Programa de Doctorado en Economía:
Instrumentos del Análisis Económico

ENSAYOS SOBRE EFICIENCIA Y TURISMO INTERNACIONAL

ESSAYS ON EFFICIENCY AND INTERNATIONAL TOURISM

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UNIVERSIDAD DE CANTABRIA

TESIS DOCTORAL

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UNIVERSIDAD DE CANTABRIA
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ESCUELA DE DOCTORADO DE LA UNIVERSIDAD DE CANTABRIA

SANTANDER, 2019

UNIVERSIDAD DE CANTABRIA

ESCUELA DE DOCTORADO DE LA UNIVERSIDAD DE CANTABRIA
DOCTORADO INTERUNIVERSITARIO DE ECONOMÍA DE LAS UNIVERSIDADES DE CANTABRIA, OVIEDO Y PAÍS VASCO

PROGRAMA DE DOCTORADO EN ECONOMÍA: INSTRUMENTOS DEL ANÁLISIS ECONÓMICO

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PhD Thesis

ESSAYS ON EFFICIENCY AND INTERNATIONAL TOURISM

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Escuela de Doctorado de la Universidad de Cantabria
Santander 2019

AGRADECIMIENTOS

A través de estas líneas quiero dedicar la finalización de esta Tesis Doctoral a todas aquellas personas que me han acompañado y dado su apoyo, consejo y ánimo a lo largo de este proceso, sin las cuales no hubiera sido posible lograr este objetivo.

En primer lugar, quiero agradecer a mi director de la tesis, el doctor y catedrático, D. Pablo Coto Millán que me guió durante este tiempo hasta el final de mi tesis. Con un agradecimiento especial me gustaría referirme al profesor Dr. Xosé Luis Fernández por transmitirme su conocimiento, apoyo y optimismo, y por tener siempre la puerta abierta para recibirme. Sin su generosidad, esto no habría sido posible. También me gustaría expresar mi agradecimiento a Marta Elisa De La Fuente Renteria, al miembro del departamento de economía Enrique Martinez Mantilla y a Ramón Gomez Vega de la Escuela de Doctorado de la UC por su apoyo y optimismo.

En segundo lugar, quiero agradecer al profesor Dr. Daniel Díaz Fuentes por ayudarme en mi primer contacto con el Programa Europeo de Becas y que me dio a conocer el programa de Doctorado en Economía de la Universidad de Cantabria. También me gustaría agradecer a los demás docentes y a mis compañeros del Departamento de Economía por su profesionalidad, amabilidad y compañerismo.

En tercer lugar, quiero dar las gracias a las personas a cargo de la biblioteca de la universidad por darme la oportunidad de dedicarme a la ciencia.

A toda mi familia y a mi hermano que cuidó a mis padres mientras yo estaba fuera. Él ha sido lo que me ha acompañado en los buenos y malos momentos y los que me ha transmitido siempre la fuerza necesaria para continuar.

Agradezco a la Comisión Europea por proporcionarme esta beca y la oportunidad de realizar mi sueño de ser alguien en esta la vida. Por último, yo agradezco a Dios que me dio la oportunidad de estudiar en España, darme conocimiento y paciencia necesaria para terminar la tesis.

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1. INTRODUCTION

Esta tesis doctoral consta de tres ensayos sobre la economía del turismo. En el primer y tercer ensayo se realiza un análisis de eficiencia turística de las regiones españolas y de los factores que pueden estar determinando su evolución. En el segundo ensayo se hace una profunda revisión bibliográfica sobre la literatura que analiza la eficiencia turística a nivel mundial. El período de análisis abarca desde la última mitad del siglo XX (entre 1978 en el caso del estudio de la bibliografía turística, año en el que Charnes, Cooper y Rhodes introducen el Análisis Envolvente de Datos) hasta el periodo más reciente de nuestra economía (2018 en el tercer ensayo). En los dos ensayos que analizan la eficiencia turística en España el periodo comprende desde inicios del siglo XXI (2008 en el caso de la eficiencia de los destinos turísticos españoles) hasta los datos más actuales disponibles en este momento.

El turismo se ha convertido en el sector que más valor aporta a la economía española tanto en producción generada (14.6% del Producto Interior Bruto), saldo comercial con el exterior (55% de las ventas de servicios al exterior que se traducen en un superávit de 40.455 millones de euros en 2018), empleo generado (2.8 millones de empleos en 2018) (Instituto Nacional de Estadística, 2019, World Travel & Tourism Council, 2019, Banco de España, 2019). Según Frontur (2018), más de 80 millones de turistas extranjeros visitan España anualmente. Varios factores ambientales (clima, ubicación geográfica, atractivo natural, entre otros) pueden contribuir a que el “atractivo turístico” de un territorio sea diferente. Además de los factores naturales, la acción (o inacción) del hombre (cultura, infraestructura y servicios, gestión turística, seguridad…) puede afectar al desarrollo turístico de un territorio.

Asumiendo las condiciones naturales de partida, esta propuesta de tesis doctoral tiene como objetivo ampliar la literatura sobre la "productividad y eficiencia" del destino turístico al determinar si las regiones españolas están utilizando sus recursos de manera óptima. Por otro lado, esta investigación pretende contribuir al conocimiento de los factores determinantes de la eficiencia turística de un territorio. Así, dado que el análisis

cubre el período de inestabilidad provocada por el proceso político en curso que persigue la salida del Reino Unido de la Unión Europea (Brexit), se estudiará el impacto del Brexit sobre la eficiencia de las regiones españolas en el contexto de los cambios globales. En general, investigaremos la importancia de las regiones en términos de eficiencia turística. Cómo afecta la desintegración de uno de los miembros de la UE al turismo regional de España y los cambios en el mercado turístico español en su conjunto.

Como principal marco de estudio metodológico en este trabajo se ha usado el método no paramétrico de Análisis Envolvente de Datos (DEA). Teniendo en cuenta el hecho de que hoy la DEA es una de las herramientas de la investigación de relaciones entre insumos y resultados más populares para el análisis de la eficiencia, la cuestión de un modelo econométrico con el que se realizará este análisis también se considera por separado. En los últimos 40 años, los artículos de revistas que utilizan el método DEA han crecido exponencialmente (Emrouznejad y Yang, 2018; Kohl et al., 2018). Este hecho nos permitirá analizar qué tan ampliamente se utiliza el método DEA en el turismo. Descubriremos si el trabajo del turismo regional prevalece entre otros subsectores turísticos.

El primer ensayo se analiza cómo el Brexit afecta el turismo regional en España a través del turismo. El período de estudio incluye la reciente situación del Brexit en 2016 y sus repercusiones en la economía europea y española. Este hecho nos permitirá analizar cómo el proceso en curso de salida de la UE por parte del Reino Unido está afectando a la eficiencia turística española. La pregunta principal es si proceso de salida del Reino unido de la UE está afectando a la eficiencia turística del resto de países de la UE, sobre todo a su principal país receptor (España). Cabe recordar que el status quo actual sobre la libre circulación de ciudadanos del Reino Unido (respaldado por la legislación sin visado del Parlamento Europeo y el Consejo del 29 de abril de 2004 (Directiva 2004/38 / CE)) en la UE (legislación de la UE sobre libertad de circulación y residencia, Diario Oficial DO L 158 de 30.4.2004, pp. 77-123) puede verse alterado por un Brexit sin acuerdo. Este trabajo estima la eficiencia técnica (TE) correspondiente a 17 regiones turísticas españolas durante el período 2008-2017, separando el estudio en el periodo

antes del Referéndum de Salida de la UE celebrado en Reino Unido en 26 de junio de 2016 y después del Referéndum.

En el segundo ensayo se realiza una profunda revisión bibliográfica sobre el análisis de eficiencia en el sector turístico usando el método DEA entre 1978 y 2018. Desde el primer trabajo de Charnes et al. (1978) se han escrito múltiples artículos que usan el modelo DEA en turismo. Los resultados del proceso de revisión de la literatura revelaron que las publicaciones sobre DEA han aumentado exponencialmente desde principios de 1980 (Emrouznejad y Yang, 2018; Paradi y Zhu, 2013; Kohl et al., 2018; Liu et al., 2013). Sin embargo, hasta donde sabemos, la literatura turística actualmente carece de una revisión y análisis significativos de los trabajos que estudian la eficiencia del turismo usando el DEA. Esta investigación permitirá llenar este hueco y proporcionar una revisión crítica de la aplicación de la DEA en el turismo, al destacar varios puntos clave de la medición de la productividad, la eficiencia o el rendimiento de las unidades de toma de decisiones (DMU) en los subsectores del turismo que guían la metodología a nuevos investigadores y trabajos futuros.

El tercer ensayo de este trabajo de investigación analiza los determinantes (ambientales y de gestión) que están impactando de forma positiva (o negativa) en los niveles de eficiencia turística de las regiones españolas durante el periodo 2008-2018. Este ensayo presenta dos novedades principales: (1) Se tiene en cuenta la heterogeneidad de las regiones españolas como punto de partida. Así, utilizando los criterios del Instituto Geográfico Nacional (2018), se diferencian dos grupos de regiones según su orientación turística: regiones especializadas en turismo, y regiones no especializadas en turismo. A nivel metodológico, se introduce el concepto de Meta-Frontera (Battese et al., 2004 y O'Donnell et al., 2008) que nos permite calcular los niveles de eficiencia teniendo en cuenta que las regiones españolas parten de un nivel tecnológico (especialización turística) diferente. (2) Los determinantes de la eficiencia se evalúan de forma separada para los dos tipos de regiones, lo que permite verificar si el impacto de los determinantes del desempeño varía según la orientación turística de las regiones.

Finalmente, se incluye un capítulo de resumen y conclusiones, en el que se destacan las principales conclusiones obtenidas en los tres ensayos analizados.

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2. BREXIT AND TOURISM EFFICIENCY: SPANISH CASE

Abstract: This paper considers the impact of UK visitors on Spanish tourism efficiency from period 2008 to 2017. Using Data Envelopment Analysis (DEA) methods, the tourism efficiency of 17 Spanish regions were estimated. Secondly, the relationship between the UK incoming tourists and the Spanish tourism efficiency were evaluated both before and after the Brexit referendum. Results suggest that UK tourist's influence Spanish tourism efficiency and the 2016 Brexit referendum has marked a shift in this relationship.
The average tourism efficiency of Spanish regions is 0.79. The most efficient region is Balears Illes.

Keywords: Brexit referendum, Spain, Tourism efficiency, DEA, Regional tourism.

Resumen: Este trabajo considera el impacto de los visitantes del Reino Unido en la eficiencia del turismo español en el periodo entre el 2008 a 2017. Utilizando métodos de Análisis Envolvente De Datos (DEA), se estimó la eficiencia del turismo de 17 regiones españolas. En segundo lugar, se evaluó la relación entre los turistas entrantes del Reino Unido y la eficiencia del turismo español antes y después del referéndum del Brexit. Los resultados sugieren que la influencia de los turistas del Reino Unido en la eficiencia del turismo español y el referéndum Brexit de 2016 ha marcado un cambio en esta relación. El promedio de la eficiencia turistica de las regiones españolas es de 0,79. La región más eficiente es Baleares.

Palabras-clave: Referéndum Brexit, España, Eficiencia turística, DEA, Turismo regional.

JEL: D02; F6; L83; Z32.

2.1. Introduction

According to the United World Tourism Organization (UNWTO, 2017), tourism is one of the largest and fastest growing socio economic sectors of our times. It can stimulate economic growth, create jobs and business opportunities, helps millions of people to escape poverty and improve their livelihoods.

To successfully generate income, countries compete to attract international tourism. The result is that the tourist market is ever more competitive. The most visited part of the world in a competitive environment is the European Union (EU) concentrating 43.57% global tourism over the last two decades (World Bank, 2018). Three out of the top five visited countries are from the EU (France, Spain and Italy). In addition, according to the Statistical Office of the European Union (Eurostat, 2016), the number of tourists arriving in the EU increased by almost 80% between 2004 and 2014. In this sense many authors agree that the growth of world tourism goes hand in hand with an increase in the number of agreements on the free movement of people. Hospers (2002), Hegarty and Przezborska (2005), Coles and Hall (2005), Gligorijevic and Petrovic (2009), Rey *et al.*, (2011) provide evidence of the positive impact of integration on tourism.

But nevertheless, regional disintegration processes have taken place, such as the Union of African States (UAS) in 1963, the Southeast Asia Treaty Organization (SEATO) in 1977, the Central Treaty Organization (CENTO) in 1979, the Soviet Union (USSR) in 1991, and the Organization of African Unity (OAU) in 2002.

On the whole, researchers agree that disintegration processes is disadvantageous to industry and trade. Commander and Yemtsov (1999) claim that soon after the USSR disintegration, between 1992 and 1994, Russia has lost 6 million jobs in all industries. Aslund *et al.* (1996) likewise highlighted the disruption of production in the former USSR states. More statistics about the negative effect after the collapse of the USSR led by Milanovic (1998). Furthermore, Blazek (1995) claims that disunification of Czechoslovakia splitting up affected the food industry from the eastern part of the Czech Republic - Moravia.

2.1.1. Brexit and Tourism: The Spanish context

Spain is one of the major tourist powers in the world, receiving over the last twenty years 14.65% of all EU income tourists (World Bank, 2018). The pleasant climate throughout the year and the vast sandy beaches have attracted foreign tourists for years. According to the Survey of tourist movements at frontiers (Frontur) in 2017 Spain received 81,786,364 tourists, representing a year-over-year increase in the range of +7.06%.

The UK is the most significant source market to the Spanish tourist sector, with a concentration of 22.96% (18,779,466) of all Spanish visitors in 2017. Moreover, since Spain joined the EU in 1986, the UK tourists show the highest rates in visiting Spain among all international tourists. The tourist flow from the UK has increased by 33.29% over the last two decades. According to the UK's Office for National Statistics in 2016 (as in 2015), the UK citizens predominantly visited Spain among the other EU member states; slightly less 32% from all visited countries. Overall, in 2016 all EU member states have been visited by 49,602,546 UK residents. However, the trend is changing, especially over recent years. Thus, from 2008 to 2017 the UK visitors share has fallen by 16.7%.

For a quarter of a century, intensive efforts were made to create a single market for the European Union. The Treaty of Maastricht establishes the free movement of persons in 1992. The gradual phasing-out of internal borders under the Schengen agreements were followed by the adoption of Directive 2004/38/EC on the right of EU citizens and their family members to move and reside freely within the EU.

On June 26, 2016, the UK announced a positive decision of the referendum on leaving the EU (hereinafter referred to as Brexit). This fact has altered the EU status quo in many issues including tourism. Currently, the free movements of the UK citizens are supported by no-visa legislation of European Parliament and the Council of 29 April 2004 (Directive 2004/38/EC) on the right of citizens of the Union and their family members to move and reside freely within the territory (EU legislation on freedom of movement and residence, Official journal OJ L 158, 30.4.2004, pp. 77-123). In fact, on March 29, 2017, in writing to European Council President Donald Tusk, the Prime Minister Theresa May formally triggered Article 50 and began the two-year countdown on the Brexit finalization.

However, after almost 3 years from the referendum date and the beginning of the Brexit issue, there is still no certainty as to how the situation will end. There are many scenarios about the future of the exit as well as the possible consequences for both, the UK and the EU. On March 20, 2019, The Prime Minister writes to European Council President Donald Tusk, asking to extend Article 50 until 30 June 2019. Taking into account the transition period proposed by the EU, the situation again hangs in the air expecting to see what happens on 30th June. This transition period gives time and opportunity to tourism and non-tourism companies and other enterprises to organize what may be necessary to prepare for new rules for the UK after leaving the EU. The UK was supposed to resolve this situation by December 31, 2020. Despite this, after the British Parliament voted on March 29, 2019 against the withdrawal agreement, the Extraordinary European Council was convened on April 10, 2019, in which the agreement was extended until October 31, 2019. If the agreement ratified before this date, then the UK leaving the EU will be carried out on the first day of the next month (Annex 2.1.1).

Since this is a recent phenomenon, as far as we know, only few studies in the literature analyze the influence of Brexit on tourism. Perles-Ribes *et al*. (2019) found that Brexit did not have the first negative impact on the arrival and expenses of British tourists to Spain in the period from summer 2016 to autumn 2017. Pappas (2017) discovered the impact of pricing issues after the Brexit referendum on tourist flows in the EU.

Despite the substantial relationship between tourism and regional integration, as far as the authors are aware, no studies have been conducted evaluating the impact of disintegration processes on tourism efficiency. To fill this gap, this article aims to analyze whether Brexit affects the efficiency of Spanish tourism.

The rest of the paper is structured as follows: The second section is devoted to a review of the literature on specific works in this field from the late eighties to the present. The third section presents an empirical model for estimation. The fourth section describes the data and presents descriptive statistics of the variables used. The fifth section displays the relevant results, and the final section highlights the conclusions of the research.

2.2. Literature Review

Despite the abundance of literature in the field of efficiency, seemingly, there are no such studies regarding the extent to which tourism affects regional efficiency. Hence, starting with the early work of Banker and Morey (1986), researchers have focused mainly on the efficiency of tourism sub-sectors. The majority were focused on the hotel business (Johns et al., 1997; Anderson et al., 1999; Tsaur, 2001; Hwang and Chang, 2003; Morey and Dittman, 2003; Sigala, 2003; Barros and Alves, 2004; Fuchs, 2004), restaurant business (Banker and Morey, 1986; Donthu and Yoo, 1998; Donthu et al., 2005; Gimenez-Garcia et al., 2007) and travel agencies (Barros and Dieke, 2007; Fuentes, 2011; Blancas-Peral et al., 2014; Ramírez-Hurtado and Contreras, 2017).

Few studies were carried out at the level of domestic tourism efficiency. Thus, a geographically broader study is Assaf and Josiassen (2012), which evaluates 120 countries located in Africa, the Americas, Asia, Europa, and Oceania. The authors identify ten negative and positive determinants of tourism performance. Abad and Kongmanwatana (2015) estimate the tourism performance of 27 EU countries, and find that 14 EU countries must demonstrate room improvements to achieve best practice procedures.

Concentrating on Italy, Bosetti et al. (2004) assess the efficiency municipalities in coastal areas while Cracolici et al. (2008) evaluate the tourism performance of 103 Italian destinations. Bosetti and Locatelli (2006) performed an efficiency analysis of the 17 Italian National Parks. Bosetti et al. (2007) evaluate the efficiency of the sustainable tourism management of the twenty Italian regions. Finally, using a DEA analysis, Cuccia *et al.* (2016) explore the effects of cultural heritage in stimulating tourism demand. In the case of France, Botti *et al.* (2009) study the performance of the 22 French regions. Barros *et al.* (2011) evaluate tourism performance for 22 regions concluding that attractions can increase the tourists' length of stay.

Studying the efficiency of 17 Spanish regions in 2010, Martin *et al.* (2017) found that Madrid, La Rioja and the Basque perform more competitively. Ma *et al.* (2009) by

assessing the efficiency of 136 Chinese national parks found that the usage efficiency of the national parks is located at varying distances from the usage efficiency frontier.

A specified (by: Author, Methodology, Sample, Country and including Input and Output with Empirical results) illustration of a literature survey on tourist efficiency is given in table 2.2.

Table 2.2: Survey of the literature review on efficiency

Authors/ s (years)	Methodology	Sample/ Country	Inputs	Outputs	Empirical results
Banker and Morey (1986)	Input and output-oriented DEA.	60 Fast food restaurants in the USA.	Labor, advertising expenditures, age of the store, location and existence of drive-in window.	Breakfast, lunch and dinner sales.	Inputs permits to targeted increases in the controllable outputs.
Johns *et al.* (1997)	Input-oriented DEA.	15 British hotels (same chain).	Room per nights available, labour hours, f&b costs, total utilities costs.	Room per night sold, served covers, beverage revenue.	The hotels perform with similar efficiency.
Donthu and Yoo (1998)	DEA.	24 restaurants in the USA (chain).	Store size, manager experience, promotions.	Sales and customer satisfaction.	The store's performance is consistent over time.
Anderson *et al.* (1999)	SFA.	48 hotel companies in the USA.	Number of employees, rooms, expenses of gaming, f&b expenses and	Rooms, gaming, f&b revenues and other revenues.	High efficiency performance of hotels in the USA.

			other expenses.		
Tsaur (2001)	DEA.	53 international hotels Taiwan.	Total operating expenses, number of employees, rooms, total floor space of the catering division.	Total operating revenues, number of occupied rooms, average daily rate, average production value per employee	Almost three out of four hotels are considered inefficient.
Hwang and Chang (2003)	Output-oriented DEA, MI.	45 hotels from 1994 to 1998 in Taiwan.	Number employees and guest rooms, total area of meal department and operating expenses.	Room and f&b revenue, other revenues.	Difference in efficiency change due to difference in sources of customers and management style.
Morey and Dittman (2003)	Input-oriented DEA, Benchmarking.	54 USA hotels in 1993.	Average daily rate, occupancy rate, nonunion employees, number of rooms.	Service level, total room revenue.	34 from 54 properties have an inefficiency type.
Sigala (2003)	Output-oriented DEA, Benchmarking.	Marketing strategies for 60 Greek hotels.	Customer relation, VIS, VCS, VTS, VDS.	Number of websites' visit, requests, ADR reservations, quality of customer service.	Hotels in Greece use their I-network and interactive capabilities in a limited fashion.

Bosetti *et al.* (2004)	DEA.	70 Italian municipalities, for 2000-2001.	Number of beds, Solid Waste.	Profit from tourism.	Decreasing of yearly produced waste is the main revel of efficiency increasing.
Barros and Alves (2004)	Output-oriented DEA, MI TFP.	Portuguese public-owned hotel chain for 1999-2001.	Number of workers and their salary, physical capital (external costs, operating costs, and book value of the property).	Sales, number of guests and spent nights in the hotel.	Some hotels experience productivity growth while others face a decline.
Donthu *et al.* (2005)	DEA, Benchmarking.	26 fast food outlets in the USA.	Manager experience, number of employees, advertising expenses.	Sales and customer satisfaction.	Benchmark of fast-food outlets.
Bosetti and Locatelli (2006)	DEA, Benchmarking.	17 Italian National Parks	Economic, management, variable costs and extraordinary expenses.	Number of visitors, protected species, parks employees, and linked economic business.	Impact of economic business created thanks to the park.
Gimenez-Garcia *et al.* (2007)	DEA.	54 restaurants of a Spanish fast-food chain.	Total service staff, number of seats, location index, average spending per customer, number of competitors.	Quality index and sales.	Efficient restaurants can improve their output after a reallocation of inputs.

Cracolici *et al.* (2008)	DEA, SPF.	103 Italian regions in 2001.	CPH, TSG, ULA.	Bed-nights.	The DEA results show a low average technical efficiency.
Ma *et al.* (2009)	DEA.	136 national parks in China for 2005.	Area, Expenditure, Investment, Employees.	Revenues.	The national parks perform with insignificant efficiency
Fuentes (2011)	DEA, smoothed bootstrap and U test.	22 travel agencies in Alicante (Spain).	The number of employees, annual expenditure, the potential service.	The number of customers, the average spends per customer.	7 of the 22 agencies assessed are efficient.
Barros *et al.* (2011)	DEA, bootstrapped truncated regression model.	Tourism performance of 22 French regions.	Accommodation capacity and arrivals.	Night slept.	Attractions can increase the tourists' length of stay.
Assaf and Josiassen (2012)	DEA and bootstrap regression model.	Tourism performance of 120 countries for 2005-2008.	Number of employees, investments by governments on tourism, available accommodation.	Number of international and domestic tourists, the average length of stay of international and domestic tourists.	10 negative and positive determinants of tourism performance were indicated.
Abad and Kongmanwatana (2015)	DEA, super-efficiency	The tourism performance of 27 EU countries.	Human resources, hotels and similar establishments, campsites, tourism attractions.	Bed-nights in hotels and similar establishments, nights spent in campsites.	14 EU countries need to show room improvement to achieve best-practice procedures.

Cuccia *et al.* (2016)	DEA	Effect of the UNESCO WHL on Italian regions for 1995-2010.	1. Total arrivals and accommodation capacity. 2. Accommodation capacity in hotel and other establishments, arrivals in hotel and other establishments.	1. Total nights slept. 2. Nights slept in hotel and other establishments.	While cultural and environmental endowment positively affects the performance, the presence of UNESCO sites exerts opposite effects.
Martin *et al.* (2017)	DEA, super-efficiency DEA.	17 Spanish Autonomous Communities in 2010.	Marketing and commercial support, connectivity and transport accessibility, tourist regulation and other conditions.	Diversification of tourist products, talent attraction, training and efficiency of H&R, tourism governance, social and economic outcomes.	Madrid, La Rioja, the Basque country, Galicia and Andalusia are the most competitive.

Note: DEA: Data Envelopment Analyses. SFA: Stochastic Frontier Analysis. MI: Malmquist Index. TFP: Total Factor Productivity. SPF: Stochastic Production Frontier. CPH: cultural patrimony and heritage standardised for population. TSG: tourist school graduates divided by working age population. ULA: labour units employed in the tourism sector. VRS: Variable Returns to Scale. VIS: Virtual Information Space; VTS: Virtual Transaction Space; VDS: Virtual Distribution Space; VCS: Virtual Communication Space; F&B: Food and Beverages; ADR: Average daily rate; WHL: World Heritage List.
SOURCE: Self-elaboration.

2.2.1. Input and Output variables in tourist efficiency

Tourism performance is often measured either in terms of the number of tourist arrivals, tourist bed-nights and/or in terms of tourist expenditure in the destination country (Ouerfelli, 2008). Illustrative examples of these variables in international issues are shown by recent studies of Assaf and Josiassen (2012), and Abad and Kongmanwatana (2015).

Apart from the above variables, many papers use rates of employment as labour proxy. It is common logic that selecting this variable is the most appropriate to disclose the firms' efficiency. Chiang *et al.* (2004) considered the employment status as one of the primary input variables. Employment rates are also used in the Koksal and Aksu (2007), Luo *et al.* (2014) and Fernandez and Becerra (2015).

The aspect of accommodation is supported by Johns *et al.* (1997); Wang *et al.* (2006); Yu and Lee (2009); Hsieh *et al.* (2010); Devesa and Penalver (2013). A principal question for tourists' destination is determined by weather and accommodation. Kozak (2002) highlights the motivations of British and German tourists on visiting destination countries. In his work Spanish weather and accommodation were the leading incentives in selecting destination for UK tourists. Accommodation being the chief reason at 16.2%, followed by the weather at 13%.

Weather is considered a critical variable in tourism in choosing a destination. Taylor and Ortiz (2009) used the weather as the definitive factor of domestic tourism in the UK. They found that the mean temperature and the sunshine hours have a significant impact. For Italian domestic tourism, Bigano *et al.* (2005) found that domestic tourism is strongly affected by extreme weather events and monthly temperature rates. Hein *et al.* (2009) found that climate is the critical concept for the tourism industry in Spain (including north-west Europe). Moreover, Bujosa and Rossello (2013) identified that the average daytime temperature is one of the critical factors that explain the choice of coastal destination for domestic tourism in Spain.

On the whole, the literature on tourist efficiency is highlighted by Johns *et al.* (1997); Anderson *et al.* (1999); Brown and Ragsdale (2002); Morey and Dittman (2003); Barros and Alves (2004); Donthu *et al.* (2005); Gimenez-Garcia *et al.* (2007); Assaf and Matawie (2008); Fuentes (2011).

To conclude, the literature review has shown that, there has been an exponential growth of studies in tourism efficiency using the method of Data Envelopment Analysis (hereinafter refered as DEA) over the last two decades. Nevertheless, despite the large number of these documents, in general there is no research on Spanish tourism in cases

of disintegration. Moreover, as far as the authors are aware, there have been no studies using DEA method on evaluation of Spanish tourism against the background of Brexit situation.

2.3. Theoretical and empirical model

To estimate efficiency, one may use methods of statistical and econometric approaches. Efficiency measurement in empirical research has multiple applications. The most used methodological approaches are the first naïve method of parametric stochastic frontier analysis (SFA) (Aigner *et al.*, 1977) and non-parametric approach Data Envelopment Analysis (DEA) (Charnes *et al.*, 1978).

We adopted DEA because it has several advantages over other methods. Due to its flexibility in used variables and the conditions under which the Spanish tourism runs, this method is the most accurate for our research. DEA measures the relative performance of organisational units presented by multiple inputs and outputs. The methodology can be applied to draw both technical and scale efficiency. In this method, if production appears within the production set, a firm is counted technically inefficient. The measurement of the Decision Making Unit (DMU) inefficiency is assessed by the distance from its observed input and output values to the production frontier (Coelli *et al.*, 2005).

DEA model can be input or output oriented. In the study of the Spanish tourism sector, the choice of an output-oriented specification, instead of an input-oriented model, can be justified by the conditions under which the Spanish regions develop their tourism policy. Tourism policy is geared towards increasing tourists' arrivals and spending. Thus, for the *j* Spanish tourists regions out of *n* regions, the output-oriented technical efficiency under constant return to scale (CRS) is obtained by solving the following linear programming problem.

$$\underset{\theta_j^{CRS}\ \lambda}{Max}\ \ \theta_j^{CRS}\ \ subject\ \ to{:}\ \theta Y_j \leq Y\lambda;\quad X_j \geq X\lambda;\ \lambda \geq 0 \qquad (2.3.1.)$$

Where X is input and Y is output vector, $\varphi_j^{CVS} = {1}/{\theta_j^{CVS}}$ is the technical efficiency (TE) of the Spanish regions under CRS and λ is an *n x 1* vector of weights. The contribution of the efficient regions measured by the non-negative weights λ is selected as a determiner of a point of reference for the inefficient *j* Spanish regions. Generally, if the region is serving for tourists on the production frontier and answer to $0 \leq \varphi_J^{CRS} \leq 1$, where $\varphi_J^{CRS} = 1$, it is technically efficient. When $\varphi_J^{CRS} < 1$, the region is technically inefficient. In the case of variable return to scale (VRS), it is a technical efficiency φ_J^{VRS} added the convexity constraint $\sum_{j=1}^{n} \lambda_j = 1$ to (1). One can see more in Banker *et al.* (1984).

To estimate the effect of *Brexit* on Spanish tourism efficiency, a two-stage bootstrap truncated regression procedure has been applied (Simar and Wilson, 2007). Simar and Wilson (2007) describe a data generating process under which two-step methods are consistent. An advantage of the Simar and Wilson (2007) bootstrap procedure is that it allows for obtaining both unbiased coefficients and valid confidence intervals. The discriminatory power of the first stage is not affected since the explanatory variables are not included in the first stage (Liebert and Niemeier, 2013). The regression is presented in applied form 2.3.2.:

$$\varphi_j = a + z_j\delta + \varepsilon_j \qquad (2.3.2.)$$

Where a is the constant term, ε_j is the error term, z_j is a vector (row) of potential covariates that are expected to be related to the DMU's efficiency score, φ. We apply the smoothing homogeneous bootstrap approach with 2000 iterations to overcome the potential problem of biased results in our second-stage regressions (for a more in-depth discussion see Simar and Wilson, 2000; Simar and Wilson, 2008).

The *impact* of tourism can be measured either by the inbound number of tourists or inbound earning. Thus, to analyze the impact of the UK withdrawal from the EU on the touristic efficiency we used two variables (as z-variables): *Brexit Effect (Tourist Share),* a measure of the UK tourists in total tourist visiting Spain, and *Brexit Effect (Spending Share)*, a measure of the spending of the UK tourists in total tourist spending in Spain.

To analyze the Brexit impact, both variables were split into two periods: for the period before the Brexit referendum (2008-2015) and after it (2016-2017).

2.4. Sources and Data

To evaluate the efficiency of the Spanish regions we considered data of the Statistical Office of the European Union (Eurostat) and the Survey of Tourist Movements at Frontiers (Frontur). We also used data of the Ministry of Agriculture and Fisheries collected by the State Agency of Meteorology (AEMET). All data has been obtained for 17 Spanish regions (Ceuta and Melilla are not included) for period 2008-2017.

The selection of output and input variables were based on a review of the international literature mentioned in section 2.2., and the data at our disposal. In the study, we used three input indicators: tourism employment, measured by the number of counts involved in the tourism sector. Tourism capacity, measured by the number of bedrooms available to receive tourists. Weather conditions, measured by the average length of sun hours in each region. Three indicators have been used as output: tourists' arrivals to Spain, measured in number of counts. Tourists spending, measured by spending amount in MLN Euros, and occupancy rate measured by % rate of bedrooms occupied by tourists in given years. The descriptive statistics of the variables used in the analysis one can see on table 2.4. and 2.4.1.

Table 2.4: Summary statistics of inputs and outputs

	Variables	Definition and units	Minimum	Maximum	Mean	Standard deviation
	Tourists arrivals to Spain	Number of tourists arriving to Spain	53.02	19046.72	3685.53	4867.14

Outputs	**Tourists spending**	Spending amount by tourists	0.05	18.65	3.49	4.80
	Occupancy rate	Rate of bedrooms occupied by tourists	23.37	78.69	43.76	12.31
	Tourism employment	Employment involved in tourism sector	8.57	272.92	82.63	72.36
Inputs	**Tourism capacity**	Number of bedrooms available to receive tourists	5.83	252.29	83.50	82.99
	Weather condition	Average length of sun hours	121.48	271.21	213.65	43.00

Note: Variable occupancy rate is shown in %. Variable weather condition is shown in length of sun hours. Rests of the variables (tourism employment, tourism capacity, tourists' arrivals and tourists spending) are shown in digit of thousands.

Table 2.4.1: Summary statistics of variables in averages by regions for 2008-2017

Region	Tourists arrivals to Spain	Tourists spending	Occupancy rate (%)	Tourism employment	Tourism capacity	Weather condition
Rioja	75.56	0.60	42.38	8.96	6.00	205.85
Pais Vasco	1268.60	9.75	47.98	59.17	26.10	140.01
Navarra	240.20	1.16	36.66	16.02	11.59	175.26
Murcia	771.20	5.47	43.09	33.94	17.21	259.05
Madrid	4933.71	58.19	51.69	192.17	102.89	240.97
Galicia	952.58	4.76	32.65	71.38	61.96	175.81

Extremadura	211.94	0.76	30.61	22.09	18.96	251.54
Comunitat Valenciana	6191.58	53.82	55.03	142.14	121.23	246.38
Cataluna	15478.60	135.11	54.88	236.47	228.54	222.62
Castilla - Leon	1049.20	4.43	27.54	68.98	33.34	224.62
Castilla - La Mancha	184.98	1.37	33.25	41.22	58.93	245.40
Cantabria	340.00	2.37	40.40	18.61	16.13	129.21
Canarias	10781.53	116.41	70.62	119.89	221.70	242.85
Balears Illes	10954.74	104.38	61.50	85.88	187.91	222.63
Asturias	228.91	2.12	34.46	30.98	23.86	154.33
Aragon	388.52	2.14	32.84	35.89	37.48	236.01
Andalucia	8602.21	90.61	48.41	220.98	245.67	259.48
Total general	62654	593.462	743.99	1404.77	1419.53	3632.02

Note: Variable occupancy rate is shown in %. Variable weather condition is shown in length of sun hours. Rests of the variables (tourism employment, tourism capacity, tourists' arrivals and tourists spending) are shown in digit of thousands.

2.5. Results

As mentioned above regional efficiency levels are obtained by the DEA method using data for period 2008-2017. The second stage employed the Simar and Wilson's (2007) parametric regression. To mount the potential problem of biased results in the analysis' second-stage, we used the smoothing homogeneous approach with 2000 iteration.

Table 2.5. shows the tourist efficiency results under CRS, VRS and the scale efficiency for the 17 Spanish regions. The results revealed that the average technical efficiency is 0.79. However, no region remains on the frontier for the entire period of study. The most

efficient regions being (score between 0.90 and 0.99) Balears Illes, Rioja, Pais Vasco, Canarias, Navarra and Cataluña, whilst the lowest score regions are Castilla - La Mancha, Aragon, Extremadura, Castilla y Leon, Extremadura and Andalucía (under 0.65). All the rest regions (Galicia, Comunitat Valenciana, Madrid, Asturias and Murcia) show a score between 0.70 and 0.84.

Table 2.5: Ranked overall technical efficiency by the average scores of the tourism efficiency in Spain

Region	Technical efficiency (CRS)	Pure technical efficiency (VRS)	Scale efficiency
Balears Illes	0.99	0.98	1.00
Rioja	0.99	0.97	0.97
Pais Vasco	0.99	0.95	0.96
Cantabria	0.97	0.86	0.88
Canarias	0.95	0.92	0.97
Navarra	0.92	0.75	0.81
Cataluna	0.90	0.88	0.98
Murcia	0.84	0.80	0.95
Asturias	0.79	0.58	0.73
Madrid	0.77	0.75	0.97
Comunitat Valenciana	0.73	0.71	0.98
Galicia	0.70	0.49	0.70
Andalucia	0.64	0.58	0.91
Extremadura	0.62	0.44	0.70
Castilla - Leon	0.61	0.44	0.72
Aragon	0.52	0.38	0.73
Castilla - La Mancha	0.51	0.37	0.72

SOURCE: Self-elaboration.

As stated by Aguilo *et al.* (2005) Spain attracts international tourists with its *Sun and Sand* type of tourism, so it is understandable that regions with an exit to the seaside will show a higher score on tourism efficiency. Apart from the islands Balears Illes and Canarias, the seaside regions such as Cataluna, Murcia, Cantabria and Pais Vasco, are scored

above average. Geographically, these regions are in the east and north of the country. On the other hand, the interior areas such as Castilla - La Mancha, Aragón, Castilla y Leon and Extremadura show low-efficiency scores. Other regions as Navarra and Rioja (wine region) show above-average efficiency levels. Geographical map of the tourism efficiency in Spain (by regions, 2008 - 2017) shown in figure 2.5.

Figure 2.5: Tourism efficiency in Spain

SOURCE: Self-elaboration.

In order to analyse the extent to which the UK tourism inbound affects Spanish regional efficiency, the sample has been split into two subsamples, before the Brexit referendum, period 2008-2015, and after the Brexit referendum, period 2016-2017. Table 2.5.1. displays the estimates for the sample of 17 Spanish regions with overall technical efficiency scores and pure technical efficiency scores as dependent variables.

Table 2.5.1: Parameter estimates for the Simar-Wilson regression model

	Overall technical efficiency - CRS- (z-statistic)		**Pure technical efficiency -VRS- (z-statistic)**	
Explanatory factors	**Before Brexit**	**After Brexit**	**Before Brexit**	**After Brexit**

Tourist Share	-0.5070**	0.6126**	-0.2907**	0.3272**
	(-2.19)	(-2.12)	(-2.02)	(-2.24)
Spending Share	-0.6150**	0.6949**	-0.3146**	0.3710**
	(-1.99)	(-2.2)	(-2.01)	(-2.21)

Notes: ***, **, and *: Below the 1%, 5% and 10% statistical significance thresholds, respectively. Likelihood ratio chi-square (df = 2)

Parameters with positive signs in table 2.5.1. show a positive relationship between the corresponding explanatory variables and the efficiency as well as, parameters with negative signs which show a negative relationship between the corresponding explanatory variables and the efficiency.

Both variables *Brexit Effect (Tourist Share)* and *Brexit Effect (Spending Share)* perform similarly. Before the Brexit referendum, they show a significant negative coefficient both in overall technical efficiency (-0.5070, -0.6150) and pure technical efficiency (-0.2907, -0.3146). However, after the Brexit referendum, they show a significant positive coefficient (0.6126, 0.6949 and 0.3272, 0.3710). Results suggest that the Brexit referendum has had a positive effect on the Spanish tourism efficiency (the *Brexit paradox*). Intuitively we might think that the loss of UK tourist *market power* over the Spanish tourism (after the Brexit) follows this pattern. UK tourists represented a high percentage of tourism in Spain over the pre-Brexit period (24.3%). Yet, after the Brexit referendum, the UK lost part of its touristic market share (22.9%). Market power adversely affects efficiency since it affects tourist prices and conditions. As stated by Nickell (1996) the more extensive the market share, the lower the sector productivity level.

2.6. Conclusion

Using the DEA method based on two-stage efficiency analysis (Simar and Wilson, 2007) this study evaluated the tourist efficiency of 17 Spanish regions (2008-2017) against the

background of UK leaving the EU. To the best knowledge of authors, this paper is the first to evaluate the impact of the Brexit process on tourism efficiency using DEA method.

The analysis' first stage revealed that no region remains on the frontier for the entire period of study. We found that technical efficiency score for all the regions is averagely 0.79. Regions with *Sun and Sand* type of tourism are more efficient than the rest of the areas. Furthermore, regions located in the east and north of the country are revealed more efficient in tourism over the 2008 to 2017 period.

We estimated that Brexit effects on the efficiency of Spanish tourism and also verified empirically the UK tourist influences on Spanish tourism efficiency. However, the Brexit process conditions this influence. Thus, before the Brexit referendum, UK tourists had negatively affected the regional efficiency. On the contrary, results show a significant positive effect after the Brexit referendum. A possible explanation for these findings may relate to the uncertainty created after the 2016 referendum. The British tourist industry may have lost its favorable conditions in the Spanish tourism market. This loss in market power had positively affected the Spanish tourism efficiency due to its influence on tourist prices and therefore tourism expenditure.

To conclude, at this stage, it has been revealed that the initial impact of the Brexit process on Spanish tourism had been positive. However, the question is still open. Negotiations about future relations between the UK and the EU are now taking place. Future relations on trade, travel, and security are still being determined. Future studies will be necessary to assess a full picture of the Brexit impact on tourism. Complementary research might also highlight the question of income tourism in the UK itself.

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ANNEX

Annex 2.1.1: Brexit's sequence of events

Event Date	Event Description
	1. Events leading up to the EU Referendum on 23 June 2016
12/17/2015	The European Union Referendum Act receives Royal Assent, providing
2/22/2016	The Prime Minister announces the EU referendum date – 23 June 2016.
	2. Referendum – General Election
6/23/2016	UK holds referendum on its membership of the EU, with the majority of voters choosing to leave the EU (51.9% of the vote versus 48.1% voting to remain).
6/24/2016	Prime Minister David Cameron announces his intention to resign.
7/13/2016	Theresa May becomes the new UK Prime Minister.
10/2/2016	In her Party Conference speech, Theresa May announces a 'Great Repeal Bill' and confirms Article 50 will be triggered before the end of March 2017.
11/3/2016	High Court gives its judgment in the Gina Miller case, finding in favour of the claimants. The Government announces it will appeal against the decision.
1/17/2017	Prime Minister gives her Lancaster House speech, setting out the Government's 'Plan for Britain' and the priorities that the UK will use to negotiate Brexit.
1/24/2017	Supreme Court rejects the Government's appeal of the Gina Miller case.
1/26/2017	Government publishes European Union (Notification of Withdrawal) Bill.
2/2/2017	Government publishes its Brexit White Paper, formally setting out its strategy for the UK to leave the EU.
3/16/2017	European Union (Notification of Withdrawal) Act received Royal Assent.
3/29/2017	Prime Minister triggers Article 50 of the Treaty on European Union.
3/30/2017	Government publishes the Great Repeal Bill White Paper.
4/18/2017	Prime Minister calls a General Election – to be held on 8 June 2017.
	3. General Election – close of Phase 1
6/8/2017	General Election results in a hung Parliament, with the Conservatives winning the most seats and Theresa May forming a government.
6/19/2017	First round of UK-EU exit negotiations begin.
6/21/2017	State Opening of Parliament – Queen's Speech includes a 'Great Repeal Bill'.

7/13/2017 Government introduces the European Union (Withdrawal) Bill, commonly referred to as the 'Great Repeal Bill'.

9/12/2017 EU Withdrawal Bill passes Second Reading in the House of Commons.

9/22/2017 Prime Minister delivers her key Brexit speech in Florence, setting out the UK's position on moving the Brexit talks forward.

10/19-20/2017 European Council meeting to assess progress on the first phase of Brexit negotiations.

11/13/2017 Government outlines plans for a Withdrawal Agreement and Implementation Bill.

12/8/2017 UK and EU publish a Joint Report on progress made during Phase 1 of negotiations. This concludes Phase 1 of negotiations and both sides move to Phase 2.

4. Close of Phase 1 – EU (Withdrawal) Act becomes law

12/11/2017 Prime Minister updates Parliament on Brexit negotiations.

1/18/2018 The European Union (Withdrawal) Bill has its First Reading in the House of Lords.

3/2/2018 Prime Minister gives a speech at Mansion House on the UK's future economic partnership with the European Union.

3/14/2018 The European Parliament endorses a resolution laying out a possible association agreement framework for future EU-UK relations after Brexit.

3/19/2018 The amended Draft Withdrawal Agreement is published.

5/16/2018 The European Union (Withdrawal) Bill finishes its House of Lords stages and goes into parliamentary ping pong

6/26/2018 The European Union (Withdrawal) Bill receives Royal Assent and becomes an Act of Parliament

5. EU (Withdrawal) Act becomes law – the 'Meaningful Vote'

6/26/2018 The European Union (Withdrawal) Bill receives Royal Assent and becomes an Act of Parliament

7/6/2018 The Cabinet meets at Chequers to agree a collective position for the future Brexit negotiations with the EU.

7/9/2018 David Davis resigns as Secretary of State for Exiting the European Union and is replaced by Dominic Raab.

7/24/2018 Government publishes White Paper on future UK-EU relations.

8/23/2018 The government publishes the first collection of technical notices providing guidance on how to prepare for a no-deal Brexit.

9/19-20/2018 EU leaders hold an informal summit in Salzburg.

10/29/2018 Budget Day, the last Budget before the UK leaves the EU.

11/14/2018 The Withdrawal Agreement is agreed and published.

11/15/2018 Brexit Secretary resigns as Secretary of State for Exiting the European Union and is replaced by Stephen Barclay the following day.

11/25/2018 At a special meeting of the European Council, EU27 leaders endorse the Withdrawal Agreement and approve the political declaration on future EU-UK relations.

12/4/2018 MPs begin the first of five days of Brexit debates, leading up to the 'Meaningful Vote' on 11 December.

12/5/2018 Government publishes the Attorney General's legal advice to Cabinet on the Protocol to the Withdrawal Agreement on Ireland and Northern Ireland.

12/10/2018 CJEU issues its judgment on the *Wightman* case, finding unilateral revocation of Article 50 TEU is a sovereign right for any Member State to pursue. Later, the Prime Minister pulls tomorrow's planned final vote on her Brexit deal.

12/11/2018 Theresa May wins a vote of confidence in her leadership of the Conservative Party.

1/8/2019 Report Stage and Third Reading of Finance (No. 3) Bill

1/9/2019 As five days of Brexit debates begin – leading to a 'Meaningful Vote' on 15 January – an amendment to the business motion is passed, giving the Prime Minister only three days to present a 'Plan B' Brexit plan if she loses meaningful vote. The deadline was originally 21 days.

1/15/2019 The Prime Minister loses the 'Meaningful Vote' and the Leader of the Opposition tables a motion of no confidence in the Government.

6. The 'Meaningful Vote' – Boris Johnson becomes PM

1/16/2019 The Prime Minister wins a vote of confidence in the Government.

1/21/2019 Theresa May presents the government's 'Plan B' Brexit deal.

1/29/2019 MPs debate the Prime Minister's 'Plan B' deal, which is then approved following two amendments.

2/14/2019 The government's Brexit plan suffers a defeat in the House of Commons.

2/26/2019 The Prime Minister promises MPs a vote on ruling out a no-deal Brexit or delaying Brexit if she loses the second 'meaningful vote' next month.

3/12/2019 The Prime Minister loses the 'Meaningful Vote 2'.

3/13/2019 In a defeat for the Prime Minister, MPs vote to rule out a 'no-deal Brexit'.

3/14/2019 MPs approve the amended government's motion, instructing the government to seek permission from the EU to extend Article 50.

3/20/2019 The Prime Minister writes to European Council President Donald Tusk, asking to extend Article 50 until 30 June 2019.

3/21/2019 Following a meeting of the European Council, EU27 leaders agree to grant an extension comprising two possible dates

3/27/2019 The Commons debates and votes on eight indicative votes, in an attempt to find a Brexit plan that wins the support of the majority of MPs. All options are defeated.

3/29/2019 The Prime Minister loses the 'Meaningful Vote 3'. This was also the long-established date the UK was expected to leave the European Union. Following a House of Commons vote on 14 March 2019, the Government sought permission from the EU to postpone this date. At a European Council meeting on 21 March 2019, EU27 leaders agreed to delay Brexit.

4/1/2019 In the second day of indicative votes, all four of the selected options are defeated.

4/2/2019 The Prime Minister announces she will seek a further extension to the Article 50 process and offers to sit down with the Leader of the Opposition, to finalise a deal that will win the support of MPs.

4/5/2019 Theresa May formally writes to Donald Tusk, requesting a further extension to the Article 50 process to the end of June 2019.

4/10/2019 The European Council meets. The UK and EU27 agree to extend Article 50 until 31 October 2019.

5/21/2019 The Prime Minister unveils her new Brexit deal.

5/23/2019 The UK votes in the European Parliament elections.

7/23/2019 Boris Johnson wins the Conservative Party leadership race.

7. Boris Johnson becomes PM – present (13 August 2019)

7/24/2019 Boris Johnson formally takes over as Prime Minister.

8. Future timetable

10/31/2019 Brexit Day? At the European Council meeting in April 2019, the UK and EU27 agreed an extension of Article 50 to 31 October. There is some uncertainty about the timing of events in this section and some are indicative only.

3. A SURVEY OF TOURDEA APPLICATIONS: 1978-2018

Abstract: The primary goal of this paper is to summarize and thoroughly review empirical estimates of tourism related papers that used the Data Envelopment Analysis (DEA) method. Secondary goal is to find out whether tourism related articles which used DEA method are included in the list of categories of tourism characteristic products and tourism industries of the UNWTO or not. In summary, the paper presents a comprehensive review of 350 tourism related articles which used DEA method and highlights several key issues. First the DEA is analyzed in general, as an econometric method, then tourism performance and previous surveys of the methods are evaluated. The survey revealed that the most number of published tourism articles that used DEA method are in the list of the UNWTO category (*Accommodation (services) for visitors*). The second largest publication using DEA method are unrelated to the UNWTO category.

Keywords: Tourism efficiency, DEA, UNWTO, survey.

Resumen: El objetivo principal de este trabajo es resumir y revisar minuciosamente las estimaciones empíricas de documentos relacionados con el turismo que utilizaron el método de Análisis Envolvente De Datos (DEA). El objetivo secundario es averiguar si los artículos relacionados con el turismo que utilizan el método DEA están incluidos en la lista de categorías de productos característicos del turismo y las industrias turísticas de la OMT o no. En resumen, este trabajo presenta una revisión exhaustiva de 350 artículos relacionados con el turismo que utilizaron el método DEA y destaca varios temas claves. En primer lugar, se analiza el DEA en general, como un método econométrico, luego se evalúa el desempeño turístico y la revisión de literatura previas de los métodos. La revisión de literatura reveló que la mayor cantidad de artículos turísticos publicados que utilizaron el método DEA están en la lista de la categoría OMT (*Alojamiento (servicios) para visitantes*). La segunda categoría más grande que utiliza el método DEA no está relacionada con la categoría OMT.

Palabras-clave: Eficiencia turística, DEA, OMT, La revisión de literatura.

JEL: D02; C59; L83; Z32.

3.1. Introduction

Tourism is a service activity which constitute an important driver of trade and a contributor of economic growth. The business volume of tourism equals or even surpasses that of oil exports, food products or automobiles (UNWTO, 2018). The World Tourism and Travel Council (WTTC, 2019) claims that Tourism and Travel is one of the world's largest economic sectors, it creates jobs, drives exports, and generates prosperity across the world. It accounted for 10.4% of global GDP and 319 million jobs, or 10% of total employment in 2018.

In a general equilibrium setting, tourism interacts with other sectors, such as transport, construction and agriculture (Sinclair and Bote Gomez, 1996, Cleverdon and Kalisch, 2000; Nowak et al., 2003). As an example, the culinary tourism (*food and beverage serving activities*) uses local resources and ingredients which impacts on agricultural practices (*livestock and arable farming*) (Hashimoto and Telfer, 2006, Smith and Xiao, 2008). Something similar happens in the *wine* sector (Hall et al., 2009; Asero and Patti, 2009), *passenger transportation* (Hawken et al., 1999, Urry, 2004, Yeoman et al., 2007, Fernández et al., 2018), *construction* and the *financial* sector (Rutherford and O'Fallon, 2007, Winter, 2007), among others.

The growing importance of tourism worldwide has created much interest in measuring the performance of agents, territories and organizations involved in tourism. Consequently, interest in the study of tourism efficiency and productivity has increased in recent years. However, measuring the productivity and efficiency of tourism is not an easy task. To understand and effectively control a process of tourism performance, researchers have used various statistical and econometric estimation techniques such as regression analysis, productivity index, and ratio analysis. Autem, over the past decades, the frontier analysis has become the most used approach in the tourism and hospitality literature. Frontier analysis can be applied using two different methodologies: parametric methods, such as the Stochastic Frontier Analysis (SFA) (Aigner et al., 1977) and non-parametric methods such as Data Envelopment Analysis (DEA) (Charnes et al., 1978).

Within the efficiency analysis, the DEA is by far the most commonly used operations research (OR) technique in assessing efficiency and productivity. According to the recent review of Emrouznejad, and Yang (2018), more than ten thousand DEA-related articles have been published in journals over the 1978-2016 period. In the several other bibliographies reviews conducted in other sectors, DEA is also the most widely used technique. Hence, Berger and Humphrey (1997) and Paradi and Zhu (2013) found that more than a 75% used DEA-like techniques to measure bank efficiency. In the case of the agriculture sector, the percentages (74%) are very similar (Candemir et al., 2011). Finally, in the case of the tourism sector, the review of Assaf and Josiassen (2016), finds that of the 57 studies reviewed, more than 70% use DEA.

The election of DEA as a worldwide accepted OR tool is a result of several advantages over other methods and, secondly, because of its flexibility in used variables with respect to conditions under which the tourism sector runs. Besides, the results of initial literature review process shows that most of the work on efficiency is related to the DEA method. Moreover, it has revealed that publications on DEA have exponentially increased since early 1980. Rich bibliographic literatures have been complemented on it already. Nevertheless, to the best our knowledge, the tourism literature currently lacks a significant review and analysis of DEA studies.

The purpose of this study is to fill this gap and provide a critical review of the DEA application in the field of tourism, by highlighting several key points of productivity measuring, efficiency and performance of decision-making units (DMUs) in tourism's sub-sectors that will guide the methodology for new researchers and future works. To this end, in this paper we tried to disclose the widest list of DEA method using studies within the tourism sector between 1978 and 2018. We reviewed more than 15000 studies and identified 350 studies that use DEA-like techniques to estimate various measures of tourism efficiency. Using a citation metric software *Publish and Perish* (2018) we also identified number of citations by authors, journals, years of publication, et cetera. These studies were published in approximately 200 journals, but about 50% of those studies appearing in 160 journals. Most articles have been published in leading tourism and hospitality journals. The most frequent sources of publication are the *Tourism Economics*

(22), the *Tourism Management* (16) and the *International Journal of Hospitality Management* (11).

The paper is structured as follows. Section 2 describes the DEA estimation in the current issue. Section 3 discusses the survey within the observed literature and the approach of the DEA method on the paper construction. Section 4 highlights the statistics of the DEA method in tourism and the last section presents a discussion regarding the results and conclusion.

3.2. DEA and tourist efficiency

Based on the principles of the production and the linear programming theory, DEA is a mathematical programing technique used for the development of production frontiers and the measurement of efficiency relative to these frontiers. The first naïve method of single output/single input efficiency measure was introduced by Farrell (1957). Later, Charnes et al. (1978) uses linear programing to extend the Farrell's ideas. The Charnes et al. (1978) methodology is a non-parametric approach for determining the relative performance of a set of similar organizational units (DMUs) by using sets of inputs and outputs. In other words, it evaluates how efficient a country, region, firm, organization, agency, or such other unit uses available resources (input) to generate a set of output data relative to other units in the data set (Ramanathan, 2003; Silkman, 1986). To assess the efficiency, DEA provides a benchmark (frontier) against which competitors can identify areas of "best practices" associated with high measures of performance. A DMU can be operating either on or within the frontier, with the distance to the frontier reflecting inefficiency (Mantri, 2008).

First naïve understanding of DEA method offered by Charnes et al. (1978) includes cost per unit, profit per unit, satisfaction per unit, and so on, which are measures stated in the form of a ratio like the following,

$$\frac{Output}{Input} \qquad (3.2.1.)$$

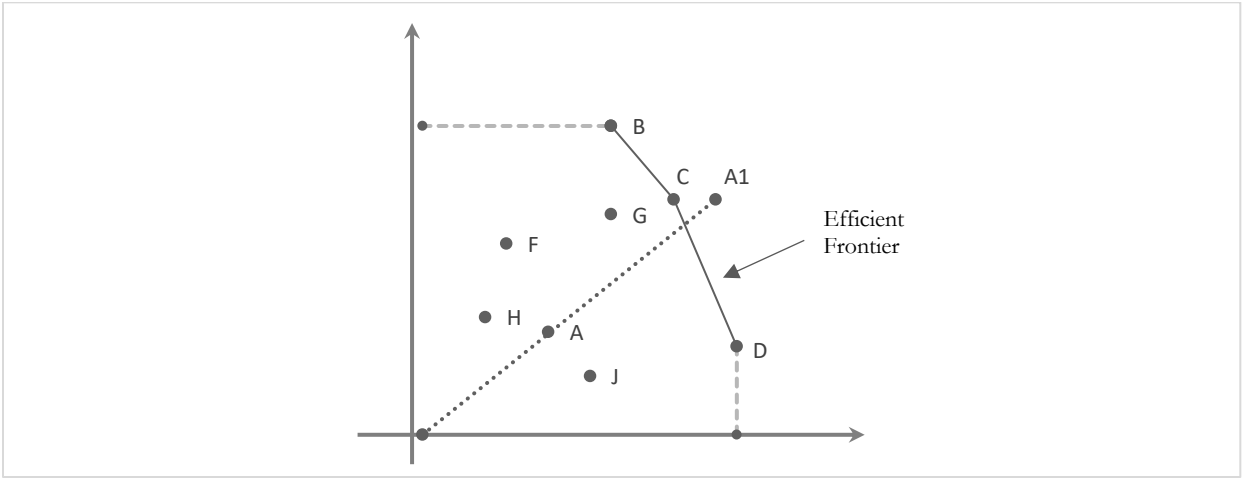
The focus is to optimize the ratio of outputs to inputs. Mathematically:

$$\max_{v,u} \theta = \frac{u_1 y_1 + u_2 y_2 + \cdots + u_s y_s}{v_1 x_1 + v_2 x_2 + \cdots + v_m x_m} \qquad (3.2.2.)$$

Where θ is efficiency score (value ranges between 0-1.), x, y are inputs and outputs. u, v are the weights to be calculated as to reach at the maximum fraction value. s, m are numbers of outputs and inputs.

Geometrically, such a model should show the efficiency/ inefficiency of the DMU's activity through the definition of Efficient Frontier. An illustrative example of such optimization problem is shown by a two-output, one-input Efficiency Frontier in the Figure 3.2. The line through the efficient DMUs B, C, and D represents the efficient frontier or the areas of "best practices". For example, DMU A is classified as ineffective in this sample, and it will have to expand to $A1$ at the border before it can also be called efficient (Avkiran, 2006).

Figure 3.2: Illustration of a two-output, one-input DEA analysis.



It is important to note that at the beginning this method was based on the names of the founders, as the Charnes, Cooper and Rhodes (CCR) method (Charnes et al., 1978). But

since the method is based on a benchmark, a geometric interpretation (figure 3.2.) showed how the efficiency frontier *envelops* the calculated inputs and outputs, the mathematical parlance gradually began to call it Data Envelopment Analysis (DEA) (Cooper et al., 2006). By adding an additional constraint of convexity on the model (Variables Returns to Scale), one can find the technical efficiency arising from optimal management practices, called pure technical efficiency (Banker et al., 1984).

3.2.1. Input and Output-oriented DEA model

Depending on the interest of the analysis, the DEA can be identified as input or output-oriented model. An objective of the Input-oriented DEA model is to minimize DMU's inputs while keeping at least the given output levels. The focus is to optimize the ratio of outputs to inputs by solving a group of weights that satisfy a system of linear equations (Rouse, 1997). A mathematical formulation of such orientation is presented below in the form 3.2.1.1.

$$Min\ H_0 = \sum_{i=1}^{m} v_i x_{i0} \qquad (3.2.1.1.)$$

subject to

$$\sum_{r=1}^{s} u_r y_{r0} = 1$$

$$\sum_{r=1}^{s} u_r y_{rj} \leq \sum_{i=1}^{m} v_i x_{ij}; \quad j = 1, \cdots \cdots, n \quad r = 1, \cdots \cdots, s$$

$$i = 1, \cdots \cdots, m \qquad u_r, v_i \geq 0$$

Where H_0 is weighted sum of the inputs of the DMU; n is number of DMUs in the data set; s is number of outputs; m is number of inputs; y_{rj} and x_{ij} are known outputs and

inputs of the j-th DMU and they are positive. $u_r, v_i \geq 0$ are weights to be determined by the solution of this optimization problem.

Above, we have been dealing with a model whose objective is to minimize firm's inputs while keeping at least the given output levels. There is another type of model that attempts to maximize outputs while using no more than the observed amount of input. It calls Output-oriented DEA model. A mathematical formulation of such orientation is presented below in the form 3.2.1.2.

$$Max\ \theta_0 = \sum_{r=1}^{s} u_r y_{r0} \qquad (3.2.1.2.)$$

subject to

$$\sum_{i=1}^{m} u_i x_{i0} = 1$$

$$\sum_{r=1}^{s} u_r y_{rj} \leq \sum_{i=1}^{m} v_i x_{ij}; \quad j = 1, \cdots \cdots, n \quad r = 1, \cdots \cdots, s$$

$$i = 1, \cdots \cdots, m \qquad u_r, v_i \geq 0$$

Where θ_0 is efficiency score of DMU. n is number of DMUs in the data set; s is number of outputs; m is number of inputs; y_{rj} and x_{ij} are known outputs and inputs of the j-th DMU and they are positive. $u_r, v_i \geq 0$ are the weight to be calculated by the solution of this optimization problem.

3.2.2. Strengths and Limitations of DEA

In this section we list the strengths and limitations of DEA. Strengths of DEA are as follows (Ozbek et al., 2009; Ramanathan, 2003; Rouse, 1997):

1. The main strength of the DEA is its objectivity. DEA provides performance estimates based on the solution of some formulations that provide optimal input and output weights for DMUs using numerical data. This does not require a priori weights for the variables. Thus, such performance evaluations are not based on the subjective opinions of investigators.

2. DEA identifies the efficient units that define the efficient frontier, quantifies the inefficiency of each of the remaining units, and also identifies those units' peers.

3. DEA can handle multiple inputs and outputs, (Bell and Morey, 1995; Morey and Dittman, 1995).

4. In the DEA model each inputs and outputs can be measured in different units.

5. DEA is nonparametric and, ergo, does not require an explicit functional form linking inputs to outputs.

6. DEA takes into account differences in scale of operations.

7. DEA deal with factors that cannot be controlled by the decision-maker. This provides a fair comparison, since such uncontrolled factors affect the performance of the units of comparison.

However, despite of these strengths, DEA is also subject of few limitations. Limitations of DEA are as follows (Ramanathan, 2003; Rouse, 1997):

1. DEA applications require a separate linear program for each DMU in the data set. When there are many DMUs, the calculation can be unwieldy. However, this limitation has been minimized with the development of software that specifically addresses to DEA issues.

2. Statistical hypothesis tests are difficult to measure to determine the validity of the results because DEA is a nonparametric method.

3. Special care should be taken to ensure that input-output data is accurate. Because DEA is an extreme point technique, errors in the measurement or recording of data input-output variables can lead to significant problems.

4. Since DEA performance evaluations are obtained by running a series of linear software formulations, it becomes difficult to explain the DEA process to non-technical audiences (decision-makers) for cases where there are more than two inputs and outputs in the model. An audience that has no experience in linear programming may find it difficult to understand its results. However, this problem can be managed by explaining the DEA process in simpler terms and by using simpler plots of its results.

3.2.3. DEA in tourism

Regarding its nature, tourism is defined as a service sector. As with other service sub-sectors (banking, transportation, healthcare etc.), tourism also needs an estimation of its efficiency. The measures such as productivity ratios, and time and motion studies borrowed from manufacturing sector are deficient in capturing the interaction between multiple service variables (Avkiran, 2006). The regression analysis cannot easily handle multiproduct sectors. Thus, to handle the complexities of productivity measurement in the service sector, it is necessary to go beyond accounting and ratio measures or regression analysis. This is where DEA has been used as a tool to measure productivity and calculate potential improvements.

Following the UNWTO (2018), tourism is a social, cultural and economic phenomenon which *entails the movement* of people to countries or places outside their usual environment for personal or business/professional purposes. Therefore, tourists needs a wide range of services and activities: transportation; allocation and accommodation (hotels, specialized accommodation facilities, etc.); food (restaurants, cafes, bars, canteens, etc.), and entertainment (parks, theaters, circuses, museums, etc.).

3.2.3.1. Selection of inputs and outputs in Tourism

Since DEA is a non-parametric approach it does not need any production function equation of a parametric form for the solution of the specified model. Ergo, any variable can be included in the model without the need to specify functional or parametric relationships. Even a variable that is neither an economic resource nor a product's result but just assign the environment or of the production process can be included in the DEA model. Ozbek et al. (2009) state that variables can be represented using one of the following four scale types: categorical, ordinal, interval, and ratio. Considering every variable that has an impact on the DMU's performance, it is likely to result in a large number of variables.

Due to its wide range (transportation, allocation and accommodation, service, entertainment etc.), the spectrum of used input and output variables in tourism cannot be specified exactly. Eventually, the choice of outputs must reflect the objectives and set of services of the organization and the inputs must be traceable to these outputs (Avkiran, 2006). In this case Ouerfelli (2008) state that tourism performance is often measured in terms of tourist arrivals, tourist bed-nights and/or in terms of expenditure in the destination country. Cracolici et al. (2008) supports this and claims that the territory's physical and human resources constitute the input of a (virtual) tourist *production process*, and the output is then formed by arrivals, bed-nights, value added, employment, customer satisfaction, etc. As a result, efficiency in tourist performance can be assessed thru the measurement of its resource use, as in the formed/ natural environment and human resources of the territory. Quality examples regarding these input/ output variables are shown in works of Assaf and Josiassen (2012) and Abad and Kongmanwatana (2015).

A list of variables should contain inputs and outputs that are considered as reasonable for DMUs. Basically, it is common sense that variables within the model should be common to all DMUs. Many studies are used the rates of employments as labor proxy. Chiang et al. (2004) used number of employment as one of the main input variables. Logically, selecting this input variable is the most appropriate way to disclose the firms'

efficiency. Other papers which used employments rates as input variables are Koksal and Aksu (2007), Luo et al. (2014) and Fernandez and Becerra (2015).

An important question for tourists is accommodation and weather in the selected destination. Lozano and Gutierrez (2011) speaks in this favor. The authors highlight tourism performance of the 25 EU member states. The main variables in the paper are number of beds, persons employed and number of days with hot temperature. The question of accommodation is mainly considered by Johns et al. (1997); Wang et al. (2006); Yu and Lee (2009); Hsieh et al. (2010); Devesa and Penalver (2013). Generally, papers on tourist efficiency which include climate variables written down by Johns et al. (1997); Anderson, et al. (1999); Brown and Ragsdale (2002); Morey and Dittman (2003); Barros and Alves (2004); Donthu et al. (2005); Gimenez-Garcia et al. (2007); Assaf and Matawie (2008); Fuentes (2011).

3.2.3.2. DEA survey bibliography

The spectrum of areas for this method is very broad. Virtually every branch of the economy or research where the efficiency performance is necessary is an object for this method. DEA is popular among researchers in Economics, Econometrics and Operations Research/Management Science, as well as practitioners in the business community and government institutions (Cherchye and Post, 2003). In the same vein, Rouse (1997) state that DEA is used in management control systems, operations research, organization theory, strategic management, economics, accounting and finance and many other disciplines.

Despite its multi-applicability many authors agree that the most popular industries that have been discussed in DEA papers are in service sector. DEA is applied mostly in fields such Agriculture and Farming, Banking, Supply Chain, Transportation, Health care and Public policy and Education (Emrouznejad and Yang, 2018; Liu et al., 2013). Cooper et al. (2006) state that the main directions of DEA is practical evaluations of organizations' performance in business firms, government agencies, hospitals, educational institutions. In the credit sector, as far as we know, the most recent paper in literature review is Paradi

and Zhu (2013). The authors review 80 DEA papers that specifically focus on bank branches. Furthermore, Fethi and Pasiouras (2010) cover 196 papers that applied DEA in the banking sector. In financial services Berger and Humphrey (1997) cover 130 studies by examine efficiency of financial institutions using efficient frontier techniques (e.g. DEA, SFA).

Likewise in the healthcare and education sector. Worthington (1999) provides a synoptic survey of frontier efficiency measurement (e.g. DEA, SFA). Katharakis and Katostaras (2016) cover 21 studies to define any differences in healthcare efficiency between DEA and SFA approaches. The most recent work in healthcare belongs to Kohl et al. (2018) by reviewing 262 papers. In education, Worthington (2001) provide a survey of empirical analyses using frontier efficiency measurement techniques (e.g. DEA, SFA). Witte and Lopez-Torres (2017) cover 223 papers on efficiency in education.

Despite extensive DEA bibliographic publications on service, to the best authors' knowledge, there are no survey publications in efficiency which refers to tourism. However, there are some interesting survey studies that have been published with tourism with in it, such as: Seiford (1996); Tavares (2002); Emrouznejad et al. (2008); Liu et al. (2013). The latest and most complete generalized bibliographic survey on DEA approach that include tourism is the paper by Emrouznejad and Yang, (2018).

There are other studies of interest on DEA survey. They are Gattoufi et al. (2004); Emrouznejad et al. (2008); Zhou et al. (2008) and Liu et al. (2013) (Annex, 3.2.3.2.).

3.3. Survey approach

Since, to the best our knowledge, this is the first attempt to construct bibliographic survey on tourist efficiency it is necessary to indicate its specification. As tourism is a specific sector of economy that relies on service and has a different base from most of other sectors, we refer to the fundamental understanding of it. Regarding basic glossary of the UNWTO the tourism sector, as contemplated in the Tourism Satellite Account, it is the cluster of production units in different industries that provide consumption goods and services demanded by visitors.

Hence, based on this, the field of searching keywords for the bibliography construction is determined by tourists demand and satisfaction. We considered both goods and service fields of tourists' requests. We scanned only for journal articles. Other working papers, dissertations, monographs and other publication outcomes has not been taken into consideration. We consider only publications that are written in English (or English and native language) between the years 1978 and 2018. All search words were compiled by the list of categories of tourism industries (the basic glossary of the UNWTO[1]). As shown in the table 3.3.

Table 3.3: List of categories of tourism characteristic products and tourism industries

#	Products	Industries
1.	Accommodation services for visitors	Accommodation for visitors
2.	Food and beverage serving services	Food and beverage serving activities
3.	Railway passenger transport services	Railway passenger transport
4.	Road passenger transport services	Road passenger transport
5.	Water passenger transport services	Water passenger transport
6.	Air passenger transport services	Air passenger transport
7.	Transport equipment rental services	Transport equipment rental
8.	Travel agencies and other reservation services	Travel agencies and other reservation services activities
9.	Cultural services	Cultural activities
10.	Sports and recreational services	Sports and recreational activities
11.	Country-specific tourism characteristic goods	Retail trade of country-specific tourism characteristic goods
12.	Country-specific tourism characteristic services	Other country-specific tourism characteristic activities

[1] UNWTO basic glossary. 2005/2007. The list of categories of tourism characteristic products and tourism industries. pp.3. http://cf.cdn.unwto.org/sites/all/files/docpdf/glossaryenrev.pdf

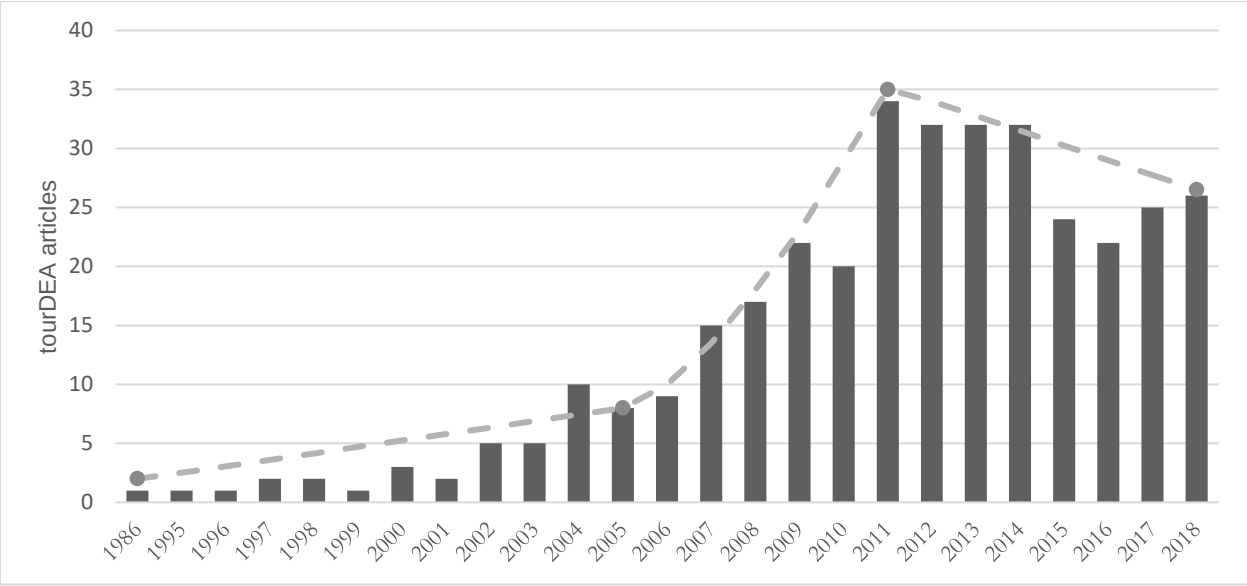
To search for articles in the tourism industry which used the DEA method, we applied the main keywords *Tourism*, *Data Envelopment Analysis*, *DEA* and *Tourism Efficiency* with a combination of additional keywords that refer to understanding of tourism in general. The survey has been made in one of the largest scientific publication databases, *The Google Scholar*. Additional studies have been conducted and collected manually.

3.4. Data and basic statistics

Generally, except of main (*Tourism, Data Envelopment Analysis, DEA and Tourism Efficiency*) keywords, the survey construction has used 12 tourism related keywords *(Tourism, Travel, Accommodation, Hotel, Hostel, restaurant, Bar, Beach, Cruise, Attraction, Transport, Service)*. Altogether, revision has been done for 15718 scientific data (articles, monographs, book etc), from them 350 articles have been identified as tourism related articles which used DEA method (hereinafter tourDEA). Conditionally, as it is mentioned above, we considered transportation industry with regards to air, water, road, rail, etc. transportations which aimed at tourists; allocation and accommodation (*hotels, specialized accommodation facilities, etc.*); food industry (*restaurants, cafes, bars, canteens, etc.*); entertainment (*parks, theaters, circuses, museums, etc.*) (Annex, 3.4.).

Despite that DEA method being found in 1978, as far as authors found, papers in tourDEA started from 1986. After all, we can roughly classify three periods of trends for tourDEA articles. First period: (1) 1986-2005: there is slow but stable growth in a number of published tourDEA articles. In this period numbers of tourDEA publications increased by up to 23.53%. Second period: (2) 2005-2011: shows an exponential grows in publication, more than +76.47% from year 2005. Third period: (3) 2011-2018: shows a decrease in the number of publications, -18.75% started from year 2011. Visual demonstration of whole period of publications can be viewed in figure 3.4.

Figure 3.4: Distribution of tourDEA articles by year (1978-2018).



Note: the source is self-developed.

3.4.1. Tourism related DEA statistics by journals

In total we found 199 journals with tourDEA articles. From all journals, more than 77% have only 1 article. It is clear that the distribution of relation between journals and published articles in them are split into two parts, less than 2 tourDEA articles per 1 journal and 2 or more articles per 1 journal.

Due to a wide range between articles' numbers within the journals that have 2 or more tourDEA article (*per 1 journal*), we can approximately identify them as the journals that contain *more than 5 articles per 1 journal* (hereinafter Mt5), *less than 5 articles per 1 journal* (hereinafter Lt5), *less than 3 articles per 1 journal* (hereinafter Lt3) and journals that published only 1 tourDEA article (hereinafter 1to1).

8 (4.02%) journals with 87 (24.86%) tourDEA articles were found in the Mt5 range. But most of them appear in the top 5 journals. They are *Tourism Economics, Tourism Management, International Journal of Hospitality Management, The service industries journal, Asia Pacific Journal of Tourism Research.* The distribution of the top 5 journals

that published the most tourDEA articles over the study period (1978-2018) is displayed in Table 3.4.1.

Table 3.4.1: Distribution of journals with the greatest number of tourDEA articles (1978-2018).

#	Journal	Numbers of papers	% of papers	% from all papers
1.	Tourism Economics	22	31.88%	6.29%
2.	Tourism Management	16	23.19%	4.57%
3.	International Journal of Hospitality Management	11	15.94%	3.14%
4.	The Service Industries Journal	11	15.94%	3.14%
5.	Asia Pacific Journal of Tourism Research	9	13.04%	2.57%
	Total	69	100%	19.71%

Note: the source is self-developed; *% of papers* denotes the percentage of articles in one journal within the top 5 journals; *% from all papers* denotes the percentage of articles in one journal within the all investigated journals.

The 263 (75.14%) remaining tourDEA articles are in the range of Lt5, Lt3 and 1to1, distributed from 1 to 7 per journal. In total, in Lt5 range 9 (4.52%) journals with 39 (11.14%) tourDEA articles were found. In Lt3 range, 32 (16.08%) journals with 74 (21.14%) tourDEA articles were found. Rest of tourDEA articles are within the range of 1to1. Descriptive statistics on number of remaining journals with corresponding numbers of tourDEA articles are shown in the table 3.4.1.1.

Table 3.4.1.1: Descriptive statistics on journals and tourDEA articles (1978-2018).

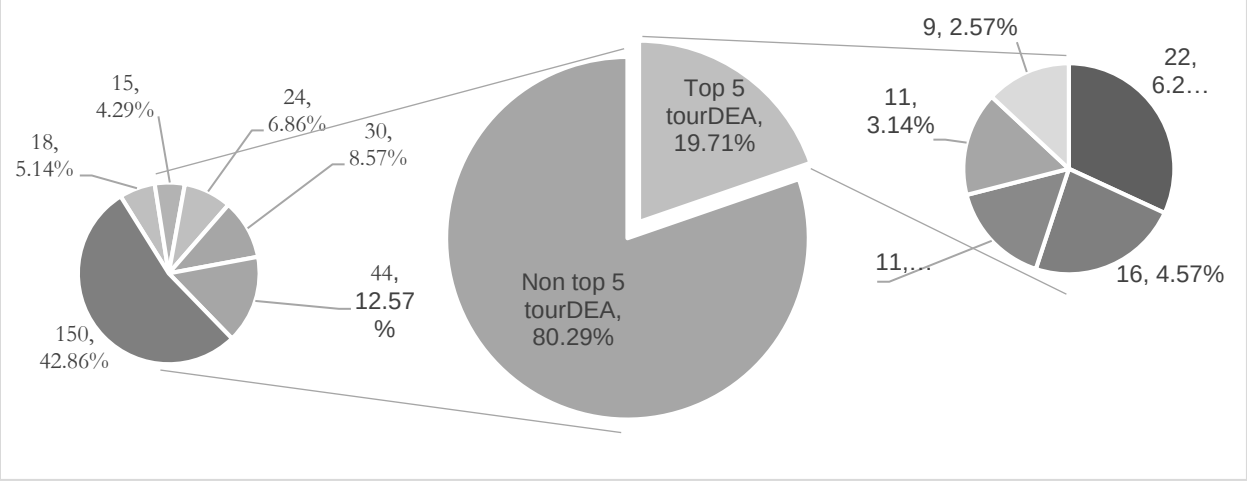
#	Number of Journals	Number of papers per 1 journal	% of journals	% from all journals	% of papers	% from all papers
1.	3	6	1.55%	1.51%	6.41	5.14%

2.	3	5	1.55%	1.51%	5.34	4.29%
3.	6	4	3.09%	3.02%	8.54	6.86%
4.	10	3	5.15%	5.03%	10.68	8.57%
5.	22	2	11.34%	11.06%	15.66	12.57%
6.	150	1	77.32%	75.38%	53.38	42.86%
Total	194		100%	97.49%	100%	80.29%

Note: the source is self-developed; *% of papers* (*journals)* denotes the percentage of articles (journals) within the list; *% from all papers* (*journals)* denotes the percentage of articles (journals) within the all investigated journals.

Ad oculos, More than 80% of all published tourDEA articles are shallow in count. About 75% of the articles found are published in the range 1to1. Most of them are published in journals that are insufficiently known to wide public. Vice-versa, the largest number of tourDEA articles appears in journals with weighty impact (to date, 2018). This is reasonable, since journals with a good impact factor are popular among researchers. Figure 3.4.1.3. illustrate the Descriptive statistics on number of top 5 and remaining tourDEA articles with corresponding distribution.

Figure 3.4.1.3: Distribution of top 5 and non-top 5 tourDEA articles (1978-2018).



Note: the source is self-developed; *1…n*, denotes the number of published articles; *1…n%* denotes the percentage of published articles.

3.4.2: Tourism related DEA statistics by keywords

In all tourDEA articles used 757 unique keywords. The greatest number of used keywords are *Data Envelopment Analysis, DEA, Efficiency, Hotel, Tourism* and so on. Table 3.4.2. shows the top 10 keywords that has been used in tourDEA articles over the period of investigation (1978-2018).

Table 3.4.2: Descriptive statistics on 10 the most used keywords by tourDEA papers (1978-2018).

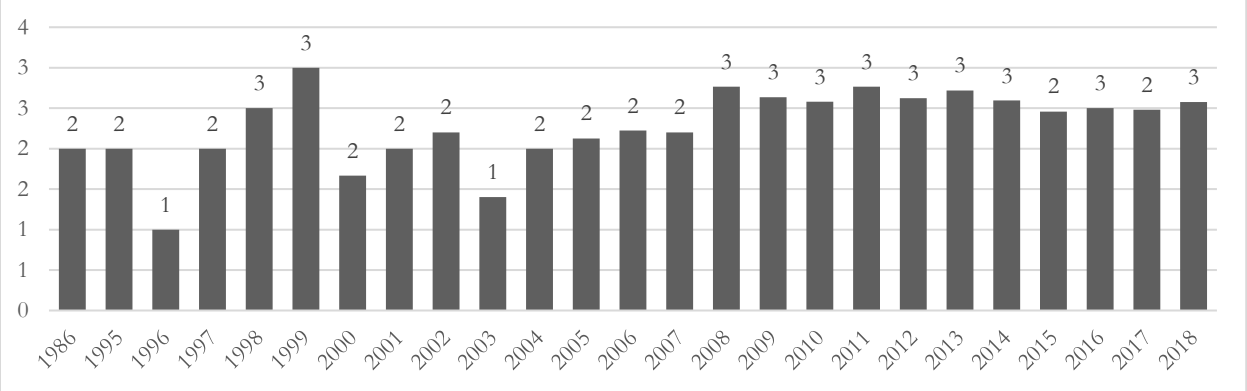
#	Keywords	Numbers of publications	% of keywords	% from all keywords
1.	Data envelopment analysis, DEA, Data Envelopment Analysis (DEA), Data envelopment analysis (DEA), (DEA), Data Envelopment Analysis Model, DEA (Data Envelopment Analysis), DEA method, DEA Model, DEA (Data Envelopment Analysis)	296	51.66%	18.20%
2.	Efficiency	96	16.75%	5.90%
3.	Hotel	48	8.38%	2.95%
4.	international tourist hotel	30	5.24%	1.85%
5.	Tourism	27	4.71%	1.66%
6.	Productivity	18	3.14%	1.11%
7.	benchmarking	16	2.79%	0.98%
8.	Technical efficiency	16	2.79%	0.98%
9.	Hotel industry	15	2.62%	0.92%
10.	Taiwan	11	1.92%	0.68%
	Total	573	100%	35.24%

Note: the source is self-developed; *% of keywords* denotes the percentage of articles in one journal within the top 5 journals; *% from all keywords* denotes the percentage of articles in one journal within the all journals.

3.4.3. Tourism related DEA statistics by authors

In general, all the tourDEA articles found were written by 1032 distinct authors. Minimum number of authors for an article is 1, maximum is 7. For all investigated years (1978-2018) an average number of authors is 2.46. Figure 3.4.3. illustrate distribution of the average numbers of authors of tourDEA articles by years (1978-2018).

Figure 3.4.3: Distribution of average numbers authors of tourDEA articles by years (1978-2018).



Note: the source is self-developed.

About 86% of all articles found were written by authors, whose number does not reach 4. About 18% of all tourDEA articles were written by 1 author, 32% by 2 authors and 36% by 3 authors. Less than 1% of articles have been written by 6/7 authors. Descriptive statistics of tourDEA articles by number of authors for period of investigation (1978-2018) displayed in the table 3.4.3.

Table 3.4.3: Descriptive statistics of tourDEA articles by number of authors (1978-2018).

#	Number of articles	% of articles	Number of authors per 1 article	Number of authors	% of authors	Cumulative % of authors.
1.	60	17.14%	1	60	3.57%	3.57%

2.	113	32.29%	2	226	7.14%	10.71%
3.	128	36.57%	3	384	10.71%	21.43%
4.	41	11.71%	4	164	14.29%	35.71%
5.	5	1.43%	5	25	17.86%	53.57%
6.	1	0.29%	6	6	21.43%	75%
7.	2	0.57%	7	14	25%	100%
Total	350	100%	28	879	100%	

Note: the source is self-developed.

Despite the number of authors ranged between 1 and 7 per article, the majority of articles are written by 2 or 3 authors. In this vein, review on the list of categories of the UNWTO showed that all articles were written on average by 2 or 3 authors. The largest numbers of authors in the list of the UNWTO categories were found in hotel services (*accommodation for visitors*), followed by entertainment (*Cultural and Sports and recreational activities*), food service (*food and beverage serving activities*) and the studies of tourism in general. Descriptive statistics on number of authors by UNWTO tourism categories can be viewed in the table 3.4.3.1.

Table 3.4.3.1: Descriptive statistics on the number of authors by the UNWTO categories of tourism characteristic products and tourism industries (1978-2018).

#	Industries (Products)*	Numbers of authors	Average number of authors	% of authors
1.	Accommodation (services)* for visitors	450	2	51.19%
2.	Food and beverage serving (services)* activities	41	2	4.66%
3.	Railway passenger transport (services)*			
4.	Road passenger transport (services)*			
5.	Water passenger transport (services)*	25	3	2.84%
6.	Air passenger transport (services)*			
7.	Transport equipment rental (services)*			

8.	Travel agencies and other reservation (services)* services activities	32	3	3.64%
9. 10.	Cultural (services)* activities Sports and recreational (services)* activities	118	3	13.42%
11.	Retail trade of (country-specific tourism characteristic goods)*	6	3	0.68%
12.	Other (country-specific tourism characteristic goods)*	2	2	0.23%
	Non specified tourism industry (product)	205	2	23.32%
	Total	879	2.56	100%

Note: the source is self-developed; * - value shows the item related to categories of tourism characteristic products from UNWTO.

3.4.4. Tourism related DEA statistics by categories of tourism products and tourism industries

From all 350 investigated tourDEA articles 268 (76.57%) articles were identified within the list of categories of tourism industries from the basic glossary of the UNWTO. As the number of remaining 82 (23.43%) tourDEA articles do not fit with the list of categories of tourism industries by their context, we classified them as *Non specified tourism industry (product)* papers. Visual illustration and descriptive statistics on categories of tourism characteristic products and tourism industries are shown in the table 3.4.4. and figure 3.4.4.

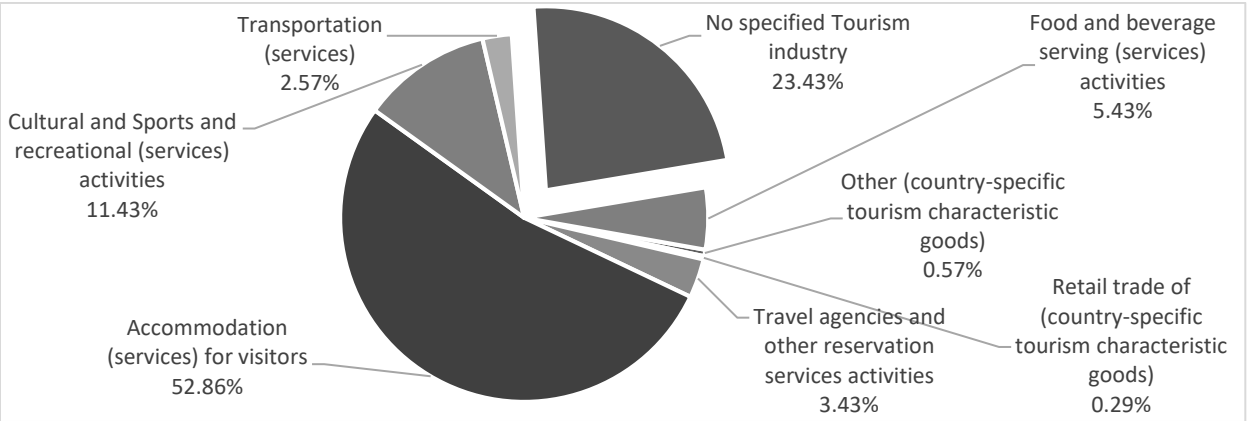
Table 3.4.4: Descriptive statistics on categories of tourism characteristic products and tourism industries.

#	Industries (Products)*	Number of papers	% of papers
1.	Accommodation (services)* for visitors	185	52.86%
2.	Food and beverage serving (services)* activities	19	5.43%

3. Railway passenger transport (services)* 4. Road passenger transport (services)* 5. Water passenger transport (services)* 6. Air passenger transport (services)* 7. Transport equipment rental (services)*	9	2.57%
8. Travel agencies and other reservation (services)* services activities	12	3.43%
9. Cultural (services)* activities 10. Sports and recreational (services)* activities	40	11.43%
11. Retail trade of (country-specific tourism characteristic goods)*	1	0.29%
12. Other (country-specific tourism characteristic goods)*	2	0.57%
Non specified tourism industry (product)	82	23.43%
Total	350	100%

Note: the source is self-developed; * - value shows the item related to categories of tourism characteristic products of UNWTO.

Figure 3.4.4: Distribution of numbers of tourDEA articles by categories of tourism products and tourism industries.



Note: the source is self-developed.

It is obvious that the greatest number of publications from the list of the UNWTO category is in *Accommodation (services) for visitors*. The number of articles found in this category

(under fair search terms with the same used keywords) is almost double than other fair categories. Following categories with the largest number of articles within the UNWTO category, there are less for 78.38% and 89.73% from the category of *Accommodation (services) for visitors*. Remaining categories of the UNWTO list are less in number of publications for 93-98%. However, it is acceptable, since the public mainly associate tourism with the activities in places outside their usual environment, with overnight stays (UNWTO, 2018). Hence the popularity of this category. The second largest number of tourDEA articles found (*Non specified tourism industry (product)*) are not on the list of the categories by the UNWTO. Here, in most studies, the DEA method was used to evaluate various topics in online tourism branding, destination benchmarking, tourism advertising, tourism management and so on, which are not related to the UNWTO categories. The third largest number of articles are in the category of *Cultural and Sports and recreational (services) activities* followed by *Food and beverage serving (services) activities*.

Each category is differs by years and numbers of tourDEA publications. Most tourDEA articles in different categories were started from year 2005. Descriptive statistics of published tourDEA articles by categories of tourism characteristic products and tourism industries by years and amount are shows in the table 3.4.4.1.

Table 3.4.4.1: Descriptive statistics on published tourDEA articles by categories of tourism characteristic products and tourism industries by years.

#	Accommodation (services)	Non specified tourism industry (product)	Transportation (services)	Cultural and Sports and recreational (services)	Food and beverage serving (services)	Travel agencies and other reservation services	Other (country-specific tourism characteristic	Retail trade of (country-specific tourism characteristic goods)	Total
1986					1				1
1995					1				1
1996	1								1

1997	1				1				2
1998					1		1		2
1999	1								1
2000	3								3
2001	1					1			2
2002	2	1		1	1				5
2003	4			1					5
2004	3	5	1		1				10
2005	6	2							8
2006	6	1		1		1			9
2007	4	3			6	1	1		15
2008	12	3	1	1					17
2009	10	4		7		1			22
2010	16	1		1	1				19
2011	21	6		1	2	4			34
2012	19	9		2	1	1			32
2013	23	3	1	4	1				32
2014	15	9	1	7					32
2015	8	9	1	4		2			24
2016	13	6	1	1	1				22
2017	7	9	2	5		1		1	25
2018	9	11	1	4	1				26
Total	185	82	9	40	19	12	2	1	**350**

Note: the source is self-developed.

3.4.5. Tourism related DEA statistics by cites

Up to year 2018 for the identified 350 tourDEA articles in the scientific databases *The Google Scholar* has found 12319 cites to other publications. Minimum number of cites for an article is 0, maximum is 1468. For all the investigated years from 1986 to 2018, the average number of cites is 32.2. Descriptive statistics on cites by categories of tourism

characteristic products and tourism industries for years between 1986 and 2018 can be viewed in the table 3.4.5.

Table 3.4.5: Descriptive statistics on cites by categories of tourism characteristic products and tourism industries

#	Industries (Products)*	Average of cites	Number of cites	% of cites
1.	Accommodation (services)* for visitors	36.5	6754	54.83%
2.	Food and beverage serving (services)* activities	126.32	2400	19.48%
3.	Railway passenger transport (services)*			
4.	Road passenger transport (services)*			
5.	Water passenger transport (services)*	21.33	192	1.56%
6.	Air passenger transport (services)*			
7.	Transport equipment rental (services)*			
8.	Travel agencies and other reservation (services)* services activities	37.5	450	3.65%
9.	Cultural (services)* activities	27.08	1083	8.79%
10.	Sports and recreational (services)* activities			
11.	Other (country-specific tourism characteristic goods)*	51.5	4	0.84%
12.	Retail trade of (country-specific tourism characteristic goods)*	4	1333	0.03%
	Non specified tourism industry (product)	16.26	450	10.82%
	Total	316.49	12319	100%

Note: the source is self-developed; * - value shows the item related to categories of tourism characteristic products from UNWTO.

Despite the greatest number of cited articles being in the category of hotel service (*Accommodation for visitors*), we found that the most cited article is in the category of food service (*food and beverage serving activities*) followed by the studies of tourism in

general. Table 10 shows the top 10 number of cites that has been used in tourDEA articles over the period of investigation (1978-2018).

Table 3.4.5.1: Descriptive statistics on categories of tourism characteristic products and tourism industries

#	Industries (Products)*	ECC	CitesPerYear	CitesPerAuthor	Year
1.	Food and beverage serving (services)* activities	1468	45.88	734	1986
2.	Accommodation (services)* for visitors	553	36.87	277	2003
3.	Accommodation (services)* for visitors	478	36.77	478	2005
4.	Food and beverage serving (services)* activities	370	17.62	185	1998
5.	Accommodation (services)* for visitors	232	16.57	77	2004
6.	Accommodation (services)* for visitors	209	16.08	105	2005
7.	Accommodation (services)* for visitors	208	26	104	2010
8.	Accommodation (services)* for visitors	189	9	63	1997
9.	Non specified tourism industry (product)	187	13.36	94	2004
10.	Accommodation (services)* for visitors	186	15.5	93	2006

Note: the source is self-developed; CitesPerYear - Set to citation count divided by the age of the article; result is rounded to 2 decimal digits; CitesPerAuthor - Set to citation count divided by the number of the authors, rounded to the nearest whole number; ECC - Estimated citation count.

3.5. Results and Conclusion

Since the first work of Charner, Cooper and Rhodes in 1978, the number of articles on tourism using the DEA method has increased exponentially and has advanced a lot. In our survey we tried to disclose the majority of the DEA-like papers that used in almost of the all tourism sub-sectors. As a main guide in the survey, we use the list of categories from the UNWTO glossary. Altogether the survey covered 15718 publications from 1978 to 2018, and from those 350 were identified as the tourDEA articles. (1) As far as we

found, the first paper in tourDEA was published in 1986. From 1986 to 2011 the number of tourDEA articles increased exponentially. From 2011 to 2018 the number decreased. (2) Based on statistics of journals *Tourism Economics, Tourism Management, International Journal of Hospitality Management, The service industries journal, Asia Pacific Journal of Tourism Research* are the most utilized journals in the field of tourism which used DEA approach. (3) About 18% of the most used keywords are Data Envelopment Analysis, Data Envelopment Analysis (DEA), DEA (Data Envelopment Analysis), DEA, DEA model, DEA method, DEA analysis, then goes Efficiency (6%), Hotel (3%) and International tourist hotel (2%). (4) The largest number of tourDEA articles (36%) were written in category 3 author per article. More than 85% of all tourDEA articles are written by less than 4 authors per article. (5) The statistical survey showed that the most intensive type of tourDEA publications are in the list of categories of tourism characteristic products and tourism industries from the UNWTO glossary, it is *Accommodation (services) for visitors* (53%). Followed by the most intensive (23%) tourDEA publications (*Non specified tourism industry (product)*) which are not on that list. (6) Despite the most published tourDEA being found in the category of *Accommodation (services) for visitors*, the most cited tourDEA articles found in the category *Food and beverage serving (services) activities.*

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ANNEX

Annex 3.2.3.2: DEA survey bibliography

#	Author/s	Year of Survey	Specification	Number of study	Metodology
1.	Paradi and Zhu (2013)	1985-2011	Financial sector	80	DEA
2.	Fethi and Pasiouras (2010)	1998-2009	Financial sector	196	DEA
3.	Berger and Humphrey (1997)	1985-1997	Financial sector	130	Frontier Efficiency
4.	Worthington (1999)	1986-1998	Healthcare sector	25	DEA, SFA, MI
5.	Katharakisa and Katostaras (2016)	2001-2012	Healthcare sector	21	DEA, SFA
6.	Kohl et al. (2018)	2005-2016	Healthcare sector	262	DEA
7.	Worthington (2001)	1981-1998	Education sector	28	DEA, SFA
8.	Witte and López-Torres (2017)	1996-2013	Education sector	223	Frontier Efficiency
9.	Seiford (1996)	1978-1995	DEA evolution		DEA
10.	Tavares (2002)	1978-2001	DEA in general	115	DEA
11.	Emrouznejad et al. (2008)	1978-2007	DEA in general	4000	DEA

12.	Liu et al. (2013)	1978-2010	DEA in general	3503	DEA
13.	Emrouznejad and Yang (2018)	1978-2016	DEA in general	10000	DEA
14.	Gattoufi et al. (2004)	1951-2001	DEA in general	1800	DEA
15.	Zhou et al. (2008)	1983-2006	Energy and Environmental (E&E) modeling	100	DEA
16.	Liu et al (2013)	1978-2010	Healthcare, Financial, Education, Transport, Agriculture sector	4936	DEA

Note: DEA: Data Envelopment Analyses. SFA: Stochastic Frontier Analysis. MI: Malmquist Index. *Number of study* denotes for reseearch papers only, other monographs, event papers, books, etc are not included to the list.

Annex 3.4: Data and basic statistics

Authors	Title	Year
RD Banker, RC Morey	Efficiency analysis for exogenously fixed inputs and outputs	1986
TD Andersson, TE Hartman	Productivity and Efficiency in Restaurants A Data Envelopment Approach	1995
C Parkan	Measuring the performance of hotel operations	1996
E Thanassoulis	Assessing the market efficiency of pubs	1997
N Johns, B Howcroft, L Drake	The use of data envelopment analysis to monitor hotel productivity	1997
LK Nozick, H Borderas, AH Meyburg	Evaluation of travel demand measures and programs: a data envelopment analysis approach	1998
N Donthu, B Yoo	Retail productivity assessment using data envelopment analysis	1998
SH Tsaur, CI Chiang, TY Chang	Evaluating the operating efficiency of international tourist hotels using the modified DEA model	1999

KW Wöber	Efficiency measures in benchmarking decision support systems: A hotel industry application	2000
Ş Tarim, Hi Dener, Şa Tarim	Efficiency measurement in the hotel industry: output factor constrained DEA application	2000
KW Wober	Benchmarking hotel operations on the Internet: a data envelopment analysis approach	2000
SH Tsaur	The operating efficiency of international tourist hotels in Taiwan	2001
KL Wang, CC Weng, ML Chang	A study of technical efficiency of travel agencies in Taiwan	2001
D Reynolds Ph D	Multi-unit Restaurant-productivity Assessment: A Test of Data-envelopment Analysis	2002
NK Avkiran	Monitoring hotel performance	2002
AA Israeli, A Mehrez	Employing DEA for ranking hotels' advertisement: A case of analyzing an advertising supplement of hotels in Israel	2002
S Lozano, G Villa, F Guerrero, P Cortés	Measuring the performance of nations at the Summer Olympics using data envelopment analysis	2002
M Fuchs, M Peters, K Weiermair	Tourism sustainability through destination benchmarking indicator systems: The case of Alpine tourism	2002
Morey, R. C., & Dittman, D. A.	Evaluating a Hotel GM’s Performance	2003
M Sigala	The information and communication technologies productivity impact on the UK hotel sector	2003
M Sigala	Developing and benchmarking internet marketing strategies in the hotel sector in Greece	2003
DJ Haas	Technical efficiency in the major league soccer	2003
SN Hwang, TY Chang	Using data envelopment analysis to measure hotel managerial efficiency change in Taiwan	2003
V Bosetti, M Cassinelli, A Lanza	Using data envelopment analysis to evaluate environmentally conscious tourism management	2004
KW Wöber, DR Fesenmaier	A multi-criteria approach to destination benchmarking: A case study of state tourism advertising programs in the United States	2004
WE Chiang, MH Tsai, LSM Wang	A DEA evaluation of Taipei hotels.	2004
CP Barros, FP Alves	Productivity in the tourism industry	2004
Y Hadad, L Friedman, AA Israeli	Evaluating hotel advertisements efficiency using data envelopment analysis	2004
BA Hu, LA Cai	Hotel labor productivity assessment: A data envelopment analysis	2004
D Reynolds	An exploratory investigation of multiunit restaurant productivity assessment using data envelopment analysis	2004
M Fuchs	Strategy development in tourism destinations: a DEA approach	2004
M Fuchs, F Zach	On the usefulness of Data Envelopment Analysis for strategy development: a tourism destination case study	2004

CA Scheraga	The relationship between operational efficiency and customer service: a global study of thirty-eight large international airlines	2004
M Fuchs, W Höpken	Towards@ Destination: a DEA-based decision support framework	2005
CP Barros	Measuring efficiency in the hotel sector	2005
S Sun, WM Lu	Evaluating the performance of the Taiwanese hotel industry using a weight slacks-based measure	2005
M Sigala, J Mylonakis	Developing a data envelopment analysis model for measuring and isolating the impact of contextual factors on hotel productivity	2005
CP Barros, MJ Mascarenhas	Technical and allocative efficiency in a chain of small hotels	2005
CP Barros	Evaluating the efficiency of a small hotel chain with a Malmquist productivity index	2005
V Bosetti, M Cassinelli, A Lanza	Using data envelopment analysis to evaluate environmentally conscious tourism management1	2005
M Sigala, P Jones, A Lockwood, D Airey	Productivity in hotels: a stepwise data envelopment analysis of hotels' rooms division processes	2005
F Cracolici, P Nijkamp, M Cuffaro	Efficiency and Productivity of Italian Tourist Destinations	2006
W Chiang	A hotel performance evaluation of Taipei international tourist hotels–using data envelopment analysis	2006
CC Shen, CF Tsai	Application of Data Envelope Analysis (Dea) Effectiveness Models: Example Application for International Hotels in Taiwan and Issues in Using Particular Models	2006
S Önüt, S Soner	Energy efficiency assessment for the Antalya Region hotels in Turkey	2006
CAP Barros, CA Santos	The measurement of efficiency in Portuguese hotels using data envelopment analysis	2006
V Bosetti, G Locatelli	A Data Envelopment Analysis approach to the assessment of natural parks' economic efficiency and sustainability. The case of Italian national parks	2006
FC Wang, WT Hung, JK Shang	Measuring pure managerial efficiency of international tourist hotels in Taiwan	2006
MF Cracolici, P Nijkamp	Competition among tourist destination. An application of data envelopment analysis to Italian provinces	2006
FC Wang, WT Hung, JK Shang	Measuring the cost efficiency of international tourist hotels in Taiwan	2006
A Karakitsiou, A Mavrommati, A Migdalas, K Tsiakali	Efficiency Measurement and Evaluation of the Greek hotel industry.	2007
V Bosetti, M Cassinelli, A Lanza	Benchmarking in tourism destinations; keeping in mind the sustainable paradigm	2007
CP Barros, Á Matias	Efficiency in a chain of small hotels with a stochastic production frontier model	2007

MF Cracolici, P Nijkamp, M Cuffaro	Efficiency and productivity of Italian tourist destinations: A quantitative estimation based on data envelopment analysis and the Malmquist method	2007
Y Hadad, L Friedman, MZ Hanani	Measuring efficiency of restaurants using the data envelopment analysis methodology	2007
GM Sanjeev	Measuring efficiency of the hotel and restaurant sector: the case of India	2007
D Reynolds, D Biel	Incorporating satisfaction measures into a restaurant productivity index	2007
D Reynolds, GM Thompson	Multiunit restaurant productivity assessment using three-phase data envelopment analysis	2007
KW Choi, YS Roh, JH Yoon	An empirical examination of productivity of a chain restaurant using data envelopment analysis (DEA)	2007
KW Wöber	Data envelopment analysis	2007
H Çiftçi, E Düzakın, YB Önal	All inclusive system and its effects on the Turkish tourism sector	2007
B Thang	Analysis of technical efficiency for the hotel industry in Vietnam	2007
S Pyo	DeA application for the tourist satisfaction management	2007
VM Giménez-García, JL Martínez-Parra, FP Buffa	Improving resource utilization in multi-unit networked organizations: The case of a Spanish restaurant chain	2007
CD Köksal, AA Aksu	Efficiency evaluation of A-group travel agencies with data envelopment analysis (DEA): A case study in the Antalya region, Turkey	2007
M Khataei, MR Farzin, Ali Mousavi	Measuring the efficiency of selected hotels in Tehran: A DEA approach	2008
Z Zhou, Y Huang, MK Hsu	Using data envelopment analysis to evaluate efficiency: An exploratory study of the Chinese hotel industry	2008
CH Ko, TR Sloan, R Presbury	The effect of location on DEA efficiency measures: case study from Taiwanese International Tourist hotel	2008
W Dai, Q Lin	Measuring cost efficiency in the hotel sector: A case from China's Zhejiang province	2008
JK Shang, WT Hung, FC Wang	Service outsourcing and hotel performance: three-stage DEA analysis	2008
U Bauernfeind, N Mitsche	The application of the data envelopment analysis for tourism website evaluation	2008
CP Barros, PUC Dieke	Technical efficiency of African hotels	2008
H Min, H Min, SJ Joo	A data envelopment analysis-based balanced scorecard for measuring the comparative efficiency of Korean luxury hotels	2008
H Min, H Min, SJ Joo, J Kim	Data Envelopment Analysis for establishing the financial benchmark of Korean hotels	2008
S de Mello, JCC Baptista, LA Meza, BB Silva	Some rankings for the Athens Olympic Games using DEA models with a constant input	2008

KJ Tseng	A Performance Study on Independent-owned International Tourist Hotels in Taiwan	2008
FJ Tapiador, A Mateos, J Martí-Henneberg	The geographical efficiency of Spain's regional airports: A quantitative analysis	2008
Y Huang, CMK Hsu, Z Zhou	Evaluating efficiency in the Chinese hotel industry: a Data Envelopment Analysis approach	2008
K Pušnik	The effect of technical and cost efficiency on income position of firms in tourism	2008
JK Shang, WT Hung, CF Lo, FC Wang	Ecommerce and hotel performance: three-stage DEA analysis	2008
MF Cracolici, P Nijkamp, P Rietveld	Assessment of tourism competitiveness by analysing destination efficiency	2008
CM Santos, PUC Dieke, Barros CP	Efficiency measurement systems in hotels: Perspectives from Luanda, Angola	2008
JJ Shuai	Web content and its influence on operational performance-case of the hotel industry	2009
L Botti, N Peypoch, E Robinot, B Solonadrasana	Tourism destination competitiveness: the French regions case	2009
CP Barros, P Garcia-del-Barrio, S Leach	Analysing the technical efficiency of the Spanish Football League First Division with a random frontier model	2009
JL Hu, HS Shieh, CH Huang, CN Chiu	Cost efficiency of international tourist hotels in Taiwan: A data envelopment analysis application	2009
R Perrigot, G Cliquet, I Piot-Lepetit	Plural form chain and efficiency: Insights from the French hotel chains and the DEA methodology	2009
JCCB de Mello, L Angulo-Meza, BPB Silva	A ranking for the Olympic Games with unitary input DEA models	2009
R Ramanathan	Estimating relative attractiveness of locations using data envelopment analysis	2009
JC Neves, S Lourenço	Using data envelopment analysis to select strategies that improve the performance of hotel companies	2009
TH Chen	Performance measurement of an enterprise and business units with an application to a Taiwanese hotel chain	2009
LY Lee, YH Kao, BH Nugroho	A benchmarking analysis of customer relationship management for international tourist hotels	2009
H Tsai	Star-Rated Hotel Productivity in China: A Provincial Analysis Using the DEA Cross-Efficiency Evaluation Approach	2009

MJ Del Barrio, LC Herrero, JÁ Sanz	Measuring the efficiency of heritage institutions: A case study of a regional system of museums in Spain	2009
D Zhang, X Li, W Meng, W Liu	Measuring the performance of nations at the Olympic Games using DEA models with different preferences	2009
H Cheng, YC Lu, JT Chung	Performance benchmarking by improved slack-based context-dependent DEA for the hotel industry in Taiwan	2009
JE Boscá, V Liern, A Martínez, R Sala	Increasing offensive or defensive efficiency? An analysis of Italian and Spanish football	2009
XA Rodríguez, F Martínez, P Murias	Institutional Support and Productivity of Rural Tourism Establishments in Galicia, NW Spain	2009
H Min, H Min, SJ Joo	A data envelopment analysis on assessing the competitiveness of Korean hotels	2009
R Sellers-Rubio, JL Nicolau-Gonzálbez	Assessing performance in services: the travel agency industry	2009
XL Ma, C Ryan, JG Bao	Chinese National Parks—Resource Usage Efficiencies, Spatial Proximity and Roles: An Application of Data Envelopment Analysis	2009
XL Ma, C Ryan, JG Bao	Chinese national parks: Differences, resource use and tourism product portfolios	2009
MM Yu, BCY Lee	Efficiency and effectiveness of service business: Evidence from international tourist hotels in Taiwan	2009
I Daskalopoulou, A Petrou	Urban tourism competitiveness: networks and the regional asset base	2009
CT Chen, JL Hu, JJ Liao	Tourists nationalities and the cost efficiency of international tourist hotels in Taiwan	2010
N Tumer	Measuring hotel performance using data envelopment analysis	2010
JK Shang, FC Wang, WT Hung	A stochastic DEA study of hotel efficiency	2010
MH Siddiqui, SN Tripathi	Performance of Tourist Centres in Uttar Pradesh: An Evaluation Using Data Envelopment Analysis	2010
M Pulina, C Detotto, A Paba	An investigation into the relationship between size and efficiency of the Italian hospitality sector: A window DEA approach	2010
H Cheng, YC Lu, JT Chung	Improved slack-based context-dependent DEA–A study of international tourist hotels in Taiwan	2010
Y Chiu, MF Wu	Performance evaluation of international tourism hotels in Taiwan—application of context-dependent DEA	2010
C Scholochow, M Fuchs, W Höpken	ICT Efficiency and Effectiveness in the Hotel Sector—A Three-Stage DEA Approach	2010
LF Hsieh, LH Lin	A performance evaluation model for international tourist hotels in Taiwan—An application of the relational network DEA	2010
EY Roh, K Choi	Efficiency comparison of multiple brands within the same franchise: Data envelopment analysis approach	2010
A Assaf, CP Barros, A Josiassen	Hotel efficiency: A bootstrapped metafrontier approach	2010
A Assaf, LK Cvelbar	The performance of the Slovenian hotel industry: evaluation post-privatisation	2010

M Othman, LY Foo, MSA Karim, YA Aziz	Total factor productivity efficiency changes in a Malaysian hotel chain	2010
H Cheng, YC Lu, JT Chung	Assurance region context-dependent DEA with an application to Taiwanese hotel industry	2010
J Wu, Z Zhou, L Liang	Measuring the performance of nations at Beijing Summer Olympics using integer-valued DEA model	2010
S Korony	Accommodation facilities productivity and efficiency analyses of Slovak districts	2010
SM Hsu, HC Chen, CC Chen	Efficiency and effectiveness evaluation model—The case of international tourist hotel in Taiwan	2010
YH Chiu, CT Ting, CW Huang	The different systems for tourist hotels efficiency estimation in Taiwan	2010
J Wu, L Liang, H Song	Measuring hotel performance using the integer DEA model	2010
JG Brida, C Detotto, M Pulina	How efficient is the Italian hospitality sector? A window DEA and truncated-Tobit analysis	2011
WB Liu, CF Tai, SJ Yang, KC Peng	An application of two-stage data envelopment analysis for the operation efficiency of international tourist hotels in Taiwan	2011
J Wu, H Song	Operational performance and benchmarking: A case study of international tourist hotels in Taipei	2011
MC Kao, CY Lin, MC Lai, HC Huang	Exploring the efficiency of international tourism development in an emerging market	2011
CP Barros, L Botti, N Peypoch, B Solonandrasana	Managerial efficiency and hospitality industry: the Portuguese case	2011
H Tsai, J Wu, Z Zhou	Managing efficiency in international tourist hotels in Taipei using a DEA model with non-discretionary inputs	2011
JG Brida, M Deidda, M Pulina	Investigating economic efficiency in Italy: a regional comparison	2011
TH Chen	Performance measurement in a small Taiwanese hotel chain	2011
Z Qi, M Junhai	Research on business efficiency of hotel and tourism enterprises based on the influence of innovation factors	2011
AR Font, AMR Penalva, CNJ Sampol	Efficiency and seasonality in the Balearic hospitality industry	2011
JJ Shuai, WW Wu	Evaluating the influence of E-marketing on hotel performance by DEA and grey entropy	2011
NK Avkiran	Applications of data envelopment analysis in the service sector	2011
J Wu, H Tsai, Z Zhou	Improving efficiency in international tourist hotels in Taipei using a non-radial DEA model	2011
AG Assaf, C Barros	Performance analysis of the Gulf hotel industry: A Malmquist index with bias correction	2011
S Lozano, E Gutiérrez	Efficiency analysis of EU-25 member states as tourist destinations	2011

G Bi, Y Luo, L Liang	Efficiency Evaluation of Tourism Industry With Data Envelopment Analysis (DEA): A Case Study in China:	2011
H Song, S Yang, J Wu	Measuring Hotel Performance Using the Game Cross-Efficiency Approach	2011
AG Assaf, M Deery, L Jago	Evaluating the performance and scale characteristics of the Australian restaurant industry	2011
TY Kim, KJ Seol, YD Kwak	The Efficiency Analysis of CRM System in the Hotel Industry Using DEA	2011
H Dong, D Zhao	The evaluation and analysis of China's regional tourism industry efficiency	2011
Y Mao, CJ Shieh	A Study on service quality performance in catering industry-The application of DEA.	2011
S Suzuki, P Nijkamp, P Rietveld	Regional efficiency improvement by means of data envelopment analysis through Euclidean distance minimization including fixed input factors: An application to …	2011
LY Foo, M Othman, YA Aziz	Efficiency measurement of a Malaysian hotel chain using DEA.	2011
N Deraman, J Said, F Saman	Data Envelopment Analysis (DEA) evaluation framework of hotel services	2011
H Cheng, YC Lu, JT Chung	DEA of Assurance Region Malmquist Index: An Illustration with International Tourist Hotels in Taiwan	2011
FL Yen, M Othman	Data envelopment analysis to measure efficiency of hotels in Malaysia	2011
CL Kuo, CL Lin	The management performance assessment of Taiwan's camping park based on DEA technique	2011
YH Chiu, CW Huang	Evaluating the optimal occupancy rate, operational efficiency, and profitability efficiency of Taiwan's international tourist hotels	2011
HP Fu, KK Chu, P Chao, HH Lee,YC Liao	Using fuzzy AHP and VIKOR for benchmarking analysis in the hotel industry	2011
AG Assaf, FW Agbola	Modelling the performance of Australian hotels: a DEA double bootstrap approach	2011
AG Assaf, CP Barros, LP Machado	The future outlook for Portuguese travel agents	2011
R Fuentes	Efficiency of travel agencies: A case study of Alicante, Spain	2011
CP Barros, L Botti, N Peypoch, E Robinot, B Solonandrasana, A.G Assaf	Performance of French destinations: Tourism attraction perspectives	2011
A Untong, M Kaosa-Ard, V Ramos, Javier Rey-Maquieira	Change in the managerial efficiency and management technology of hotels: an application to Thailand	2011
B Escobar Pérez, A Lobo Gallardo, JI Otero Terrón	A DEA model for measuring efficiency adapted to the hotel sector	2012

YL Huang, IF Lee, YH Lee	Modeling operational efficiency using data envelopment analysis: evidence from Atlantic City hotels	2012
H Shirouyehzad, FH Lotfi, A Shahin, B Aryanezhad, R Dabestani	Performance evaluation of hotels by data envelopment analysis based on customers' perception and gap analysis	2012
H Shirouyehzad, FH Lotfi, A Shahin, B Aryanezhad, R Dabestani	A DEA approach for comparative analysis of service quality dimensions with a case study in hotel industry	2012
YY Luo, ZX Liao, J Wang, JF Ren, ZS Liu	Compared Research on Operational Management Efficiency of Tourism Enterprises Based on Low-Carbon Management Perspective	2012
MC Wu, CY Chen	An examination of the operating efficiency of international tourist hotels in Taiwan and associated factors	2012
Q Yan, HQ Zhang	Evaluation of the economic effectiveness of public tourism coupons in China in 2009–A corrected DEA approach	2012
Y Chiu, C Huang	A non-radial measure of different systems for Taiwanese tourist hotels' efficiency assessment	2012
CT Ting, CW Huang	Measuring the effectiveness of mutual learning for Taiwan's tourist hotels with the DEA approach	2012
MM Yu	An integration of the multi-component DEA and GAR models to the measurement of hotel performance	2012
TL Yeh, TY Chen, CK Li	Strategic alliances and hotel efficiency in Taiwan	2012
J Wu, Z Zhou, H Tsai	Measuring and decomposing efficiency in international tourist hotels in Taipei using a multidivision DEA model	2012
HS Shieh	The greener, the more cost efficient? An empirical study of international tourist hotels in Taiwan	2012
SJ Joo, PJ Billington, PA Stoeberl	Labour management for a restaurant using data envelopment analysis	2012
B Benito, J Solana, MR Moreno	Assessing the efficiency of local entities in the provision of public sports facilities.	2012
Y Huang, HI Mesak, MK Hsu, H Qu	Dynamic efficiency assessment of the Chinese hotel industry	2012
CW Huang, YH Chiu, CT Ting, CH Lin	Applying a hybrid DEA model to evaluate the influence of marketing activities to operational efficiency on Taiwan's international tourist hotels	2012
AG Assaf, A Josiassen	Identifying and ranking the determinants of tourism performance: A global investigation	2012
S Motaghi	The efficiency of Tourism in the Iran's Provinces	2012
C Xiong-fei, W Ren-wen, G Xi-tong	Measuring DEA efficiency in international tourist hotels in Taipei	2012

JR Chou, CJ Shieh, KP Huang	A study of the performance on human resource management strategy in tourism industry with Data Envelopment Analysis.	2012
Y Lee, LT Lu, AD Sung	A measure to the operational performance of international hotels in Taiwan: DEA and malmquist approach	2012
HS Shieh	Does cost efficiency lead to better financial performance? A study on Taiwan international tourist hotels	2012
J Shyu, SC Hung	The true managerial efficiency of international tourist hotels in Taiwan: three-stage data envelopment analysis	2012
A Medal-Bartual, CJ Garcia-Martin, R Sala-Garrido	Efficiency analysis of small franchise enterprises through a DEA metafrontier model	2012
A Salman Saleh, AG Assaf, H Son Nghiem	Efficiency of the Malaysian hotel industry: a distance function approach	2012
S Honma, JL Hu	Analyzing Japanese hotel efficiency	2012
AG Assaf	Benchmarking the Asia Pacific tourism industry: A Bayesian combination of DEA and stochastic frontier	2012
JIN Chun-yu, C Hao, S Guang-rui	Research on the Evaluation of China's Efficiency of Regional Tourism Industry Based on Three-stage DEA Model.	2012
S Hadad, Y Hadad, M Malul, M Rosenboim	The economic efficiency of the tourism industry: A global comparison	2012
O Goncalves, QB Liang, N Peypoch, S Sbai	Technical Efficiency Measurement and Inverse B-Convexity: Moroccan Travel Agencies	2012
SP Yeh	Innovative management in tourism industry: data envelopment analysis	2012
T Cuccia, C Guccio, I Rizzo	Does UNESCO inscription affect the performance of tourism destinations? A regional perspective	2013
S Radovanović, M Radojičić, V Jeremić, G Savić	A novel approach in evaluating efficiency of basketball players	2013
SC Hui, MC Wan	Study of hotel energy performance using data envelopment analysis	2013
JM Hsiao, CW Sung, D Kralj	The measurement of operating efficiency: A case study of Fong Shan Tourism Plaza	2013
Y Yılmaz	Impact of strategy on efficiency in the luxury hotel industry of Turkey	2013
JB Chin, MC Wu, LF Hsieh	Strategic planning of optimal resource allocation in response to global financial crisis–a study of international tourist hotels	2013
E Mansourirad	A Categorical Fuzzy DEA Method to Evaluate Efficiency of Hotels Based on Stars Rating	2013
SS Tsang, YF Chen	Facilitating benchmarking with strategic grouping and data envelopment analysis: the case of international tourist hotels in Taiwan	2013
WW Wu, LW Lan, YT Lee	Benchmarking hotel industry in a multi-period context with DEA approaches: A case study	2013

Q Ru, X Ruonan	The study on the efficiency evaluation of urban tourism based on the method of DEA	2013
CL Paço, JMC Pérez	The use of DEA (Data Envelopment Analysis) methodology to evaluate the impact of ICT on productivity in the hotel sector	2013
SF Chou, CY Fang	Exploring surplus-based menu analysis in Chinese-style fast food restaurants	2013
H Shirouyehzad, FH Lotfi, R Dabestani	Aggregating the results of ranking models in data envelopment analysis by Shannon's entropy: a case study in hotel industry	2013
C Manasakis, A Apostolakis, G Datseris	Using data envelopment analysis to measure hotel efficiency in Crete	2013
Z Jia, Z Zhou, J Wu, Z Chen	A unified DEA approach for evaluating congestion: a case of hotels in Taipei	2013
H Shirouyehzad, FH Lotfi, SM Arabzad, R Dabestani	An AHP/DEA ranking method based on service quality approach: a case study in hotel industry	2013
CH Ko, YH Tsai	Influence of Location on Dea Efficiency Measure Case Study from Taiwanese Hotels	2013
H Tsai, J Wu, J Sun	Cross-Efficiency Evaluation of Taiwan's International Tourist Hotels Under Competitive and Cooperative Relationships	2013
H Taheri, S Ansari	Measuring the relative efficiency of cultural-historical museums in Tehran: DEA approach	2013
HT Lin, CY Hsieh, SL Lin, ML Shih	Two-Stage Evaluation of International Tourist Hotels in Taiwan Using Data Envelopment Analysis	2013
KH Peng, JH Huang, WH Wu	Rasch model in data envelopment analysis: application in the international tourist hotel industry	2013
CW Huang, CT Ting, CH Lin, CT Lin	Measuring non-convex metafrontier efficiency in international tourist hotels	2013
Y Chen, H Chinm	Evaluating the Operation Performance of International Tourist Hotel in Taiwan by Data Envelopment Analysis	2013
CY Fang	Did the financial crisis and policy deregulation for Chinese tourists affect the efficiency and output slacks of taiwanese hotels?	2013
MIA Marques, MM Ribeiro, MJPL dos Santos	Technical Efficiency of Francisco Sá Carneiro Airport Porto: The potential impacts on regional tourism	2013
S Rebelo, F Matias, P Carrasco	Application of the DEA methodology in the analysis of efficiency of the Portuguese hotel industry: an analysis applied to the Portuguese geographical regions	2013
MJS Devesa, LFM Peñalver	Research Note: Size, Efficiency and Productivity in the Spanish Hotel Industry — Independent Properties versus Chain-Affiliated Hotels	2013
TH Chen, SD Wu, YY Wang, JF Shih	Research Note: Performance Improvement in a Small Hotel Chain	2013

R Oliveira, MI Pedro, RC Marques	Efficiency and its determinants in Portuguese hotels in the Algarve	2013
A Ashrafi, HV Seow, LS Lee, CG Lee	The efficiency of the hotel industry in Singapore	2013
GF Liu, W Yang	DEA-based investment efficiency model and a positive analysis of the cultural tourism industry.	2013
MZ Liang, T YI, B Li	Study on the Evolutional Model of Tourism Efficiency Based on DEA-MI.	2013
J Kosmaczewska	Tourism interest and the efficiency of its utilisation based on the example of the EU countries	2014
T Cuccia, C Guccio, I Rizzo	Does UNESCO inscription play a significant role in tourism destinations performance? Evidence from the Italian regions	2014
BR Debata, B Patnaik, S Mahapatra, Sreekumar	Efficiency measurement in medical tourism: a DEA approach	2014
CH Yang, HY Lin, CP Chen	Measuring the efficiency of NBA teams: Additive efficiency decomposition in two-stage DEA	2014
FL Agabo-Mateos, B Escobar Pérez, A Lobo Gallardo	Measuring efficiency of the youth hostel sector in Andalusia using an adapted DEA model	2014
HF Lewis	Performance measurement of major league baseball teams using network DEA	2014
R Rusielik, W Zbaraszewski	The efficiency of scientific and tourism activity of Polish National Parks with use DEA method	2014
H Luo, Y Yang, R Law	How to achieve a high efficiency level of the hotel industry?	2014
E Rahmati, Sha Jalil	Efficiency and Effectiveness of Marketing of the Hotels in Kuala Lumpur.	2014
HQ Wu, YX Liu, DL Zhuang, WD Zhu	A DEA-based measurement of effectiveness of provincial image advertisement for local tourism destination: evidence from China	2014
H Shirouyehzad, F Hosseinzadeh Lotfi, R Dabestani	A modified model for sensitivity analysis of inefficient DMUs in DEA: a case study in hotel industry	2014
V Cvetkoska, P Barišić	Measuring the Efficiency of Certain European Countries in Tourism: DEA Windov Analysis	2014
F Yan, B Xianhong	Tourism efficiency characteristics analysis of forest parks in China based on DEA	2014
H Shirouyehzad, F Yazdani	Performance evaluation and ranking of participation Asian countries in 2012 London Olympic Games through Data Envelopment Analysis	2014
R Li, Q Guo, D Wu, H Yin, H Zhang, T Zhu	Spatial characteristics of development efficiency for urban tourism in eastern China: A case study of six coastal urban agglomerations	2014
AG Assaf, FW Agbola	Efficiency analysis of the australian accommodation industry: a bayesian output distance function	2014

S Hathroubi, N Peypoch, E Robinot	Technical efficiency and environmental management: The Tunisian case	2014
Z Zhou, J Wu	Applying a peer-restricted Cross-efficiency approach to measuring the performance of International Tourist hotels in Taipei	2014
C Detotto, M Pulina, JG Brida	Assessing the productivity of the Italian hospitality sector: a post-WDEA pooled-truncated and spatial analysis	2014
E Gutiérrez, S Lozano	A DEA approach to performance-based budgeting of formula one constructors	2014
JG Brida, M Deidda, M Pulina	Tourism and transport systems in mountain environments: analysis of the economic efficiency of cableways in South Tyrol	2014
T Elena	Regional scale efficiency evaluation by input-oriented data envelopment analysis of tourism sector	2014
C Huang, FN Ho, Y Chiu	Measurement of tourist hotels′ productive efficiency, occupancy, and catering service effectiveness using a modified two-stage DEA model in Taiwan	2014
FJ Chien	A Study on the Operating Efficiency of Taiwan Tourist Hotels	2014
JM Xavier, VMF Moutinho	Performance evaluation using DEA and Malmquist Index technique in the hotel industry: the case of the Pestana Group.	2014
J De Jorge, C Suárez	Productivity, efficiency and its determinant factors in hotels	2014
V Pérez, F Guerrero, M González, F Pérez, R Caballero	The sustainability of Cuban nature based tourism destinations: a quantitative approach	2014
BA Sami, G Mohamed	Determinants of tourism hotel profitability in Tunisia	2014
B Benito, J Solana, P López	Determinants of Spanish regions' tourism performance: a two-stage, double-bootstrap data envelopment analysis	2014
R Oliveira, MI Pedro, RC Marques	Cost efficiency of Portuguese hotels in the Algarve: a comparative analysis using mathematical and econometric approaches	2014
JT Pastor, FJ Del Campo, F Vidal, D Pastor	Research Note: Efficiency in Attracting Tourists via the Web — An Application to the Mediterranean Countries	2014
SM Nam, HC Shin	Applying DEA to evaluate the Management Efficiency of Resort in South Korea	2014
W Pan, L Zhao, X Zhang, B Xue, S Dai, Y Wang, L Dan	The Research on Efficiency Evaluation and Optimization of Eco-tourism in Coastal Zone Based on Data Envelopment Analysis	2015
Dos-Santos, Maria José Palma Lampreia, Mendes-Ribeiro, Mafalda, Andrés-Marques, Isabel	Portuguese airport efficiency analysis: The case study of Oporto	2015

MR González-Rodriguez, R Martín-Samper, A Carlos Giuliani	Evaluating the efficiency progress with technology in a Spanish hotel chain	2015
JT Pastor Ciurana, FJ Del Campo Gomis, F Vidal Giménez, D Pastor Campos, A Agulló Torres	Analysis of the efficiency of golf tourism via the Internet. Application to the Mediterranean countries	2015
X Lei, Y Li, Q Xie, L Liang	Measuring Olympics achievements based on a parallel DEA approach	2015
T Yi, M Liang	Evolutional model of tourism efficiency based on the DEA method: A case study of cities in Guangdong Province, China	2015
L Parte-Esteban, P Alberca-Oliver	Determinants of technical efficiency in the Spanish hotel industry: regional and corporate performance factors	2015
SUN Yuan-yuan	Measuring effi ciency of listed tourism companies in China	2015
P Yin, H Tsai, J Wu	A hotel life cycle model based on bootstrap DEA efficiency: the case of international tourist hotels in Taipei	2015
E Robinot	Does Environmental Initiatives Really Mater My Customers? A Joint Analysis of Performance and Satisfaction Measurement in the Hotel Industry	2015
JC Valdivieso, PFJ Eagles, JC Gil	Efficient management capacity evaluation of tourism in protected areas	2015
D Man, H Zhang	The Study of DEA Application in Tourism City: A Case for Members of the World Tourism City Federation in China	2015
A Alzua-Sorzabal, M Zurutuza, F Rebón, JK Gerrikagoitia	Obtaining the efficiency of Tourism Destination website based on Data Envelopment Analysis	2015
E da Silva Santos, M Fortes	Performance of brazilian state capitals as tourism destinations	2015
RSLP Oliveira, MIC Pedro, RDRC Marques	Efficiency Evaluation of Portuguese Hotels in the Algarve using Data Envelopment Analysis (DEA)	2015
D Huang, X Chi	Application of Delphi-AHP-DEA-FCE Model in Competitiveness Evaluation of Sports Tourism Destination	2015
CML Paço, JMC Pérez	Assessing the impact of Information and Communication Technologies on the Portuguese hotel sector: an exploratory analysis with Data Envelopment Analysis	2015
A Abad, P Kongmanwatana	Comparison of destination competitiveness ranking in the European Union using a non-parametric approach	2015
AG Assaf, LK Cvelbar	Why negative outputs are often ignored: a comprehensive measure of hotel performance	2015
A Corne	Benchmarking and tourism efficiency in France	2015

ZY Hu	An analysis of the efficiency characteristics of the travel agency industry of China based on a DEA-Malmquist model.	2015
P Alberca-Oliver, A Rodríguez-Oromendía, L Parte-Esteban	Measuring the efficiency of trade shows: A Spanish case study	2015
D Khezrimotlagh, A Mirzapour	Performance measurement of turkey's tourism sector by using Data Envelopment Analysis	2015
T Ramaj	Data Envelopment Analysis: An Application To Measure Technical Efficiency Of Hotel Units In Elbasan, Albania	2015
J Solana-Ibáñez, M Caravaca-Garratón, Lorena Para-González	Two-stage data envelopment analysis of Spanish regions: Efficiency determinants and stability analysis	2016
T Kularatne, C Wilson, V Hoang, B Lee	Technical efficiency and environmental management of hotels: The case of Sri Lanka	2016
M Sveum, ME Sykuta	Making a Motivated Manager: A Census Data Investigation into Efficiency Differences Between Franchisee and Franchisor-Owned Restaurants	2016
C Huang, Y Chiu, C Tu, Z Luo, Z Wang	Using the nonhomogeneous frontier two-stage DEA model to assess the efficiencies of expense utilization and operation of the Taiwanese hotel industry	2016
JS Ibañez, LP González, CN Nieto	Destination Competitiveness and Sustainable Tourism: A Critical Review	2016
F Cao, Z Huang, C Jin, M Xu	Chinese national scenic areas' tourism efficiency: Multi-scale fluctuation, prediction and optimization	2016
MM Yu, LH Chen	Productivity growth of taiwanese international tourist hotels in a metafrontier framework	2016
SN Hwang, TY Chang	Formulating management strategy for international tourist hotel using DEA	2016
T Cuccia, C Guccio, I Rizzo	The effects of UNESCO World Heritage List inscription on tourism destinations performance in Italian regions	2016
K Poldrugovac, M Tekavcic, S Jankovic	Efficiency in the hotel industry: an empirical examination of the most influential factors	2016
N Ueasin, A Wongchai	The operational efficiency of health tourism industries in three provinces of northeastern Thailand	2016
S Ben Aissa, M Goaied	Determinants of tourism hotel market efficiency	2016
JL Hu, HL Liang	Operating Efficiency of International Tourist Hotels in Taiwan by Taking Into Account Congestion	2016
A Shahin, H Shirouyehzad	Importance-performance analysis of service quality dimensions for the customer groups segmented by DEA	2016
A Guizzardi, A Monti, E Ranieri	Rating hotel quality for corporate business travel departments	2016
A Fragoudaki, D Giokas	Airport performance in a tourism receiving country: Evidence from Greece	2016

A Oukil, N Channouf, A Al-Zaidi	Performance evaluation of the hotel industry in an emerging tourism destination: The case of Oman	2016
ER Sambyal	Data Envelopment Analysis to measure Technical Efficiency of JKTDC establishments in J&K state	2016
LT Lu	A comparison of performance and efficiency in hotel industry: evidences of Taipei and scenic area hotels in Taiwan	2016
Y Ohe, N Peypoch	Efficiency analysis of Japanese Ryokans: A window DEA approach	2016
SB Aissa, M Goaied	Determinants of Tunisian hotel profitability: The role of managerial efficiency	2016
TS Stumpf, D Reynolds	Institutional conformance and tourism performance: an efficiency analysis in developing Pacific Island countries	2016
J Solana Ibáñez, L Para González, C Nieves Nieto	Efficiency and exogenous factors: evidence from Spanish tourism regions	2017
HS Shieh, JL Hu, TY Liu	An environment-adjusted dynamic efficiency analysis of international tourist hotels in Taiwan	2017
Su Zhen, Li Qiuying	The Efficiency of Tourism Impact on People's Livelihood: A Theoretical Framework	2017
TY Cho, TY Wang	Estimations of cost metafrontier Malmquist productivity index: using international tourism hotels in Taiwan as an example	2017
LC Herrero-Prieto	Evaluating the Efficiency of Cultural Travel Destinations: A DEA Approach	2017
A Corne	Destination performance: Decision-making tools for tourism sector. The case of France	2017
C Huang	Assessment of efficiency of manual and non-manual human resources for tourist hotel industry: an application of the hybrid DEA model	2017
N Manavizadeh, H Hamed Farrokhi-Asl, M Rabbani	Robust data envelopment analysis with uncertain date: An analysis to measure hotel efficiency in Crete	2017
GN Gregoriou, MM Gultek, I Demirer	Efficiency of Cruise Ships: A Data Envelopment Analysis Approach.	2017
S Ben Aissa, M Goaied	Performance of tourism destinations: Evidence from tunisia	2017
Z Yang, L Xia, Z Cheng	Performance of Chinese hotel segment markets: Efficiencies measure based on both endogenous and exogenous factors	2017
X Xu, CG Chi	Examining Operating Efficiency of US Hotels: A Window Data Envelopment Analysis Approach	2017
CW Huang, HY Chen, CT Ting	Using a network data envelopment analysis model to assess the efficiency and effectiveness of cultural tourism promotion in Taiwan	2017
AG ASSAF, FW AGBOLA	Frontier approaches for performance measurement in the hospitality and tourism industries	2017
J Liu, J Zhang, Z Fu	Tourism eco-efficiency of Chinese coastal cities–Analysis based on the DEA-Tobit model	2017
A Miró, Á Pereira	Effects of the Internet use in the technical efficiency of the tourism sector: a case study of the hinterland regions of Catalonia	2017

JC Martín, C Mendoza, C Román	Regional Spanish Tourism Competitiveness. A DEA-MONITUR approach	2017
H Yu	Research on the Economic Benefits of Pro-Poor Tourism in Chongqing Based on the DEA Model	2017
JC Martín, C Mendoza, C Román	A DEA travel–tourism competitiveness index	2017
M Wei	Spatial Distribution and the Agglomeration Performance of High-Star Hotels	2017
T Cuccia, C Guccio, I Rizzo	UNESCO sites and performance trend of Italian regional tourism destinations: A two-stage DEA window analysis with spatial interaction	2017
LC Herrero-Prieto, M Gomez-Vega	Cultural resources as a factor in cultural tourism attraction: Technical efficiency estimation of regional destinations in Spain	2017
I Önder, K Wöber, B Zekan	Towards a sustainable urban tourism development in Europe: the role of benchmarking and tourism management information systems–A partial model of destination …	2017
H Peng, J Zhang, L Lu, G Tang, B Yan, X Xiao, Y Hanb	Eco-efficiency and its determinants at a tourism destination: A case study of Huangshan National Park, China	2017
YT Chang, S Lee, HK Park	Efficiency analysis of major cruise lines	2017
S Alfiero, M Cane, R Doronzo, A Esposito	The efficiency of the continental European transportation cruise ship companies. A slack based DEA application	2018
MJ Dolasinski, C Roberts, T Zheng	Measuring hotel channel mix: A Dea-Bsc Model	2018
J Yuan, Z Gao	Evaluation of region tourism efficiency and spatial differences of guangdong province under the background of happiness industry	2018
Y Ohe	Does Farmer's Identity Make a Difference in Efficiency in Dairy Farms Conducting Educational Tourism? Evaluation by Slacks-based Measure DEA Models	2018
C Guccio, I Mazza, A Mignosa, I Rizzo	A round trip on decentralization in the tourism sector	2018
D Jacob, S Onadeko, I Nelson, A Shotuyo	Evaluation of Old Oyo National Park Efficiency Using DEA Approach	2018
R Sellers-Rubio, AB Casado-Díaz	Analyzing hotel efficiency from a regional perspective: The role of environmental determinants	2018
O Shaheen, M Morse, O Qoura, K Gomaa	Factors Affecting Employees' Productivity in Food and Beverage Department in Mercure Hotels Chain in Egypt	2018

V Figueroa, LC Herrero, A Báez, M Gómez	Analysing how cultural factors influence the efficiency of tourist destinations in Chile	2018
A Oukil, A Al-Zidi	Benchmarking the hotel industry in Oman through a three-stage DEA-based procedure	2018
B Zuo, L Li	Resource Reallocation and Heterogeneous Productivity Growth in the Tourism Industry	2018
H Choo, YH Ahn, DB Park	Using the Data Envelopment Analysis to Measure and Benchmark the Efficiency of Small-scale Tourism Farms in South Korea	2018
W Xi, X Cheng	The Difference of Capital Input and Productivity in Service Industries: Based on Four Stages Bootstrap-DEA Model	2018
I Ilić, I Petrevska	Using DEA method for determining tourism efficiency of Serbia and the surrounding countries	2018
E Gutiérrez, S Lozano	Benchmarking Formula One auto racing circuits: a two stage DEA approach	2018
A Karakitsiou, M Kourgiantakis, A Mavrommati, A Migdalas	Regional efficiency evaluation by input-oriented data envelopment analysis of hotel and restaurant sector	2018
MA Karadayi, M Isik	A Categorical DEA Framework for Evaluating Medical Tourism Efficiency of “Top Destinations”	2018
J Zha, L He, Y Liu, Y Shao	Evaluation on development efficiency of low-carbon tourism economy: A case study of Hubei Province, China	2018
HS Chen, BK Tsai, GB Liou, CM Hsieh	Efficiency Assessment of Inbound Tourist Service Using Data Envelopment Analysis	2018
SH Chiu, TY Lin	Performance evaluation of Taiwanese international tourist hotels: evidence from a modified NDEA model with ICA technique	2018
M Pulina, V Santoni	A two-stage DEA approach to analyse the efficiency of the hospitality sector	2018
C van Heerden, M Saayman	Sustainability of a national arts festival: An application of a data envelopment analysis approach	2018
C Huang	Assessing the performance of tourism supply chains by using the hybrid network data envelopment analysis model	2018
CN Chiu	How can managerial efficiency be improved? Evidence from the bed and breakfast industry	2018
LF Mendieta-Peñalver, JF Perles-Ribes, AB Ramón-Rodríguez, MJ Such-Devesa	Is hotel efficiency necessary for tourism destination competitiveness? An integrated approach	2018
T Škrinjarić	Evaluation of environmentally conscious tourism industry: Case of Croatian counties	2018

4. TOURIST AND NON-TOURIST REGIONS IN SPAIN: META-FRONTIER ANALYSIS

Abstract: This study aims to contribute to the analysis of the determinants of tourism performance in Spanish regions over the 2008-2018 period. Accordingly, a Meta-frontier DEA (Carnes et al., 1978; Battese et al., 2004; O'Donnell et al., 2008) was used to obtain the efficiency scores for each region. The second stage adopted the bootstrapping method proposed by Simar and Wilson (2007) to measure the efficiency impact of explanatory factors on regional efficiency. The study presents novelties in the form of the division of regions between tourist and non-tourist. The results suggest that geographical location have a significant impact on the efficiency of Spanish regional tourism. The most efficient regions are tourist regions with an exit to the seaside, located in the south and east of the country. Furthermore, a convergence in the efficiency level between the tourist and non-tourist regions of Spain was found. Results also suggest that beaches have a positive impact on both tourist and non-tourist regions. National Parks have a positive impact on non-tourist regions. On the other hand, the sun and security have negative impact on tourist and non-tourist regions.

Keywords: Spain, Meta-frontier, DEA, Tourism efficiency, Regional tourism.

Resumen: El objetivo de este estudio es contribuir al análisis de los determinantes del rendimiento turístico en las regiones españolas durante el período 2008-2018. Con este objetivo, se realiza un análisis DEA Meta-frontera (Carnes et al., 1978; Battese et al., 2004; O'Donnell et al., 2008) para obtener los indices de eficiencia para cada región. En una segunda etapa, el método de bootstrap propuesto por Simar y Wilson (2007) se ha utilizado para medir el impacto de la eficiencia de los factores explicativos en la eficiencia regional. El estudio presenta novedades al dividir las regiones entre turistas y no turistas. Los resultados sugieren que la ubicación geográfica tiene un impacto significativo en la eficiencia del turismo regional español. Las regiones más eficientes son las regiones turísticas con salida a la costa, ubicadas en el sur y este del país. También encontramos una convergencia en el nivel de eficiencia entre las regiones turísticas y no turísticas de España asi mismo, los resultados muestran que las playas tienen un impacto positivo en las regiones turísticas y no turísticas. Los parques nacionales tienen un impacto positivo en las regiones no turísticas. Por otro lado, el sol y la inseguridad tienen un impacto negativo en regiones, turísticas y no turísticas.

Palabras-clave: España, Meta-frontera, DEA, Eficiencia turística, Turismo regional.

JEL: D02; L83; Z32; P48.

4.1. Introduction

Tourism is a true global force for economic growth and development. By serving as a catalyst for innovation and entrepreneurship and creating of more and better jobs, it helps to build better lives for millions of individuals (UNWTO, 2019). According to the World Travel and Tourism Council (WTTC, 2019), tourism contributes 3.2% ($ 2,750.7 billion) to the global GDP and supports one in every ten jobs in the world, generating 3.8% of the total employment in 2018 (122,891,000 jobs directly in industries such as hotels, restaurant, travel agents, airlines and other passenger transportation services excluding commuter services).

Despite the downside risks (Economic slowdown, Brexit uncertainty etc.), the number of international travelers is still increasing worldwide (UNWTO, 2019). For years, the most popular part of the world is the European Union (EU), concentrating 39.15% of global tourism over the past decade (World Bank, 2019). The EU attracts foreign tourists by their agreeable warm climate throughout the year with rich historical culture and extensive sandy beaches.

In this sense, Spain is one of the major tourist powers, receiving 5.20% of all international tourists from around the world (World Bank, 2019) over the last twenty years. Spain has a suitable environment for natural, cultural and both sand and sea and ski tourism in most regions, due to its historical endowment and geographical situation (orographic conditions) with the Mediterranean, the semi-arid and oceanic climate. According to the Tourist Movement on Borders (Frontur, 2019), Spain received 81,786,364 international tourists in 2018.

Spain is often shown to be at the top of the list of countries with the most effective international tourism destinations with respect to their productivity. Despite this it is relevant to evaluate whether are differences among the efficiency of regional tourism (hereinafter RT) in Spain. By RT we mean a geographical location (region) where natural and man-made environment, supplied by private and public agents, are organized and managed to attract tourists and be enjoyed by them (Botti et al., 2009; Barros et al., 2011).

This study aims to contribute to the analysis of the determinants of tourism performance. The evaluation of the drivers of tourism performance is especially relevant, due to the importance of the tourism sector in the Spanish regional economy.

To address the above research question, the analysis revel from the approach proposed by Carnes et al. (1978) Data Envelopment Analysis (DEA), and Battese et al. (2004) and O'Donnell et al. (2008) Meta-frontier. First carried out a Meta-frontier DEA to obtain efficiency scores for each region in the first stage. Then, used the bootstrapping method proposed by Simar and Wilson (2007) to measure the efficiency impact of explanatory factors on tourist and non-tourist regions in Spain. This research presents the following novelties: (1) efficiency evaluation is carried out separately by grouping regions in accordance with their tourism focus (Non-tourist: Pais Vasco, Cantabria, Asturias, Aragon, Galicia, Rioja, Castilla – Leon, Navarra, Castilla - La Mancha, Extremadura; Tourist regions: Balears Illes, Canarias, Comunitat Valenciana, Cataluna, Madrid, Murcia, Andalucia), which allows dealing with regional heterogeneity in the DEA estimation. (2) Efficiency determinants are evaluated separately for the two types of regions, which allows us to see whether the impact of factors determining performance depends on the tourist orientation of the regions.

The article is organized as follows. In section 4.2., we review the literature on previous studies on the efficiency of RTs. Section 4.3. presents an empirical model for estimation. Section 4.4. describes the data and descriptive statistics of the variables used. Section 4.5. illustrates the results and section 4.6. highlights the conclusion of the research.

4.2. Literature review

Tourism stimulates economic research to investigate ways to use it as a driver of economic growth, due to its economic relevance. In reference to the literature, there is an increasing interest in assessing the efficiency of tourism sub-sectors (hotel, restaurant, service, tourist transportation etc.) and the effectiveness of public policy for increasing the efficiency of RT. Various frontier models are used, from nonparametric to parametric and stochastic methods. Among the various frontier approaches the most used are two

different methodologies: the parametric method, Stochastic Frontier Analysis (SFA) (Aigner et al., 1977) and the non-parametric method, Data Envelopment Analysis (DEA) (Charnes et al., 1978). The advantage of these frontier methods over regression, partial and simple productivity techniques lies on the calculation of efficiency based on the concept proposed by Farrell (1957). According to this concept, the productivity is defined as the ratio of input to output and can be calculated using a single or by aggregating multiple inputs and outputs.

In the frontier methods, the criterion in comparing the efficiency of a Decision making unit (DMUs) is assessing the distance of each DMU from the frontier. Thus, focusing on RT efficiency, the frontier is used as the basis for comparison between different DMUs. Nevertheless, many researchers ignore the fact that if the DMUs under study operate under different characteristics, it becomes inaccessible to use a single frontier in comparing the efficiency of the different firms (Matawie and Assaf, 2008). Such problems particularly occur when comparisons between DMUs from different groups are inaccessible. To solve this, referring to the concept of Meta-frontier proposed by Hayami (1969), and Hayami and Ruttan (1970), later Battese and Rao (2002), Battese et al. (2004) and O'Donnell et al. (2008) have addressed the issue of a single frontier when group differences exist between the different firms. An advantage of this model is that it allows for the investigation of DMUs' efficiency in different groups that operate under different characteristics. Therefore, the Meta-frontier model is considered as an envelope of all the possible group frontiers.

The approach proposed by O'Donnell et al. (2008) shows that the meta technical inefficiency under the Meta-frontier can not only be divided into two parts (technology gap inefficiency and group technical inefficiency) but also can be used to justify the direction for improvement of technology. Since the development of the Meta-frontier DEA model (O'Donnell et al., 2008) coming out, various Meta-frontier approaches based on DEA have been proposed. Assaf and Matawie (2010), Sala-Garrido et al. (2011), Tiedemann et al. (2011), Chiu et al. (2013) several other papers have updated this method individually. Table 4.2. shows the DEA oriented Meta-frontier approach timetable.

Table 4.2: DEA oriented Meta-frontier approach timetable

#	Article	Applied method	Year
1	Assaf and Matawie	Bootstrapping method	2010
2	Sala-Garrido et al.	Non-concave Meta-frontier DEA	2011
3	Tiedemann et al.	Non-concave Meta-frontier DEA	2011
4	Sala Garrido et al.	Ratio form to compute the technology gap	2011
5	Chiu et al.	Hybrid Meta-frontier DEA to distinguish inputs and outputs into radial inputs and outputs	2013
6	Chiu et al.	Meta-frontier DEA model based on the two-stage network directional distance function with quasi-fixed inputs	2013
7	Zhang et al.	Meta-frontier non-radial directional distance function	2013
8	Yu et al.	Meta-frontier generalised directional distance function approach from O'Donnell et al. (2008) and Fare and Grosskopf (2010)	2015
9	Mei et al.	Meta-frontier slack-based efficiency measure	2015
10	Chiu et al.	Meta-frontier DEA model with the two-stage network directional distance function	2016

Likewise, since every additional update, more and more number of studies have applied various meta-frontier DEA models to measure the group efficiency, meta-efficiency and technology gap in various industries. For example, the efficiencies and technology gaps of franchises in Spain were assessed by Medal-Bartual et al. (2012) using the non-concave Meta-frontier DEA model developed by Sala-Garrido et al. (2011). Wang et al. (2014) did cross-country assessment of CO2 emission performance using the Meta-frontier DEA model proposed by O'Donnell et al. (2008). Molinos-Senante et al. (2015) assesses the efficiencies and technology gaps of water companies using the non-concave meta-frontier approach introduced by Tiedemann et al. (2011). Chen et al. (2017) measures the techno-economic efficiencies and technological gap ratios of airports across countries using the non-concave meta-frontier model proposed by Tiedemann et al. (2011). Chao et al. (2018) assessed the profitability efficiency,

marketability efficiency and technology gaps of Taiwanese banks using the two-stage meta-frontier approach proposed by Chiu et al. (2013). Yu and Chen (2019) followed the Meta-frontier DEA model proposed by O'Donnell et al. (2008) in evaluating the efficiency and technological bias of tourist hotels in Taiwan.

Regarding the analysis of tourist efficiency, the literature has analyzed tourism efficiency worldwide (Assaf and Josiassen, 2012; Hadad et al., 2012), Europe (Abad and Kongmanwatana, 2015; Lozano and Gutiérrez, 2011; Soysal-Kurt 2017). At the regional level, studies on tourism efficiency were carried out in the case of Italy (Bosetti et al., 2004; Bosetti et al., 2007; Cuccia et al., 2016), France (Peypoch, 2007, Botti et al., 2009, Barros et al., 2011) and Spain (Benito et al., 2014, Martin et al., 2017) among others.

In terms of applications in the tourism industry, most studies which use the Meta-frontier approach evaluate hotel performance, such as Assaf et al. (2010), Huang et al. (2013), Lin et al., (2012), Yu and Chen (2019), Cho and Wang (2018), Lu and Chen (2012). In addition, restaurants are assessed by Fang and Hsu (2012), Fang et al. (2013), Fang and Hsu (2014), Alberca and Parte (2018). In regional tourism (Benito et al., 2014; Cuccia et al., 2017; Assaf and Josiassen (2016); Assaf and Dwyer (2013); Zha et al., 2019).

Despite the increasing number of papers using various types of Meta-frontier approaches, the method is relatively novel in operation research (OR), and in the literature, as far as we found, there are still no studies on Spanish RT that use any of the given approaches.

4.3. Theoretical and empirical Model

The efficiency of RT has been analyzed using different approaches such as regression analysis, productivity index, and ratio analysis. However, the frontier analysis is by far the most used approach. Frontier analysis can be applied using two different methodologies: parametric methods, such as the Stochastic Frontier Analysis (SFA) and non-parametric methods such as Data Envelopment Analysis (DEA). At the first stage of papers' analysis, we use DEA for implementing the non-concave Meta-frontier as DEA is suited to measure efficiencies of deterministic industry for multiple inputs/outputs sets (Lam et al., 2009).

4.3.1. Data envelopment analysis

DEA is a non-parametric methodology introduced by Charnes et al. (1978). Based on linear programming, it is used measure the relative performance of a set of similar organizational units (DMUs) by using multiple measures of inputs and outputs. The DEA model determines the efficiency score for each DMU, obtained as a ratio of weighted outputs to weighted inputs.

Formally, since a total of $L = \sum_k L_k$ is regions, the input-oriented technical efficiency under constant return to scale (CRS) is obtained by solving the following linear programming problem:

$$\begin{gathered} \min_{\theta_{it},\lambda_{it}} \theta_{it} \\ s.t.\ \theta_{it} x_{it} - \lambda_{it} X \geq 0, \\ -y_{it} + \lambda_{it} Y \geq 0, \\ \lambda_{it} \geq 0 \end{gathered} \tag{1}$$

where y_{it} is the $Mx1$ vector of output quantity for the ith region in the tth period, x_{it} is the $Mx1$ vector of input quantities for the ith region in the tth period; Y is the MxL matrix of output quantities for all L regions; X is the MxL matrix of input quantities for all L regions; λ_{it} is an $Lx1$ non-negative vector of weights; and θ_{it} depicts a scalar. Thus, $1/\theta_{it}$ is an estimate of the overall technical efficiency (OTE) of ith region in the tth period under CRS. By adding an additional constraint of convexity on the model (Variables Returns to Scale), one can find the technical efficiency arising from optimal management practices, called pure technical efficiency (PTE) (Banker et al., 1984). Finally, the technical efficiency due to optimal or suboptimal production scale, scale efficiency (SE) can be obtained by the ratio between OTE and PTE (Coelli et al., 2005).

4.3.2. The Meta-frontier model

On a theoretical basis, the organizational units (DMUs) participating in the same frontier employ the same set of inputs and share the same technology set. Thus, the DEA discriminatory power is dependent on the homogeneity of the domain of the sample

(Samoilenko and Osei-Bryson, 2008). However, as discussed in section 4.2., the Spanish RT have different touristic technologies, management levels, and therefore different production frontiers. To take into account the differences in technology across the Spanish RT, this paper proposes the meta-frontier approach. Based on the meta-production function introduced by Hayami (1969), and Ruttan and Hayami (1970), this technique aims to provide a homogenous boundary for all heterogeneous DMUs by estimating the frontiers of relatively homogenous groups (Battese and Rao., 2002; Battese et al., 2004; O'Donnell et al., 2008). Finally, a new production frontier (called metatechnology) is obtained through enveloping the frontiers of different groups.

Formally, let x and y denote the (non-negative) input and output vectors of dimensions $(Mx1)$ and $(Nx1)$. We assume that production technology is the knowledge and ability of transforming inputs into outputs. We consider $K(>1)$ specific technology groups, T^K. The production technology (T^k) of the kth group, with $k = 1,2,3, \dots K$, is given by:

$$T^k = \{(x^k, y^k) \in R^+ | x^k canproduce y^k\} \quad (2)$$

The production technology set T^k, provides an equivalent representation of the capability of transforming inputs into outputs. The group-specific input set (X^k) defined for a specific output vector y^k is defined as:

$$X^k(y^k) = \{x^k : (x^k, y^k) \in T^k\} \quad (3)$$

The boundaries of the input sets determine the 'isoquants'. The group-specific output set (P^k) is defined for a specific vector of input x^k as:

$$P^k(x^k) = \{y^k : (x^k, y^k) \in T^k\} \quad (4)$$

The technology set for the kth group can be represented by the following distance function based on input minimization:

$$D_i^k(x^k, y^k) = sup_\lambda\{\lambda > 0: (x^k/\lambda) \in X^K(y^k)\} \quad (5)$$

and it shows the ratio of the actual production levels to the frontier production levels. The distance function can be used to measure the technical efficiency of the production unit (Shepard 1962):

$$0 \leq TE^k(x^k, y^k) = \left[D_i^k(x^k, y^k)\right]^{-1} \leq 1 \quad (6)$$

As we assume that there `is a sub technology collection T^k which operates under a common technical collection, the production technology of the meta-frontier (T^{meta}) is given by:

$$T^{meta} = \{T^1 \cup T^2 \cup \ldots \cup T^k\} = \{(x, y) \in R^+ | xcanproducey\} \quad (7)$$

Since, meta-frontier is different from group frontier, the technical gap between the groups can be overcome, and all the production units have the same technical possibilities to pursuit input minimization (Battese and Rao, 2002). The input-orientated meta-distance function (D_i^{meta}) can be represented as:

$$D_i^{meta}(x, y) = sup_\lambda\{\lambda > 0: (x/\lambda) \in X^{meta}(y^{meta})\} \quad (8)$$

Finally, the Technical Efficiency based on common frontier can be expressed as:

$$0 \leq TE^{meta}(x,y) = [D_i^{meta}(x,y)]^{-1} \leq 1, \quad (9)$$

From the definition of the metatechnology it can be easily shown that $D_i^k(x^k, y^k) \leq D_i^{meta}(x,y)$.

A purpose of distinguishing the difference between technologies, we define the technology gap ratio (TGR) of efficiency. Following Battese et al. (2004) and O'Donnell et al. (2008) the technology gap ratio (TGR) is constructed as shown in Eq. (9). The bigger the technology gap ratio, the closer the group frontier technology to the meta-frontier. If TGR equals 1, no gap exists between the group frontier technology and meta-frontier technology. To illustrate it, the input-orientated TGR can be defined using the input distances functions from technologies T^k and T^{meta} as:

$$0 \leq TGR_i^k = \frac{D_i^k(x^k,y^k)}{D_i^{meta}(x,y)} = \frac{TE^k(x^k,y^k)}{TE^{meta}(x,y)} \leq 1 \quad (10)$$

The CCR model fits a linear production technology in the meta-frontier, whereas the BCC model features variable returns to scale, which are more flexible and reflect managerial efficiency as well as purely technical limits.

4.3.3. Parametric regression

In order to analyse the extent to which efficiency impact of explanatory factors on Spanish RT, the second stage of the analysis is to split: tourist and non-tourist regions. As a methodology to estimate the effect of explanatory factors on Spanish tourist and non-tourist regions we use the two-stage bootstrap truncated regression procedure (Simar and Wilson, 2007).

An advantage of the Simar and Wilson (2007) bootstrap procedure is that it allows to obtain unbiased coefficients, valid confidence intervals and describe a data generating process under which two-step methods are consistent. The basic idea of bootstrapping

is the recalculation of the parameter of interest. This is achieved by the approximation of the distribution of the estimator via re-sampling. In this research, the recalculated parameter of interest is the DEA efficiency score. Since variables exist, which are neither inputs nor outputs but are used to mainly explain the variation in the efficiency scores, the bootstrap procedure can also be extended to account for the impact of environmental variables on efficiency (Assaf and Josiassen, 2011). The discriminatory power of the first stage is not affected since the explanatory variables are not included in the first stage (Liebert and Niemeier, 2013).

The mathematical expression of such regression given by:

$$\varphi_j = a + z_j\delta + \varepsilon_j \tag{11}$$

Where a is the constant term, ε_j is the error term, z_j is a vector (row) of potential covariates that are expected to be related to the DMU's efficiency score, φ.

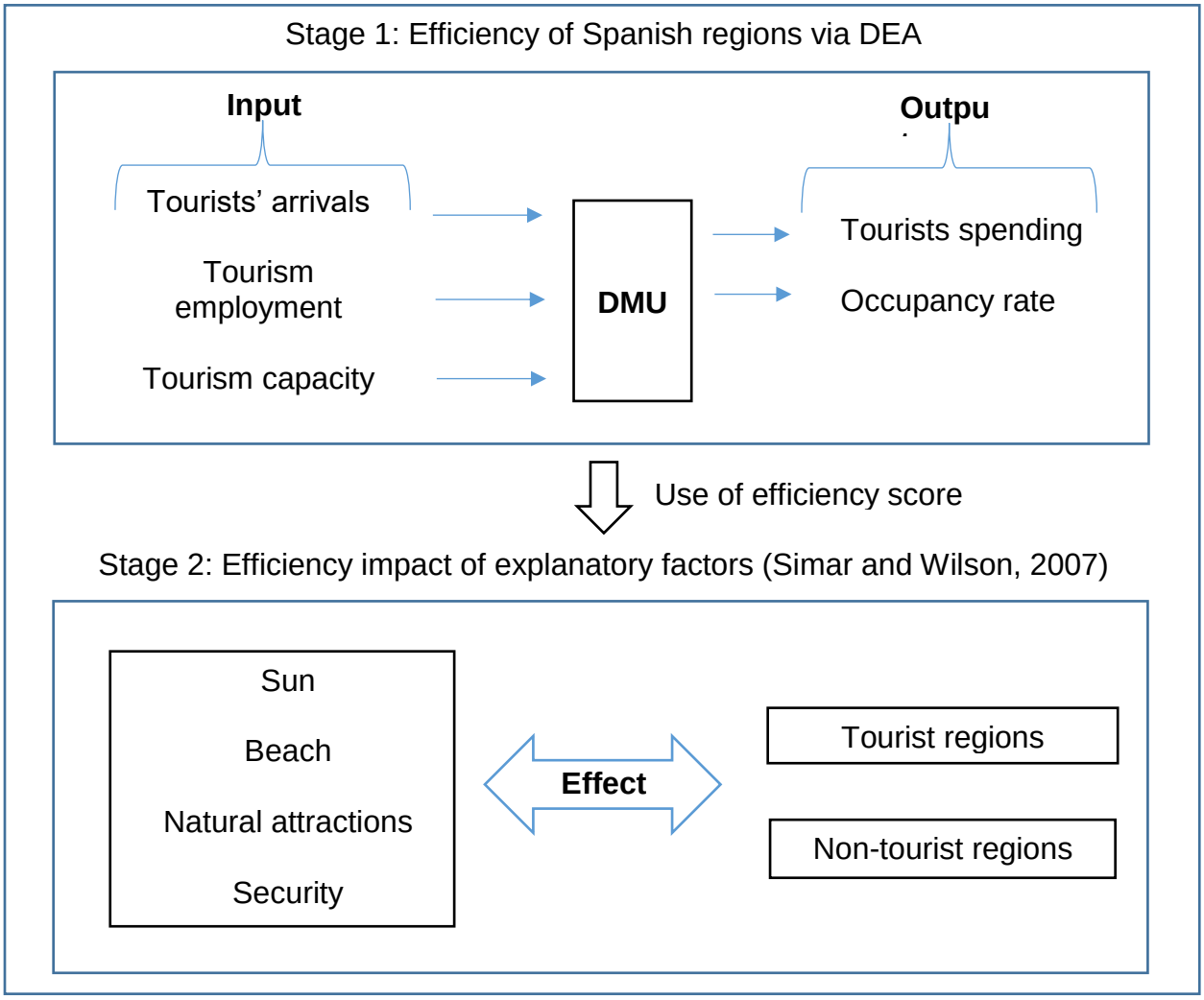
4.3.4. The research framework

The research framework of this study is shown in figure 4.3.4. The first stage assess the efficiency of Spanish regions via DEA (Carner et al., 1978; Banker et al., 1984). The design involves the DEA which explains technical efficiency (CRS, VRS) and scale efficiency. An advantage of the DEA assessment is that the model can be calculated from different angles and builds a comprehensive analysis with additional approaches (Benito et al., 2014). In the second stage, to discover the factors that significantly affect the efficiency in tourist and non-tourist regions in Spain it applies the bootstrapping method proposed by Simar and Wilson (2007).

The Spanish regions form a quite heterogeneous group in terms of size and output composition. Therefore, changes in the environment or the technology, could not affect all equally. Consequently, to carry out the analysis, regions are grouped by similar characteristic. In this sense, the National Geographical Institute of Spain classifies them

in two groups according to their tourism orientation (Fernandez et al. 2018). Group 1 contains regions with the high-density touristic areas (Balears Illes, Canarias, Comunitat Valenciana, Cataluna, Madrid, Murcia, Andalucia) and group 2, regions that do not specialize in tourism (Pais Vasco, Cantabria, Asturias, Aragon, Galicia, Rioja, Castilla – Leon, Navarra, Castilla - La Mancha, Extremadura).

Figure 4.3.4: Framework of this study.



SOURCE: Self-elaboration.

4.4. Sources and Data

To evaluate the RT in Spain, the data for 17 Spanish regions (Ceuta and Melilla are not included) have been collected for the period 2008-2018. For the construction of the input and output variables of the determinants of efficiency, has been used the data of the Tourist Movement on Borders (FRONTUR), Tourism Expenditure Survey (EGATUR), The Hotel Occupancy Survey (HOS), The Campsite Occupancy Survey (COS), Labour Force Survey (LFS), The Survey of domestic tourism, The Tourist Accommodation Occupancy Survey covers, The Hostel Occupancy Survey of the National Statistical Institute (INE) and the State Meteorological Agency (AEMET). To measure the effect of explanatory factors on the efficiency on both Spanish tourist and non-tourist regions, variables need to be logically connected in order to determine the efficiency. As Lew (1987), Leiper (1990), Barros et al., (2011) and Assaf and Josiassen (2012) indicated the variables selected at this stage include tourism attractors that clearly affect the success of its destination. Thus, to analyse the impact of explanatory factors four variables were used (z-variables): SUN, BEACH, NATURAL ATTRACTIONS, and SECURITY. Table 4.4. contains the selection, description and analysis of antecedents of these variables.

Table 4.4: Variables for the Simar and Wilson (2007) analysis of determinants.

Factor	Description
SUN	The destinations climate is one of the main factors considered by travellers (Hein et al., 2009). Gómez-Martín (2006) shows that the sun is considered as an uncontrollable tourism attractor in Spanish destinations. The total number of hours of sunshine per year (2008-2018) has been used as a proxy of the variable. The data for our analysis has been gathered by the State Meteorological Agency (AEMET, http://www.aemet.es/es/portada).
BEACH	Beaches are a key driver of RT in Spain (Gisbert et al., 2018). Hence the main motivation for 60% of the tourists coming to Spain is to enjoy

	the sun and beaches (New et al., 2002). Studies moreover show that economic effects of beaches are significant to local communities (Pendleton et al., 2011). The length of beaches (km) by region were used as a determining factor in the analysis. The data has been obtained in the National Statistical Institute (INE, https://www.ine.es).
NATURAL ATTRACTIONS	National parks are considered as an uncontrollable attractor that create considerable income for adjacent communities and can diversify the regional tourism (Mayer et al., 2010). In addition, national parks have an economic impact on the regions (Buultjens and Luckie, 2004). 15 Spanish national parks were used in the analysis. Variable dummy takes the value 0 if the region has no national parks and 1 if otherwise. Data for these have been obtained in the Spanish Ministry for the Ecological Transition (MITECO, http://www.miteco.gob.es).
SECURITY	Security affects the tourism demand (Harper 2001; George 2003). Studies on return visits also show that tourists are more likely to be deterred from traveling or returning to dangerous countries or regions in which there are security concerns (Alegre and Cladera, 2006). For example, when the tragic events of September 11th occurred, the image of international tourism was badly damaged, and travelers canceled their planned trips due to perceived increased risk (Akama and Kieti 2003). The security factor is measured by the number of crimes recorded by the Spanish police department by regions (2008-2018). The data obtained from the National Statistical Institute (INE, https://www.ine.es).

SOURCE: Self-elaboration.

In the first stage of the analysis, the selection of output and input variables have been chosen based on a review of the literature mentioned in section 4.2., and the data at our disposal. Figure 4.3.4. shows the following variables which are used as input variables:

Tourists arrivals to Spain measured by the number of tourists arriving to Spain, Tourism employment measured by the number of employees involved in tourism, and Tourism capacity measured by the number of available bedrooms to receive tourists. As output variables, Tourists spending is measured by amount of tourists' spending in MLN euros and, Occupancy rate measured by the number of tourists' overnight stays in hosting places. The descriptive statistics of the variables used are shown on table 4.4.1. and 4.4.2.

Table 4.4.1: Summary statistics of inputs and outputs

	Variables	Definition and units	Source	Min.	Max.	Mean	St. Dev.
Inputs	**Tourists arrivals to Spain**	Number of tourists arriving to Spain	FRONTUR, The Survey of domestic tourism (INE)	1412.77	44566.67	12976.42	11053.37
	Tourism employment	Employment involved in tourism sector	LFS, Hospitality and Tourism Employees (INE)	943.98	58729.50	13371.57	14894.38
	Tourism capacity	Number of bedrooms available to receive tourists	HOS, COS, TAOS (INE)	12473.86	490312.12	141293.55	146205.76
Outputs	**Tourists spending**	Spending amount by tourists	Survey of domestic tourism, EGATUR (INE)	201.20	23835.10	5133.76	5907.04
	Occupancy rate	Number of tourists' overnight stays	FRONTUR, HOS, COS, Survey of domestic tourism, TAOS, HosOS (INE)	1383.44	105335.70	26399.00	32156.48

Note: AEMET: State Meteorological Agency. INE: National Statistical Institute. FRONTUR: Tourist Movement on Borders. EGATUR: Tourism Expenditure Survey. HOS: Hotel Occupancy Survey. COS: Campsite Occupancy Survey. LFS: Labour Force Survey. TAOS: The Tourist Accommodation Occupancy

Survey covers. HosOS: The Hostel Occupancy Survey. Variables tourism employment, tourism capacity, tourists' arrivals and tourists spending are shown in digit of thousands.

Table 4.4.2: Summary statistics of variables in averages by regions for 2008-2018

Non-tourist regions	Tourism capacity	Tourism employment	Tourists arrivals to Spain	Occupancy rate	Tourists spending
Pais Vasco	39212.66	4379.20	5226.27	6641.20	1734.73
Cantabria	39098.11	2560.45	3991.07	4407.17	821.32
Asturias	40936.12	3153.76	4759.03	4567.84	999.69
Aragon	68330.05	4733.31	7619.92	7243.94	1191.14
Galicia	82459.19	7320.15	9616.08	10404.69	1906.79
Rioja	14238.86	1008.39	1710.59	1466.18	247.89
Castilla – Leon	47878.81	3897.47	12025.24	4348.08	1273.46
Navarra	24407.12	1925.67	2914.16	2547.95	489.87
Castilla - La Mancha	87457.08	7844.95	17479.97	9356.92	2498.78
Extremadura	28150.52	2694.52	4967.85	2846.58	742.34
Tourist regions					
Balears Illes	236510.46	30446.66	14178.27	73719.68	11692.19
Canarias	395995.67	50444.42	16292.57	101545.83	13473.15
Comunitat Valenciana	280334.90	18141.28	23560.24	45169.85	8903.85
Cataluna	467683.63	34089.75	38244.43	79574.13	17599.41
Madrid	129798.27	15246.02	16269.45	25413.53	8140.63
Murcia	40939.13	2724.84	4344.06	5167.97	1158.15
Andalucia	378559.77	36705.80	37399.89	64361.52	14400.54

Note: Variables tourism employment, tourism capacity, tourists' arrivals, tourists spending and population are shown in digit of thousands.

4.5. Results

As mentioned in section 4.3., the assessment consist of two stages. The DEA approach was used in 17 regions to assess the efficiency levels of the Spanish regions (Ceuta and Melilla are not included) at the first stage over the 2008-2018 period, and the second stage used the parametric regression proposed by Simar and Wilson (2007). In the

second stage the smoothing homogeneous approach with 1000 iteration was applied to solve the potential problem of biased results.

The tourist efficiency results under CRS, VRS and the scale efficiency of the 17 Spanish regions are displayed in table 4.5. These scores are relative measures with respect to the most efficient unit (100%), ranging between 0 - 1, where 0 is inefficient and 1 is efficient. The results revealed that the average technical efficiency for all regions is 0.70 (CRS), for tourist regions is 0.89 (CRS) and non-tourist regions is 0.56 (CRS). The most efficient regions (score between 0.73 and 1.0) are those with an exit to the seaside, such as Balears Illes, Canarias, Comunitat Valenciana, Cataluña, Madrid (capital), Murcia and Andalucía.

Table 4.5: The average scores of efficiency of tourist and non-tourist regions in Spain (2008-2018) ranked overall technical efficiency (CRS), pure technical efficiency (VRS) and scale efficiency.

Region	Overall technical efficiency (CRS)	Pure technical efficiency (VRS)	Scale efficiency
Non-tourist regions			
Pais Vasco	0.69	0.83	0.82
Cantabria	0.66	0.80	0.82
Asturias	0.58	0.69	0.84
Aragon	0.58	0.65	0.88
Galicia	0.56	0.60	0.93
Rioja	0.55	1.00	0.55
Castilla - Leon	0.52	0.56	0.94
Navarra	0.51	0.74	0.69
Castilla - La Mancha	0.51	0.60	0.84
Extremadura	0.46	0.68	0.69
Average	**0.56**	**0.72**	**0.80**
Tourist regions			
Balears Illes	1.00	1.00	1.00
Canarias	0.99	1.00	0.99
Comunitat Valenciana	0.96	0.96	1.00
Cataluna	0.94	0.97	0.98

Madrid	0.85	0.87	0.98
Murcia	0.77	0.88	0.87
Andalucia	0.73	0.75	0.97
Average	**0.89**	**0.92**	**0.97**
Average in total	**0.70**	**0.80**	**0.87**

SOURCE: Self-elaboration.

Apart from the Canary islands and Madrid (capital), geographically, all regions are located in the Mediterranean area.

On the other hand, all non-tourist regions are located in the central and northwestern parts of the country. The level of efficiency of non-tourist regions is lower (between 0.46 and 0.69) compared with the tourist regions. The highest efficiency score (score between 0.50 and 0.60) among the non-tourist regions belongs to Pais Vasco and Cantabria. The lowest efficiency score belong to Extremadura (under 0.50). All the rest regions (Asturias, Aragon, Galicia, Rioja, Castilla - Leon, Navarra and Castilla - La Mancha) show a score between 0.40 and 0.50.

As it expected, Spain attracts international tourists with its Sun and Sand type tourism (Aguilo et al., 2005). These results are in line with results of Munoz (2007), which states that international travelers are concentrated in destinations, such as Balearic Islands, Canary Islands, Andalusia and Catalonia. The results are also concurrent with the research by Herrero-Prieto and Gomez-Vega, 2017, and Fernández et al., 2018 for airports and cultural festivals.

Table 4.5.1. displays the measure of the effect of explanatory factors on the efficiency of both Spanish tourist and non-tourist regions. The analysis results shows that the SUN factor negatively affects the efficiency of the tourist (-0.0105, CRS; -0.0074, CRS) and non-tourist regions (-0.0018, CRS; -0.0013, VRS). The results can be explained in accordance with Leibenstein (1966) and its X-inefficiency theory on non-allocative form of efficiency. Sunny regions feel more protected against competition due to the favorable environmental conditions. Also Benito et al., (2014), Munoz (2007), Martin et al., (2017), Hein et al., (2009) support the influence of sun on incoming visitors.

Table 4.5.1: Parameter estimates for the Simar-Wilson regression model of tourist and non-tourist regions in Spain (2008-2018).

	Overall technical efficiency -CRS- (z-statistic)		Pure technical efficiency -VRS- (z-statistic)	
Explanatory factors	**Tourist regions**	**Non-tourist regions**	**Tourist regions**	**Non-tourist regions**
SUN	-0.0105**	-0.0018***	-0.0074***	-0.0013**
	(-2.41)	(-6.22)	(-3.64)	(-2.18)
BEACH	0.0002*	0.0000	-0.0002	0.0002*
	(1.83)	(0.98)	(-0.49)	(1.79)
NATURAL ATTRACTIONS	0.0998	0.0414**	-0.0162	0.0095
	(0.87)	(2.08)	(-0.17)	(0.26)
SECURITY	-8.4200*	-1.3200	-1.5500***	-4.4100
	(-1.84)	(-0.41)	(-3.42)	(-0.69)

Notes: ***, **, and *: Below the 1%, 5% and 10% statistical significance thresholds, respectively. Likelihood ratio chi-square (df = 2)

The variable BEACH has a positive effect on tourist (0.0002, CRS) and non-tourist (0.0002, VRS) regions efficiency. In other words, the longer the beaches, the higher the efficiency level of the region. The results are consistent with Benito et al., (2014), who found that the nature and beaches have a positive effect on the competitiveness of Spanish autonomous communities. Furthermore, seaside and beaches argues by Barros et al (2011), Sellers-Rubio and Casado-Díaz (2018), Claver-Cortés et al., (2007).

The explanatory factor NATURAL ATTRACTIONS has a significant positive effect on efficiency in non-tourist regions (0.0414, CRS). This effect may be associated with attractors of these regions. It is important to have national parks, as most non-tourist regions regarding their geographical and natural environment have no specific attractors as in tourist regions. These results are consistent with those obtained by Cuccia et al. (2017).

Security is an important driver of tourism performance. The explanatory factor SECURITY has a significant negative effect on the efficiency of tourist regions (-8.4200, CRS; -1.5500, VRS). The results are in line with Pizam, (1999), Levantis and Gani, (2000), and Santana-Gallego et al., 2016, who too have considered tourist security.

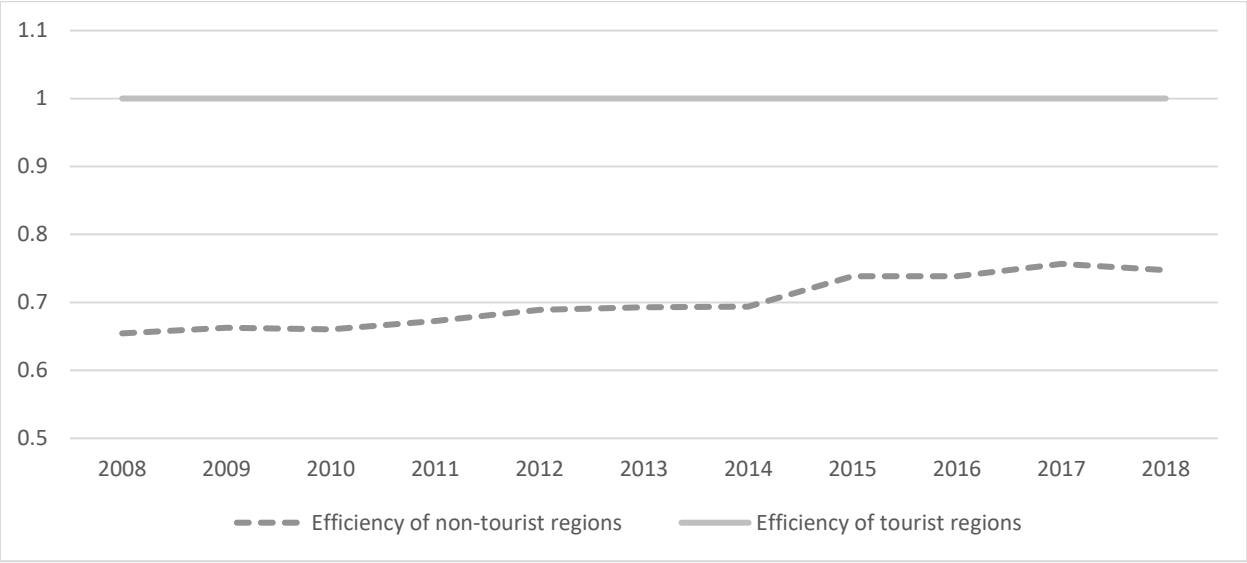
Table 4.5.2. shows Technical efficiency (TE^k), Metafrontier efficiency (TE^{meta}), and technological gaps (TGR), as indicated in section 4.3. In average, the tourist regions possess the best tourism utilisation technology. The results indicate that they require a smaller amount of input to produce a given set of outputs compared to non-tourist regions.

Table 4.5.2: Technical efficiency (TE^k), Metafrontier efficiency (TE^{meta}) and technological gaps (TGR)

Criteria	Average	Std. Dev.
All regions	**Average**	**Std. Dev.**
Technical efficiency	0.84	0.12
Metafrontier efficiency	0.70	0.19
Technology Gap Ratio	0.82	0.15
Tourist regions	**Average**	**Std. Dev.**
Technical efficiency	0.89	0.12
Metafrontier efficiency	0.89	0.12
Technology Gap Ratio	1.00	0.00
Non-tourist regions	**Average**	**Std. Dev.**
Technical efficiency	0.70	0.12
Metafrontier efficiency	0.56	0.08
Technology Gap Ratio	0.70	0.06

There are significant differences in efficiency between the tourist and non-tourist Spanish regions over the last 10 years. Figure 4.5. shows the average ratio of the technological gap in the tourist and non-tourist regions of Spain for the period 2008 - 2018.

Figure 4.5: Evolution of Technology Gap Ratio (TGR) by groups (2008-2018).



SOURCE: Self-elaboration.

As the figure illustrate, tourist regions remain on the meta-frontier throughout the entire period (TGR = 1). However, there is a convergence between the tourist and non-tourist regions of Spain.

Non-tourism regions show improvements in their level of efficiency. A visible leap in efficiency gains of non-tourist regions has been seen in 2014 and 2016.

4.6. Conclusion

This article aims to assess the drivers of tourism performance of Spain at the regional level. A Meta-frontier DEA (Carnes et al., 1978; Battese et al., 2004; O'Donnell et al., 2008) was first carried out to obtain the efficiency scores for each region. Secondly, the bootstrapping method (Simar and Wilson, 2007) was applied to measure the impact of explanatory factors on tourist and non-tourist regional efficiency. The following novelties are presented in this study: (1) we take into account the heterogeneity of regions in the DEA estimation. Therefore the efficiency evaluation is carried out separately by grouping the regions in accordance with their focus on tourism. (2) We evaluate the factors

determining performance depending on the tourist orientation of the regions. The first stage of the analysis shows that geographical location have a significant impact on efficiency of Spanish RT. The most efficient regions are the capital and the tourist oriented regions with an exit to the seaside.

Over the past 10 years a convergence in the efficiency level between the tourist and non-tourist regions of Spain has been observed. On the whole, tourist regions have the best tourism technology. This result indicates that they need fewer resources to get a given set of outputs.

The analysis of the efficiency effect on RT of the second stage showed that the NATURAL ATTRACTIONS impacts positively on tourism performance of the non-tourist regions and the length of the BEACH positively affect the efficiency levels of both tourist and non-tourist regions.

The drivers of tourism performance such as the SUN and SECURITY have a negative effect on the efficiency of Spanish RT. The SUN factor, negatively effects the efficiency of both tourist and non-tourist regions. A possible explanation for these finding may relate to X-inefficiency theory on non-allocative form of efficiency by Leibenstein (1966). Regions with more number of sunny days feel more protected against competition due to the favorable environmental conditions and a large number of inbound tourists. The SECURITY Factor also negatively effects the efficiency of tourist regions.

In general, the main conclusion of this study allows us not only to understand but also to establish what factors are significant in regional performance, thus providing statistically reliable information on the efficiency of Spanish RT. Our findings are useful for both scientists and practitioners who seek to understand the factors that contribute to the efficiency of regional tourism. From this point of view, the results of the study can, above all, be considered as an important guide for regional authorities in order to maximize the use of geographical and natural advantages to attract tourists as a source of economic development.

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5. SUMMARY AND CONCLUSIONS

La presente tesis doctoral se compone de tres ensayos sobre economía turística. En el primer ensayo, siguiendo la metodología del Análisis Envolvente de Datos de Charnes, Cooper y Rhodes (1978) y de análisis de los determinantes de eficiencia de Simar y Wilson (2007), se analiza el impacto de la salida del Reino Unido de la UE (Brexit) sobre la eficiencia turística de las regiones españolas. La primera etapa del análisis reveló que las regiones con turismo de tipo Sol y Playa son más eficientes que el resto de regiones. Aunque ninguna región permanece en la frontera durante todo el período de estudio, las regiones costeras muestran unos niveles desempeño turístico significativamente más altos. Además, las regiones ubicadas en el este y el norte del país alcanzan niveles más altos de eficiencia durante el período 2008-2017. Las regiones más eficientes (niveles entre 0.90 y 0.99) son Balears, La Rioja, País Vasco, Canarias, Navarra y Cataluña, mientras que las regiones con menores niveles de eficiencia (por debajo del 0,65) son Castilla - La Mancha, Aragón, Extremadura, Castilla y León, Extremadura y Andalucía. El promedio de eficiencia técnica para todas las regiones es de 0.79.

Dentro del turismo internacional recibido en España, el Reino Unido representa el principal mercado emisor. La recopilación de datos inicial revela que, tras el anuncio de los resultados del referéndum Brexit en 2016, el porcentaje de turistas británicos se incrementó en un 7% (Frontur), un porcentaje muy superior al constatado en años anteriores. Una posible explicación podría extraerse de la Economía del Comportamiento. Los resultados del referéndum sobre el Brexit de 2016 provocaron un impacto psicológico - aversión a la pérdida (Thaler, 1980; Kahneman y Tversky, 1979, Thaler et al., 1991)- en los turistas del Reino Unido. El análisis empírico basado en el método DEA confirma un efecto significativamente positivo de la iniciación del Brexit en la eficiencia turística de las regiones españolas. Los resultados van en la línea de Perles-Ribes et al. (2019) y Pappas (2017) que argumentan que Brexit no tiene ningún efecto inicial adverso sobre el sector turístico en España.

El debate político en curso para redefinir las relaciones entre el Reino Unido y la Unión Europea iniciado hace tres años continúa hasta nuestros días. De acuerdo con el último

estado actualizado de la disposición Brexit (https://www.gov.uk/brexit), el 31 de octubre de 2019 sería el escenario final para un Brexit sin acuerdo.

El segundo ensayo de esta investigación los artículos académicos sobre eficiencia con metodología DEA realizados en los subsectores turísticos. Como regla general, se utiliza la lista de categorías del glosario de la Organización Mundial del Turismo. En total, la investigación cubrió 15718 publicaciones de 1978 a 2018, de las cuales 350 se identificaron como artículos de turismo con DEA (tourDEA). El primer artículo en tourDEA se publicó en 1986. De 1986 a 2011, el número de artículos de tourDEA aumentó exponencialmente. De 2011 a 2018, se observa una disminución en el crecimiento. Según los resultados, *Tourism Economics*, *Tourism Management*, *International Journal of Hospitality Management*, *The service industries journal* y *Asia Pacific Journal of Tourism Research* son las revistas más utilizadas en el campo del turismo usando la metodología DEA. Alrededor del 18% de las palabras clave más utilizadas están relacionadas con la metodología DEA. En segundo lugar, está el concepto de eficiencia (6%), hotel (3%) y hotel turístico internacional (2%). Más del 85% de los artículos de tourDEA están escritos por menos de 4 autores por artículo. El *survey* además mostró que la mayoría de publicaciones de tourDEA se encuentra en la lista de categorías de productos turísticos e industrias turísticas del glosario de la OMT. Alojamiento (servicios) para visitantes (53%) encabeza el ranking. A pesar de que el tourDEA más publicado se encuentra en la categoría de Alojamiento (servicios) para visitantes, los artículos más citados de tourDEA se encuentran en la categoría de alimentos y bebidas.

El tercer ensayo de esta tesis doctoral tenía como objetivo evaluar los determinantes de la eficiencia turística española a nivel regional. Bajo esta premisa, en una primera etapa se realizó un análisis de eficiencia teniendo en cuenta la heterogeneidad de las regiones españolas usando una metodología de Meta-frontera-DEA (Carnes et al., 1978; Battese et al., 2004; O'Donnell et al., 2008). En el segundo paso, se aplicó el método de estimación de Simar y Wilson (2007) para medir el impacto de los factores explicativos (ambientales y no ambientales) en la eficiencia turística regional.

Las principales conclusiones sobre la primera etapa del análisis muestran que la ubicación geográfica tiene un impacto significativo en la eficiencia de las Regiones Españolas. Las regiones más eficientes son la capital y las regiones orientadas al turismo, y las demás regiones con costa.

La segunda conclusión del tercer ensayo es que se ha observado un proceso de convergencia en los niveles de eficiencia en las regiones españolas. Así, a pesar de que se evidencia que las regiones turísticas tienen la mejor tecnología turística, se ha reducido el gap tecnológico turístico entre las regiones turísticas y las no turísticas.

El análisis de los determinantes de la eficiencia de la segunda etapa mostró que el factor PLAYAS (km de playas) es un factor que más positivamente impactan en la eficiencia de las regiones turísticas y no turísticas en España. El número de PARQUES NATURALES es un factor determinante de la eficiencia de las regiones no especializadas en turismo. El factor SOL (horas anuales de luz) parece afectar negativamente tanto a regiones turísticas como no turísticas. Regiones con una climatología más benévola se asocian con menores índices de eficiencia. Una posible explicación de estos hallazgos puede estar relacionada con la teoría de la ineficiencia X de Leibenstein (1966) y la forma no asignativa de eficiencia. Las regiones con más días soleados se sienten más protegidas contra la competencia, debido a las condiciones ambientales favorables y a una gran cantidad de turistas entrantes. Por último, el factor INSEGURIDAD tienen un efecto negativo en la eficiencia turística de todas las Regiones Españolas. Así, a mayores niveles de inseguridad mayores niveles de ineficiencia.

En general, la conclusión principal de este estudio nos permite no solo comprender, sino también establecer qué factores son significativos en el desempeño turístico regional. Los resultados obtenidos son útiles tanto para los científicos como para los profesionales que buscan comprender los factores que contribuyen a la eficiencia del turismo de un territorio. Desde este punto de vista, los resultados del estudio pueden considerarse, sobre todo, como una guía importante para las autoridades regionales a fin de maximizar el uso de las ventajas geográficas y naturales para atraer turistas como fuente de desarrollo económico.