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DEA-Based Malmquist Productivity Indexes for Assessing Greek Tourism Regions

Athanasia Mavrommati[*], Fotios Chatzitheodoridis[**], Alexandra Pliakoura[***], Achilleas Kontogeorgos[§]

Abstract: For this research project, a DEA-based Malmquist index model was built to evaluate the effectiveness and productivity of Greece's thirteen distinct tourist zones. The purpose of this article is to present a statistical analysis comparing the economic performance of different tourist locations in Greece. It does this by using a technique known as data envelopment analysis (DEA), which measures the Malmquist efficiency of the tourist sector in each of Greece's thirteen regions for the years 2017-2021. According to the findings of our study, the level of competitiveness enjoyed by a number of Greece's areas has not increased throughout the period under review. Our study approach and results give a reference for places in Greece that urgently need quick tourist growth to affect economic recovery. This need arises against the background of global climate change, the energy crisis, and the age that follows COVID-19.

Keywords: Malmquist productivity indexes; efficiency; tourism; Greek regions; regional analysis.

JEL classification: C43; R19; Z32.

[*] Department of Business Administration of Food and Agricultural Enterprises, University of Patras, Agrinio, Greece; e-mail: *amavrom@upatras.gr*.

[**] Department of Regional and Cross-Border Development, University of Western Macedonia, Kozani, Greece; e-mail: *fxtheodoridis@uowm.gr* (corresponding author).

[***] Department of Business Administration of Food and Agricultural Enterprises, University of Patras, Agrinio, Greece.

[§] Department of Agriculture, International Hellenic University, Thessaloniki, Greece; e-mail: *akontoge@ihu.gr*.

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1. INTRODUCTION

The growth of tourism in Greece, which is one of the country's most important industries and has a strong multiplier impact on the economy (Brida *et al.*, 2016; Kolokontes *et al.*, 2018; Comerio and Strozzi, 2019; Nunkoo *et al.*, 2020) has been directly correlated with the country's recent economic success (Brida *et al.*, 2016; Comerio and Strozzi, 2019; Nunkoo *et al.*, 2020). The country's tourism sector had significant growth over the last ten years as a result of continued high levels of appeal as a vacation destination and major improvements in infrastructure that was directly related to tourism. Alongside the greater growth in worldwide tourism, the number of arriving visitors and travel revenues quadrupled throughout the period of 2010-2019 (Bank of Greece, 2019), thereby largely absorbing the extended recessionary shock caused by the post-debt Greek crises of 2010. The number of tourists that arrive is growing, the length of time they stay has not decreased much, the amount of money they spend each day has remained relatively stable, and the number of countries that generate a substantial amount of tourism is expanding. On the other hand, admissions continue to be at historically high levels, daily expenditure is low when compared to international norms, and the majority of demand is still directed toward the same heritage destinations (OECD, 2020b). On the other hand, the fact that the Greek economy is so heavily reliant on the travel and tourist industry makes it particularly susceptible to disruptions from the outside world, such as the pandemic problem that has been unfolding in recent years.

As a result of the COVID-19 epidemic and the significant disruption it brought to the economy of the whole world, the tourist industry is facing a number of new issues. Greece went through a severe economic downturn in the year 2020, which was substantially worse than the average for the OECD. This was mostly attributable to the country's high level of reliance on the tourist industry. The unusual demand-side shock that was induced by travel bans and containment efforts was a prominent feature of the coronavirus pandemic (Scott *et al.*, 2019). This extraordinary demand-side shock resulted in a precipitous and significant decrease in the number of tourists who visited the affected areas. According to the OECD's projections for 2020, travel revenues only amounted for 19% of the total service receipts, which meant that they only covered the trade deficit by 23%. It is important to highlight, however, that the year 2019 was a record-breaking year for tourism in Greece, as the nation was visited by 31.3 million visitors, which resulted in earnings of 18.2 billion euros from tourism. According to OECD (2020a), the unexpectedly large number of tourists who traveled to Greece during the peak summer months of 2021 was a major contributor to the robust recovery of GDP, which reached 8.3%. This new trend was quite like what occurred during the last economic crisis in Greece, when the country relied heavily on tourism to weather the storm and keep its economy afloat. Because of the large number of tourists who visited Greece in the first year after COVID-19, the country's gross domestic product (GDP) was able to recover from the negative effects of the event nearly completely (-9% in 2020). According to the projections for the year 2022, there will be a significant improvement. When compared to the same months of 2021, tourism-related income in 2022 was up 224.5% in June and 329.3% overall from January to June.

Tourism tends to become a competitive activity among areas, which are compelled to improve their performance in order to attract more visitors and boost their earnings (Pearce, 1997; Alavi and Yasin, 2000; Dwyer *et al.*, 2000; Ritchie and Crouch, 2000; Enright and Newton, 2004). Many people today view a tourist destination (such as a city, region, or site) not

as a collection of distinct natural, cultural, or environmental resources, but rather as an overall appealing product that is available in a specific area. This product is defined as a comprehensive and integrated portfolio of services provided by an area of interest that supplies holiday experiences that satisfies the requirements of the tourist (Ritchie and Crouch, 2001).

A tourism site thereby develops a compound bundle of tourist services based on the indigenous supply potential of the destination itself (Buhalis, 2000; Murphy *et al.*, 2000; Giaoutzi and Nijkamp, 2006; Gaki *et al.*, 2013; Giannakis and Bruggeman, 2017). It is crucial for the industry and the government to understand how and why competitiveness is shifting (Alavi and Yasin, 2000; Giaoutzi and Nijkamp, 2006). It is beneficial for the industry to understand where a country's competitive position is weakest and strongest (Kolokontes *et al.*, 2020). The flourishing growth of the tourist industry in Greece may be attributed to both the country's wonderful nature and the enormous demand for its products. In addition, the most successful companies have a significant impact on the industry by serving as a model for other businesses to follow. Therefore, conducting an analysis of the operational effectiveness of the tourism regions in Greece and gaining an understanding of the differences between the various types of tourism companies that operate in regions can provide the foundation for the improvement of those regions' operational efficiency as well as the development of additional small and medium-sized businesses (Chatzitheodoridis and Kontogeorgos, 2020).

By focusing on the competitiveness of tourist destinations and assessing regional competitiveness in terms of technical effectiveness and total factor productivity (TFP), the current research seeks to make a distinctive contribution to the existing body of tourism literature. This contribution revolves around a specific aspect: destination competitiveness. While the majority of tourism effectiveness studies typically consider statistical units like hotels and restaurants, our investigation is centered on territorial regions, also known as tourist destinations. This article employs major production theory methods to apply Data Envelopment Analysis (DEA), providing a performance measure for Greek tourist districts. Notably, the incorporation of the Malmquist index in our research enables the identification of primary contributors to variations in efficiency. This approach takes our inquiry a step further in evaluating the success of tourist locations. Utilizing a combination of the DEA model and the Malmquist index, the study conducts both static and dynamic analyses of operational efficiency values for tourism companies across thirteen regions in Greece from 2017 to 2021. The findings reveal operational weaknesses in these companies and offer recommendations for enhancing the operational effectiveness of Greek tourism regions.

Section 2 provides an in-depth exploration of the existing literature. Following this, Section 3 outlines the methodology for estimating efficiency and productivity changes. The findings and their discussion are then presented in Section 4, leading to the summarization of conclusions in the final Section.

2. LITERATURE REVIEW

Regarding the study of how effective the tourism industry is, researchers initially concentrated on the highly competitive hotel industry (Charnes *et al.*, 1978; Morey and Dittman, 1995; Barros, 2004; Chiang *et al.*, 2004; Barros, 2005; Barros and José Mascarenhas, 2005; Karakitsiou *et al.*, 2007) then extended to the branch industries such as travel agencies (Sun and Lu, 2005; Fuentes, 2011); and travel transportation Recent years have seen the development of a number of regional applications of frontier analysis in different areas of the

economy (Farrell, 1957; Macmillan, 1986; Charnes *et al.*, 1989; Martić and Savić, 2001; Susiluoto and Loikaanen, 2001; Zhu, 2002).

The efficiency of hotel companies has been a subject of extensive research, particularly through the application of Data Envelopment Analysis (DEA). Johns *et al.* (1997) pioneered DEA to monitor and benchmark productivity in a chain of 15 hotels, sparking subsequent applications globally. In Portugal, Barros (2005) assessed overall and technical efficiency in state-owned Pousadas de Portugal hotels. Barros and Santos (2006) used DEA to measure economic efficiency in 15 Portuguese hotels, proposing managerial enhancements. Oliveira *et al.* (2013) explored factors like star ratings and golf courses on hotel efficiency in Algarve. French hotel chains were evaluated by Perrigot *et al.* (2009), revealing plural form chains as more efficient. Botti *et al.* (2009) corroborated this using DEA with different inputs. Taiwanese hotel industry efficiency has seen extensive study. Tsaur (2001) analyzed 53 international tourist hotels. Hwang and Chang (2003) found international franchise-chains more efficient. Lovell (2003) and Huang *et al.* (2014) continued this exploration, applying DEA and Malmquist indices. Few studies focus on hotel and restaurant efficiency. Sanjeev (2007) measured the efficiency of 68 Indian establishments, revealing efficiency patterns within the largest and smallest companies using a variable return to scale framework. The literature on regional-level application of the DEA approach is limited. Pulina *et al.* (2010) examined hotel sector efficiency across 20 regions in Italy identifying Lombardy and Molise, Piedmont, and Umbria as the most efficient regions. Barros *et al.* (2011) employed a two-stage DEA to assess the competitiveness of French tourism regions, revealing significant efficiency variations. Toma (2014) utilized DEA to analyze the efficiency of the hotels and restaurants sector in all eight Romanian regions, employing two separate constant return to scale and variable returns to scale input-oriented analyses. The inputs considered were diverse, encompassing the number of employees and investments, while the output remained consistent—the turnover of the hotel and restaurant sector in each region. These studies collectively underscore the importance of examining efficiency at the regional level within the context of the hotel and tourism industry. The diverse methodologies employed and the varied geographical contexts considered contribute to a nuanced understanding of regional efficiency disparities and underscore the need for further exploration in this domain. As we move forward in this paper, we build upon this foundation to investigate and analyze the efficiency of tourist destinations, drawing upon both regional and sector-specific insights.

The majority of researchers make use of Data Envelopment Analysis (DEA) when conducting efficiency evaluations (Farrell, 1957; Morey and Dittman, 1995; Crouch and Ritchie, 1999; Ritchie and Crouch, 2000; Habibov and Fan, 2010; Oliveira *et al.*, 2013). Additionally, researchers have investigated the possibility of combining traditional DEA with other methods, such as the Malmquist index (Simar and Wilson, 1999; Zhu, 2002).

There is a lack of research on tourist provinces that have their own unique features, according to Giaoutzi and Nijkamp (2006). Existing studies have undertaken valuable investigations on the efficiency of tourism. The disparity that now exists between the rates of tourist development in the various areas of the country is rapidly spreading, and the issue is becoming more apparent. Considering the brisk economic expansion and policies that are beneficial to tourism, the provinces have taken a variety of steps to improve their ability to compete in the tourist industry. However, tourism, which is dependent on inputs of both capital and labor, can effectively drive regional economic development in the short term. However, in the long term, it will lead to the overexploitation of natural resources and an excess of human

resources (Mavrommati and Migdalas, 2005; Karakitsiou *et al.*, 2007; Chen *et al.*, 2018; Norio, 2021; Mavrommati *et al.*, 2022). Furthermore, even though it is becoming more widespread, the tourist industry is still plagued by poor development levels and unequal growth across areas. The primary objective of this research is to conduct a comprehensive evaluation of the operational efficiency exhibited by tourist destinations. This evaluation encompasses an in-depth analysis of the destinations' capacity to judiciously utilize the resources at their disposal. The central focus is on attracting a significant share of the overall demand from tourists while concurrently upholding a competitive stance relative to their most prominent rivals within the tourism industry. Through a nuanced examination, this study seeks to unravel the intricate dynamics that contribute to the effectiveness of tourist destinations in meeting the demands of the tourism market and positioning themselves strategically in a competitive landscape.

3. EFFICIENCY AND PRODUCTIVITY CHANGE ESTIMATES: METHODOLOGY

The study aims to contribute to the understanding of the economic performance of Greece's tourist zones over a specific time period, emphasizing the need for quick tourist growth to facilitate economic recovery. The broader context of global challenges, such as climate change and the aftermath of the COVID-19 pandemic, is also considered in framing the urgency of addressing tourism competitiveness in the highlighted regions. From a methodological viewpoint, this work estimates the regions' technical efficiency scores by using DEA and changes in productivity by using the Malmquist index. DEA's ability to handle multiple inputs and outputs, its non-parametric nature, and its flexibility in orientation make it well-suited for efficiency assessments in the complex and diverse landscape of the tourism sector. Researchers and practitioners in the tourism industry often choose DEA for its versatility and adaptability to the industry's multifaceted nature.

3.1 Data Envelopment Analysis (DEA)

The Decision-Making Units (DMUs) are the organizations or entities which are responsible for the translation of inputs into outputs. The DEA is based on a ratio of efficiency known as Outputs/Inputs. The purpose of the DEA is to achieve the highest possible ratio of efficiency for each DMU that is being taken into account (DMUo). The DEA approach lets researchers build a deterministic, non-parametric production frontier comparing the performance of several Decision-Making Units (DMUs), which in our case are the Greek regions (Eastern Macedonia and Thrace, Central Macedonia, Western Macedonia, Thessaly, Epirus, the Ionian Islands, Western Greece, Central Greece, Peloponnese, Attika, the Islands of Northern Aegean, the Islands of Southern Aegean and Crete).

The axial distance between each DMU in relation to the border is used as a basis for computing the scores for technical efficiency. We have used Farrell's (1957) output-oriented model and believed Variable Returns to scale (VRS) (Banker *et al.*, 1984). The purpose of the VRS hypothesis is to obtain pure technology efficiency (PTE), with the proviso that the effects of scale effectiveness on technology efficiency are not taken into consideration. Consequently, the formula for technology efficiency (TE) is pure technological efficiency (PTE) divided by scale efficiency (SE). Let's say there are r DMUs, and each of them has m inputs and n yields; the notation xj and yj will be used to denote the inputs and outputs, respectively.

$$\min \theta - \varepsilon \sum_{i=1}^{m} s_i^- + \varepsilon \sum_{z=1}^{n} s_z^+$$

s.t.

$$\sum_{j=1}^{r} x_{jj+}\, s_i^- = \theta \chi_0$$

$$\sum_{j=1}^{r} y_{jj} - s_z^+ = y_0$$

$$\sum_{j=1j}^{r} = 1$$

$$j \geq 0, s^-, s^+ \geq 0$$

ε is the Non-Archimedean infinitesimal, θ is the operational efficiency value of DMU, s−, s+ are slack variables. When θ = 1 and s_i^- = 0, s_z^+= 0, the DEA of this DMU is valid; when θ < 1, the DEA of this DMU is invalid.

3.2 Malmquist index

The Malmquist index (MPI) is a method (Malmquist, 1953) for assessing shifts in productivity and decomposing them into their main elements (Färe *et al.*, 1992; Färe *et al.*, 1994; Lambert, 1999; Alavi and Yasin, 2000; Lovell, 2003; Wendong *et al.*, 2012). This method has been utilized in a variety of fields, including, for instance, education, energy efficiency, tourism, and health care.

This index is used in the process of computing the ratio of outputs to inputs at various intervals (Färe *et al.*, 1992; Grosskopf, 2003). assuming that data on only one input (x) and output (y) are available for analysis throughout two different time periods (t and t+1). The MPI gives us the ability to evaluate, for each observed unit, how the actual production at period t (or t+1) compares to the potential production that might have been achieved in period t +1 (or t). In other words, we are able to assess two separate Malmquist indices due to the fact that we have two distinct technologies, namely, the technology that existed in period t and the technologies in period t+1. The following is the method that is used to determine the MPIs:

$$MPI^t = \frac{D^t(x^{t+1}, y^{t+1})}{D^t(x^t, y^t)}$$

and

$$MPI^{t+1} = \frac{D^{t+1}(x^{t+1}, y^{t+1})}{D^{t+1}(x^t, y^t)}$$

Using the geometric mean of the alternative expression of MPI^t and MPI^{t+1}, we obtain:

$$MPI^{t,t+1}\,(x^t, y^t, x^{t+1}, y^{t+1}) =$$

$$\left[\frac{D^t(x^{t+1}, y^{t+1})}{D^{t+1}(x^{t+1}, y^{t+1})}, \frac{D^t(x^t, y^t)}{D^{t+1}(x^t, y^t)}\right]^{\frac{1}{2}} * \frac{D^{t+1}(x^{t+1}, y^{t+1})}{D^t(x^t, y^t)}$$

x^t stands for the input vector in period t; x^{t+1} stands for the input vector in t+1 period;
y^t stands for the output vector in period t; y^{t+1} stands for the output vector in t+1 period;
D^t stands for the function of distance in period t when the technology in period t is taken as the reference;
D^{t+1} stands for the function of distance in period t+1 when the technology in period t+1 is taken as the reference.

The Malmquist productivity index is now the $MPI^{t,\,t+1}$ value; this value is used for measuring the overall efficiency change. According to Malmquist (1953), increases in production are indicated by scores for the Malmquist index that are greater than 1. The Malmquist index is constructed using the components in the form of distance ratios. This first factor, which depicts changes in efficiency from time t to time t+1 and is known as Effectiveness Change or Increase in Efficiency (EFF), is an example of a component. The second factor is commonly referred to as Technological Change or Shift in Tech (TECH), and it is a representation of the transition of technology from the previous frontier to the new frontier that takes place between time t and time t+1. In specifically, the first component, which is denoted by the letter EFF, is a representation of a region's capability to get to the frontier in the time t using the inputs of period t+1. Therefore, this index demonstrates the capacity of a tourist zone to make use of the resources that will be accessible at time t+1, while assuming that the circumstances that existed at time t will remain the same (Wendong *et al.*, 2012). The technological change component, abbreviated as TECH, reflects an increase in regional production as measured relative to the frontier at time t as measured relative to the present situation. This component, for the sake of our research, indicates the capacity of a Greek tourist area to reorganize the operation of its business, that is, to exploit the inputs at time t+1 in a new manner, therefore either enhancing or deteriorating its position in regard to the border at time t. In light of the information presented above, the Total Factor Productivity (TFP) between time t and time t+1 may be recalculated by making use of the product of the change in efficiency and the change in technology. The Malmquist TFPCH index is decomposed into technological effectiveness (EFFCH) improvement and advancement in technology change (TECHCH) in the context of the VRS assumption. The first option may be broken down even further into two subcategories: pure technological efficiency improvement (PECH) and scale effectiveness change (SECH). That is:

$$MPI^{t,t+1} = TFP^{t,t+1} = EFF^{t,t+1} * TECH^{t,t+1} =$$

$$= PECH^{t,t+1} * SECH^{t,t+1} * TECHCH^{t,t+1}$$

If the score of the Malmquist TPF index is greater than one, it implies that the level of total factor productivity of the decision-making unit t+1 period is higher when compared to the level of productivity seen in the period that came before it. If the value of the Malmquist TFP index is 1, it shows that the total factor productivity has remained stable between the two time periods. If the value of the Malmquist total factor productivity index is less than one, this indicates that total component productivity has decreased.

3.3 Index Selection and Data Source

The assessment of the productive capacity of the tourist industry in Greece was carried out based on information gathered for all 13 of the country's regions during the course of a period of five years (2017–2021). The quality of the findings acquired via the application of the DEA analysis is dependent on the quality of the data, particularly in the case of the use of economic data. The Hellenic Statistical Authority, the Institute of Greek Tourism Confederation (INSETE), and the Research Institute for Tourism (RIT) all contributed data to this study, which we utilized. It is important to point out that all of the data comes from the official financial accounts of the tourist units. These statements have been prepared in compliance with the laws of both Greece and Europe, which means that they adhere to international accounting standards.

Eastern Macedonia and Thrace, Central Macedonia, Western Macedonia, Thessaly, Epirus, the Ionian Islands, Western Greece, Central Greece, Peloponnese, Attika, the Islands of Northern Aegean, the Islands of Southern Aegean, and Crete are the thirteen areas that makeup Greece. Crete is the largest island in the Aegean Sea. Each area was analyzed as if it were a DMU, which is the entity that is being assessed based on its capabilities to transform inputs into outputs. For the purpose of putting the DEA into practice, the following categories of inputs were chosen number of local units, number of personnel, and investments (total assets). The following categories of output were chosen revenues and net profits.

Land, capital, and labor force are the three elements that contribute most significantly to production in economics. The land is not considered to be one of the most essential requirements for the establishment of tourist businesses; hence, its presence is not reflected in the input variable index. The manner in which all of the assets are put to use will have a direct bearing on the progression of future development in the area. For the purpose of illustrating capital investment, this study uses the aggregate assets held by tourist businesses in each geographical area. The tourist business is one that relies heavily on human labor; the number of workers may more accurately represent the contribution of the operational activities that tourism enterprises engage in within an area. As a result, we have decided to use this statistic to reflect the region's total labor investment. As a result, in order to illustrate the company's development size and profitability, the paper chooses the primary business revenues and net profits of the tourist businesses as the output indexes assessing the operational efficiency. This is done by selecting the main business revenues and net profits of the tourism companies.

The selection of inputs and outputs is strategically aligned with the unique characteristics of the tourism industry in each region. The choice of 'number of local units' serves as a proxy for the industry's breadth and scale within a region, capturing the diversity and magnitude of establishments contributing to the overall tourism landscape. Simultaneously, the 'number of personnel' reflects the human capital and workforce deployed in the tourism sector, emphasizing the industry's labor-intensive nature and its contribution to regional employment. On the output side, 'Revenues' and 'net profits' have been selected as indicators of the tourism industry's financial performance. 'Revenues' provide insights into the overall economic activity generated by tourism-related businesses, offering a measure of the industry's contribution to the region's economic prosperity. 'Net profits,' on the other hand, signify the financial viability and profitability of these businesses, reflecting their efficiency in converting inputs into economic gains. By utilizing these specific inputs and outputs, our DEA analysis seeks to holistically capture the multifaceted nature of the tourism industry's

productive capacity in each region. This strategic selection aims to balance the quantitative representation of industry scale and workforce with a nuanced assessment of economic performance, providing a robust framework for evaluating efficiency and guiding regional tourism management decisions.

4. RESULTS AND DISCUSSION

Using the input-oriented and variable returns to scale DEA model, the study carried out a static analysis of 13 tourism regions' operational efficiency reported in 2017-2021. Limited by writing, the work extracts the data result for 2017, 2019, and 2021, as shown in Table no. 1. Scale Efficiency (SE) assesses how well a region is operating at its optimal scale, considering the difference between the existing scale and the scale needed to achieve the production frontier. A SE value of 1.00 indicates optimal scale, while values below 1.00 suggest potential inefficiencies in the size of operations relative to the optimal scale. Regions with lower SE might benefit from adjusting their scale of operations for improved productivity. Pure Technical Efficiency (PTE) measures a region's efficiency in using its resources for tourism without considering the scale of operations. It reflects how well a region converts inputs into outputs, irrespective of the scale. A PTE value of 1.00 implies optimal resource use at the current scale. Values below 1.00 suggest there is room for improvement in utilizing resources effectively. Improving PTE involves optimizing processes to achieve higher output with the existing resources.

Table no. 1 – The values of operating efficiency of Greek tourism regions

Region	2017			2019			2021		
	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Eastern Macedonia & Trace	0,64	0,73	0,87	0,59	0,72	0,82	0,79	0,83	0,95
Central Macedonia	0,82	0,85	0,97	0,77	0,85	0,90	0,86	0,88	0,98
Western Macedonia	0,79	1,00	0,79	0,71	0,87	0,82	0,74	0,98	0,75
Thessaly	0,77	0,80	0,96	0,66	0,78	0,85	0,79	0,81	0,97
Epirus	0,81	0,90	0,90	0,86	0,95	0,90	0,88	0,95	0,93
Ionian Islands	0,95	0,96	0,99	0,94	0,96	0,98	0,99	1,00	0,99
Western Greece	0,90	0,93	0,97	0,80	0,84	0,95	0,95	0,96	0,99
Central Greece	0,74	0,82	0,90	0,80	0,86	0,93	0,96	1,00	0,96
Peloponnese	0,83	0,87	0,95	0,81	0,87	0,93	0,90	0,95	0,95
Attica	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
North Aegean	0,97	1,00	0,97	0,93	0,96	0,97	0,92	1,00	0,92
South Aegean	1,00	1,00	1,00	0,80	0,98	0,82	1,00	1,00	1,00
Crete	0,91	0,94	0,97	0,87	0,91	0,96	0,82	0,85	0,97
Mean	0,86	0,91	0,94	0,81	0,89	0,91	0,86	0,94	0,95
Mean (2017-2021)	0,85 (TE)	0,91 (PTE)	0,95 (SE)						

Source: authors' own work

Technology efficiency, often known as TE, is an essential component to consider when determining how effectively resources are allocated and used. According to the findings shown in Table no. 1, the average value of the technological efficiency of Greece's 13 tourist regions throughout the period 2017-2021 is 0.85. This finding suggests that when all potential causes of inefficiency are considered, the Greek regions as a whole have the potential to improve their inputs by up to 15% (given the amount of output they now produce). In 2017, the median combined effectiveness of the Greek regions was 0.86; in 2019, this mean value

dropped to 0.81; and in 2021, this mean value increased to 0.86, representing an improvement. In 2017, two areas, namely Attica and South Aegean, gained DEA effectiveness. This number decreased to one region in 2019 (Attica), and then increased again to two regions in 2021 (both Attica and South Aegean). In the variable model, Central Macedonia, Epirus, Peloponnese, and the North Aegean all achieve good efficiency, but their scale efficiency is quite poor. In 2019, the majority of areas experienced decreased overall efficiencies, mostly as a result of lower-scale efficiencies. In 2019, there was a decrease in both the efficiency of scale and the efficiency of pure technical processes, which led to a decrease in the overall efficiency of both of these areas combined. Based on these findings, it seems that the hotel and restaurant industries in these places are operating at a size that is inappropriate for their businesses. The challenge that these areas are facing is one that is related to the capacity of their production. Despite the fact that their overall technical efficiency ratings are quite near to those of the most efficient areas, Crete, Western Greece, and the Ionian Islands are all technically inefficient regions. In order to increase their performance, these three areas need to reduce the amount of input they get. The following locations all have relatively poor efficiency, according to all of the models. This indicates that they should improve their management methods as well as the capacity of their manufacturing facilities.

The analytical mean of the pure technical efficacy (PTE) of the enterprises operating in the 13 Greek tourist districts throughout the period 2017-2021 is 0.91, which places them very near to the effectiveness frontier. Only Attica was able to maintain a PTE value of during all of the years, which demonstrates that their leadership level and technological expertise are both high, as well as that they have appropriately distributed their invested resources. It is important to point out that Western Macedonia's PTE value has significantly decreased during 2017, going from 1 to 0.87 in the current year. A drop of this magnitude is most likely attributable to the region's robust development and the successful execution of critical investments. The area has to place a significant emphasis, as part of the ensuing growth, on the improvement of its capability management level. In addition, the values of PTE in the majority of the areas are lower than 0.9, which indicates that there is space for development. Scale efficiency (SE) is a metric that assesses the productivity efficiency of tourist zones as it relates to their scales. This metric also shows the difference between their existing scales and the scales that are needed to achieve the production frontier. The mean value for scale efficiency across all 13 Greek regions over the time period under consideration is 0.95. It should come as no surprise that the reduction in scale efficiency is the primary cause of the poor and deteriorating technological efficiency. According to the findings of the calculations, all of the other regions showed varying degrees of loss, with the exception of Attica and the South Aegean, which maintained the highest level of productivity throughout. In general, the vast majority of tourist destinations in Greece do not have an ideal fit between the degree of operating technology, the management level, and the magnitude of the inputs. Therefore, it is suggested that they increase the amount of work they put into making investments and enhance the effectiveness of the approach they use to make use of their cash. The DEAP2.1 program is used to compute and deconstruct the overall factor productivity shift index, and further assess the modifications in the efficiency. The particular results of the process are provided in Table no. 2, which are based on the data from tourism in Greek regions from 2017 to 2021.

Table no. 2 – The Malmquist index of Greek tourism regions during 2017-2021

YEAR	EFFTC	TECCH	PECH	SECH	TFPCH
2017-2018	0,98	1,08	1,01	0,97	1,06
2018-2019	0,96	1,01	0,98	0,98	0,97
2019-2020	0,89	1,03	1,12	0,79	0,92
2020-2021	0,96	1,40	1,32	0,73	1,34
Mean	0,95	1,13	1,11	0,87	1,07

Source: authors' own work

The average value of the Malmquist index for the period of 2017-2021 was 1.07, which pointed to a consistent overall performance as well as a yearly increase in TFPCH of the Greek tourist areas of 1.07% on average. The TFPCH index for the period 2017–2021 is shown to be more than one in Table no. 2, with the exception of the years 2018–2019 and 2019–2020, during which it was less than one. As a result of the significant expansion that will be seen in the years 2020 and 2021, the operational effectiveness of tourist areas will be very vulnerable to the affects of the economic climate, international circumstances, and regulatory conditions, amongst other factors. The PECH values of tourist areas stayed around 1 and averaged 1,11, with just a tiny amount of variability and no discernible disparities among the unit input and output from year to year. Regarding the SECH, the values that have been recorded during these years are all very below 1, with an average of 0.87. Following a decline that happened in 2018-2019 and 2019-2020, there was a sluggish rebound that took place in 2020-2021. The bad performance in SECH and steady performance in PECH immediately led to the poor performance in EFFCH, which of tourist regions resulted in an annual increase of -7%. In terms of the alterations brought about by TECHCH, the efficiency values are larger than 1, with an average score of 1,13; this makes it the sole indication that is showing a significant improvement. It is abundantly clear that the advancements in technology produced by tourist businesses in Greek areas have neutralized the unfavorable rise in scale economics and are the primary driving force behind the expansion of operational capabilities within the tourism sector. During the period of 2017-2021, Attica and the South Aegean had the greatest overall operating efficiency TFPCH. It is important to note that a significant portion of areas have Malmquist indices that are lower than 1. This indicates that these tourism destinations have been seeing a decline in output over the course of time. Concerning the inefficiency of a great number of areas, several theories may be conceived for the inefficient utilization of the inputs with the intention of maximizing the production potential for the greatest amount of output that is achievable.

According to the study's results, regions perceived as inefficient should consider investing in organizational aspects related to tourist management. These aspects encompass initiatives in marketing, enhancements in quality, and achieving a better balance between inputs and outputs, among other measures. Notably, certain regions like Eastern Macedonia and Trace, Thessaly, Western Macedonia, and Central Greece experience notable fluctuations in their technological efficiency levels over several years. This variability may be attributed to the inability of tourism region managers to effectively adjust inputs or accurately anticipate (or generate) the demand for tourism in their respective areas over time. Alternatively, a combination of these factors could contribute to the observed fluctuations. The variations in efficiency among regions highlight the need for a nuanced approach to regional tourism management. By understanding and addressing factors such as management capabilities, demand forecasting, and technology adoption, regions can work towards improving their efficiency and competitiveness in the tourism industry.

5. CONCLUSION

Regional tourist strategy in Greece plays an important part in laying the foundation for a progressive spatial expansion of the sector as well as the diversification of the country's model. This is an important function since regional planning for tourism in Greece is necessary. This study will investigate the tourism competitiveness of Greek areas from 2017 through 2021, as well as the evolution of that competitiveness over the course of those five years. Tourism regions are comparable to tourist profit units since they are responsible for the management of appropriate inputs in order to maximize outputs (i.e., the number of national and international tourists who arrive and stay in a destination). Particularly, we have examined one of the five factors that define the comparative advantage enjoyed by tourism sites, namely, the effective management of the resources available at these locations.

According to the findings of this research, the performance of a number of different areas in Greece has a lot of room for improvement. In addition, a collection of productive areas is able to keep its position unchanged over the course of several years. This conclusion is reinforced by the findings of the Malmquist index, which demonstrated that very few areas have seen an increase in their levels of production. To put it another way, the effectiveness of the Greek regions has not significantly changed during the years that were taken into consideration. Attica, Crete, the North Aegean, and the South Aegean are the areas with the highest levels of efficiency. On the other hand, the regions of Eastern Macedonia and Thrace, Western Macedonia, Thessaly, and Central Greece have the lowest levels of efficiency. There are a variety of potential reasons for such inefficiencies, including inadequate marketing of the tourist products in a particular region, overinvestment in the (highly cyclical) tourist sector, substantial variations in tourist attractiveness variables due to variation in in the past determined cultural facilities or in physical geography (for example, seaside areas), and so on and so forth.

The findings of this study provide enlightening perspectives that might be helpful to managers working in the hospitality and service sectors. The overall conclusion that can be drawn from the inefficiencies of the majority of Greek areas is that local destination management organizations need to make a significant effort in order to enhance the tourism performance of Greek locations by equilibrating the balance of inputs and outputs. This is the general conclusion that can be drawn from the inefficiencies of the majority of Greek regions. It is highly advised that the tourist policies and initiatives be decentralized because of the disparities in the performance of the regions of Greece. Additionally, it is strongly suggested that each area establish autonomously its tourism policy and development, always basing it on its own requirements and features. The regional administrations of Greece should build monitoring mechanisms (such as observatories) in order to assess the inputs/outputs ratio in significant tourist sectors such as the hotel and restaurant sectors, as well as to forecast the amount of demand that will be placed on their respective areas for tourism. Regional efforts for the lifetime training of tourist businesses in managing resources, as well as for transferring expertise from areas that are more efficient, will also be extremely valuable. These initiatives will be very useful.

In light of the fact that the vast majority of Greek areas are inefficient, the overarching conclusion that can be drawn is that regional destination management agencies need to put in a lot of effort in order to enhance the tourism success of Greek destinations by concentrating more on the equilibrium of inputs and outputs. Additionally, it is important for the regions of Greece to pay attention to the promotion of local tourist brands, to assist the development of "regional tourist districts," and to spend financial resources in tourism infrastructure.

Research Limitations and extensions

The study is confined to the years 2017-2021, and as such, it may not capture the most recent developments in the tourism industry. The dynamic nature of the field suggests that conditions beyond this period could influence the current landscape. To address these limitations, future research endeavors should consider incorporating more recent data, expanding the scope to diverse tourist zones, and exploring additional variables for a more nuanced understanding of the subject. To enhance the generalizability of findings, future research could explore a broader range of tourist zones, considering variations in size, popularity, and geographical characteristics.

ORCID

Athanasia Mavrommati https://orcid.org/0000-0003-0260-5831
Fotios Chatzitheodoridis https://orcid.org/0000-0003-2008-1023
Achilleas Kontogeorgos https://orcid.org/0000-0002-4186-0379

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