

Identifying the economic impact behind a cultural asset: an input–output subsystems analysis

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Abstract Nowadays, cultural activities are recognised as having a positive impact on regional and local development. In this paper, we analyse the economic impact of a new museum (the Gaudí Centre) on the regional economy by quantifying the amount of new productive income and new employment it has created. As far as we know, this is the first study to analyse the economic impact of a museum in quantitative terms by using an input–output subsystem analysis in which we differentiate the service sectors, which are closely connected to the museum’s direct demand, from the non-service activities, which are not so closely connected. Our results show that the museum has a considerable impact on the regional economy and suggest that cultural investments can play a role in income generation that goes beyond that of mere cultural activities.

JEL Classification E12 · E23 · R11 · Z10

1 Introduction

Cultural assets include both material and immaterial investments such as museums, exhibition halls and exhibitions. These kinds of asset have an economic impact on local and regional economies that was ignored until a few decades ago when the seminal contribution by [Cwi and Lydall \(1977\)](#) who argued the importance of their impact in terms of employment and production levels. Subsequently a large group of scholars

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tried to demonstrate the positive effects of several specific cultural assets/activities: namely, museums (Plaza 2006, 2000; Getzner and Oberlercher 2003; Baniotopoulou 2001; Johnson and Thomas 1992), theatres (Mitchell 1989), music concerts (Gazel and Schwer 1997), European Capitals of Culture (Herrero et al. 2006; Richards and Wilson 2004) and temporary exhibitions (Skinner 2006; Stanley et al. 2000), among others. Unfortunately, however, some of these papers focus only on the positive effects on culture-related activities (e.g. jobs in cultural industries, services provided to cultural industries), and highlight only subjective and non-measurable effects or analyse the effects on the whole economy without looking for spillovers at a more disaggregated industry level. Accordingly, given the focus, findings, and shortcomings of previous empirical literature, in this paper, we not only quantify the economic impact of a new cultural asset (a museum) but also show how it affects the whole economy (at an industry level) and whether each of the specific industries considered are related to service activities or, more specifically, to cultural industries.

Although previous studies focus on the positive impacts, there is some debate about whether the effects are positive for all types of cultural assets (i.e. whether all cultural assets have a positive influence on the economic activity of their regional areas) or only for the larger ones.¹ This is a key issue because it may mean that all cultural assets cannot be expected to have real effects (i.e. size matters) so research on the impact of small-medium sized assets such as the one analysed here is of little importance. Although some scholars acknowledge the positive impact of museums on local and regional economies but limit these positive cases to the so-called superstar museums (Frey 1998), there is empirical evidence to suggest that small and medium museums such as the one analysed here can also write their own success stories (Getzner and Oberlercher 2003; Johnson and Thomas 1992). Accordingly, it seems reasonable to determine whether this positive effect exists and, if it does, how big it is, to what extent it can expand income at a sectorial level, and what its boundaries are.

Several methodologies can be used to measure the economic impacts of cultural activities, but input–output modelling and aggregated income multipliers are particularly important. Input–output modelling has been used by *Americans for the Arts* (2006) for non-profit arts and the cultural sector in Minnesota, Herrero et al. (2006) for European Cultural Capitals, Plaza (2006) for the Guggenheim Museum in Bilbao, Skinner (2006) for blockbuster art exhibits,² Dunlop et al. (2004) for the whole cultural sector in Scotland, Brand et al. (2000) for the museum and art gallery sector in the southwest region (UK), the *Welsh Economy Research Unit* (1998) for several arts institutions in Wales, *Alliance for the Arts* (1997) for several arts institutions in New York, Gazel and Schwer (1997) for music concerts, and DiNoto and Merk (1993) for arts organisations in Idaho. Aggregate income multipliers have been used by Saayman and Saayman (2006) for art festivals in South Africa, SQW Ltd (2006) for art festivals

¹ There are several ways of separating between small- and medium-sized assets and large -for instance, physical size of buildings- but in this paper we have thought mainly in terms of number of visitors. Accordingly, with an attendance which is roughly 60,000 visitors per year, the Gaudí Centre can be regarded as a small-medium cultural asset in comparison to others in Catalonia, such as the Fundació Joan Miró (969,000 visitors) and MACBA (591,000).

² In any case, this input–output approach is only marginal in Plaza (2006) and Skinner (2006).

in Scotland, [Travers \(2006\)](#) for museums and art galleries in the UK, [Dziembowska-Kowalska and Funck \(2000\)](#) for several cultural institutions, [Zivan and Truscott \(1999\)](#) for a museum in Cambridge, [Johnson and Thomas \(1992\)](#) for an Open Air Museum in Beamish, and [Myerscough \(1988a,b,c,d\)](#) for several arts activities in UK, Glasgow, Ipswich and Merseyside.

Since we use an input–output framework in this paper, we will first make a brief review of the main findings of the previous empirical literature that has used this approach to analyse the impact of museums. Unfortunately, this methodology has only been used in very few empirical studies of museums. One of these is a detailed report for the SouthWest Museums Council ([Brand et al. 2000](#)), which found that GDP multipliers for museums (1.43) and education (1.49) were quite similar and slightly bigger than those of retail (1.35) and hotels and catering (1.34). [Dunlop et al. \(2004\)](#) also estimated income (1.65) and employment multipliers (1.64) for some museums and Scottish galleries. When analysing the impact of the Guggenheim Museum in Bilbao, [Plaza \(2006\)](#) collected estimations (using input–output analysis) from the Provincial Treasuries of Biscay. According to this data, one non-Basque visitor generates an additional tax revenue of 36.01€(this includes both direct and indirect taxes). However, the quantifications of the economic impact of such cultural assets are often very heterogeneous, so some scholars suggest that great care should be taken with these results ([Baró and Bonet 1997](#)).³

The input–output model provides a framework for assessing the economic impact associated with those production activities that increase the final demand of an economy. In fact, the input–output model can be applied to a wide range of activities from industry or services, public or private investments and local or national activities. A quantitative approach to these issues is extremely important for planning economic strategies.

Various studies have also developed the so-called input–output subsystems analysis, focusing on an individual sector or group of sectors, which is regarded as being a subsystem that interacts with the other sectors. The basic idea behind the subsystems approach is that an individual sector can be analysed as a particular unit without modifying the main characteristics of the system to which the unit belongs. The usefulness of this approach is that it isolates the relations of a limited number of activities from the whole system, and this provides specific information about the production relations of individual units as part of the entire production sphere. The subsystems model was first proposed by [Sraffa \(1960\)](#) and developed by [Pasinetti \(1973, 1988\)](#); [Deprez \(1990\)](#) and [Scazzieri \(1990\)](#), among others. More recently, [Alcántara \(1995\)](#) and [Sánchez-Choliz and Duarte \(2003\)](#) provided a conceptual set that illustrates the ability of the subsystems approach to show the isolated impacts of individual agents. [Alcántara and Padilla \(2009\)](#) used a subsystem modelisation to study CO₂ emissions from the Spanish service sector. In a parallel approach, [Cardenete and Fuentes \(2011\)](#) used a subsystem representation within a social accounting matrix model to analyse the CO₂ emissions from Spanish energy activities. Although the subsystem approach

³ Because reports about the economic impact of cultural institutions are often financed by these cultural institutions, readers should consider them carefully. Academic papers, on the other hand, do not have such bias.

is very useful for improving the knowledge about the economic effects of cultural investments, no reports have been published about its application to cultural activities.

The aim of this paper is to show all the interindustry effects generated by the demand shock of a cultural activity. In order to demonstrate and quantify these effects, we analyse the case of the Gaudí Centre, an interactive museum that was opened in 2007 in Reus⁴ and which shows and explains the Art Nouveau buildings designed in the early twentieth century by the most famous Catalan architect, Reus-born Antoni Gaudí.

As well as making standard analyses of the economic impact of cultural activities, which focus on service-related activities such as shops, restaurants and hotels, we will explore the impact on other unrelated activities such as agriculture, construction and manufacturing. Starting inflows will be generated by the extant cultural asset (Gaudí Centre) that attracts medium–high income visitors who can potentially make expenditures on both cultural and non-cultural activities (retail shops, restaurants, etc.).

In this paper, we define an input–output subsystem representation of the production system, which differentiates services from non-services. The novel aspect of our study is that it takes into account not only the amount of new productive income created by the new museum in the regional economy but also the channels by which this income is created and transmitted throughout the production activities. We also provide the employment effects of the museum on the regional economy. Our analysis is important if we are to gain further insights into the effect of cultural activities, which are largely seen in terms of their positive impacts on services sectors. However, although cultural assets are important in terms of their direct impact on services, our results suggest that the total effects on non-service activities cannot be neglected. This means that cultural activities can have considerable positive effects on the whole production system, and the associated impacts are not limited to those sectors that receive the direct cultural demand. Our detailed representation of the production system provides deeper insight into the extent to which cultural assets can create and expand regional income and employment, and this furthers our knowledge about the channels through which the economic effects of cultural activities are transmitted throughout the economy.

The rest of the paper is organised as follows. Section 2 describes the main characteristics of the Gaudí Centre. Section 3 defines an input–output subsystem model that is used to calculate economic impact. Section 4 describes the databases used in our empirical application to the Catalan economy, and Sect. 5 contains the main results. The final section presents the conclusions.

2 The main characteristics of the Gaudí Centre

The Gaudí Centre was opened in June 2007. It is located in a pedestrian area in the city centre of Reus. The site, about 1,200 m², includes several interactive exhibitions that enable visitors to discover Gaudí's creative mechanisms and surprising shapes. Visitors can also watch several audiovisual presentations and touch sensory and tactile

⁴ Reus is a city of 110,000 inhabitants located roughly 100 km south of Barcelona, the capital of Catalonia. The city's economy is based on retail and manufacturing but since the early eighties the strategy of the city council has been to take advantage of the large number of tourists holidaying at nearby seaside resorts such as Salou and Cambrils and the more culturally oriented visitors to Tarragona.

Table 1 Number of visitors to the Gaudí Centre: 2007–2009

Origin	2007	2008	2009
Catalonia	6,699	17,694	19,900
Rest of Spain	9,458	24,980	28,095
Rest of the world	3,547	9,367	10,536
Total	19,704	52,041	58,531

displays. As well as the museum exhibitions, the Gaudí Centre has shopping facilities and a restaurant.

Given that Antoni Gaudí worked mainly in Barcelona and that none of his masterpieces is located in his home town, the location of this new museum in Reus (the only museum dedicated to Gaudí) introduces visitors to Gaudí's masterpieces in the region that influenced his architectural creations. In particular, the Gaudí Centre aims to explain the fundamentals and architectural details of Gaudí's work.

The museum belongs to the city council and is managed in accordance with the strategic guidelines of the city's tourist office, so it is therefore mainly directed at non-local visitors. One distinctive feature of the Gaudí Centre is that, instead of hosting masterpieces by celebrity artists, the museum exhibits virtual objects (and reproductions) in which the artist, not the object, is the celebrity. However, this allows the museum to concentrate on explaining what is being exhibited, which is important because most museums are shifting towards "explaining" rather than just "showing". Visitors expect not only to contemplate (virtual) reproductions of Gaudí's masterpieces but also to understand how they were designed and how they worked.

Table 1 shows the number of visitors to the museum since it was opened. As the Gaudí Centre opened in June 2007, the number of visitors during this year is the lowest of all the periods. Table 1 also shows that most visitors came from the rest of Spain (approximately 50%). In contrast, foreign tourists are the lowest percentage of visitors (approximately 18%).

3 Methodological approach to economic impact

As our aim is to identify the individual impacts of the Gaudí Centre on the production activities of the regional economy, we differentiate those sectors that receive most of the demand of the cultural activity (that is to say, service sectors) from those sectors that receive less (that is to say, non-service sectors).

Initially, we decompose the N accounts of the input–output system into $1, 2, \dots, m$ sectors belonging to the non-service subsystem and $m + 1, \dots, n$, belonging to the s sectors of the service subsystem. By taking into account this division, the input–output representation of the income impacts can be written as follows:

$$\begin{pmatrix} \mathbf{A}_{MM} & \mathbf{A}_{MS} \\ \mathbf{A}_{SM} & \mathbf{A}_{SS} \end{pmatrix} \begin{pmatrix} \Delta \mathbf{x}^M \\ \Delta \mathbf{x}^S \end{pmatrix} + \begin{pmatrix} \Delta \mathbf{y}^M \\ \Delta \mathbf{y}^S \end{pmatrix} = \begin{pmatrix} \Delta \mathbf{x}^M \\ \Delta \mathbf{x}^A \end{pmatrix}, \quad (1)$$

where the subscripts and superscripts denote the group of accounts m and s , respectively. In expression (1), matrices \mathbf{A} contain the technical input–output coefficients, the column vector $\Delta \mathbf{x} = \begin{pmatrix} \Delta x^M \\ \Delta x^S \end{pmatrix}$ contains the increase in sectorial production, and the column vector $\Delta \mathbf{y} = \begin{pmatrix} \Delta y^M \\ \Delta y^S \end{pmatrix}$ contains the shock in final demand due to the cultural activity.⁵ From expression (1), we can calculate the increase in sectorial production as $\Delta \mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1} \Delta \mathbf{y} = \mathbf{B} \Delta \mathbf{y}$. Taking this solution into account, the input–output representation in expression (1) is given by:

$$\begin{pmatrix} \mathbf{A}_{MM} & \mathbf{A}_{MS} \\ \mathbf{A}_{SM} & \mathbf{A}_{SS} \end{pmatrix} \begin{pmatrix} \mathbf{B}_{MM} & \mathbf{B}_{MS} \\ \mathbf{B}_{SM} & \mathbf{B}_{SS} \end{pmatrix} \begin{pmatrix} \Delta y^M \\ \Delta y^S \end{pmatrix} + \begin{pmatrix} \Delta y^M \\ \Delta y^S \end{pmatrix} = \begin{pmatrix} \Delta x^M \\ \Delta x^S \end{pmatrix}. \tag{2}$$

This expression decomposes the total increase in final production into two parts: the productive inputs (in matrix \mathbf{A}) and the final production (in matrix \mathbf{B}) needed to increase the final production.

Operating expression (2), we can write the following two equations:

$$\begin{aligned} \mathbf{A}_{MM} \mathbf{B}_{MM} \Delta y^M + \mathbf{A}_{MM} \mathbf{B}_{MS} \Delta y^S + \mathbf{A}_{MS} \mathbf{B}_{SM} \Delta y^M + \mathbf{A}_{MS} \mathbf{B}_{SS} \Delta y^S + \Delta y^M &= \Delta x^M \\ \mathbf{A}_{SS} \mathbf{B}_{SM} \Delta y^M + \mathbf{A}_{SS} \mathbf{B}_{SS} \Delta y^S + \mathbf{A}_{SM} \mathbf{B}_{MM} \Delta y^M + \mathbf{A}_{SM} \mathbf{B}_{MS} \Delta y^S + \Delta y^S &= \Delta x^S. \end{aligned} \tag{3}$$

The first equation in (3) divides the effects on the production of the non-service sectors (Δx^M) into the impacts originated by two demand shocks:

- First, the demand shock in non-service activities (Δy^M). This effect is made up of three different components. The first one, $\mathbf{A}_{MM} \mathbf{B}_{MM} \Delta y^M$, contains the inputs and the final production from m to cover the demand increase in m . This component shows the *internal effects* that the demand shocks received by m have on m production. The second component, $\mathbf{A}_{MS} \mathbf{B}_{SM} \Delta y^M$, contains the inputs that m has to produce for s , so that s can provide the output that m demands. This component captures the *circular effects* that are activated by the feedback from non-services to services and back to non-services. Finally, the third component, Δy^M , contains the inflow in the final demand for non-services caused by the cultural asset or *direct effect*.
- Second, the demand shock in service activities (Δy^S). This component is also divided into two parts: $\mathbf{A}_{MM} \mathbf{B}_{MS} \Delta y^S$ and $\mathbf{A}_{MS} \mathbf{B}_{SS} \Delta y^S$. These parts contain the impacts from s to m so that s can cover the new demand made by the cultural activity. Jointly, these two components show the *open effects* that originate in s and materialise in m .

In summary, production by non-service activities is increased by their internal effects (caused within the non-services subsystem), circular effects (caused by the

⁵ Following the traditional approach used in the subsystem analysis, our model assumes that all the final demand items are exogenous and, therefore, there is no induced link between increase in production, employees’ income and final consumption. The consequence of this assumption is that our results can be interpreted as a lower bound of the true effect caused by the Gaudí Centre.

feedback between non-services and services), open effects (caused by the impacts of services on non-services) and, finally, direct effects on the final demand for non-services.

Additionally, the second equation in expression (3) divides the impact on the production of the services subsystem (Δx^S) into the following two components:

- First, increases in the demand for services (Δy^S) that, at the same time, have three different parts. The first one, $A_{SS}B_{SS}\Delta y^S$, contains the inputs from s to cover the demand increase in s or the *internal effects* that materialise within the services subsystem. The second component, $A_{SM}B_{MS}\Delta y^S$, shows the inputs that s has to produce for m so that m can produce what s demands. This can be regarded as a *circular effect* between the two subsystems. Finally, the third component is the inflow in the demand for services, Δy^S , which shows the *direct effects* of the cultural activity on the demand for services.
- Second, the increases in the demand for non-services (Δy^M). This effect is divided into two parts, $A_{SS}B_{SM}\Delta y^M$ and $A_{SM}B_{MM}\Delta y^M$, which show the impacts from m to s so that m can cover the new demand. Together, these two components show the *open effects* of the non-services subsystem on the services subsystem.

Parallel to the non-services subsystem, the increase in the production of services can be determined by adding four components: the internal effects caused within the services subsystem; the circular effects, caused by the feedback between services and non-services; the open effects, caused by the impacts of non-services on services; and finally the direct effects on the final demand for services.

The subsystems approach can also be used to quantify the effects of the Gaudí Centre on employment. Let E^M be a $m \times m$ diagonal matrix, the main diagonal of which contains the employment coefficients, calculated as the number of jobs in 1 year divided by the final output in each non-service sector, and zeros in the rest. Similarly, let E^S be an $s \times s$ diagonal matrix of employment coefficients in each of the service sectors. Then, we can calculate the number of new workers in each subsystem or employment effects (ΔO^M and ΔO^S , respectively) as:

$$\begin{aligned} \Delta O^M &= E^M \Delta x^M \\ \Delta O^S &= E^S \Delta x^S, \end{aligned} \tag{4}$$

where the results are the full-time equivalent jobs created by the Gaudí Centre in 1 year.

By applying the subsystem method to the Gaudí Centre, studies can be made not only of the importance of cultural activities in the process of income creation but also of the mechanism by which the income impacts are transmitted throughout the production system. This kind of analysis complements the information provided by a conventional input–output analysis, as it divides the total impacts into the different channels through which the income effects are produced and transmitted in an economy.

4 Database

The model described in the section above evaluates the economic impact of the Gaudí Centre on the productive system of the Catalan economy. To implement the model empirically, we use the latest available Input–Output Table for Catalonia, which contains data from 2001 (IDESCAT 2007).⁶ As the official source does not provide the symmetric input–output table, we applied an indirect calculation of this matrix.⁷

Additionally, the resulting symmetric matrix \mathbf{A} of input–output coefficients, which is for the year 2001, was updated to the year 2009. Specifically, matrix \mathbf{A} in 2001 (\mathbf{A}_{01}) is rescaled to the price levels in 2009, following the procedure described in Suh (2004):

$$\mathbf{A}_{09} = \mathbf{P}\mathbf{A}_{01}\mathbf{P}^{-1},$$

where \mathbf{A}_{09} is the deflated matrix of coefficients that will be used in our empirical application and \mathbf{P} is a diagonal matrix that contains the price indexes. The elements of this matrix were obtained from consumer price indexes (INE 2010a,b) for the service activities and from production price indexes (INE 2010a,b) for industrial activities.

The resulting database shows twenty-seven production sectors, seventeen of which are non-service activities and ten of which are service activities (that is, $n = 1, \dots, 27$; $m = 1, \dots, 17$; $s = 18, \dots, 27$).

To implement the model empirically, we also need to reflect the new demand of the Gaudí Centre in the regional economy. As our objective is to analyse the expansive impact of the direct demand on the entire production system, we focus on the inflows caused by the museum during one specific year of operation (2009). These inflows, which were defined above as vectors $\Delta\mathbf{y}^M$ and $\Delta\mathbf{y}^S$, were obtained by adding different expenditure components.⁸

First, the inflows of the Gaudí Centre are caused by consumption by the staff, $\Delta\mathbf{c} = \begin{bmatrix} \Delta\mathbf{c}^M \\ \Delta\mathbf{c}^S \end{bmatrix}$, which shows the final demand the staff made on non-services and

⁶ The region of Catalonia is located in the northeast of Spain. With a small surface area (32,000 km²), it covers approximately 16% of the Spanish territory. In 2008, Catalonia had around 7,400,000 citizens, which is 18% of the Spanish population. Catalonia is a dense, highly industrialised region that has been at the forefront of the manufacturing industry in Spain since the nineteenth century. Its economy is one of the most important of all the Spanish regions and in 2007 the Catalan gross domestic product was 19% of the total Spanish GDP.

⁷ Llop (2011) describes the process of constructing the symmetric input–output table for the Catalan economy.

⁸ As the Gaudí Centre is a public institution, we should also take into account a leakage or reduction in the inflows equal to the taxation required to fund their activity. However, in 2009 the public revenues in the museum's budget were only 24% of total expenditures (while in 2008 they were 37%), and the museum's objective is to be a self-funded institution in the medium term. On the other hand, as no information is available, we cannot attribute how much of the public funds received by the institution are due to an increase in the existing taxation and how much are a reallocation from other public services. All of this explains why we have not taken into account the taxation leakage in the calculation of the museum's inflows. Therefore, we can interpret the results in the paper as an upper bond of the economic impact given that, as we have ignored the negative effect of the taxation leakage, it could be an over-estimation of the economic impact.

services, respectively. To obtain the values of employee consumption, we applied an indirect calculation. Wages and salaries is a variable in the Gaudí Centre's budget but, for an accurate calculation, we need to bear in mind that part of this expenditure does not materialise in consumption but in savings and in direct taxation.⁹ Therefore, to the amount of salaries, we applied a reduction for the proportion of income represented by taxation and the proportion that effectively materialises in consumption. The resulting value, which shows the amount of consumption by the staff, then has to be assigned to each production sector. The sectorial destination of consumption was obtained from the input–output table for Catalonia (IDESCAT 2007).

The tourists and visitors attracted by the museum increase the demand for such services as accommodation, restaurants and commerce. To capture the full economic impact, therefore, we must take into account not only the museum's current activity but also the demand that the visitors attracted by the cultural venue make:¹⁰ $\Delta \mathbf{v} = \begin{bmatrix} \Delta \mathbf{v}^M \\ \Delta \mathbf{v}^S \end{bmatrix}$. The information on the income spent by visitors when they come to the museum is approximated through the information on a survey that they fill in during their visit.¹¹

Table 2 shows the total expenditure, or direct effects, related to the activity of the Gaudí Centre in 2009. By sectors, hotel management receives most of the overall demand (85%), followed by commerce (13%). These two activities, therefore, jointly receive 98% of the new museum demand. By subsystems, Table 2 shows that the non-service accounts receive least demand (just 0.3% of the total) while services receive the most (99.7%). The two components of the museum's demand also show large quantitative differences. The largest value is due to visitor expenditure (99.1%) whereas consumption by staff represents the remaining 0.9% of the overall new demand of the museum.

Finally, to calculate the employment effects (expression (4)), we need to know the relationship between employment and final production in each sector. The information on sectorial employment and sectorial output is obtained from the Input–Output Table for Catalonia (IDESCAT 2007).

5 Empirical results

This section shows the results of the productive income and the employment created by the Gaudí Centre in 1 year of operation (2009) by using a subsystem input–

⁹ The proportion of direct taxation is 0.136, which indicates that taxation is 13.6% of private income (INE 2007). The proportion of consumption is 0.879, which indicates that consumption is 87.9% of personal income (INE 2007).

¹⁰ One of the assumptions underlying this calculation is that the museum's visitors from outside Reus come to the city only to visit the Gaudí Centre. The only data available that can be used to support this assumption is the 21,000 visitors to the Modernism Route in 2003 versus the 58,000 visitors to the Gaudí Centre in 2009. In any case, our calculation could over estimate the potential impact of the Gaudi Centre but there are no other alternative data sources in order to provide a more precise calculation.

¹¹ The survey that visitors fill in contains questions regarding the visitors' expenditure made during their stay in the city, such as the amount they spend on restaurants, shopping, accommodation and other costs.

Table 2 New demand of the Gaudí Centre (2009) (Euros)

	Δc Consumption	Δv Visitors	Δy Total demand
<i>m</i>			
1. Agriculture	1,365	0	1,365
2. Fishing	430	0	430
3. Energy, minerals, petroleum, fuels	1,275	0	1,275
4. Electrical energy, gas and water	1,766	0	1,766
5. Food	7,531	0	7,531
6. Textile	2,683	0	2,683
7. Manufacture of wood and cork	36	0	36
8. Paper	726	0	726
9. Chemistry	883	0	883
10. Rubber and plastic products	63	0	63
11. Other non-metallic products	59	0	59
12. Metal	43	0	43
13. Machinery	499	0	499
14. Electrical equipment, electronics	777	0	777
15. Manufacture of transport material	2,944	0	2,944
16. Other industries	1,477	0	1,477
17. Construction	686	0	686
<i>s</i>			
18. Commerce	13,821	1,204,380	1,218,201
19. Hotel management and restaurants	14,846	7,726,000	7,740,846
20. Transport and communications	5,065	94,800	99,865
21. Financial intermediation	3,693	0	3,693
22. Entrepreneurial services	10,404	0	10,404
23. Public services	0	0	0
24. Education	1,818	0	1,818
25. Sanitary, social services	3,088	0	3,088
26. Other services, personal services	4,750	0	4,750
27. Homes that employ domestic staff	1,253	0	1,253
Total	81,983	9,025,180	9,107,163

output model that separates service activities, receivers of most of the direct demand, and the non-service activities, receivers of the small remaining part of the museum's demand.

The information reported by the model shows different aspects of the economic impact. First, we focus on the total increase in production caused by the Gaudí Centre. Second, we analyse the various channels by which income is generated within the non-service subsystem and the income impacts accrued in the service subsystem. Finally, we calculate the number of jobs created.

Table 3 Total production effects of the Gaudí Centre: Catalonia, 2009 (euros)

	Δy Direct demand		Δx Total effects	
<i>m</i>				
1. Agriculture	1,365	23,244 (0.3%)	649,952	5,551,334 (31.6%)
2. Fishing	430		107,517	
3. Energy, minerals, petroleum, fuels	1,275		586,505	
4. Electrical energy, gas and water	1,766		305,856	
5. Food	7,531		1,750,182	
6. Textile	2,683		81,629	
7. Manufacture of wood and cork	36		51,750	
8. Paper	726		280,799	
9. Chemistry	883		343,240	
10. Rubber and plastic products	63		153,110	
11. Other non-metallic products	59		99,448	
12. Metal	43		245,107	
13. Machinery	499		160,676	
14. Electrical equipment, electronics	777		216,940	
15. Manufacture of transport material	2,944		169,512	
16. Other industries	1,477		44,984	
17. Construction	686		304,127	
<i>s</i>				
18. Commerce	1,218,201	9,083,918 (99.7%)	1,979,840	12,033,277 (68.4%)
19. Hotel management and restaurants	7,740,846		7,814,194	
20. Transport and communications	99,865		717,324	
21. Financial intermediation	3,693		269,570	
22. Entrepreneurial services	10,404		1,070,535	
23. Public services	0		0	
24. Education	1,818		28,225	
25. Sanitary, social services	3,088		48,996	
26. Other services, personal services	4,750		103,340	
27. Homes that employ domestic staff	1,253		1,253	
Total	9,107,163	9,107,163	17,584,611	17,584,611

5.1 Total production effects

Table 3 summarises the production effect of the Gaudí Centre on the Catalan economy in 2009, the total of which is 18,019,756 euros. The last row in the table indicates that the total impact was 1.94 times larger than the direct demand generated. This result, therefore, suggests that the multiplier effect is of considerable quantitative importance. In relative terms, the total production effects of the Gaudí Centre represent 1.1% of the annual value added of the cultural activities in Catalonia in 2009.

If we compare the two subsystems, the direct demand of the Gaudí Centre on services is much greater (99.7%) than the demand on non-services (0.3%). However, the relative importance of the two subsystems changes significantly when the total impact is analysed. As Table 3 shows, non-services receive 31.6% of the total production increase while services receive the remaining 68.4%. This suggests that cultural activities must be taken into account not only in terms of their positive (direct) effects on services but also in terms of their ability to generate new income in other activities.

5.2 Production effects on the non-service subsystem

Table 4 divides the division of the total impact on non-services into the different channels of income transmission. The last row in this table illustrates that the total effect is more than 50 times greater than the direct effect.¹² This means that the non-service subsystem is largely positively affected by the cultural activity even though it receives less direct demand. It is interesting that the open effects contribute 99.0% of the total impact, meaning that the largest impact on non-services is caused by services. In other words, the linkages between services and non-services, which materialise in both input demand and final production demand by services on non-services, explain most of the impact received by the non-services subsystem. As Table 4 shows, the remaining components provide a smaller contribution to total effects: direct effects are 0.3% of the total impact, the internal effects of non-services are 0.6%, and finally, circular effects are 0.1%.

At the sectorial level, food undergoes the largest increase in production (31.5% of total impact). This is followed by agriculture (11.7%) and energy, minerals, petroleum and fuels (10.6%). These three sectors together, then, receive 53.8% of the overall impact of the Gaudí Centre on the non-service subsystem.

5.3 Production effects on the service subsystem

To determine the production effects on the service subsystem, various components of the total effects of the Gaudí Centre need to be identified. Table 5 shows that the total effects on services are quantified to be 12,033,277 euros, 1.3 times the amount of the direct demand received. Compared with the non-service multiplier effect, the service subsystem is less able to expand the direct demand received. This is an important finding about the economic impacts of a cultural activity on production activities. The subsystem that receives most of the direct demand is the one that gets the proportionally smallest increase in its final production while the subsystem that receives the least final demand increases its production proportionally more. This result is of great interest because it implies that the effects of cultural assets are not obvious and can have a significant effect on several (apparently) unrelated economic activities.

¹² It should be noted that this is the overall effect for the whole range of non-service industries, but the effect is considerably higher for such industries as metal, rubber and plastic products, other non-metallic products and the manufacture of wood and cork.

Table 4 Production effects of the Gaudí Centre on the non-service subsystem: Catalonia, 2009 (euros)

	Direct effects	Internal effects	Circular effects	Open effects	Total effects
<i>m</i>					
1. Agriculture	1,365	3,376	7	645,203	649,952
2. Fishing	430	72	3	107,013	107,517
3. Energy, minerals, petroleum, fuels	1,275	5,707	171	579,351	586,505
4. Electrical energy, gas and water	1,766	712	139	303,240	305,856
5. Food	7,531	3,282	53	1,739,315	1,750,182
6. Textile	2,683	1,914	19	77,014	81,629
7. Manufacture of wood and cork	36	453	18	51,244	51,750
8. Paper	726	1,261	165	278,647	280,799
9. Chemistry	883	3,351	70	338,935	343,240
10. Rubber and plastic products	63	1,110	44	151,893	153,110
11. Other non-metallic products	59	628	9	98,752	99,448
12. Metal	43	3,101	19	241,945	245,107
13. Machinery	499	1,127	45	159,005	160,676
14. Electrical equipment, electronics	777	1,023	205	214,936	216,940
15. Manufacture of transport material	2,944	1,313	154	165,101	169,512
16. Other industries	1,477	400	23	43,084	44,984
17. Construction	686	2,081	186	301,174	304,127
Total	23,244	30,911	1,329	5,495,850	5,551,334

Table 5 Production effects of the Gaudí Centre on the services subsystem: Catalonia, 2009 (euros)

	Direct effects	Internal effects	Circular effects	Open effects	Total effects
<i>s</i>					
18. Commerce	1,218,201	549,558	209,753	2,327	1,979,840
19. Hotel management and restaurants	7,740,846	62,300	10,843	205	7,814,194
20. Transport and communications	99,865	492,197	122,994	2,268	717,324
21. Financial intermediation	3,693	216,411	48,577	889	269,570
22. Entrepreneurial services	10,404	805,491	251,398	3,243	1,070,535
23. Public services	0	0	0	0	0
24. Education	1,818	16,289	10,004	115	28,225
25. Sanitary, social services	3,088	35,319	10,455	135	48,996
26. Other services, personal services	4,750	61,428	36,689	472	103,340
27. Homes that employ domestic staff	1,253	0	0	0	1,253
Total	9,083,918	2,238,991	700,713	9,655	12,033,277

Most of the economic impact on services comes from the direct demand (75.5% of the overall effect). The internal effects of services on themselves account for approximately 18.6% of the total impact, and the circular and open effects, with percentages of 5.8 and 0.1%, make the smallest contributions to total effects.

At the sectorial level, hotel management is the activity that receives most impact on production (7,814,194 euros, approximately 65% of the total production effects). This is followed by commerce and entrepreneurial services that, with values of 1,979,840 euros and 1,070,535 euros, respectively, represent 16.4 and 8.9% of the total effects. This suggests, therefore, that the production impacts are concentrated in a limited number of services that are greatly benefited by the museum.

An interesting result is that the various channels of income expansion behave differently in the two subsystems. In the non-service group, the greatest impact comes from the open effects: that is, the effects caused by the input and final production demand that services make on the non-service subsystem. In the service group, on the other hand, the direct demand explains most of the total production effects.

5.4 Employment effects

Table 6 shows the employment effects generated by the presence of the Gaudí Centre. The direct demand of the museum and its visitors generates 114 jobs, which are all in the service sector. The total employment effects are quantified as 191 new workers, which are annual full-time equivalent jobs, 77.5% of which are in service activities (148) and 22.5% in non-service activities (43). The last row in Table 6 illustrates that the total employment impact is approximately 1.7 times larger than the direct effect.

Our results suggest that the economic impact has asymmetric multiplier effects on services and non-services in both income and employment, which can generate substantial differences in the effects of cultural assets on the various production sectors.

6 Conclusions

In recent years, economic research has paid special attention to the analysis of cultural and tourist investments as important sources of income and economic growth in local and regional economies. Scholars have also been interested in improving the technical instruments for evaluating the economic contribution of shocks to the final demand. In the field of territorial development, it is generally accepted that tourism and culture play an important role in economic and social development but most previous empirical studies have roughly estimated overall impacts and not gone deeper into specific sectorial effects. In this respect, it is generally accepted that services benefit most from cultural and tourism activities and that non-service activities receive practically no effects from cultural assets.

In this paper, we have defined a subsystem input–output model, which considers the non-service and the service sectors separately, to analyse the economic impact of a cultural activity on both services and non-services. We have also identified various channels of income generation and transmission within the input–output subsystem.

Table 6 Employment effects of the Gaudí Centre: Catalonia, 2009 (number of full time equivalent workers)

	Direct demand		Total effects	
<i>M</i>				
1. Agriculture	0	0 (0%)	10	43 (22.5%)
2. Fishing	0		2	
3. Energy, minerals, petroleum, fuels	0		1	
4. Electrical energy, gas and water	0		1	
5. Food	0		10	
6. Textile	0		1	
7. Manufacture of wood and cork	0		1	
8. Paper	0		2	
9. Chemistry	0		2	
10. Rubber and plastic products	0		1	
11. Other non-metallic products	0		1	
12. Metal	0		3	
13. Machinery	0		2	
14. Electrical equipment, electronics	0		1	
15. Manufacture of transport material	0		1	
16. Other industries	0		1	
17. Construction	0		4	
<i>S</i>				
18. Commerce	22	114 (100%)	36	148 (77.5%)
19. Hotel management and restaurants	90		91	
20. Transport and communications	1		6	
21. Financial intermediation	0		2	
22. Entrepreneurial services	0		9	
23. Public services	0		0	
24. Education	0		1	
25. Sanitary, social services	0		1	
26. Other services, personal services	0		2	
27. Homes that employ domestic staff	0		0	
Total	114	114	191	191

Our empirical application to the Catalan economy suggests that non-services receive a significant impact mainly because of the open effects that are explained by the inputs and final production that services demand of non-services. On the other hand, the economic impact on services is explained mostly by the direct demand of the cultural asset. Our subsystem model is an improvement on a conventional input–output approach, because it generates two qualitatively different results. First, the multiplier effects of cultural activities on the production sectors depend quite considerably on the subsystem analysed. Second, the various channels that expand and transmit income and employment impacts do not have the same importance in each subsystem. Our results

show how an initial demand shock in cultural activities positively influences almost all economic activities even if they have no direct relationship with the cultural activities.

The empirical context in this paper may help to explain the economic effects of cultural assets on the local and regional economies. This information may also be useful for determining regional development policies that use cultural assets as magnets to increase both the number of visitors and regional income.

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