Measuring the economic contribution of tourism to destinations within an input-output framework: some methodological issues

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Abstract

The input-output model is a traditional tool employed in the literature for measuring the contribution of an economic activity within a given territory. In the case of tourism, this methodological framework has been used to estimate the contribution of the tourism sector as a whole, and for specific products in the tourism market, such as cruise visits. The present paper computes the economic contribution of international tourism arriving at three major destinations on the Mediterranean coast of Spain; namely, Barcelona, Palma de Mallorca and Alicante. For each destination, both the country-level and regional-based input-output tables were employed, using the INTERTIO project, a regional input-output framework developed for the Spanish economy by the Lawrence Klein Institute of the Autonomous University of Madrid. The results show important differences in the magnitude of the computed economic effects between the country and regional approaches. To shed more light on the issue, we identify the main sources driving such dissimilar results, including the role of backward linkages of industries and the differing sectoral distributions of initial economic effects. Finally, we point to the role played by specific sectors in the model in amplifying the initial effects by using a centrality analysis of hub-and-authority effects. The methodological discussion in the paper helps to highlight the need for using the regional input-output model when available, and the other additional methodological tools we provide throughout the study for more accurately computing the economic impact of tourism for particular regions or destinations.

Keywords: Regional input-output tables, International tourism, Economic contribution, Hub and authority, Methodological tools

JEL codes: L83, C67, R11

1. Introduction

The input-output (I-O) model is a well-established framework in the literature for measuring the economic contribution of tourism within a given territory. Nowadays, the role of cities as major nodes in the expanding global economy is becoming increasingly recognised (UN-Habitat 2011). In this context, tourist destinations are also becoming important nodes within individual countries (Felsenstein et al. 2002; Lohmann and Pearce 2010). Europe continues to be the top tourist destination in the world, with 685 million international arrivals in 2018, while Southern Mediterranean Europe, with 275 million arrivals, has become the preferred place to visit for Europeans and other international tourists (UNWTO 2019). Within this area, particular localities have become mass destinations, such as Barcelona and Palma de Mallorca, with 8 and 11 million visitors, respectively, in 2017. This massive arrival of tourists at particular locations has brought a number of undesired negative impacts on the resident populations (Campón-Cerro et al. 2019). Extending the benefits of the tourism activity among the local population is therefore a desirable objective to be achieved in order to limit its negative effects. However, the economic contribution of touristic activities depends on the particular characteristics of each destination, and should therefore be estimated for each specific case. The main objective of this paper is to improve the estimation of such economic effects within the framework of the input-output tables, as a simple and accessible tool to be employed by interested researchers, and even by destination managers and related stakeholders who need to monitor the contribution of the tourism sector to the local or regional economy.

With this objective, the present research studies three main destinations on the Spanish Mediterranean coast, namely Barcelona, Palma de Mallorca and Alicante, this being three of the most important destinations in the world, showing however some differences in their economic structure. Firstly, the paper computes the economic contribution of international tourism at the level of these three destinations by using a two-tier approach, i.e. the country-level versus the regional-based I-O computation setting. For the regional approach, the paper employs the INTERTIO framework developed by the Lawrence Klein Institute of the Autonomous University of Madrid in Spain. Such a project develops an input-output framework for the whole Spanish economy and for each of its regions which, as a whole, is consistent with the national input-output framework. All of these estimated matrices rigorously fit the National Accounts Statistical framework defined by the Spanish Institute of Statistics (INE). The country level I-O table is also taken from INTERTIO to ensure comparability of results. Secondly, the research also breaks down the computed economic impact of tourism into their main building blocks, in order to offer a deeper understanding of this type of exercises for the interested reader. These include the identification of the global backward linkages shown by all industries in the input-output table, and the sectoral distribution of expenditure of tourists at each destination, as the key figures in this step of the computation. Further on, in a third step, the research highlights the role played by specific sectors in amplifying the initial economic effects of tourism across the model. This is performed by using a network analysis representing the productive structure of the system with each sector becoming a node. Then, the analysis illustrates the existing ties among all nodes in the system by relying on the intermediate trade in goods arising among them. In this setting, the relative importance of each sector inside the whole system can thus be measured by computing its “degree of centrality” score. Two types of nodes, namely hubs and authorities, appear in this analysis, which are characterized recursively. A sector is considered to be a good hub when it points (sells) to many good authorities. Therefore, the “hub” centrality of a sector shows how well it transmits a shock to the authorities in the network. Similarly, a sector is considered to be a good authority when it points (buys) to many good hubs, so the “authority” centrality of a sector indicates how well it receives the shock from the hubs. This third step centrality analysis, taken from the regional economics literature, will allow to show how demand shocks are transmitted throughout the I-O table according to the differing production structure of each of the regional economies under study.

In sum, the main contributions of this paper are methodological, although we illustrate them by showing empirical evidence for three world top tourism destinations. Firstly, we show the relevance of using regional I-O tables when available to deal better with micro-territorial computations for single destinations or regions of a country. Secondly, we highlight the key pieces in these computations, and how they may differ among a sample or the regional economies under study. And thirdly, we provide a hub- and-authority analysis to finally improve the characterization of the propagation of a shock within the I-O system, with interesting policy recommendations emerging. Input- Output tables are simple tools for economic impact studies. Although, new methods have emerged in recent years, our main interest lies in continuing to keep this simple and informative method in use for researchers and the general public, and to continue improving its analytical capacity.

After this introduction, the rest of the paper is organized as follows. In section 2, the literature is reviewed according to the use of the input-output framework for studies of tourism contributions and impacts. Section 3 describes the methodology employed for computing the economic effects of tourism at particular destinations. Section 4 presents the data and results of the computing exercise for the three selected destinations and discusses the main differences arising between the country-level and regional-based approaches. Section 5 identifies the methodological issues driving the observed differences between these two models. Finally, section 6 presents the conclusions.

2. Literature review

The economic contribution of tourism has become a popular research topic in tourism economics since the 1980s. The number of studies of tourism economics has steadily grown since then, including the application of Keynesian-type multipliers, input-output (I-O) models, the social accounting matrix, computable general equilibrium methodologies, cost-benefit analysis, and tourism satellite accounts (Song et al. 2012). Standard I-O techniques have been widely used for analysing the contribution of tourism to a given economy, once the use of ad hoc multipliers was progressively abandoned (Fletcher 1989; Fletcher and Archer 1991). The list of issues addressed by the I-O studies is important, and a good survey can be found in Polo and Valle (2012). A few examples, including country-case studies, are those of Baster (1980) for Scotland, O'Hagan and Mooney (1983) and Henry and Deane (1997) for Ireland, Cooper and Pigram (1984) for Australia, Jones and Munday (2004) for Wales, Atan and Arslanturk (2012) for Turkey, Munjal (2014) for India, and Khanal et al. (2014) for Laos.

On a local scale, many I-O studies have been carried out analysing the economic effects of tourism on regions, islands and cities. These include the contributions of Ruiz (1985) in Puerto Rico, Var and Quayson (1985) in the Okanagan Region (B. C., Canada), Mescon and Vozikis (1985) in Dade County, Miami, Heng and Low (1990) in Singapore, Archer and Fletcher (1996) in the Seychelles, Horváth and Frechtling (1999) in Washington D. C., Manente (1999) in some regions of Italy, Eriksen and Ahmt (1999) in the Danish regions, West and Gamage (2001) in Victoria, Australia, Cai et al. (2006) in Hawai, Polo and Valle (2008 and 2011) in the Balearic Islands, Spain, Van Leeuwen et al. (2009) in several Dutch cities, Murillo et al. (2013) in the city of Barcelona, Klijs et al. (2015) in the province of Zeeland, The Netherlands, Pratt (2015a) in seven small island developing states (American Samoa, Aruba, Fiji, Jamai- ca, Maldives, Mauritius and Seychelles), Chang et al. (2016) in Incheon (South Korea), De Santana et al. (2017) in the Brazilian Northeast, Faturay et al. (2017) in eight Indonesian regions, Artal-Tur et al. (2019) in the Region of Murcia, Spain, Kronenberg et al. (2018) in the Swedish region of Jämtland, and Pratt (2015b), and Yang et al. (2018) in thirty Chinese provinces.

As noted, the basic I-O model is a useful tool for estimating the total economic effects that a change in final demand will have on a reference economy. Since the original contribution of Leontief, I-O tables continue to offer a rich and detailed representation of a regional or national economy, providing measurable quantities of technical relations of production and consumption among the different sectors of the economy. The process for obtaining the direct, indirect and induced effects, and the multipliers on output, income, and employment arising in the model has become standard in the industry. As a result, the I-O framework continues to be widely used in academic and non-academic forums because of its relative simplicity in computation and the intuitive results provided for tourism management issues.

However, it is also important to note that the I-O standard approach is not exempt from limitations. The most relevant lies in the static character of this computational tool. The basic I-O model assumes a constant return to scale, and a fixed proportions technology setting. That is, the quantity relations between the inputs in the model and with output are established constantly and independently of the production level, so we cannot properly account for increasing returns to scale or increases in marginal demand, sometimes leading to overestimations of the final tourism impact on the regional economy, as pointed out by authors such as Crompton (1995). Given these restrictive assumptions, the results of the I-O analysis need to be applied with suitable caution to practical problems, a cautionary recommendation that we want to highlight again in this type of study. Jago and Dwyer (2006) also state that the relationship in the real business world is quite flexible and should be taken as is in modelling exercises, or the model has no factor constraints, which results in a tendency to overestimate the effects. All the above-mentioned facts could generate a potential bias of the estimated results (Dwyer et al. 2004).

In order to address these and other limitations (for instance, to allow for price changes and reallocation of resources between production sectors), several studies have pointed towards the use of Computable General Equilibrium Models (CGE), e. g. Dwyer et al. (2000, 2003, 2016), Blake et al. (2001), Kasimati (2003), Kumar and Hussain (2014), Dwyer (2015), or Banerjee et al. (2017). However, CGE modelling is not exempt of its own problems and criticisms. Some of the most cited include the suitability of this methodology with respect to the selected size of the area under study (national, regional or local), and the availability of data for such local or regional approaches (Dwyer et al. 2003). However, adjustments can be made to the basic I-O model to obtain more accurate results and realistic frameworks of analysis; for example, with the building of regional I-O tables within a coherent regional-based statistical framework. Moreover, CGE models appear to be too complex given the large number of assumptions to be made if they are expected to work properly, e.g., ignoring market failures, or data collection issues, as indicated by Croes and Severt (2007). In this way, following Klijs et al. (2012), I-O models continue to be an ‘in-between’ option to more complex or naïve modelling strategies when computing the economic contribution of tourism to a given place, being easier to use, less data-demanding, and providing intuitive results for non-specialist destination managers and politicians, with this also being in the spirit of this paper when using the I-O approach.

These facts explain why I-O analysis continues to be a very popular approach for studying the economic effects of tourism, as demonstrated by the amount of related literature published in recent years. New contributions also incorporate or modify several aspects of the basic I-O model in order to address some of the drawbacks associated with the basic model. Cai et al. (2006) develop a methodology for computing the forward and backward linkages of tourism and propose to complement traditional tourism impact analysis with a “linkage analysis”. Polo and Valle (2008) use I-O techniques with alternative assumptions over endogeneity of final demand components for assessing the impact of tourism on the Balearic Islands. Van Leeuwen et al. (2009) perform a meta-analysis on tourism output multipliers, with the aim of addressing which characteristics of the documentation source, the research area, or the tourism sector affect the size of the output tourism multiplier. Bess and Ambargis (2011) focus on the assumptions and limitations of I-O models, and on the information that is required to use input-output multipliers correctly. Klijs et al. (2015) apply a non-linear input–output model to the province of Zeeland, The Netherlands, accounting for price-induced input substitution. Yang et al. (2018) apply latent class regression models to analyse the determinants of output, income, and employment multipliers of tourism in Chinese provinces.

In this paper, we continue to extend the basic I-O model by using regional I-O tables developed by the INTERTIO project. This is a regional input-output framework for the Spanish economy and its regions developed by the Lawrence Klein Institute of the Autonomous University of Madrid, and which coherently matches the statistical framework of the National Statistics Institute of Spain (INE). When computing the economic effects of tourism for three selected destinations in Spain, the results show important differences in the magnitude of outcomes between the country and regional I-O-based approaches. To shed more light on these issues, the paper identifies the main sources driving such differences, including the role of backward linkages and the differing sectorial distribution of initial economic effects. Furthermore, the research also analyses the role played by specific sectors in the model in amplifying the initial effects throughout the production network. With this objective, a centrality analysis of hub-and-authority effects is employed following contributions taken from regional economics (Newman 2010).

3. Methodology: a note on the input-output framework of analysis

The well-known input-output framework assumes that each of the *n* sectors of an economy produces a given amount of a good that it sells to other sectors (including itself) as intermediate inputs and to consumers to satisfy final demand (see Miller and Blair 2009, for a review of the input-output model). More precisely, the production of a sector *i*, denoted by x_i, can be expressed as:

$$x_i = \sum_{j=1}^{n} a_{ij} x_j + y_i, \quad i = 1, 2, \ldots, n, \tag{1}$$

where a_{ij} is a technical coefficient that measures how many units of output from sector i must the sector j use to produce one unit of output; and y_i represents the output that sector i sells to final consumers.

With $\mathbf{x}$ representing the vector total output of the economy, $\mathbf{y}$ the vector of final demand, and $\mathbf{A}$ the matrix of technical coefficients, equation (1) can alternatively be written as

$$\mathbf{x} = \mathbf{A}\mathbf{x} + \mathbf{y}. \tag{2}$$

Solving for $\mathbf{x}$, the following equation that relates final demand to total output in the economy is obtained:

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{y}. \tag{3}$$

Matrix $\mathbf{B} \equiv (\mathbf{I} - \mathbf{A})^{-1}$ in equation (3) is known as the Leontief inverse matrix. Interestingly, each element of the Leontief inverse indicates by how much the output of sector *i* would increase if final demand for sector *j*'s output, were increased by one unit, that is, $b_{ij} = \partial x_i / \partial y_j$. Therefore, the output multiplier of sector *j* is defined as the sum of the elements in the *j*-th column of the Leontief inverse matrix,

$$b_{.j} = \sum_{i=1}^{n} b_{ij}. \tag{4}$$

This indicator measures the total output from all sectors generated from one unit of final demand of sector *j*'s output or, in other words, it measures the effects of one monetary unit change in the final demand for each sector on total output of all sectors (including the sector itself). Moreover, under some mild conditions,[1] the Leontief inverse matrix can be written as,

$$(\mathbf{I}-\mathbf{A})^{-1} = \mathbf{I}+\mathbf{A}+\mathbf{A}^2+\mathbf{A}^3+\ldots\ , \tag{5}$$

such that the output multipliers are commonly decomposed as the sum of three types of effects, say, initial, direct, and indirect effects, which are given by the corresponding coefficients of the matrices $\mathbf{I}$, $\mathbf{A}$, and $\mathbf{S}=\sum_{k=1}^{+\infty}\mathbf{A}^k$, respectively (see, i.e., Miller and Blair 2009).

Output multipliers provide a simple measure of the economic relevance of a sector after a demand shock. However, it is possible to gain a deeper insight about the role of sectors in the system by examining the inter-sectoral relationships in a social network framework. Following this approach, the system is interpreted as a network with *n* nodes, each corresponding to a sector, that are mutually linked by the trading of intermediate output. To define the magnitude of the ties for a pair of sectors, *i* and *j*, one can consider the purchases of output of the sector *i* made by sector *j* relative to the total output of sector *j*, that is, x_{ij}/x_j, which matches the technical coefficient a_{ij}.[2] Within this framework, a weighted and directed graph with self-loops and an associated adjacency matrix given by **A** emerges**,** representing the productive structure of the whole national or regional economy defined in the I-O table.

A key concept in social network analysis is the identification of central nodes in a network. Centrality refers to the importance of a node (sector) due to its structural position into the whole network. However, the concept is still rather imprecise and the literature has suggested several different metrics and definitions of centrality (see Newman 2010, for a review). In the case of networks with directed ties, a convenient approach is based

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[1] In short, the spectral radius of the matrix **A** must be less than unity.

[2] Note that for the production of an additional of output, the sector *j* has to buy a_{1j} units of intermediate output from sector 1, a_{2j} units of intermediate output from sector 2, and so on. Therefore, we measure the magnitude of ties between sector *j* and the rest of sectors in the system (including itself) is better characterized by the intensity of usage of output of sector *i* by sector *j* (the technical coefficients $a_{1j}, a_{2j}, \ldots$) than by the absolute value of the intermediate output that each sector supplies to sector *j* collected in the input-output table (the terms $x_{1j}, x_{2j}, \ldots$).

on the concept of hubs and authorities introduced by Kleinberg (1999) for rating the importance of each node. Originally, a node with a high authority value is pointed to by many other nodes with high hub scores, and a node with high hub value points to many nodes with high authority scores. Therefore, the computation of hub and authority values represents a useful tool for the characterization of the network structure. In this setting, each node is described by two measures: hub centrality (η) and authority centrality (υ). These two measures are defined recursively: a sector receives a high score as a hub if it supplies sectors that play a key role as buyers. On the other hand, a sector receives a high score as an authority if it is supplied by sectors with a relevant role as hubs. This mutually reinforcing relationship can be formalized as:

$$\eta_i = \alpha \sum_j a_{ij} \upsilon_j , \tag{6}$$

$$\upsilon_i = \beta \sum_j a_{ji} \eta_j , \tag{7}$$

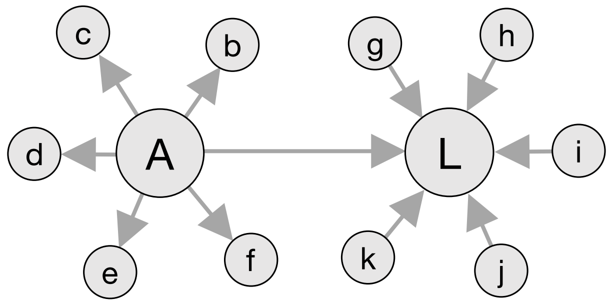
where α and β are normalizing constants. Equation (6) defines the hub centrality of a node *i* (η_i) to be proportional to the sum of the authority scores of the nodes it points to. Likewise, from equation (7), the authority centrality of a node i (υ_i) is proportional to the sum of the hub scores of the nodes that points to it (Newman 2010).[3] For illustrative purposes only, let us consider the directed network depicted in figure 1 where each arrow represents a unit value link between two nodes. In this network, the nodes A and L achieve the highest hub and authority scores, respectively. At the same time, node A plays a null role as authority, while node L obtains a zero hub score.

[3] The definition of hub and authority centrality can be written in matrix form as

$$\boldsymbol{\eta} = \alpha \mathbf{A} \boldsymbol{\upsilon},$$
$$\boldsymbol{\upsilon} = \beta \mathbf{A}^{\mathrm{T}} \boldsymbol{\eta}.$$

After a little of algebra, it can be shown that the vectors of hub and authority scores, $\boldsymbol{\eta}$ and $\boldsymbol{\upsilon}$, coincide with the principal eigenvectors of the symmetric positive definite matrices $\mathbf{A}^{\mathrm{T}}\mathbf{A}$ and $\mathbf{A}\mathbf{A}^{\mathrm{T}}$, respectively (Newman 2010).

Figure 1. Hub and authority centrality in a network



In this research, the centrality scores are not designed to be interpreted as multipliers; instead, they simply provide a measure of the intensity of participation of sectors in many production chains (Alatriste-Contreras 2015). For example, let us consider an increase in the final demand of sector *j* followed by the necessary increase in production in order to satisfy its new customers. To produce a higher amount of output, sector *j* will have to purchase intermediate goods from other sectors (including itself). However, the chain does not end here, as the production of intermediate goods by each of the sectors will, in turn, require successive increases in their production. The role of sector *j* as authority in the network will be higher either because it purchases goods from a large list of supplier sectors, or because it uses inputs from sectors that themselves play a relevant role as suppliers for the whole system, i.e., they have a high hub centrality score. In the end, the circularity of the definition of hub and authority centralities stems from the fact that the latter sectors will have a higher hub score as they supply a sector with a high authority score. Besides, the computation of hub and authority centralities allows us to rank the sectors according to their ability to generate a wide diffusion of the effects of a shock throughout the economic system. Accordingly, the key sectors will be those linked to a wider part of the productive structure, and especially to other key sectors, either as a supplier or as a buyer of intermediate inputs. This concept, taken from regional and urban economics, provides a useful insight for the I-O analysis of tourism studies.

4. Computing the economic contribution of international tourists in an input-output framework

In this section, the economic contribution of international tourists arriving in the three Spanish Mediterranean destinations in the study is computed; namely, Alicante, Barcelona and Palma de Mallorca. These case-studies will allow us to illustrate some key methodological issues arising in the computation process. Throughout the section, data issues and the results of the I-O model are discussed.

4.1. Data issues

The data set in the study includes a number of variables. The input-output tables come from the INTERTIO project carried out by the Lawrence Klein Institute at Autonomous University of Madrid, Spain. This project provides a coherent framework of regional input-output tables in 2010 for all 17 regions in Spain (EU NUTS-2 classification), plus one country table for the whole Spanish economy, all fitting the Statistical National Accounts framework developed by the Spanish Institute of Statistics (INE) (for further details, see Pérez et al. 2009; Pérez-García et al. 2009). The symmetrical input-output tables employed here are defined for 21 sectors, including all primary, secondary and tertiary activities in the economy, and their interrelationships both for the demand and supply sides. The present analysis employs input-output tables for the regions where the destinations under study are located, namely, Catalonia, the Balearic Islands and the Valencian Community, corresponding to the cities of Barcelona, Palma de Mallorca and Alicante. We decided to employ these three case studies as they differ in tourism and economic terms. Palma de Mallorca is an island (Mallorca) with certain limitations in its production structure, but with a long tradition in international tourism arrivals. Barcelona has the second largest economy in Spain, but has suffered huge problems due to overtourism in the city centre in recent years. Alicante has a long tradition as an international destination, but still has a long way to go, and so is considered to be a tourism economy in the middle of the destination cycle. In this sense, we will employ these differences among the three destinations to better highlight our methodological discussion.

Total expenditure employed in computing the economic impact of tourism includes the total number of international arrivals in these particular locations in the year 2017, as well as the average expenditure of tourists and its sectoral breakdown by industry in the I-O tables. All tourism-related variables are taken from the EGATUR survey (tourist expenditure survey) of INE. In order to homogenise the currency units between the year 2010 of the input-output tables and the expenditure of tourists in 2017, GDP deflators are computed following the sectoral classification of the Regional Accounting Frame- work of the National Statistics Institute of Spain for the three regions of interest and the Spanish economy as a whole (CRE-INE).[4]

4.2. Results

In this section the results of the computation of the economic impact of international tourism reaching the three destinations in the study are presented. According to the data, tourists expenses are concentrated in only four sectors of activity, namely retail trade, hotel and restaurant services, transport services and other services (see, for example, table 2), with the initial impact vector having zero values in all elements but for these four sectors where tourist expenditure is concentrated. Furthermore, the initial impact vector computations and corresponding input-output tables are employed to estimate the direct and indirect effects on equation (3), which relates the final demand vectors to the output of the sectors in the economy.[5]

Table 1 shows the results for Alicante, Barcelona and Palma de Mallorca in terms of the economic contributions of tourism to the input-output model, including the effects on output or production, gross value added, employment, wages and the profits or surplus of firms. As shown in the table, the effects are computed in three stages, including initial effects, those primarily related to the first round of tourist expenditure; direct effects, capturing the impact of the first round of purchases on their providers from these companies initially selling goods and services to tourists; and indirect effects, or the impact of the remaining rounds of purchases among companies enabling the final sales to tourists at destinations, following the methodological approach in Miller and Blair (2009).

In sum, table 1 shows all the economic contributions of international tourists in Alicante, Barcelona and Palma de Mallorca by types of effects - initial, direct, indirect and total – and for the related variables in the analysis including production, value added, employment and rents. The first two blocks of results in the table show the computed economic effects by using the country-level (national) input-output table of Spain (TIO-

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[4] The GDP deflators are shown in the Appendix (table A.1).

[5] From equation (3), the total effect on output ($\Delta\mathbf{x}$) of a change in the final demand ($\Delta\mathbf{y}$) can be expressed as $\Delta\mathbf{x} = \mathbf{B}\,\Delta\mathbf{y}$.

E), or the regional-based input-output tables (TIO-R) specific to each of these three destinations. In general, the results differ according to the input-output framework employed. As shown by the third block of results in Table 1, the computed effects clearly differ in magnitude between the country and regional frameworks (TIO-E/TIO-R), particularly for direct and indirect effects, as expected, as these computations are those that really build on the input-output framework and the relationships among industries throughout the national and regional economies. For example, the total economic effects of tourism on output or total production appear to be 22%, 20% and 26% higher in Alicante, Barcelona and Palma, respectively, when using the country-level framework (TIO-E) versus the regional-based one (TIO-R), with the main differences relying on the indirect effects that accumulate all linkages and purchases of the final companies or industries to their providing counterparts throughout the economy. The magnitude of national and regional-based effects differs by a factor of 2–3 in the case of indirect effects, and by a factor of around 1–2 for direct effects, showing existing differences in the relative positions of industries and bilateral relationships with the rest of the economy for the country and regional frameworks. Moreover, when making the total effect the numeraire (1.00), the share of component effects also differs in relative terms between the regional and national approaches, as shown in the fourth and fifth blocks of table 1, pointing again to existing differences between both tables and their structures, an issue that will be more deeply explored in the next section of the paper.

Table 2 shows the breakdown of the computed total effects of international tourism by destination sector throughout the local economies under analysis. As shown in the table, the main effects arise for real estate and the hotel and restaurant sectors, followed by those of the retail trade, transport services, food and beverages, non-market governmental services and other tourism related services. Relative participation of effects in terms of Gross Value Added (GVA) and Employment services (Jobs), when using country-related (TIO-E) or regional-based (TIO-R) input-output frameworks, appears to be similar for all three destinations. However, some slight changes appear regarding the sectoral breakdown of the effects of tourism. For example, in Alicante, when using the regional framework, some effects spread to finances and energy and extractives, while in the country-related framework these effects shift towards the food and beverage and non-market services.

A preliminary conclusion of this section is the need to rely on regional input-output frameworks when computing the economic effects or impacts of tourism for specific destinations, given that this approach is better suited than the national input-output approach for the city-region analysis as shown in this section.

5. Explaining the differences in the computed effects between regional and national input-output frameworks

This section provides deeper insights into the factors which explain the observed differences in the computed economic effects of international tourism through the regional and national frameworks, with those differences arising due to a number of factors. In absolute terms, the most obvious difference comes from the number of tourists received by each destination, together with the dissimilar average expenditure per tourist once there. At this point, the 8 million international tourists received by Barcelona, or the 11 million in Palma de Mallorca, sharply contrast with the 4 million that arrived in Alicante in 2017. Moreover, while every international visitor to Palma and Barcelona spent, on average, 1059 and 1006 euros, respectively, during their stay, visitors to Alicante spent 956 euros, according to EGATUR (INE). Once these absolute differences are stated, it appears more appropriate to focus the subsequent analysis on a relative measure of the economic contribution of tourists, allowing us to rule out this type of size effects. In doing so, the focus would now be on the economic impact per euro of tourist expenditure at three selected destinations, in order to highlight the sources of the differences in effects computed using the national and regional I-O frameworks.

In this setting, the impact on output of a unit of tourist expenditure, denoted by b_w, can be expressed in terms of the input-output multipliers times the structure of the tourist expenditure as follows,

$$b_w \equiv \mathbf{b}^{\mathrm{T}}\mathbf{w}\ , \qquad (8)$$

where $\mathbf{b}$ and $\mathbf{w}$ are $n \times 1$ vectors containing the sectoral output multipliers and the weights of each sector in the final demand of tourists (so that $\sum_j w_j = 1$), respectively. Note that, in practice, b_w defines the output multiplier of the consumption expenditure made by international visitors to a destination. Such an index may also be interpreted as a measure of the leverage effect of the touristic activity in a given region, where one can get additional insights about the different impact of international tourist flows by comparing the b_w's for each destination with the multiplier associated to a reference case, $\bar{b}_w$. Moreover, the following decomposition of the differential $b_w - \bar{b}_w$ in equation (9), allows to identify, for each sector, the share attributable to differences in the composition of the tourist expenditures ($\mathbf{b}^T(\mathbf{w}-\boldsymbol{w})$), and that stemming from deviations of the intersectoral structure of a particular destination with regards to the benchmark case ($\mathbf{w}^T(\mathbf{b}-\boldsymbol{b})$), the country of Spain in this case:

$$b_w - \bar{b}_w = \mathbf{b}^T(\mathbf{w} - \bar{\mathbf{w}}) + \bar{\mathbf{w}}^T(\mathbf{b} - \bar{\mathbf{b}}) \qquad (9)$$

The tourist multipliers ($\mathbf{b}^T$), the structure of the tourist expenditure ($\mathbf{w}$), and the differentials $b_w - \bar{b}_w$ for each destination, as well as their decomposition according to equation (9), are shown in table 3 for the tourism-related sectors in the I-O table. As shown, the multipliers appear to be smaller for each of the local destinations´ cases than for the national case. Indeed, this result is explained by the fact that interior technical coefficients in the country input-output table (TIO-E) systematically appear to be higher than the corresponding coefficients in the three employed regional input-output tables (TIO-R). The structure of the tourist expenditure also differs among the local and national cases, although not showing a clear pattern as in the multipliers case. Regarding the computed differentials $b_w - \bar{b}_w$, they appear to be basically driven by differences which arise in the inter-sectoral relationships in the table for the three cases ($\mathbf{w}^T(\mathbf{b}-\boldsymbol{b})$), the so-called "effect of **b**" in table 3, i.e., differences in the production function structure among the regional and national I-O tables. However, the relative importance of such a factor varies significantly from one destination to another, with Catalonia exhibiting a much more pronounced difference in the production structure with regards to the benchmark of Spain.

Notwithstanding, the bulk of the differences in these computed relative multipliers is mostly related to the differing economic structures observed for the city-regions and the national cases, which reinforces the necessity of employing an input-output framework which truly captures the idiosyncrasy of the local-regional economy under study in this type of exercise. Moreover, the differences in the sectoral structure of tourist expenditure (effect of **w**), despite being of a much smaller magnitude, contribute to exacerbating the global differentials for the cases of the Valencian Community and the Balearic Islands, while reducing them in the case of Catalonia.

Table 1. Economic impact of international tourism using country-level and regional-based input-output tables

Alicante

Results based on TIO-E

Effects	Output	GVA	Employment	Wages	GOS
Initial	4,324	2,438	45	1,173	1,243
Direct	1,464	715	12	349	360
Indirect	1,104	510	9	242	270
Total	**6,893**	**3,663**	**66**	**1,765**	**1,873**

Distribution of effects	Output	GVA	Employment	Wages	GOS
Initial	0.63	0.67	0.68	0.67	0.66
Direct	0.21	0.20	0.19	0.20	0.19
Indirect	0.16	0.14	0.13	0.14	0.14
Total	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Results based on TIO-R

Effects	Output	GVA	Employment	Wages	GOS
Initial	4,324	2,613	50	1,194	1,385
Direct	942	498	9	224	266
Indirect	384	189	3	85	101
Total	**5,650**	**3,300**	**62**	**1,503**	**1,752**

Distribution of effects	Output	GVA	Employment	Wages	GOS
Initial	0.77	0.79	0.80	0.79	0.79
Direct	0.17	0.15	0.14	0.15	0.15
Indirect	0.07	0.06	0.05	0.06	0.06
Total	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Deviations TIO-E / TIO-R

Deviations	Output	GVA	Employment	Wages	GOS
Initial	1.00	0.93	0.90	0.98	0.90
Direct	1.55	1.44	1.39	1.56	1.35
Indirect	2.88	2.70	2.66	2.85	2.67
Total	**1.22**	**1.11**	**1.07**	**1.17**	**1.07**

Barcelona

Results based on TIO-E

Effects	Output	GVA	Employment	Wages	GOS
Initial	11,166	6,071	109	3,030	2,996
Direct	4,564	2,173	34	1,091	1,064
Indirect	3,584	1,622	25	790	835
Total	**19,315**	**9,866**	**169**	**4,912**	**4,895**

Distribution of effects	Output	GVA	Employment	Wages	GOS
Initial	0.58	0.62	0.65	0.62	0.61
Direct	0.24	0.22	0.20	0.22	0.22
Indirect	0.19	0.16	0.15	0.16	0.17
Total	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Results based on TIO-R

Effects	Output	GVA	Employment	Wages	GOS
Initial	11,166	6,311	107	3,196	3,067
Direct	3,347	1,682	26	869	794
Indirect	1,522	759	11	386	365
Total	**16,036**	**8,752**	**145**	**4,451**	**4,225**

Distribution of effects	Output	GVA	Employment	Wages	GOS
Initial	0.70	0.72	0.74	0.72	0.73
Direct	0.21	0.19	0.18	0.20	0.19
Indirect	0.10	0.09	0.08	0.09	0.09
Total	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Deviations TIO-E / TIO-R

Deviations	Output	GVA	Employment	Wages	GOS
Initial	1.00	0.96	1.02	0.95	0.98
Direct	1.36	1.29	1.31	1.26	1.34
Indirect	2.35	2.14	2.24	2.05	2.29
Total	**1.20**	**1.13**	**1.17**	**1.10**	**1.16**

Palma de Mallorca

Results based on TIO-E

Effects	Output	GVA	Employment	Wages	GOS
Initial	10,484	6,038	105	2,921	3,061
Direct	3,950	1,900	31	935	949
Indirect	3,073	1,382	22	667	721
Total	**17,507**	**9,321**	**158**	**4,522**	**4,731**

Distribution of effects	Output	GVA	Employment	Wages	GOS
Initial	0.60	0.65	0.66	0.65	0.65
Direct	0.23	0.20	0.20	0.21	0.20
Indirect	0.18	0.15	0.14	0.15	0.15
Total	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Results based on TIO-R

Effects	Output	GVA	Employment	Wages	GOS
Initial	10,484	7,192	124	3,347	3,765
Direct	2,417	1,335	22	615	703
Indirect	1,001	520	9	249	265
Total	**13,902**	**9,047**	**155**	**4,210**	**4,733**

Distribution of effects	Output	GVA	Employment	Wages	GOS
Initial	0.75	0.80	0.80	0.80	0.80
Direct	0.17	0.15	0.15	0.15	0.15
Indirect	0.07	0.06	0.06	0.06	0.06
Total	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Deviations TIO-E / TIO-R

Deviations	Output	GVA	Employment	Wages	GOS
Initial	1.00	0.84	0.85	0.87	0.81
Direct	1.63	1.42	1.38	1.52	1.35
Indirect	3.07	2.66	2.53	2.68	2.72
Total	**1.26**	**1.03**	**1.02**	**1.07**	**1.00**

Source: Own elaboration.

Notes: GVA stands for Gross Value Added. GOS stands for Gross Operating Surplus. Units in million EUR and thousands of employed persons.

Table 2. Sectoral breakdown of total economic effects of international tourism using country-level and regional-based input-output tables

Alicante

Results based on TIO-E

Sector	GVA	JOBS
Real State	40%	33%
Hospitality sector	23%	23%
Wholesaler and reatil trade	14%	18%
Transport and communications	11%	13%
Food, beverages and tobacco	2%	2%
Non-market services	2%	3%
Other tourism-related sectors	8%	8%
TOTAL	**100%**	**100%**

Results based on TIO-R

Sector	GVA	JOBS
Real State	42%	31%
Hospitality sector	24%	25%
Wholesaler and reatil trade	15%	20%
Transport and communications	13%	16%
Finances	1%	1%
Energy and extractives	1%	1%
Other tourism-related sectors	4%	5%
TOTAL	**100%**	**100%**

Barcelona

Results based on TIO-E

Sector	GVA	JOBS
Real State	33%	27%
Hospitality sector	20%	19%
Wholesaler and reatil trade	15%	19%
Transport and communications	14%	17%
Finances	4%	4%
Non-market services	3%	5%
Other tourism-related sectors	11%	10%
TOTAL	**100%**	**100%**

Results based on TIO-R

Sector	GVA	JOBS
Real State	34%	28%
Hospitality sector	25%	23%
Wholesaler and reatil trade	16%	20%
Transport and communications	16%	19%
Intermediación financiera	3%	3%
Non-market services	2%	3%
Other tourism-related sectors	5%	4%
TOTAL	100%	100%

Palma de Mallorca

Results based on TIO-E

Sector	GVA	JOBS
Real State	38%	32%
Hospitality sector	21%	20%
Wholesaler and reatil trade	16%	21%
Transport and communications	8%	9%
Finances	4%	4%
Food, beverages and tobacco	2%	2%
Other tourism-related sectors	11%	11%
TOTAL	**100%**	**100%**

Results based on TIO-R

Sector	GVA	JOBS
Real State	34%	24%
Hospitality sector	38%	38%
Wholesaler and reatil trade	16%	22%
Transport and communications	5%	7%
Finances	3%	3%
Energy and extractives	2%	1%
Other tourism-related sectors	4%	5%
TOTAL	**100%**	**100%**

Source: Own elaboration.

Table 3. Output multipliers of the touristic activity

Sector	Catalonia		Valencian Community		Balearic Islands		Spain	
	b	**w**	**b**	**w**	**b**	**w**	**b**	**w**
Retail trade	1.4457	0.1710	1.3764	0.1370	1.3982	0.1930	1.6576	0.2042
Hotel and restaurant services	1.3818	0.3112	1.3531	0.3471	1.0988	0.3319	1.7493	0.2537
Transport services	1.5692	0.2576	1.4686	0.1800	1.8183	0.1210	1.9233	0.2040
Real state services and other business services	1.3382	0.2602	1.3269	0.3359	1.3333	0.3540	1.5230	0.3380
Tourist multiplier, b_w	**1.4297**		**1.3683**		**1.3267**		**1.6896**	
Differential $b_w - \bar{b}_w$	-0.2599		-0.3213		-0.3629		–	
Effect of **w**	0.0113		-0.0043		-0.0593		–	
Effect of **b**	-0.2713		-0.3170		-0.3036		–	

Source: Own elaboration.

Furthermore, the availability of regional input-output tables allows us to carry out a more in-depth analysis of the inter-sectoral relationships and, consequently, to evaluate the structural relevance of each sector in the corresponding economic system. In particular, it is important to determine the "centrality" degree of the sectors acting as providers of the tourist demand. Consequently, the hub and authority scores are computed for each sector according to equations (6)–(7), with the corresponding values displayed in table 4.[6] In general, the table shows that the distribution of the hub scores of sectors are positively skewed, i.e., only a few sectors of the economy can be considered to have a central hub position, including retail trade, transport services, and real estate and other business services. Regarding the distribution of the authority scores, it appears to be positively skewed for the case of Catalonia and, particularly for the Valencian region. However, the sectors directly related with the tourism activities in the table do not emerge as those appearing as relevant authorities. As shown, the ability of the tourism-related sectors to diffuse shocks along the whole economy stems from their prominent role as hubs, i.e., the contribution of these sectors to spread the impact of the tourist initial expenditures along the local-regional economies is mainly based on their activity as suppliers of inputs to other sectors, not as final consumers. This is an important result, given the prominent role that those inter-sectoral differences appear to play in the global analysis of the economic effects of international tourism in this research as shown in table

[6] The values are normalized for the interval [0,1].

3. In general, differences in the hub and authority values for the tourism-related sectors for the three regional cases and the national case are also highlighted in table 4, with no clear pattern emerging.

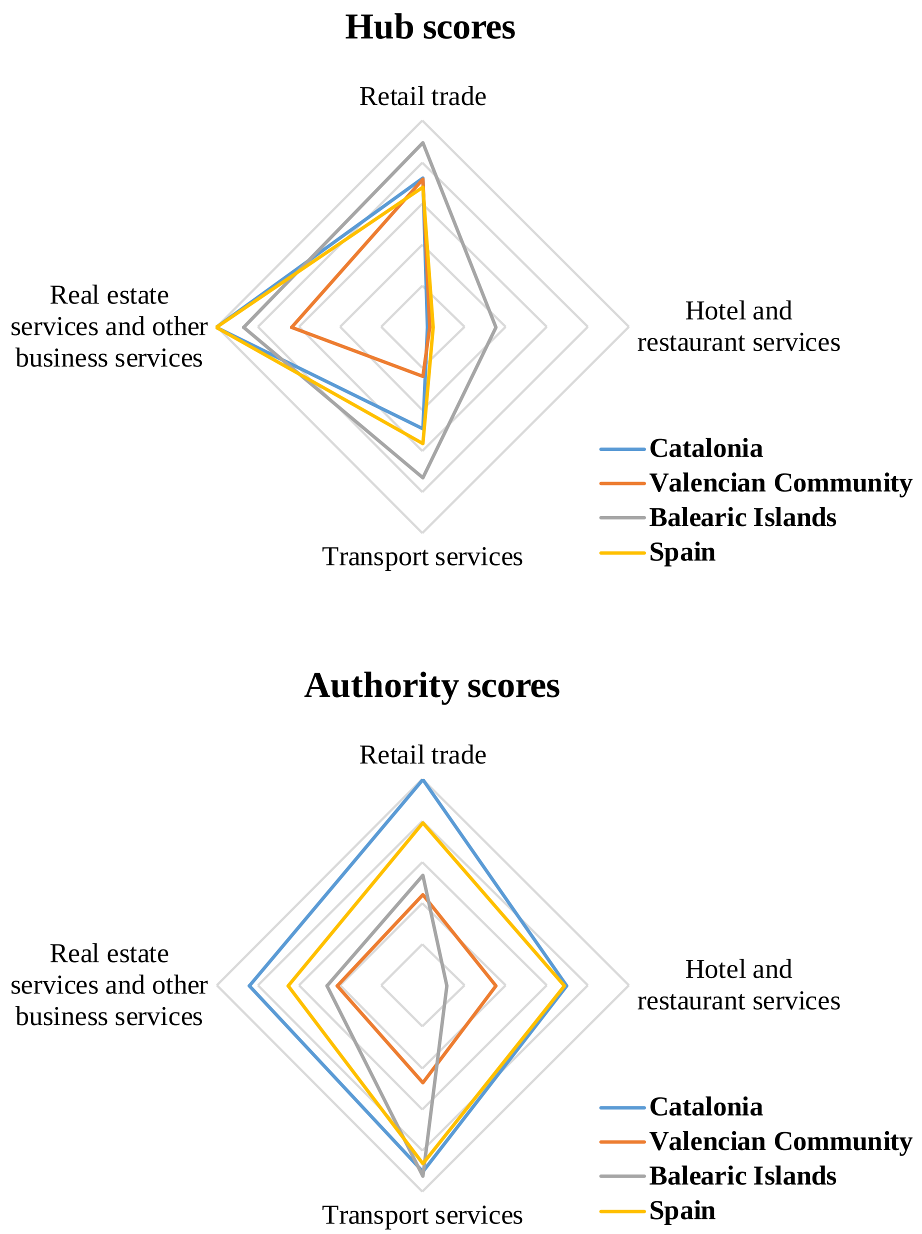
Table 4. Hub and authority centrality scores

	Catalonia		**Valencian Community**		**Balearic Islands**		**Spain**	
Sector	**Hub**	**Authority**	**Hub**	**Authority**	**Hub**	**Authority**	**Hub**	**Authority**
Products of agriculture, forestry and fishing	0.1324	0.5094	0.0555	0.2568	0.0394	0.3910	0.2553	0.5981
Mining	0.4948	0.8332	1.0000	0.9419	1.0000	0.7008	0.7252	0.8409
Food products and beverages	0.3284	0.7159	0.2553	0.4930	0.0967	0.6106	0.5316	1.0000
Textiles, wearing apparel and furs, leather products	0.0963	0.5885	0.0355	0.4748	0.0774	0.6966	0.2012	0.7594
Wood and products of wood and cork	0.0294	0.6233	0.1643	0.5585	0.0967	0.7272	0.1317	0.7724
Paper products, printed matter and recorded media	0.1393	0.7200	0.1276	0.4338	0.0458	0.4481	0.1915	0.7566
Chemical products	0.2078	0.6034	0.1597	0.6454	0.0135	0.7786	0.3233	0.7443
Rubber and plastic products	0.0632	0.4553	0.0900	0.3178	0.0030	0.8675	0.1553	0.6329
Other non-metallic mineral products	0.0945	0.4783	0.1248	0.8759	0.2015	0.5670	0.1754	0.8320
Basic metals and fabricated metal products (except machinery and equipment)	0.2560	0.4457	0.2990	0.4491	0.1416	0.5567	0.7002	0.9663
Machinery and equipment n.e.c.	0.0083	0.6056	0.0607	0.3722	0.0116	0.6042	0.0761	0.8654
Office machinery and computers, electrical product, precision and optical products	0.0476	0.4591	0.1452	0.5336	0.0110	0.4462	0.1470	0.7746
Motor vehicles and other transport equipment	0.0216	0.3745	0.0591	0.3254	0.0105	0.4155	0.0961	0.5923
Other manufactured goods n.e.c.	0.2694	0.9615	0.1988	0.4214	0.2242	0.7803	0.2518	0.7510
Construction work	0.3830	0.7892	0.6300	1.0000	0.6444	1.0000	0.2816	0.6941
Retail trade	**0.7236**	**1.0000**	**0.7183**	**0.4424**	**0.8951**	**0.5339**	**0.6809**	**0.7897**
Hotel and restaurant services	**0.0215**	**0.6974**	**0.0318**	**0.3527**	**0.3548**	**0.1194**	**0.0507**	**0.6870**
Transport services	**0.4936**	**0.9023**	**0.2403**	**0.4739**	**0.7300**	**0.9246**	**0.5672**	**0.8640**
Financial intermediation services	0.3121	0.5589	0.2916	0.4481	0.2542	0.2568	0.2706	0.4922
Real estate services and other business services	**1.0000**	**0.8376**	**0.6380**	**0.4127**	**0.8707**	**0.4634**	**1.0000**	**0.6514**
Public administration; education, health, etc.	0.1172	0.3944	0.0699	0.1938	0.1032	0.3210	0.1272	0.3483

Source: Own elaboration.

Finally, figure 2 allows us to better understand the structural differences between the regions in the study by focusing on the diffusion capacity of their tourism-related sectors. As already remarked, the hub centrality scores appear to be higher for the retail trade, real estate services and transport services in the three regions, as well as in Spain. The values are, however, lower for the case of the Valencian Community as compared to the other economies. Turning to the authority centrality scores, we observe a more balanced pattern for the four tourism-related sectors in all the cases except that of the Balearic Islands, where the score for the transport services sector is clearly higher than the rest. In the case of the Valencian Community, the authority scores are significantly lower for the four sectors, making it the destination where tourism-related sectors exhibit the least capacity to diffuse shocks to the economy, such that it therefore plays a less remarkable role either as a hub or as an authority.

Figure 2. Hub and authority centrality scores for tourism-related sectors



Source: Own elaboration.

6. Conclusions

The input-output framework has formed part of tourism studies for at least four decades. It has become a standard paradigm although it has its limitations and has been the object of certain criticisms given the advances made in new more informationally demanding computational techniques. The static nature of the I-O analysis, the potential overestimation of some related economic effects, and other limitations linked to the partial equilibrium system it represents when measuring the impact of new shocks on the economy and the corresponding spill-over sectoral effects are all internalized by the users. New techniques have appeared in the literature for estimating the economic contribution of some industries to a particular territory. Two of the most cited include the GCE models and Cost-Benefit analysis. However, new developments continue in the I-O setting, extending the basic model to introduce economic dynamics, endogeneity issues and suitable tables capturing the nature of the production structure of the territory under study. Accordingly, the I-O framework continues to be a key paradigm for researchers interested in understanding in detail how the effect of tourism spreads throughout the host economies. Its simplicity and infor- mative capacity for non-specialists are some of the main attributes shown by this modelling technique, together with the reasonable results it provides, which would explain its lasting presence in tourism studies. Moreover, if rigorously computed, the I- O framework still represents a valid characterization of the productive relationships arising among the industries of a given economy, or even their economic linkages to external territories that share international exchanges with that of reference.

In this context, the present paper has continued to enlarge the framework of analysis of the I-O model for tourism studies in two main directions. First, the research has built on a regional I-O framework, showing better findings than those employing the country table when computing the economic contribution of international arrivals to particular tourism destinations. Second, the study has also identified the source of some of these differences, focusing on the production specialisation of regions, and input-output inter- linkages of the tourism industry within that particular economy.

The main results have shown the usefulness of employing regional input-output tables when measuring the economic contributions of tourism to single destinations. Regional tables allow us to better capture the nature of the productive relationships of the territory under analysis. Furthermore, the research has proposed and employed a methodological approach for capturing the factors leading to these economic effects within an I-O framework. In particular, we have identified three main sources of effects; namely, the size of the tourism flows and expenditures entering the destination, the specific sectoral expenditure structure for the destination, and the input-output multi- pliers in the system and differing production structures among regional economies. For the present cases of study in the three Mediterranean regions of Spain, all being major global destinations with more than 23 million international arrivals in 2017, the empirical results of the I-O model have shown the relevance of the input-output structure as a first-order factor in explaining the economic effects of tourism in relative terms. The role of the relative expenditure and its structural classification in this setting appears, however, as a second-order factor, which reinforces the need to accurately choose the correct representation of the regional economy in this type of exercise.

Finally, and borrowing from the regional economics literature, the paper has provided a methodological extension by relying on a social network framework, enabling us to shed more light on the role that individual sectors of the economy play when driving the estimated effects on the system. In this direction, the paper has introduced the figures of "hub and authority" effects as systemic drivers and amplifiers of the initial effects of tourist expenditure at destinations. Empirical results in this regard have shown how, in the case of the tourism industry, the main amplifying effects rely on the hub nature of the tourism-related sectors, acting as important suppliers for the other industries in the local economy. The methodology has also shown the differences which have arisen in the results for the three case destinations analysed and the national case of Spain in this final context. In sum, the results of this research show that I-O analysis enriched in this case by the network approach taken from regional economics, continues to be a useful tool for analysing the effects which arise in this system.

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APPENDIX

Table A.1. GDP deflator in 2017 (2010=100)

Sectors	Clasificación NACE rev.2		Valencian region	Balearic Islands	Catalonia
1	01-03	Primary sector	109.74	98.24	87.89
2	05-39	Extractive industries, manufacture industries, energy supply, water for human and sanitary	104.22	112.57	106.33
3	41-43	Construction	56.40	93.77	94.35
4	45-56	Commerce, vehicles repairs, transport and hospitality industries	132.94	110.93	102.96
5	58-63	Information and comunications	83.21	62.07	79.71
6	64-66	Finance and insurance	63.30	119.86	120.61
7	68	Real State	137.20	105.54	106.27
8	69-82	Other market services	107.81	106.28	100.94
9	84-88	Non market services and public services	88.01	99.84	101.44
10	90-98	Other non-market services	98.86	100.96	100.72
		Total	**106.42**	**105.00**	**102.44**

Source: Own elaboration from INE (www.ine.es).