An analysis of the efficiency of Italian museums using a
generalised conditional efficiency model

Calogero Guccio\textsuperscript{a}, Marco Martorana\textsuperscript{a}, Isidoro Mazza\textsuperscript{a},

Giacomo Pignataro\textsuperscript{a,b}, Ilde Rizzo\textsuperscript{a}

\textsuperscript{a}Department of Economics and Business, University of Catania

\textsuperscript{b}Department of Management, Economics and Industrial Engineering, Politecnico di Milano

Abstract

Museums are among the most relevant cultural institutions and assume a central role from the cultural and the economic perspectives in a country having an outstanding cultural heritage, such as Italy, which makes the evaluation of their efficiency of primary importance. However, so far, the literature evaluating museums’ efficiency has often neglected the distinction between outputs under the direct control of museums and outcomes, which depend on users’ involvement, thus providing incorrect conclusions on museums’ performance. In this paper, we employ a generalised conditional efficiency model to assess the true efficiency of Italian museums, i.e. the efficiency in the provision of museums’ service potential, and to consistently deal with the impact on the efficiency of the socio-demographic and institutional environment in which museums operate. Results show that the operational environment matters. Among other aspects, conditional estimates suggest that higher income levels and larger hospitality sectors positively influence museums efficiency.

JEL classification: Z1; C14; C61; I21

Keywords: Cultural heritage; Museums; technical efficiency; Non-parametric Frontier; FDH; Conditional estimates.

\textsuperscript{*}Corresponding author: Corso Italia, 55 – 95129 Catania, guccio@unict.it
1. Introduction

The analysis of the efficiency of production of museums has gained a rising interest over time, with a focus on technical efficiency and growing use of the frontier techniques. A crucial step for ensuring a conceptually consistent application of this methodology and the provision of correct information to decision-makers is the definition of the production function in terms of inputs and, especially, outputs that are actually under the control of museums’ managers. In that regard, one of the most relevant problems is the use of measures of outcomes among the outputs of museums, such as the number of visitors. Moreover, a correct estimation of efficiency often faces the additional problem of the potential idiosyncratic impact of environmental and contextual factors, not under the control of managers, on the different museums. These issues are not specific to the field of museums since they characterize the production of several public services. However, while there are several studies on the measurement of efficiency and performance of different services (health care, local services, public libraries, etc.) dealing with the identification of outputs, as separate from outcomes, as well as with the impact of exogenous factors on the production process, the literature on the efficiency of museums has substantially overlooked these issues. Only recently, Del Barrio and Herrero (2019) have estimated the efficiency of a sample of Spanish museums taking into account both aspects.

This paper aims at contributing to fill this gap. It provides an estimate of the technical efficiency of Italian museums, focusing on the production process of outputs that can be considered under the direct control of their managers and taking into account the potential heterogeneity arising from the relevant context in which production of services is realized. The analysis is based on a large database of Italian museums (over 3,800 units), built on by the Italian National Statistical Office (in collaboration with the Ministry of Cultural Activities and the Regional governments), which run three waves of surveys, in 2011, 2015 and 2017. Each survey contains over 100 questions.

Following a line of reasoning that traces back to Bradford et al., (1969) and Parks et al. (1981), we characterize museums’ provision as a two-stage production process where only the first stage is fully under the control of museums and consists in the use of the available space and workers to provide a service defined in terms of opening days and exhibitions of collections, while the second stage entails the active involvement of users to ‘produce’ outcomes. Given that the second stage outcomes critically depend on users’ behaviour, we focus on the first stage, so as to assess the true efficiency of museums’ management.
Following De Witte and Geys (2011), the estimation of the productive efficiency frontier and the measurement of the efficiency scores of each museum are carried out using a generalised conditional efficiency model, which allows taking into account inputs, outputs and environmental factors simultaneously, estimating productive efficiency in just one step. As for the environmental factors, we consider some variables mainly related to the potential demand of museums services, which can exert an “external” pressure on the service potential size, as well as to the governance of museums, which can “exogenously” influence the choice of inputs. More precisely, we will consider the following factors: population size and number of beds of the hotels and similar structures in the province where the museum is located, and the per capita income at regional level, accounting for the potential demand in the area, as well as current expenditure for cultural and touristic activities at regional level and the public/private nature of the museum governance.

Our approach is different from the one adopted by Del Barrio and Herrero (2019), since we limit our analysis to the measurement of the efficiency of transformation of inputs into the service outputs realized by museums, while they also consider the subsequent contribution of these services to a measure of outcome, like the number of visitors. While such an approach is surely more ambitious of the route we follow in this paper, since it aims at providing an overall evaluation of the activities of museums, our choice is motivated by the theoretical and empirical shortcomings of the way this approach is currently implemented, as discussed in the following paragraph 2.2. Moreover, to the best of our knowledge, it is the first time that such a large dataset is used in a work on the estimation of museums’ efficiency and, therefore, it allows for a thorough analysis of a decentralised and diffused system of museums, like the Italian one. Finally, the extension of our dataset allows to test the methodology of measurement of efficiency applied in this work, on a wider basis than it has been done up to now.

Our results show that the operational environment matters and significantly affects museums efficiency. Conditional estimates suggests in fact that higher income levels and larger hospitality sectors positively influence museums efficiency. In addition, private ownership is associated to stronger incentives towards efficiency and, finally, lower efficiency levels are reported for State-run museums.

---

1 A recent paper by Bertacchini et al. (2018) draws on the same data (for 2011), but the objective of the work is to test the impact of the ownership and the organizational structure of museums on their performance, as measured in terms of effectiveness in disseminating culture to audiences and contributing to the local development.
The remainder of the paper is structured as follows. Section 2 positions our approach and contribution in the context of the relevant literature. Section 3 describes the estimation methodology, while Section 4 discusses the institutional setting and data. Our findings are presented in Section 5. Finally, the main conclusions are summarized in Section 6.

2. Literature review

The measurement of the efficiency of production of museums, as well as of other cultural institutions, has developed from an initial stage characterized by the wide use of productivity indicators\(^2\) to several attempts of employing efficiency frontiers. With regards to the application of the latter methodology to museums, we can mention Pignataro (2002); Mairesse and Vanden Eeckaut (2002); Bishop and Brand (2003); Basso and Funari (2004); Del Barrio et al. (2009); Taheri and Ansari (2013); Del Barrio and Herrero (2014); Wang et al. (2017); Basso et al. (2018); Sebova (2018); Del Barrio and Herrero (2019).

The effort to move the analysis of efficiency of museums towards the use of more advanced approaches has been however, up to now, modestly paralleled by a refinement of their application, in line with the work done in other fields, to take into account issues, which are crucial for the scientific rigor of the analysis as well as for the accuracy of the information to be provided to decision-makers. Among the most relevant of these issues is, perhaps, the characterization of the production process of museums in terms of what is strictly under control of their managers. This is a crucial aspect for developing a consistent operationalization of the theoretical concept of efficiency of production and for using the results of its measurement for purposes of evaluation and control of the museums’ managers.

2.1 Outputs and outcomes

A first question regards the identification of what has to be considered as the output of the production process managed by museums’ managers and, therefore, to be appropriately assessed as to whether being efficiently (or inefficiently) achieved through this process. Bradford et al. (1969) already discussed the issue of an appropriate definition of the output of public services, in the context of the analysis (and quantification) of the costs of local

\(^2\) For a thorough discussion of the main conceptual limitations of productivity indicators see Pignataro (2011).
public services. They make a “distinction between the services directly produced (which we call "D-output") and the thing or things of primary interest to the citizen-consumer (termed "C-output")” (Bradford et al., 1969, p. 186). This distinction is substantially consistent with the one between output and outcome of public services, which rests on the idea that while outputs (the D-output) are the result of the inputs employed by the producer of a service, the realization of outcomes (the C-output) is due to the concurrence of the use of outputs and of other factors not under the control of the producer. One relevant strand of literature traces back these factors to characteristics and actions of the consumers of services. Following Parks et al. (1981), a key characteristic of public service provision is that nothing of value can actually result without the active (and productive) involvement of users. This concept, generally known as citizens’ coproduction, applies to fields such as health care – where patients have to follow doctor’s prescriptions and recommendations to obtain health improvements – or education – as studying is necessary to achieve good marks – but also to culture, where cultural goods may result in cultural values (i.e. inspiration, knowledge, identity, etc.) only when people actively choose to attend theatrical pieces, search for books and documents in libraries and archives, and visit museums. Therefore, final outcomes of public provision are generally beyond the direct control of providers given the relevance of recipients’ active involvement, and thus are not actually ‘produced’ by providers. This implies that final outcomes, as well as observable outputs that refers directly to demand, should not be included in the evaluation of providers’ technical efficiency (De Witte and Geys, 2013). Their inclusion would in fact bias the efficiency assessment exercise, penalizing the scores of those providers that are located in areas with relatively low demand, independently of their effort to use resources efficiently. Moreover, it would mix-up issues of efficiency in producing outputs and of effectiveness in achieving outcomes, since the production function would be based on elements under control of production managers (the inputs) and elements (at least partially) out of their control (the outcomes).

Considering now the above mentioned literature on the assessment of the efficiency of production of museums, we do not find, in general, any attempt to identify a production function on the basis of a clear-cut notion of output, as differentiated from outcome, since most of those studies consider a production function contrasting the inputs directly controlled by museums with the number of visitors: for some of them this is the only output while, for others, it is one of multiple outputs. In a sense, the literature on efficiency of museums is lagging behind the work done for other cultural institutions on a critical issue like the clear and consistent identification of the output of the production process strictly
under the control of managers. We refer basically to the studies on libraries by Vitaliano (1998), Hammond (2002), De Witte and Geys (2011, 2013), Simon et al. (2011) and Guccio et al. (2018). The only noticeable exception regarding the efficiency of museums is represented by Del Barrio and Herrero (2019) who distinguish between programmed outputs, in direct control of museums’ managers, which in their analysis are measured by the number of temporary exhibitions, the number of publications and the number of dissemination actions (e.g. educational workshops, concerts, seminars, etc.), and the (only) observed output, that is the number of visitors, which they regard as “the most basic expression of demand … that depends on the appeal of supply as well as on visitor preferences and external factors that shape said demand” (Del Barrio and Herrero, 2019).

Once acknowledged the distinction between outputs and outcomes (or the similar terminology used in the literature referenced above), it comes the issue of how to deal with it in terms of the technical characteristics of the model to evaluate the efficiency of public provision. The general approach is to regard the provision of services as a two-stage process. In the first stage, providers use inputs to produce a ‘service potential’ (Hammond, 2002), which, in the second stage, is used for the realization of outcomes. As emphasized by Førsund (2017), in his brief but interesting review of the models based on this approach, the analysis of the first stage should support the assessment of the efficiency of the provider of services while the second stage is concerned with the effectiveness of services. There are, however, different ways to operationalize this approach through appropriate measures. Quite a general practice is to consider the analysis of the two stages as two efficiency problems in Farrell’s fashion, therefore transforming the effectiveness analysis of the second stage into an assessment of the efficiency in achieving outcomes (the outputs of the second stage “production function”) through the outputs realized in the first stage (the inputs of the second stage “production function”). There are several studies representatives of this empirical strategy. Limiting our attention just to the field of cultural institutions, among the others, Guccio et al. (2018) employ a centralized network DEA estimator, along the lines of Zhu (2011, 2014), while Del Barrio and Herrero (2019) consider a DEA SBM network model. These techniques provide estimates of DEA scores for each of the two stages of the provision of services as well as a composite score for the overall process. Førsund (2017) takes a sort of “radical” stance on this way of dealing with the two stages of the services’ provision. He argues that “the efficiency problem and the effectiveness problem are set up as separate operations” (Førsund, 2017, p. 96) and, moreover, the second

3 The second stage “production function” is, of course, an artifact since it is not representative of a “proper” technology as the one in the first stage.
stage transformation of outputs into outcomes is not explicitly and properly modelled. He believes, instead, that the efficiency and the effectiveness problems are highly interconnected, since “doing the things right” (the efficiency problem) cannot be separated from “doing the right things” (the effectiveness problem). Doing the right things requires, according to Førsund (2017), the statement of preferences for the different outcomes, which, in the model elaborated in his paper, is represented by an outcome preference function and is at the basis of an “overall preference effectiveness” measure, decomposed into technical efficiency and output-mix effectiveness. De Witte and Geys (2011), in their work on libraries, choose to focus on assessment of technical efficiency and deliberately exclude the analysis of the second stage, which may also respond to a set of external constraints different from the ones relevant for the first stage. Their effort, essentially, is one of selecting the appropriate outputs for the technical efficiency assessment as well as the proper contextual and environmental factors that can constrain the efficient transformation of inputs into outputs, in the first stage.

As it will be shown in section 3, in our analysis of the efficiency of production of museums we will consider the distinction between outputs and outcomes of museums, like Del Barrio and Herrero (2019) but, differently from them, we adopt the point of view of De Witte and Geys (2011) and we will, therefore, focus our analysis only on the assessment of the efficiency of transformation of museums’ inputs into outputs. We are aware of the limitations of this approach, as also acknowledged by De Witte and Geys (2011): “… we implicitly assume public service providers to provide services fitting to local preferences. In other words, decisions regarding service potential are assumed to reflect the characteristics of expected demanders” (p. 321). However, we believe that limitations on data and information do not allow to consider a thorough approach along the lines suggested, for instance, by Førsund (2017).

---

4 The major shortcoming of not exploiting the interlink between the efficiency and the effectiveness problems are for the measure of effectiveness. According to Førsund (2017), “… using observed service outputs as inputs in the effectiveness calculation having outcomes as products, the observations on service outputs contains inefficient output levels. The more inefficient a unit is the smaller is the input in these calculations, but, Ceteris Paribus, this leads to a higher effectiveness score. The output data are not cleaned up but remain ‘contaminated’ with inefficiency as opposed to our approach in (11) where observed outputs are projected to the frontier of the output production function before the efficiency mix score is calculated” (p. 100).
2.2 Contextual and environmental factors

The second question related to the characterization of the production process of museums in terms of what is strictly under control of their managers regards the consideration of factors that are exogenous to the management of the production process of museums, often termed as contextual and environmental factors. Overlooking the potential heterogeneity arising from these factors for the different museums, can severely bias the assessment of the efficiency of each institution. Inclusion of contextual and environmental factors in the analysis of efficiency requires a meaningful selection of the factors themselves and a technically appropriate methodology to ascertain their influence on the assessment of efficiency.

Again, this is an issue generally disregarded in the studies on museums referenced above, with the exception of Del Barrio and Herrero (2019) who consider variables “related to the socioeconomic characteristics of the environment where the museum is located (hotel capacity, alternative cultural attractions, economic conditions and ease of access) as some of the differentiating features of museums (age and managing institution)”. They therefore regress their efficiency scores on this variables, following the approach used by Simar and Wilson (2007). While we will discuss which are the contextual and environmental variables to introduce in our analysis in the following section, we can now consider the issue of the model for their inclusion in the analysis of efficiency, without any claim of offering a survey of the possible models. The approach used in the paper by Del Barrio and Herrero (2019) is part of a family of models, generally termed as two-stage, made up of a first stage in which efficiency scores are computed through nonparametric techniques and a second stage where those scores are regressed on exogenous variables. The technique used by Simar and Wilson (2007), based on the use of bootstrap methods, represents an advancement with the use of OLS or Tobit, which fail to account for the bias and the serial correlation among efficiency estimates. The main limitation of the two-stage approach is perhaps its reliance on the so-called separability condition, that is the environmental and contextual factors do not influence the shape of the production set but the position of each production unit within the set. The restriction implied by this condition is overcome by the conditional approach (Cazals et al., 2002; Daraio and Simar, 2005), which conditions the production process to a given value of environmental and contextual factors, in such a way

5 Updated reviews of the different approaches to the problem of introducing the influence of exogenous variable into the analysis of efficiency are provided, among the others, in Cordero et al. (2016) and Narbón-Perpiná and De Witte (2018).
that its input requirements change according to the favourable or unfavourable external conditions.\footnote{It is worth noting that there are other approaches to deal with environmental and contextual factors. Following Cordero et al. (2016), the one-stage approach developed by Banker and Morey (1986) include these factors as non-discretionary inputs, i.e. inputs that are not under the managers’ control, in the form of an additional restriction in the standard DEA program. Narbón-Perpiná and De Witte (2018) identify a meta-frontier approach: “It evaluates separate efficiency performance for different groups according to the environmental characteristics (De Witte and Marques, 2009)” (p. 1109).}

Following the above considerations about the limitations of the two stage approach, we will use the conditional approach and, more specifically, the generalised conditional efficiency model developed by De Witte and Kortelainen (2013) that is as an extension of the method by Daraio and Simar (2005, 2007a,b), which is built on, and it is robust to the presence of extremes. Our application of this method will be detailed in the next section.

3. Methods

Our approach to the estimation of the technical efficiency of Italian museums, as outlined in the context of the literature review of the previous section, will focus on the first stage of the provision of museums’ services, that is on the outputs directly controlled by their managers (the $D$-output in the words of Bradford et al., 1969; or the service potential, according to Hammond, 2002). This implies a careful selection of the variables representing the outputs. Moreover, we will condition the assessment of efficiency on some contextual variables that may be relevant in constraining the production of the outputs within the museums, following the model developed by De Witte and Kortelainen (2013). We will discuss these two elements of our approach to the estimation of the technical efficiency of Italian museums in turn.

3.1 The outputs of museums

In general, museums’ activities are not limited to the preservation and exhibitions of pieces of art, and the provision of ancillary services as they may include for instance dissemination, education and even research in some cases. However, the latter activities are undertaken by a limited share of museums while exhibition is normally provided by all of them. This is why in what follows we focus specifically on exhibition, in the definition of the service potential provided by museums. Essentially, we consider a production process involving the use of inputs such as the number of workers, and exhibition area (in...
square meters), which are commonly used in the literature (see Basso et al. 2018). Regarding the outputs, our selection is restricted to those that are under the direct control of museums, thus representing the provided service potential. Such variables have to reflect the physical and temporal extent of the exhibition function. Precisely, we consider a set of three outputs: the extent of exhibited collections (number of pieces actually exhibited), the number of opening days in the year (in range), and the number of temporary exhibitions.

3.2 A generalised conditional efficiency estimator

As previously mentioned, the operating environment in which DMUs operate may influence their performance, and may explain variations in the efficiency levels. To assess this issue, Daraio and Simar (2005, 2007ab) developed a non-parametric conditional approach, built on the order-m estimator, that overcomes the main limit of traditional two-stages procedures (Simar and Wilson 2007, 2011), namely the separability condition, as it assumes that the environmental factors affect the shape of frontier directly.

Essentially, this approach incorporates the external factors in the frontier estimation by estimating the efficiency conditional to the influence of the operational environment. Formally, assuming n DMUs using \( x (x \in \mathbb{R}^p) \) inputs to produce \( y (y \in \mathbb{R}^q) \), and being \( Z \) the vector of external (environmental) variables that are beyond the control of the DMUs, this approach involves the estimation of a partial order-m frontier (i.e. comparing DMUs with a subsample of size \( m \) instead that with the full sample), where the subsamples of size \( m \) are selected probabilistically based on a Kernel function around a given value of \( Z = z, (z \in \mathbb{R}^k) \). In turn, for each DMU there is a higher probability to be benchmarked against observations having similar exogenous characteristics. The resulting order-m conditional efficiency measure, following the probabilistic formulation in Daraio and Simar (2005), is denoted by

\[
\hat{\lambda}_{m,n}(x,y|z) = \int_0^\infty \left[ 1 - \left( 1 - \hat{S}_{y,n}(uy|x,z) \right)^m \right] du
\]

(1)

Where full efficient DMUs are located on the frontier and gets a \( \hat{\lambda}_n = 1 \). Conversely, an Inefficient DMU obtains a \( \hat{\lambda}_n > 1 \), and \( (\hat{\lambda}_n - 1) \) measures the increase in the output that the DMU should attain to perform as its \( m \) peers. Given that the score is calculated on a
subset of DMUs, the evaluated DMU can perform better than its peers and in this case obtains a $\lambda_m < 1$ and is thus considered super-efficient.\textsuperscript{7}

To study the direction of the influence of the environmental factors on the production process, Daraio and Simar (2005) suggest comparing the conditional scores to those estimated independent of the external factors (i.e. the unconditional ones). More specifically, they employ a smoothed non-parametric Kernel regression of the ratio of conditional scores to unconditional scores $Q_m^z = \hat{\lambda}_{m,n}(x,y|z)/\hat{\lambda}_{m,n}(x,y)$ on $z$ and then study its slope. This approach allows to detect whether $z$ is favourable (the slope is positive) or unfavourable (the slope is negative) to efficiency.

While this model allows only for continuous $z$, we follow the procedure by De Witte and Kortetalainen (2013) who extended the former one so as to include also discrete variables by using a mixed Kernel estimation. In addition, they developed a non-parametric bootstrap procedure, based on the work by Li and Racine (2007), to obtain statistical inference on the direction of the influence and test the significance of mixed environmental variables. This methodology avoids the problems related to the traditional two-stage procedure\textsuperscript{8}, thus allowing to evaluate robustly the efficiency of a sample of DMUs and the impact of the operational environment.

3.3 External factors

In studying the influence of the contextual and environmental factors on the service potential of museums, we focus on those factors potentially affecting the demand of museums services, as well as on the institutional features which can affect museums’ use of available inputs. Among the first class of factors we consider: the population size as well as the number of beds available in hotels and similar structures in the province where the museum is located and the per capita income in the region. To account for the institutional environment, we consider the current expenditures for cultural and touristic activities at regional level, the public/private nature of the museum, and among public institutions, whether they are run by the state or local jurisdictions.

\textsuperscript{7} The key parameter $m$ should be chosen at the value that stabilizes the number of superefficient DMUs, according to (Daraio and Simar, 2005), or be set at $m = \sqrt{N}$, according to the rule suggested by Daouia et al. (2012).

\textsuperscript{8} See Simar and Wilson (2007) and Fried et al. (2008) for a detailed discussion on this issue.
In what follows, we motivate the inclusion of the above environmental factors indicating the expected effect on museums’ efficiency. As for the first type of factors, it is generally acknowledged that socio-demographic characteristics may affect the demand and the willingness to pay for cultural goods eventually affecting the provision of museums. Following the line of reasoning of De Witte and Geys (2011), we should expect a significant effect of income level in the area where the museum is located. In fact, it can be presumed that the demand for cultural goods rises with income, potentially generating an interest group of high-income citizens pressuring museums to maximize their service potential, which would lead to an expected favourable effect of income level on museums’ efficiency.

The same logic can be applied to the accommodation capacity in hotels and similar structures, as a larger and stronger hospitality sector would make pressure to cultural provides. Also the size of population may affect providers behaviour, although, especially in the latter two cases, the risk of congestion could potentially lead such factors to be unfavourable or to weaken the pressure on museums to improve the efficiency, as expectations towards congestion will lower individuals’ expected benefit of the service (De Witte and Geys, 2011). Consistently with this argument, Barrio et al. (2019) finds a negative effect of the accommodation capacity and no significant effect of the GDP level on the efficiency of museums.

Finally, regarding the institutional factors, we guess regional government expenditures in culture and tourism may result in a more favourable environment for cultural institutions such as museums, potentially affecting the demand, in line with the above points. On an opposite perspective, public transfers to cultural institutions, resulting in additional inputs for providers, may weaken the internal incentive to improve efficiency (De Witte and Geys, 2011). Finally, public/private ownership and state/local governance may determine different internal incentives to use resources efficiently. Regarding ownership and governance, private institutions may have stronger internal incentives towards an efficient use of the available resources. Finally, among the public institutions, we may expect museums run by local jurisdictions to respond better to local demand side pressures, given the higher proximity of the management.

Table 1 summarises the full set of variables used in the following efficiency analysis.
Table 1. Variables description.

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inputs</strong></td>
<td></td>
</tr>
<tr>
<td>Personnel</td>
<td>No. of workers</td>
</tr>
<tr>
<td>Exhibition space</td>
<td>Available space for exhibitions in square meters</td>
</tr>
<tr>
<td><strong>Outputs</strong></td>
<td></td>
</tr>
<tr>
<td>Exhibited pieces</td>
<td>No. of exhibited items</td>
</tr>
<tr>
<td>Opening days</td>
<td>Opening days in the year, in range, taking values: opened days≤31; 31&lt;days≤50; 51&lt;days≤100; 101&lt;days≤150; 151&lt;days≤200; 201&lt;days≤250; 250&lt;days≤300</td>
</tr>
<tr>
<td>Temporary exhibitions</td>
<td>No. of temporary exhibitions</td>
</tr>
<tr>
<td><strong>Socio-demographic and institutional factors</strong></td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td>Dichotomous variable taking values: 1 if public owned, 0 if private</td>
</tr>
<tr>
<td>No_State</td>
<td>Dichotomous variable taking values: 1 if owned by local bodies, 0 if state owned</td>
</tr>
<tr>
<td>Number_beds</td>
<td>No. of beds in hotels and similar facilities in the province</td>
</tr>
<tr>
<td>GDP</td>
<td>Per capita GDP at regional level</td>
</tr>
<tr>
<td>Expenditure_culture</td>
<td>Current per capita expenditures in cultural and touristic activities by region</td>
</tr>
</tbody>
</table>

Source: our elaboration on data provided by ISTAT

4. Institutional setting and data

4.1 Institutional setting

The Italian has a wide and heterogeneous set of museums, which differ as far as institutional features, type of collection, geographical location, and number of visitors are concerned.

The 2015 survey run by the Italian National Statistical Office (ISTAT) identifies 4,158 museums. Most of them 64.1% are in public property: among these, 43% belong to Municipalities while the museums and other state institutions belonging to the State are 439, that is only 8.8% of the total. Italian museums offer different types of collections ranging from ethnographical and anthropology collections (16.6%) to ancient art (15.9%) and archaeology (14.7%), just to recall the most represented ones.
Overall, museum supply is widespread all over the country with one Municipality out of three having at least a museum. At the same time, however, 30% of the total is concentrated in three Regions: Toscana (548), Emilia-Romagna (477) and Piemonte (427).

Visitors show an increasing trend (though with a small decrease in the most recent years) as well as a marked polarization: the top 20 museums and similar institutions attract 31.9% of visitors while 36.5% registers no more than one thousand admissions per year. A major role is played by state museums and similar institutions, which attract more than 47 million visitors, that is the 42.6% of the total.

Museums, alongside with monuments and archaeological sites, have always been at the 'core' of Italian cultural policy, with responsibilities shared between the State -with the Ministry for Heritage and Cultural Activities (Ministero per i beni e le attività culturali - MIBAC)- and the decentralized levels.

Until the mid-1990s museums were directly managed by national or local governments, as sub-units of the pertinent departments, without any financial or organizational autonomy; having no budget or spending powers, even the revenues from ticket sales and sponsorships accrued to the general budget of the responsible level of government.

In the last twenty years, in the museum field major reforms have been undertaken, mainly oriented toward the enlargement of the autonomy of important institutions, the decentralization of competences and functions to Regional level of government and the introduction of private actors in the ownership and in the management. Broadly speaking, similar trends characterize cultural policies in many European countries (Mignosa, 2016).

In the Italian experience, however, reforms appear subject to variability through time, the ‘up and down’ depending on the changes in cultural policy priorities of the different governments, which have been in power in the last twenty years (Bodo and Bodo, 2016).

---

9 Even Municipalities with less than 2,000 inhabitants (27.9% of total Municipalities) have a high percentage of museums (16.7%).
10 Archaeological sites show and opposite geographical pattern: more than half (52.8%) are located in the South and the Islands.
11 Museums visitors were 53.9 million in 2011 and increased up to 59.2 million in 2015.
12 The protection and enhancement of cultural heritage is regulated by the Heritage and Landscape Code (Codice dei beni culturali e del paesaggio).
13 Ponzini (2010) provides an extensive analysis of the various forms of privatization in the period 1996-2006 - alienation of state-owned historic real estate, mixed public-private entities to manage and to promote cultural heritage, introduction of private actors into policy-making and implementation - is provided by Ponzini (2010).
The detailed analysis of the institutional setting is outside the scope of this paper and here it is enough to recall just some significant examples of the changes occurred. In such a perspective, it is worth mentioning the transformation in 1998 of the National Egyptian Museum in Turin into a public-private foundation, with Regional and local governments as well as of private bank partners. It appears, however, a rather isolated example of operation of state museums in association with other public authorities or private entities.

Another significant change in 1998 refers to the granting of an autonomous status and budget to four national museum poles (poli museali nazionali) including the national art galleries and museum in Rome, Venice, Florence and Naples. In most recent years, since 2014, following the same direction, a national museum system has been created. On the one hand, autonomy has been granted to twenty of the most important Italian museums, monuments and archaeological sites, followed by further ten in 2016, which are responsible for the management and enhancement of their own collections. On the other hand, all the other less important national non-autonomous museums and heritage sites have been gathered in seventeen regional museum poles (poli museali regionali), under the responsibility of Regional secretariats. An important implication of this reform is the separation between the protection and the management and enhancement of cultural heritage.

Notwithstanding some positive effects of the reform of state museums, such as, for instance, the increasing degree of their financial autonomy and of their capability of raising funds (Federculture, 2018; Unioncamere, 2018), it is widely agreed that the reform process is still largely incomplete and has severe shortcomings. Overall, internal resistance, at managerial as well as at employee level, have contrasted the full implementation of new organizational models and, after all, a real process of destatization has not taken place (Bertacchini et al., 2018). Apart from the above implementation limits, a major shortcoming of the reform process, or its ‘original sin’ (Zan et al, 2018), is found in the dominance of legal approach and in the lack of a management perspective, as it is

---

14 A detailed description can be found on the web site of the Ministry [http://musei.beniculturali.it/en/structure](http://musei.beniculturali.it/en/structure) and in Bodo and Bodo (2016)

15 In 2009, the state museum for contemporary art, MAXXI became foundation and, afterwards, a partnership with private entities was established.

16 Pompei archaeological site is the first example of the enlargement of autonomy to a national institution.

17 Directors were selected through international open competitions, giving rise to a heated debate and judicial controversies.

18 The former is assigned to the peripheral entities of the Minister, i.e. the Superintendencies, while the latter belongs to autonomous national museums and Regional poles.
demonstrated by the scarce consideration given to a crucial input of the production process, such as human resources. The organization of labour, in fact, is not in the responsibility of the museum managers but has remained under the control of the ministerial administration, hindering the effective autonomy of museums.

A further interesting aspect of the reform is the delegation of some authority toward Regional governments, mainly as far as the heritage enhancement is concerned, leading to a wide range of experiences and different organizational models experimented at the local level.19

Whether the enlarged autonomy of state museums, though with the above limitations, decentralization and the various forms of public-private partnerships have really affected museums performance is an open question and not easy to assess.

4.2 Data

All the data we use in the following analysis are taken from ISTAT and refers to the year 2015. The abovementioned “Indagine sui musei e le istituzioni similari” is the main source of data as it provides information on the relevant inputs and outputs of museums. Data on accommodation capacity in the hospitality sector are from the annual survey “Capacity of collective accommodation establishments”. The ISTAT data warehouse is also the source for data on socio-demographic variables at provincial and regional levels.

After data cleaning, the final sample used in the following analysis includes 2496 museums. The sample reflects some relevant features in the population, including the share of public owned museums (65%) and state owned museums (7%). We employ two models that differ in the definition of the output set. Model 1 includes opening days and temporary exhibitions, while in Model 2 we add the exhibited pieces. Table 2 summarizes the sets of variables employed in the two models, the contextual factors and the relative descriptive statistics.

19 Aspen Institute (2013) analyses several local museum systems; the experience of the Foundation of Municipal Museums of Venice (MUVE) is investigated by OECD (2018)
Table 2. Descriptive statistics and models

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mod 1</th>
<th>Mod 2</th>
<th>Obs.</th>
<th>Mean</th>
<th>St. Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inputs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personnel</td>
<td>♦</td>
<td>♦</td>
<td>2,496</td>
<td>11.58</td>
<td>21.56</td>
</tr>
<tr>
<td>Exhibition_space</td>
<td>♦</td>
<td>♦</td>
<td>2,496</td>
<td>1,088.84</td>
<td>3,130.56</td>
</tr>
<tr>
<td><strong>Outputs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opening_days</td>
<td>♦</td>
<td>♦</td>
<td>2,496</td>
<td>223.81</td>
<td>92.12</td>
</tr>
<tr>
<td>Temporary_exhibitions</td>
<td>♦</td>
<td>♦</td>
<td>2,496</td>
<td>2.03</td>
<td>7.98</td>
</tr>
<tr>
<td>Exhibited_pieces</td>
<td>♦</td>
<td></td>
<td>2,496</td>
<td>1202.26</td>
<td>2920.83</td>
</tr>
<tr>
<td><strong>Socio-demographic and institutional factors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td></td>
<td></td>
<td>2,496</td>
<td>0.65</td>
<td>0.48</td>
</tr>
<tr>
<td>No_state</td>
<td></td>
<td></td>
<td>1,630</td>
<td>0.93</td>
<td>0.25</td>
</tr>
<tr>
<td>Number_beds</td>
<td></td>
<td></td>
<td>2,496</td>
<td>66,620.44</td>
<td>70,451.84</td>
</tr>
<tr>
<td>GDP</td>
<td></td>
<td></td>
<td>2,496</td>
<td>28,199.43</td>
<td>6,356.25</td>
</tr>
<tr>
<td>Expendidute_culture</td>
<td></td>
<td></td>
<td>2,496</td>
<td>2.03</td>
<td>7.98</td>
</tr>
</tbody>
</table>

*Source: our elaboration on data provided by ISTAT*

5. Results

5.1 The results of the efficiency estimates

Summary statistics of the unconditional and conditional estimates are shown in Table 3, with the $m$ parameter set at $m=300$, following the rule suggested by (Daraio and Simar, 2005).
We start by presenting and discussing the estimates from the unconditional order-$m$, which do not account for the heterogeneity arising from the operational environment in which museums operate. Looking at model 1, the average score of 1.068 indicates that Italian museums could improve their efficiency, on average, of about 6.8%. However, remarkable differences among regions, areas, and ownership also emerge and, additionally, we observe a remarkable variation around the mean (standard deviation=0.797). Regional average
efficiency levels range from 0.921 (Piemonte), to 1.494 (Campania). In four regions, all located in northern Italy, the average value is lower than 1 (Fiuli-Venezia Giulia, Liguria, Piemonte, Trentino-Alto Adige), i.e. museums in such regions are on average superefficient, while the lower levels of efficiency (scores > 1.15) are displayed by southern regions (Campania, Sicilia, Puglia, Calabria). More in general, museums in northern Italy show higher efficiency levels, on average (around 0.99), while museums in the South present an average value of 1.211.

Private museums (1.040) perform generally better than public ones (1.082). Among the latter, lower levels of efficiency are displayed by State-run museums.

The inclusion of the number of exhibited pieces in the output set (model 2) does not change remarkably the results, although, in this case, average values are generally higher (1.137 the full sample mean score), the standard deviation is noticeably lower (0.343) than in model 1, and no regions or areas show scores lower than 1. However, results from Model 2 have to be taken with caution given the marked heterogeneity of items exhibited by museums. In fact, the number of pieces does not take into account the different types of items which may strongly differ in size and value.

5.2 Accounting for contextual factors

Regional differences in the unconditional scores from Model 1 and 2 are shown also in figure 1. At a glance, museums efficiency varies significantly among different areas, implying that museums in northern Italy performs better than those in southern Italy. However, strong differences within the country also exists in the operational environment in which museums operate, as shown in Figure 2.

---

20 Note that lower scores imply higher levels of efficiency.
Comparing Figures 1 and 2, a connection apparently emerges between the distribution of scores and some contextual factors, especially the per capita GDP and the number of beds available in hotels and similar structures. As previously discussed, the socio-demographic and institutional context may in fact exert an “external” pressure on the service potential, implying that the unconditional scores may be biased, favouring those museums operating in more favourable contexts. To take account of such potential bias, we now presents in tables 4 and 5 (respectively for Model 1 and 2), the scores estimated through the generalised conditional efficiency model described in paragraphs 3.2. In the two tables, the three columns differ in the set of the conditioning variables. More specifically, column (1) considers the public/private ownership only; columns (2) is run on the subsample of public museums and is conditioned to the state- or local- governance; column (3) includes ownership and the socio-demographic factors.
**Figure 2.** Distribution of socio-demographic factors, by region

**Number_beds**

**GDP**

**Expenditure_culture**

Source: our elaboration on data provided by ISTAT
Compared with the unconditional scores, the conditional estimates shown in table 4 and 5 presents a lower mean value (ranging from 1.057 to 1.036 for Model 1 and from 1.103 to 1.080 for Model 2), implying a lower level of inefficiency on average, and a lower standard deviation (lower than 0.69 and 0.34 for Model 1 and 2, respectively).

Regarding the institutional factors, public ownership is generally unfavourable, but strongly significant only in Model 2, implying that private institutions display on average lower levels of inefficiency. Among public museums, state-owned ones display on average lower levels of efficiency.

Among the socio-demographic factors, hospitality sector’ size and income level are favourable and significant, in line with the idea that a stronger demand for cultural goods pressures providers towards a more efficient use of available resources. This result is also in line with the positive influence of income level on library service potential reported by De Witte and Geys (2011). Finally, the amount of public expenditures on cultural and touristic activities is not significant.

By and large, conditional estimates show that the operational environment matters and that estimating the frontier independent of it would lead to incorrect conclusions on the efficiency of museums.

<table>
<thead>
<tr>
<th>Environmental Variables</th>
<th>Model 1</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Influence</td>
<td>P-Value</td>
<td>Influence</td>
<td>P-Value</td>
</tr>
<tr>
<td>Public unfavourable</td>
<td>*</td>
<td>unfavourable</td>
<td>Not sign.</td>
</tr>
<tr>
<td>No_state</td>
<td>favourable</td>
<td>***</td>
<td>favourable</td>
</tr>
<tr>
<td>Number_beds</td>
<td>favourable</td>
<td>***</td>
<td>GDP</td>
</tr>
<tr>
<td>Expendidute_culture</td>
<td>favourable</td>
<td>Not sign.</td>
<td></td>
</tr>
</tbody>
</table>

Mean efficiency score 1.052 1.057 1.036
St. dev. efficiency score 0.681 0.701 0.625
Observations 2,496 1,630 2,496
R-square 0.036 0.016 0.102

Source: our elaboration on data provided by ISTAT. Note: m=300; no. of bootstrap replications=500; Model 1 (2) estimated on the subsample of public museums.
Table 5. Conditional estimates – Model 2

<table>
<thead>
<tr>
<th>Environmental Variables</th>
<th>Mod 2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td><strong>Influence</strong></td>
<td>P-Value</td>
<td>Influence</td>
<td>P-Value</td>
</tr>
<tr>
<td>Public unfavourable</td>
<td>***</td>
<td>unfavourable</td>
<td>***</td>
</tr>
<tr>
<td>No_state favourable</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Number_beds favourable</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>GDP favourable</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Expendidute_culture</td>
<td>favourable</td>
<td>Not sign</td>
<td>favourable</td>
</tr>
<tr>
<td>Mean efficiency score</td>
<td>1.103</td>
<td>1.117</td>
<td>1.080</td>
</tr>
<tr>
<td>St. dev. efficiency score</td>
<td>0.331</td>
<td>0.288</td>
<td>0.279</td>
</tr>
<tr>
<td>Observations</td>
<td>2,496</td>
<td>1,630</td>
<td>2,496</td>
</tr>
<tr>
<td>R-square</td>
<td>0.0475</td>
<td>0.0442</td>
<td>0.143</td>
</tr>
</tbody>
</table>

Source: our elaboration on data provided by ISTAT. Note: m=300; no. of bootstrap replications=500; Model 1 (2) estimated on the subsample of public museums.

6. Conclusions

There are two important features characterizing public service providers, and among them museums, that have to be considered when evaluating efficiency: first, the role of users’ activity for the achievement of the intended goals of public provision and, second, the relevance of the operational environment in which public providers behave, which may affect their choices and, in turn, the levels of provision. The first feature calls for characterizing appropriately the provision of museum as a two-stage production process, and concentrate the analysis of efficiency on the first stage, which involves the provision of outputs, fully under the direct control of providers, i.e. the so called service potential, or D-output. The second one requires the choice of a robust methodology to yield an accurate and correct measurement of providers’ efficiency, accounting for the external factors that may impact on the actual production frontier.

To tackle both the issues, we used a recent development in the class of non-parametric frontier estimators, viz, a generalised conditional efficiency model (precisely the extended version developed by De Witte and Kortalainen (2013), to consistently assess the efficiency of Italian museums, using a large dataset based on a survey conducted by the ISTAT.
Results from the unconditional estimate show that Italian museums could increase their service potential by 0.68% (13.7%, when including the number of exhibited pieces in the output set) and that strong differences exist among regions and geographical areas. However, when considering the contextual factors, the average potential increase in output decreases remarkably. In fact, our results show that the operational environment matters, implying that neglecting its impact would lead to incorrect conclusions on providers’ (in)efficiency. More specifically, income levels and size of the hospitality sector have a favourable and significant influence on efficiency, in line with the idea that a stronger demand for cultural goods makes pressure on providers towards a more efficient use of resources. Finally, ownership is relevant, in line with expectations. In fact, stronger internal incentives towards efficiency are reported for private institutions while, among public institutions, efficiency is generally lower for State-owned museums.
References


