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Estimation of multipliers for the activity of hotels and restaurants

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HIGHLIGHTS

- We model Rasmussen multipliers for the Hotels and Restaurants industry.
- The significant explanatory variables are: income, size of the, country and imports.
- The income has a negative sign in our model, in contrast to previous, works results.
- Tourism impact depends heavily on the economic complexity of the receiving countries.

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ABSTRACT

The purpose of this paper is to model and estimate the multipliers for Hotels and Restaurants, the most characteristic of the industries that make up the tourism business. This multiplier can be used for estimating the economic impact of tourism demand. Likewise, a tool for planners and policy makers is provided. The data source is the set of Input–Output tables gathered by the OECD, which, in its last edition, has collected a sufficiently representative number of countries with an equally suitable disaggregation level. Two models are elaborated, for the estimation of the Rasmussen backwards multiplier and of the imports multiplier, respectively. Some explanatory variables previously used in the literature are confirmed, while others are proposed as alternative ones.

1. Introduction

1.1. General considerations

The Input–Output literature has often analysed relationships between multipliers and tourism, frequently to calculate the impacts of tourism. One reason is that these calculations permit a very appropriate application of the Leontief demand model (the most robust analysis of the Input–Output analysis), thereby giving reasonable estimations about economic impacts under different conditions. However, there is a gap relating to the estimation of explicative models of those multipliers. This is due to the fact that historically there has been an inadequate number of homogeneous Input–Output Tables within the same time frame to provide an adequate number of multipliers. Although today the number of Input–Output Tables that can be obtained from the different Statistical Offices is relatively high, their different aggregation levels make the simple task of homogenisation both laborious and tedious. Nonetheless the existence of tables in a growing number of countries, their regular publication and their use as the basis for a wide number of related statistics, have not only improved their availability but, more importantly, their quality and reliability.

Recently, the introduction of Tourism Satellite Accounts has constituted a considerable advance over the previous situation, allowing the knowledge of the main entries of tourism expenditures, and facilitating the impact studies of tourism. Nevertheless, the problem of converting the expenditure account of the Tourism Satellite Account into a wider and more detailed expenditure vector like the household consumption one of the Input–Output Table is still a difficult task.

Likewise, Tourism Satellite Accounts aim to delve deeper into the characteristics of supply, that is, production in the tourism characteristic industries, by proposing a recompilation of their purchase structure, which would be an alternative to the one found in the Input–Output Tables. In any case, it should be stressed that this issue remains a complex undertaking which has seldom been carried out. For this reason, in general, IOTs are still needed in order to study the supply in the industries related to tourism.

The methodologies concerning the Input–Output Tables, all of them derived from the System of National Accounts, do not impose

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the publication of the final domestic consumption vector disaggregated depending on the circumstance of the consumers being residents or not in the territory. So, we face the paradox that those vectors are estimated but not published – but on few occasions – maybe because of lack of confidence in the breakdown of the non-resident expenditures – mainly tourists – depriving the researchers interested in them from a valuable source of information. It is surprising that the methodologies behind the construction of the System of National Accounts and Satellite Accounts are so exhaustive and rigorous but forsake the publication of such an important vector.

1.2. Objectives

The studies of tourism impact require two prior conditions: the estimation of a tourists' expenditure vector, which is always expensive, and the existence of an input–output table for the area, which is even more costly.

In the case that these two instruments are not available, the existence of an estimation model for the multipliers would allow substituting them and discerning the impact of tourism expenditure. If the differences in the multipliers of various countries can be explained by a model, then an efficient procedure for their estimation, with little cost, can be established, just requiring that the needed information about the explanatory variables is accessible.

As is well known, tourism has a remarkable multi-sectoral profile, being integrated by very different activities and does not appear as a specific sector in the input output tables. This is the reason why we chose to carry out a study of the multipliers of Hotels and Restaurants, the most representative industry of the touristic activity, among the possibilities allowed by the source used. In this work we will consider comparative situations both in relation to other activities and to countries with different economic structures. The goal of the article is to investigate the similarities and differences among the multipliers of the Hotels and Restaurants industry for different countries, explaining them through a multiple regression model which will also allow predicting their value.

The work is articulated in two distinct parts. The first one is a theory section where a disquisition on the source used, the multiplier concept that will be used and a survey of the previous literature on the subject with a brief description of the antecedents can be found. The second one is the estimation section where the models used and the results obtained are presented and explained.

1.3. Information source

Since 1995 the OECD has been involved in the commendable task of compiling Input–Output Tables from different countries and making them available to researchers. What began as a limited group of tables subjected to considerable aggregation (Ahmad, 2002; Yamanon and Ahmad, 2006), has been vastly improved with the 2000 and 2006 edition (OECD, 2006), both in the number of countries (37, 28 OECD and 9 non-OECD), as well as in the number of activities (48 industries) included, thus permitting more consistent and detailed comparative studies among countries.

Despite these considerable advances, the database is not entirely free of certain inevitable drawbacks. The sample in question is unselected and not representative of all the possible countries and cases, although it does include the largest economies and a large group of other developed and developing countries.

The information provided by eleven of the countries is quite complete (symmetric Input–Output Tables at the necessary 48 industry level), however, in other cases the OECD has received only partial information (supply-use tables at purchaser's prices, product-by-product tables…), which has required a transformation of the data into a harmonised, based on basic prices and industry-by-industry symmetric table.

Moreover, data on certain industries of several countries are missing. In the majority of the cases it is a matter of aggregation since not all countries have constructed their tables according to the choice of industries used by the OECD. This means, for example, that activity 42, Research & Development, may not appear if a given country has chosen to include it in activity 45, Education. In the Hotels and Restaurants industry, three countries (Israel, Russia and Taiwan) were eliminated from the sample due to insufficient information.

2. Antecedents

2.1. Input output analysis, linkages, multipliers and models

The input–output analysis has a long-standing tradition as much due to its existence for half a century as for having been the focus of constant debate. Those that may be called pioneer works appear at the end of the 1950s and are attributed to well-known authors as Chenery and Watanabe (1958), Rasmussen (1956) and Hirschman (1958). Given that, in matrix form, an input–output table can be expressed as a sum of rows or columns:

$$x = Ax + D, \quad x = xB = v$$

with x being the total output, A the matrix of technical coefficients, B the matrix of allocation coefficients, D the final demand and v the primary inputs. Chenery and Watanabe (1958) proposed the sum of the columns of the matrix of technical coefficients as a measurement of the *backward linkages*, a_{ij}, and the sum of the rows of matrix of allocation coefficients as a measurement of the *forward linkages*, b_{ij}.[2]

$$A = Z \cdot \widehat{x}^{-1} \qquad \begin{aligned} Z &: \text{ matrix } (n \times n) \text{ of intermediate inputs} \\ A &: \text{ matrix } (n \times n) \text{ of technical coefficients} \end{aligned}$$

$$a_{ij} = \frac{z_{ij}}{x_j} \quad A = \{a_{ij}\};\ z_{ij} \text{ being the intermediate output of sector } i \text{ to sector } j$$

where a_{ij} is the amount of output of industry i needed to produce an output unit of industry j and b_{ij} are the allocation coefficients that represent the share of the output of industry i sold to industry j over the total production of industry i.

$$B = \widehat{x}^{-1} \cdot Z \quad B = \{ b_{ij} \},\ \text{matrix } (n \times n) \text{ of allocation coefficients}$$

$$b_{ij} = \frac{z_{ij}}{x_i} = a_{ij}\left(\frac{x_j}{x_i}\right)$$

These first multipliers were called *direct multipliers* since they only collected the relationships between production and distribution among the industries in the first place, without taking into account the following rounds of intermediary purchases that would have taken place to supply, in the most classic model by Leontief, an exogenous stimulus of final demand. To broaden the concept of the multiplier, Rasmussen (1956) suggested using the sums of the columns and rows of the Leontief inverse matrix, L:

[2] The circumflex sign is used to convert a vector into a diagonal matrix. It must be remembered that the inverse of a diagonal matrix is one whose elements are reciprocals of the elements of the original matrix.

$$x = L \cdot D$$

The matrix notation of the input output model set out output levels in each one of the activities, where x vector ($n \times 1$), can vary due to changes in the final demand, D vector ($n \times 1$), and/or in the elements of Leontief's inverse matrix ($n \times n$), L. Part of the total production is available for final use, after intermediate requirements have been satisfied.

The elements of the inverse matrix represent output increases needed by a unitary increase in the final demand. Information is gathered on direct effects (technical coefficients) and indirect ones, i.e. demand *spillover* – the output (extra) of industry *i*, directly and indirectly required to satisfy a unit (extra) of the final demand of industry *j*-:

$$L = (I - A)^{-1}$$

Calling l_{ij} the *ij* element of the inverse, the multipliers are defined for any industry j as $k_j = \sum_i l_{ij}$, which entails the diffusion or multiplier effect of the production and, alternatively (forward), defined as $k_i = \sum_j l_{ij}$, characterizing the *absorption or multiplier effect of a uniform expansion of the demand.*

The Rasmussen multipliers of the various industries differ depending on their productive complexity. Multipliers also vary conditioned by the inputs and the use of production factors. Thus, the industrial activities usually present high multipliers, while they are lower for the service ones. In the case of Spain, for example, and according to the Input–Output Table for 2000, the inner backward multiplier is 1.62, whereas the average industrial multiplier and the average service multiplier are 1.70 and 1.52, respectively.

Multipliers have been widely used in tourism research and policy support (Gasparino, Bellini, Del Corpo & Malizia, 2008), although they have been frequently misused and misinterpreted in these studies (Archer, 1976, 1982, 1984; Archer & Fletcher, 1988; Fletcher 1989) and a considerable source of confusion among non-economists. Many tourism studies borrow multipliers from previous works without understanding that they could vary widely by region, activities and time (Archer 1984). The most common abuse pointed out by researchers is the use of national tourism multipliers for regions (Archer & Owen 1971), and also the lack of recognition of the fact that its amount can be seriously affected by the level of aggregation of the table used.

Multipliers represent the features of an economy in a given moment and, for this reason, it is expected that their values will change in time (Stynes 1998). In fact, this aspect has been widely discussed in the Input–Output literature: Augusztinovics (1970) indicated a long time ago that the stability of coefficients and multipliers seemed to depend, to a great extent, on the complexity or richness of the productive structure of the countries: "*the more complex forms seem to be more stable*" (p. 261), an aspect that has subsequently been corroborated by Giarratani (1980), Bon (1986) or Robles and Sanjuán (2005).

A good number of multipliers could be added to the output multipliers (the simpler ones, already described). Sales multipliers would measure the value of business turnover due to the unitary expenditure of a tourist while income multipliers would represent the added value generated by unit of expenditure. Wage multipliers and others that can be defined in physical terms: employment multipliers, CO_2 multipliers, Water multipliers, etc, could also be used. It can be observed, nonetheless, that in the case of the Hotels and Restaurants industry, the sales multiplier equals the output multiplier given that in this activity there are no stocks, and that both multipliers have a close relationship with the income multiplier, which is only a proportion of them.

The import multiplier is also of great interest, since it can show the existing leakages in the domestic or inner effects. The value of the multipliers depends critically on leakages and therefore on the percentage that the imports represent of the total output. Taking these considerations into account, two multipliers will be used in this work: the output multiplier and the import multiplier.

2.2. Survey

In the previous sub-section multipliers have been defined in a general sense. In this section special consideration on tourism multipliers will be made. It should be noted that multipliers are indicators of the impact of the unitary expenditure on tourism activities. However, the absolute impact of tourism in a region will, obviously, be mainly determined by the number of visitors. It is then evident that a relatively low multiplier can be greatly compensated if the arrival of various millions of tourists per year in a given place is considered. Multipliers, just as rates and indexes, are relative indicators and it is always advisable to accompany their value with the absolute numbers that back them.

As already mentioned, tourism will cause direct and indirect effects. It has been revealed in the literature that the direct effects are closely related to tourist's characteristics and to travel motivation (Gasparino et al. 2008). Hence, demand will depend on the price and other conventional factors such as income, but also on the motivation of the travel, differentiating among others sun and beach tourism, cultural tourism, bathing resorts tourism or pilgrimage tourism… which usually involves different types of expenditures. Of course, the means of transportation, the kind of lodging and the food provisions chosen along with the duration of stay are the most significant determinants of the expenditure, since while the disbursement of the tourist can be considered miscellanea of small expenses, they are highly concentrated in these categories.

Likewise, the linkages of the tourism industries keep a relationship with the structure of the destiny countries, and with their capacity to provide the required inputs without having to resort to imports. In this regard, the Hotels and Restaurants Industry – in a large enough country or region – usually has a preferably domestic nature, with a relatively low resort to the exterior, as it also happens in other service activities.

As already mentioned, the size of the multiplier depends on the productive technology of the industry, on the amount of inputs required as well as on the required participation of the productive factors. In other words, it depends on the costs structure reflected by its column in the Input–Output Table. Regarding the Hotels and Restaurants industry two characteristics can be noted. Firstly, as expected, its input requirements are not as high as those of a manufacturing industry, although, at the same time, these requirements have been growing and getting more complex over time. Secondly, the Hotels and Restaurants industry is a relatively work intensive industry as almost all the service ones are.

The kind of establishment and its size have also some influence, as pointed out by Liu and Var (1982). The small establishments, managed by familiar workers, will probably be more prone to acquire their inputs in their surrounding area while a grand hotel, pertaining to a commercial chain, will buy them -more varied and complex on the other hand- from a centralised office, maybe from the headquarters.

Related to the search for the explanatory variables of the multipliers of the touristic industries, two works with which ours is directly connected stand out. One is written by Chang (2000) and the other one by Baaijens, Nijkamp and Van Montfort (1998). Chang used the database and the software IMPLAN to obtain tables and multipliers of one hundred different areas of USA. He then defined a

tourism multiplier as a weighted mean of the multipliers of certain industries typical of tourism, estimating sales multipliers, income multipliers and job multipliers. After different trials he identified the logarithm of the population as the most significant predictor and also found out that the sales and income multipliers grow almost linearly when its predictor did. Baaijens et al. (1998) collected an ensemble of regional income tourist multipliers published by different authors and referred to eleven very different geographic levels, from different islands such as Bermudas or Bahamas to countries such as Turkey. They estimated regression models using population, area, number of tourist arrivals, and other regional characteristics to predict income multipliers. Other related works are Stewart (1976), Liu and Var (1982) Tyrell (1999) and Wood and Liang (2001), although their papers referred to regional or even lower (local) scale.

On broad lines, all the papers found in the related literature have pointed out some factors that particularly affect tourism multipliers. We will subsequently comment on those aspects:

1 The *size* of the country or the size of the region or area under study. A direct relationship between size and domestic effects is expected (Van Leeuwen, Nijkamp & Rietveld, 2009; Wiersma, Morris & Robertson, 2004). At the national level the inner effects will be important, but, at the other end, in a particular city a hotel establishment will not be able to acquire but a few and determined inputs. To this respect, the case of the islands dedicated to tourism is the paradigm, and the low multipliers estimated for the islands Hawaii (Liu, 1986), Canarias (Hernández, 2004) or Seychelles (Archer & Fletcher, 1996) corroborate this fact. At the far end of the islands, Yan and Wall (2001), who studied the impact of tourism on the Chinese economy for 1992, concluded that it had a limited impact due to the size and diversity of the Chinese economy.

To evaluate this factor, population is usually considered the most adequate variable (Fletcher, 1989; Tooman, 1997; Wiersma, Morris and Robertson, 2004).

2 The *degree of openness* of the economy to the exterior. This variable can be related to the previous one, since the size of the country has very often an influence on its exterior trade. So, in general, the large countries need, to a lesser extent, to resort to the exterior while the smaller ones do so with intensity.
3 The *degree of development* of the country. Fletcher (1989) collected rent multipliers of 30 very diverse countries, cities and regions, and, once ordered, he found that the multipliers were larger for regions with larger and more developed economies. Likewise, Stynes (1998) pointed out that the overall size and economic diversity of the region's economy influences the value of the multiplier. The underlying idea is that regions

Table 1
Economic variables for the countries in the survey.

Country	Backward multiplier	Imports multiplier	Population	Openness ratio	GDP per capita, PPP	Average backward multiplier
Argentina	1.961	0.040	38,747	44	10,819	1.57
Australia	2.016	0.108	20,310	39	32,698	1.77
Austria	1.620	0.120	8189	104	33,377	1.46
Belgium	1.829	0.253	10,419	156	32,127	1.52
Brazil	2.042	0.046	186,405	27	8505	1.67
Canada	1.736	0.132	32,268	72	35,033	1.54
Switzerland	1.760	0.143	7252	91	35,784	1.52
China	2.408	0.122	1,315,844	69	4115	2.00
Czech R.	1.874	0.184	10,220	141	20,362	1.63
Germany	1.642	0.129	82,689	77	31,364	1.56
Denmark	1.688	0.213	5431	93	33,214	1.48
Spain	1.746	0.094	43,064	57	27,377	1.62
Finland	1.873	0.175	5249	80	30,684	1.57
France	1.807	0.119	65,446	53	29,809	1.67
U. Kingdom	1.612	0.132	59,668	56	32,731	1.64
Greece	1.514	0.122	11,120	53	24,640	1.40
Hungary	1.921	0.183	10,098	134	16,955	1.47
Indonesia	1.875	0.061	222,781	64	3217	1.56
India	2.111	0.059	1,103,371	41	2308	1.71
Ireland	1.700	0.333	4148	152	38,578	1.39
Israel	1.605	0.222	6725	86	23,390	1.39
Italy	1.898	0.122	58,093	52	28,144	1.68
Japan	1.812	0.080	128,085	27	30,310	1.84
Korea	2.028	0.159	50,000	76	22,783	1.77
Luxembourg	1.276	0.350	465	286	68,319	1.26
Netherlands	1.632	0.186	16,299	131	35,105	1.50
Norway	1.698	0.131	4620	73	47,305	1.54
New Zealand	2.012	0.166	4028	57	25,305	1.59
Poland	1.876	0.105	38,530	75	13,784	1.63
Portugal	1.773	0.169	10,495	65	21,294	1.55
Slovak R.	1.616	0.154	5387	157	16,164	1.47
Sweden	1.736	0.175	9038	89	32,723	1.50
Turkey	1.919	0.088	73,193	47	10,977	1.62
United States	1.857	0.045	298,213	26	42,534	1.67
South Africa	2.040	0.090	48,432	55	8597	1.52
Chile	2.102	0.154	16,295	74	12,172	1.52
Romania	1.682	0.154	21,711	76	9361	1.54
Federation	1.000	0.000	143,202	57	11,853	1.33
Slovenia	1.586	0.209	1999	125	23,498	1.44
Thailand	1.920	0.148	64,233	149	6751	1.58
Vietnam	1.482	0.212	84,238	143	2143	1.35

Source: OECD. World Bank. UNO.

with large, diversified economies producing many higher order goods and services will have high multipliers since households and businesses can find most of the goods and services they need locally. Van Leeuwen, et al. (2009) in turn improve their findings when they claim that: "The longer ago the multiplier has been derived, the higher the multiplier. If we assume that the tourism sector has changed over the years and becomes more internationally oriented, the "older" multipliers should be higher".

Once all the previous considerations are taken into account, what seems clear is that the variable accounting for economic development does not have an unequivocal direct effect over the value of the multipliers. Moreover, in our opinion, touristic models in an initial phase or belonging to economically underdeveloped countries can paradoxically have relatively high domestic linkages, given that their production will be simpler and will have less necessity of imports, which constitute the leakage of the multiplier. Analyzing the results of the multipliers for the different countries in the sample Table 1 it can be corroborated that it is possible to find high multipliers both for the developed and the developing countries, among those with a considerable size.

The existing literature has also gathered some variables for which it has not been possible to establish a relationship with the multiplier:

As discussed, the multiplier seems to be positively correlated with population but, on the other hand, the multiplier and the geographical size of the region under study do not appear to be related.

In different impact studies it has been pointed out that the tourists' nationality and their consumption patterns are not related either (Archer & Fletcher, 1996; Heng & Low, 1990).

Regarding the number of tourists received, Van Leeuwen, et al. (2009) based their studies on the assumption that the more visitors or expenditures of visitors, the higher the multiplier. They assumed this positive relationship between the multiplier and the affluence of tourists under the idea that in case of receiving great numbers of them, the economy of the country or region would focus towards tourism, developing the necessary indirect effects to that end. Nevertheless, the variable was found not to be significant in their work.

Lastly, it has been alleged that if the visitors come mainly from a given country, the multiplier will decrease due to imports that will take place from that particular country. However, this assumption has not been proved either.

3. The models and empirical results

3.1. Rasmussen multiplier estimation

As it can be observed, the majority of the authors mentioned have looked for explanatory variables of the domestic multipliers in two ambits: the inner one, signalling the size of the country and its income level, and the exterior one: compiling variables such as the number of visitors, expenditure of the non-residents, degree of openness and others of similar nature.

In general, it can be said that in the existing models the inner variables have been more successful than the exterior ones. In our case, the attempts to incorporate the following exterior variables related to tourism coming from the World Bank or the IMF have not had the expected success: "International tourism, number of arrivals", "International tourism, receipts (current US$)", "International tourism, receipts (% of total exports)" and "total services exports". Broadly speaking, a direct or positive relationship between the domestic multiplier and the mentioned variables was expected, but we have not achieved relevant results.

Nevertheless, a successful model has been obtained using inner variables, similar to the ones mentioned in the literature, and also general exterior variables, not strictly related to tourism. A classical model has been estimated by ordinary least squares. The variables used may be defined as follows:

MBL: Is the dependent variable, Rasmussen backwards multiplier.
POP: Population of the countries in the sample, according to the data collected by the United Nations (Population on Reference Bureau). As previously indicated, this explaining variable represents the size of the country and a positive sign is expected.
GDPpp: Gross Domestic Product per capita. The obtained sign is negative.
MWEIGHT: The weight of the imports over the GDP. Both the expected and the obtained sign are negative, since if this weight were high, the leakages of the multiplier in form of imports would also be high.
OR: Openness ratio. This variable also presents a negative sign as indicated in the literature survey, with a very similar explaining power to the one that the previous variable, MWEIGHT, exhibits. If these two variables are used simultaneously, the explaining capacity of the model increases, but the problem of multicollinearity arises. The multicollinearity can be assumable if what is preferred is to achieve a high explaining capacity, but as it is well known, this would be reached at expense of losing economic significance of the model. This way, in this work we have opted for including only the variable MWEIGHT.

Variables POP and GDPpp have been standardized to solve scale problems. Finally, the results are presented in Table 2 where it can be observed that the Adjusted R-squared reaches a value of 0.525, and all the variables included are highly significant: all of them are statistically significant at a confidence level of 99%.

Nevertheless, in the search for variables that could explain the repercussion of the tourists' activity, it seemed a good idea to turn to the interior of each country, to the complexity of its own economic structure. The complexity is a multidimensional characteristic with many possible definitions and approaches, and its study has progressively extended to the analysis of social and economic systems (see e.g., Rosser 1999). The starting hypothesis is that the repercussion of the tourists' expenditure will be higher the more complex the economy of each country is.

Table 2
Regression model. Dependent variable: backward multiplier. Year 2005.

Dependent variable: MBL
Method: least squares
Sample: 1 40
Included observations: 40
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. error	*t*-statistic	Prob.
C	1.954787	0.043161	45.29028	0.0000
POP	0.078243	0.024469	3.197646	0.0029
GDPPC	−0.059549	0.022354	−2.663947	0.0115
MWEIGHT	−0.340741	0.097169	−3.506694	0.0012

R-squared	0.562042	Mean dependent var	1.809632
Adjusted R-squared	0.525545	S.D. dependent var	0.208583
S.E. of regression	0.143674	Akaike info criterion	−0.947906
Sum squared resid.	0.743116	Schwarz criterion	−0.779018
Log likelihood	22.95812	Hannan–Quinn criter.	−0.886841
F-statistic	15.39987	Durbin–Watson stat	2.253549
Prob (F-statistic)	0.000001		

Source: OECD, World Bank, UNO.

It is also expected that the size of the country influences the complexity and so, the smaller ones – as is the case of the regions – will have less complex structures than the larger ones. And, likewise, the degree of openness of the countries can influence its complexity, and is likely to be higher for those countries less open to the exterior.

Secondly, there is a conviction that the Input–Output Tables are, for their qualities, one of the best ways to measure the economic complexity. In fact, the computation and the representation of the inter-sectorial relationships or linkages are one of the most outstanding aspects of the Input–Output analysis, and they are fundamental in the search for an adequate measure of the mentioned complexity.

Different measures exist to quantify the value and extent of linkages, demonstrating Lopes, Dias, and Ferreira do Amaral (2008) that the ones based on the technical coefficients or on the multipliers are all of them much correlated as expected. We refer here to classical measures such as the ones proposed by Chenery and Watanable or Rasmussen or some more recent like the average propagation length (weighted or not) suggested by Dietzenbacher and Romero (2007) and the complexity as interdependence measures contemplated by Amaral, Dias and Lopes (2007). Which one of them is chosen is not crucial. Anyway, in our case, it seemed more useful to use the Rasmussen multipliers as a starting point since they compile the total of the direct and indirect linkages. In this way, a classical measure such as the Average Output Multiplier (AVOM) based on Rasmussen has been chosen:

$$AVOM = \frac{1}{n} i'(I - A)^{-1}$$

with n the number of industries, i′ a transposed unit vector of appropriate dimension, and I the unit matrix.

In this second model, the variables used are the most important ones of those used in the previous model: POP and GDPPC, adding the explicative variable AVOM. The results are presented in Table 3 where it can be observed that the adjusted R-squared has the value 0.65. Again, all the variables are statistically significant at a confidence level of 99%.

3.2. Estimation of the imports multiplier

Although the imports multiplier is not very important in the case of a service industry such as the Hotel and Restaurants industry, nonetheless it does not lack importance. Actually, the external trade usually affects the goods to a much greater extent than to the services, with the service industries presenting a much more domestic nature. However, there is no doubt that the content of imports may have importance in some cases, more so if it its referred to small geographical ambits like islands – Hernández (2004) – regions or cities. All in all, the consumption that can be considered related to tourism not always generates dynamic effects over the local economy since leakages may occur. These leakages are the imports both of final goods by tourists and of intermediate outputs acquired by those who supply the tourists. These imports made by the Hotels and Restaurants industry or its providers can be studied through the import multipliers, which involves both quantities.

Import multipliers offer a measure of the effects on imports by all industries of an economy resulting from a change in final demand for a given industry, Hotels and Restaurants in this case. They can be computed as follows:

$$M^i = \sum_{i=1}^{n} A^m L$$

Where A^m is the matrix containing the technical imports coefficients and L is Leontief's inverse of the domestic technical coefficients.

The average multiplier of the countries' sample corresponding to 2005 is 0.15 which implies that the countries import that amount for each unit of expenditure of the tourists. All the same, and as expected, the differences are important in the group, from the maximum value 0.35 for Luxemburg to the minimum 0.04 of Argentina.

The import multipliers are numbers which range from 0 to 1, and for this reason, a logistic function by Non-Linear Least Squares has been estimated, which is a more adequate function than the linear or log-linear function when the dependent variable takes values out of a limited range. In this way, the predicted values are always within this range, whereas if predicted by any of the other models they might not be.

$$k_l = \frac{1}{1 + \exp(-B'X)} + u_l$$

In this model, we have studied variables referred to economic development, such as GDP, Human Development Index (HDI) or Gini index. We have also included others related to the size of the country, such as population, and some associated to the openness of the economy to the exterior: goods and services imports (% of the GDP) and openness rate. The obtained model is presented in Table 4.

The variables used and their expected signs are:

M^i: imports multiplier, the dependent variable.
HDI: Human Development Index elaborated by the OECD. It represents the degree of development or well-being of the different countries. The estimated sign is positive, showing, as expected, a rent-demand effect, so that an increase in income brings an increase in the demand (import demand in this case).
IMP: The weight of the goods and services imports over the GDP, provided by the World Bank. The estimated sign is again positive, meaning that each country's imports, as a result of the tourism activity, follow the same pattern as the rest of the imports from the same country.

The Adjusted R^2 is high, 0.66, showing a reliable and useful model to estimate the imports multiplier in the absence of direct information. The variable IMP is statistically significant at a

Table 3
Regression model II. Dependent variable: backward multiplier. Year 2005.

Dependent variable: MBL
Method: least squares
Sample: 1 40
Included observations: 40
White heteroskedasticity-consistent standard errors & covariance

Variable	Coefficient	Std. Error	*t*-statistic	Prob.
C	0.353290	0.309005	1.143314	0.2605
POP	0.023206	0.013298	1.745032	0.0895
AVOM	0.928383	0.195834	4.740654	0.0000
GDPPC	−0.062668	0.021216	−2.953751	0.0055
R-squared	0.677681	Mean dependent var		1.809632
Adjusted R-squared	0.650821	S.D. dependent var		0.208583
S.E. of regression	0.123255	Akaike info criterion		−1.254488
Sum squared resid	0.546902	Schwarz criterion		−1.085600
Log likelihood	29.08976	Hannan–Quinn criter.		−1.193423
F-statistic	25.23021	Durbin–Watson stat		1.776928
Prob(F-statistic)	0.000000			

Source: OECD, World Bank, UNO.

Table 4
Regression model III. Dependent variable: imports multiplier. Year 2005.

Dependent variable: M^i
Method: least squares
Sample: 1 40
Included observations: 40
Convergence achieved after 11 iterations
White heteroskedasticity-consistent standard errors & covariance
$M^i = 1/(1 + EXP(-(C(1) + C(2)*IMP + C(3)*IDH)))$

	Coefficient	Std. error	t-statistic	Prob.
C(1)	−3.846437	0.728253	−5.281730	0.0000
C(2)	1.440048	0.175131	8.222709	0.0000
C(3)	1.622828	0.808656	2.006821	0.0521
R-squared	0.679210	Mean dependent var		0.147168
Adjusted R-squared	0.661870	S.D. dependent var		0.068105
S.E. of regression	0.039602	Akaike info criterion		−3.547811
Sum squared resid	0.058029	Schwarz criterion		−3.421146
Log likelihood	73.95623	Hannan–Quinn criter.		−3.502013
Durbin–Watson stat	2.039865			

Source: OECD, World Bank, UNO.

confidence level of 99% while HDI is statistically significant at a confidence level of 95% – Table 4.

4. Conclusions

This work focuses on the estimation of tourism multipliers. From the existing ones, those corresponding to the most representative industry of tourism, Hotels and Restaurants, have been chosen. Likewise, the study concentrates on the two multipliers that we consider the most representative from the available information, Rasmussen's output multiplier and the imports multiplier.

Maybe due to the absence of suitable databases, the studies trying to estimate the tourism multipliers are scarce. However, the information source we have used, the Input–Output tables compiled by the OEDC, has been improved over time allowing this task to be carried out properly.

This database has still some shortcomings that should be taken into account and that necessarily restrain the outcomes and the economic policy decisions that could be derived from them. Specifically, the sample is unselected and not representative of all the possible countries. Furthermore, in some cases it has required a transformation of the data. Finally, the information about a small number of industries is missing. Nevertheless, in our opinion, the set of tables provide, since the year 2000, a sufficiently adequate detail and coverage level as to overcome these drawbacks and reach credible conclusions.

It is possible to find previous works with different kind of estimations. However, some of them are based on tables elaborated by systems like IMPLAN for the USA and others collect multipliers previously published in different papers and referring to very diverse geographical levels. Finally, other authors have tried to build explanatory models for the tourism multipliers on a very local basis, like certain islands or touristic locations placed in diverse countries.

Our work, in contrast, uses a sample of forty countries, among which the largest economies in the world can be found. Although is not a representative sample of all possible cases, there is no doubt that it is significant and of great interest for the task in hand. From these tables the corresponding Hotels and Restaurants multipliers have been estimated for each country to subsequently elaborate various estimation models for them with diverse explanatory variables.

It has been proved that the variables referred to the number of tourists received or to their expenditure were not statistically significant. Some variables associated to the size of the countries and their population were explicative as expected and according to the scientific literature on the topic, while the GDP per capita, with explaining capacity, shows a negative sign, contrary to some of the reports found in the related literature. As depicted in the text, it seems plausible that the sign of this variable changes according to the level of development of the countries.

Surprisingly, in regions or countries less developed, the hotel and restoration establishments may have such a simple productive structure that they do not require significant imports. Therefore, their domestic relative impact can be higher. As development occurs, this structure will become more sophisticated and complex and, even if this growth of the country will lead to the necessity of acquiring new inputs, it is also possible that the sector will have to resort to imports, which would lower the value of the inner multiplier.

In the end it has been possible to obtain a first explanatory model of the multiplier of the Hotels and Restaurants industry with a fairly good explanatory power. The significant explanatory variables found are: population, Gross Domestic Product per capita, and weight of the imports over the GDP.

We have gone further and introduced a new variable with appreciable explanatory force such as the average multiplier of the Input–Output table, which turned out to be very relevant. In relative terms, the impact of tourism depends on the economic complexity of the receiving countries. This way, the impact of a unity of expenditure of the tourist will be greater and will reach further in successive impact rounds if its economic structure is more complex. This complexity is a variable related to economic development but not in every case, since the size of the country has its own effect. The most complex country turns out to be Korea. China is also complex but its development level in terms of GDP per capita is much lower. In both cases, nevertheless, tourism has a remarkable impact in relative terms.

Along these lines a new research path opens in the search for ways to measure the economic complexity for the countries that lack Input Output tables and intend to estimate the tourism multipliers.

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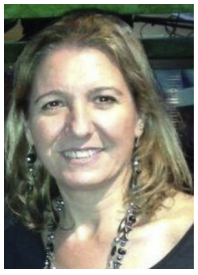

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