THE PLS METHOD IN TOURISM RESEARCH: A BIBLIOMETRIC APPROACH

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Abstract

*Objectives***:** Observe the development of the application of Partial Least Squares Structural Equation Modelling (PLS-SEM), and why it is suitable for theory development in tourism research, their main expositors both in terms of authors and countries, as well as the relationships between them and the keywords used.
*Methods***:** This study empirically examines the PLS method in tourism research published between 2000 and 2020 in the Web of Science (WoS) databases, using the terms "PLS" and "tourism". Bibliometric review software Rstudio was used, applying the "Bibliometrix" and "Biblioshiny" packages.
*Results***:** It shows the increase in publications in recent years, being in 2014 when the exponential increase begins, the country with the highest production of scientific articles is Spain, while the most prolific university is the University Sains of Malaysia, as well as the classification of authors by the various indexes or by their production over time, also has the relationships that exist between keywords, authors and universities, to conclude with a heat map of research worldwide
*Conclusion***:** The main conclusions of the present study are that there is a clear increase in the use of the PLS-SEM technique in tourism research, where Spain is the country that publishes the most on the subject, not having journals specialised in this topic, and where the main authors and the different classification indices for them are shown.

Keywords

PLS-SEM, Tourism, Bibliometric, Rstudio

1. Introduction

Tourism researchers did not always apply recommended best practices, such as the reporting of missing data statistics, it is in recent years that tourism researchers and policymakers have realised that it is necessary to measure and monitor positive and negative impacts beyond conventional methods (Ali, Kim, Li, & Cobanoglu, 2018; Hsu, Wu, Chen, & Cheung, 2020), this is why there has been a considerable increase in the application of Partial Least Squares Structural Equation Modelling (PLS-SEM), today, tourism researchers are increasingly using this technique to examine complex relationships, which is based on the widely recognised, applied and robust variance in the social sciences, which has become increasingly popular in tourism research in the last decade, due to its flexibility, nevertheless, it remains largely unknown in tourism research (Ali, Kim, et al., 2018; Ali, Rasoolimanesh, Sarstedt, Ringle, & Ryu, 2018; Barnes, Mattsson, & Sørensen, 2016; & Kucukergin, 2018; Vázquez-Martinez, Sanchís-Pedregosa, & Leal-Rodríguez, 2019).

This increase is mainly due to the fact that PLS-SEM is suitable for theory development in tourism research, as the use of multivariate analysis methods should be frequently reviewed to ensure the robustness of research and publications, PLS-SEM is based on iterative ordinary least squares regression to obtain the weights used to construct linear combinations of observed indicators as proxies for all constructs in the model and, is able to simultaneously evaluate measurement and structural models, this technique is appropriate for studies related to prediction and model fitting, producing valid results while handling common situations encountered in the social sciences, is particularly suitable for exploratory studies involving predictive models with a higher level of complexity (Ali, Rasoolimanesh, et al., 2018; Campón-Cerro, Folgado-Fernández, & Hernández-Mogollón, 2017; Hair, Sarstedt, Pieper, & Ringle, 2012; Md Noor, Rasoolimanesh, Jaafar, & Barghi, 2019; Müller, Schuberth, & Henseler, 2018; Murphy, Pritchard, & Smith, 2000).

The aim of this study is to observe the development of the application of Partial Least Squares Structural Equation Modelling (PLS-SEM), and why it is suitable for theory development in tourism research, their main expositors both in terms of authors and countries, as well as the relationships between them and the keywords used.

2. Theoretical and Conceptual Framework

In recent years, the use of SEM has become widespread in various fields of knowledge, such as tourism. PLS-SEM is variance-based and emerges as the suggested alternative to deal with causality problems between latent variables when the assumptions of analysis by covariance or CB-SEM cannot be met, as this involves strict rules and assumptions, as well as identifying the model earlier, which, if not fulfilled, may compromise the validity of the results (Brown, Smith, & Assaker, 2016; do Valle & Assaker, 2016).

The studies that used PLS-SEM provided at least one justification for its use, mainly related to the size of the sample or the characteristics of the data (Ali, Rasoolimanesh, et al., 2018). In fact, most empirical data in business and social sciences are characterised by non-normal data (Hair Jr, Sarstedt, Hopkins, & Kuppelwieser, 2014), PLS technique imposes minimal requirements on measurement levels and is more suitable for small sample sizes (Bianchi, Pike, & Lings, 2014), as well as formatively measured constructs, which are not observable and require several indicators to construct them (Álvarez-García, Del Río-Rama, & Miras-Rodríguez, 2017; Hair Jr et al., 2014). It is also important to mention that any PLS-SEM study that includes formative constructs should explore both the importance and relevance of indicator weights (Usakli & Kucukergin, 2018). It also shows an increase in the popularity of PLS-SEM since 2011, because it overcomes the dichotomy between explanation and prediction, indicating a growing interest of tourism researchers in examining models based on prediction, rather than confirmation of their original version (Ali, Rasoolimanesh, et al., 2018; Esfandiar, Sharifi-Tehrani, Pratt, & Altinay, 2017; Shmueli et al., 2019).

The PLS algorithm is performed in two stages of analysis, one of which assesses the reliability and validity of the measurement model, and the associated relationships between the structural model variables (Lee, 2017; Tasci, Fyall, and Fu, 2020). To measure the determinants, the various authors use Likert scales in different variants, some use the 5-point scale (Garau-Vadell, Gutiérrez-Taño, & Díaz-Armas, 2019; Jeon, Ali, & Lee, 2019; Murphy et al., 2000; Rasoolimanesh, Ringle, Jaafar, & Ramayah, 2017; Xu, Huang, & Whitmarsh, 2020), other authors opt to use the 7-point scale instead (Ali, Kim, et al., 2018; Esfandiar et al., 2017; Hsu et al., 2020; Merli, Preziosi, Acampora, Lucchetti, & Ali, 2019) and some others use a mixture of the two scales (Ting, Fam, Jun Hwa, Richard, & Xing, 2019), as a procedure that helps to address the potential bias of the common approach (Ting et al., 2019). To ensure the validity and reliability of the scale, the appropriateness of the measurement model is assessed, where the criteria of reliability, convergent validity and discriminant validity are assessed, and of the structural model, in which the constructs of the model must reach the parameters of Cronbach's alphas (Esfandiar et al., 2017).

3. Methodology

Bibliometric studies are characterised by the use of statistics to analyse academic literature (Ruhanen, Weiler, Moyle, & McLennan, 2015), and to address the problem, this study empirically examines the PLS method in tourism research published between 2000 and 2020. The research was limited to the Web of Science (WoS) databases using the terms “PLS” and “tourism”, and the following results were obtained: 395 documents were in the databases, of which 327 are articles, 1 article; data paper, 56 articles; early access, 1 article; proceedings paper, 2 editorial material, 1 review, 1 review; early access, the documents contain 1016 Plus Keywords and 1529 Author Keywords, being a total of 995 authors, corresponding 23 to authors of single-authored documents and 972 to authors of multiple-authored documents, containing 21,033 cited references, from 149 different sources.

We used the bibliometric review software (Rstudio), which provides us with a set of tools for quantitative research in bibliometrics and scientometrics (Aria & Cuccurullo, 2017), applying the packages "Bibliometrix" and "Biblioshiny"(Aria & Cuccurullo, 2020). As with other research methodologies, before embarking on a comprehensive bibliometric analysis, we need to draw a mental map (Durán-Sánchez, Álvarez-García, González-Vázquez, & Río-Rama, 2020), it can be used the PRISMA process (Preferred Reporting Items for Systematic reviews and Meta-analyses) (Flores-Romero, Pérez-Romero, Álvarez-García, & Del Río-Rama, 2021), or as shown in Figure 1, putting the most important steps to follow in the bibliographic research process.

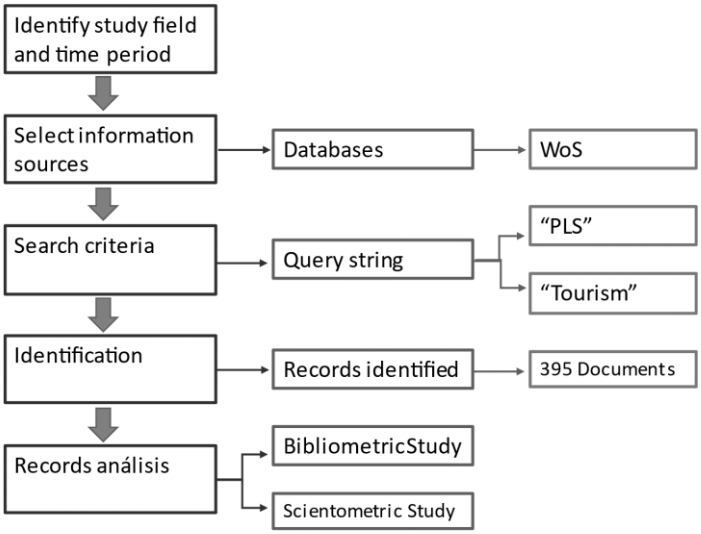

Figure 1. Methodological scheme followed in the bibliometric analysis.
Source: Based on Durán-Sánchez (2020)

4. Results

As we can see in Figure 2, it shows the increase over the years of the application of the PLS method in tourism, being the first in 2000 with very few in the following years, but it is in 2014 that the use of this method started to increase, starting with 9 articles published that year and growing exponentially in the following years, reaching 101 articles published in 2020.

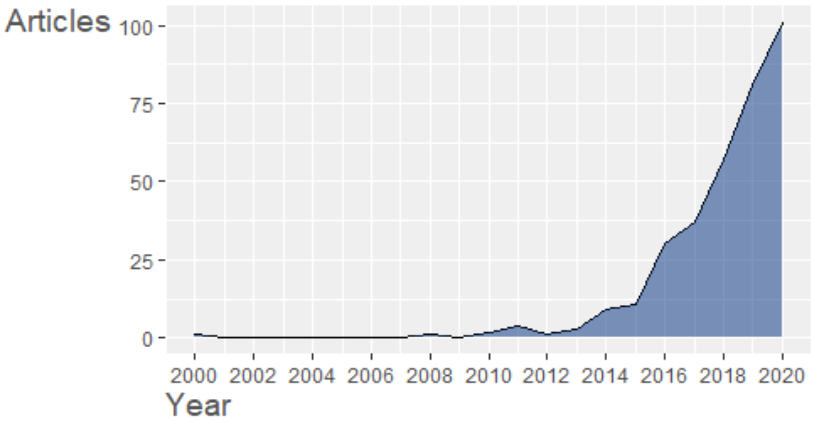

Figure 2. Annual scientific production
Source: own elaboration based on WoS data.

The production of the top ten countries is illustrated in table 1, where Spain is the most productive country with 61 papers, accounting for 15.44% of the articles published, of which 47 in solo publications and 14 in multi-country collaborative publications, in second place, is Malaysia with 58 and in third China 28, the country with the most publications from multiple countries is also China with 26 and a percentage of 48.1% of its total published articles, the country with the highest percentage of articles in collaboration with other countries is Korea with 66.7% of its research in collaboration with other countries, Indonesia and Australia are the other countries with the most collaborative publications with 62.5% and 61.9%. It can also be seen that the only American country in the top ten publications is the United States with 24 publications, of which 10 are solo publications and 14 in conjunction with other countries, as can be seen graphically in figure 3.

Table 1
Production per-country

	Country	Articles	Frequency	SCP	MCP	MCP_Ratio
1	SPAIN	61	0.1544	47	14	0.23
2	MALAYSIA	58	0.1468	40	18	0.31
3	CHINA	54	0.1367	28	26	0.481
4	USA	24	0.0608	10	14	0.583
5	AUSTRALIA	21	0.0532	8	13	0.619
6	PORTUGAL	19	0.0481	15	4	0.211
7	KOREA	18	0.0456	6	12	0.667
8	UNITED KINGDOM	13	0.0329	7	6	0.462
9	IRAN	11	0.0278	7	4	0.364
10	INDONESIA	8	0.0203	3	5	0.625

Source: own elaboration based on WoS data. SCP: Single Country Publications, MCP: Multiple Country Publications

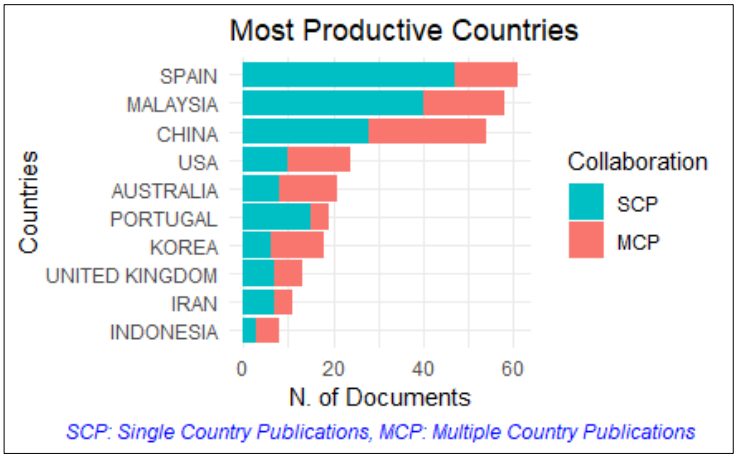

Figure 3. Production by country
Source: own elaboration based on WoS data.

Now that we know which are the countries that publish the most on this topic, it is relevant to mention which are the institutions with the highest scientific production, with the first place being the University of Sains Malaysia with 56 and the second place being the University of Extremadura in Spain with 26, Spain also has the University of Castilla la Mancha, the University of Seville and the University of Valencia in the top 9 most relevant affiliations, as shown in Table 2, which explains why Spain is the country with the highest production in the world.

Table 2
Most relevant affiliations

Affiliations	Articles
UNIV SAINS MALAYSIA	56
UNIV EXTREMADURA	26
TAYLORS UNIV	20
UNIV CASTILLA LA MANCHA	19
UCSI UNIV	18
KYUNG HEE UNIV	17
UNIV PUTRA MALAYSIA	16
UNIV SEVILLE	16
UNIV VALENCIA	14

Source: own elaboration based on WoS data.

Review studies focusing on journals show how journals are evolving (Koseoglu, Rahimi, Okumus, and Liu, 2016), in this study, we focus on publications on this topic, with a total of 149 publications, where the most relevant are Sustainability and Tourism Management with 36 and 22 publications each, as shown in table 3, it is worth mentioning that there are 103 journals with only one publication on the subject, representing 73%, and with two publications we have 17 journals representing 11%, adding up to 85%, which indicates that there are no journals specialised in the subject (Niñerola, Sánchez-Rebull, and Hernández-Lara, 2019).

Table 3
Leading journals

Sources	Articles
SUSTAINABILITY	36
TOURISM MANAGEMENT	22
JOURNAL OF TRAVEL RESEARCH	18
CURRENT ISSUES IN TOURISM	17
INTERNATIONAL JOURNAL OF CONTEMPORARY HOSPITALITY MANAGEMENT	15
JOURNAL OF HOSPITALITY AND TOURISM TECHNOLOGY	15
INTERNATIONAL JOURNAL OF HOSPITALITY MANAGEMENT	13
ASIA PACIFIC JOURNAL OF TOURISM RESEARCH	11
JOURNAL OF SUSTAINABLE TOURISM	9
JOURNAL OF DESTINATION MARKETING \& MANAGEMENT	8

Source: own elaboration based on WoS data.

Lotka's (1926) distribution tells us that there is a quantitative relationship between the author and the number of articles produced, being an unequal relationship since the smallest number of authors produces the largest number of articles, this is something that can be verified, having 853 authors with only one article, representing 85.72% of the total, 99 authors with 2 articles, representing 9.94% and 25 authors with 3 articles, representing 2.51%, having only 18 authors with 4 or more articles on this topic, which represent 1.83% of the scientific population that publishes with PLS in the area of tourism.

Table 4
Lotka's Law

Articles	Authors	Frequency
1	853	0.85728643
2	99	0.09949749
3	25	0.02512563
4	5	0.00502513
5	2	0.00201005
6	5	0.00502513
7	2	0.00201005
8	1	0.00100503
11	1	0.00100503
12	1	0.00100503
13	1	0.00100503

Source: own elaboration based on WoS data.

Table 5 shows which are the most cited authors and how they are positioned in the different indexes, as well as the year in which these authors started publishing, as far as this research is concerned, the most cited author is Correia with 529 citations and 5 publications, it should be noted that a high h-index means that a certain author's research has a higher impact, representing a balance between the number of publications

and the number of citations they get (Hirsch & Buela-Casal, 2014; Niñerola et al., 2019), in the case of the present research the author with the highest h-index is Rasoolimanesh SM with 10 followed by Ali F with an h-index of 9, in the g-index, which helps us to measure the overall citation performance of a set of articles (Egghe, 2006), the authors with the highest index are Rasoolimanesh SM with 12 and Assaker G with 11, in the m-index which is the result of the h-index divided by the number of years since first publication (Hirsch & Buela-Casal, 2014), the author with the highest index is Ali F with 1.5, followed by Rasoolimanesh with 1.429. As can be seen, each of the results is different for each item in the table, leaving it to the discretion of the researcher as to which is the most appropriate for their criteria.

Table 5
Most cited authors

Author	h index	g index	m index	Times cited	Number Publications	Year
CORREIA LOUREIRO SM	5	5	0.357	529	5	2008
RASOOLIMANESH SM	10	12	1.429	505	12	2015
MURPHY P	1	1	0.045	424	1	2000
PRITCHARD MP	1	1	0.045	424	1	2000
SMITH B	1	1	0.045	424	1	2000
ALI F	9	10	1.5	374	10	2016
ASSAKER G	8	11	1	337	11	2014
RINGLE CM	6	6	1	298	6	2016
OOI KB	6	7	1	259	7	2016
JAAFAR M	6	6	0.857	241	6	2015

Source: own elaboration based on WoS data.

Another important element in the production of articles is to know how it developed in the various authors, which years were the most productive and which year has the most citations, in figure 4 we can see the top ten most productive authors over time, where the size of the circle represents the number of articles published in the year and the intensity of the colour marks the number of citations obtained from the articles in that year, as an example, we can observe that Rasoolimanesh published 4 articles in the years of 2017, 2018 and 2019, but he only got more than 40 citations in the articles published in 2018, so we can presume that the most important work of the mentioned author is in that year. Same case for Assaker, who even though he has articles published from 2014 to 2020, it is in 2016 when his most cited work is found.

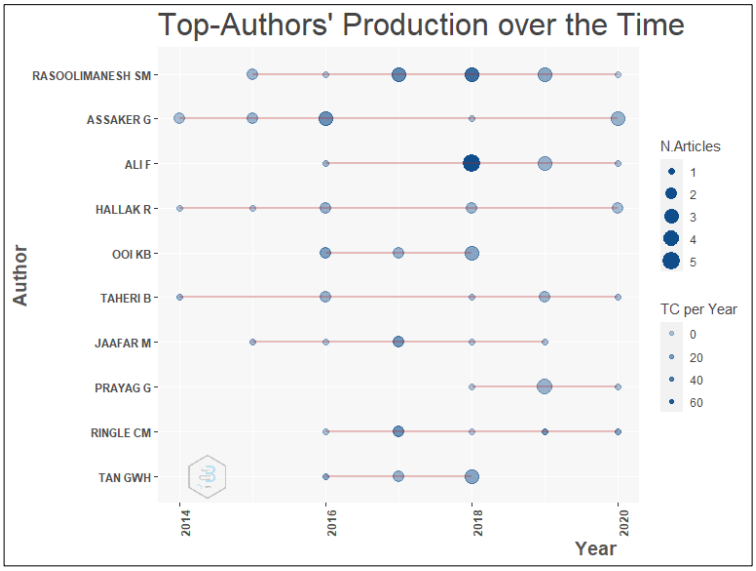

Figure 4. Top Authors production
Source: own elaboration based on WoS data.

A co-word analysis produces semantic maps of a field that facilitate the understanding of its cognitive structure (Aria and Cuccurullo, 2017), the co-occurrence network of plus keywords and author keywords can be seen graphically in figure 5, where the different groups of occurrences are differentiated by colour, as well as the number of times they are proposed by the size of the circles, where the three most repeated words in both cases are tourism, PLS-SEM and satisfaction.

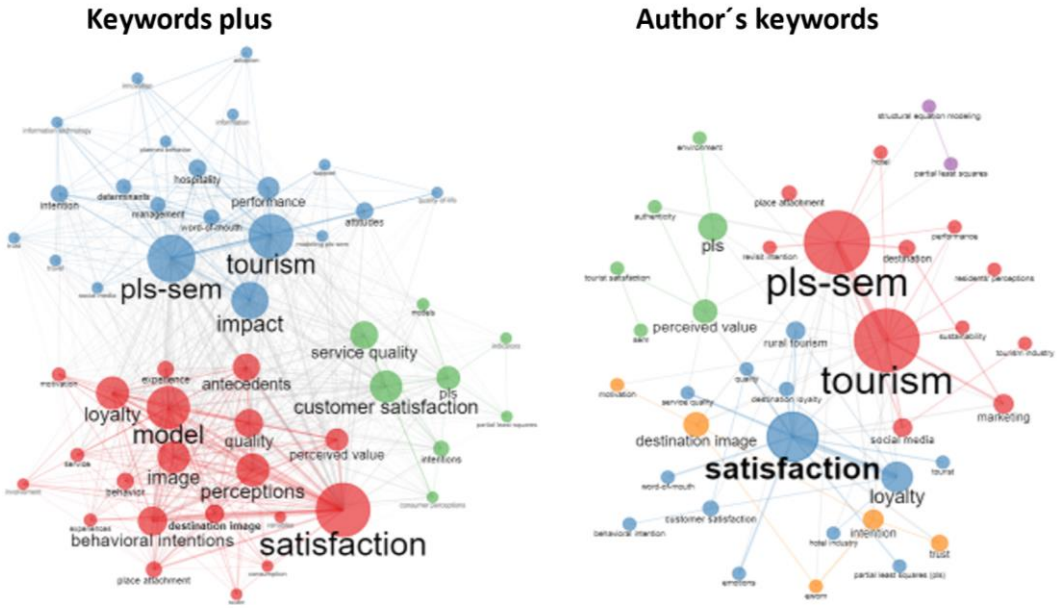

Figure 5. Co-occurrence Network
Source: own elaboration based on WoS data.

Figures 6 and 7 show the collaboration networks that exist between the various authors and institutions, differentiated by colour and size of the circles, where it can be

seen how among the authors there are 6 collaborative groups where the largest one consists of 5 researchers and the one that generates the most is the one led by Rasoolimanesh SM, as mentioned by Donthu, Kumar and Patnaik (2020) the greater number of author affiliations has given rise to a greater number of publications, while on the other hand, among the institutions we find 8 collaboration groups, the most important of which is the one formed by the University Sains Malaysia, University Newcastle, Univesity Putra Malaysia, Hamburg Univ Technol Tuhh, UCSI University and Monash University Malaysia. We can also observe that the University of Extremadura, which is the second university with the second-highest number of publications, does not have any collaborative relationships with other universities. The other Spanish universities in the top 9, mentioned in table 2, do not have inter-institutional collaborations either, and there is an area of opportunity to increase their research if they were to carry out joint research.

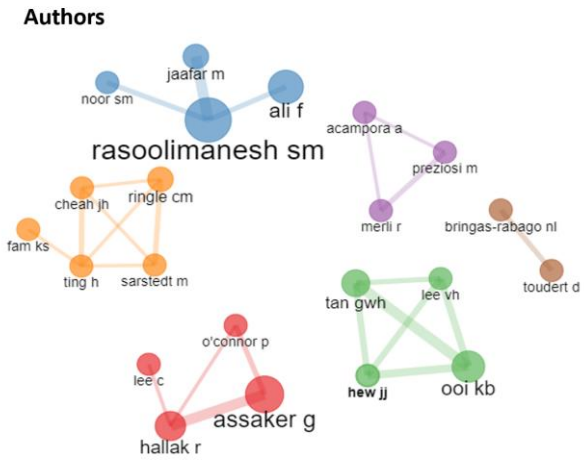

Figure 6. Authors collaboration network
Source: own elaboration based on WoS data.

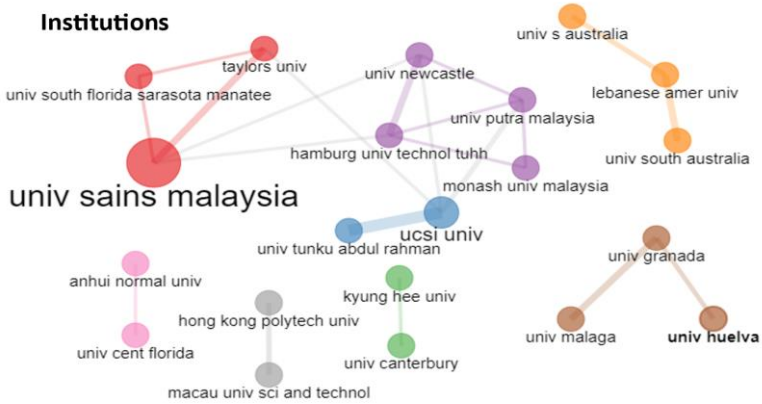

Figure 7. Institution's collaboration network
Source: own elaboration based on WoS data.

To show in a simpler way how the scientific production of the application of PLS in tourism is distributed worldwide, a world heat map is shown in figure 8, where the higher the intensity of the blue colour corresponds to a higher production, and the grey

colour corresponds to all those countries that do not have publications on the subject, and also shows the relationships between the different countries, taking as a parameter having at least 3 collaborations together.

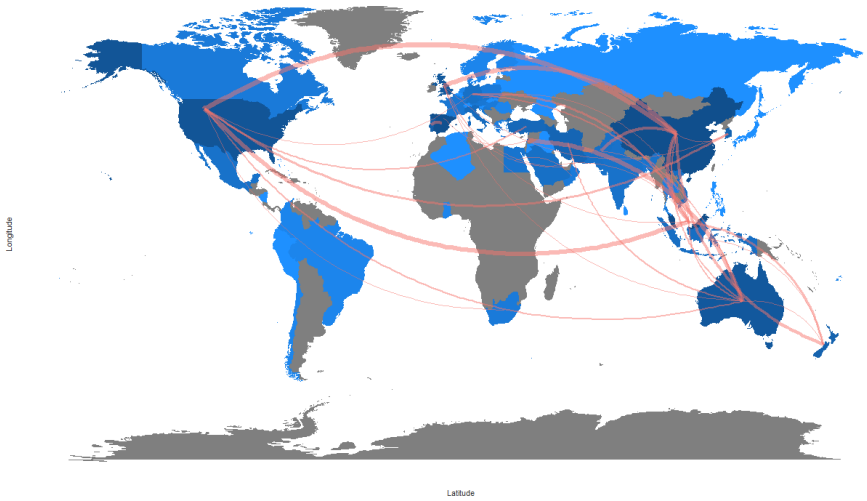

Figure 8. Heat world map
Source: own elaboration based on WoS data.

5. Conclusions

Bibliometric studies are always necessary in any of the different disciplines as they provide useful and timely information to researchers (Koseoglu et al., 2016), these are characterised by the use of statistics to analyse the academic literature (Ruhanen et al., 2015). The most prominent justifications for using PLS-SEM are attributed to: non-normal data, small sample sizes and formatively measured constructs (Hair Jr et al., 2014), it should also be noted that PLS-SEM is not a miracle cure for investigations with small sample sizes (Usakli & Kucukergin, 2018). In this research, publications in Web of Science databases of papers containing the terms PLS and tourism were reviewed, and the review period was from 2000 to 2020.

The main advantage of CB-PLS over PLS-SEM is that it provides a universal goodness-of-fit index of the structural model (Zatori, Smith, & Puczko, 2018), while the advantages of PLS-SEM over CB-SEM are that it can better deal with a complex model, unrestricted use of moderating variables, non-linear terms, a small sample size, a non-normal data distribution as it makes no distributional assumptions, formative measures and predictive and exploratory research (Ahrholdt, Gudergan, & Ringle, 2019; Brown et al., 2016; Suhartanto, Dean, Nansuri, & Triyuni, 2018; Zhang, Wu, & Buhalis, 2018).

As can be seen, despite criticism, PLS-SEM is becoming increasingly popular and is being used more frequently to estimate structural models in research (Ali, Rasoolimanesh, et al., 2018), where there is clearly an increase in annual publications, with 101 in 2020, with Spain being the most productive country and with the highest number of affiliations in the top 9, also noting that there are 149 journals with publications on the subject and that 85% of them have only 1 or 2 articles published, so it can be said that there are no journals dedicated to this type of research. This study

also shows the number of publications, the number of citations and the different indexes obtained by the main researchers in the field, leaving the reader the option of choosing which one, according to their personal criteria, they are going to choose as the most relevant.

One of the limitations of the present study is that it has only focused on Web of Science databases, giving rise to the recommendation that future research should take into account a greater number of databases in order to deepen the knowledge that can provide a broader view of the phenomenon of the application of the PLS technique in tourism-based studies.

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