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Abstract:

The goal of the present work is to evaluate the efficiency of a regional system of museums, taken as an example of cultural institutions. We also explore the impact which certain exogenous factors, such as the institutional management model and location, can have on the efficiency level and the evolution of productivity. A non-parametric approach, Data Envelopment Analysis, is used to measure efficiency in these institutions, and we employ a complex production function embracing a number of inputs and outputs adapted to the various functions which museums fulfil: preservation, research, communication, and exhibition. An empirical analysis of data from a regional system of museums in Spain illustrates this application of the operational research model. The most important findings indicate that at least half the museums chosen operate efficiently. The most efficient museums are those located in urban areas and run by regional administration, rural museums under municipal management not proving so efficient. Quite significant progress is evident in the productivity of the first group of museums, mainly due to improvements in internal efficiency, basically own management of resources in relation to services provided. Contrastingly, as expected, technological change has less impact in these cultural heritage institutions, which prove less receptive to new technologies compared to other cultural industries. Finally, in an effort to enhance the overall efficiency thereof as well as the performance of each individual institution involved, the work seeks to evidence this technique's usefulness in establishing guidelines and offering recommendations concerning the use of resources.

Key Words: Efficiency evaluation, cultural institutions, economics of museums, Data Envelopment Analysis, conditional efficiency

JEL Codes: Z11, D61, H41

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1.- Introduction

Despite the provision of culture being one example of the allocation of public goods, comparable to others such as health, education, municipal services, and so on, which have, by contrast, been the focus of much analysis, few studies have to date evaluated the efficiency and behaviour of cultural institutions. This may well be due to the uniqueness of cultural goods, resulting from their symbolic and intangible significance, which makes it difficult to objectivise the services they secure or the resources they require. This may result from the difficulty involved in collecting reliable and representative data from the institutions charged with managing and overseeing said goods, or merely because analysing culture and cultural institutions from a financial perspective is uncommon.

Yet, there is no reason why the behaviour and efficiency of such institutions should not be evaluated. This is firstly because providing cultural goods consumes certain resources, which are scarce and which may be put to other uses, therefore implying an opportunity cost. Given the current economic crisis and the financial constraints being imposed, such an issue becomes even more critical. Secondly, simply because many of the services provided by cultural institutions are of an intangible nature or are non-marketable, does not mean their production and management may not be defined and evaluated, at least in an effort to provide comparative references vis-à-vis possible best practices. For these reasons, developing theoretical knowledge and practical applications to gauge cultural institution efficiency proves both crucial and invaluable at the present time.

Broadly speaking, efficiency studies assessing institutions which supply a public good may be divided into two categories. By applying a series of performance indicators, the first group comprises works that seek to measure how well the institutions function. Such an approach might at first sight appear to be straightforward since it involves gathering a number of basic variables related to activities and to the use of resources, as well as their relative proportion compared to other aggregated indicators, thereby allowing for the situation between various institutions to be contrasted or for the evolution of their behaviour over time to be explored. In the specific area of cultural institutions, studies pursuing this line include Weil (1995), Evans (1997), Boyle (2007)

and Turbide and Laurin (2009). These studies draw on a series of quantitative and qualitative components that provide for an analysis of the extent to which the various activities chosen are being fulfilled. They even allow for a balanced scorecard to be devised for the institution under examination (Weinstein and Bukovinsky, 2009). Peacock (2003) and Pignataro (2003) describe a series of conditions required to draw up an appropriate system of performance indicators which will also allow for a consistent interpretation thereof. Yet, these authors admit that said indicators can never offer an all-inclusive and fully comprehensive description of how cultural institutions function, and they urge extreme caution to be exercised when attempting to use the indicators to compare institutions and to assemble rankings amongst them.

The second group of studies is aimed directly at providing a specific production function, which merges a range of inputs in order to obtain goods and services corresponding to the main tasks allocated to the institution. Based on this approach, the goal is to estimate an optimal frontier in this transformation process, and to gauge the level of efficiency of the various study units as a distance from said optimal efficiency frontier. The problem lies in determining where this frontier lies, a hurdle which may be overcome by applying parametric or non-parametric models (Fernández et al., 2013). The former are more rigid since they require a precise definition of the functional form of the production function, although they prove more accurate in estimating the productivity linked to each factor and when dealing with stochastic error[2]. By contrast, the second group is more flexible, since they basically consist of a mathematical optimisation process using empirical data on combinations of factors that generate a number of outputs.

Of the non-parametric methods, DEA is a fairly standardised technique, and is based on Farrell's (1957) basic concepts of efficiency and measurement thereof as a distance to a frontier of cases of good practices[3]. The advantage of such a model lies in its greater flexibility, since it requires no prior definition of the production function and may take account of multiple output situations, which on many occasions may prove useful. This method is also more operative as it provides a large amount of specific information

[2] Applications of the evaluation of cultural institutions using this analytical approach may be found in Last and Wetzel (2010) and Zieba (2011)

concerning the study units, which can be used to establish guidelines for enhancing efficiency and indications for good practice. By contrast, DEA as a non-parametric method, is a deterministic model since it assumes that any distance from the optimal frontier is the result of inefficient performance and is not random. This is particularly relevant when specific variables outside the institution under study, and therefore beyond the reach of the curator or museum manager, might have a significant impact on performance. Applying DEA also demands that study units be sufficiently harmonised, and that gathering of variables be conducted scrupulously, since any differentiating factor (due to an error in information or the over disperse nature of the units) may impact the efficiency estimations and cause certain units to be considered efficient when in fact they are not, and vice-versa. Despite these drawbacks, as we shall see later, this technique has been widely applied to assess cultural institutions, particularly museums.

The present work is thus framed within the latter field of analysis, since it seeks to gauge the efficiency of a regional system of museums, bearing in mind that two external factors, location and type of management model, may determine both the degree of efficiency and the latter's evolution over time in the institutions studied. The empirical application is carried out on the network of museums in the Autonomous Community of Castilla y León in Spain, a region boasting a wealth of cultural heritage thanks to its long and rich history of art forms. The museum network consists of a particular type of institution which implies a certain level of organisational accreditation of the entities involved, thereby also ensuring some degree of uniformity therein. A non-parametric DEA approach is used to measure the efficiency of this group of institutions, considering a complex production function embracing a number of inputs and outputs adapted to the various functions which museums fulfil. The study also aims to explore the evolution of efficiency over time and to provide a breakdown thereof into factors reflecting technical progress and internal improvements in the running of the museum, by applying Malmquist Indices. Finally, the work seeks to evidence this technique's usefulness for establishing guidelines and recommendations concerning the use of resources in an effort to enhance the overall efficiency thereof as well as the performance of each individual institution involved.

[3] The theoretical basis for this optimisation method and its different variations may be consulted in Gambley and Cubbin (1992)

In order to undertake this task, the work is structured in four parts. After this introductory section, part two offers a review of the state of the art vis-à-vis the evaluation of cultural institutions. Section three contains the empirical analysis, describing the sample of museums used, the methodological approach, and the main findings to emerge from the research. The work concludes with the discussion and main conclusions section.

2.- Evaluating the efficiency of cultural institutions: *state of the art*

Efficiency studies have been applied to the field of culture later than in other public service sectors such as health or education. The earliest applications are found in the evaluation of the performing arts (Gapinski, 1980) and symphony orchestras (Lange *et al*., 1985), focusing on an appraisal of the production technology of these activities by estimating production functions and cost functions. The first study conducted into the domain of cultural heritage involved adopting this technique to the case of a broad sample of North-American museums (Jackson, 1988), and has since only been followed up in the work of Bishop and Brand (2003) to measure the efficiency of a selection of museums in the United Kingdom. By estimating an extremely simple production function, the work found that the greater the level of public funding and the greater the involvement of volunteers in museum tasks, the lower the efficiency measured in terms of the number of visitors. No further analysis has been carried out along this line of research, probably due to the intrinsic constraints of the model itself, which requires synthesising in a single output the large number of goals and tasks inherent in such institutions[4].

A greater number of efficiency studies have been conducted based on non-parametric mathematical programming techniques, particularly DEA and derivatives thereof. Based on the flexibility which, as pointed out, this technique affords, there have been numerous applications since the 1990s, above all in the field of museums. Studies of a similar nature have also emerged for orchestras (Luksetich and Nold Hughes, 1997), libraries (Vitaliano, 1998; De Witte and Geys, 2011), and theatres (Taalas, 1997 and Marco Serrano, 2006). Focusing on the field of museums, Paulus (1995) explores the technical efficiency of French museums, while Mairesse (1997) and Mairesse, and

[4] This is not the case for theatres, for which fresh studies, such as those of Fazioli and Filippini (1997), Zieba (2011) and Last and Wetzd (2010) have emerged along this line.

Vanden Eeckaut (2002) evaluated samples of Belgian museums. The work by Taalas (1998) is one of the few approaches to evaluating allocative efficiency, and offers an application to a particular type of Finnish museum. In Italy, Pignataro (2002) explored efficiency and technical change in museums in Sicily. Basso and Funari, (2004) offer a detailed appraisal of productivity gains for a sample of museums located in three large tourist cities (Bologna, Florence and Venice). Finally, Del Barrio, *et al*. (2009) evaluate the efficiency of a wide network of museums in Spain, based on a prior classification thereof using multivariate statistical techniques.

As can be seen, most applications have been carried out in a European context, probably due to the implications which the findings to emerge from this technique might have for public policy in terms of relative efficiency ranges, productivity gains, and benchmarking. Within such a broad domain as cultural heritage, it is striking that the only evaluation studies conducted are those exploring museums. Whilst it is true that museums do represent one of the most characteristic forms of cultural heritage, there is currently a conspicuous lack of research into other institutions such as archives, historical libraries, or even monuments, historical ensembles, and archaeological sites which entail some kind of management. Likewise, any other type of entity engaged in promoting, preserving or conducting research into heritage would certainly lend itself to evaluation. However, the sole exception in this sense are the efficiency studies carried out into *Soprintendenze* in Italy (Finocchiaro Castro and Rizzo, 2009; Finocciaro Castro, *et al*., 2011), these being the bodies entrusted with preserving cultural heritage in the area under their control and specific intervention, through the application to an emblematic case in a region rich in heritage, namely the island of Sicily.

Having established that museums are the most frequently evaluated example of cultural heritage institutions, it should be pointed out that most studies are based on data collected from *ad hoc* surveys, since the goal is to achieve as accurate an approach as possible to the series of inputs and outputs that are characteristic of museums, under the assumption that said institutions fulfil at least three types of functions: namely to conserve and maintain their collection; to display their exhibits under the best possible conditions so as to achieve the greatest impact; and finally to engage in a pool of activities related to disseminating, researching, and educating, which is linked to the institution's role as a public service. Perhaps the most complex evaluation approach adopted for museums is that proposed by Mairesse and Vanden Eeckaut (2002) who,

drawing on the same set of inputs (employment, various budgetary items and infrastructure), evaluate three service models (conservation, communication, and impact), with their corresponding outputs, the models evidencing increasingly higher levels of efficiency in the order stated. Basso and Funari (2004) conduct an efficiency evaluation based on a set of two inputs (work and size of exhibition rooms), and four outputs (visitors paying the full admission fee and a reduced admission fee, number of temporary exhibitions and other related activities). Del Barrio and Herrero (2013) also use a complex production function involving three inputs (employment, size and museum facilities, and four outputs (visitors, temporary exhibitions, the museum's social impact, and the impact of the art collection) The remaining applications tend to synthesise the production function into a single output (number of visitors) and a range of resources that varies in size, but which always includes the labour force as well as the scale and quality of the facilities[5].

Most evaluation studies exploring museums utilise input-oriented models. In other words, to estimate relative efficiency and the best practice frontier, they attempt to minimise inputs given a certain output level. Such an approach proves convincing, particularly when integrating the number of museum visitors as the only output, since this figure may well be determined by other independent variables such as the size of the urban area or its historical appeal[6]. The basic structure for measuring efficiency in most studies concurs in the sense that it posits the overall efficiency and a breakdown between technical efficiency and scale efficiency. Put differently, it considers the technological hypotheses of constant scale performance, known as the CCR (Charnes, Cooper and Rhodes, 1978) model, and variable scale performance or BCC (Banker, Charnes and Cooper, 1984) model. This is a crucial point since, because of the enormous diversity inherent in museums, it is difficult to assume that they all produce on the optimal scale, and since inefficiencies may arise which are not in any way related to management but to the size of the museum, which may at times be either too small or too big.

[5] Unlike the majority of studies carried out, Taalas (1998) addresses minimising the total cost of a museum in terms of a wide range of resources and services classified according to varying thematic types of museum.

[6] Certain applications (Paulus, 1996; Mairesse, 1997) consider output-oriented models. In other words they posit maximising the final product given a level of inputs. The underlying hypothesis is grounded on the non-discretional nature of such models, in certain cases, such as state museums, where the principal-agent problem prevents managers from being able to alter inputs, at least in the short term.

Finally, the issue of technical change and the evolution of efficiency ratios over time is one which thus far has been the subject of little scholarly inquiry. Only Pignataro (2002) and Del Barrio and Herrero (2013) constructed Malmquist indicators to decompose such effects between the museums studied and as a mean evolution for all of the institutions involved[7]. Other studies (Mairesse and Vanden Eeckaut, 2002) have included a certain dynamic component from a different perspective by considering data grouped into several years ("window analysis") under the hypothesis that museums require periods of more than one year to carry out some of their activities such as organising temporary exhibitions or preparing a teaching programme.

This is the state of the art of efficiency studies in cultural institutions and particularly regarding the work carried out into museum evaluation. There is clearly a long way to go both with regard to streamlining the techniques used as well as in the creation of new applications with which to compare findings. This is the purpose of the empirical application we now set out.

3.- Empirical Analysis

3.1.- Case study and data sample

The present case study is the group of museum institutions that belong to the System of Museums in the Autonomous Community of Castilla y León (Spain)[8], an institutional demarcation which entails a certain level of accreditation due to the organisational and managerial requirements demanded of any museum wishing to form part of the network, but which at the same time provides them with preferential access to channels of dissemination, financial support, and help with training. Being endorsed in such a manner also allows for certain uniformity amongst the units contained in the sample, which in turn affords one of the basic conditions for ensuring that the efficiency evaluation proves reliable.

[7] Findings indicate that productivity in Sicilian museums grew by 4.5% each year between 1994 and 1998, mainly due to technical factors rather than to actual improvements in museum efficiency. By contrast, the growth in productivity in Spanish museums between 2005 and 2008 was 18%, and was mainly due to internal improvements in the running of the museums.

[8] See http://www.museoscastillayleon.jcyl.es/

This regional system of museums is made up of three clearly defined groups. The first is the group of museums run by the regional authorities, and which basically consists of the provincial museums (owned by the state but managed by the regional administration) and the museums recently set up by the regional authorities. The second group contains so-called integrated museums, which are felt to be of interest to the Autonomous Community and which, through an agreement with the administration, have joined the regional network, with the benefits and obligations this entails. These museums are mainly owned by local and provincial authorities although in certain instances management thereof is in the hands of consortia and foundations, which endows them with a certain amount of independence. Finally, there is a group of museums that are classed as recognised museums, which means that they are at a stage prior to being fully admitted into the regional museum system. These are mainly small municipal museums of an ethnographic nature, as well as certain private collections covering a range of themes.

To sum up, the Castilla y León regional museum system, as an accredited specific group of institutions, comprised a total of 45 museums in 2009, when the field work was conducted. Drawing on this group of museums, a survey was carried out in which quantitative information was requested concerning the activities the museum had engaged in between 2005 and 2008, as well as a list and volume of resources used for said activities[9]. The response rate was 73%, although certain museums had to be removed from the survey as they failed to provide us with basic data for some of the relevant variables, such as the number of visitors, staff employed, or because they had extremely limited opening hours. The final list of museums considered for efficiency evaluation is shown in Table 1, and consists of 23 institutions, half the total number in the regional system. Nevertheless, the sample may be deemed to represent an extremely significant proportion of the network, since it in fact contains 75% of the integrated museums and those that are run by the regional authorities, those not included in the sample being mainly the recognised museums, control over which proves more difficult. Broadly speaking, the museums are a uniform group of mainly fine arts and archaeological museums, none of which stands out in particular due to its specificity or because of the scope of its collection. The group basically comprises museums which

[9] Both the format of the survey as well as data gathered are available upon request.

have brought together the most representative ethnographic, archaeological, or art works from the area or province, together with other museums of a more specific nature dealing with crafts and design or offering collections by a particular artist or creator. The sample therefore comprises museums that are similar in nature. The superstar theory (Frey, 1998) that one particular museum or masterpiece stands out over the rest due to its power of attraction does not therefore apply here.

(TABLE 1)

We have attempted to make the descriptive variables for this sample of museums representative of all the inputs and outputs linked to the production function of a museum. On the input side, we first have the work or staff factor for the personnel involved in the museum's various activities: management, administration, technical staff, security, maintenance staff, and so on. Secondly, capital resources are specified in two variables: the museum's size in square metres, which gives an idea of the scale and importance of the building housing the collection, and one indicator for the equipment and services which are deemed essential for the museum to undertake many of its activities[10]. This section does not contain any variable reflecting the cultural value or official accreditation of the museum collection itself, since this would be a qualitative variable[11]. However, the impact of this factor is assumed to have a direct correlation on the remaining variables, such as through museum size, which tends to be linked to the museum's importance or to the historical value of the building where it is housed, but particularly through the art collection's dynamism in terms of the proportion of works loaned out or new additions, since this indirectly reflects the importance and scope of the collection. The former aspect is an input, whereas the latter has been posited as a museum activity and, therefore, as an output, as shall now be seen.

[10] This indicator specifically calculates the existence of library services, archive, restoration workshop, warehouse, photography workshop, audiovisual facilities, areas for educational activities, environmental control, computerised control, cloakroom, public car park for the disabled, areas for rent, tourist guides, audio-guides, webpages, conference room, cafeteria and shop.

[11] Clearly, a museum's cultural value cannot be confined to the number of pieces in the collection, given the disperse nature thereof. Nor is it possible to consider qualitative external evaluations, since these tend to be applied to the collection as a whole and fail to draw any distinction among the various pieces. Indeed, quantitative measurement of a museum's cultural value remains one of the challenges facing economic analysis, and is one which might only prove possible by estimating stated preferences through the contingent valuation method. However, positing any such technique would fall way outside the scope of the present research.

Indeed, as regards the variables representing output, we first consider those linked to the museum's exhibition function; namely, visitor numbers, the most basic expression of demand; and the number of temporary exhibitions organised by the museum, measured as the number of days of occupation per year. In fact, this second variable is also an output which is specific and representative of one of a museum's most characteristic activities, namely the organisation of exhibitions that complement the permanent collection. From this standpoint, and since organising such exhibitions may involve a certain amount of time, it was decided to calculate the value as the mean number of exhibitions (days) held over the two years, 2005-2006, for the first time period, and 2007-2008, for the second.

Carrying on with the representative outputs, two impact indicators were calculated. The first is linked to the museum's dissemination, communication, education and research activities, since we calculated the number of publications issued by the institution (guides, catalogues, artworks, and research articles) as well as the organisation of dissemination related activities, such as educational workshops, concerts, seminars, conferences, and mini-conferences, and so on. Given the disperse nature of these activities, we decided to call this variable the social impact of the museum. The second indicator is linked to the impact of the museum collection itself, since it calculates the movement of works loaned and new acquisitions compared to the size of the permanent collection. As stated earlier, this variable also indirectly reflects the museum's cultural value, since it assumes that the greater the collection's importance, the greater will be the number of loans and compilations of works it generates. In sum, Table 2 shows the descriptive statistics of the variables included in the efficiency basic analysis of our selected sample of museums for the two time periods considered, 2005 and 2008.

(TABLE 2)

3.2.- Method

For the efficiency analysis of the regional system of museums in Castilla y León, we considered a complex formulation of the production function, namely one encompassing the basic resources of work and capital in order to obtain a multiple set of

outputs reflecting the various functions undertaken by a museum. We sought to use this in order to overcome the restriction found in most museum efficiency studies of considering only one outcome, attendance measured through the number of visitors. We included a total of four possible outputs, namely those mentioned previously, and which in turn attempt to merge the majority of the services provided by museums. On the input side, of the three taken into account, employment, size and equipment, the second is taken as a non-discretional resource, in the sense that we feel that the museum management has little scope in the short term to alter the size of the museum or the number of exhibition rooms.

Yet, based on this general and hypothetical production function generated for the network of museums under study, we contend that certain contextual factors might impact such institutions' performance, these factors specifically being the institutional management model and the museum's location[12]. The former relates to the museum's organisational and strategic approach, which might range from merely exhibiting a collection of art to undertaking all the tasks related to conservation, research, and dissemination. Clearly, this might affect both the number of inputs available as well as the museum's actual impact. Likewise, the museum's location might also impact performance, since museums located in urban areas have the advantage of demographic size and the surrounding area, and are likely to benefit from better communications and accessibility. Figure 1 summarises the hypothetical museum production function considered in this research with its determinant basic variables and the independent factors that might affect it.

(FIGURE 1)

On the basis of these hypotheses, two external contextual variables that shape a museum's activities have been created. The first is the institutional approach to management, which distinguishes between museums run by the regional authorities and the rest, which are mainly museums run at a local council scale. The second variable is location, which basically distinguishes between museums located in provincial capitals and the remainder which are found in rural areas. Based on this approach, a contrast of

[12] For an evaluation study of efficiency for all the museums without taking into account external factors that might affect the efficiency ratios, see Del Barrio and Herrero (2013)

significant differences was performed, both in input as well as output levels, due to the prevalence of these two external factors. For this, a Kruskal-Wallis non-parametric test, which compares the difference in medians between groups of variables, was conducted. Table 3 shows the results of this analysis. First, the management model evidences substantial differences for four relevant variables: employment and museum size on the input side, and the number of visitors and social impact on the output side. Secondly, the location variable reveals significant differences in the same indicators mentioned, together with a further one, the level of equipment in the museums, which appears to differ significantly when comparing urban and rural museums. In an attempt to ascertain whether there are also noticeable differences both in the level of efficiency and how this evolves, efficiency evaluation is performed separately for the four resulting groups. For this purpose, we use the production function which proves representative in each case, in other words, a two-input and two-output function for institutional segmentation, and a three-input and two-output function for the geographical segmentation of the museums.

TABLE 3

Efficiency evaluation through DEA analysis may be carried out by applying a number of different approaches: input oriented or output oriented. In the present research, we selected the model we deemed the most appropriate for our case study, which leads us firstly to specify a DEA analysis focusing on *minimising inputs*. By adopting such an approach, the efficiency indicator outcomes will show to what extent the existing inputs can be enhanced in order to achieve the same output; or put differently, what potential of maximum radial reduction of inputs is required to maintain a given level of output. As an approach, it also proves to be an option that is consistent with the focus on saving resources which central management bodies impose on decentralised institutions like museums at a time of budget restrictions such as the present.

Efficiency analysis is conducted under two technological hypotheses: assuming that the units work with constant scale performance (CCR model), or with variable scale performance (BCC model). Such a distinction is highly convenient in our case study, since when large differences exist between the sizes of the analysis units, it may prove inappropriate to draw a proportional comparison between large and small units, such

that we must accept a more flexible option, namely the existence of variable scale performance[13]. Proceeding thus, with the first model we obtain an overall technical efficiency indicator (OTE), in which inefficient situations or ones that are some distance from the frontier may be due to inadequate productive management, or the result of being in an inappropriate size. The second model, however, removes the component resulting from an inadequate production scale, and addresses what is actually pure technical efficiency (PTE) linked to optimisation of resources. Using these two indices offers the possibility of obtaining another, the scale efficiency index (SE), which would be calculated as the quotient between the two previous ones, in other words, SE = OTE / PTE (See Ganley and Cubbin, 1992).

3.3.- Results

The efficiency evaluation results for the regional system of museums in Castilla y León for the various groups to emerge from the segmentation analysis are shown below[14]. Applying segmentation following the institutional management model, we first used the representative production function, the one employing the work and museum size inputs to secure visitor demand and social impact, perceived as a compound indicator of activities related to education, research, and dissemination. The results are shown in Table 4. Taking the case of variable scale returns in 2008, the group of regionally run museums has a more abundant efficiency frontier, since six of the nine museums achieve an optimal performance, compared to only five of the fourteen in the group of museums run at a local council scale. This is reflected in the mean efficiency ratio of each group, which is substantially higher in the former case, 82% compared to 77%. These data indicate the remaining museums in the network are working below their capacity, either due to inadequate resource management, or as a result of an inappropriate scale. Specifically, in the case of regionally run museums, the same levels of goods and services could be achieved with 18% fewer resources, which in the case local museums would imply a mean adjustment of 23%.

(TABLE 4)

[13] Indeed, being twice the size and having twice as many resources does not imply that a museum should obtain twice the output, but perhaps more, or even less. The same should also be assumed in the opposite sense.

Efficiency can also be examined individually for each museum, the analysis revealing that among the most efficient museums we find those under regional ownership and management and recently opened by the regional government, as well as many of the provincial museums, together with some of the local museums run by foundations which enjoy a certain degree of independence. All of these are endowed with significant resources and focus on several complementary aims. It is also interesting to notice how efficiency evolves over time. Malmquist Indices prove suitable since they allow us to decompose productivity into changes resulting from technical progress (displacements from the efficiency frontier) or shifts in productive management efficiency (variations in the distance from the unit to the frontier). In turn, the latter may be broken down into pure changes in efficiency or changes in scale efficiency. Table 5 shows the values of all the indices and sub-indices to emerge from this method[15], individualised for each museum in the sample and as a mean ratio for the two groups of museums. It is also striking that regionally run museums evidence a significant growth in mean productivity (29% between 2005 and 2008), basically due to internal improvements in management and not so much to adaptations to technical change. By contrast, in general terms, local museums evidence stagnation in their productivity levels

(TABLE 5)

As regards efficiency analysis in geographic segmentation, a three-input and two-output production function was used, where a museum's level of equipment as a capital provision was added to the previous combination, since this proved significant when comparing differences between urban and rural museums. The evaluation outcomes are shown in Table 6, which reflects how, broadly speaking, urban museums evidence better mean efficiency ratios as well as significant growth in productivity (Table 7), whereas rural museums are less efficient and display a certain stagnation in their productivity levels. This is because the majority of rural museums house small collections and are run by local councils in contrast to the cities, where both provincial museums together with others run by foundations and local consortia are to be found, these museums emerging as more efficient in the institutional segmentation analysis.

[14] The PIMSoft (Performance Improvement Management, 2011) Program was used for this analysis
[15] For further details, see Zofío (2001)

(TABLE 6)

(TABLE 7)

One application of non-parametric DEA analysis for evaluating the supply of public services is that for inefficient units it allows the necessary adjustments to be calculated, both in inputs and outputs, to reach an optimum result, in other words the efficiency frontier. The results of this analysis for the case study in hand are shown in Tables 8 and 9 which reflect the improvements that the sub-optimal museums to emerge from institutional and location segmentation, respectively, need to make[16]. It can thus be seen that the main sources of inefficiency in the regional system of museums in Castilla y León are the result of over-staffing in museums, although regionally run museums and urban museums also need to undertake a number of key improvements vis-à-vis attracting more visitors and achieving a greater social impact, with the related activities that this implies. By contrast, municipal museums and those in rural areas offer hardly any potential improvements in output, and seem somewhat overstaffed and over-equipped. This is a general reflection of the fact they are small, the limited scope of their results meaning that any saving can only be achieved in terms of staffing and equipment.

(TABLE 8)

(TABLE 9)

4.- Conclusions

Efficiency evaluation of cultural institutions is an area that has been the focus of little scholarly attention although said institutions may indeed be considered prime examples of public entities that draw on a variety of inputs which are not always measurable in objective terms, yielding in turn a complex set of outputs, that are sometimes intangible and non-market. In sum, what is assessed is the efficiency of a public service,

[16] The museum size variable has been removed from the analysis, as it is deemed a non-discretional resource in the short term by museum managers.

comparable to education or health, areas which have, however, been the subject of greater attention in recent years. Developing theoretical knowledge and practical applications in the evaluation of cultural institution efficiency proves nowadays both crucial and invaluable.

The present research provides an empirical application of an evaluation of cultural institutions, taking a regional network of museums in Spain as an example. The evaluation technique used was Data Envelopment Analysis, the special feature in this instance being that the analysis considers a system of multiple inputs and outputs in the production function, adapted to the various functions which museums fulfil as public services. We contend that certain exogenous factors may impact both levels and evolution of efficiency and, as a result, we analyse the influence of the two variables, the museum's institutional management model and its location, as possible determinants of the level of efficiency in these institutions. To achieve this, a contrast of differences in the system of museums based on these two variables was conducted. This yielded two quite different groups of museums with production functions that proved representative for each case. Efficiency evaluation is thus carried out separately for these resulting groups, in an attempt to ascertain whether there are also noticeable differences both in the level of efficiency and in how this evolves. We estimate efficiency ratios based on two differing technological hypotheses (constant performance and variable scale performance) and gauge the efficiency dynamics by decomposing Malmquist Indices.

The most important findings to emerge indicate that at least half the museums chosen operate efficiently. Yet, the museums achieving the highest efficiency levels are those located in urban areas and run by regional administration, compared to municipally run rural museums, which proved less efficient. This is usually because the former museums engage in a broader range of activities and functions and tend to have more resources available. They have the added advantage of enjoying greater potential demand in terms of visitors, both due to the size of the area where they are located and because they benefit from better communications and access. As regards the evolution of productivity, quite significant progress is evident in the ratios of these museums, mainly due to improvements in internal efficiency, in other words, own management of resources in relation to services provided. Contrastingly, as expected, technological

change has less impact, which proves less receptive to new technologies in cultural heritage compared to other cultural industries.

On the other side of the scale are the rural museums run at a municipal level, which evidence lower efficiency levels, there being a smaller number of optimum museums. The evolution of productivity over time is also seen to have practically stagnated. All of these features reflect how small these museums tend to be and the restricted scope they have, as well as the fact that they are basically small ethnographic and artistic collections. Nevertheless, they fulfil the goal of maintaining rural cultural heritage. Justification for public provision would therefore be due to their existence value and legacy value (O'Hagan, 2009), more than because of deficits in management efficiency levels. Indeed, the findings from the present study regarding an estimation of the changes in inputs and outputs required to achieve the optimal efficiency frontier, scarcely point to any significant improvements in this group of museums, whereas efforts in the former group focus particularly on changes in staffing levels and securing a higher number of visitors and a greater social impact.

Finally, the usefulness of the findings to emerge from research of this nature is not confined to providing objective and robust insights into the efficiency of a regional network of museums but may also afford an opportunity for cooperation between analysts and decision-makers involved in the cultural sector. Firstly, museum managers themselves may benefit from this application by gaining a relative measure of how efficiently they are running their museums. Secondly, cultural policy makers may benefit by being able to draw on an objective tool for allocating resources to museum networks, either through a share of funding aimed at efficient groups, or through more imaginative formulas, such as establishing management performance related efficiency bonuses. Finally, private stakeholders and particularly sponsors may benefit from such a hierarchisation by being able to gain an idea of how productive their sponsorship of such activities is proving.

Table 1. Sample of Museums

Code	MUSEUM	Type	Management	Location
M1	Castilla y León Ethnographic Museum	Regional	Regional Govt.	Urban
M2	Castilla y León Mining and Steel Industry Museum	Regional	Regional Govt.	Rural
M3	Ávila Museum	Provincial	Regional Govt.	Urban
M4	Burgos Museum	Provincial	Regional Govt.	Urban
M5	León Museum	Provincial	Regional Govt.	Urban
M6	Palencia Museum	Provincial	Regional Govt.	Urban
M7	Numantino Museum in Soria	Provincial	Regional Govt.	Urban
M8	Valladolid Museum	Provincial	Regional Govt.	Urban
M9	Zamora Museum	Provincial	Regional Govt.	Urban
M10	Dinosaur Museum	Integrated	Local Govt.	Rural
M11	Roman Museum	Integrated	Local Govt.	Rural
M12	Upper Bierzo Municipal Museum	Integrated	Local Govt.	Rural
M13	Sierra-Pambley Museum	Integrated	Foundation	Urban
M14	Bierzo District Museum of History	Integrated	Local Govt.	Rural
M15	Valencia de Don Juan Castle Museum	Integrated	Local Govt.	Rural
M16	Piedad Isla Ethnographic Museum	Integrated	Foundation	Rural
M17	Mateo Hernández Museum	Integrated	Local Govt.	Rural
M18	Esteban Vicente Museum of Contemporary Art	Integrated	Consortium	Urban
M19	Museum of the “Fueros”	Integrated	Local Govt.	Rural
M20	“Las Ferias” Museum	Integrated	Foundation	Rural
M21	Villadiego Municipal Museum	Recognised	Local Govt.	Rural
M22	Chocolate Museum	Recognised	Local Govt.	Rural
M23	David Melui Jewish Museum	Recognised	Local Govt.	Rural

Table 2. Descriptive Variables

Variable	Mean	Sum	Std. Dev	Min.	Max.
Size (*)	1 753.4	40 327.5	1 996.1	165.0	7 500.0
Employment 05	10.2	234.0	9.6	1.0	29.0
Equipment 05	6.9	158.0	4.5	-	13.0
Visitors 05	13 011.5	299 265.0	18 148.4	680	87 078.0
Temporary Exhibs. 05 (**)	77.9	1 790.5	104.5	-	322.0
Social Impact 05	7.7	177.0	10.2	-	46.0
Impact of Collection 05	5.6	128.2	12.7	-	51.5
Employment 08	12.2	281.0	9.2	1.0	27.0
Equipment 08	9.6	220.0	3.2	4.0	15.0
Visitors 08	14 814.0	340 721.0	12 737.3	1.517.0	59 967.0
Temporary Exhibs. 08 (**)	108.9	2 504.0	108.2	-	365.0
Social Impact 08	16.6	381.5	17.4	-	66.5
Impact of the Collection 08	5.6	129.4	8.4	-	31.0

N.B.: (*) In square metres; (**) Days of occupation

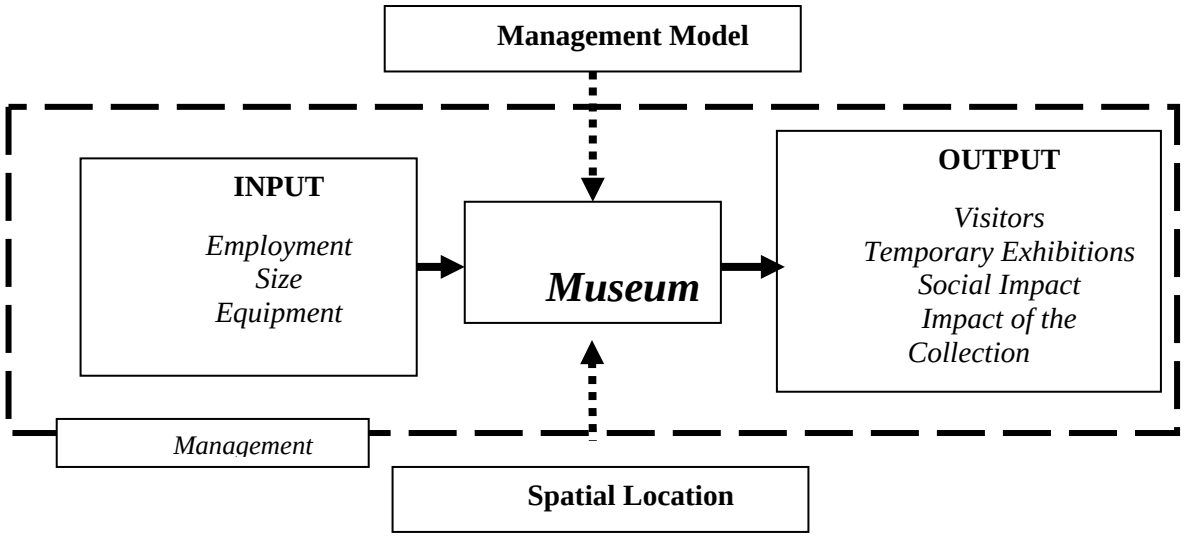

Figure 1. Production function of a museum

Table 3. Results of the Kruskal-Wallis Test of median differences in input and output variables by management model and location				
	Management Model		**Location**	
Variable	**Statistic**	**p-value**	**Statistic**	**p-value**
Size	118.0	0.000594785[a]	116.5	0.00155808[a]
Employment 05	108.0	0.00479185[a]	122.0	0.000422251[a]
Equipment 05	54.5	0.61164	82.0	0.30256
Visitors 05	83.5	0.207599	98.0	0.0437932[b]
Temporary Exhibs. 05	73.5	0.522818	85.5	0.208322
Social Impact 05	67.0	0.824897	82.5	0.290072
Impact of Collection 05	85.0	0.169594	89.0	0.139408
Employment 08	121.0	0.000282241[a]	130.0	0.0000607375[a]
Equipment 08	70.5	0.656929	94.5	0.0700588[c]
Visitors 08	94.0	0.0546911[c]	98.0	0.0438453[b]
Temporary Exhibs. 08	89.0	0.107761	91.0	0.11333
Social Impact 08	108.5	0.00456643[a]	109.0	0.00695303[a]
Impact of Collection 08	79.0	0.326459	78.0	0.435933

Notes: Institutional Management Model: regional administration vs local administration; Location: urban vs rural

[(a) (b) (c)] Significant at the 99%, 95% and 90%, level of confidence respectively.

Table 4. Management model segmentation: Efficiency outcomes

	2005			2008		
Code (Regional / Local Management)	**CCR Overall Technical Efficiency**	**BCC Pure Technical Efficiency**	**SE Scale Efficiency**	**CCR Overall Technical Efficiency**	**BCC Pure Technical Efficiency**	**SE Scale Efficiency**
M1	19.02	19.02	100	100	100	100
M2				100	100	100
M3	100	100	100	100	100	100
M4	29.69	29.69	100	32.76	38.46	85.17
M5	44.98	44.98	100	99.6	100	99.6
M6	21.04	21.04	100	40.48	58.82	68.81
M7	100	100	100	65.99	100	65.99
M8	25.63	100	25.63	42.56	100	42.56
M9	21.04	21.04	100	19.38	41.67	46.52
Mean Eff.	45.18	54.47	90.70	66.75	82.11	78.74
Standard Dev.	34.81	38.57	26.29	33.67	27.39	23.56
No. of Eff. Museums	2	3	7	4	6	4
M10	85.95	85.95	100	58.01	58.66	98.9
M11	100	100	100	46.45	58.99	78.74
M12	22.28	22.28	100	58.82	61.9	95.02
M13	46	46	100	30.34	31.32	96.89
M14	81.21	82.06	98.97	58.7	66.22	88.64
M15				11.91	100	11.91
M16	100	100	100	69.55	70.81	98.23
M17	77.18	77.18	100	100	100	100
M18	80.31	100	80.31	100	100	100
M19	72.06	72.06	100	100	100	100
M20	100	100	100	96.11	97.77	98.31
M21	20.72	20.72	100	18.55	50	37.09
M22	100	100	100	100	100	100
M23	50	50	100	80.88	85.71	94.36
Mean Eff.	71.98	73.56	98.41	66.38	77.24	85.58
Standard Dev	28.54	29.54	5.44	31.33	23.22	26.98
No. of Eff. Museums	4	5	11	4	5	4

Table 5. Management model segmentation: Malmquist indices

Code (*)	GTPF	TC	EC	PEC	SEC
M1	2.29	0.44	5.26	5.26	1
M2					
M3	1	1	1	1	1
M4	1.05	0.88	1.1	1.3	0.92
M5	1.49	0.67	2.21	2.22	1
M6	1.39	0.6	1.92	2.8	0.83
M7	0.81	1	0.66	1	0.81
M8	1.29	1	1.66	1	1.29
M9	0.96	0.71	0.92	1.98	0.68
Mean	1.29	0.79	1.84	2.07	0.94
M10	0.82	1.21	0.67	0.68	0.99
M11	0.68	1.3	0.46	0.59	0.89
M12	1.62	0.6	2.64	2.78	0.97
M13	0.81	1.21	0.66	0.68	0.98
M14	0.85	1.11	0.72	0.81	0.95
M15					
M16	0.83	1.19	0.7	0.71	0.99
M17	1.14	0.88	1.3	1.3	1
M18	1.12	1	1.25	1	1.12
M19	1.18	0.85	1.39	1.39	1
M20	0.98	1.01	0.96	0.98	0.99
M21	0.95	0.64	0.9	2.41	0.61
M22	1	1	1	1	1
M23	1.27	0.76	1.62	1.71	0.97
Mean	1.02	0.98	1.10	1.23	0.96

Notes: (*) Regional / Local Management Model. GTPF: Growth in total productivity of the factors; TC: Technical change; EC: Efficiency change; PEC: Pure efficiency change; SEC: Scale efficiency change

Table 6. Location segmentation: Efficiency outcomes

	2005			2008		
Code (Urban / Rural)	**CCR Overall Technical Efficiency**	**BCC Pure Technical Efficiency**	**SE Scale Efficiency**	**CCR Overall Technical Efficiency**	**BCC Pure Technical Efficiency**	**SE Scale Efficiency**
M1	17.49	50	34.98	85.37	90.16	94.69
M3	100	100	100	100	100	100
M4	40.1	66.1	60.67	54.16	76.07	71.19
M5	44.98	96	46.85	100	100	100
M6	17.95	64.86	27.67	34.06	98.57	34.55
M7	100	100	100	80.67	100	80.67
M8	22.43	100	22.43	97.64	100	97.64
M9	18.99	54.55	34.82	28.57	76.29	37.45
M13	56.55	100	56.55	100	100	100
M18	100	100	100	100	100	100
Mean Eff.	51.85	83.15	58.40	78.05	94.11	81.62
Standard Dev	35.65	21.41	31.05	28.53	9.93	25.94
Num. Mus. Eff.	3	5	3	4	6	4
M2				100	100	100
M10	85.95	85.95	100	60.78	67.14	90.52
M11	100	100	100	60.94	65.08	93.63
M12	40	40	100	58.82	61.9	95.02
M14	82.65	82.65	100	72.96	82.47	88.47
M15				17.92	100	17.92
M16	100	100	100	72.68	76.81	94.61
M17	100	100	100	100	100	100
M19	83.54	87.14	95.87	100	100	100
M20	100	100	100	96.11	97.77	98.31
M21	21.37	21.37	100	21.86	100	21.86
M22	100	100	100	100	100	100
M23	51.85	51.85	100	80.88	100	80.88
Mean Eff.	78.67	79.00	99.62	72.53	88.55	83.17
Standard Dev	28.05	28.13	1.25	28.36	15.54	28.65
Num. Mus. Eff.	5	5	10	4	7	4

Table 7. Location segmentation: Malmquist indices

Code (*)	GTPF	TC	EC	PEC	SEC
M1	2.21	0.74	4.88	1.8	1.65
M3	1	1	1	1	1
M4	1.16	0.93	1.35	1.15	1.08
M5	1.49	0.98	2.22	1.04	1.46
M6	1.38	0.81	1.9	1.52	1.12
M7	0.9	1	0.81	1	0.9
M8	2.09	1	4.35	1	2.09
M9	1.23	0.85	1.5	1.4	1.04
M13	1.33	1	1.77	1	1.33
M18	1	1	1	1	1
Mean	1.38	0.93	2.08	1.19	1.27
M2					
M10	0.84	1.13	0.71	0.78	0.95
M11	0.78	1.24	0.61	0.65	0.97
M12	1.21	0.8	1.47	1.55	0.97
M14	0.94	1	0.88	1	0.94
M15					
M16	0.85	1.14	0.73	0.77	0.97
M17	1	1	1	1	1
M19	1.09	0.93	1.2	1.15	1.02
M20	0.98	1.01	0.96	0.98	0.99
M21	1.01	0.46	1.02	4.68	0.47
M22	1	1	1	1	1
M23	1.25	0.72	1.56	1.93	0.9
Mean	1.00	0.95	1.01	1.41	0.93

Notes: (*) Urban / Rural Location. GTPF: Growth in total productivity of the factors; TC: Technical change; EC: Efficiency change; PEC: Pure efficiency change; SEC: Scale efficiency change

Table 8. Management model segmentation: Possible improvements in achievement of inputs and outputs

	INPUTS			OUTPUTS					
	Employment			Visitors			Social Impact		
Code	Value	Target	Gain %	Value	Target	Gain %	Value	Target	Gain %
M4	26	10	-61.54	18,993	22,299	17.41	13	25	92.31
M6	17	10	-41.18	6,647	22,299	235.47	17.5	25	42.86
M9	24	10	-58.33	10,373	22,299	114.97	9	25	177.78
M10	6	3.52	-41.34	11,000	11,000	0	8	8	0
M11	5	2.95	-41.01	9,327	9,327	0	7	7	0
M12	3	1.86	-38.1	3,440	5,353	55.6	6	6	0
M13	12	3.76	-68.68	12,889	12,889	0	7	7	0
M14	7	4.64	-33.78	16,190	16,190	0	6.5	7.67	18.06
M16	4	2.83	-29.19	7,136	7,136	0	9	9	0
M20	6	5.87	-2.23	16,311	16,311	0	14	14	0
M21	2	1	-50	1,517	4,090	169.61	0	3	
M23	2	1.71	-14.29	2,833	5,142	81.52	5.5	5.5	0

Table 9. Location Segmentation: Possible improvements in achievement of inputs and outputs

	INPUTS						OUTPUTS					
	Employment			Equipment			Visitors			Social Impact		
Code	Value	Target	Gain %	Value	Target	Gain %	Value	Target	Gain %	Value	Target	Gain %
M1	24	21.64	-9.84	13	11.72	-9.84	9,706	24,500	152.42	61.5	61.5	0
M4	26	19.78	-23.93	10	7.61	-23.93	18,993	18,993	0	13	13	0
M6	17	16.76	-1.43	11	10.84	-1.43	6,647	16,755	152.07	17.5	17.5	0
M9	24	18.31	-23.71	11	8.39	-23.71	10,373	16,712	61.11	9	9.45	5.04
M10	6	4.03	-32.86	11	7.39	-32.86	11,000	11,000	0	8	8	0
M11	5	3.25	-34.92	11	7.16	-34.92	9,327	9,327	0	7	7	0
M12	3	1.86	-38.1	12	6.79	-43.45	3,440	5,353	55.6	6	6	0
M14	7	5.77	-17.53	10	8.25	-17.53	16,190	16,190	0	6.5	11.29	73.65
M16	4	3.07	-23.19	8	6.15	-23.19	7,136	7,136	0	9	9	0
M20	6	5.87	-2.23	11	8.8	-20.01	16,311	16,311	0	14	14	0

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