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Research paper

Measuring the vulnerability of tourist destinations to the availability of air transport, using multi-criteria composite indexes

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ABSTRACT

Tourist destinations are vulnerable to the decisions of commercial stakeholders that may have different organisational priorities to theirs. A high level of tourism concentration, and dependence on certain airports and airlines, can increase the strategic risks and threaten the competitiveness of destinations. This paper develops a novel methodology to measure the vulnerability of tourist destinations to the availability of air transport through the use of composite indexes. The applicability of the methodology is demonstrated in Catalonia (Spain) from 2007 to 2017. The result is a rigorous control of easy interpretation that allows multiple analyses and flexible application to different circumstances. The system provides politicians and technical staff with the tools they need to have a comprehensive and integrated understanding of the vulnerability of their destination. It also provides robust data that can be used to analyse current policies, negotiate contractual conditions and prepare contingency plans for those instances where the collective needs at a destination differ from those of individual commercial stakeholders.

1. Introduction

Vulnerability refers to a state of being at risk of being harmed. The concept of vulnerability is context-dependent and the language used to define it varies across disciplines, although all definitions have in common an exposure to changes, a sensitivity or susceptibility towards such changes, a capacity to address such risks, and resilience to adapt to the change (Füssel, 2007; Sheffi, 2005). The tourism literature has defined vulnerability mainly in relation to single exogenous circumstances that are difficult to control (Brouder & Lundmark, 2011; Hinkel, 2011; Paraskevas & Altinay, 2013; Scott, 2011). Few studies consider multiple criteria of vulnerability, beyond Scheyvens and Momsen (2008), who analyse both economic dependency and environmental fragility, and Strickland-Munro, Allison, and Moore (2010), who combine data on resilience from protected areas and local communities.

Destination management organisations (DMOs) need to equip themselves with data, and then to act upon it, in order to reduce the vulnerability of their destinations and to improve their competitiveness and sustainability (Ritchie & Crouch, 2003). This paper fulfils the need to create a novel methodology through the use of composite indicators in order to improve substantially the interpretation and use of simple indicators. This provides decision-makers with an alert system to analyse the vulnerability of their tourist destination towards external factors, based on data publicly available. Vulnerability is defined in relation to the level of tourism concentration and dependency towards key stakeholders, in the present case, the airline industry. The literature on destination vulnerability in relation to the airline industry is first summarised. The paper then moves on to a detailed outline of the methodology, which is its main contribution, by determining the key measurement dimensions and then identifying associated indicators that will be subsequently normalised, weighted and aggregated into a single index. The value of this methodology is next demonstrated in the Spanish region of Catalonia. The paper then presents some conclusions and reflections on the political and management implications. Recommendations for future research are also made.

2. Literature review

Tourist destinations are vulnerable to decisions made by external stakeholders who do not share the same organisational objectives as those established by the destination managers and who, therefore, may take commercial decisions that negatively affect the destination (Efthymiou & Papatheodorou, 2018). A tourist destination authority can do well, financially, while at the same time being vulnerable if it is dependent on: (a) a single airport and/or single airline operator, (b) tourist generating markets, and (c) seasonal variations (Koo,

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Halpern, Papatheodorou, Graham, & Arvanitis, 2016). It is this interpretation of vulnerability that is of interest to this study. Vulnerability is defined here as being the result of two key concepts (Füssel, 2007; Prideaux, 2000): (a) *concentration*, *where* one element of the tourism system (e.g. the market, season, airline, airport) has an impact on how sensitive a tourist destination will be towards changes in that element; and (b) *dependency,* where high dependency on a single entity within a tourism system gives that entity a degree of power that limits the destination's ability to adapt. For example, the breadth of transport providers catering for a given destination relates to the level of concentration, whereas the relative dominance of the single most important transport provider relates to dependency.

2.1. Air transport concentration and dependency

Most destinations are reliant on air transport provision (Ivanova, 2017): in 2016, more than half of global international travel was air bound (UNWTO, 2017). Airlines choose their routes based on the attractiveness and viability of the destinations, and these destinations in turn depend on air transport availability to source customers (Graham, Papatheodorou, & Forsyth, 2008; Tan, Koo, Duval, & Forsyth, 2017). The greater freedom of airlines, resulting from the liberalisation of air transport in Europe in the three instalments of 1987, 1990 and 1993–1997 (European Commission, 2007), means that airports are more exposed to risk due to commercial decisions made by the airline: hence the need for destinations to reduce their exposure to risk by reducing their dependency on single sources of markets and/or single airlines (Koo et al., 2016). Policy-makers need to develop strategic synergies with airlines to inform destination planning and leverage appropriate resources in order to fulfil the destination requirements of guaranteeing the economic viability of destination stakeholders (Graham, , Papatheodorou, , & Forsyth, 2008; Liasidou, 2013, 2017). The strategic development of tourist destinations depends on an intimate understanding of the airlines' policies in order to have a resilient transport plan (Camilleri, 2018; Ivanova, 2017) and, equally, airlines depend on their understanding of the marketing and development plans of destinations (Bieger & Wittmer, 2006).

While destination managers and transport providers may rely on each other, in practice the power that each stakeholder has is reflected in their influence in the negotiations to determine the incentives and prices that will be offered by the destination policy-makers and the airport authorities in order to attract the airlines (Barrett, 2004; Graham et al., 2008; Halpern, Graham, & Dennis, 2016; Laurino & Beria, 2014; Liasidou, 2013, 2017). For example, many non-conventional tourist destinations, with secondary regional airports ignored by flag carriers, have developed a position in international markets thanks to their partnerships with low-cost airlines. These airports often become dependent on a single low-cost airline that, consequently, has bargaining power (Gillen & Lall, 2004; Koo et al., 2016). As the low-cost airlines have become the drivers of tourist demand, the destinations have become dependent on the airlines, and the latter can negotiate prices and conditions that suit them (Barrett, 2004; Halpern et al., 2016; Laurino & Beria, 2014). To be effective, local policy-makers need data to inform their negotiations with such airlines. There is clearly great complexity in organisational decision-making in the airline industry (Halpern & Graham, 2018), which has increased due to the growth of leisure travel, the liberalisation of the airline industry and the increase in airport activity (Graham et al., 2008). This paper does not therefore intend to analyse the variables that affect the behaviour of these airlines but, instead, to consider the consequences of airline decisions on tourist destinations and how these can ultimately impact the local tourism business models.

2.2. The use of indicators for destination decision-making

Resilient organisations plan how to overcome their vulnerability with early detection information systems and flexible planning and management approaches (Calgaro, Lloyd, & Dominey-Howes, 2014; Cochrane, 2010; Sheffi, 2005). It is worth remembering that indicators are early-warning systems that identify areas of concern, but the decision of whether or not policy is to be adapted accordingly is subject to a variety of factors (Sanderson, 2006; White, McCrum, Blackstock, & Scott, 2006). Information systems consist of data, usually presented in the form of indicators, that are necessary to evaluate the performance of current policies and to equip policy makers to take informed decisions (Jurado et al., 2012; Ruiz, Cabello, & Luque, 2011; Sanderson, 2002). Indicators are quantitative instruments that allow researchers to appraise a reality that cannot be understood in a direct and complete manner (Chevalier et al., 1992).

The design of indicators runs the risk of developing exhaustive lists that are technically robust but too complex to manage in reality; the challenge is to develop a reduced number of cost effective indicators that maximise the information usefulness (Atauri, De Lucio, & Castell, 2002, pp. 207–228). A large number of indicators may be required to ensure that the concept at hand is measured adequately, and to guard against the possibility of having chosen an inappropriate indicator in error (Selden, 1990). A number of lessons have been learned from the development of sustainable tourism indicators (Blancas, Lozano-Oyola, González, Guerrero, & Caballero, 2011; Jurado et al., 2012; Pulido & Sánchez, 2009; Torres-Delgado & Palomeque, 2014). First, on the one hand, a model that is practical, agile and operative should not have an excessive number of indicators, while on the other hand it is also not logical to encompass all aspects of vulnerability of a tourist destination in a single indicator. Second, a universal, optimal number of indicators does not exist because that number depends on the complexity of the concept to be measured, the extent to which the data from the indicators can be collated within the financial and human resources allocated to it, and the perceived gains to be made from the information provided by the indicators. Third, the more closely an indicator measures the aspect to be analysed the fewer indicators that will be needed, as the alternative is to measure an issue with a number of indicators by approximation. Finally, indicators need to be clearly and unambiguously understood.

There are two types of indicators: simple indicators and composite (or synthetic) indexes. The distinction depends on the level of elaboration of the information included in each indicator (Nardo, Saisana, Saltelli, Tarantola, et al., 2005). Simple indicators present statistics directly obtained in the field, or with a simple statistical analysis, while composite indexes are the result of combining multiple simple indicators with a weighting system to create a hierarchy of the components (Pulido & Sánchez, 2009). Based on the previous summary of lessons learned from indicators, it is necessary to consider the value of developing composite indexes (Nardo, Saisana, Saltelli, Tarantola, et al., 2005). Vulnerability analysis, in particular, is a multidimensional construct that requires the use of composite indexes (Pena, 1994). In the case of the analysis of vulnerability, the quantity of information that can be collected by the indicator system can become an obstacle to the use of this information as a decision-making tool, since data needs to be presented in a concise and holistic way that allows politicians and technical staff to consider different options and their likely consequences. Questions such as "what will be the result if indicator X increases and/or if indicator Y decreases?", or "what will be the overall outcome if some indicators increase while others decrease?" occur frequently, and their response requires the synthesis of information to offer a unique answer (OECD, 2008). This study develops a methodology that uses simple and composite indexes to measure both the

current status of a tourist destination and the evolution of the aspects that make a tourist destination vulnerable in order to foresee, anticipate and prevent problems.

3. Methodology

The process of calculating composite indexes has seven phases (derived from the OECD (2008) and Nardo, Saisana, Saltelli, and Tarantola (2005), as shown in Fig. 1, that will be outlined in turn and applied to the case study destination to design a tourist destination vulnerability index.

3.1. Phase 1: conceptual framework

Key indicators were selected based on a literature review of the airline industry (Koo et al., 2016) and sustainable tourism (Jurado et al., 2012; Torres-Delgado & Palomeque, 2018). This facilitated the selection of indicators that: (a) have an impact on the tourist destination as a result of the airline industry; (b) allow data collection in relation to the vulnerability measures of dependency and concentration; (c) provide data at a regional level; and (d) are easy to process and communicate. Based on this analysis, ten simple indicators were chosen to build a composite indicator, as shown in Table 1.

First, for the concept being studied, the dimensions to measure need to be identified. For any given destination's perspective, it is necessary to know the weight that air transport has (indicator V1 in Table 1), and the airline routes, in order to determine the main characteristics of that destination (indicators V2 to V10 in Table 1) (Bieger & Wittmer, 2006; Camilleri, 2018). These characteristics include both demand and supply variables.

Demand variables included: (a) the *source markets* for that destination (indicators V2 and V3 in Table 1), and (b) the effects of *seasonality;* the commercial decisions of airlines determine the routes, and potential volumes, of international travellers (Castillo-Manzano, López-Valpuesta, & González-Laxe, 2011; Forsyth, 2003), and they determined the potential for year-round demand (Liasidou, 2017). The set of airline routes is directly relevant to the study of vulnerability, since either a greater dependency on a single market (indicator V4 in Table 1) or a concentration of demand in specific outbound airports (indicator V5 in Table 1) can increase the vulnerability of a tourist destination. Hence, it was considered that market concentration, in relation to either origin or seasonality, increases the risk of dependency and therefore vulnerability.

Supply variables included: (a) the *commercialisation* of the destination through the airlines, (b) the *airline mix* of low-cost carriers and full-service airlines, and (c) *access to the destination* from the airport. Firstly, airlines are central to the commercialisation of tourist destinations, hence, for this study, it was considered that market concentration (indicator V6 in Table 1), and dependency on the commercialisation strategies of a few airlines (indicator V7 in Table 1), both increase a tourist destination's vulnerability. Although there is a relationship between the supply and demand variables, a worsening in some of them does not necessarily imply a worsening in others. Thus, a destination can be made more vulnerable by a greater dependence on a certain airline. Such airline can, however, have a commercial policy in terms of routes and countries that it serves that benefits the destination. Secondly, it is important to understand the mix of low-cost carriers and full-service airlines (indicator V8 in Table 1) because each type of provider has different implications for the resultant characteristics of a market (Bieger & Wittmer, 2006; Vera Rebollo & Ivars Baidal, 2009). Adopting a risk-management approach to the development of a destination portfolio requires a balance between different types of airline providers and tour operators (Farmaki & Papatheodorou, 2015).

Thirdly, *access* to the destination from the airport is important; to measure destination accessibility, it is necessary to look at the availability and quality of transport infrastructure at the destination (indicators V9 and V10 in Table 1). In general, the fewer the number of airports serving a destination the greater the dependency of that destination on those airports and, therefore, the higher the vulnerability of that destination. Airport dependency can affect a tourist destination in multiple ways. First, it increases the destination's sensitivity towards any threats to infrastructure (such as economic trends in key markets, geopolitical hazards, meteorological conditions, strikes, terrorist attacks …) (Dobruszkes & Van Hamme, 2011; Mazzocchi, Hansstein, & Ragona, 2010). Second, the authorities reduce their chances of better redistributing their tourist flows and thus minimising the consequences of high concentrations of tourists in the territory, and they also reduce their negotiation margin with airlines that may be of interest to the destination but whose business model is based on secondary airports (Camilleri, 2018; Graham et al., 2008; Ivanova, 2017; Liasidou, 2013, 2017).

All the indicators are of a decreasing type (Krajnc & Glavič, 2005) i.e. as their value decreases the destination becomes less vulnerable. They are expressed in two units of measure; those that measure dependency are expressed as a percentage (0%–100%) and those that measure concentration are expressed with the Gini index (0–1) (Gastwirth, 1972). The Gini index has already been used to measure air transport distribution (Reynolds-Feighan, 2001), air transport liberalisation and airport dependency (Koo et al., 2016). This simplification of the units of measurement makes it easier for the results to be interpreted by decision makers.

3.2. Phase 2: data collection

The ability to measure an issue, practically, is an essential characteristic of any good indicator. This includes the availability of data to calculate it (Torres-Delgado & Palomeque, 2014). For the present study, it is sensible to first make use of statistical information already available, preferably originating from official entities that follow a rigorous methodology, statistical representability and longitudinal

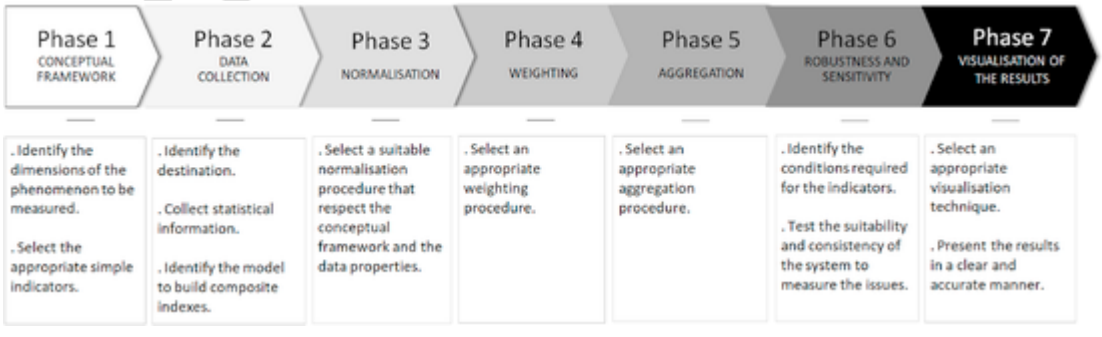

Fig. 1. The phases of the process of calculating composite indexes of vulnerability.Source: Authors, based on OECD (2008).

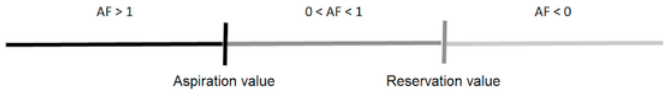

Fig. 2. Interpretation of an individual Achievement Function (AF).Source: Authors

Table 1
Indicator system.

AIR TRANSPORT INDUSTRY	Weight	V1| Importance of air transport to the tourist destination	
Characteristics			
Level of concentration: Concentration of one element of the tourism system (market, seasonality, airline and airport) has an impact on how sensitive a tourist destination will be towards changes in that element. > level of concentration = > vulnerability		Markets	V2| Level of concentration of tourist markets using air transport
			V3| Key market (using air transport)
		Seasonality	V4| Seasonal concentration of airport activity
			V5| Key month for airport activity
		Commercialisation	V6|Level of airline concentration
Level of dependency: where high dependence on a single element within a tourism system (transport, market, season, airline and airport) gives that element a degree of power that limits the destination's ability to adapt. >Level of dependency = > vulnerability			V7| Key airline
			V8| Type of airline (low cost/flag carrier)
		Accessibility	V9| Level of airport concentration
			V10| Key airport

Source: authors

availability. In this case, a thorough revision of national statistical sources was conducted, to determine the scope of potentially relevant indicators for this study while considering the availability of comparable data at the regional level.

The Spanish national official body for airports and air navigation (Aeropuertos Españoles y Navegación Aérea, AENA) is an excellent source of publicly available information on air traffic (including flights and passengers) for all Spanish airports, broken down by month and year, by market and by company. For this study, AENA data on 90 source markets and 300 airlines, broken down by airport and year, was used. The data enabled rigorous measurement of indicators V2 to V10. Indicator V1, which measures the relative importance of air transport compared to other forms of tourist transport, is the result of an estimation that combines two national tourism surveys (Frontur and Familitur) conducted by the National Statistics Institute (INE). The data set and standardisation procedures are available in the Data in Brief article [NAME TO BE ADDED AFTER REVIEW]. The Data in Brief article also has a factsheet for each simple indicator that includes all the information (definition, method of calculation and interpretation) necessary to allow researchers and DMO managers to apply the methodology proposed by this study to destinations of their choice. Each indicator was subject to scrutiny against a technical sheet specification similar to that shown in Table 2.

While simple indicators are useful to detect specific impacts and to apply partial solutions, composite indexes provide a global and integrated understanding of the tourism system (Blancas et al., 2011; Stiglitz, Sen, & Fitoussi, 2009). The literature shows that there is no ideal model for the aggregation of composite indexes (Nardo, Saisana, Saltelli, & Tarantola, 2005; Nardo, Saisana, Saltelli, Tarantola, et al., 2005; OECD, 2008; Pulido & Sánchez, 2009). Methodologies are specific to the context and scope, the data availability, the desired comparisons and/or aggregations, and the acceptable return on investment for the level of analysis desired (Esty, Levy, Srebotnjak, & De Sherbinin, 2005).

Based on the literature discussed earlier, in defining a composite index to measure a destination's vulnerability the following issues were considered:

- *Multidimensional aspect of vulnerability:* Data should be collected on each of the multiple dimensions of vulnerability.
- *Volume of data:* The quantity of data collected should be limited to be sufficient yet manageable.

Table 2
Technical sheet specification.

Fact sheet		Definition/content
V3	Key market (using air transport)	Code and name of the indicator (illustrated by the letter V for Vulnerability and then the number, as stated in Table 1)
Purpose	To know the weight of the largest air bound market in that destination	Brief description of the objective of the indicator
Methodology	Max % of passengers (by origin)	Methodology to calculate the indicator
Aspect measured	(X) Dependency ( ) Concentration	Definition of the aspect measured
Interpretation	The higher the percentage, the greater the dependency on a single market, and therefore the greater the vulnerability	Interpretation of the indicator for the vulnerability analysis
Type of indicator	( ) Increasing (X) Decreasing	Indicator trend. Increasing: as the value increases the destination becomes more vulnerable. Decreasing: as the value decreases the destination becomes less vulnerable.
Unit	%	Unit of measurement
Cost	0 euros	Cost of calculation
Source	Spanish Airports and Air Navigation (AENA)	Collaborating organisation
Statistics	Air traffic statistics (AENA)	Statistical source of the data used
Web site	http://www.aena.es/es/corporativa/estadisticas-trafico-aereo.html	Website of the data source used
Breakdown	Geographical: (X) Sites (X) Provinces (X) Regions Temporary: (X) Monthly (X) Trimester (X) Annual	Data availability in geographical and temporary terms
Observations	AENA collects passenger data based on every flight's airport of origin.	Observations to consider

Source: Authors

- *Correlation of variables:* The ability to conduct the calculations needed to allow for correlation between variables.
- *Irreducibility of dimensions:* All the variables initially selected for the composite index should be continuously available over time.
- *Baseline data:* The ability to provide data on the status of each indicator relative to an initial data point. This can be determined statistically (average, maximum value, minimum value, etc) or by considering a situation that is desirable or not desirable, as defined by destination managers or experts.
- *Compensation between indicators:* The ability to determine the degree to which the disadvantages presented in a group of indicators can be compensated for by a better situation in others.
- *Ease and flexibility of calculation:* The ability to provide an agile and practical tool that can be adapted to different realities, offering the possibility to consider different definitions of the parameters calculated (weights, limits or thresholds, degree of compensation between indicators …).
- *Comparative analysis:* The ability to compare the evolution of a destination over time and in comparison with other destinations.
- *Simulation:* The methodology needs to enable the analyst to simulate different vulnerability scenarios.
- *Generate rankings:* Composite indexes help to discriminate between destinations. Therefore the indexes need to generate rankings that can be analysed against market and destination characteristics.
- *Ease of interpretation:* The results should be simple and easy to interpret by tourist destination managers, assuming limited technical knowledge.

Taking into account all of the above requirements, a multi-criteria, double-point method was chosen to analyse the vulnerability of tourist destinations to air transport decisions. This method has been applied globally to measure sustainability (Cabello, Navarro, Prieto, Rodríguez, & Ruiz, 2014; Cabello, Navarro-Jurado, Rodríguez, Thiel-Ellul, & Ruiz, 2018) and in tourism it has been used to measure sustainable limits to growth in tourist destinations (Jurado et al., 2012). It is applied here for the first time to the analysis of tourism vulnerability.

3.3. Phase 3: normalisation

Normalisation is the process of developing a common unit to measure variables that were previously quantified through different units. This allows for the correct aggregation of indicators considered in the calculation of the composite index (OECD, 2008). Multi-criteria methods normalise by using the Reference Point Method, which measures the position of an indicator relative to a reference value (which can be a target value, the mean, an extreme value or other, as determined by the needs of the decision-maker). The procedure uses individual Achievement Functions (AFs), defined for each indicator, to measure how far apart the values of each unit of analysis are from those established as the reference points. The original reference point scheme can be generalised if a double reference point is used. In this study, two levels were established for each indicator: (a) a reservation level, defined as the maximum admissible value; and (b) an aspiration level, defined as the desirable value (Cabello et al., 2018; Ruiz et al., 2011).

A value of $AF < 0$ indicates that, for this indicator, the tourist destination takes a value above the *reservation level* establishedFigure 2. The latter is defined, in the present case, as the mean value between the average and the maximum values of the analysed destinations, while discarding the outliers, since atypical or extreme values (remote values of more than 1.5 or 3 lengths, respectively, of the 75th percentile box) can alter the reference values. A value of $AF < 0$ denotes a weakness that makes the destination more vulnerable. The more negative the value of the function, the greater the weakness of the destination with respect to the indicator being analysed. In contrast, a value of $AF > 0$ indicates that, for this indicator, the tourist destination takes a value between the reservation and aspiration level (AF between 0 and 1)Figure 2, where the established *aspiration level* is AF = 1. In the present case, the aspiration value has been defined as the mean value between the average and the minimum value of the analysed destinations (discarding the outliers). Therefore, a value of $AF > 0$ identifies strengths that make the destination less vulnerable. The more positive the value of the function, the less vulnerable the destination is with respect to the aspect being analysed.

3.4. Phase 4: weighting

Weighting makes it possible to analyse the relative importance of the various indicators in order to construct the composite index (Freudenberg, 2003; OECD, 2008). In the present case, the Equal Weight method has been chosen; given the novelty of this approach in studying the vulnerability analysis of tourist destinations, the causal relationships of the analysed system are unknown, i.e. without previous experience or consensus about what factors make tourist destinations more or less vulnerable. Equal weighting means attributing the same value to each of the indicators, which is as much of a subjective choice as having given different values to indicators based on expert opinion or other reasons (Mikulić, Kožić, & Krešić, 2015), as has been done in other sustainable tourism composite indicators (Blancas, Caballero, González, Lozano-Oyola, & Pérez, 2010; Castellani & Sala, 2012; Torres-Delgado & Palomeque, 2018; Twining-Ward & Butler, 2002). However, it is likely that not all variables affect the vulnerability of a destination to the same extent. This is one of the main challenges already identified in the literature, and it has been hinted as an important line of future research by many of the authors mentioned above.

3.5. Phase 5: aggregation

To aggregate indicators, AFs are calculated for each indicator, and then grouped into three stages: (a) the indicators are grouped according to their different characteristics (markets, seasonality, commercialisation and accessibility) as established in Phase 1: Conceptual Framework; (b) these characteristics are aggregated into a global index; and (c) the weight variable is added (V1) to the composite index of vulnerability, as shown in Fig. 3.

The strength of composite indexes depends on the degree of compensation between the different constituent indicators (Díaz-Balteiro & Romero, 2004; Ruiz et al., 2011). A composite index that allows for compensation between the different indicators is considered to be *weak*, while a composite index that takes into account the worst indicator in each case is considered to be *strong*. Both indexes show the extreme situations, from the least demanding where everything compensates, to the most demanding where there is no compensation and the worst possible data prevails. The multicriteria methodology developed in this paper also allows the analyst to construct composite indexes that can partially compensate i.e. *mixed* indexes.

Mixed index = λ x weak index + (1-λ) x strong index

Where $\lambda \in [0,1]$ is the coefficient of compensation.

The higher λ, the greater will be the compensation allowed and the more similarity there will be between the mixed and the weak index, which are equal when $\lambda = 1$; whereas in the alternative case, $\lambda = 0$, the mixed index equals the strong index.

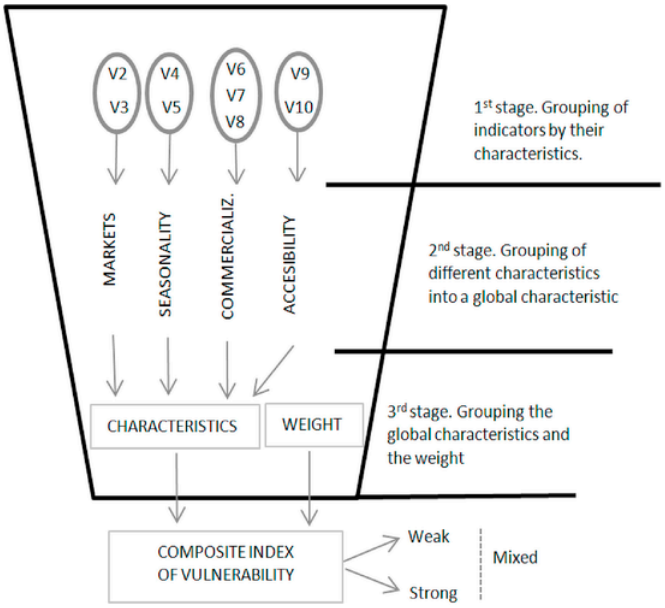

Fig. 3. Aggregation procedure.Source: Authors

3.6. Phase 6: robustness and sensitivity

This phase verifies the reliability of the simple and composite indexes obtained. The robustness and sensitivity of the composite index were tested through the empirical evidence shown in the results section, by testing whether the system is able to adequately reflect specific changes occurring to these destinations. However, it is necessary to first test whether the simple indicators that make up a composite index are in themselves robust and sensitive, which is done below.

A review of the conditions that are required for an indicator can be found in EUROSTAT (2017); OECD (1993); Pannell and Glenn (2000); Pintér, Hardi, Martinuzzi, and Hall (2018). The conditions can be categorised as two types: (a) *theoretical properties,* which speak about the ability of the indicator to explain vulnerability; these refer to the mathematical calculation of the indicator and its statistical properties; and (b) *practical properties,* which refer to the effort required to obtain the indicator and its subsequent degree of usability. In this case, the indicators included in the system meet the 11 desirable properties (see Table 3), except indicator V1, which is not considered *robust* since the original sources do not offer global data on the weight of air travel in relation to the overall transport methods used by tourists to reach the given tourist destination, hence a weighted estimate per market has been calculated.

3.7. Phase 7: visualisation of results

This phase focuses on the communication strategy for the indicators. A fundamental premise of the indicators, and composite indexes, should be their easy communication and interpretation by any user. A technique was therefore chosen that facilitates the rapid and accurate visualisation of these indicators. The visual design should provide clear signals that alert and expose extraordinary situations and that identify possible areas of intervention (Schuschny & Soto, 2009).

4. Results

This section exemplifies the potential benefits of the methodology described above. Catalonia is one of the main world tourist destinations, with 19 million foreign tourists in 2017 that generated a total expenditure of 19,224 million euros (INE, 2018). Most of the

Table 3
Desirable properties of simple indicators.

PROPERTIES		DEFINITION	% indicators
THEORETICAL PROPERTIES	Robust	Reliable and statistically validated, based on internationally established criteria.	90%
	Relevant	Directly measures the desired objective.	100%
	Normative	Easy-to-interpret; consensus on the meaning of change in the results.	100%
	Clear	Easily understood and unequivocal title and definition.	100%
	Reliable	The statistical source of the indicator is publicly available.	100%
	Measurable	The unit of measurement is appropriate and easily interpreted.	100%
PRACTICAL PROPERTIES	Feasible	The property can be designed based on currently available data, to the extent that this is possible. The measurement should not be unnecessarily onerous.	100%
	Cost effective	The cost of data collection to elaborate the indicator needs to be reasonable.	100%
	Continuous	Data can be collected regularly, at least annually.	100%
	Comparable	Data allows for comparisons between destinations by having the same method of calculation and interpretation.	100%

Table 3 (*Continued*)

PROPERTIES		DEFINITION	% indicators
	Goal-driven	A goal to quantify the achievement of a certain result can be established.	100%

Source: Authors

tourists came from Europe, in particular from France, the UK and Germany. Catalonia is a destination rich in natural and cultural resources, with a mature and relatively diversified sector including a total of 370,000 legally registered tourist beds (INE, 2018). Its appeal is largely based on its Mediterranean coastline and the city of Barcelona, with high summer seasonality. The tourist sector has grown steadily over the years until the point at which it now represents one of the main strategic sectors of the Catalan economy at around 12% of the region's total GDP. It also generates half a million jobs, which represents 13.2% of the active population.

Catalonia was selected as a case study to exemplify this methodology for a number of reasons. First, it is the most important international tourist destination in Spain. This fact is based on the 2017 Tourist Movement on Borders Survey (INE, 2018) that lists Catalonia as top among the three coastal Mediterranean regions (Catalonia, Andalusia and Valencia) and two island regions (the Balearics and the Canaries) that together accounted for over 80% of the international tourist arrivals in Spain in that year (see Table 4). Second, Catalonia was considered because of its importance with regards to air traffic. Amongst the four airports in Catalonia, Barcelona stands out as one of the key airports in Europe (EUROSTAT, 2018) and the main gateway to Catalonia, with 25.1 million passengers in 2017 (AENA, 2018). Since 2010, Catalonia has continuously increased its air traffic, with year on year growth of over 7.5% in 2016 and 2017. Third, it was considered interesting to analyse a region that has devolved policy competences for tourism (a feature typical in Spain, where most tourism policy is decentralised to regional level, see Turrion-Prats & Duro, 2017): hence, the stakeholders in Catalonia have the power to negotiate directly with the airline industry.

Table 4
Ranking of the largest Spanish tourist destinations for international tourism, 2017

Ranking		International tourists	Share (% total international tourists)
1	Catalonia	19,046,720	23.3%
2	Canary Islands	14,213,686	17.4%
3	Balearic Islands	13,790,968	16.9%
4	Andalusia	11,530,070	14.1%
5	Valencia	8,918,327	10.9%

Source: INE, 2018.

Analysis of Catalonia's air transport allowed the researchers to: (a) empirically contrast the methodology, (b) show the richness and breadth of analysis it allows, (c) offer an easy and intuitive visualisation of the results, and (d) provide data for decision making. The methodology outlined in Fig. 1, and discussed in the sections above, explains the process that would be used by a civil servant to create composite indexes and use them to determine the vulnerability index of a tourist destination. However, this results section describes the inverse of that process, namely, it shows the data as it would be presented to a policy decision-maker and identifies how they would move from that headline data to composite indexes and then work backwards to specific AFs and simple indicators, which would ultimately enable them to trace the origins of the composite index result.

In the first place, the global vulnerability of the destination is analysed through the mixed composite index. As already pointed out, this methodology allows an analyst to establish different degrees of exigency in the study of vulnerability through the compensation coefficient in the calculation of the mixed index. The most demanding situation would be obtained with a strong composite index, where there is no compensation ($\lambda = 0$) and the worst possible data prevails. The least demanding situation would be where everything compensates ($\lambda = 1$), which would coincide with a weak composite index.

Taking the intermediate case ($\lambda = 0.5$) as an example, it can be seen that since 2009 Catalonia has become more vulnerable to air transport, intensifying in the 2015-17 period, during which the composite index is already negative (see Fig. 4). To better understand the causes, the composite index is analysed from the two extreme perspectives allowed by this methodology, those of weak and strong vulnerability. For a better interpretation of the results, the vulnerability matrix is defined, where the X axis shows the values of the weak index and the Y axis shows those of the strong index, as shown in Fig. 5. Three scenarios are possible. First, a safe scenario occurs when both the weak and strong indexes are positive, as this implies that the destination under analysis does not present any indicator with a value higher than its

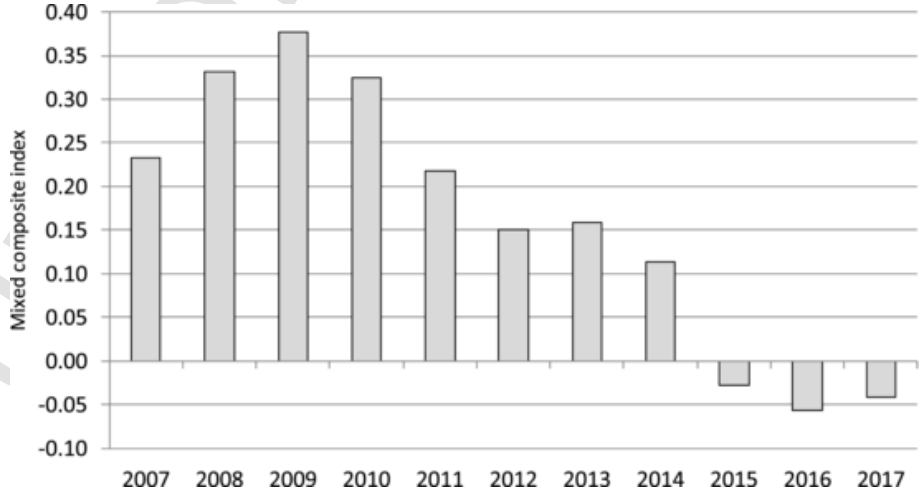

Fig. 4. Evolution of the mixed composite index of vulnerability (compensation coefficient $\lambda = 0.5$); Catalonia 2007–2017Source: Authors

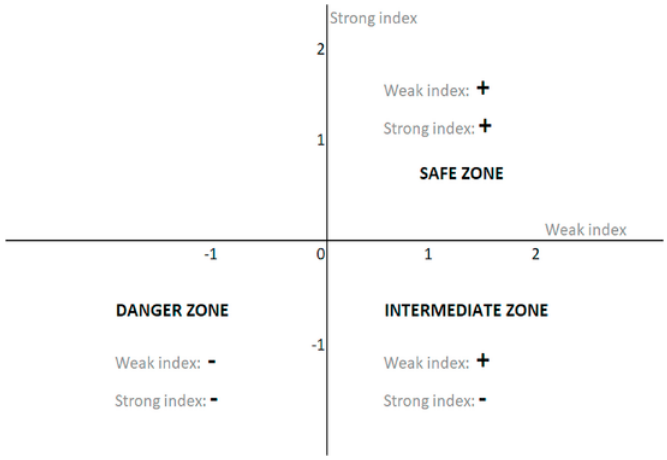

Fig. 5. Combination of weak and strong composite indexes - possible scenarios.Source: Authors

reserve level. Second, a dangerous scenario occurs when both indexes are negative; in this case the destination does not compensate for its negative indicators and it has at least one individual indicator with a value higher than its reserve level. Third, an intermediate scenario occurs when both indexes are of an opposite sign. A destination can have a strong negative index, compensated by other positive indexes, which results, overall, in a weak index but with a positive result. However, by the very definition of the strong index, a fourth quadrant cannot occur, since a weak negative index means that there is at least one negative simple indicator, and as a result the strong indicator would also reflect that negative simple value.

Catalonia is in the bottom right hand side of Fig. 5, i.e. in the intermediate zone. The paper now delves deeper to study how the position within this quadrant has changed over time. In the intermediate situation, a destination is in a safe situation when both the weak and strong composite indexes have higher values, which would mean being located at the top right-hand side of Fig. 6. This shows that Catalonia is located in the intermediate quadrant during the entire period 2007–2017. The performance improved from 2007 to 2009, after which an increasingly strong negative index considerably reduced the compensation of the rest of the indicators resulting in a decreasing weak index.

The data from Catalonia can now be contextualised in relation to the main coastal tourist destinations in Spain (see Table 4). Catalonia shows a significant change between data in 2017 (see Fig. 7) and data in the year in which Catalonia was the least vulnerable in air transport terms i.e. 2009 (see Fig. 8).

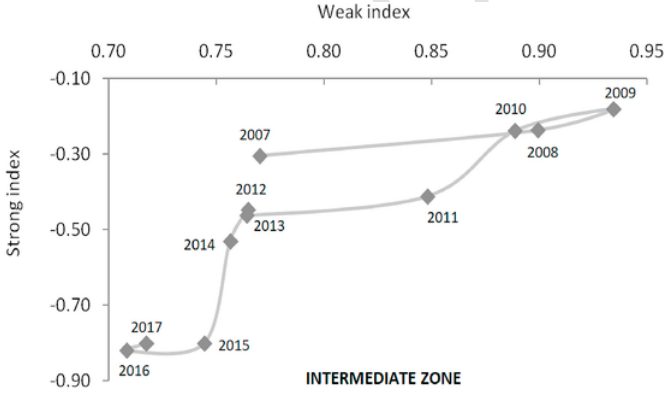

Fig. 6. Evolution of the weak and strong composite indexes; Catalonia, 2007–2017.Source: Authors

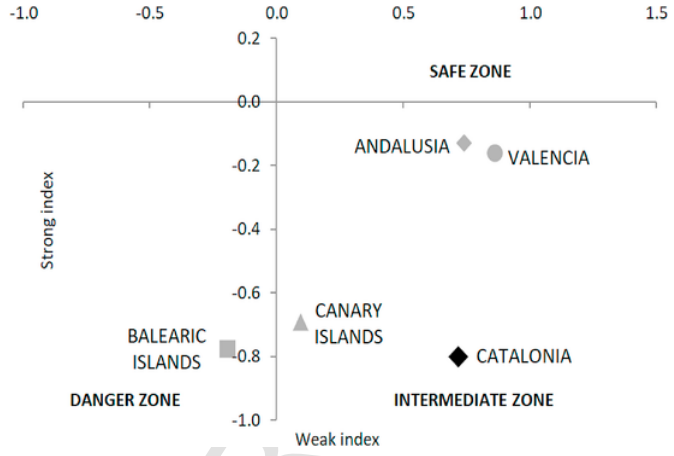

Fig. 7. Catalonia's position compared to the main coastal tourism regions in Spain, 2017.Source: Authors

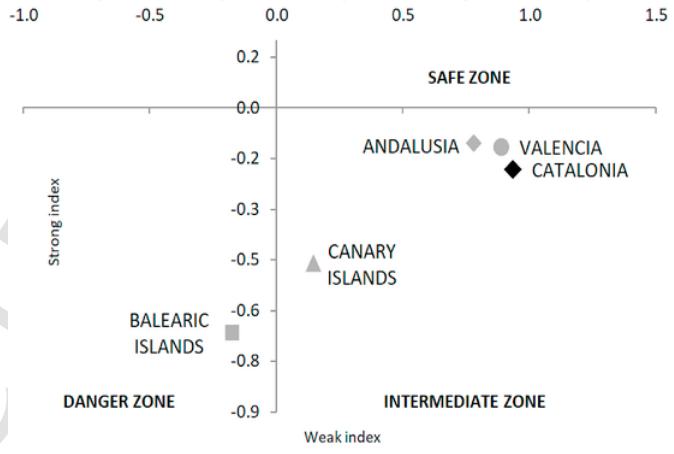

Fig. 8. Catalonia's position compared to the main coastal tourism regions in Spain, 2009.Source: Authors

A comparison between 2009 and 2017 data shows that Catalonia is the region that has most changed its position in the vulnerability matrix. The best situation within the intermediate zone is on the upper right, as this would indicate a better compensation between indicators (weak index) and a low negative indicator (strong index). In 2009, Andalusia, Valencia and Catalonia are in the "best area" of the quadrant, while in 2017 only Catalonia moves away considerably from this position, mainly due to the worsening of its strong indicator, as shown in Figs. 7 and 8. This change is significant enough to indicate a significant loss of vulnerability of Catalonia against Andalusia and Valencia. Catalonia has moved from a more favourable position together with Andalusia and Valencia in 2009, to a less favourable one closer to the Canary Islands and the Balearic Islands in 2017 (island destinations are always more vulnerable due to their high dependency on air transport).

To understand the reasons for this change, it is necessary to delve deeper and analyse the values of AFs. As noted earlier, negative values are identified with weaknesses that make the destination more vulnerable, while positive values are identified with strengths. Moreover, the more positive the value, the greater the strength with respect to whichever indicator is being measured. Although Catalonia presents a small number of weaknesses throughout the period analysed ($AF < 0$) (see Table 5), there is one particular weakness that stands out due to its consistently strong indicator, namely the concentration of access to Catalonia via the airport of Barcelona (indicator V10). The analysis shows that this weakness has intensified since the opening of

Table 5
Strong and weak indexes - individual Achievement Functions (AFs); Catalonia 2007–2017.

AIRLINE INDUSTRY		INDICATOR	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
WEIGHT	V1	Importance of air transport to the tourist destination		1.149	1.140	1.115	1.031	0.976	0.979	1.015	1.051	0.987	0.994
MARKETS	V2	Level of concentration of tourist markets using air transport	1.043	1.056	1.057	1.063	1.065	1.067	1.151	1.157	1.164	1.160	1.164
	V3	Key market (using air transport)	0.401	0.976	0.968	0.654	0.891	1.034	1.066	1.067	1.074	1.060	1.073
SEASONALITY	V4	Seasonal concentration of airport activity	0.246	0.335	0.280	0.270	0.293	0.099	0.103	0.080	0.111	0.205	0.140
	V5	Key month for airport activity	0.171	0.510	1.016	1.021	1.024	1.019	1.016	1.008	1.014	1.023	1.019
COMMERCIALISATION	V6	Level of airline concentration	0.064	0.837	1.009	1.014	1.015	1.011	0.9726	0.798	0.621	0.475	0.621
	V7	Key airline	0.293	0.713	0.480	0.527	0.788	0.095	-0.045	-0.071	-0.078	-0.073	-0.070
	V8	Type of airline (lost cost versus flag carrier)	0.935	1.093	1.092	1.089	1.092	0.694	0.575	0.447	0.368	0.332	0.342
ACCESSIBILITY	V9	Level of airport concentration	0.613	0.795	0.968	0.779	0.525	0.468	0.516	0.423	0.335	0.323	0.340
	V10	Key airport	-0.305	-0.237	-0.181	-0.239	-0.412	-0.463	-0.447	-0.531	-0.800	-0.820	-0.801

AF >1	Strength. Value above the aspirational level.
1 < AF >0	Strength. Value between the reserve and aspirational level.
AF <0	Weakness. Value below the reserve value.

Source: Authors

Terminal T1 (in June 2009), as reflected in the increasingly negative values from −0.181 in 2009 to −0.801 in 2017.

In 2013, a new risk factor appeared for Catalonia, since the AF for indicator V7 (key airline) is negative (see Table 5). This is the result of the growth of Vueling airline at Barcelona airport, that disproportionately increased its share of the total number of passengers at the airport in volume and, as a result, its market share of the airline passengers reaching Catalonia. In 2016, Barcelona Tourist Board publicly expressed concern about the reputational risk to the city that could result from major delays and cancellations in Vueling flights during the summer of 2016 (El Pais, 2016). A greater range of airlines serving a destination or airport does always has a beneficial impact as to the range of routes and countries served, instead such benefits depend on the commercial policies of the airlines that serve the destination. The value of the system created in this research is its ability to provide an overview of the destination's vulnerability. In the case of Catalonia, the system warns of a worsening of vulnerability due to a greater dependence on Vueling. While the commercial policy of this company has not affected the destination in terms of the variety of source markets, managers must be attentive to future commercial decisions of Vueling since any change will affect the destination.

Catalonia is, however, performing well on other indicators. Its low dependence on any specific market stands out (V3 – key market using air transport), with an AF that ranges from +0.40 in 2007 to +1.07 in 2017 (see Table 5). Catalonia has managed to diversify its market portfolio to attract tourists from a range of countries (V2 - level of concentration of tourist markets using air transport), with an AF that ranges from +1.04 in 2007 to +1.16 in 2017 (see Table 5), such that Catalonia's Gini index is gradually moving towards 0, a value that would represent a totally uniform distribution.

The Catalan case clearly shows how a system of simple indicators and a composite index can be used as a dashboard to help manage the vulnerability of a tourist destination, in this case specifically in relation to air transport. The composite mixed indicator acts as a warning sign (see Fig. 4), through which the weak and strong composite indicators show the extreme scenarios that the tourist destination can find itself in, based on the exigence level adopted (see Figs. 6–8). The individual Achievement Functions (AFs) offer a quick diagnosis of the weak and strong points of the destination (see Table 5), while a more exhaustive analysis to identify the causes behind the destination's vulnerability is then possible through studying the simple indicators. In the analysis of airport activity in Catalonia, an excellent level of market diversification and low seasonality is found. And yet, every year, Catalonia is more vulnerable, due to the risks arising from its dependence on a single airport (Barcelona) that, in turn, has become increasingly dependent on a single airline (Vueling). Having access to such an alert system to forecast and manage vulnerability risks is essential for DMOs to make good strategic planning and management decisions.

5. Conclusions and management implications

This is a powerful methodology because it is able to provide valuable management data with a set of indicators based on official sources of publicly available data; as such, it ensures a rigorous methodological procedure and statistical representativeness. Maximising the use of public resources is cost effective, as no customised data needs to be collated, and provides a guarantee of data continuity. It would be easy to reproduce the vulnerability analysis developed in this paper in any other tourist destination. This paper also provides additional methodological support and the full Spanish data set in Data in Brief article [reference to be added after publication] to further familiarise civil servants and researchers with the methodology.

The composite indicator developed in this study can collect data from multiple vulnerability dimensions, and the modelling flexibility of the system makes it especially suited for decision making as destination managers can use different weightings, reference situations, degrees of compensation between indicators etc. The methodology lends itself to a wide variety of analyses in time and between destinations, such as: (a) to make diagnoses from each of the simple indicators and their comparisons; (b) to identify vulnerability strengths and weaknesses through the individual Achievement Functions (AFs) of destinations; (c) to analyse, for each destination, the weak (total compensation between indicators), strong (not offset) and mixed vulnerability (50% compensation); (d) to position destinations in the vulnerability matrix against their competitors; and (e) to rank destinations.

The study also makes a theoretical contribution in relation to the application of composite indexes (Blancas et al., 2010; Cabello et al., 2014, 2018; Jurado et al., 2012; Ruiz et al., 2011), by applying them to the measurement of vulnerability. To date, relatively little is known about how tourist destination authorities plan their engagement with businesses whose objectives are not always aligned

with their own. The present study outlines the characteristics that can help determine a destination's risk factors, namely: (a) high *dependence*, i.e. the power of one element over the rest, that determines its adaptability; and (b) high *concentration,* due to reliance on a few supply elements. Both these characteristics can undermine the sustainability and competitiveness of a destination, for example, if the elements that the destination depends on the most (market, season, airline or airport) are threatened. The study does not discuss the relative merits of destination specialisation or diversification. Nor does it discuss the usefulness of specific market positioning or the profit-earning capacity that such positioning may bring about for the destination. It is argued here that the different value propositions made by destination authorities need to take into account: (a) the potential risks that are implicit within those propositions; (b) how destination authorities may be able to manage the risks associated with sudden changes to suppliers or markets; and (c) how destination authorities can take informed decisions to address potential dependencies (Koo et al., 2016).

This study has a number of management implications with close parallels to the findings of Koo et al. (2016) in relation to the ability of destination authorities to use this methodology, in the present case for the purpose of air transport planning (Camilleri, 2018; Graham et al., 2008; Ivanova, 2017; Liasidou, 2013, 2017). It has aimed to develop a realistic and useful methodology, avoiding, on the one hand, excessively theoretical or utopian approaches that are difficult to implement and, on the other hand, excessively simple systems that do not reflect a reality as complex as tourism. Its flexible system provides an agile and practical tool that is adaptable to different realities and that can be used to simulate different decision-making scenarios.

For this study, it was imperative to offer easy-to-interpret results for the managers of the tourist destinations, who do not have to be experts in the subject in order to understand the findings (Schuschny & Soto, 2009). This has been achieved in a variety of ways. First, the use of only two bounded measurement units for the simple indicators (dependency: 0–100% and concentration: 0–1 Gini index) that can both be interpreted in the same way i.e. the lower the indicator, the better. Second, the system allows all the information to be synthesised into one index that offers a global vision of vulnerability, easily identifying its strengths ($AF > 1$) and weaknesses ($AF < 0$). Third, the system offers various visualisation techniques that can be selected, according to the target audiences, to show the results in a range of clear and precise ways (OECD, 2008). To do this, a colour scale (range of greys) and various graphics (such as the positioning matrix) are used to demonstrate, visually, the vulnerability situation of different competitor destinations.

This index system and the calculation of composite indexes enables politicians and civil servants to be more aware of the vulnerability of a tourist destination to strategic choices. Having an understanding of risk factors like these is invaluable for a destination because it allows stakeholders to know their current situation, to prepare contingency plans to address potential risks and, in addition, because it provides valuable information to support negotiations of contracts with airports and airlines with a view to maximising the competitiveness of the tourist destination. The system created alerts on situations of dependency or concentration not desired by the destination, which can create discomfort and dissatisfaction of the tourists who visit it. Thus, a higher concentration at a given time (indicator V4) and airport (indicator V9) would result in a worsening of the synthetic vulnerability indicator. This would alert managers about poor management in the accessibility area and consequently a "possible" reduction in tourist satisfaction, which could be tested in future studies.

The flexibility provided by the methodology lends itself to suggest recommendations for further research: (a) the ranking of destinations applying different degrees of compensation between indicators; (b) testing the methodology by modifying the reference levels (reservation and aspiration) according to the preferences of the decision-making centre (Ruiz et al., 2011) within a defined planning process; and (c) carrying out simulations by changing the different parameters. Also, it would be possible to improve knowledge of the causal relationships of the system with a view to establishing optimum weightings between single indicators, since there is no previous experience or consensus on what factors make a destination more or less vulnerable. The relevance of each indicator could be conducted with factor analysis, or expert focus groups, for example.

It would be possible to apply the same approach and methodology as this study to other aspects of tourist supply, such as how commercial decisions can affect the configuration and evolution of a destination and make it more or less vulnerable. For example, the aspect of hotel accommodation, as tourists who choose a particular type of accommodation offer a profile and differential expenditure habits that can affect a destination (Masiero, Nicolau, & Law, 2015; Nicolau & Más, 2005). Over time, as different components of the tourist offer are further analysed, it will be possible to develop a more complete model of the vulnerability of tourist destinations. The more complete the model becomes, the more likely that it will be possible to ask increasingly specific questions, such as whether or not a greater level of specialisation increases profitability at the expense of greater vulnerability. Finally, there are several limitations of this study that could be addressed with further research. Conceptually, it is clear that evidence-based policy is not a linear and immediate process i.e. that many intervening factors condition the ability of policy makers and civil servants to take strategic decisions and that indicators, at best, inform, rather than determine, policy (Lehtonen, Sébastien, & Bauler, 2016; Morse, 2018; Sanderson, 2002, 2006). Applied research is needed to understand better under which conditions this system can be used and which policy decisions it can inform. Methodologically, a strength of multi-criteria composite indexes is that they strive to be fit-for-purpose rather than optimal (Ruiz et al., 2011), yet this subjectivity can be seen as a weakness. Further research is needed to engage tourism destination authorities, to identify the values that they consider to be acceptable levels of aspiration and reservation, to understand what stakeholder consensus processes are used to reach these agreements, and to explore how this, ultimately, affects policy-making.

Contributions

Dr Inmaculada Gallego developed the methodology and results as part of her PhD thesis.

Prof Xavier Font contributed to the reworking of the PhD thesis into a journal article.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jdmm.2019.100382.

References

AENA (2018). Annual Spanish airport statistics report [Informes estadísticos anuales de los aeropuertos españoles]. Retrieved 3.09.19. from http://www.aena.es/csee/Satellite?pagename=Estadisticas/Home.

Atauri, J., De Lucio, J., & Castell, C. (2002). El papel de los indicadores en la gestión de los espacios naturales protegidos. *Indicadores ambientales. Situación actual y perspectivas*.

Barrett, S. D. (2004). The sustainability of the Ryanair model. International Journal of Transport Management, 2(2), 89–98.

Bieger, T., & Wittmer, A. (2006). Air transport and tourism: Perspectives and challenges for destinations, airlines and governments. Journal of Air Transport Management, 12(1), 40–46.

Blancas, F., Caballero, R., González, M., Lozano-Oyola, M., & Pérez, F. (2010). Goal programming synthetic indicators: An application for sustainable tourism in Andalusian coastal counties. Ecological Economics, 69(11), 2158–2172.

Blancas, F., Lozano-Oyola, M., González, M., Guerrero, F. M., & Caballero, R. (2011). How to use sustainability indicators for tourism planning: The case of rural tourism in Andalusia (Spain). The Science of the Total Environment, 412, 28–45.

Brouder, P., & Lundmark, L. (2011). Climate change in Northern Sweden: Intra-regional perceptions of vulnerability among winter-oriented tourism businesses. Journal of Sustainable Tourism, 19(8), 919–933.
Cabello, J., Navarro-Jurado, E., Rodríguez, B., Thiel-Ellul, D., & Ruiz, F. (2018). Dual weak–strong sustainability synthetic indicators using a double reference point scheme: The case of Andalucía, Spain. Operational Research, 1–26.
Cabello, J., Navarro, E., Prieto, F., Rodríguez, B., & Ruiz, F. (2014). Multicriteria development of synthetic indicators of the environmental profile of the Spanish regions. Ecological Indicators, 39, 10–23.
Calgaro, E., Lloyd, K., & Dominey-Howes, D. (2014). From vulnerability to transformation: A framework for assessing the vulnerability and resilience of tourism destinations. Journal of Sustainable Tourism, 22(3), 341–360.
Camilleri, M. (2018). Travel marketing, tourism economics and the airline product: An introduction to theory and practice. New York (NY): Springer.
Castellani, V., & Sala, S. (2012). Ecological footprint and life cycle assessment in the sustainability assessment of tourism activities. Ecological Indicators, 16, 135–147.
Castillo-Manzano, J. I., López-Valpuesta, L., & González-Laxe, F. (2011). The effects of the LCC boom on the urban tourism fabric: The viewpoint of tourism managers. Tourism Management, 32(5), 1085–1095.
Chevalier, S., Choiniere, R., Bernier, L., Sauvageau, Y., Masson, I., & Cadieux, E. (1992). User guide to 40 community health indicators. Ottawa: Community Health Division, Health and Welfare Canada.
Cochrane, J. (2010). The sphere of tourism resilience. Tourism Recreation Research, 35(2), 173–185.
Dobruszkes, F., & Van Hamme, G. (2011). The impact of the current economic crisis on the geography of air traffic volumes: An empirical analysis. Journal of Transport Geography, 19(6), 1387–1398.
Díaz-Balteiro, L., & Romero, C. (2004). In search of a natural systems sustainability index. Ecological Economics, 49(3), 401–405.
Efthymiou, M., & Papatheodorou, A. (2018). Evolving airline and airport business models. In Halpern, N., & Graham, A. (Eds.), The routledge companion to air transport management (pp. 120–136). London: Routledge.
El Pais (2016). Barcelona Tourism Board says that the Vueling crisis risks the city's image [Turismo de Barcelona dice que la crisis de Vueling pone en riesgo la imagen de la ciudad]. Retrieved 3.09.19. from: https://elpais.com/ccaa/2016/07/05/catalunya/1467729362_320865.html.
Esty, D. C., Levy, M., Srebotnjak, T., & De Sherbinin, A. (2005). Environmental sustainability index: Benchmarking national environmental stewardship. New Haven: Yale Center for Environmental Law & Policy.
European Commission. (2007). Guide to European Community legislation in the field of civil aviation. Brussels: European Commission.
EUROSTAT (2017). European statistics code of practice: Revised edition 2017. Retrieved 3.09.19. from: http://ec.europa.eu/eurostat/web/products-catalogues/-/KS-02-18-142.
EUROSTAT (2018). Air transport statistics. Retrieved 3.09.19. from http://ec.europa.eu/eurostat/statistics-explained/index.php/Air_transport_statistics.
Farmaki, A., & Papatheodorou, A. (2015). Stakeholder perceptions of the role of low-cost carriers in insular tourism destinations: The case of Cyprus. Tourism Planning & Development, 12(4), 412–432.
Forsyth, P. (2003). Low-cost carriers in Australia: Experiences and impacts. Journal of Air Transport Management, 9(5), 277–284.
Freudenberg, M. (2003). Composite indicators of country performance: A critical assessment. Report DSTI/IND(2003)5. Paris: OECD.
Füssel, H.-M. (2007). Vulnerability: A generally applicable conceptual framework for climate change research. Global Environmental Change, 17(2), 155–167.
Gastwirth, J. L. (1972). The estimation of the Lorenz curve and Gini index. The Review of Economics and Statistics, 306–316.
Gillen, D., & Lall, A. (2004). Competitive advantage of low-cost carriers: Some implications for airports. Journal of Air Transport Management, 10(1), 41–50.
Graham, A., Papatheodorou, A., & Forsyth, P. (Eds.). (2008). Aviation and tourism: Implications for leisure travel. Aldershot: Ashgate.
Halpern, N., & Graham, A. (Eds.). (2018). The Routledge companion to air transport management. London: Routledge.
Halpern, N., Graham, A., & Dennis, N. (2016). Low cost carriers and the changing fortunes of airports in the UK. Research in Transportation Business & Management, 21, 33–43.
Hinkel, J. (2011). "Indicators of vulnerability and adaptive capacity": Towards a clarification of the science–policy interface. Global Environmental Change, 21(1), 198–208.
INE. (2018). Border tourism statistics (Frontur) December 2017 and year 2017 [Notas de Prensa. Estadística de Movimientos Turísticos en Fronteras (FRONTUR) Diciembre 2017 y año 2017]. Press release. Retrieved 3.09.19. from: http://www.ine.es/daco/daco42/frontur/frontur1217.pdf.
Ivanova, M. G. (2017). Air transport–tourism nexus: A destination management perspective. Varna: Zangador.
Jurado, E. N., Tejada, M. T., García, F. A., González, J. C., Macías, R. C., Peña, J. D., … García, G. M. (2012). Carrying capacity assessment for tourist destinations: Methodology for the creation of synthetic indicators applied in a coastal area. Tourism Management, 33(6), 1337–1346.
Koo, T., Halpern, N., Papatheodorou, A., Graham, A., & Arvanitis, P. (2016). Air transport liberalisation and airport dependency: Developing a composite index. Journal of Transport Geography, 50, 83–93.
Krajnc, D., & Glavič, P. (2005). How to compare companies on relevant dimensions of sustainability. Ecological Economics, 55(4), 551–563.
Laurino, A., & Beria, P. (2014). Low-cost carriers and secondary airports: Three experiences from Italy. Journal of Destination Marketing & Management, 3(3), 180–191.
Lehtonen, M., Sébastien, L., & Bauler, T. (2016). The multiple roles of sustainability indicators in informational governance: Between intended use and unanticipated influence. Current Opinion in Environmental Sustainability, 18, 1–9.
Liasidou, S. (2013). Decision-making for tourism destinations: Airline strategy influences. Tourism Geographies, 15(3), 511–528.
Liasidou, S. (2017). Drafting a realistic tourism policy: The airlines' strategic influence. Tourism Review, 72(1), 28–44.
Masiero, L., Nicolau, J. L., & Law, R. (2015). A demand-driven analysis of tourist accommodation price: A quantile regression of room bookings. International Journal of Hospitality Management, 50, 1–8.
Mazzocchi, M., Hansstein, F., & Ragona, M. (2010). The 2010 volcanic ash cloud and its financial impact on the European airline industry. (Paper presented at the CESifo Forum).
Mikulić, J., Kožić, I., & Krešić, D. (2015). Weighting indicators of tourism sustainability: A critical note. Ecological Indicators, 48, 312–314.
Morse, S. (2018). Analysing the use of sustainability indicators. In Malito, D. V., Umbach, G., & Bhuta, N. (Eds.), The Palgrave handbook of indicators in global governance (pp. 431–448). New York, NY: Springer.
Nardo, M., Saisana, M., Saltelli, A., & Tarantola, S. (2005). Tools for composite indicators building. European Comission, Ispra, 15, 19–20.
Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., Hoffman, A., & Giovannini, E. (2005). Handbook on constructing composite indicators: Methodology and users guide. OECD statistics working paper 2005/3. Paris: OECD.
Nicolau, J. L., & Más, F. J. (2005). Heckit modelling of tourist expenditure: Evidence from Spain. International Journal of Service Industry Management, 16(3), 271–293.
OECD (1993). OECD core set of indicators for environmental performance reviews: A synthesis report. Paris: OECD.
OECD (2008). Handbook on constructing composite indicators: Methodology and user guide. Paris: OECD.
Pannell, D. J., & Glenn, N. A. (2000). A framework for the economic evaluation and selection of sustainability indicators in agriculture. Ecological Economics, 33(1), 135–149.
Paraskevas, A., & Altinay, L. (2013). Signal detection as the first line of defence in tourism crisis management. Tourism Management, 34, 158–171.
Pena, J. (1994). Regional social indicators [Los indicadores sociales regionales]. Madrid: Mundi-Prensa.
Pintér, L., Hardi, P., Martinuzzi, A., & Hall, J. (2018). Bellagio STAMP: Principles for sustainability assessment and measurement. In Bell, S., & Morse, S. (Eds.), Routledge handbook of sustainability indicators (pp. 51–71). London: Routledge.
Prideaux, B. (2000). The role of the transport system in destination development. Tourism Management, 21(1), 53–63.
Pulido, J. I., & Sánchez, M. (2009). Measuring tourism sustainability: Proposal for a composite index. Tourism Economics, 15(2), 277–296.
Reynolds-Feighan, A. (2001). Traffic distribution in low-cost and full-service carrier networks in the US air transportation market. Journal of Air Transport Management, 7(5), 265–275.
Ritchie, J. R. B., & Crouch, G. I. (2003). The competitive destination: A sustainable tourism perspective. Wallingford (Oxon): Cabi.

Ruiz, F., Cabello, J., & Luque, M. (2011). An application of reference point techniques to the calculation of synthetic sustainability indicators. Journal of the Operational Research Society, 62(1), 189–197.
Sanderson, I. (2002). Evaluation, policy learning and evidence-based policy making. Public Administration, 80(1), 1–22.
Sanderson, I. (2006). Complexity,'practical rationality'and evidence-based policy making. Policy & Politics, 34(1), 115–132.
Scheyvens, R., & Momsen, J. (2008). Tourism in small island states: From vulnerability to strengths. Journal of Sustainable Tourism, 16(5), 491–510.
Schuschny, A., & Soto, H. (2009). Guía metodológica: Diseño de indicadores compuestos de desarrollo sostenible [Methodological guide: Design of composite indicators of sustainable development. Retrieved 3.09.19. from: https://www.cepal.org/es/publicaciones/3661-guia-metodologica-diseno-indicadores-compuestos-desarrollo-sostenible.
Scott, D. (2011). Why sustainable tourism must address climate change. Journal of Sustainable Tourism, 19(1), 17–34.
Selden, R. W. (1990). Developing educational indicators: A state-national perspective. International Journal of Educational Research, 14(4), 383–393.
Sheffi, Y. (2005). The resilient enterprise: Overcoming vulnerability for competitive advantage. Cambridge, MA: MIT Press.
Stiglitz, J. E., Sen, A., & Fitoussi, J. P. (2009). Report by the commission on the measurement of economic performance and social progress. Retrieved 3.09.19. from: http://ec.europa.eu/eurostat/documents/118025/118123/Fitoussi+Commission+report.
Strickland-Munro, J. K., Allison, H. E., & Moore, S. A. (2010). Using resilience concepts to investigate the impacts of protected area tourism on communities. Annals of Tourism Research, 37(2), 499–519.
Tan, D. T., Koo, T. T., Duval, D. T., & Forsyth, P. J. (2017). A method for reducing information asymmetry in destination–airline relationships. Current Issues in Tourism, 20(8), 825–838.
Torres-Delgado, A., & Palomeque, F. L. (2014). Measuring sustainable tourism at the municipal level. Annals of Tourism Research, 49, 122–137.
Torres-Delgado, A., & Palomeque, F. L. (2018). The ISOST index: A tool for studying sustainable tourism. Journal of Destination Marketing & Management, 8, 281–289.
Turrion-Prats, J., & Duro, J. A. (2017). Tourist seasonality in Catalonia: The relevance of demand factors. Tourism Economics, 23(4), 846–853.
Twining-Ward, L., & Butler, R. (2002). Implementing STD on a small island: Development and use of sustainable tourism development indicators in Samoa. Journal of Sustainable Tourism, 10(5), 363–387.
UNWTO (2017). Tourism highlights. Retrieved 3.09.19. from: https://www.e-unwto.org/doi/pdf/10.18111/9789284419029.
Vera Rebollo, J. F., & Ivars Baidal, J. A. (2009). Spread of low-cost carriers: Tourism and regional policy effects in Spain. Regional Studies, 43(4), 559–570.
White, V., McCrum, G., Blackstock, K., & Scott, A. (2006). Indicators and sustainable tourism: Literature review. Aberdeen: The Macaulay Institute.

Biography

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