes as a proxy of the investment of the country in each sport (Benicio, Bergiante, & Soares de Mello, 2013; Debnath & Malhotra, 2015; Soares de Mello et al., 2012). Finally, other authors question the link between the sports achievements of countries and their population and economic wealth. For them, public policies in the field of high-performance sports and the capacity of the government and social organizations to form an efficient system of Olympic preparation are much more important than the GDP or the population of the country (Platonov, 2011). The results of the "SPLISS" project (Sports Policy factors Leading to International Sporting Success) conducted by De Bosscher, Bingham, Shibli, van Bottenburg, and de Knop (2008) evidence the complexity of the sporting success. They compare over 100 factors that may lead to international sporting success and classify them into 9 pillars of success (De Bosscher et al., 2008) that correspond to the following 9 policy areas: (1) financial support; (2) integrated approach to policy development; (3) participation in sport; (4) talent identification and development systems; (5) athletic and post career support; (6) training facilities; (7) coaching provision and coach development; (8) international competition; and (9) scientific research. The first one (financial support) is an input variable and the rest can be considered throughputs.

2.1.1. Impact of the Financial Structure and Performance of the Sports Federations

According to Sánchez and Barajas (2009), the study of the funding of high-level sports remains almost unexplored despite the large amount of money involved and the need to evaluate the socio-economic profitability of the money spent on athletes.

Sports federations, as most nonprofit organizations, depend to a great extent on external financing provided by public and private entities (Friedrich, Helmig, & Ingerfurth, 2014). Three funding models can be identified: public, private and mixed (López-Egea, Sanchís, Sánchez, & Ortega, 2008). Spain, as well as the United Kingdom, Italy and France, has developed a mixed model in which sports federations receive funds from unconditional grants from the CSD, specific grants from the Olympic Sports Association (Asociación de Deportes Olímpicos, ADO) and revenues from private sources (licenses and sponsors). Public resources have traditionally constituted the main source of funding for non-professional sport but the trend is to increase private contributions. The diversification of the funding sources reduces the financial instability of sport federations if one of them fails and provides a greater degree of autonomy from public authorities (Lasby & Sperling, 2007; Pfeffer & Salancik, 1978). Furthermore, the recent deep financial crisis has fuelled the debate on the effectiveness of the investments in top-level sports and the role that public funding should play in their financing (Langer, 2006; Papadimitriou, 1999). There is a controversy about the convenience of focusing this funding on grassroots sports (Inglés & Seguí, 2014; Romeo-Velilla & Shibli, 2011) or on top-level sports (De Bosscher, Van Hoecke, Truyens, van Bottenburg, & De Knop, 2009). In general, with the exception of the USA, governments are willing to participate in the development and financing of top-level sports (De Bosscher et al., 2009). Sporting triumphs contribute to enhancing the image of a country and to hiding other deficiencies (Green & Houlihan, 2005).

3. Methodology

Spain has 66 sports federations, 26 belonging to the summer Olympic program. The sample is made up of the 22 Spanish Olympic federations that participated in both the Summer Games of Beijing 2008 and London 2012. The data have been obtained from the sports statistic database DEPORTEData, compiled by the Office of the Deputy Director on Statistics and Studies of the General Technical Secretariat of the Ministry of Education, Culture and Sports which is available at the CSD webpage[2].

In order to conduct an analysis of the efficiency of the resources used with respect to the results obtained by the Spanish Olympic federations in the Olympic Games of Beijing and London, Data Envelopment Analysis (DEA) has been used. The relative efficiency obtained through the DEA is compared with the weight of each funding source for each federation. Then, the Malmquist index has been used to analyse the variation in efficiency in the period studied. Finally, the performance persistence of the federations in consecutive periods is studied in order to evaluate the consistency of the results obtained and to try to identify a behavioural pattern.

3.1. Data Envelopment Analysis (DEA)

The DEA analysis is a mathematical and non-parametric technique which is used to assess the relative efficiency of a group of productive units that, using the same type of resources (inputs), generate similar products (outputs). These units are called "Decision-Making Units" (DMUs). The DEA allows the measurement of efficiency to be focused on the assessment of the inputs necessary to produce a certain level of output or the maximum output that can be obtained with the inputs used. The first approach is known as input-oriented and the second as output-oriented.

Assuming the existence of *f* DMUs that consume *m* inputs to produce *s* outputs, the mathematical approach of the DEA can be expressed through the following fractional model (Charnes, Cooper, & Rhodes, 1978):

$$\textbf{Maximize } Hz = \frac{\sum_{r=1}^{s} u_r y_{rz}}{\sum_{i=1}^{m} v_i x_{iz}}$$

which is subject to:

$$\begin{array}{ll} \frac{\sum_{r=1}^{s} u_r y_{rz}}{\sum_{i=1}^{m} v_i x_{iz}} \leq 1, & f = 1, \ldots, n \\ u_r \geq 0, & r = 0, \ldots, s \\ v_i \geq 0, & i = 0, \ldots, m \end{array}$$

where y_r = outputs obtained (r = 1, ..., s); x_i = inputs used (i = 1, ..., m); f = number of DMUs assessed (f = 1, ..., n); z = DMUs to be assessed; u_r = weight applicable to the i inputs to assess the DMU z; v_i = weight applicable to the r outputs to assess the DMU z; and $\boldsymbol{h}_z$ = coefficient of relative efficiency DMU z.

The measurement of efficiency adopted by the model relates the weighted sum of the outputs plus the inputs, $\boldsymbol{h}_z$ being the value of the efficiency ratio of the evaluated unit z. As the ratio of any DMU cannot surpass 1, a DMU will be efficient if $\boldsymbol{h}_z$ has a value of 1 and it will be inefficient if the contrary occurs. For the proposed technique to have discriminatory power, it is necessary for the total number of elements of the sample *f* to be superior to the total amount of inputs/outputs included in the model. Some authors even suggest that the total number of DMUs should be at least three times the total number of variables used (El-Mahgary & Lahdelma, 1995).

The two DEA models that are most frequently applied, from the approach of Farrell (1957), are the CCR model of Charnes et al. (1978), and the BCC model of Banker, Charnes, and Cooper (1984). The basic difference between them can be found in the returns to scale. The CCR model assumes that DMUs operate with constant returns to scale, that is to say that changes in the outputs are proportional to changes in the inputs. The BCC model assumes variable returns to scale, meaning that the change in the outputs is not necessarily proportional to the change in the inputs. We apply a model of variable returns to scale (BCC model) that compares DMUs of similar size.

3.1.1. Selection of the model and the variables

The output-oriented DEA, which is predominant in the sports literature (Angulo et al., 2015; Lozano et al., 2002; Soares de Mello, Angulo, & Branco, 2008; Soares de Mello, Gomes, Angulo, & Biondi, 2008; Wu et al., 2008; Wu, Liang, & Yang, 2009; Zhang et al., 2009) has been used in this paper since the coaches, athletes and members of the federations give priority to the results over the resources used.

The selection of the inputs and outputs to be included in the model is critical in the development of the DEA because they should reflect the essence of the "productive process" of the units evaluated and because the results are sensitive to the number of variables. The higher the number of variables, the higher the number of efficient DMUs and, consequently, the model will have less power of discrimination (Cooper, Seiford, & Tone, 2000). Thus, the total number of inputs and outputs included in the model should be less than a third of the number of DMUs (El-Mahgary & Lahdelma, 1995).

Regarding the inputs, the predominant criteria in the literature for multi-sports events is to use the GDP and the population as proxies, respectively, of the economic and demographic factors of each country (Lozano et al., 2002). However, as this study is focused on the same country, it is necessary to propose two, more specific inputs. The first is a measure of the spending per capita for each sport (Wu, Liang, & Chen, 2009), calculated as the total amount of resources available to federations during each OG period over the number of athletes belonging to a federation in the years in which OG

cogent • social sciences

were held (see Appendix 1). The use of this indicator assumes that the success in elite sports is more related to the expenditure in grassroots sport than the specific investment in elite athletes. Although this statement is controversial and cannot be generalised to any context, the study conducted by Romeo-Velilla and Shibli (2011) within the framework of the SPLISS project proves that, in Spain, success in elite sport depends on the absolute, rather than relative, expenditure on elite sport. The second input is the size of the delegation (number of athletes of each federation participating in the OG), already used by Benicio et al. (2013) and Debnath and Malhotra (2015). It can be considered to be a proxy of the investment of each federation in the Olympic program. In the Spanish Olympic team, there is a highly significant correlation for both years between the size of the delegation in each sport and the funds for that sport (R^2 = 0.792** in 2008 and R^2 = 0.808** in 2012). Although winning Olympic medals depends on the combined potential of diverse factors, it appears that the size of the Olympic team plays the role of transmitting the composite impact of a country's size and economy to the end-phase of Olympic success (Vanegas & Vlachokyriakou, 2012). Evidence suggests that the larger the size of an Olympic delegation, the greater the chance of achieving a medal. Nevertheless, the introduction of this variable may impair team sports, since they require a larger number of participants to compete for just one medal. The results of the DEA will verify whether federations with team sports systematically achieve lower scores than federations with individual sports. We believe that the negative effect for team sports of using this variable may be compensated by the composition of the first input variable that introduces the number of licenses in the denominator of the variable.

With regard to the outputs, the predominant criterion in the literature is to consider the gold, silver and bronze medals obtained, in a weighted form (Soares de Mello, Angulo, & Branco, 2008; Wu et al., 2008; Wu, Liang, & Yang, 2009; Zhang et al., 2009). This criterion does not take into account the different number of medals offered in each sport which creates a favourable scenario for some sports and less favourable for others (Lins et al., 2003). Because of this, as in Angulo et al. (2015), the results achieved by each federation were divided by the total number of competitions in which they participated (some athletes participated in several competitions while, in collective sports, several athletes are required for one single competition). In this way, as in De Bosscher et al. (2008), the result would be linked to the "market share" corresponding to each federation based on the total number of events in the Olympic program.

Furthermore, to consider exclusively the first three places of the classification as outputs is an insufficient measure of the performance of each federation. In the Spanish case, this criterion would not allow as to measure the efficiency of more than 50% of the federations because they did not obtain any medals (thirteen federations for each edition, nine of which did not obtain medals in either of the OG studied). In order to strengthen the model, and given the fact that the athletes are awarded a diploma when they come between 4th and 8th (Olympic Charter, 1984), these results are also considered within the outputs, as in Nielsen (2012). The scores for the federations are now assigned as follows: 1st place-1 point, 2nd place-1/2 point ... 8th place-1/8 point. Additionally, 1/9 point is assigned for all federations in order to avoid technical problems of DEA with DMUs showing 0 units of output. This additional score could be considered as a bonus to be qualified for the OG. However, it does not affect the results, since it is added to all participants. Although this output indicator is more sophisticated than those that are most frequently found in the literature, it still has the shortcoming of not discriminating after the 8th position. The following ratio summarizes, in a single figure, the results of each federation:

$$IO_t = \frac{\sum_{i=1}^{m} \frac{1}{n_t}}{m_t}$$

where *IO* is the index of the *output*; *n* is the position obtained in the competition; *m* is the total number of competitions offered in which each federation participates.

Table 1 shows inputs and outputs included in the study.

Table 1. Variable inputs and outputs

Input	Total funding source	Delegation
	Lincence	
Output	$10_t = \frac{\Sigma_{i=1}^{m} \frac{1}{n_t}}{m_t}$	

Source: Author's elaboration.

The BCC model has been chosen because it takes into account the effect of variable returns to scale. In this case, the changes in the results obtained (outputs) may not be proportional to the size of the delegation or to the relation between the available budget and the number of athletes of each federation (inputs). The variables of inputs and outputs for the two OG analysed are shown in Appendix 2.

To evaluate the influence of the financial structure of the federations on their performance, an analysis of the correlations of the relative efficiencies obtained with regard to the different funding sources of the federations (CSD grants, ADO grants and private revenues) (see Appendix 3) is carried out with the Pearson coefficient. The coefficients closer to ±1 imply a higher linear correlation, while those closer to 0 imply less linear correlation between the observed variables.

3.2. Dynamic Analysis of Efficiency

The Malmquist index allows us to perform an analysis of the variations in efficiency during a given period, based on the Data Envelopment Analysis (DEA) results. The change in the efficiency between two points is measured by calculating the quotient of the distances to each point in relation to a common technology -production frontier- (Färe, Grosskopf, Norris, & Zhang, 1994), through the following formula:

$$M_1(x^t, y^t, x^t + 1, y^{t+1}) = \left[\frac{D_1^t(x^{t+1}, y^{t+1}) D_1^{t+1}\{x^{t+1}, y^{t+1})}{D_1^t(x^t, y^t) D_1^{t+1}(x^t, y^t)}\right]^{1/2} \quad (1)$$

where x and y represent the inputs and outputs of the DMUs whose efficiency is to be studied and t represents the period analysed. From an output orientated perspective, a value of $M > 1$ means an efficiency increase and a value of $M < 1$ denotes a decrease. A value of $M = 1$ means there is no efficiency variation during the period.

The variation in efficiency might be a consequence of a change in the relative position of the DMU with respect to the production frontier or because the frontier has moved for the whole system (Färe et al., 1994). The original expression of the Malmquist index (1) is factorised by identifying two sources of change in efficiency: the technical change and the technological change.

$$M_1(x^t, y^t, x^{t+1} + 1, y^{t+1}) = \frac{D_1^{t+1}(x^{t+1}, y^{t+1})}{D_1^t(x^t, y^t)} \left[\frac{D_1^t(x^{t+1}, y^{t+1}) D_1^t\{x^t, y^t)}{D_1^{t+1}(x^{t+1}, y^{t+1}) D_1^{t+1}(x^t, y^t)}\right]^{1/2}$$

The first factor (outside the square brackets) represents the technical change, i.e., the evolution of the distance of a DMU from the production frontier. The factor that determines the technical change is the evolution of the efficiency of a DMU with respect to the others, based on its capacity to reduce inputs and/or increase outputs. The second factor (between square brackets) measures the changes in technology during the periods under study, i.e. if the frontier is changing over time. The technological change measures the movement in the production frontier, determined by the efficiency of all DMUs of the sample in each period. The main factors explaining movements in the production frontier are technological advances or organizational changes that affect all the DMUs.

3.3. Performance persistence

The study of performance persistence consists of the comparison of the efficiency level of a sample of units in consecutive periods. This allows us to evaluate the consistency of the results obtained and to forecast future results.

There are different methodologies to test the existence of persistence in performance: regression analysis (parametric methodology) and efficiency rankings and double-entry contingency tables (non-parametric technique). In order to be consistent with DEA analysis -whose nature is non-parametric- contingency charts have been used.

The contingency tables technique is based on the comparison of efficiency classifications from two consecutive periods. For each period, a sub classification of "winning" and "losing" entities is carried out. The characterization of an entity as "winning" or "losing" comes from the median. The most efficient half of each classification is made up of winning entities, and the less efficient half is made up of losing entities. Then, a double-entry contingency chart is constructed (see Table 5). This is a 2 × 2 matrix in which the labels WW (winning entities in both periods), WL (winning entities in the first period, losing entities in the second period), LW (losing entities in the first period, winning entities in the second period) and LL (losing entities in both periods) are used. In order to determine the robustness of the possible performance persistence phenomenon, Malkiel (1995)'s statistic *Z* will be used:

$$Z = \frac{(Y - np)}{\sqrt{np\,(1 - p)}} \tag{2}$$

where *Z* represents the statistic, which follows a normal distribution (0, 1); *Y* indicates the number of winning entities in two consecutive periods; *n* is WW + WL; Malkiel gives *p* a value of 0.5, assuming a neutrality hypothesis regarding persistence in performance.

4. Results

4.1. Efficiency analysis

Table 2 shows the results of the DEA[3] and Malmquist index of the Spanish Federations in the Beijing 2008 and London 2012 Olympic Games.

At the Beijing Games, ten federations achieve an efficiency of over 50% while eight do so in London. Seven are 100% efficient in Beijing 2008 (basketball, judo, taekwondo, tennis, archery, triathlon and volleyball) and five in London 2012 (basketball, judo, wrestling, taekwondo and triathlon). Only the basketball, judo, taekwondo and triathlon sports federations achieve 100% efficiency in both the Beijing and London games.

The temporal analysis is performed through the Malmquist index. It would not be appropriate to interpret a trend based on the efficiency indices because they are relative valuations based on the behavior of the set of DMUs for each period studied. Malmquist index values above 1 indicate an increase in efficiency between the two Games and values below 1 indicate a decrease. On average, as can be seen in the Table 2, the federations were less efficient (0.971) due to a decrease in the results and an increase in inputs: "income per capita" increased 16.7%, a greater weight than the reduction in "size" of only 6.8% (See Appendix 2).

This behavior can be observed in the tennis (0.187), cycling (0.214) and hockey (0.572) federations whose inputs increase while their results worsen. The federations of boxing (0.423), archery (0.500) and volleyball (0.589) show efficiency decreases as a result of increasing their inputs and of not getting any results. Although basketball (0.834) and judo (0.478) are efficient in both periods, in the values of the Malmquist index, we see a reduction of their efficiency due to a decline in their results despite having decreased or maintained their inputs. Finally, the results of the athletics (0.417) and

Table 2. DEA and Malmquist coefficients in the Beijing 2008 and London 2012 Olympic Games

DMUs		Technical Efficiency & VRTS		Technical change	Technological change	Malmquist
		Beijing 2008	London 2012			
1	Athletics	0.104	0.047	0.289	1.557	0.449
2	Badminton	0.198	0.154	0.797	1.254	1.000
3	Basketball	1.000	1.000	0.647	1.862	1.205
4	Handball	0.550	0.976	0.532	1.670	0.889
5	Boxing	1.000	0.100	0.131	3.183	0.418
6	Cycling	0.521	0.117	0.145	1.484	0.215
7	Gymnastics	0.272	0.081	0.135	1.063	0.143
8	Weightlifting	0.906	1.000	1.252	3.221	4.033
9	Equestrianism	0.102	0.160	1.672	1.403	2.346
10	Hockey	1.000	1.000	1.000	0.578	0.578
11	Judo	0.207	0.103	0.336	1.422	0.477
12	Wrestling	0.102	1.000	2.967	1.346	3.994
13	Swimming	0.078	0.168	1.041	1.878	1.955
14	Canoeing	0.397	1.000	2.916	1.488	4.340
15	Taekwondo	0.295	1.000	3.880	1.564	6.067
16	Tennis	1.000	0.320	0.153	1.300	0.198
17	Table Tennis	0.095	0.092	0.839	1.497	1.256
18	Archery	1.000	0.193	0.399	1.254	0.500
19	Shooting	0.051	0.152	1.929	1.301	2.509
20	Triathlon	1.000	1.000	0.714	1.411	1.008
21	Sailing	0.464	0.636	1.076	1.317	1.417
22	Volleyball	0.271	0.098	0.395	1.457	0.576
Geometric median				0.670	1.482	0.993

Source: Author's elaboration.

canoeing (0.734) federations have a negative impact on their efficiency, in the latter accompanied by a significant increase in income per capita. The only federation that does not improve or get worse is badminton (1.000), with no results and no significant variations in its inputs.

On the contrary, the equestrian (2.345), gymnastic (1.111) and sailing (1.474) federations increase their efficiency by reducing their inputs and improving their results. The efficiency of the federation of table tennis (1.256) increases as a result of decreasing its inputs and maintaining its outputs. In the case of the swimming (2.212) and triathlon (1.008) federations, efficiency increases when the results improve, despite the fact that in the latter, the size of the delegation grows while its per capita expenditure decreases. Other federations, such as handball (1.176), weightlifting (2.091), taekwondo (5.719) and Olympic shooting (2.509), despite increasing per capita spending and maintaining or increasing the size of the delegation, improve their efficiency as a result of better performance. Finally, in wrestling (3.994), the size of the delegation decreases and per capita spending increases, but the federation obtains better results, leading to an improvement in efficiency.

If we divide the index into its technical and technological changes, a positive displacement of the latter, the production frontier (>1) formed by the efficient sports federations, can be seen. This suggests that, during the period analysed, the expectations of performance of the majority of the federations increase. The technical change (<1) indicates that, on average, federations do not fully achieve the expected results. Therefore, the DMUs are located in a zone further from the efficiency frontier in comparison to the zone they were in at the beginning of the period.

The increase of resources available, mainly financing sources and, therefore, per capita spending (see Appendix 1) has not meant an improvement in the sports results achieved in London compared to those in Beijing. This is illustrated in Table 3:

The analysis of persistence in performance through the methodology of contingency charts shows that the number of federations that repeat as winners (W) or losers (L) in both OG is higher than the number of federations that do not. This shows the presence of persistence, and its statistical significance is confirmed through the Malkiel statistic, as can be seen in Table 4. These results show that some federations are systematically more efficient than others.

Table 3. Spanish sports results in the Beijing 2008 and London 2012 Olympic Games

OOGG	Gold	Silver	Bronze	Medals	4º	5º	6º	7º	8º	Diplomas	Rank
2008	5	11	3	19	5	12	4	8	6	35	14º
2012	4	10	4	18	7	7	7	4	4	29	17º

Source: Memory 2008/Federations Data/Other Statistics from the Spanish Supreme Council for Sports (CSD).

Table 4. Persistence in the efficiency of Spanish of Spanish federations

Total		2008	
	22	***W* 11**	***L* 11**
2012	*W* 11	*WW* 9	*WL* 2
	L 11	*LW* 2	*LW* 9
Z Malkiel			2.11058
p			0.03481*

*Statistical significance for a 5% level.

Source: Author's elaboration.

4.2. Funding structure and the performance of sports federations

The analysis of the funding structure of sports federations shows an increase in their resources during the 2009–2012 period (see Appendix 3). This is due to an increase in the private revenues collected by the federations that compensated for the decrease in public funding -grants issued by the CSD and the ADO- in the same period. On average, private revenues have increased from 49% in 2008 to more than 55% in 2012. The other important source comes from the CSD grants, which are the main funding source of more than half of the Spanish sports federations. However, the ADO funding is, on average, under 10% of the total funding sources, and decreases during the period (see Table 5).

Table 5 shows the relative efficiency of each sports federation in the two OG and the share of each funding component, for which a Pearson correlation test was applied. The results show no linear relation among them (see Table 6).

Table 5. Efficiency indexes and funding structure of Spanish federations

DMU	Federations	Beijing 2008				London 2012			
		EFFIC (%)	Private revenues (%)	CSD grants (%)	ADO grants (%)	EFFIC (%)	Private revenues (%)	CSD grants (%)	ADO grants (%)
1	Athletics	10.40	57.36	36.42	6.22	4.70	64.34	30.76	4.90
2	Badminton	19.80	60.84	32.63	6.53	15.40	37.02	57.97	5.00
3	Basketball	100.00	81.02	14.74	4.23	100.00	81.39	14.59	4.02
4	Handball	55.00	54.65	35.80	9.55	97.60	58.82	33.22	7.96
5	Boxing	100.00	9.32	84.43	6.25	10.00	13.48	79.00	7.52
6	Cycling	52.10	29.39	53.52	17.09	11.70	35.93	53.41	10.66
7	Gymnastics	27.20	25.72	58.30	15.97	8.10	30.99	60.82	8.19
8	Weightlifting	90.60	6.37	81.99	11.63	100.00	11.07	80.53	8.40
9	Equestrianism	10.20	50.32	42.50	7.18	16.00	61.03	35.52	3.46
10	Hockey	100.00	29.97	50.00	20.03	100.00	25.64	53.79	20.57
11	Judo	20.70	34.82	54.49	10.70	10.30	38.46	52.49	9.05
12	Wrestling	10.20	29.79	55.30	14.91	100.00	35.88	52.91	11.21
13	Swimming	7.80	31.48	51.63	16.89	16.80	33.84	49.69	16.48
14	Canoeing	39.70	28.86	59.09	12.05	100.00	24.00	60.70	15.29
15	Taekwondo	29.50	18.67	61.53	19.80	100.00	31.32	52.37	16.31
16	Tennis	100.00	68.61	28.53	2.86	32.00	82.16	16.05	1.79
17	Table Tennis	9.50	36.04	55.49	8.46	9.20	39.11	50.74	10.15
18	Archery	100.00	49.97	40.80	9.23	19.30	47.01	44.32	8.66
19	Shooting	5.10	32.55	61.71	5.75	15.20	38.57	55.32	6.10
20	Triathlon	100.00	51.67	40.70	7.63	100.00	57.74	36.36	5.89
21	Sailing	46.40	28.50	55.91	15.59	63.60	33.15	50.59	16.26
22	Volleyball	27.10	52.36	42.22	5.41	9.80	53.18	43.51	3.31

Source: Author's elaboration.

Table 6. Pearson correlation test among efficiency and funding sources for Beijing 2008 and London 2012

			Private revenues	CSD grants	ADO grants
EFFICIENCY	Beijing	Pearson coef.	0.101	−0.076	−0.132
		Estatic sig	*0.654 (NS)*	*0.738 (NS)*	*0.558 (NS)*
	London	Pearson coef.	−0.085	−0.019	0.381
		Estatic sig	*0.706 (NS)*	*0.933 (NS)*	*0.,080 (NS)*

Source: Author's elaboration.

5. Discussion

The lack of a framework that allows countries to be realistic about their sports performance expectations (Shibli et al., 2013) has increased interest in improving sports efficiency measurements (Lozano et al., 2002; Wu et al., 2008; Wu, Liang, & Chen, 2009; Zhang et al., 2009). Some authors also emphasize the need to estimate the social-economic cost-effectiveness of the money spent on athletes and federations (Sánchez & Barajas, 2009). This has led to improvements in performance measurements to evaluate a wider range of issues related to the federations' performance in the OG (Nielsen, 2012; Shibli et al., 2015). However, the measurement of performance in multi-sports competitions, such as the OG, is a controversial issue and some weaknesses have been found in the most frequent indicators used in the literature. The main criticisms are that they do not capture some of the results and that they fail to differentiate properly between federations participating in several competitions or not, or between team and individual sports (Angulo et al., 2015; Soares de Mello, Angulo, & Gomes, 2012).

The synthetic indicator proposed in this study overcomes these weaknesses. Extending the positions considered to include more than just the medal winners allows us to better discriminate the efficiency of the federations. Furthermore, the best results in terms of efficiency are now achieved by the basketball, judo, taekwondo and triathlon federations, one of which is a team sport. The other three team sport federations of the sample (handball, hockey and volleyball) obtained relatively high efficiency scores in at least one of the Olympic Games. So, as in Debnath and Malhotra (2015), the size of the delegation as an input indicator does not cause a negative impact on the efficiency of team sports' federations.

Although some federations are systematically more efficient than others, the Malmquist index shows an overall decrease in the efficiency of the sample between the two OG. This worsening in their performance is a consequence of both the decrease in the sports results (output) and the increase in the funding sources (inputs) from one OG to the other. The expenditure per capita, a proxy of the economic capacity of each federation, increased by 16.78% between the two OG although the delegation size, a proxy of the elite sports investment, decreased by 7.31%. Romeo-Velilla and Shibli (2011) state that success in elite sports responds mainly to the grassroots sports expenditure rather than to specific expenditure in elite sports, but our results do not support this conclusion, providing evidence that the performance of federations depends on more factors than the money spent.

During the period analysed, there were cuts in the public funds allocated to sports, which forced federations to look for new sources of incomes from the private sector. The analysis of the federative funding structure in the two OG shows important differences in the obtaining of private resources. A few federations (athletics, basketball, handball and tennis) received most of these private funds. The results of the study show that the efficiency of the federations is not related to the nature, public or private, of their funding sources. This is the case of the gymnastics and athletics federations which, despite changes in their financial structures, achieved a low efficiency in both OG. Furthermore, fencing, modern pentathlon and rowing, with heavy dependence on the CSD grants, did not qualify for the London 2012 OG, and the Spanish Football Federation, with a very low dependence on public funds, did not qualify for the Beijing 2008 OG. The low relationship between the sports results and the type of funding of federations would explain the deceleration of the return on investment (ROI) observed after the Barcelona 1992 OG (López-Egea et al., 2008).

The results of this study provide evidence that the international competitiveness of elite sports does not only depend on the available resources, but also on the capacity of transforming these resources into competitive results (Storm & Nielsen, 2010). Furthermore, it would be necessary to take into account the evolution of the resources available to competitors. According to De Bosscher et al. (2008), the sporting success of a nation depends on *not what a nation does relative to what it did in the past but what it does now relative to what its competitors are doing now*. Thus, Spanish federations may be less competitive because their rivals are spending more. The study also highlights the importance of public policies and the ability of both governmental and social organizations (CSD, ADO and the national sports federations, in the Spanish case) in high-performance sports (De Bosscher, Shibli, Westerbeek, & van Bottenburg, 2015; Platonov, 2011). At the same time, it acknowledges the difficulty to measure high-level sport performance, the complexity of their processes and the factors involved. The SPLISS project identifies more than 100 factors, but in addition, discretional variables such as the innate talent of some athletes, the role of private clubs or just the luck at the time of competition must be considered. It is difficult to evaluate the success of four-year policies just by a few seconds of performance during the Games. It would require to take into account the results of other competitions held during the four-year period. This study, as well as others aiming to synthesize high-level sport performance in a few variables, provides a partial view of the efficiency and, therefore, the results are more academic than operational.

6. Conclusions

This study contributes to the measurement of the Spanish performance in the OG by using a comprehensive index that evaluates the efforts of the federations more accurately. On average, the efficiency of the Spanish federations decreased from Beijing 2008 to London 2012. This reflects that they were unable to take advantage of the improvement in production factors in the framework of the economic crisis.

The Spanish sports federations display a heavy dependency on the ordinary grants issued by the CSD. As these grants decreased, the federations felt compelled to look for new private sources. However, this study shows that none of the funding sources conditions the efficiency of the federations. The performance of the Spanish federations has worsened despite increasing their funding in the period analysed. This suggests that the sports results do not depend exclusively on economic investment, although this is a necessary element. There are many other factors which influence the results, including the individual talent of some athletes in a given period. Furthermore, these results contradict the idea that sports with a higher percentage of private funding get better results than those that are funded mainly with public funds (Crompton, 2015).

The results of this study are useful for the entities in charge of designing policies and allocating resources to sports in each country. They also provide criteria to determine the level of public funding policies depending on the characteristics of each federation and taking into account factors such as the popularity of each sport and its capacity to generate revenues.

Future research will appraise the Spanish federations' efficiency in later OG editions, analysing the federations' performance through time in order to capture the possible long-term effects of certain strategies such as the investment in grassroots sport versus top-level sport. It would also be of interest to determine how efficiency is affected by operative variables such as the number of high-level athletes and trainers, the structure of governmental agencies, the number of clubs, and the financial situation of the sports federations.

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Notes
1. Sports federations are private nonprofit entities and act as collaborative agents of public administrations (article 30.2 of the Sports Law and STC 05/24/84).
2. http://www.csd.gob.es/csd/estadisticas. http://www.csd.gob.es/csd/asociaciones/1fedagclub/otras-estadisticas/.
3. For the data processing, DEAP software Version 2.1 by the Queensland University *Centre for Efficiency and Productivity Analysis* (CEPA) was used.

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Appendix 1

Funding of the Olympic games Beijing 2008 proportionally to the federation licenses

DMU	Federations	Funding Period 2005–2008					Licenses 2008	Funding 2005 2008
		2005	2006	2007	2008	Total		Licenses 2008
1	Athletics	18,100,140.54	14,404,559.72	15,026,634.24	24,444,732.59	**71,976,067.09**	77,940	923.4804605
2	Badminton	857,543.00	2,549,576.72	1,196,464.00	1,285,792.76	**5,889,376.48**	6,688	880.5885885
3	Basketball	10,400,133.00	13,776,412.77	35,436,474.39	19,529,336.91	**79,142,357.07**	366,994	215.6502751
4	Handball	5,959,774.72	7,217,000.00	7,973,166.84	7,873,547.52	**29,023,489.08**	93,950	308.9248439
5	Boxing	1,143,161.63	1,119,550.00	1,195,882.00	1,227,415.03	**4,686,008.66**	3,360	1394.645435
6	Cycling	4,796,343.33	4,861,322.92	5,037,138.11	5,550,765.10	**20,245,569.46**	50,694	399.3681592
7	Gymnastics	3,958,574.78	4,070,267.57	4,338,657.54	5,270,386.41	**17,637,886.30**	9,777	1804.018237
8	Weightlifting	1,113,637.53	1,221,604.16	1,324,422.00	1,248,992.59	**4,908,656.28**	2,179	2252.710546
9	Equestrianism	4,030,941.74	4,707,827.38	4,985,556.93	5,218,840.75	**18,943,166.80**	39,495	479.6345563
10	Hockey	2,992,200.00	4,982,008.97	3,839,069.00	4,432,260.68	**16,245,538.65**	9,436	1721.655219
11	Judo	3,742,197.20	3,640,357.61	3,798,807.70	4,141,143.11	**15,322,505.62**	109,773	139.5835553
12	Greco-Roman Wrestling	1,069,755.29	1,132,805.67	1,327,553.43	1,277,611.68	**4,807,726.07**	11,686	411.4090424
13	Swimming	7,362,617.27	8,018,850.88	8,494,798.37	9,715,280.69	**33,591,547.21**	51,360	654.0410282
14	Canoeing	4,143,566.45	4,934,164.98	5,670,897.71	5,591,909.65	**20,340,538.79**	48,228	421.7578749
15	Taekwondo	1,696,847.00	2,038,492.59	2,179,300.42	1,942,559.08	**7,857,199.09**	39,429	199.2746225
16	Tennis	5,375,833.00	5,715,290.00	5,307,311.00	12,548,319.00	**28,946,753.00**	109,389	264.6221558
17	Table Tennis	820,416.56	1,048,689.00	979,076.79	1,613,873.47	**4,462,055.82**	7,163	622.931149
18	Archery	2,175,875.40	950,720.84	1,218,571.53	1,207,222.40	**5,552,390.17**	10,806	513.8247427
19	Shooting	3,308,352.00	3,927,151.00	4,985,773.64	3,363,422.47	**15,584,699.11**	65,972	236.2320243
20	Triathlon	2,022,459.00	1,920,797.64	2,605,581.02	2,979,195.29	**9,528,032.95**	11,996	794.2675017
21	Sailing	4,526,134.81	5,559,222.11	6,163,185.00	6,499,981.68	**22,748,523.60**	35,929	633.1521501
22	Volleyball	3,568,585.20	4,623,221.15	4,865,459.32	6,356,517.22	**19,413,782.89**	58,228	333.4097494
	TOTAL	**93,165,089.45**	**102,419,893.68**	**127,949,780.98**	**133,319,106.08**	**456,853,870.19**	**1,220,472.00**	**709.3264507**

Source: Ministry of Education, Culture and Sports. Supreme Council for Sports. Office of the Deputy Director of Sports Promotion and Paralympic Sports.

Funding of the Olympic games London 2012 proportionally to the federation licenses

DMU	Federations	Funding period 2009–2012					Licenses 2012	Funding 2009 2012
		2009	2010	2011	2012	TOTAL		Licenses 2012
1	Athletics	19,335,654.45	29,414,158.97	13,427,649.29	16,841,317.06	**79,018,779.77**	80,309	983.9343009
2	Badminton	1,381,044.09	1,219,324.68	1,182,348.65	943,263.61	**4,725,981.03**	6,763	698.7995017
3	Basketball	19,370,475.53	19,190,891.59	21,349,117.28	25,447,680.21	**85,358,164.61**	407,728	209.3507549
4	Handball	7,451,667.06	7,261,571.68	7,486,313.14	10,807,671.21	**33,007,223.09**	95,763	344.6761598
5	Boxing	1,261,957.50	1,089,331.14	1,135,895.06	1,121,241.91	**4,608,425.61**	1,381	3337.020717
6	Cycling	4,927,968.92	5,193,320.47	5,521,792.00	5,533,354.16	**21,176,435.55**	61,733	343.0326657
7	Gymnastics	4,032,585.95	4,032,386.41	3,929,852.04	3,518,487.01	**15,513,311.41**	29,639	523.4087321
8	Weightlifting	1,409,116.74	1,277,642.97	1,078,830.38	855,431.51	**4,621,021.60**	1,967	2349.273818
9	Equestrianism	5,398,047.67	5,668,173.66	5,504,682.65	4,999,019.09	**21,569,923.07**	51,982	414.9498494
10	Hockey	4,272,972.11	3,850,975.42	3,850,109.87	2,849,202.59	**14,823,259.99**	10,629	1394.605324
11	Judo	4,002,113.50	3,737,885.82	3,742,700.03	3,331,583.23	**14,814,282.58**	106,753	138.7715809
12	Greco-Roman Wrestling	1,346,547.75	1,297,938.19	1,294,717.78	1,133,613.58	**5,072,817.30**	6,052	838.2051058
13	Swimming	8,529,194.80	8,086,736.18	8,177,909.50	9,208,408.28	**34,002,248.76**	59,841	568.2099022
14	Canoeing	5,952,275.73	4,803,787.26	5,626,369.51	3,736,725.29	**20,119,157.79**	6,754	2978.850724
15	Taekwondo	2,021,858.78	2,352,907.45	2,428,160.95	1,997,724.70	**8,800,651.88**	32,230	273.0577685
16	Tennis	14,374,134.44	7,033,517.31	14,403,468.00	11,774,565.00	**47,585,684.75**	103,898	458.0038571
17	Table Tennis	1,067,688.46	1,101,122.77	1,432,376.50	1,246,116.99	**4,847,304.72**	10,024	483.5699042
18	Archery	1,245,865.62	1,165,791.25	1,618,138.12	1,034,849.20	**5,064,644.19**	6,681	758.0667849
19	Shooting	3,916,315.86	4,003,900.94	4,184,402.71	3,886,500.84	**15,991,120.35**	59,083	270.6551859
20	Triathlon	3,157,812.59	2,935,101.17	3,333,534.48	3,253,166.72	**12,679,614.96**	21,079	601.5282964
21	Sailing	5,652,780.42	6,492,328.38	6,687,032.47	5,538,153.28	**24,370,294.55**	52,703	462.4081086
22	Volleyball	5,136,053.53	4,949,894.03	4,459,366.06	3,469,975.56	**18,015,289.18**	55,904	322.254028
	TOTAL	125,244,131.50	126,158,687.74	121,854,766.47	122,528,051.03	495,785,636.74	1,268,896	852.3924123

Source: Ministry of Education, Culture and Sports. Supreme Council for Sports. Office of the Deputy Director of Sports Promotion and Paralympic Sports.

Appendix 2

Inputs and outputs variables Beijing 2008

DMU	Federations	Inputs		Outputs								Malmquist
		Spending per capita	SIZE	Gold	Silver	Bronze	4º	5º	6º	7º	8º	
				1	0,50	0,33	0,25	0,20	0,17	0,14	0,13	
1	Athletics	923	54				1	3	2	3	2	0.417
2	Badminton	881	2									1.000
3	Basketball	216	24		1			1				0.834
4	Handball	309	14			1						1.176
5	Boxing	1,395	1									0.423
6	Cycling	399	19	2	1	1	1		2	1	1	0.214
7	Gymnastics	1,804	15		1						2	1.111
8	Weightlifting	2,253	2		1							2.091

DMU	Federations	Inputs		Outputs								Malmquist
		Spending per capita	SIZE	Gold	Silver	Bronze	4º	5º	6º	7º	8º	
				1	0,50	0,33	0,25	0,20	0,17	0,14	0,13	
9	Equestrianism	480	3									2.345
10	Hockey	1,722	32		1					1		0.572
11	Judo	140	6					2		1		0.478
12	Wrestling	411	3					1				3.994
13	Swimming	654	47		2			1		1		2.212
14	Canoeing	422	10	1	2		1	1				0.734
15	Taekwondo	199	3					1				5.719
16	Tennis	265	9	1	1							0.187
17	Table Tennis	623	5									1.256
18	Archery	514	1									0.500
19	Shooting	236	7								1	2.509
20	Triathlon	794	4				1	1				1.008
21	Sailing	633	16	1	1		1	1				1.474
22	Volleyball	333	2									0.589
TOTAL			279	5	11	2	5	12	4	7	6	0.971

Inputs and outputs variables London 2012

DMU	Federations	Inputs		Outputs								Malmquist
		Spending per capita	size	Gold	Silver	Bronze	4º	5º	6º	7º	8º	
				1	0,50	0,33	0,25	0,20	0,17	0,14	0,13	
1	Athletics	984	46				1	1		1	1	0.417
2	Badminton	699	2									1.000
3	Basketball	209	12		1							0.834
4	Handball	345	29			1		1				1.176
5	Boxing	3.337	2									0.423
6	Cycling	343	16				1		2			0.214
7	Gymnastics	523	13				1		1			1.111
8	Weightlifting	2.349	2	1					1			2.091
9	Equestrianism	415	3							1		2.345
10	Hockey	1.395	16						1			0.572
11	Judo	139	6					1				0.478
12	Wrestling	838	1			1						3.994
13	Swimming	568	51		4	1			1		2	2.212
14	Canoeing	2.979	8		2	1	3	1		1		0.734
15	Taekwondo	273	3	1	2							5.719
16	Tennis	458	12				1	1				0.187
17	Table Tennis	484	4									1.256

DMU	Federations	Inputs		Outputs								Malmquist
		Spending per capita	size	Gold	Silver	Bronze	4º	5º	6º	7º	8º	
				1	0,50	0,33	0,25	0,20	0,17	0,14	0,13	
18	Archery	758	2									0.500
19	Shooting	271	8					2	1			2.509
20	Triathlon	602	6		1					1		1.008
21	Sailing	462	14	2							1	1.474
22	Volleyball	322	4									0.589
TOTAL		18.753	260	4	10	4	7	7	7	4	4	0.971

Source: Author's elaboration.

Appendix 3

Structure of the funding sources of the Olympic sports federations period 2005-2008

Number	Federations	Total funding 2005-2008						
		Private revenues	%	CSD grants	%	ADO grants	%	Total
1	Athletics	41,286,340.88	57.36%	26,211,126.21	36.42%	4,478,600.00	6.22%	71,976,067.09
2	Badminton	3,582,922.62	60.84%	1,921,803.86	32.63%	384,650.00	6.53%	5,889,376.48
3	Basketball	64,124,086.72	81.02%	11,668,670.35	14.74%	3,349,600.00	4.23%	79,142,357.07
4	Handball	15,862,046.56	54.65%	10,390,442.52	35.80%	2,771,000.00	9.55%	29,023,489.08
5	Boxing	436,667.63	9.32%	3,956,411.03	84.43%	292,930.00	6.25%	4,686,008.66
6	Cycling	5,949,647.15	29.39%	10,835,353.61	53.52%	3,460,568.70	17.09%	20,245,569.46
7	Gymnastics	4,537,190.37	25.72%	10,283,314.96	58.30%	2,817,380.97	15.97%	17,637,886.30
8	Weightlifting	312,764.69	6.37%	4,024,841.59	81.99%	571,050.00	11.63%	4,908,656.28
9	Equestrianism	9,531,674.94	50.32%	8,051,491.86	42.50%	1,360,000.00	7.18%	18,943,166.80
10	Hockey	4,868,131.99	29.97%	8,123,146.66	50.00%	3,254,260.00	20.03%	16,245,538.65
11	Judo	5,334,908.53	34.82%	8,348,797.09	54.49%	1,638,800.00	10.70%	15,322,505.62
12	Greco-Roman Wrestling	1,432,050.33	29.79%	2,658,621.74	55.30%	717,054.00	14.91%	4,807,726.07
13	Swimming	10,576,003.47	31.48%	17,343,532.74	51.63%	5,672,011.00	16.89%	33,591,547.21
14	Canoeing	5,870,838.66	28.86%	12,018,790.13	59.09%	2,450,910.00	12.05%	20,340,538.79
15	Taekwondo	1,466,864.43	18.67%	4,834,734.66	61.53%	1,555,600.00	19.80%	7,857,199.09
16	Tennis	19,859,721.20	68.61%	8,258,879.80	28.53%	828,152.00	2.86%	28,946,753.00
17	Table Tennis	1,608,232.96	36.04%	2,476,217.68	55.49%	377,605.18	8.46%	4,462,055.82
18	Archery	2,774,383.06	49.97%	2,265,650.60	40.80%	512,356.51	9.23%	5,552,390.17
19	Shooting	5,072,531.00	32.55%	9,616,701.47	61.71%	895,466.64	5.75%	15,584,699.11
20	Triathlon	4,923,412.25	51.67%	3,877,760.70	40.70%	726,860.00	7.63%	9,528,032.95
21	Sailing	6,483,796.76	28.50%	12,718,046.84	55.91%	3,546,680.00	15.59%	22,748,523.60
22	Volleyball	10,165,762.20	52.36%	8,197,172.69	42.22%	1,050,848.00	5.41%	19,413,782.89
	TOTAL	226,059,978.40	49.48%	188,081,508.79	41.17%	42,712,383.00	9.35%	456,853,870.19

Source: Author's elaboration.

Structure of the funding sources of the Olympic sports federations period 2009–2012

Number	Federations	Total funding 2009-2012						
		Private revenues	%	CSD grants	%	ADO grants	%	Total
1	Athletics	50,837,882.10	64.34%	24,306,897.67	30.76%	3,874,000.00	4.90%	79,018,779.77
2	Badminton	1,749,738.48	37.02%	2,739,880.55	57.97%	236,362.00	5.00%	4,725,981.03
3	Basketball	69,473,341.84	81.39%	12,452,790.52	14.59%	3,432,032.25	4.02%	85,358,164.61
4	Handball	19,413,791.58	58.82%	10,965,931.51	33.22%	2,627,500.00	7.96%	33,007,223.09
5	Boxing	621,390.81	13.48%	3,640,534.80	79.00%	346,500.00	7.52%	4,608,425.61
6	Cycling	7,608,968.97	35.93%	11,309,666.58	53.41%	2,257,800.00	10.66%	21,176,435.55
7	Gymnastics	4,807,458.82	30.99%	9,434,702.59	60.82%	1,271,150.00	8.19%	15,513,311.41
8	Weightlifting	511,700.00	11.07%	3,721,321.60	80.53%	388,000.00	8.40%	4,621,021.60
9	Equestrianism	13,163,111.66	61.03%	7,661,036.41	35.52%	745,775.00	3.46%	21,569,923.07
10	Hockey	3,800,274.13	25.64%	7,973,235.86	53.79%	3,049,750.00	20.57%	14,823,259.99
11	Judo	5,697,577.09	38.46%	7,775,755.49	52.49%	1,340,950.00	9.05%	14,814,282.58
12	Greco-Roman Wrestling	1,820,331.87	35.88%	2,683,835.43	52.91%	568,650.00	11.21%	5,072,817.30
13	Swimming	11,505,052.34	33.84%	16,894,207.42	49.69%	5,602,989.00	16.48%	34,002,248.76
14	Canoeing	4,829,296.79	24.00%	12,212,641.00	60.70%	3,077,220.00	15.29%	20,119,157.79
15	Taekwondo	2,756,149.14	31.32%	4,609,002.74	52.37%	1,435,500.00	16.31%	8,800,651.88
16	Tennis	39,096,703.80	82.16%	7,639,424.95	16.05%	849,556.00	1.79%	47,585,684.75
17	Table Tennis	1,895,737.46	39.11%	2,459,382.91	50.74%	492,184.35	10.15%	4,847,304.72
18	Archery	2,381,133.33	47.01%	2,244,760.86	44.32%	438,750.00	8.66%	5,064,644.19
19	Shooting	6,168,198.48	38.57%	8,846,671.87	55.32%	976,250.00	6.10%	15,991,120.35
20	Triathlon	7,321,843.00	57.74%	4,610,631.96	36.36%	747,140.00	5.89%	12,679,614.96
21	Sailing	8,078,515.77	33.15%	12,329,591.34	50.59%	3,962,187.44	16.26%	24,370,294.55
22	Volleyball	9,580,616.42	53.18%	7,838,252.76	43.51%	596,420.00	3.31%	18,015,289.18
	TOTAL	273,118,813.88	55.09%	184,350,156.82	37.18%	38,316,666.04	7.73%	495,785,636.74

Source: Author's elaboration.