Including Tourism in the Input-Output Matrix of Ceará Using the Tourism Satellite Account

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Resumo

O turismo é uma das mais importantes fontes de emprego e renda de algumas regiões brasileiras menos desenvolvidas e, por não ser um setor tradicional, a avaliação precisa de seus impactos é escassa. Assim, a elaboração de indicadores que auxiliem o desenho de políticas públicas voltadas a este conjunto de atividades é essencial para as estratégias de desenvolvimento destas regiões. Neste sentido, o presente trabalho realiza uma primeira contribuição ao desenvolver uma metodologia capaz de introduzir um setor específico para o turismo em matrizes insumo-produto (MIP). A partir de uma MIP e de contas-satélite do turismo para a economia cearense, uma nova MIP é construída utilizando a metodologia proposta. Uma contribuição adicional do artigo é o índice tração, capaz de sintetizar os índices de ligações para frente e para trás, bem como suas dispersões em um único resultado. Os resultados obtidos indicam que o turismo apresenta o quinto maior índice de tração, sendo o sétimo setor em termos dos multiplicadores de empregos e salários.

Palavras-Chave: Matriz Insumo-Produto; Turismo; Índices de ligações.

Abstract

Tourism is one of the most important sources of employment and income in some less developed Brazilian regions and, as it is not a traditional sector, accurate assessment of its impacts is scarce. Thus, the elaboration of indicators that help designing public policies aimed at this set of activities is essential for the development strategies of these regions. In this sense, this paper makes a first contribution by developing a methodology capable of introducing a specific sector for tourism in input-output matrices (IOM). Using an MIP and tourism satellite accounts for the economy of Ceará, a new MIP is built using the proposed methodology. An additional contribution of this paper is the pull index, capable of synthesizing the indices of forward and backward links, as well as their dispersions in a single result. The results obtained indicate that tourism has the fifth highest traction index, being the seventh sector in terms of employment and income multipliers.

Keywords: Input-Output Matrix; Tourism; Linkage indexes.
JEL codes: D57; L83; Z32.

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1 – Introduction

Even being potentially held responsible for income, employment, and tax revenue generation as well as the improvement of Brazilian economic structure, the segment of tourism is a topic of limited national interest. Such lack of interest lies on how we single out good and services directly consumed by tourists from those consumed by residents, as well as single out workers attending exclusively tourists. For this reason, data seasonally related to the number of visitors, their overnight stays and wholly expenditures provide no accurate analysis as for the effects of tourism on economic activity; consequently, this prevents us from verifying the accuracy of the data tied to tourism and its impacts on economic activity. Brida *et al.*, (2008) argues that the tourism total economic impact is the sum of its direct, indirect, and induced effects, of which the last two are more difficult to estimate. Tourism is not a traditional sector, but instead an activity that gravitates around distinct economic sectors (e.g, accommodation service, catering, transportation, hospitality, entertainment, and commercial services), thus measuring its significance from an economic viewpoint may turn out to be a very complex task.

The preliminary effect of tourism expenditure may rise to further effects, which in turn spread through the economy in a whole, increasing both income and expenditure in several other groups, many of them unrelated to tourism. A cumulative-spending process like this is labeled in the existing literature as multiplier effect.

The term "multiplier" refers ordinarily to describe the final changes over the production of a given economy vis-à-vis early changes in tourism expenditures. As such, it is a central measurement by means of which the economic impact of tourism is determined. Truly, the impact of tourism does not actually reduce to tourist expenditures only; instead, it follows from all-inclusive effects that such expenditures are able to ultimately promote throughout the economy and beyond its domain.

These multipliers vary depending on which variable the effect is measured. As an illustration, output multipliers quantify effects of tourism-related spending in the overall economy, income, and employment multipliers measure effects of tourism on income and employment, respectively. Bearing in mind limitations previously noted, their estimations tend to be rather problematic (SINCLAIR; STABLER, 1998).

In general, their values are directly gathered from both Input-Output Matrix (IOM) and Supply and Use Table (SUT). Altogether, these data provide metrics for the tourism sector. Some of them are known in the literature as linkage-based indicators, which pinpoint how connected and interconnected rests a given sector (the intersection in-between) with the wholly economy. In making use of such approach, it would render possible to frame the "tourism sector" and its backward (inputs demanded) and forward (products supplied) linkages with other sectors. Furthermore, policymakers can advocate the use of income, wage, employment, tax, and product multipliers, in addition to backward-forward linkage index, for strategic planning and allocating funds to this sector.

A prior attempt to assess the economic impacts of tourism was proposed by World Travel and Tourism Council (WTTC) that elaborated a Tourism Satellite Account (TSA) for many countries. Although the conventions used do not correspond to those employed by the WTO, in turn creating problems in a comparative manner, TSA provides the starting point in regard tourism significance in economic development.

Along the same lines, Institute of Research and Economic Strategy of Ceará (IPECE) elaborated an IOM and a TSA for Ceará. As far as we know, based on structured data in accordance with international guidelines, such IOM/TSA-Ceará exemplify the first regional mapping out, which locally focused takes tourism seriously.

A study of an economic activity based on IOM-TSA is important for two reasons, at least. First, the supportive hypothesis of constant returns to scale (CRS) allows us to disaggregate tourism-related main activities of the supply side, as consequence, to get these breakdowns together in what might be framed as a real "tourism sector". So conceived and properly merged into the IOM-Ceará, multipliers, linkage indicators, and several other metrics are calculated providing us a better understanding of this sector. By adding a sector of tourism in the IOM, it is possible to verify not only linkage degree between sectors, but also the way this linkage occurs, i.e., whether supply/demand of outputs/inputs is concentrated in one sector or distributed along sectors.

The present study also contributes to the tourism economics in unifying two indices - the linkage and dispersion indexes of Rasmussen-Hirschman - to obtain what we call the "pull index", which integrates, in turn, in a single index all underlying ideas behind the mentioned previously. The pull index evaluates the role played by any sector, indicating key ones.

Section 2 below includes briefly reviewing the literature that has addressed the topic under consideration. Section 3 presents methodological directives, which allow us to witness tourism sector by means of constant returns to scale. The pull index is explained in section 4. We calculated several economic indicators of Ceará, which are in section 5. Section 6 concludes.

2 – Literature review

In the tourism literature, a standard characterization of tourism-related activities is given by disaggregating their so-called tourism characteristic activities (TCA) in terms of input-output based linkage measures.

To take a case in point, although the list is not exhaustive[1], Lage and Milone (1991) illustrate a bunch of economic activities tied to this segment: transport services (road/water/air/supporting transport services), accommodation services (hotels, inns, flats), food-serving services (restaurants, bars, snack bars), cultural or other recreational services (theatres, concert halls, etc.[2]).

Casimiro Filho and Guilhoto (2003) cover 6 segments to outline the tourism sector, which are summarized by as follows: passenger transport services; travel agency, tour operator and tourism guide services; food/beverage-serving services; accommodation services, cultural, recreation and other entertainment services, sundry tourism services[3]. Side note: "food/beverage-serving services" should be however viewed with caution and be applied only to tourism-specific products which are used by tourists and their consumption. Not all food/beverage-serving services are fully devoted to tourist so that some adaptation is required here (residents also make use of them, when need). This has the consequence that linkage and multipliers indexes are likely to overestimate tourism with respect this segment[4].

To evade from this issue, tourism workforce shares were disaggregated by Takasago *et al.*, (2010). Concerning food-serving service workforce, authors data (provided by IPEA) confirm that no more than 11.92% of the total are due to tourism (it thus has relatively little influence)[5]. In the same way, Takasago and Mollo (2011) study tells us a great deal about growth, income and employment generation tied tourism sector in the Federal District. Similarly, tourism workforce relatively share of Northeast region (IPEA data) was accurately disaggregated by De Souza, Guilhoto and Silveira Neto (2016), to wit: road passenger transport service; air passenger transport service; rail passenger transport service; water passenger transport service; transport supporting service – passengers; car rental; accommodation; food-serving service; recreational activities.

FJP (2017)[6] provided, in a slightly more fashion, the added value of ACT´s from Minas Gerais for the period 2010-2014. Concerning only the supply side, and in line with National and Regional Accounts portrayed by the Brazilian Institute of Geography and Statistics (IBGE), through such disaggregation, it was applied a sort of filtering process that leaves out activities not closely related to tourism. In the last resort, relatively shares were reached, those can be further applied to both production value (PV) and intermediate consumption (IC), so that the difference between them ends up distinguishing added value (AV) of TCA´s.

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[1] See Espanha (1996).

[2] Lundberg *et al*., (1995) point out as economic sector tied to tourism: hotels, restaurants, air transportation, rent-a-car market, and travel agencies.

[3] Eduardo and Frainer´s 2020 study, which appraises the Municipality of Campo Grande, is based on these categories.

[4] "For reasons over occupations, studies are overestimated, as they presuppose that all occupation is solely designed to serve tourists. Food-serving, cultural, recreation and other entertainment services exemplify that distortion, given within those segments, tourist consumption is not so high compared to that of residents" (IPEA, 2006).

[5] The employment share in different activities that serve both tourists and residents was formally calculated by IPEA (2006), the one corresponding to tourist services separately. The Employment in Tourism survey gathered data from RAIS and found percentages of tourist-related workforce share.

[6] João Pinheiro Foundation in Portuguese.

Using the same strategy, Gonçalves, Farias and Horta (2020) identify a set of national and regional economic activities by means of their corresponding gross salary for the period 2010-2015, namely: i) transport, storage, and mail-order houses; ii) accommodation and food-serving services; iii) professional, scientific and technical, administrative activities and complementary services; iv) arts, culture, sport and recreation and other service activities. Gross salary is assumed to be a proxy for building up activities and therefore, a criterion for disentangling them in line with TACs definition themselves[7].

Unlike FJP's study, which used the weights of both PV and CI, resulting from the sum of structural surveys furnished by IBGE (e.g, Annual Services Survey, Annual Trade Survey, Annual Industrial Survey and Annual Survey of the Construction Industry), applied directly to gross PV and CI, such as the valued added value (AV) is then obtained by difference; Gonçalves, Farias and Horta (2020) use the disaggregation weights emerged from gross salary directly employed in the AV. To sum up, throughout the many years that studies (oriented by input-output analysis) carried out by IPECE have taken an interest in determining the effects (in different sectors) of specific events (FIFA 2103 Confederations Cup Brazil) or infrastructure equipment (Convention Centre of Ceará, and "Acquario" Ceará). However, such studies focus on the multiplier effects with respect sectors vis-à-vis activities highlighted in each study (IPECE, 2013; 2012a; 2012b).

Despite an increased interest in tourism economics, it is surprising that so little empirical research (locally speaking) has been conducted on the topic, especially from the perspective of classical linkage. While Lage and Milone (1991), Casimiro Filho and Guilhoto (2003) and Eduardo and Frainer (2020) overestimated the role of tourism, they overlooked important variables, namely, multipliers and linkage indices; studies carried out by Takasago *et al.*, (2010), Takasago and Mollo (2011) and De Souza, Guilhoto and Silveira Neto (2016) are not realistic at all, data on labor market related to serve tourists are not tangible (until 2016 these data were monitored by IPEA, discontinued later on; we face here the need for an encompassing and integrated set of data); by focusing on proxies, FJP (2017) and Gonçalves, Farias and Horta (2020) cannot account for their merit, they overlooked the deeper issue of calculating linkage indices and the standard multipliers that configurate an input-output viewpoint.

3 – Building up a tourism sector

Conceived as economic indicators, income, wages, employment, taxes, and output multipliers, as well as backward-forward linkages, should be considered when tourism related policies are planned. The review of the literature indicated that, in general, studies proceed as follows: all of them try to uncover TCAs subtleties so that it is possible to observe their meaningful (at once or at a time) contribution to the economy.

The present study aims at overcoming these limitations using the CRS hypothesis. Our data emerge from both TSA and IOM. TSA refers the way to accurately uncover, to be precise, TCAs input-output effects of the demand side, while CRS, viewed as the economic underpinning behind this disaggregation process, refers the effects of the supply side. This makes it possible to entertain TSA and IOM.

An IOM presents two major sources of information: i) a matrix, M1, which includes IC, taxes, sectoral imports, and AV for each sector in each column and ii) a row matrix that includes IC, Total Product and Demand Components, which we will call M2.

[7] They argue that such procedure is widely used by official statistics agencies, especially when it comes to regional breakdowns as adopted by the IBGE (2015) from the state to the municipality level. It is even used employment variables such as gross salary and total of at working people as one of the apportionment criteria. A second advantage comes from the availability of information and as well as the employee compensation correlation (wage bill plus total social contributions) with GDP.

Figure 1 - Typical M1 and M2 representations

		Output			Final demand	Total demand
		Sector 1	Sector 2	Sector 3		
Input	Sector 1	M1				
	Sector 2					
	Sector 3					
Taxes						
Imports						
VA						
Labour						

		Output			Final demand	Total demand
		Sector 1	Sector 2	Sector 3		
Input	Sector 1	M2				
	Sector 2					
	Sector 3					
Taxes						
Imports						
VA						
Labour						

In fact, to detach a given activity is something tricky, but it can be done using the CRS hypothesis and data from TSA. The first makes possible to partition rows and columns to maintain system stability. For example, $\gamma y_j = f(\gamma x_{1j}, \dots, \gamma x_{nj})$ suggests that if we double the number of inputs ($\gamma = 2$), then output must double. Similarly, if we partition the number of inputs in the production process ($0 \leq \gamma \leq 1$) then the product must be proportionally partitioned.

This same reasoning can be easily applied to IOM, by means of statistical information tied to TSA scale parameters. Then parts of certain sectors may be detached within the production system and these detachments may ultimately joint into a specific sector, about which there was no initial information.

According to IBGE´s productive structure, tourism and health are not specific sectors. This makes it difficult to calculate certain important indicators, such as income, employment and tax multipliers, or backward-forward linkages. Rather, by using CRS hypothesis and TSA metrics, the calculation of these indicators becomes easier.

Here we develop an algorithm that gathers information from IOM-TSA- Ceará and then operates on the former IOM-IPECE, but now incorporating the tourism sector into it. The estimated IPECE matrix is of type sector-by-sector and exemplifies 32 activities[8].

Parameters tied to CRS were obtained as follows: first, we framed production supply observed in TSA in a way that is compatible with IOM sectors. Also, the relationship between this sectoral production and final sectorial demand of the economy was observed[9] (see table below).

[8] Data and Matlab code available here

[9] A question remais open: TSA output values tied to accommodation services sector were superior to those found in the IOM. Thus, we kept 100% of the allocation of this service to the tourism sector.

Table 1 – Constant returns to scale parameters

	Tourism (Supply)	Ceará (Demand)	Percentage
Public administration, safety, education and health publics and social security	1666	28,556	5.8%
Financial activities, insurance, and related services	41	5,900	0.7%
professional, scientific, and technical, administrative activities and complementary services	711	5,900	12.1%
Sale and motor vehicles and motorcycles repairing	101	20,742	0.5%
Manufacturing of food products	15	7,720	0.2%
Manufacture of textile products, clothing and accessories, footwear, and leather goods	307	10,442	2.9%
Food-serving services	3,067	5,418	56.6%
Accommodation services	834	533	100.0%
Transport, storage, and mail-order houses	1,768	7,144	24.7%
Total	**8510**	**92,354**	**9.2%**

Source: IOM and TSA data.

Following these percentages, we set sectorial return to scale parameters (γ_j) and applied the algorithm aggregating relatively input-output shares as for tourism sector. In other words, we disaggregated M1 and M2 matrices according to these percentages, and then we aggregate breakdowns in the so-called "tourism sector".

The pay-off is considerable here: we get consistent vectors with respect total demand (related to the economy in a wholly) and demand (related to intra-intersectoral outputs). But we face a problem: the way in which demand is distributed among its components happens to be suspicious. Yet, that issue does not prevent us from calculating backward-forward linkage indices, it bears no change in pure multipliers. On the other hand, induced multipliers, which directly depend on the household's consumption vector, may change according to the intensity of resources that value this vector. For the most part, however, all these changes have had a negligible effect in the induced effects under the CRS assumption when compared to those that flow from former IOM[10].

4 – Pull index

Considering Leontief´s basic model and following Rasmussen (1956) and Hirschman (1958), we determine sectors, which would have the greatest power of linkage, that is, we calculate both backward linkage, which would provide how much this sector would demand from others, as well as forward linkage, which would give us the value of production demanded from other sectors.

Let ℓ_{ij} be an element of Leontief inverse matrix, $L = (I - A)^{-1}$; L^* be the average of all elements of L; L_{*j} and L_{i*} be the sum of a j-th column and i-th row of L, respectively, then we get the definition of the following indexes:

i) Backward linkage index: $$U_j = [L_{*j}/n]/L^* \quad (1)$$

ii) Forward linkage index: $$U_i = [L_{i*}/n]/L^* \quad (2)$$

Since such indexes are normalized, values greater than 1 suggest above average sectors, therefore key sectors suit to economic growth[11]. Besides they are normalized, these indices are independent of measurement units, allowing intersectoral, interregional and intertemporal comparisons. Dispersions as for backward-forward linkage indices are determined, respectively, as follows:

[10] One way of getting closer to a more harmonic IOM demand vectors as those of TSA would be to pin the values of demand components into the matrix found, under the assumption of CRS, running in parallel with the values provided by TSA, and then use some matrix balancing technique, such as RAS, to get a more reliable demand component. This issue is beyond the purpose of the present study, but a suggestion for future work.

[11] Criticisms addressed to these indices lies in the fact they do not consider different levels of production in each economic sector, which is considered when we employ Pure Indices of Interindustry Linkages.

$$V_j = \frac{\sqrt{\sum_{i=1}^{n} \frac{\left(\ell_{ij} - \left(L_{*j}/n\right)\right)^2}{n-1}}}{L_{*j}/n} \quad (3)$$

and

$$V_i = \frac{\sqrt{\sum_{i=1}^{n} \frac{\left(\ell_{ij} - \left(L_{i*}/n\right)\right)^2}{n-1}}}{L_{i*}/n} \quad (4)$$

Dispersion indices show how the linkage effects spread across other sectors. A low dispersion value of the backward linkage index means that the impact of a variation in the production of the sector under analysis will uniformly stimulate the others; a high dispersion value suggests that the stimulus will be concentrated in a few sectors. Similarly, a low dispersion value of the forward linkage index means that this sector will be uniformly demanded by the others; yet a high value indicates that inputs demanded from this sector will be concentrated in a few sectors.

According to Miller and Blair (2009), key sectors classification in the manner of Rasmussen-Hirschman criteria means that sectors whose backward or forward linkages are greater than 1 are indeed key sectors suit to economic growth. McGilvray (1977) suggests that this classification should be more restrictive and that key sectors should be considered as being those that have both backward and forward linkage indices greater than 1.

As the indicators are normalized ones, we must pay attention to those sectors with forward-backward linkages greater than 1. Thus, in general, sectors can be classified in 4 ways, as shown in the following table[12]:

Table 2 – Industries description by backward and forward linkages indexes

		Forward linkage	
		Low (<1)	High (>1)
Backward linkage	Low (<1)	Generally independent	Dependent on interindustry demand
	High (>1)	Dependent on interindustry supply	Generally dependent

Source: Adapted from Miller and Blair (2009).

We can also carry out an analysis bearing in mind the indices proposed by Rasmussen-Hirschman. The dispersion indices show how the linkage effects spread across the other sectors. The smaller the value of V_i is the greater the number of sectors in which sector i will act, as a supplier. Thus, if a sector has a high value for U_i (greater than 1) and a low value for V_i, besides has great forward linkage power, it will also reach many sectors in the inverse matrix.

On the other hand, the smaller the value of V_j is, the greater the number of sectors related to intermediate demand induced by sector j. Thus, if a sector has a high value for U_j (greater than 1) and a concomitant low value for V_j, besides has great backward linkage, it will also reach many sectors in the inverse matrix.

Although not directly discussed throughout the literature, this idea permeates the field: the way in which each linkage in a sector gets along with the others depends on the coefficients of variation; thus, sectors with high dispersion indices tend to generate more misshapen vectors for the matrix of the field of influence, while vectors with low dispersion indices tend to generate more homogeneous vectors.

Indeed, a key sector should be listed as one in which U_i and U_j exceed unity and in which V_i and V_j are relatively low. Notice that it is possible to propose an index that aggregates all the Rasmussen-Hirschman indices presented above. Such index is equal to the sum of forward-backward linkage indices,

[12] In short, we get: (1) weakly linked with other sectors, or generally independent on other sector (U_i and $U_j < 1$); (2) generally linked or dependent on other sectors (U_i and $U_j > 1$); (3) dependent on intersectoral supply (only $U_i > 1$), and; (4) dependent on intersectoral demand (only $U_j > 1$).

multiplied by one minus the ratio between the sectoral dispersion and the maximum sectoral dispersion, V_i^+, that is,

$$T_i = U_i\left(1 - \frac{V_i}{V_i^+}\right) + U_j\left(1 - \frac{V_j}{V_j^+}\right) \quad (5)$$

From (5), it is observed that the greater the relative sectorial dispersion is, the less weight is given to the linkage index within the pull index. Such index is new and has not yet been presented in the literature. It has the advantage of synthesizing, in a single index, the whole idea behind indicators presented above.

5 – Results and discussions

Comparisons between some items of TSA and the results obtained using the CRS hypothesis are outlined below:

Table 3 – Comparison between TSA and CRS. Amounts in R$ millions of 2013. Percentage items refers to Ceará.

	TSA	%CE	CRS	%CE
Total output	8,510	5.2%	8,631	5.2%
Intermediate consumption	3,632	8.9%	2,618	6.4%
Gross added value	4,878	5.1%	5,056	5.3%
Remunerations	1,806	3.5%	2,871	5.6%
Gross operating surplus and gross mixed income	3,028	7.1%	2,137	5.0%
Taxes subsidies on products and imports	652	12.5%	327	6.3%
Factor labour	240,809	6.6%	245,850	6.7%
GDP	5,486	5.8%	5,336	5.6%
Export	6	0.0%	315	1.3%
Family consumption	6,585	7.9%	3,823	7.3%
Government expenditures	1,666	6.0%	1,616	5.8%
Sum of final demand vectors	8,257	5.0%	8,631	5.2%

In general, regarding CRS, most results tied to tourism sector are in line with those of TSA. Our methodology suggests a CI smaller than that presented in TSA and a more equitable distribution between Remunerations and Capital Income.

As highlighted in Section 3, some inconsistency regarding demand components is to be expected: it is possible that exports and household consumption are overvalued under our proposal. Since entering the discussion about induced effects is not under consideration, this is a second-order problem that can be solved in future studies. Furthermore, the results reported below suggest that the differential between these effects under our approach and the standard IOM is very small.

Table 3 presents backward and forward linkages indexes, their respective dispersion indices, and Pull Index. Sectors were ranked according to the proposed index. As a comparison criterion, these indices were calculated for both IOM (disregarding tourism sector) and IOM updated (considering tourism sector formed through CRS hypothesis).

The first interesting result is that there is no change in the pull index order of the sectors. The second one is that tourism emerges as the 5th activity that most pull economy, almost 70% higher than the pull average in regard of the Ceará economy. The sector has the 11th smallest dispersion in the acquisition of inputs and the 14th backward linkage, it is very close to the average of the economy and has the 6th forward linkage with the 5th smallest dispersion. This result differs somewhat with findings seen in the literature. Although tourism is a core activity, indicators found here suggest that it is able of providing inputs to the entire economy, and in a very widespread way across sectors.

Table 4 – Linkage indices (i) tourism not included and (ii) tourism included, ranked by means of Pull index

	Tourism not included					Tourism included				
	backward linkage	backward dispersion	forward linkage	forward dispersion	Pull	Backward linkage	Backward dispersion	Forward linkage	Forward dispersion	Pull
Sale and motor vehicles and motorcycles repairing	0.96	4.50	2.44	1.87	1.85	0.96	4.50	2.46	1.86	1.86
Professional, scientific, and technical, administrative activities and complementary services	0.96	4.64	1.95	2.34	1.33	0.96	4.60	1.78	2.53	1.18
Transport, storage, and mail-order houses	1.03	4.36	1.73	2.62	1.18	1.03	4.28	1.49	2.97	0.97
Financial activities, insurance, and related services	1.13	4.33	1.52	3.24	0.93	1.13	4.33	1.50	3.27	0.92
Tourism						**1.01**	**4.21**	**1.26**	**3.36**	**0.79**
Electricity and gas, water, sewage, waste management and decontamination activities	1.20	4.65	1.55	3.60	0.80	1.20	4.64	1.51	3.69	0.76
Extractive industries	1.01	4.16	1.07	3.95	0.61	1.01	4.14	1.07	3.92	0.62
Information and communication	1.24	4.19	1.19	4.37	0.61	1.24	4.17	1.19	4.37	0.61
Refining of petroleum and coke and of alcohol and other biofuels	1.24	3.46	0.75	5.80	0.48	1.24	3.45	0.75	5.78	0.48
manufacturing of food products	1.14	3.90	0.89	5.04	0.47	1.15	3.90	0.90	4.99	0.48
Arts, culture, sport and recreation and other service activities	1.13	3.69	0.81	5.20	0.48	1.13	3.70	0.81	5.21	0.47
Beverage manufacturing	1.10	3.96	0.83	5.26	0.41	1.11	3.95	0.85	5.16	0.42
Metallurgy	1.08	4.06	0.88	5.02	0.42	1.09	4.06	0.88	5.02	0.42
Accommodation services	1.07	3.86	0.78	5.33	0.40					
Manufacture of non-metallic mineral products	1.04	4.19	0.87	5.03	0.38	1.04	4.19	0.86	5.05	0.38
Food-serving services	1.04	3.99	0.86	4.84	0.45	1.05	3.98	0.79	5.27	0.38
Agriculture	0.86	5.02	0.98	4.39	0.33	0.86	5.02	0.98	4.41	0.33
Manufacture of wood products, other than furniture, of cellulose, paper and paper products and engraving printing and reproduction services	0.99	4.43	0.87	5.04	0.33	0.99	4.43	0.87	5.04	0.33
Construction	1.00	4.47	0.88	5.06	0.32	1.00	4.47	0.88	5.09	0.31
Real estate activities	0.80	5.24	1.00	4.20	0.33	0.80	5.24	0.98	4.28	0.31
Chemicals manufacturing	0.99	4.48	0.86	5.13	0.30	0.99	4.48	0.86	5.13	0.30
Manufacture of motor vehicles, trailers and bodies and other transport equipment	1.03	4.16	0.77	5.60	0.30	1.03	4.16	0.77	5.59	0.30
Administration, defense, education and public health and social security	0.92	4.51	0.83	4.99	0.30	0.93	4.51	0.83	5.04	0.29
Manufacture of computer equipment, electronic and optical products, machinery, appliances and electrical materials	0.97	4.34	0.77	5.53	0.26	0.98	4.34	0.77	5.52	0.26
Fab of pharmochemicals and pharmaceuticals	0.98	4.33	0.76	5.60	0.26	0.98	4.32	0.76	5.59	0.26
Private education and health	0.95	4.48	0.78	5.44	0.25	0.95	4.48	0.78	5.44	0.24
Manufacture of rubber and plastic material products	0.92	4.63	0.80	5.31	0.23	0.92	4.63	0.80	5.31	0.23
Machine maintenance, repair and installation. and equip	0.89	4.69	0.79	5.26	0.23	0.89	4.69	0.79	5.27	0.22
Manufacture of textile products, clothing and accessories, footwear and leather goods	0.95	4.65	0.81	5.43	0.22	0.95	4.64	0.81	5.44	0.22
Manufacture of metal products, except machinery and equipment	0.89	4.76	0.79	5.31	0.21	0.89	4.76	0.79	5.31	0.21
Manufacture of machinery and equipment	0.89	4.66	0.75	5.57	0.19	0.90	4.66	0.75	5.57	0.19
Other industrial activities	0.88	4.72	0.74	5.61	0.17	0.88	4.72	0.74	5.61	0.17
Domestic services	0.74	5.66	0.74	5.66	0.02	0.74	5.66	0.74	5.66	0.02

Tourism is an activity that has the greatest potential in the state of Ceará. Unquestionably, it has expanded in recent decades, influencing the socioeconomic development of the state. The government adopted procedures aimed at expanding it, seeking to pull new tourists, and increasing their stay to ultimately consolidate the state as one of the main tourist destinations in Brazil (IPECE, 2013; 2012a; 2012b). In this way, an accurate appraisal of tourism-related activities – here defined as a "new" sector – and how they interact with other sectors is essential for the design of development strategies in Ceará.

The following tables present the product, income/salaries, state sales tax (ICMS), added value and employment multipliers. In general, the sector ranking according to their multipliers change little when comparing total multipliers of the two matrices (tourism included and not included), regardless of the multiplier analyzed. When comparing the results based on both IOMs – tourism included and not included – we also note that the total values of the indicators are close, for all types of indicators. This suggests that much of the structure of the former matrix, that is, without tourism included, is preserved under the CRS assumption.

As pointed out earlier, the disaggregation/aggregation methodology based on the assumption of CRS generates misaligned demand component vectors as those presented in the TSA. Given induced multipliers depend directly on the household's consumption vector, significant differences for this metric were to be expected when comparing the two data sets. Our results indicate that this induced effect for the output multiplier is 1.23% higher, on average, in the dataset that includes tourism. Results found for the induced effects of other multipliers indicate that they are, on average, 4% lower for wages, 0.16% lower for state sales tax, 0.23% higher for employment and 1.79% lower for value added.

Table 5 – Output multipliers (i) IOM tourism not included and (ii) IOM tourism included

	Output multipliers					
	IOM tourism not included			IOM tourism included		
	Simple	Induced	Total	Simple	Induced	Total
Domestic services	1.000	2.001	3.001	1.000	2.024	3.024
Financial, insurance and related services activities	1.533	1.269	2.802	1.532	1.285	2.817
Administration, defense, education and public health and social security	1.253	1.520	2.773	1.253	1.540	2.793
Arts, culture, sport and recreation and other service activities	1.538	0.957	2.495	1.532	0.989	2.520
information and communication	1.681	0.749	2.430	1.682	0.755	2.437
Private education and health	1.287	1.042	2.329	1.286	1.056	2.342
Professional, scientific and technical, administrative activities and complementary services	1.303	0.978	2.282	1.303	0.989	2.292
Tourism				**1.362**	**0.866**	**2.228**
Accommodation services	1.457	0.752	2.209			
Transport, storage and mail-order houses	1.392	0.782	2.174	1.392	0.791	2.184
Refining of petroleum and coke and of alcohol and other biofuels	1.684	0.421	2.104	1.683	0.426	2.110
Manufacture of motor vehicles, trailers and bodies and other transport equipment	1.395	0.681	2.076	1.395	0.689	2.084
Manufacturing of food products	1.551	0.520	2.070	1.551	0.526	2.076
Sale and repair of motor vehicles and motorcycles	1.299	0.731	2.030	1.299	0.739	2.038
Manufacture of textile products, clothing and accessories, footwear and leather goods	1.283	0.743	2.026	1.283	0.751	2.035
Electricity and gas, water, sewage, waste management and decontamination activities	1.625	0.401	2.026	1.625	0.405	2.030
Beverage manufacturing	1.498	0.523	2.021	1.498	0.529	2.027
Fab of pharmochemicals and pharmaceuticals	1.324	0.625	1.949	1.324	0.632	1.956
Extractive industries	1.373	0.573	1.947	1.372	0.582	1.955
Construction	1.351	0.594	1.944	1.351	0.600	1.951
Food-serving services	1.417	0.521	1.938	1.417	0.526	1.943
Manufacture of non-metallic mineral products	1.408	0.499	1.906	1.408	0.504	1.912
Manufacture of wood products, other than furniture, of cellulose, paper and paper products and engraving printing and reproduction services	1.340	0.544	1.884	1.340	0.551	1.891
Manufacture of computer equipment, electronic and optical products, machinery, appliances and electrical materials	1.321	0.534	1.855	1.321	0.540	1.861
Manufacture of machinery and equipment	1.213	0.629	1.842	1.213	0.637	1.850
Metallurgy	1.471	0.356	1.827	1.471	0.361	1.832
Manufacture of metal products, except machinery and equipment	1.201	0.623	1.824	1.201	0.630	1.832
Manufacture of rubber and plastic material products	1.244	0.565	1.809	1.244	0.572	1.816
Chemicals manufacturing	1.340	0.406	1.746	1.340	0.411	1.751
Other industrial activities	1.195	0.526	1.720	1.195	0.532	1.727
Machine maintenance, repair and installation. and equip	1.207	0.434	1.640	1.207	0.439	1.645
Agriculture	1.168	0.306	1.474	1.168	0.309	1.477
Real estate activities	1.082	0.073	1.156	1.083	0.074	1.157

Table 6 – Income/wages multipliers (i) IOM tourism not included and (ii) IOM tourism included

	Income/wages multipliers					
	IOM tourism not included			IOM tourism included		
	Simple	Induced	Total	Simple	Induced	Total
Domestic services	1.000	0.467	1.467	1.000	0.487	1.487
Administration, defense, education and public health and social security	0.759	0.354	1.114	0.761	0.371	1.132
Financial, insurance and related services activities	0.634	0.296	0.930	0.635	0.309	0.944
Private education and health	0.521	0.243	0.764	0.522	0.254	0.776
Professional, scientific and technical, administrative activities and complementary services	0.489	0.228	0.717	0.489	0.238	0.727
Arts, culture, sport and recreation and other service activities	0.478	0.223	0.701	0.488	0.238	0.726
Tourism				**0.428**	**0.208**	**0.636**
Transport, storage and mail	0.391	0.182	0.573	0.391	0.191	0.582
Accommodation services	0.376	0.175	0.551			
Information and communication	0.374	0.175	0.549	0.373	0.182	0.555
Manufacture of textile products, clothing and accessories, footwear and leather goods	0.371	0.173	0.544	0.371	0.181	0.552
Sale and repair of motor vehicles and motorcycles	0.365	0.170	0.536	0.365	0.178	0.543
Manufacture of motor vehicles, trailers and bodies and other transport equipment	0.340	0.159	0.499	0.341	0.166	0.506
Manufacture of machinery and equipment	0.314	0.147	0.461	0.315	0.153	0.468
Fab of pharmochemicals and pharmaceuticals	0.312	0.146	0.458	0.312	0.152	0.465
Manufacture of metal products, except machinery and equipment	0.311	0.145	0.456	0.311	0.152	0.463
Construction	0.297	0.138	0.435	0.296	0.144	0.441
Extractive industries	0.286	0.134	0.420	0.288	0.140	0.428
Manufacture of rubber and plastic material products	0.283	0.132	0.414	0.283	0.138	0.420
Manufacture of wood products, other than furniture, of cellulose, paper and paper products and engraving printing and reproduction services	0.272	0.127	0.399	0.272	0.133	0.405
Manufacture of computer equipment, electronic and optical products, machinery, appliances and electrical materials	0.267	0.124	0.391	0.267	0.130	0.397
Other industrial activities	0.263	0.123	0.385	0.263	0.128	0.391
Beverage manufacturing	0.261	0.122	0.383	0.261	0.127	0.388
Food-serving services	0.260	0.121	0.382	0.260	0.127	0.387
Manufacturing of food products	0.260	0.121	0.381	0.260	0.127	0.386
Manufacture of non-metallic mineral products	0.249	0.116	0.365	0.249	0.121	0.371
Machine maintenance, repair and installation. and equip	0.217	0.101	0.318	0.217	0.106	0.322
Refining of petroleum and coke and of alcohol and other biofuels	0.210	0.098	0.308	0.211	0.103	0.313
Chemicals manufacturing	0.203	0.095	0.297	0.203	0.099	0.302
Electricity and gas, water, sewage, waste management and decontamination activities	0.200	0.093	0.294	0.200	0.097	0.297
Metallurgy	0.178	0.083	0.261	0.178	0.087	0.265
Agriculture	0.153	0.071	0.224	0.153	0.074	0.227
Real estate activities	0.037	0.017	0.054	0.037	0.018	0.054

Table 7 – State sales tax (ICMS) multipliers (i) IOM tourism not included and (ii) IOM tourism included

	State sales tax multipliers					
	IOM tourism not included			IOM tourism included		
	Simple	Induced	Total	Simple	Induced	Total
Beverage manufacturing	0.0076	0.0002	0.0078	0.0076	0.0002	0.0078
Manufacture of computer equipment, electronic and optical products, machinery, appliances and electrical materials	0.0052	0.0002	0.0054	0.0052	0.0002	0.0054
Manufacture of metal products, except machinery and equipment	0.0036	0.0002	0.0037	0.0036	0.0002	0.0037
Manufacture of wood products, other than furniture, of cellulose, paper and paper products and engraving printing and reproduction services	0.0026	0.0002	0.0027	0.0026	0.0002	0.0027
Manufacture of rubber and plastic material products	0.0023	0.0002	0.0025	0.0023	0.0002	0.0025
Manufacture of motor vehicles, trailers and bodies and other transport equipment	0.0020	0.0002	0.0022	0.0020	0.0002	0.0022
Manufacture of machinery and equipment	0.0019	0.0002	0.0021	0.0019	0.0002	0.0021
Other industrial activities	0.0018	0.0002	0.0020	0.0018	0.0002	0.0020
Metallurgy	0.0012	0.0001	0.0013	0.0012	0.0001	0.0013
Manufacture of textile products, clothing and accessories, footwear and leather goods	0.0010	0.0002	0.0012	0.0010	0.0002	0.0012
Chemicals manufacturing	0.0010	0.0001	0.0011	0.0010	0.0001	0.0011
Manufacture of non-metallic mineral products	0.0009	0.0002	0.0011	0.0010	0.0002	0.0011
manufacturing of food products	0.0005	0.0002	0.0006	0.0005	0.0002	0.0006
food-serving services	0.0005	0.0002	0.0006	0.0005	0.0002	0.0006
Domestic services	0.0000	0.0006	0.0006	0.0000	0.0006	0.0006
Administration, defense, education and public health and social security	0.0000	0.0005	0.0005	0.0000	0.0005	0.0005
Tourism				**0.0002**	**0.0003**	**0.0005**
Financial, insurance and related services activities	0.0001	0.0004	0.0004	0.0001	0.0004	0.0004
Arts, culture, sport and recreation and other service activities	0.0001	0.0003	0.0004	0.0001	0.0003	0.0004
Professional, scientific and technical, administrative activities and complementary services	0.0001	0.0003	0.0004	0.0001	0.0003	0.0004
Sale and repair of motor vehicles and motorcycles	0.0001	0.0002	0.0004	0.0001	0.0002	0.0004
Accommodation services	0.0001	0.0002	0.0003			
Private education and health	0.0000	0.0003	0.0003	0.0000	0.0003	0.0003
Construction	0.0001	0.0002	0.0003	0.0001	0.0002	0.0003
Information and communication	0.0001	0.0002	0.0003	0.0001	0.0002	0.0003
Transport, storage and mail-order houses	0.0000	0.0002	0.0003	0.0000	0.0002	0.0003
Fab of pharmochemicals and pharmaceuticals	0.0000	0.0002	0.0002	0.0000	0.0002	0.0002
Machine maintenance, repair and installation. and equip	0.0001	0.0001	0.0002	0.0001	0.0001	0.0002
Extractive industries	0.0000	0.0002	0.0002	0.0000	0.0002	0.0002
Refining of petroleum and coke and of alcohol and other biofuels	0.0000	0.0001	0.0002	0.0000	0.0001	0.0002
Agriculture	0.0001	0.0001	0.0002	0.0001	0.0001	0.0002
Electricity and gas, water, sewage, waste management and decontamination activities	0.0000	0.0001	0.0002	0.0000	0.0001	0.0002
Real estate activities	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table 8 – Value added multipliers (i) IOM tourism not included and (ii) IOM tourism included

	Value added multiplier					
	IOM tourism not included			IOM tourism included		
	Simple	Induced	Total	Simple	Induced	Total
Domestic services	1.000	1.182	2.182	1.000	1.202	2.202
Administration, defense, education and public health and social security	0.903	0.898	1.800	0.903	0.914	1.817
Financial, insurance and related services activities	0.900	0.749	1.650	0.900	0.763	1.663
Professional, scientific and technical, administrative activities and complementary services	0.903	0.578	1.481	0.902	0.587	1.490
Private education and health	0.811	0.615	1.426	0.811	0.627	1.438
Arts, culture, sport and recreation and other service activities	0.808	0.565	1.373	0.811	0.587	1.398
Sale and repair of motor vehicles and motorcycles	0.903	0.432	1.335	0.903	0.439	1.342
Information and communication	0.868	0.442	1.310	0.866	0.448	1.314
Tourism				**0.797**	**0.514**	**1.311**
Accommodation services	0.812	0.444	1.256			
Transport, storage and mail-order houses	0.707	0.462	1.169	0.708	0.470	1.178
Extractive industries	0.777	0.338	1.115	0.780	0.346	1.125
Food-serving services	0.774	0.308	1.081	0.773	0.313	1.086
Real estate activities	0.977	0.043	1.020	0.977	0.044	1.021
Agriculture	0.826	0.181	1.007	0.826	0.184	1.010
Construction	0.653	0.350	1.004	0.653	0.356	1.009
Fab of pharmochemicals and pharmaceuticals	0.632	0.369	1.000	0.632	0.375	1.007
Manufacture of textile products, clothing and accessories, footwear and leather goods	0.533	0.438	0.971	0.533	0.446	0.980
Beverage manufacturing	0.647	0.309	0.956	0.647	0.314	0.961
Machine maintenance, repair and installation. and equip	0.692	0.256	0.949	0.692	0.261	0.953
Manufacture of non-metallic mineral products	0.641	0.294	0.936	0.642	0.299	0.941
Manufacture of machinery and equipment	0.545	0.372	0.917	0.545	0.378	0.923
Manufacture of motor vehicles, trailers and bodies and other transport equipment	0.489	0.402	0.892	0.489	0.409	0.899
Manufacture of wood products, other than furniture, of cellulose, paper and paper products and engraving printing and reproduction services	0.553	0.321	0.874	0.553	0.327	0.880
manufacturing of food products	0.553	0.307	0.860	0.553	0.312	0.865
Other industrial activities	0.533	0.310	0.844	0.534	0.316	0.849
Manufacture of metal products, except machinery and equipment	0.460	0.368	0.828	0.460	0.374	0.834
Manufacture of rubber and plastic material products	0.462	0.334	0.796	0.462	0.340	0.802
Electricity and gas, water, sewage, waste management and decontamination activities	0.547	0.237	0.783	0.547	0.240	0.787
Manufacture of computer equipment, electronic and optical products, machinery, appliances and electrical materials	0.376	0.315	0.691	0.376	0.321	0.697
Chemicals manufacturing	0.352	0.240	0.592	0.353	0.244	0.598
Metallurgy	0.337	0.210	0.547	0.338	0.214	0.552
Refining of petroleum and coke and of alcohol and other biofuels	0.272	0.248	0.521	0.274	0.253	0.527

Table 9 – Employment multipliers (i) IOM tourism not included and (ii) IOM tourism included

	Employment multipliers					
	IOM tourism not included			IOM tourism included		
	Simple	Induced	Total	Simple	Induced	Total
Domestic services	204.24	51.65	255.89	204.24	51.47	255.71
accommodation services	95.78	19.40	115.18			
Arts, culture, sport and recreation and other service activities	65.60	24.69	90.29	63.60	25.14	88.74
Agriculture	76.21	7.89	84.11	76.23	7.87	84.10
Private education and health	35.83	26.89	62.72	35.79	26.85	62.64
Sale and repair of motor vehicles and motorcycles	40.14	18.87	59.01	40.22	18.79	59.02
Tourism				**36.23**	**22.01**	**58.24**
Professional, scientific and technical, administrative activities and complementary services	31.25	25.25	56.50	31.28	25.15	56.43
food services	42.64	13.44	56.08	42.67	13.39	56.06
Administration, defense, education and public health and social security	16.95	39.22	56.17	16.86	39.16	56.02
Manufacture of textile products, clothing and accessories, footwear and leather goods	35.28	19.16	54.44	35.34	19.11	54.45
Transport, storage and mail	28.94	20.19	49.12	29.09	20.13	49.21
Financial, insurance and related services activities	12.44	32.75	45.19	12.38	32.68	45.06
Construction	28.16	15.32	43.48	28.17	15.26	43.43
Manufacture of machinery and equipment	27.10	16.24	43.34	27.10	16.19	43.29
Manufacture of metal products, except machinery and equipment	26.91	16.07	42.99	26.92	16.03	42.95
Manufacture of motor vehicles, trailers and bodies and other transport equipment	24.99	17.58	42.57	25.03	17.53	42.55
manufacturing of food products	27.65	13.41	41.05	27.72	13.37	41.09
Manufacture of rubber and plastic material products	25.72	14.59	40.32	25.74	14.54	40.29
Fab of pharmochemicals and pharmaceuticals	23.61	16.12	39.73	23.63	16.08	39.71
information and communication	17.59	19.32	36.92	17.65	19.20	36.85
Other industrial activities	22.97	13.57	36.54	22.97	13.53	36.50
Manufacture of wood products, other than furniture, of cellulose, paper and paper products and engraving printing and reproduction services	21.63	14.05	35.68	21.68	14.01	35.68
Manufacture of non-metallic mineral products	22.60	12.87	35.46	22.66	12.82	35.49
Manufacture of computer equipment, electronic and optical products, machinery, appliances and electrical materials	16.86	13.77	30.63	16.91	13.73	30.64
beverage manufacturing	16.49	13.50	29.99	16.59	13.44	30.04
Machine maintenance, repair and installation. and equip	16.34	11.19	27.53	16.35	11.16	27.51
Extractive industries	11.38	14.79	26.17	11.69	14.81	26.50
Refining of petroleum and coke and of alcohol and other biofuels	12.41	10.85	23.26	12.63	10.84	23.47
Chemicals manufacturing	11.48	10.47	21.95	11.57	10.46	22.03
Electricity and gas, water, sewage, waste management and decontamination activities	9.82	10.34	20.16	9.94	10.29	20.23
Metallurgy	10.90	9.19	20.09	11.00	9.18	20.18
Real estate activities	2.09	1.89	3.99	2.10	1.88	3.98

6 – Conclusions

As pointed out by Coelho (1991), the standard way of analyzing the role played by tourism to GDP is to look at tourist consumption, since we must consider the enormous difficulty in defining what counts as tourist production, in virtue of its very characteristics, nuanced in nature, has a certain immateriality in the provision of services, besides the way to meet an explicit definition for it.

The consumption-based approach follows the insights tied to the so-called "subjectivist school" in opposition to the "sectoral school", which seeks to quantify tourist activity through production (tourist supply). Whether in its direct or indirect form, tourist consumption generates an added value that can be compared with an overall added value of the economy (GDP). Therefore, researchers wonder the participation of the added value tied to the tourist activity in regard its general counterpart, i.e, the added value tied to the Brazilian economy, in each period.

The State of Ceará has its own IOM and TSA. These data support the sectoral school and based on them, the CRS hypothesis was used here to disaggregate a portion of the production tied to tourism TCAs outlined in the IOM-Regional. The results were aggregated in what may be called "tourism sector". This proposal generates a new IOM, whose structure is very similar to the former matrix, but with tourism sector well-defined, rendering possible to explore a series of relevant questions.

It was proposed a new index able of indicating key sectors for the economy. Such index reconciles Rasmussen-Hirschman dispersion and linkage indices and we called here of Pull index. Based on it, we demonstrated that tourism sector occupies the 5th place among the 32 IOM sectors that pull the development of Ceará. In particular, the results guided by the index suggest that tourism pulls the economy more than traditional sectors, such as construction, extractive industries, and oil refining sector.

Product, income/salaries, ICMS (State sales tax), added value and employment multipliers tied to tourism sector were also calculated. We found that, regarding R$ 1.00 added to final demand in the tourism sector, there would be an increase of R$ 2.23, which R$ 1.36 would be due to effects on the production process and about R$0.87 on account of household consumption. Regarding wages, tourism is the 7th sector that contributes most in terms of generating income to the Ceará´s population. In terms of ICMS (State sales tax), tourism sector is very close to the average of the economy. Finally, regarding the employment multiplier, for every million increases in tourist demand, there would be a job generation coefficient of approximately 58 jobs created in Ceará, of which 36 would be direct and 22 induced.

In short, the approach presented here based on TSA-Regional vis-à-vis OIM proves to be a great framework for public policy managers interested in the tourism segment.

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