Scientific production on revenue management in tourism on Web of Science and SCOPUS

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Scientific production on revenue management in tourism in Web of Science and SCOPUS

This research constitutes a bibliometric and content study work about research on Revenue Management in Tourism included in the Web of Science and SCOPUS databases between 1989-2013 (25 years-period). The study analyses the evolution and trend, the origin of the scientific production (by countries, authors, universities and companies, and the collaboration between them), its dissemination (journals) and content (research methods and Revenue Management strategies). A total of 293 works centred on Revenue Management in Tourism (638 signatures) of 433 authors from 183 universities and 56 companies which have been published in 67 journals have been identified and classified by the authors of this research in accordance with the measurements analysed. The results confirm an annual growth rate of 15.9%. The research originates in countries of the 5 continents, 2% of authors sign 83% of the production and most of this production comes from Universities (83%). Collaboration between institutions is around 27% of the cases. 6 journals accumulate 48% of the research published. Models and/or simulations are the research methodologies most used (59%), and capacity management (43%) the main strategy studied. The findings will facilitate both the design of future research and the establishing of collaboration strategies between authors and/or institutions.

Keywords: Revenue Management, scientific production, bibliometric analysis, Web of Science, SCOPUS

Introduction

Revenue Management is a management philosophy which is the basis of all booking systems that currently operate and which airlines in the United States first applied at the end of the 1970s. Its aim is the maximisation of the firm's long-term profits, combining the management of the firm's resources, the demand and the prices. It enables adopting decisions beforehand and until the tourism service provision, based on data analysis, and often supported by management tools and software specifically developed with this purpose in mind.

From its origins, its implementation has been associated with the increase of revenues and/or profits (Smith, Leimkuhler, & Darrow, 1992; Kimes, 1999a; Kimes, Barrash, & Alexander, 1999) derived from the improvements which it provides in management in general and in the use of perishable resources in particular (Kasilingam, 1996; Elimam & Dodin, 2001; Kimes &Thompson, 2004; Pinder, 2005).

This is why it has spread in and from the tourism sector where it counts on successful implementation cases in a multitude of firms, such as Marriot International, Carlson Starwood, Hertz, and Royal Caribbean Cruise Line (Hanks, Cross, & Noland, 1992; Lieberman, 1992;

Smith *et al*., 1992; Geraghty & Johnson, 1997; Cross, Higbie, & Cross, 2009; 2009; Cross, Higbie, & Cross, 2011).

Its relevance has promoted the development of research which compiles works on Revenue Management centred mainly on the analysis of its content. Of these, McGill & van Ryzin (1999) concentrate on the advances and developments in airlines carried out before their publication. Baker & Collier (1999) show a comparison of the heuristic techniques applied in hotels. Chiang, Chen, & Xu (2007). Guadix-Martin, Onieva-Giménez, Cortés-Achedad, Muñuzuri-Sanz, & Quesada-Ibargüen (2011), Chávez-Miranda & Ruiz-Jiménez (2004), Chávez-Miranda (2005) and Domingo-Carrillo (2016) analyse the evolution of the application of *Revenue Management* in the services and tourism sector. Lastly, Ivanov & Zhechev (2012) focus on the advances in the hotel sector.

However, an important gap has been identified related with the study of the evolution and trends of completing research via the quantitative analysis of the scientific production. This is why in this work we carry out a bibliometric study which enables determining the evolution and identifying the trends and gaps in Revenue Management in the tourism sector in such a way that it boosts the development of future research.

We hence mean to contribute numerous benefits. According to Law, Leung &Cheung. (2012) and Saur-Amaral, Ferreira & Conde (2013), researchers can maximise publication and their impact and practitioners can better understand the expected evolution of the knowledge. Additionally, emerging areas of study can be identified (Dann, Nash, & Pearce, 1988). At the same time, this investigation will allow researchers to define strategies, plan research stays and ways of collaborating with other researchers and/or institutions, as well as selecting journals for submitting their works or from which to read up-to-date and relevant information. The importance of this investigation is not exclusively academic as it permits having examples of firms which actively participate in the scientific production.

Measurement of the scientific production on revenue management in tourism

In general terms, in this work we analyse the evolution in the production concerning Revenue Management in Tourism in the international context during a complete 25-year period (1989-2013). Specifically, coinciding with a bibliometric research profile, we study **the evolution and trend in Revenue Management research** [Objective 1, O1], the **origin and evolution** of the scientific production (**by countries** [O2], **authors** [O3], **institutions** – including both, universities and companies- [O4] and the **collaboration** [O5] -between authors, universities or companies- the dissemination of production by **journals** [O6], and the classification and content analysis of papers based on the **research methods** applied [O7] and the **Revenue Management strategies** used [O8]).

With this purpose (Objective 1, and from O3 to O6), we have followed the indications of classic bibliometric authors (Lotka, 1926; Bradford, 1934; Price, 1978) and other references that have been cited in the following section. Likewise, we have used maps to represent the evolution of the discipline by countries (Objective 2) to determine the extension and dispersion of Revenue Management.

The analysis is completed with the study of the **research methodology (M)-** a section frequently incorporated into bibliometric studies (Objective 7). From the contributions of Dann *et al*. (1988), Chon, Evans, & Sutherlin (1989), Reid & Andereck (1989), Crawford-Welch &

McCleary (1992) and Baloglu & Assante (1999), we identify 6 categories (non-exclusive) which will enable us to classify the articles: theoretical works [M1], literature reviews [M2], models and/or simulations [M3] and empirical [M4], among which are considered those that are qualitative [M5] and those based on surveys [M6].

For the classification of works according to their content, we use **Revenue Management strategies (RM-S)** -Objective 8. These are the main dimensions into which we can divide the subject both for its study and development and for its practical application.

To identify the different categories (7 in total), we carry out a review of the bibliography focused on previous research that has proposed a classification of Revenue Management dimensions. This allows us to notice how this has expanded in response to the very evolution of the discipline. Hence, we find that Weatherford & Bodily (1992) consider *overbooking* [RM-S1] (in spite of the concept being developed at the end of the 60s) and *pricing* [RM-S2] as an integral part of the subject of Revenue Management. Later, McGill & van Ryzin (1999) incorporate *forecasting* [RM-S3] and *seat inventory control*. Baker & Collier (1999) broadened the previous concept to that of *allocation* and introduce *dynamic pricing*. For their part, Talluri & van Ryzin (2005) extended the concept of *inventory control* to that of *capacity management* [RM-S4]. Chiang *et al.* (2007), setting out from the strategies of Baker & Collier (1999). They proposed the separation between *pricing* and *auctions* [RM-S5] by requiring from the latter specific techniques for its development that considered the active participation of the users and the suppliers in the price determining process. Lastly, Ivanov & Zhechev (2012) added *channel management* [RM-S6] and *segmentation* [RM-S7], thus completing the list of *Revenue Management strategies.*

Method

This work is to be seen among those which review the scientific production via bibliometric analysis to show the activity developed concerning specific research questions (Yoo, Lee, & Bai, 2011; Law, Leung, Au, & Lee, 2013; Xing, Li, Bi, Wilamowska-Korsak, & Zhang, 2013; Chang & Katrichis, 2016).

To compile the works to be analysed we did searches in the *Web of Science* and *SCOPUS* databases, selected for their great number of corroborated quality journals, which include more than 9,000 and 20,000, respectively. 1989 was set as the beginning of the study period, as this was the year in which the work of Kimes (1989) was published, which is considered pioneering concerning Revenue Management.

Databases have traditionally been used in bibliometric studies in the tourism sector. McKercher (2008) used *Google Scholar* and *Publish and Perish*, with the aim of locating the most influential authors in Tourism in general. Hall (2011) extracted information from Web of Science, Scopus and Google Scholar to analyse the suitability of the criteria used by the institutions to evaluate the scientific results of their members. Lastly, Cheng, Li, Petrick, & O'Leary. (2011) employed the databases *Hospitality and Tourism Index* (EBSCO) to select a list of journals to explore knowledge in Tourism, setting out from the trend marked by the articles published.

We have centred exclusively on the study of the articles published in journals, in accordance with other bibliometric studies (Sheldon, 1991; Jogaratnam, Chon, McCleary,

Mena, & Yoo, 2005; Law *et al.*, 2012). We have excluded books, communications presented in congresses and other documents.

To carry out the searches we used the expressions "*Revenue Management*" and "*Yield Management*" (term used originally) in the *topic* or in the title of the article. Corresponding to the study field, we selected the *categories* in *Web of Science*, or else *subject area* in *SCOPUS* as well as the period of time previously defined, as is shown in Table 1.

Table 1. Summary of methodology applied to select papers from Web of Science and SCOPUS.

Web of Science			
Topic: Revenue Management OR Title: "Revenue Management" 1989-2013 Social Sciences Citation Index (SSCI) All languages Results: 1291 references	Type of document: Papers Categories: Management OR Operations research management science OR Business OR Hospitality leisure sport tourism OR Business finance OR Computer science hardware architecture OR Computer science interdisciplinary applications OR Computer science software engineering OR Computer science information systems OR Computer science theory methods OR Computer science artificial intelligence	154 selected papers	293 selected papers
Topic: Yield Management OR Title: "Yield Management" 1989-2013 Social Sciences Citation Index (SSCI) All languages Results: 1306 references		105 selected papers	
SCOPUS			
Title-Abstract-Keywords: "Revenue Management" 1989-2013 Results: 738 references	Type of document: Papers Subject area: Business management and accounting OR Decision Sciences OR Computer science OR Economics, Econometrics and Finance OR Social sciences	225 selected papers	
Title-Abstract-Keywords: "Yield Management" 1989-2013 Results: 202 references		70 selected papers	

In the first search we obtained 3,537 references that have been imported to Ms Excel. After excluding the articles which did not deal specifically with Revenue Management or that were not centred on tourism, there were 554 articles specifically about Revenue Management in Tourism. Lastly, after eliminating articles that appear more than once we obtained a sample of 293 articles (53% of those initially obtained). A similar process to that applied by Domingo-Carrillo, Chávez-Miranda and Cubiles-de la Vega (2017) has been followed. The dataset also required a step-by-step revision in detail to homogenise the data in order to obtain a dataset prepared for statistical exploitation. For instance, the same author, university or other values appear with different names, for some papers additional information has been required, typing in the information (because it appears as an image), etc. All the process has been done manually by the authors.

Next, to classify belonging to the tourist sector (Chávez-Miranda & Ruiz-Jimenez, 2006), we considered as a reference the List of Characteristic Activities of Tourism (*World Tourism Organization*, 2010). The three authors carried out this process separately and, later, pooled their classification. When necessary, we again revised the work as many times as was needed until a consensus was reached regarding the category(ies) into which it was classified. Before their classification we completed the blank fields of all the references selected and the full text was located to be able to appropriately analyse its content.

After that, we began the classification of articles according to the research methods used in the work and the Revenue Management strategies addressed. This process was also carried out separately by the three researchers, who pooled their results before the definitive classification following a process similar to those describe before.

As to the data processing, in each section we have applied a specific analysis method, based on classic bibliometric studies. In general terms we obtain counts and percentages of the totals which are determined with respect to two values: [1] the published works (N=293) and/or [2] the total of signatures (N=638). This latter lets us consider the multiple participation in the development of the same work. In this way we mean to more thoroughly reflect the state of development of the matter by expanding the number of authors to the total signatures instead of limiting it to the first of them.

Before the data exploitation, the dataset prepared with the Ms Excel (version 2016) format was also exported to IBM SPSS Statistics (version 24). The latter, in general, was used to count values and to obtain descriptive values. Ms Excel was employed to obtain the Figures, Tables and functions included in this paper, except for Figure 6 that has been adapted using Ms Power Point (version 2016). The world map (Figure 2) has been constructed with ArcGIS 10.6.

Regarding the results that respond to Objective 1, to obtain the exponential **trend** line, the prediction model and the degree of fit from the data observed (see results in Figure 1), we applied the ordinary least squares method, obtaining a value similar to other studies (Richard Ramón, Martínez Blasco, & García Blandón, 2011). The result obtained was compared with the postulates of Price (1978) to identify the discipline's stage of development. This was completed with the analysis of obsolescence, applying Price's index, calculated as a percentage of references which are less than 5 years old. In the calculation we used counts of works.

Objective 2 has required the study of the concentration and dispersion of the scientific production by **countries** per year is carried out from the geographic representation in maps of the universities that all the authors who sign the paper belong to (see Figure 2).

Next, to complete Objective 3, we analyse the productivity of **authors** using Lotka's law (1926) and, for the study of its distribution, Bradford's (1934) areas (see Figure 3). For the more prolific authors we also referred to indicators of production, such as the number of works per author and their temporal evolution (included in Table 2). In this case, the reference variable for the counts was the signatures.

For Objective 4, focus on **institutions** from authors, either universities and/or firms, we carried out counts and percentages by categories which also considered the signatures (this is shown in Figure 4). The collaboration between them (Objective 5) was evaluated via the collaboration index between authors calculated as the ratio between the number of signatures and the number of articles for each year of study, and the total of the period analysed (Figure 5). This was completed, along with the text, with the identification of the centres which had the highest value and the exploration of the possible causes.

For the classification of **journals** according to their productivity (Objective 6), we carried out a grouping by quartiles, depending on the number of works published for each of them in accordance with Bradford's (1934) dispersion law of scientific bibliography (Figure 6).

As to the categories used for the classification of works in accordance with the **research method** (Objective 7, and the results in Figure 7) and the **Revenue Management strategies**

used (Objective 8, Figure 8), these have been extracted from previous studies, referred to in the previous section. We used the count of works in which they are observed, there being the possibility of a selection of various categories for the same work.

Additionally, we have carried out a broad work of thoroughly revising the papers in order to identify and compare the contributions of the authors and their coinciding concerning the Revenue Management strategies. We have prioritised the coincidence in topics dealt with by various authors. As far as possible, the exposition of ideas is carried out in ascending chronological order. The discussion is exposed in the most synthesised manner for the benefit of researchers, in particular, or readers, in general.

Results and discussion

Evolution and trend in Revenue Management research [Objective 1]

Revenue Management is a consolidated discipline and shows a rhythm of growth and evolution typical of a stage of growth. This statement, and consequently Objective 1, is supported by the exponential **trend** line, the prediction

n model and the degree of fit obtained (Figure 1). The results clearly show a beginning of slow growth typical of the dissemination of a new discipline, followed by a more than proportional increase in the number of publications as time goes by. The degree of fit (0.79) is close to the values obtained in similar studies (Richard Ramón *et al.*, 2011). The model obtained confirms the discipline's exponential growth and shows its coincidence with the profile of scientific evolution postulated by Price (1978). This fact allows cataloguing it as a research area whose initial stage has already passed and that, as has been proven, still does not have the linear growth characteristic of mature stages or close to levels of maturity. Indeed, it obtains an annual growth rate of 15.9%.

Figure 1. Evolution and exponential trend of the works on Revenue Management in the tourism sector.

The chart shows a scatter plot with the equation $y = 2E\text{-}123e^{0.1422x}$ and $R^2 = 0.7887$.
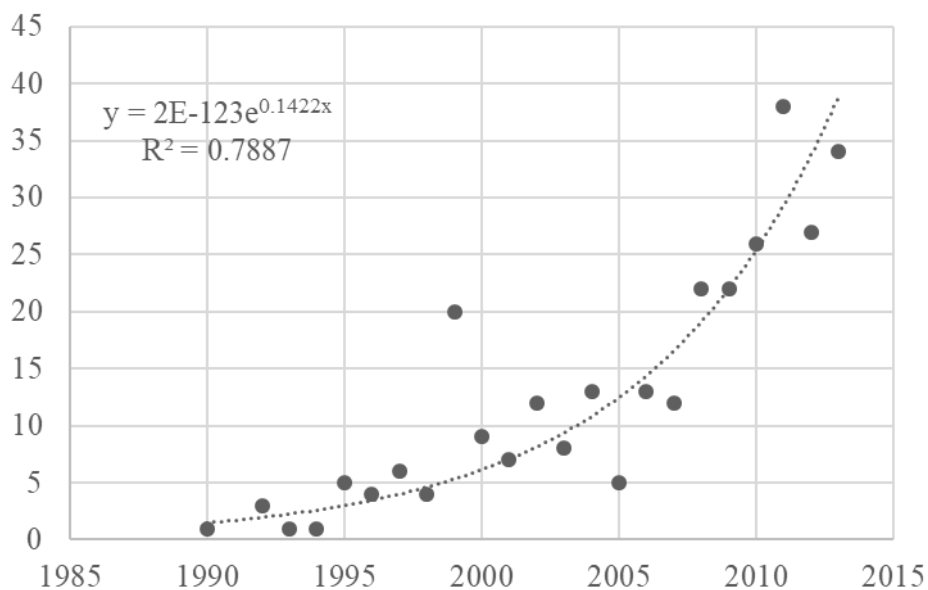
It is checked that its intensification coincides with the period of economic crisis - 2008 and is maintained afterwards. This circumstance could be explained by firms perceiving Revenue Management as a useful manner to improve efficiency in the use of resources, an even more important aim in times of economic crisis.

Likewise, the validity and timeliness of Revenue Management in Tourism is noted. Considering the average of observations, the set can be divided into two periods of equal production, 1999-2008 and 2009-2013, in such a way that the papers published on the first 10 years is duplicated in the following 5.

We wish to clarify that the atypical value obtained in 1999 (see Figure 1) is due, on the one hand, to the publication of seven articles in a special number of the journal *Transportation Science,* dedicated to what was then known as Yield Management and, on the other hand, to the rare coincidence of the publication of various works on Revenue Management (four in total) in the same number of *The Journal of the Operational Research Society*.

Origin and evolution of the scientific production by countries [Objective 2]

Taking the international context as a reference, it is noted that the publication of works on Revenue Management dedicated to the tourism sector originates in **countries** of the five continents, both those developed and those marginally emerging. This geographic dispersion of the research supports the strength of this subject (Figure 2). That said, its distribution is not homogenous, the concentration of the production in North America standing out, especially in centres located on the east coast. This is followed by Europe and, with results increasingly closer, Asia which is notable for its strong growth in recent years. Africa and Oceania, where the contributions remain scant, are at the opposite extreme.

Figure 2. Map of signatures per year and location of the origin of the scientific production on Revenue Management in Tourism.
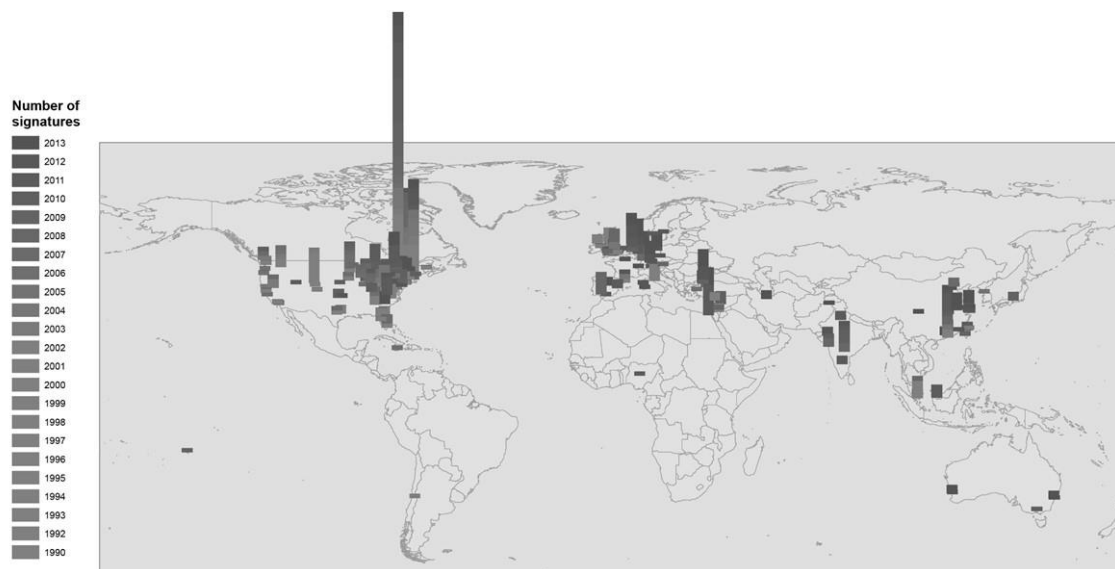
The USA is positioned at the top of the ranking, having 12.5% of the signatures. It is followed by China, whose production has been increasing in recent times, which reaches 3.4%. The third and the fourth positions go to the United Kingdom (3%) and Canada (2.1%), respectively. Fifth is Germany (1.5%). Then, Australia and India share the sixth place (1.1%) and Spain comes after (0.9%), completing the group of countries with more than 4 signatures.

It is noted that the countries which publish most hold, as was to be expected, a privileged situation in the classification of the *World Tourism Organization* (2014). This fact enables an increase in the future to be foreseen, given that there are many researchers who are working in the Revenue Management domain.

Scientific production by authors [Objective 3]

The 293 articles on Revenue Management in Tourism analysed have been done by 433 different authors. This means a total of 638 signatures, so we may state that in general not many repetitions take place. This fact can be explained by its being a relatively new subject matter, in which the production is supported by a small group of consolidated authors, researchers who are beginning their scientific production and occasional investigators - who constitute a minority.

This behaviour is consistent with Lotka's law (1926) which sustains that the majority of scientific works in an area correspond to a small number of very productive authors. In our case, it is noted that setting out from the number of authors with a signature (A1), the number of authors with two or more signatures can be predicted according to the following expression $An=A1/n2$ (Figure 3).

Figure 3. Distribution of authors according to the number of signed works on Revenue Management in Tourism.

$$y = 9.5212x^{-0.39}$$
$$R^2 = 0.8757$$
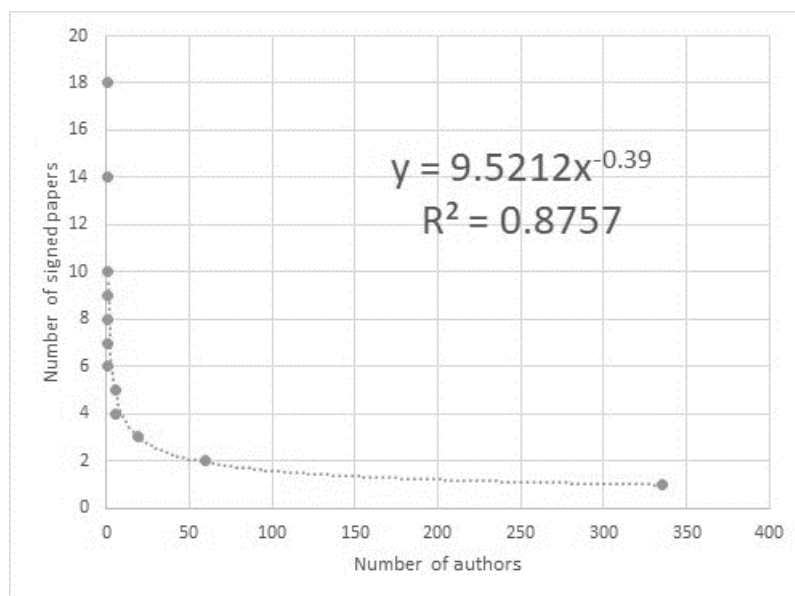
To analyse the distribution of authors according to their productivity, we use Bradford's (1934) areas as a reference. In our case a nucleus is obtained made up of 2% of the authors who sign 83% of the works. Therefore, we can catalogue them as prolific authors. The following group has 21% of the authors with an average production, given that they concentrate 16% of the signatures. Lastly, the most numerous group, and far from the centre, corresponds to 77% of the authors who only accumulate 1% of the total signatures. It is noteworthy that among the authors of the nucleus Kimes, Topaloglu, & van Ryzin are especially important as these three accumulate close to 60% of the signatures of this group.

Focusing on the authors who have published more than 6 works (Table 2), a great difference is seen in their publication trajectory. Kimes &Weatherford published from the

origins of Revenue Management until 2013 and 2003, respectively. Belobaba (1987) has maintained his production since the 80s, although his works are sporadic. Topaloglu & Kunnumkal have joined more recently (in 2008) and very intensely, especially the former, and van Ryzin joined in1997 and made contributions until 2008.

Table 2. Most prolific authors in Revenue Management.

Author	1992	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2007	2008	2009	2010	2011	2012	2013
Kimes, Sheryl E. (18)	1					1	3	1	3		1	2	1	1	1		2		1
Topaloglu, Huseyin (14)														2	3	4	2	3	
van Ryzin, Garrett (10)				1	1	1	1			1		2		3					
Belobaba, Peter P. (9)			1	1			2			1		1					1	1	1
Weatherford, Lawrence R. (8)	1		2	1	1				1	1	1								
Kunnumkal, Sumit (7)														2		3	1	1	

(*) The jumps are due to having omitted the years without production.

Scientific production by institutions (Universities and companies) [Objective 4]

As to the **institutions**, the majority participation of authors of the **university area** is determined (83%), as well as the growth in the participation of companies. We consider this question of great importance because the link with firms allows authors to, on the one hand, count on the information necessary to verify theories and, on the other hand, check the suitability and accuracy of the different techniques applicable or being developed. Additionally, this facilitates knowledge given that it is possible to develop research which is better adapted to business needs.

Specifically, a minimum of 1 and a maximum of 6 universities take part in the same work. Considering all the signatures (638) of the 293 articles analysed, we have identified 183 different universities, although not all of them contribute in the same way. To identify the most relevant we have taken into account the affiliation of all the authors who stand out with more than 9 signed works, Cornell University (USA, 61), Massachusetts Institute of Technology (USA, 23), Columbia University (USA, 22), The Hong Kong Polytechnic University (Hong Kong, 12), The Pennsylvania State University (USA, 12), Cairo University (Egypt, 11) and Georgia Institute of Technology (USA, 10). Together they concentrate 28.5% of the total.

The growing participation of authors from **companies** has been confirmed (Figure 4), up to 56 signatures are accounted for, among which stand out airline, hotel and software companies, tools of Revenue Management, of consulting and of leisure. In particular, we note Lufthansa (8), SABRE (6), Carlson Rezidor Hotel Group (5), Marriott International (5) and Revenue Analytics (5). Three of them have their headquarters in the USA, one in Germany (Lufthansa) and another in Belgium (Carlson Rezidor Hotel Group) which, unlike the others, is not in the first positions of our ranking by countries. In general terms, we can consider this fact as an indication of the boost in university research centres consolidated with investigations carried out with the participation of companies. Firms, for their part, seem to implicitly recognise the benefits that Revenue Management gives them and adopt an active role to continue advancing in its application, either responding to the proposal of investigations or else fostering their development. The count of signatures from Universities and from companies per year appear represented in Figure 4.

Figure 4. Evolution of the signatures per year belonging to universities and to companies.
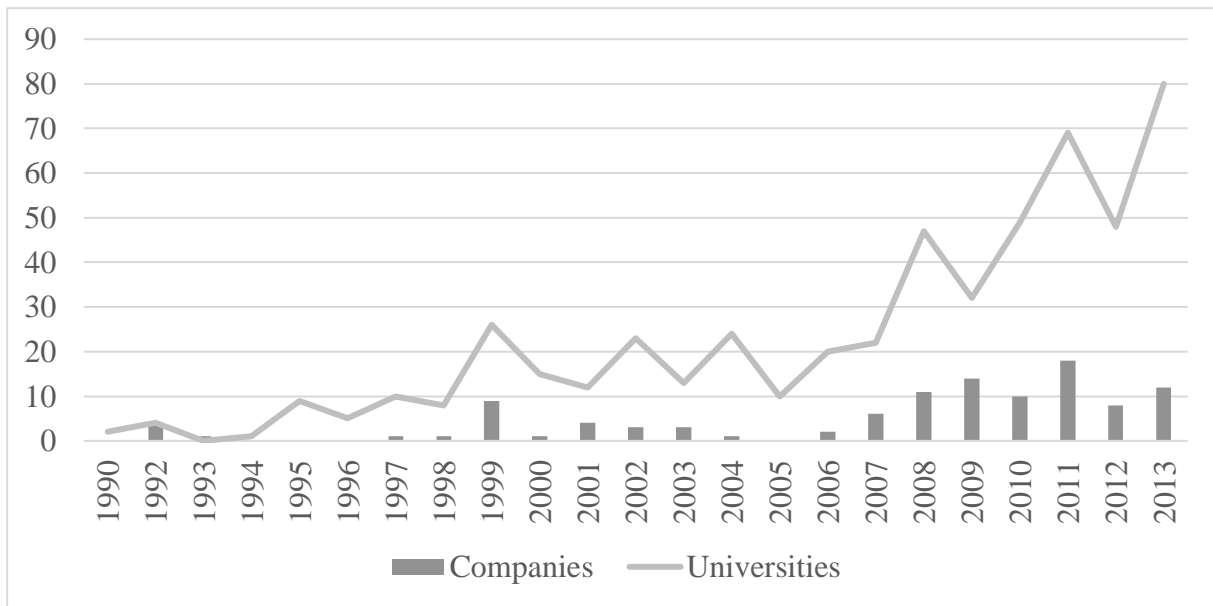
Collaboration between authors, universities and companies [Objective 5]

Likewise, collaboration helps to determine the scientific consolidation of a subject and facilitates the identification of the so-called invisible colleges (Crane, 1972). The index of **collaboration between authors** for the period analysed (ratio between the number of signatures and number of articles) is 2.18. As is seen in Figure 5, in recent years there has been a slow growth, attaining higher values, close to three, which allows us to foresee a stabilising at around two or three authors per work.

Figure 5. Evolution of the index of collaboration between authors.
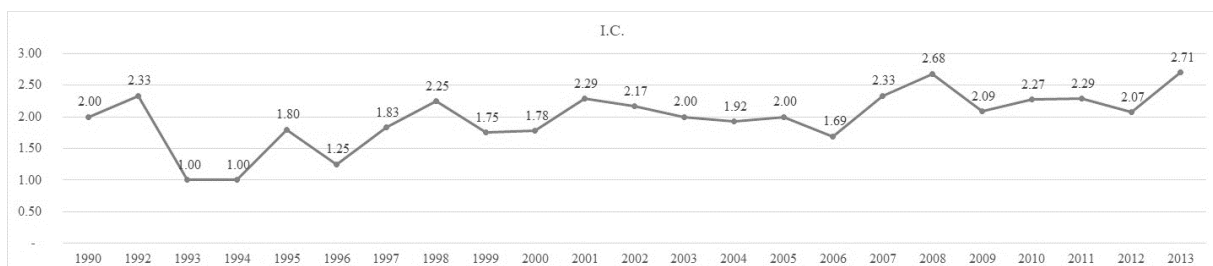
What is most usual is for the works to be signed by two authors (47.4%) which, along with those done by a sole author, accumulate 72%. If we broaden this to three, we reach 81.7%. The maximum number of signatures in the same work is 10.

As to the **collaboration between different institutions**, the data confirm that 51 universities out of a total of 183 (27.9%) do joint works. In the case of firms this is 15 out of 56 (26.8%), very similar proportions.

The most collaborative universities are Cornell University (8 works with other institutions), Columbia University (7) and Indian School of Business (7). The following universities of the list have a maximum of 4 works in collaboration.

Cornell University (USA) collaborates with 4 different firms (CBORD Solutions, 1999; Hospitality Division at Radiant Systems, 2001; Spa-The Americas for Mandarin Oriental Hotel Group, 2009; Walt Disney Parks and Resorts, 2013) and universities that are both in the USA

(University of Southern California-Marshall, 1998) and in other countries (Southern Taiwan University of Technology, and National Cheng Kung University, both from Taiwan, 2009; Sabanci University of Turkey, 2012; Shanghai University in China, 2012), the latter being more numerous. The production of Doctor Sheryl Kimes stands out, participating in the majority (63%).

The University of Columbia (USA) maintains a relatively constant relation of collaboration with New York University (2004, 2008; 2 works), one with the participation of the Tel Aviv University (Tel Aviv, Israel, 2008). It has collaborated once with Queens University (Kingston, Ontario, Canada, 2000). The co-production with firms is also noted, specifically with SABRE Holding Research Group and IBM's Watson Research Center (2009) and more frequently with Nomis Solutions (2004 and 2008). In this case, Doctors van Ryzin & Gallego stand out, having equally shared 86% of the production.

Lastly, our attention is called to the levels of collaboration of Indian School of Business (7), given that it does not figure in the first positions of the ranking of Universities. The data show the existence of a direct connection between the researchers of this University and Cornell University. There are indications, not verified, of links between both institutions, in general, or rather between their authors. This is because the collaboration is established between two authors, Kunnumkal & Topaloglu, who sign 100% of the works jointly, confirming a permanent relation (between 2008 and 2012), and in which Talluri (in 2012) of University Pompeu Fabra (Barcelona, Spain) occasionally participates.

The analysis of the results has also enabled us to identify the authors who have most fostered this collaboration between institutions: Kimes & Topaloglu (Cornell University), van Ryzin & Gallego (Columbia University) and Kunnumkal (Indian School of Business). Their research on Revenue Management in some cases crosses frontiers.

It is therefore accepted to underscore the work developed by the previously noted authors as great boosters in the development of research on Revenue Management. The existing links seem to respond more to the interest and drive of the participating authors than to the development of strategies between institutions.

As to European countries, it is surprising that no European university figures in spite of the important production of authors in countries such as Germany and the United Kingdom, each having 15 works. This may be explained by the high dispersion of works from these institutions.

Dissemination of production by journals [Objective 6]

The 293 published works have been disseminated through 67 different journals belonging to a varied number of knowledge areas and not exclusively to tourism. Figure 6 shows Bradford's (1934) areas of dispersion which, in our case, we have grouped into quartiles depending on the number of works published by each one of them, put into order from greater to lesser production.

Figure 6. Dispersion of the production by journals.
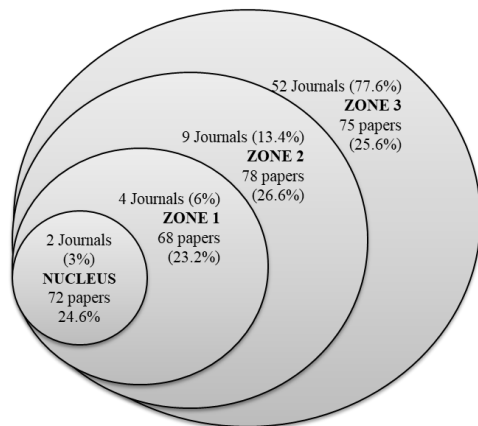
Nucleus: Journal of Revenue and Pricing Management (43 papers) and Cornell Hospitality Quarterly (29).

Zone 1: International Journal of Hospitality Management (18 papers); European Journal of Operational Research (17); Transportation Science (17) and International Journal of Revenue Management (16).

Zone 2: Operations Research (16 papers); Management Science (12); Journal of the Operational Research Society (10); Decision Sciences (7); International Journal of Production Economics (7); Transportation Research Part E-Logistics and Transportation Review (7); Interfaces (6); Production and Operations Management (6) and OMEGA-International Journal of Management Science (4).

Zone 3: International Journal of Contemporary Hospitality Management (3 papers); Journal of Hospitality and Tourism Research (3); Journal of Travel Research (3); M&SOM-Manufacturing & Service Operations Management (3); OR Spectrum (3); Service Industries Journal (3); Transportation Research Part B-Methodological (3); Central European Journal of Operations Research (2); Computers & Industrial Engineering (2); Expert Systems with Applications (2); Informs Journal on Computing (2); International Journal of Forecasting (2); International Journal of Heritage Studies (2); International Journal of Operations & Production Management (2); Journal of Air Transport Management (2); Journal of the Operations Research Society of Japan (2); Naval Research Logistics (2); Tourism Economics (2); Transportation Research Part A: Policy and Practice (2); Annals of Operations Research (1); Annals of Tourism Research (1); Business & Information Systems Engineering (1); Computational Optimization and Applications (1); Computer-Aided Civil and Infrastructure Engineering (1); Computers & Operations Research (1); Cuadernos de Administracion (1); Decision Support Systems (1); Egyptian Informatics Journal (1); European Journal of Information Systems (1); Flexible Services and Manufacturing Journal (1); IEEE Transactions on Fuzzy Systems (1); IIE Transactions (1); Information Sciences (1); Journal of Combinatorial Optimization (1); Journal of Hospitality and Tourism Technology (1); Journal of Hospitality Marketing and Management (1); Journal of Human Resources in Hospitality and Tourism (1); Journal of Marketing (1); Journal of Service Research (1); Journal of Travel & Tourism Marketing (1); Machine Learning (1); Management Research News (1); Manufacturing and Service Operations Management (1); Mathematical and Computer Modelling (1); Mathematical Methods of Operations Research (1); Neural Computing & Applications (1); Operations Research Letters (1); QME-Quantitative Marketing and Economics (1); RAND Journal of Economics (1); Research Journal of Applied Sciences, Engineering and Technology (1); Revue Française de Gestion (1) and Transportation Journal (1).

As Bradford (1934) established, referring to scientific dissemination on a specific topic, the high concentration of the subject in a small number of journals which widely disseminate is confirmed, compared to a high number of them that have published few works (in our case, between 1 and 3). The nucleus (Figure 6) is made up of only two journals which accumulate 24.6% of the scientific production on Revenue Management, while 52 journals (77.6% of the total) have published 25.6% of the articles.

Journal of Revenue and Pricing Management (Henry Stewart Publications, UK), which ranks in the first position, along with International Journal of Revenue Management (Inderscience, UK), are currently the only two journals specific to Revenue Management. The former has been edited since 2002 and the latter since 2007.

Cornell Hospitality Quarterly (Sage Publications since 2008, USA) launched its first number in 1960, as Cornell Hotel and Restaurant Administration Quarterly until 2007 (inclusive). The results confirm that the journal attaches great interest to the publication of papers on Revenue Management and in turn determine that the majority of the authors who they publish are linked with Cornell University (69% of the total published in the journal).

The high number of journals and their diversity respond to the variety of Revenue Management research methods and strategies. This is dealt with in the following sections. Our attention is drawn, however, to the scant appearance of journals specific to the tourism sector, around 29% of the total, compared to those catalogued in other knowledge areas. Therefore, the consideration of the categories of *management*, *business*, *operations research*, *computer*

science and *finance,* as well as *tourism,* is recommended both for literature reviews and for the defining of publication strategies.

Applied research methodology [Objective 7]

The methodologies most used are those based on *models and/or simulations* (59%, 173 articles of the 293 analysed), followed by *empirical studies* (28%, 82 articles) and, lastly, *theoretical works* (11.3%, 33). Figure 7 notes their evolution over time. To analyse them we incorporate the linear trend into the figure. Although they are included in the chart, the fit values obtained are not considered relevant, but they do enable us to compare the growth in the use of the different research methodologies. The greatest value in the slope of the regression line of the works that employ *models and/or simulation* confirms the increase of complexity in the subject, as we will see later. This statement is consistent with the diversity of journals in which there is scientific production concerning Revenue Management. For their part, empirical studies have a less regular evolution over the period, although they have attained especially high values in recent years of the series.

Figure 7. Evolution and classification of the publications according to the methodology employed.
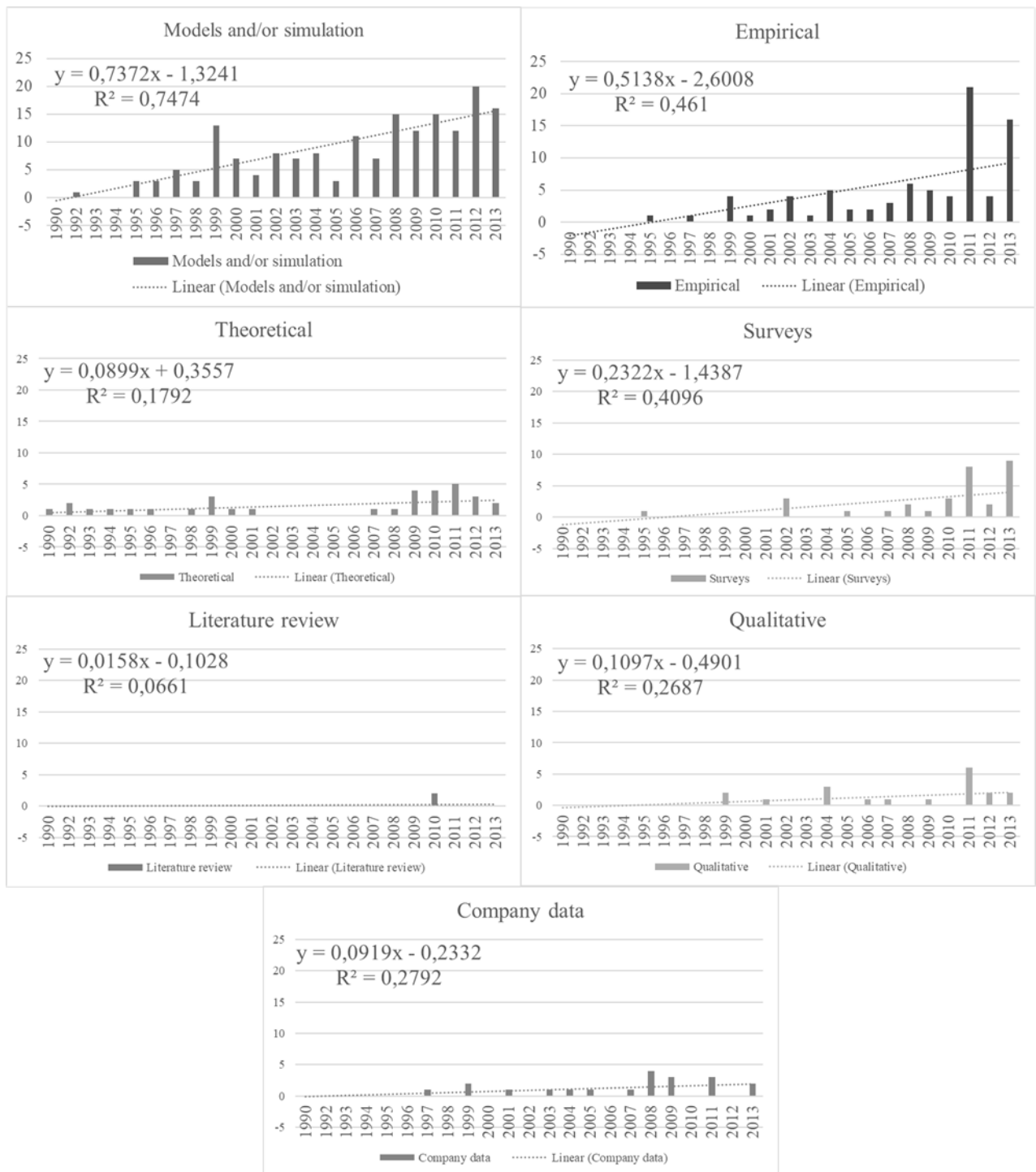
Centring on the values of each group, among the works based on *models and/or simulations,* the majority use both models and simulations (63.58%, 110 articles), followed by those which use only models (33.1%, 59) and, lastly, those that employ only simulations (2.3%, 4). For their part, *empirical* works evolve in a similar pattern to that observed for all the articles published on Revenue Management. In our opinion, this proves the interest in this matter and underlines its relevance and vitality. Here, higher values are achieved by those which use *surveys* (10.6%, 31), compared to those that are *qualitative* (6.5%, 19). Additionally, a new category has been discovered related to works in which research is based on company data (6.8%, 20). This is considered an important result from this research. In the previous section, the companies´ participation in Revenue Management research has been confirmed and now

we show the relevance of papers that consider company data to do research. In our opinion, the increasing of data available and the participation of companies will grow in the future together with the push of the big data phenomenon. In the Revenue Management area this profile of research started some years ago.

Theoretical works, for their part, although in slow progression, also have their place (11.3%), while *literature reviews* receive marginal attention (0.7%).
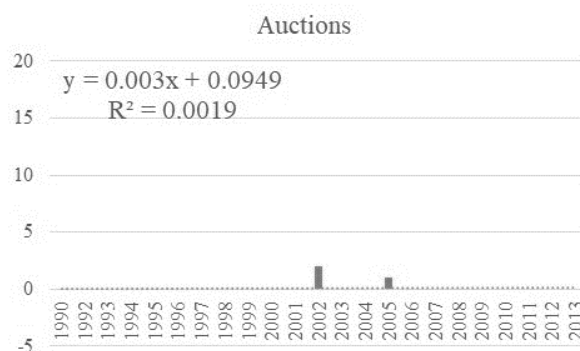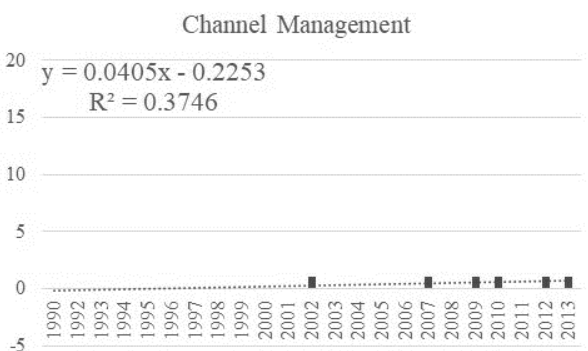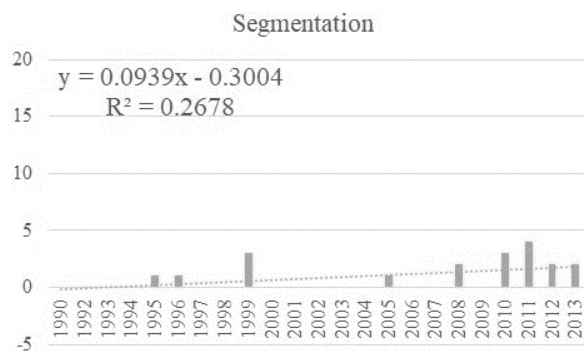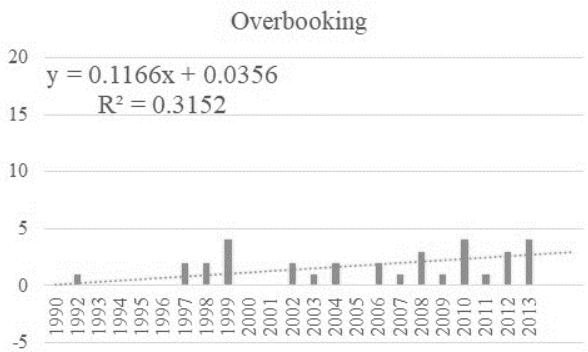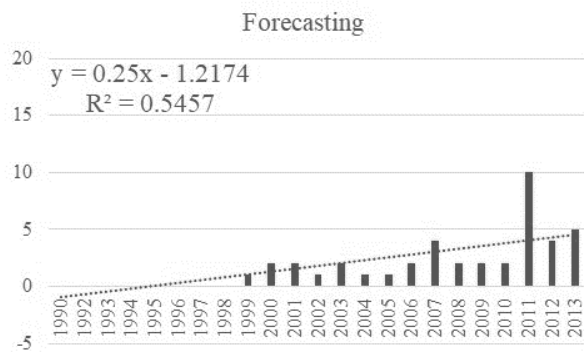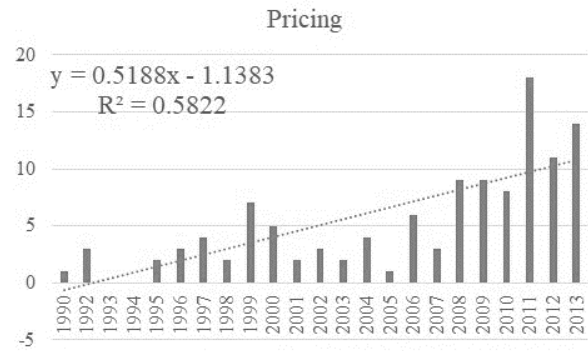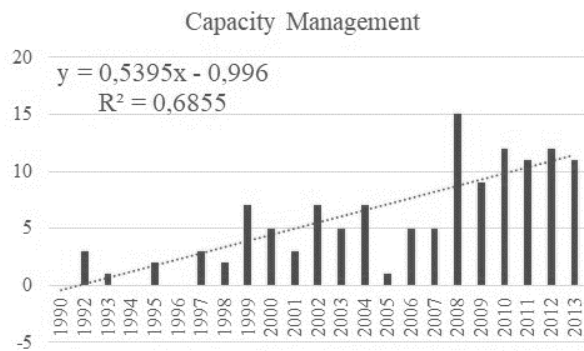
Classification and content analysis of papers based on Revenue Management strategies [Objective 8]

The results obtained give first place to *capacity management* (126 works, 43%), followed by *pricing* (117 works, 39.9%), *forecasting* (41, 14%), *overbooking* (33, 11.3%), *segmentation* (19, 6.5%), *channel management* (6, 2%) and, in last position, *auctions* (3, 1%). Figure 8 shows the particular evolution of each strategy.

The analysis of the content of **capacity management** papers allows us to determine the interest of the authors in perfecting, improving and optimising the revenues obtained from limited resources. Discount (seat) allocation, booking limit, allocation capacity and capacity control are related with this dimension. Most of the advances come from the airline industry. A large sample of related concepts was introduced by Smith *et al.* (1992) based on American Airlines' experience and include spoilage, discount seat allocation, nesting, virtual nesting (and buckets of inventory), and some novelties sum up the previous list, such as displacement (Weatherford & Bodily, 1992), upgrading (You, 2001), upselling, downselling (Harewood, 2006; Gallego, Li, & Ratliff, 2009) and replenishment (Sato & Sawaki, 2009).

The subject increases in complexity from multiple product set (Gallego & van Ryzin, 1997) to multiple flight legs (You, 1999) and multiple origins and competing origin-destination routes (Feng & Xiao, 2001) and, in general, the consideration of a network approach (Talluri & van Ryzin, 1998); as well as from a static to a dynamic framework (Lautenbacher & Stidham, 1999; Liang, 1999; You, 1999).

Figure 8. Evolution and classification of the publications according to the strategy of Revenue Management.

Capacity Management

$y = 0{,}5395x - 0{,}996$
$R^2 = 0{,}6855$

Pricing

$y = 0.5188x - 1.1383$
$R^2 = 0.5822$

Forecasting

$y = 0.25x - 1.2174$
$R^2 = 0.5457$

Overbooking

$y = 0.1166x + 0.0356$
$R^2 = 0.3152$

Segmentation

$y = 0.0939x - 0.3004$
$R^2 = 0.2678$

Channel Management

$y = 0.0405x - 0.2253$
$R^2 = 0.3746$

Auctions

$y = 0.003x + 0.0949$
$R^2 = 0.0019$

To control inventory in sale, bid prices (also referred as threshold values) is a frequent issue studied which has maintained attraction for researches throughout the years to both improve its application and/or to broaden its scope (Talluri & van Ryzin, 1998; de Boer, Freling, & Piersma, 2002; Feng, 2006; Wang & Wang, 2007; Topaloglu, 2008; Topaloglu, 2009a; Kunnumkal & Topaloglu, 2010a; Kunnumkal & Topaloglu, 2011).

Differences on customer choice behaviour is an important question incorporated into capacity management models (Talluri & van Ryzin, 2004; Gallego, Kou, & Phillips, 2008; Chen & Homem-de-Mello, 2010; Fiala, 2012; Liu, Wu, & Qu, 2013). The remaining capacity

is also considered to be a valuable topic (Anjos, Cheng, & Currie, 2004; Barz & Waldmann, 2007; Schön, 2010).

Since 2004, papers have been devoted to the fleet assignment matter (Lohatepanont & Barnhart, 2004; Wang & Meng, 2008; Vaze & Barnhart, 2012). Later, some advances have been introduced considering competitive effects (Netessine & Shumsky, 2005; Gallego *et al.*, 2009), and co-opetition (Chen & Hao, 2013) or alliances between airlines (Wright, Groenevelt, & Shumsky, 2010; Graf & Kimms, 2011; Topaloglu, 2012; Kimms & Çetiner, 2012; Graf & Kimms, 2013; Çetiner & Kimms, 2013).

To take into account changes in the booking process during the booking horizon period (timing) and/or to reduce computing time, some authors propose time decomposition based models (Cooper & Homem-de-Mello, 2007; Liu & van Ryzin, 2008; Kunnumkal & Topaloglu, 2010b; Topaloglu, 2012; Gönsch, Koch, & Steinhardt, 2013), considering a fraction of request or partial acceptance (Topaloglu, 2008; van Ryzin & Vulcano, 2008a), or the relaxation of some presumptions or constraints (Jiang, 2008; Topaloglu, 2009b).

Focusing on capacity management contributions from other activities (other than airlines), we observe the idiosyncrasy of each of them. In hotels, for example, there is the length of stay (Weatherford, 1995; Bertsimas & Popescu, 2003), group management and duration of stays (El Gayar, Saleh, Atiya, El-Shishiny, Zakhary, & Habib, 2011); in restaurants, supply mix optimisation (Kimes & Thompson, 2004), the influence of events (Chan & Chan, 2008), some advantages of reducing dining duration (Thompson, 2009) and the table mix problem (Thompson, 2011); in car rentals, the fleet scheduling and assignment problem (Ernst, Horn, Kilby, & Krishnamoorthy, 2010; Haenel, Mederer, & Schmidt, 2012) and the lengths of rents (Madden & Russell, 2012); in railways, multiple travel legs (Gopalakrishnan & Rangaraj, 2010) and, finally, in golf courses, the demand assignation to the available tee-times (Rasekh & Li, 2011).

Turning to the pricing dimension, price setting and price optimisation are the basis for paper classifications in this category. In general terms, ***pricing*** in the Revenue Management arena and its benefits has been highlighted mainly from both, the airline (Botimer, 1996; Vinod, 2010; Westermann & Lancaster, 2011) and hotel sectors (Brotherton & Mooney, 1992; Kimes, 2011). Discount prices, show-up, diversion (Bodily & Weatherford, 1995; Belobaba & Weatherford, 1996; Botimer & Belobaba, 1999), opaque products (Post & Spann, 2012) and transfer prices in airline competition (Graf & Kimms, 2013) are related terms. The contributions about pricing from hotel activities originate specific concepts like rack rate (Donaghy, McMahon, & McDowell, 1995), function space (Kimes & McGuire, 2001), multiple night stays (Noone & Mattila, 2009; Pekgün, Menich, Acharya, Finch, Deschamps, Mallery, van Sistine, Christianson, & Fuller, 2013; Aslani, Modarres, & Sibdari, 2013) and price multipliers (Bayoumi, Saleh, Atiya, & Aziz, 2013).

After all, pricing models needed to respond to a reality and this motivates some changes from an origin-destination problem to a network scenario (García-Díaz & Kuyumcu, 1997; Talluri & van Ryzin, 1998; Kunnumkal & Topaloglu, 2010c), from two products to a multiple-choice demand behaviour. The models must also be considered from the pricing perspective (Gallego & van Ryzin, 1997; Desiraju & Shugan, 1999; Shioda, Tunçel, & Myklebust; 2011; Kunnumkal & Topaloglu, 2011).

Pricing models likewise incorporate the changes throughout the timing and the remaining time before the customer's arrival (Feng & Xiao, 1999; Feng & Gallego, 2000; Feng & Xiao, 2000; Anjos *et al.*, 2004).

On the other hand, integration with other Revenue Management strategies constitute a real challenge: pricing and resource allocation problems in both airlines (García-Díaz & Kuyuncu, 1997; Kuyumcu & García-Díaz, 2000; Xiao, Chen, & Chen, 2007; Mookherjee & Friesz, 2008; Cizaire & Belobaba, 2013) and in hotels (Baker & Collier, 2003), with a continuous-time basis (Feng & Xiao, 2006), with dynamic pricing problems (Zhang & Cooper, 2009; Erdelyl & Topaloglu, 2011) and those which consider ~~considering~~ the remaining capacity (in airlines, Anjos *et al.*, 2004; and in hotels, Badinelli, 2000).

Next come, by their importance, mainly in airlines, the competitors´ influence on pricing policies (Walczak & Brumelle, 2007; Currie, Cheng, & Smith, 2008; Gallego *et al.*, 2009; Zhang & Cooper, 2009; Mantin & Koo, 2009; Vila & Córcoles, 2011), in the case of airline alliances (Graf & Kimms, 2013; Çetiner & Kimms (2013), presenting less research in hotels (Noone, Canina, & Enz, 2013).

Pricing strategies through channels (internet distribution systems, online travel agencies, websites and third-party websites) has been mostly studied in hotels (Schütze, 2008; Ropero, 2011; Maier, 2012; Guo, Ling, Dong, & Liang, 2013) but also in airlines (Boyd & Bilegan, 2003; Isler & D´Souza, 2009).

Low cost airlines is another issue studied (Koenigsberg, Muller, & Vilcassim, 2008; Marcus & Anderson, 2008; Poelt, 2011; Westermann, 2012), together with the specific pricing consideration about group management and their related concepts -dilution, group blocks- (Banerjee & Turner, 2012, Vinod, 2013), in hotels too (Hormby, Morrison, Dave, Meyers, & Tenca, 2010; Noone & Hultberg, 2011). And a few advances have been made on fairness (in airlines, Chapuis, 2013; in hotels, Kasikci, 2006; Rohlfs & Kimes, 2007; Heo & Lee, 2011), and concerning customer loyalty (Brunger, 2013).

Pricing has widened its horizons into new sectors. In restaurants, the related research is about the price fences concept and the duration of the relationship with prices (Kimes, Chase, Choi, Lee, & Ngonzi, 1998), fairness perception in restaurant and hotels (Palmer & McMahon-Beattie, 2008), cross-product elasticity and customer loyalty in ski resorts, (Perdue, 2002), differential pricing practices in railway companies (Bharill & Rangaraj, 2008), the premium fee concept in golf courses (Licata & Tiger, 2010), and the setting of car rental prices (Ernst *et al.*, 2010).

Forecasting has been incorporated into the context of Revenue Management more recently. In this area, anticipated knowledge of the foreseen values of demand and bookings, occupation, prices and profitability are vital. Concepts connected with this area include censored forecasting methods (van Ryzin & McGill, 2000), unconstrained demand (Baker, Murthy, & Jayaraman, 2002), the pick-up concept (Weatherford & Kimes, 2003) and multiplier factors (Bayoumi *et al.*, 2013).

Some similitudes arise in the research production between airlines and hotels, despite contributions on the latter being more numerous. Both study the use and influence of historical observations, recent data and updating in forecasting (airlines, van Ryzin & McGill, 2000; Cooper, Homem-de-Mello, & Kleywegt, 2006; Lin, 2006; and in hotels, Haensel & Koole, 2011). Authors also consider the human adjustment influence on forecasting (in airlines,

Mukhopadhyay, Samaddar, & Colville, 2007; and in hotels, Ghalia & Wang, 2000; Schwartz & Cohen, 2004).

Advances in hotels are obtained in group forecasting (Kimes, 1999b; Hormby *et al.*, 2010; Noone & Hultberg, 2011) and comparisons between different forecasting methods (Weatherford & Kimes, 2003; Guadix-Martín, Onieva-Giménez, Cortés-Achedad, Muñuzuri Sanz, & Quesada-Ibargüen, 2008; Hormby *et al.*, 2010).

Other issues related to data processing address the importance of detailed information according to the arrival day (Rajopadhye, Ghalia, Wang, Baker, & Eister, 2001), aggregation and disaggregation in forecasting (Weatherford, Kimes, & Scott, 2001) and the impact of forecasting errors concerning results (Weatherford & Belobaba, 2002). These are followed chronologically by those which take an increased number of variables, such as reservations, cancellations, durations of stays and no-shows, among others (El Gayar *et al.*, 2011); and what Bayoumi *et al.* (2013) refer to as multiplier factors: arrivals, durations of stays, no-shows, individual and group reservations, seasonality and trend. Lastly, Queenan, Ferguson, & Stratman (2011) study the forecasting impact on revenue.

Overbooking, for its part, shows its validity despite being a concept developed by airlines since the 1960s (Thompson, 1961; Rothstein, 1971a, 1971b and 1974). Overbooking practices pursue compensating the revenue losses from empty seats (or inventory units, in general) due to no-shows and cancellations. Additional related concepts are show up, denied boarding or bumping (Weatherford & Bodily, 1992; Chatwin, 1999; Coughlan, 1999; Suzuki, 2002), refunds and penalties (Chatwin, 1998; Karaesmen & van Ryzin, 2004; Ng, 2007), go-shows (Gallego *et al.*, 2008), passenger transferences between competing airlines (Ge, Xu, & Dai, 2010) and aversion (Zhang & Chen, 2013).

Most advances in this strategy are attributed to the airlines. In the period studied, Weatherford & Bodily (1992) and Baker & Collier (1999) conceptualise and summarise concepts and applied techniques, and Phillips (2012) proposes a comprehensive and complete approach to this matter.

Similar to capacity management and pricing strategies, competition and alliances have been investigated from the overbooking point of view (Ge *et al.*, 2010; Huang, Ge, Zhang, & Xu, 2013; Chen and Hao, 2013). Regulatory systems and their influence on customer satisfaction complete the list of other research (Zhang & Chen, 2013).

Although focused on the overbooking problem, some research combines this with capacity management, including basic variables, such as no-shows and cancellations (Chatwin, 1998), adding penalty costs in dumping situations and refundable tickets (Chatwin, 1999; Erdelyi & Topaloglu, 2009), random cancellations (Gosavi, Bandla, & Das, 2002), considering the time dependent demand (Pulugurtha & Nambisan, 2003), the penalty cost of denying (Kunnumkal & Topaloglu, 2008), applying a decomposition of the problem (Kunnumkal & Topaloglu, 2008; Erdelyi & Topaloglu, 2009; Erdelyl & Topaloglu, 2010), proposing other methods for reducing complexity (Topaloglu, Birbil, Frenk, & Noyan, 2012; Kunnumkal, Talluri, & Topaloglu, 2012), and suggesting and comparing various models (Aydin, Birbil, Frenk, & Noyan, 2013).

Other progress contemplates overbooking combined with pricing (Desiraju & Shugan, 1999), and a set of the three strategies: pricing-capacity and overbooking (Gallego & van Ryzin,

1997; Pulugurtha & Nambisan, 2003; Mookherjee & Friesz, 2008) and forecasting (Romero Morales & Wang, 2010).

In hotels, Hadjinicola & Panayi (1997) study the overbooking levels when rooms are distributed through various tour-operators and Noone & Lee (2011) the compensation of non-accommodated customers and its influence on customer satisfaction levels. Another activity studied in this category is restaurants, where Kimes *et al.* (1998) identify differences about the overbooking problem in this specific case even though it is not this paper's main subject.

Segmentation has aroused an intermittent interest over time, where the example of airlines has been followed by other activities. This distinguishes grosso modo between tourist customers who book long before at more economic prices, business customers who book little in advance and are less sensitive about prices, and groups which can access large discounts by anticipating their booking decision. Restrictions or rules concepts (Botimer & Belobaba, 1999) are related with this area. Forecasting papers are frequently addressed together with other Revenue Management strategies. About airlines, Koenigsberg et al. (2008), from a case of study, concludes that a higher number of segments is related with a higher time horizon for sales in advance. Vinod (2010) includes a section about market segmentation and its connection with fare management and rules, and Li & Tang (2012) and Liu *et al.* (2013) consider segmentation in a seat allocation problem. In hotels, Ladany (1996) studies the optimal number of segments in a case study of a 400 hotel rooms.

It is seen how it remains necessary to carry out studies which consider the data available in each case, and according to the sector of activity and its integration with other Revenue Management strategies.

Channel management in hotel research has been done about the Best Available Rate perception of fairness and the multiple night stays pricing problem in distribution channels (Rohlfs & Kimes, 2007), measurement and testing of the web site and the effectiveness of third-party distribution channels (Maier, 2012) and pricing optimisation strategy in online distribution channels (Guo *et al.*, 2013). In airlines, Dunleavy & Phillips (2009) study the fare structures and distribution channels and highlight their importance and related costs. Without a specific sector as a target, Baker & Murthy (2002) focus on auctions in channel distribution matters while Jerath, Netessine & Veeraraghavan (2010) compare direct lastminute sales directly with intermediation through an opaque channel.

The *Auctions* concept was introduced by Baker & Murthy (2002), who also compare its application with other models for setting prices. Vulcano, van Ryzin & Maglaras (2002) work on auction optimisation considering capacity control decisions, and Baker & Murthy (2005) justify the increasing importance of auctions in distribution channels, making advances in the forecast error associated with this.

So, in general terms channel management and auctions have been identified as the most recent strategies, though they have been dealt with less. A greater production of them is expected in the future.

Conclusions

This work is centred on the study of the evolution of Revenue Management, whose importance has been determined both in the academic and the professional fields. Specifically, we have

analysed, during the period 1989-2013, the current state and the evolution of the articles published on Revenue Management referring to the tourism sector through publications in the most well-known periodic scientific journals, included in the *Web of Science* and *SCOPUS* databases. Both the character of a bibliographic study and its scope, number and variety of journals analysed, and the breadth of the temporal study period mean a contribution with respect to previous research. Table 3 includes a brief summary of these research results.

Table 3. Summaries about the scientific production on revenue management in tourism on Web of Science and SCOPUS.

Evolution and trend on Revenue Management research (Objective 1. Figure 1) Revenue Management research production is in a stage of growth. Annual growth rate: 15.9%	*Origin and evolution of the scientific production by countries* (Objective 2. Figure 2) The research originates from the 5 continents. **Top 7. Ranking by country** (with more than 4 signatures) 1. USA. 2. China. 3. United Kingdom. 4. Canada. 5. Germany. 6. Australia and India. 7. Spain.
Scientific production by authors (Objective 3. Figure 3 and Table 2) 433 different authors. 2% authors sign 83% of the research papers. 77% authors accumulated 1% of signatures. **Top 6. Ranking by author** (with more than 6 articles) 1. Sheryl E. Kimes. 2. Huseyin Topaloglu. 3. Garrett van Ryzin. 4. Peter P. Belobaba. 5. Lawrence R. Weatherford. 6. Sumit Kunnumkal.	*Scientific production by institutions (Universities and Companies)* (Objective 4. Figure 4) 183 different universities. Authors from universities sign 83% of the works. Scientific research is also signed by authors from companies. **Top 7. Ranking by university** (with more than 9 signed articles) 1. Cornell University. 2. Massachusetts Institute of Technology. 3. Columbia University. 4. The Hong Kong Polytechnic University. 5. The Pennsylvania State University. 6. Cairo University. 7. Georgia Institute of Technology. **Top 5. Ranking by company** (with more than 4 signed articles) 1. Lufthansa. 2. SABRE. 3. Carlson Rezidor Hotel Group. 4. Marriott International. 5. Revenue Analytics.
Collaboration between authors, universities and companies (Objective 5. Figure 5) **Author collaborations** The participation in the same paper is stabilising around 2-3 authors. An article is signed by 2 authors in 47.4% of the cases. The most collaborative: • Kimes and Topaloglu. • Van Ryzin and Gallego. • Kunnumkal. **Institution collaborations** 27.9 % of universities do joint works with other institutions. 26.8% of firms develop research with others. The most collaborative universities: • Cornell University. • Columbia University. • Indian School of Business.	*Dissemination of production by journals* (Objective 6. Figure 6) 67 journals disseminate the Revenue Management research about Tourism. **Top 7. Journal ranking** (with more than 12 articles published) 1. Journal of Revenue and Pricing Management. 2. Cornell Hospitality Quarterly. 3. International Journal of Hospitality Management. 4. European Journal of Operational Research. 5. Transportation Science. 6. International Journal of Revenue Management. 7. Operations Research.

Applied research methodology	Classification and content analysis of papers based on Revenue Management strategies
(Objective 7. Figure 7)	(Objective 8. Figure 8)
A new category of research methodology has been identified: using company data.	Revenue Management strategies ordered by their consideration during the period of study:
Research methodology order from higher to fewer use in articles:	1. Capacity management (43.0%).
1. Models and/or simulations (59%).	2. Pricing (39.9%).
2. Empirical (28%).	3. Forecasting (14.0%).
3. Theoretical (11.3%).	4. Overbooking (11.3%).
4. Survey (10.6%).	5. Segmentation (6.5%).
5. Company data (6.8%).	6. Channel management (6.2%).
6. Qualitative (6.5%).	7. Auctions (1.0%).
7. Literature reviews (0.7%).	

The results obtained as to the volume of publications included enables the determining not only of the importance but also the topicality of Revenue Management. They also let us identify the **trend** of future advances. The subject shows its consolidation and growth as a research subject in the tourism sector and, very especially, since the 2008 economic crisis, although without yet achieving the phase of linear growth characteristic of the mature or close to saturation stages identified by Price (1978).

Research in Revenue Management in the tourism sector is a discipline which has left behind a stage of initiation and is in a stage of exponential growth. Although the origin of the scientific production was authors located in universities in the United Sates, this has been extended to all the continents, having a stronger presence in Europe and more recently a great intensity in Asia. Likewise, it is noted that all the **countries** which make up the *ranking* figure among the classification of the first 50 in the world in tourism elaborated by the *World Tourism Organization* (2014).

On the other hand, the majority of the articles correspond to a reduced number of very prolific **authors**, in accordance with what is established by Lotka's (1926) law. The USA dominates both the *ranking* of authors and that of institutions. In particular, Kimes and Topaloglu (*Cornell University*) and van Ryzin (*Columbia University*) are the most productive authors.

Over the 25 years analysed, the **universities** of the USA (Cornell University, Massachusetts Institute of Technology, Columbia University, The Pennsylvania State University) have been recently joined by those of other continents, which have moreover made their mark in the ranking, Hong Kong (The Hong Kong Polytechnic University) standing out.

Regarding the **collaborations** between institutions, the increase of the participation of firms in the investigations is confirmed, mainly of software, airline and hotel companies. Likewise, it is stressed that the most cutting-edge universities are the ones which carry out most works in collaboration with firms. They are therefore an example to follow. Nevertheless, collaboration links respond more to the impulse of participating authors than to the development of explicit strategies between institutions.

Addressing the research dissemination through **journals**, we point out that a good number of those which pay more attention to Revenue Management are not specific to Tourism. This fact emphasises the need to consider publications of different areas in the bibliographic reviews if one wishes to appropriately analyse the evolution of the discipline. On the other hand, this circumstance highlights that there are numerous alternatives to disseminate works on Revenue Management, among which stand out publications in Management, in general, in Operations Management, in particular, and in Computer Science. We consider that this also

reflects the multi and interdisciplinarity of the study field. Furthermore, a significant concentration of publications on Revenue Management in two journals is noted, *Journal of Revenue and Pricing Management* and *Cornell Hospitality Quarterly*, the first of them is a monograph on this topic.

Among the **research methodologies** used, works about development, evaluation and/or tests of *models and/or simulation* stand out, although empirical studies have increased notably and are in second place. This situation reflects how Revenue Management is maturing as a study field, given that, the same as in other disciplines, in the initial stages the empirical works were mostly case studies. Then there have been survey-based studies, with which it is meant to empirically verify hypotheses derived from prior exploratory research. The results suggest that a new category should be considered for classifying Revenue Management research: company data.

Referring to **strategies of Revenue Management**, in general terms a trend is seen of the development of more complex works about behaviour modelling and/or seeking optimisation in management. Those related with capacity management and *pricing* clearly stand out. Following far behind are *forecasting* and *overbooking*. The findings, in general, demonstrate the development of studies adapted to the specific problem of their application in the subject of Revenue Management in new contexts. The study of *segmentation* has been experiencing a growth in recent years while *channel management* and *auctions* will, in our opinion, receive greater attention in the future as they are considered to be emerging topics.

As the main contribution of this work, we highlight that the results serve as a guide for future researchers, given that as well as presenting the authors, universities and countries which lead research on Revenue Management, how the research methods and the strategies of Revenue Management have been evolving is identified. Likewise, the convenience of considering publications not necessarily circumscribed within the tourism area to disseminate works is also demonstrated. The broad bibliography compared, worked on and incorporated into this study, along with the identification of the main areas researched and the specific terms of the discipline are considered additional values.

Lastly, we are aware that the work presents some limitations. On the one hand, the results respond to a specific study time horizon and, on the other hand, as our analysis has centred on articles published in journals included in the *Web of Science* and *SCOPUS* databases, it is likely that the results are biased towards publications in English. That is why, we consider that it would be interesting, as an extension of this work, to include publications in other languages to detect possible particularities of the application of Revenue Management in different geographic environments and broaden the range of dates considered. It is probable that this would also increase the number of works, given that some authors publish mainly or exclusively in their native -and non-English – language, as well as providing new research lines.

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