MEASURING THE EFFICIENCY AND PRODUCTIVITY OF MEDITERRANEAN TOURISM: A WINDOW DEA ANALYSIS

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Abstract

Purpose – Tourism is an important economic sector in the EU with particular significance for the Mediterranean countries. The aim of the study is to analyze the efficiency and productivity of Mediterranean countries in order to gain an insight into the causes of inefficiency and changes in productivity.
Methodology/Design/Approach – The method used is Window Data Envelopment Analysis and Malmquist Productivity Index on the basis of data collected for the period from 2014 to 2021. Technical efficiency (TE) is calculated as well as its main components, the pure technical efficiency (PTE) and the scale efficiency (SE). Productivity is broken down to technical and technological change and its main components.
Findings – Due to the Covid-19 pandemic in 2020, PTE, which is influenced by management, technology and external factors, experiences a sharp decline. However, the decomposition of TE (overall efficiency) revealed that prior to the pandemic, the primary source of inefficiency was the inability of the Mediterranean tourism sectors to operate at optimal scale. Productivity fell in all countries between 2019 and 2020, mainly due to a technological decline.
Originality of the research – This paper analyses two distinct samples. The initial sample comprises the EU member states, whereas the second sample comprises the Mediterranean countries within the EU.
Keywords tourism efficiency, Window Data Envelopment Analysis, Malmquist Productivity Index, Mediterranean countries, integrated planning and management

Original scientific paper
Received 15 February 2024
Revised 25 June 2024
09 July 2024
Accepted 15 July 2024
https://doi.org/10.20867/thm.31.1.1

INTRODUCTION

The tourism sector has experienced significant growth and a strong upturn in the global market, which has had a direct and indirect positive impact on other sectors of the economy. According to the WTTC (n.d.), tourism revenues accounted for 10.3% of global GDP in 2019. Tourism plays an important role in the European Union (EU) economy, where, according to the European Parliament (2021), 27.3 million people of working age were directly and indirectly employed in the 2018 tourism season, representing 11.7% of the total working population. It has an impact on related activities such as hospitality, services, retail, infrastructure and culture, and ultimately tourists contribute to GDP through their consumption. It is one of the most important economic sectors in the Mediterranean region contributing significantly to GDP growth, job creation, income generation and strengthening the balance of payments (Stevens & Duhamel, 2022). European tourism is deeply rooted in Europe and plays a supporting role in European unity. The efficiency of European tourism is attributed to a number of factors, including a diverse tourist offer, modernized transport systems, competitive prices and high-quality services (Brînză & Butnaru, 2020). Overall, tourism is proving to be an important sector for the EU, promoting economic growth and integration.

The contribution of this research[1] is reflected in two analyzed samples. The first sample consists of the EU Member States, while the second (sub)sample consists of the Mediterranean countries in the EU. The authors' intention was to investigate whether Mediterranean countries have efficient tourism compared to other EU countries that have a lower share of tourism in GDP or a lower share of tourism employment. This raised the question of whether the countries with well-known destinations prove to be more efficient or whether they are relatively inefficient as they have to achieve a higher output for the inputs invested compared to other countries. The aim of this paper is therefore to analyze the efficiency of the tourism sectors in the Mediterranean countries of the EU using Window Data Envelopment Analysis (WDEA), which measures the efficiency of each tourism sector within the sample in terms of inputs invested and outputs achieved. In addition, the Malmquist Productivity Index (MPI) is used to assess the productivity of Mediterranean countries over time. The analysis is conducted on the basis of data collected from Eurostat (n.d.) for the period from 2014 to 2021. As far as the authors are aware, there is no research on the dynamic efficiency of tourism at country level that considers Mediterranean countries separately as tourism-oriented countries.

After the Introduction, the most important tourism indicators such as the share of tourism in GDP, the share of people employed in tourism and the share of tourism in exports are presented at the level of the EU countries and the importance of tourism for the Mediterranean countries is explained. The relevant literature and its results are presented in the literature review, followed by an explanation of the method used, the sample selection and the variables of the model. Finally, the results of the WDEA and MPI were presented and conclusions were drawn.

[1] This research is the result of a study conducted as part of the master's thesis of student Klare Justinić entitled "Analysis of the efficiency of tourism in the European Union with a special emphasis on Croatia", available at: https://zir.nsk.hr/islandora/object/efri:4314

1. THE ROLE OF TOURISM IN THE ECONOMIES OF THE EUROPEAN UNION

One of the most important indicators of the importance of tourism to the economy of a given country is the share of tourism in GDP, the values of which are shown in the table below for the individual member states of the European Union.

Table 1: **Share of tourism in GDP from 2019 to 2021 (in %)**

STATE	2019	2020	2021
Croatia	24.8	13.2	16.1
Greece	20.7	9.2	14.9
Portugal	17.1	8.7	10.9
Malta	15.0	4.9	6.7
Spain	14.0	5.9	8.5
Cyprus	13.7	3.7	9.3
Estonia	12.1	6.1	6.0
Netherlands	11.1	7.8	8.1
Slovenia	10.8	7.2	7.7
Austria	10.7	7.9	7.1
Italy	10.6	6.1	9.1
Luxemburg	10.3	7.9	8.6
Average EU	10.3	5.5	6.6
Bulgaria	9.9	4.2	4.9
Germany	9.8	6.3	6.4
Hungary	8.3	4.0	4.6
Finland	7.9	4.9	5.5
Latvia	7.7	4.2	4.3
Sweden	7.2	4.7	5.3
Denmark	6.5	4.8	4.6
Slovakia	6.4	3.4	3.8
Czechia	6.2	3.9	3.6
Romania	6.0	3.5	3.8
Lithuania	6.0	3.0	3.3
Belgium	5.5	3.6	4.3
Poland	4.8	2.6	2.8
Ireland	4.7	1.2	1.2
France	4.03	3.19	3.19

Source: World travel & tourism council. (n.d.). *Economic Impact Reports*. Retrieved April 2, 2023, from https://wttc.org/research/economic-impact

Looking at the share of tourism in the GDP of the EU member states, the Mediterranean countries stand out with a significantly higher share of tourism in total GDP than the EU average, which was 10.3% in 2019. Among the outstanding countries, Croatia has the largest share of tourism, followed by: Greece with 20.7% in 2019, Portugal with 17.1% in 2019, Malta with a share of tourism in GDP of 15%, Spain with a share of 14% and Cyprus with 13.7%. Although tourism holds significance in Italy and France, its contribution to GDP in these countries is comparatively lower than in other Mediterranean countries, as there are various developed sectors in their economies.

It is expected that a higher share of income from tourism in GDP will also lead to higher employment of the working-age population in this industry. The percentage of employment in the tourism industry by country is shown in the following table.

Table 2: **Share of employees in tourism from 2019 to 2021 (in %)**

STATE	2019	2020	2021
Croatia	23.2	19.4	19.7
Portugal	21.3	18.2	18.9
Malta	21.1	18.1	19.1
Greece	21	18.3	19.9
Netherlands	18.4	18.2	18.3
Spain	14.4	11.9	12.7
Cyprus	14.0	11.6	12.9
Germany	13.0	11.3	11.4
Italy	12.2	10.6	11.6
Estonia	11.7	10.2	11.0
Austria	11.4	10.3	10.2
Average EU	11.3	9.9	10.2
Slovenia	11.2	10.8	10.9
Hungary	9.3	8.6	8.7
Bulgaria	9.0	7.2	7.2
Latvia	8.3	7.0	7.4
Finland	8.3	6.8	7.0
Czechia	8.2	7.1	7.2
Luxemburg	7.6	7.0	6.9
Sweden	7.6	6.4	6.4
Denmark	6.9	6.4	6.2
Romania	6.7	6.0	6.3
Belgium	6.4	5.7	5.9
Slovakia	6.2	5.9	5.8
Ireland	6.0	5.6	5.4
Poland	5.2	4.6	4.7
Lithuania	4.8	3.7	4.0

Source: World travel & tourism council. (n.d.). *Economic Impact Reports*. Retrieved April 2, 2023, from https://wttc.org/research/economic-impact

As expected, the share of tourism employees follows the trend of the share of tourism revenues in GDP, with the share of tourism employees at the EU level being significantly higher than at the global level, which was not the case for the share of tourism in GDP. In 2020, a decrease is observed due to the Covid-19 pandemic, with a gradual recovery already in 2021. Considering that tourism represents a very large part of GDP in Mediterranean countries and exports are a very important indicator of the development of the whole economy, it is interesting to see how much of the export is due to the consumption of foreign tourists and make a comparison with other countries (Table 3).

Table 3: **Share of tourism in exports from 2019 to 2021 (%)**

STATE	2019	2020	2021
Croatia	37.7	21.7	23.7
Greece	27.6	10.2	17.6
Portugal	23.3	12.2	13.1
Spain	17.8	5.2	7.4
Cyprus	16.0	3.0	8.8
Bulgaria	10.5	4.5	4.7
Austria	10.2	6.6	4.4
Estonia	9.8	3.7	2.5
Malta	9.6	2.2	3.2
Average EU	9.2	4.0	4.5

STATE	2019	2020	2021
Italy	7.9	3.5	3.6
Slovenia	7.2	3.3	3.8
Hungary	7.2	2.9	3.3
Latvia	5.4	1.0	1.3
Finland	5.1	1.6	1.1
Poland	4.5	2.4	2.2
Denmark	4.4	2.2	1.8
Sweden	4.2	2.2	2.3
Romania	4.2	1.7	1.6
Czechia	4.1	2.1	1.5
Luxemburg	4.0	3.2	3.2
Lithuania	3.8	1.4	1.2
Netherlands	3.2	1.7	1.6
Slovakia	2.9	1.1	0.9
Germany	2.8	1.3	1.3
Ireland	2.7	0.6	0.4
Belgium	2.4	1.8	1.7

Source: World travel & tourism council. (n.d.). *Economic Impact Reports*. Retrieved April 2, 2023, from https://wttc.org/research/economic-impact

This indicator shows a drastic decrease in the year 2020 as a consequence of the strict border crossing rules during the Covid- 19 pandemic, but it is interesting to note that there is a very slight recovery in 2021 if we compare it to 2019. This trend can also be seen in the EU average, which was 9.2% in 2019, fell to 4.0% in 2020 and improved to just 4.5% in 2021. Considering the importance of tourism in most Mediterranean countries, as shown in the previous tables, it can be concluded that for the long-term sustainability of tourism, it is important to manage travel and tourism efficiently in order to achieve economic growth, job creation and export generation (Barišić & Cvetkoska, 2020).

2. LITERATURE REVIEW

Although DEA has traditionally been the most popular approach to assess relative efficiency in the tourism sector (Assaf & Josiassen, 2016), previous studies have primarily focused on efficiency evaluation at the hotel level (Higuerey et al., 2020; Karakitsiou et al., 2020; Tekiner, 2023) rather than at the industry level. As this study focuses on the efficiency of the tourism sector in the Mediterranean countries compared to the EU countries, the following section presents studies that deal with the assessment of the efficiency of the tourism sector in the EU and include the Mediterranean countries.

Various studies have evaluated the efficiency of tourism in Europe using different methods and criteria. The most commonly used method is Data Envelopment Analysis (DEA). Lozano-Ramírez et al. (2023) assessed the sustainability efficiency in 27 European Union countries between 2015 and 2019. The study identified leading countries in terms of sustainable tourism practices and highlighted the need for sectoral recovery after a pandemic. Doğanalp and Arslan (2021) evaluated technical efficiency in tourism in six European countries using tourism revenues and number of visitors as output metrics. They found that Spain, Italy and Greece use their natural and cultural resources efficiently, while Turkey, Portugal and France show inefficiencies. The efficiency of the tourism sector was also studied by Pavković et al. (2021) using a sample of 25 European countries and for 2017 data. The inputs used were the capacity of hotels and similar accommodation establishments, the number of rooms and the number of beds, and the outputs were the number of arrivals, the number of overnight stays and tourist consumption during arrivals. The results of the analysis show that Croatia, Belgium and Denmark are efficient.

Marcikic Horvat and Radovanov (2020) examined the relative efficiency of tourism development in 33 European countries using a two-stage DEA model. They found lower efficiency scores in the most recent EU accession countries, in contrast to notable efficiency improvements in the Western Balkans, with the EU-15 achieving the highest average efficiency score. Barišić and Cvetkoska (2020) examined the impact of travel and tourism on GDP and employment in all 28 EU member states, providing insights and proposing policy recommendations. The study highlights the importance of efficient travel and tourism management for economic growth, job creation and export generation. Model was based on two inputs and two outputs. The variables of domestic consumption and investment expenditure were used as inputs, and the share of tourism in GDP and employment were used as outputs. The research was conducted using the BCC model with an output orientation. The results of the research led to the conclusion that within the European Union (28), thirteen member states are relatively efficient, namely: Bulgaria, Cyprus, Estonia, Germany, Greece, Hungary, Italy, Latvia, Malta, Portugal, Romania, Spain and the United Kingdom, while the other member states are considered relatively inefficient.

The study of the efficiency of the tourism sector in the work of Prorok, Šerić and Peronja (2019) for DMU uses the countries of the Western Balkans and divides them into countries of the EU and countries that are not part of the EU. They use the output oriented CCR model. Inputs were determined based on the evaluation of 14 pillars defined in the Annual Report on Tourism Competitiveness of Countries in 2017 (WEF) published by the World Economic Forum, and for outputs the share of tourism in GDP and employment growth were used. This analysis showed the highest relative efficiency of the tourism sector in Cyprus, Malta, Bulgaria, Greece, Croatia, Estonia and Ireland.

In examining the efficiency of the tourism sector in European countries, Soysal-Kurt (2017) measured relative efficiency in 29 European countries based on 2013 data. Study use three inputs and three outputs. The input variables used are tourism costs, number of employees, and number of beds; the outputs are tourism receipts, number of arrivals, and number of overnight stays. The analysis is carried out using input oriented CCR model. The results of the analysis show that 16 countries are relatively efficient and 13 countries are relatively inefficient. Relatively efficient countries in the tourism sector are: Cyprus, Croatia, Estonia, Finland, France, Greece, Hungary, Ireland, Latvia, Luxembourg, Malta, Poland, Portugal, Spain, Switzerland and Turkey.

In addition to the efficiency evaluation of the tourism sector, the MPI was used to measure changes in productivity between two time periods. The MPI not only measures the efficiency changes for each DMU, but also provides information on the causes of these changes by presenting the main components of the estimated change. Barros and Alves (2004) and Hwang and Chang (2003) were among the first studies to apply the MPI methodology to measure productivity changes in the hospitality industry, using a sample of different hotels. Cordero and Tzeremes (2017) and Tzeremes (2021) used the MPI between 2004 and 2013 to measure the productivity changes of hotels in the Spanish Balearic and Canary Islands.

There are not many studies conducted at country level. Assaf & Tsionas (2018) measured the productivity levels of 101 tourism destinations in the period from 2008 to 2012. Sun et al. (2015) measured the productivity of the tourism industry in China in the period from 2001 to 2009 using the MPI. They found that technological change is the most important factor for productivity changes. Jebali & Essid (2020) measured environmental productivity in the Mediterranean countries from 2009 to 2014. They found a negative development trend for the overall environmental productivity factor in the Mediterranean countries. They also found that the main source of productivity growth is technological progress.

Previous studies on the efficiency and productivity of tourism in EU show that the results change depending on the purpose of the study, which determines the selection of input and output variables. Although the studies on Mediterranean tourism are not very extensive, they cover various aspects, such as the performance evaluation of countries in terms of tourism-related technical efficiency (Doğanalp & Arslan 2021), the comparative performance evaluation of Mediterranean destinations using DEA to uncover efficiency and effectiveness trade-offs (Niavis & Tsiotas, 2019), the impact of seasonality and spatiality of tourist flows on the regional performance of 36 coastal regions in the northern Mediterranean (Niavis & Kallioras 2021).

Although the existing literature has made great progress in evaluating the efficiency and productivity of the tourism sector, further progress can still be made in this area. As far as the authors are aware, there are no studies that combine efficiency and productivity approaches from a Mediterranean perspective, using the WDEA to assess efficiency and the MPI to measure productivity changes. Furthermore, this paper analyses the dynamic efficiency of Mediterranean countries compared to other EU countries in order to answer the research question of whether Mediterranean countries have efficient tourism compared to other EU countries as they have to achieve a higher output for the input invested. In view of this, this paper aims to fill this gap. The methodology as well as the inputs and outputs of the model are described in the following section.

3. METHODOLOGY

3.1. Data Envelopment Analysis and Malmquist Productivity Index

DEA is mathematical method developed by Charnes et al., (1978). According to Beasley (n.d.), it is a nonparametric method for evaluating the relative efficiency of homogeneous decision-making units (DMUs). In the analysis, it is possible to use multiple inputs and outputs expressed in different units, which is considered one of the advantages of the method. There are two basic static models of DEA analysis (Škrinjarić, 2017): the constant returns to scale (CCR) model and the variable returns to scale (BCC) model.

We consider efficiency in terms of three basic concepts (Al-Refaie et al., 2016): technical efficiency (TE), pure technical efficiency (PTE) and scale efficiency (SE). Technical efficiency that assumes operating under CRS (constant returns to scale) shows the efficiency of resource utilization and the possibility of its distribution among all selected DMUs, i.e., this measure provides information about the ability of each DMU to transform more inputs into more outputs in relation to its efficiency frontier. This indicator tells us which inputs can be reduced without changing the outputs, i.e., it enables the realization of benefits by changing the balance between inputs and outputs (Iqbal & Awan, 2015). Thus, the technical efficiency of tourism is its ability to transform multiple resources, such as the number of beds and employees, into multiple outputs, such as the number of overnight stays and consumption by tourists. Pure technical efficiency that implies VRS (variable returns to scale) is determined by estimating the efficiency frontier under the assumption of variable returns to scale. It excludes scale efficiency and measures only the management performance in organizing inputs and the impact of exogenous factors on the production process, i.e., on the outputs achieved by the tourism sector (Kumar & Gulati, 2008). Finally, scale efficiency refers to information about the optimal size of production, i.e., information about the optimal number of resources. From the firm's perspective, this indicator shows the extent to which the firm can reduce inputs to a certain degree, i.e., it shows the overall success of DMUs (in this paper, EU member states and Mediterranean countries) in utilizing inputs (Iqbal & Awan, 2015). As DEA is a non-statistical method based on linear programming (LP), therefore no standard errors are provided and there is no basis for hypothesis testing. In DEA, any deviation from the efficiency frontier is considered inefficiency (Ray, 2004).

The rule of thumb is that the number of DMUs must be at least three to four times higher than the sum of the selected inputs and outputs. This rule can be overcome by using WDEA, a dynamic analysis that observes selected DMUs over a period of time. The WDEA is based on the premise that what has been achieved in the past will also be achieved in the future. According to Cullinane et al. (2004), there is no theoretical basis that defines the choice of a particular window size. Since the same DMUs are observed as different DMUs in different periods, it is possible to accommodate a relatively larger number of inputs and outputs compared to basic DEA models. This approach increases the discriminatory power, especially in scenarios where the number of DMUs is limited (Halkos & Tzeremes, 2009). According to Asmild et al. (2004), time window should be sufficiently small to allow a fair comparison of DMUs over time, but at the same time large enough to ensure an adequate sample size. Formula *n*p*w* is used for calculating the number of different data points where *n* stands for number of DMUs (in our case no. of countries), *p* for window length and *w* for number of windows (Cooper et al., 2007).

DEA is very commonly used to analyze the efficiency of the public sector, non-profit organizations, as well as commercial enterprises to study the efficiency of resource use. It is also used in various sectors including: education (Arbula Blecich, 2024, 2020), transportation, health (Stefko et al., 2018; Dukić Samaržija et al., 2018), R&D (Arbula Blecich, 2021), banking (Gržeta, 2020; Kamarudin et al., 2019; Ouenniche & Carrales, 2018), and industry (Wang et al., 2019).

The Malmquist Productivity Index (MPI) is a widely used method originally proposed by Caves et al., (1982) to measure the change in productivity of a DMU over time. Färe et al. (1994) decomposed productivity growth into two components: technical efficiency change (catch-up) (TEC) and technological change (frontier shift) (TC)

$$\text{Malmquist productivity index (MPI)} = \text{Technical Efficiency change (TEC)} * \text{Technological change (TC)}$$

The former formula for the output-based MPI can also be written as follows (Färe et al., 1994):

$$M_0(x^{t+1}, y^{t+1}, x^t, y^t = \left[\frac{D_0^t(x^{t+1}, y^{t+1}}{D_0^t(x^t, y^t)} \cdot \frac{D_0^{t+1}(x^{t+1}, y^{t+1}}{D_0^{t+1}(x^t, y^t)}\right]^{\frac{1}{2}}$$

where x stands for the input vector and y for the output vector. The function of the distance results is defined as (*xt, yt*) and M as the total change in productivity between periods t and *t*+1.
where (Färe et al., 1994):

$$Technical\ efficiency\ change\ (TEC) = \frac{D_0^{t+1}(x^{t+1}, y^{t+1})}{D_0^t(x^t, y^t)}$$

$$Technological\ change\ (TC) = \left[\left(\frac{D_0^t(x^{t+1}, y^{t+1})}{D_0^{t+1}(x^{t+1}, y^t)}\right)\left(\frac{D_0^t(x^t, y^t)}{D_0^{t+1}(x^t, y^t)}\right)\right]^{\frac{1}{2}}$$

Efficiency changes measures how much a DMU has improved its efficiency compared to a fixed technology. It essentially captures the DMU's ability to move closer to the best practice frontier over time. As a DMU becomes more efficient, it catches up with the frontier. Technological change measures shift at the technology frontier itself. It captures technological advances that move the entire frontier outwards, so that all DMUs have the potential to improve their productivity regardless of their individual efficiency changes. If a DMU experiences growth from one period to another, its MPI index will be higher than 1, and conversely, if productivity falls, its MPI index will fall below 1.

To calculate the changes in scale efficiency (SEC), the distance functions must be calculated within the VRS by adding the following restriction:

$$\sum_{k=1}^{K} z^{k,t} = 1\ (VRS)$$

The scale efficiency in each period is calculated as the ratio between the distance function that fulfils the CRS and the distance function restricted to satisfying the VRS. Following Färe et al. (1994), this paper uses an extended decomposition of the MPI, which can be written as follows:

$$M_0(x^{t+1}, y^{t+1}, x^t, y^t = TEC * PPTEC * SEC$$

TEC stands for technological change, PTEC for pure technical efficiency change and SEC for scale efficiency change. SEC and PTEC are the main components of TEC which is calculated relative to CRS:

TEC = PTEC * SEC

TEC refers to efficiency change calculated under CRS, while PTEC stands for efficiency change calculated under VRS.

3.2. Sample Size and Model Variables

Countries may have different relative efficiency in different time periods. For this reason, a longer time period (2014-2021) is considered in this study. When conducting a DEA analysis, it is crucial to select the relevant inputs and outputs that provide the most complete information about the relative efficiency of each DMU. Since the selection of input and output variables can influence the results, this can be overcome by selecting only basic inputs and outputs. The selection of variables in this paper is based on previous studies and reflect the process being evaluated. The input variables in the analysis included the number of beds (Soysal-Kurt, 2017; Pavković et al., 2021), the number of employees (Soysal-Kurt, 2017; Barišić & Cvetkoska, 2020; Prorok et al., 2019) and public investment in culture. The latter variable served as a surrogate cost measure for the amount of public investment required in a tourism destination to attract visitors as cultural heritage plays an important role in the diversification of destinations (Justinić, 2023). European tourist economy trends lie in the advancement of cultural tourism diversity (Đokić et al., 2008). While previous studies used tourism costs (Soysal-Kurt, 2017) or capital expenditure (Barišić & Cvetkoska, 2020) as cost variables, the selection of public investment in culture was necessary due to data limitations for the entire study period. Tourism consumption (Barišić & Cvetkoska, 2020; Pavković et al., 2021) and the number of overnight stays (Soysal-Kurt, 2017; Pavković et al., 2021) were considered as output variables.

Table 4: **Inputs and outputs of the model**

INPUT	OUTPUT
number of beds	tourist consumption
public investment in culture	number of overnight stays
number of employees	

Source: Authors

The period of the analysis extends from 2014 to 2021 with a window length of three years, resulting in the following six windows: Window 1 (2014, 2015, 2016), Window 2 (2015, 2016, 2017), Window 3 (2016, 2017, 2018), Window 4 (2017, 2018, 2019), Window 5 (2018, 2019, 2020), and Window 6 (2019, 2020, 2021). Windows are created using moving averages to reveal the dynamics of DMU efficiency over a certain period of time. With a period of 8 years and a time window of 3 years, the analysis exceeds the limit of the number of DMUs in terms of the number of inputs and outputs, since the number of different DMUs (in the sample of the EU member states) is 486, which we obtain by the following formula:

*Number of data points = n * p * w*

Where:
n = number of DMUs
p = window length
w = number of windows (w = k – p + 1)
k = number of years

This means that there are 486 distinct data points in this study, so we can accommodate more input and output variables without losing discriminatory power than with standard non-dynamic models.

In addition to carrying out a WDEA analysis at EU Member State level, a similar analysis was carried out specifically for the Mediterranean countries within the EU: Spain, Greece, France, Italy, Portugal, Cyprus, Croatia, Slovenia and Malta. They have coasts on the Mediterranean Sea (although Portugal does not border the Mediterranean, it is considered a Mediterranean country in terms of culture, history, language and climate) and the tourism industry plays an important role in the economy. This analysis covered the period from 2014 to 2021. The reason for examining a smaller subset of countries was to mitigate the impact of DMU selection on the relative efficiency results. Relative efficiency is calculated in relation to the values within the selected sample, in the former case the tourism sectors of the EU member state. Within the subgroup, the EU Mediterranean countries are the most similar, as they are heavily dependent on tourism. Consequently, countries that are less active in tourism (invest less) are often more efficient. The following table contains summary statistics for the Mediterranean countries for the period from 2014 to 2021.

Table 5: **Summary statistics for Mediterranean countries for the period from 2014 to 2021**

	number of beds	public investment in culture	number of employees	tourist consumption	number of overnight stays
Max	5,131,417.1	16,386.0	27,063.4	74,115,357,700.0	1,098,224,707.0
Min	45,465.1	48.7	229.2	427,676,632.6	3,513,047.1
Average	1,874,061.3	3,108.6	8,974.8	15,031,897,019.0	241,829,907.7
SD	1,991,546.7	5,084.7	10,206.9	23,424,234,878.0	352,392,990.7

Source: Authors

If the analysis were performed on the basis of data from a single year, the number of DMUs would be 8. In this case, however, a WDEA approach with 6 windows, each covering 3 years, leads to a total number of 144 data points (8 * 3 * 6). DEA Solver Pro 11.0 was used to perform this analysis.

4. RESULTS

Since we focus on the Mediterranean countries, the interpretation of the results will concentrate on the efficiency of these countries, first in comparison with the EU member states and then in comparison with each other. The table below shows the efficiency of the EU member states according to the categories of TE, PTE, and SE. An efficiency score of 1 stands for an efficient DMU compared to its peers and an efficiency score below 1 indicates a relatively inefficient DMU.

Table 6: **Average results of TE, PTE and SE at the European Union level for the period from 2014 to 2021**

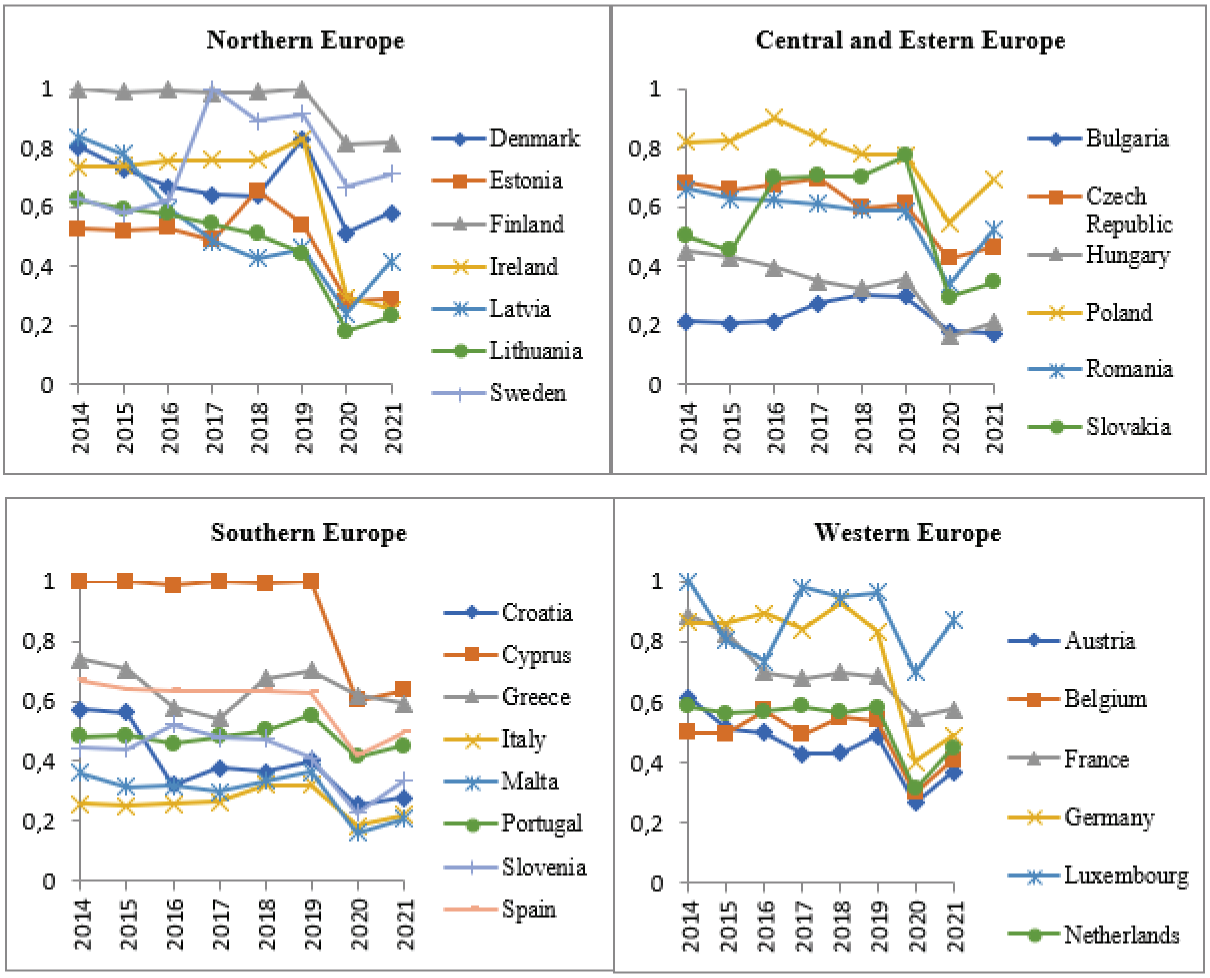
COUNTRY	TE	PTE	SE
Finland	0.962956	0.964427	0.998475
Cyprus	**0.931896**	**0.955729**	**0.975062**
Luxembourg	0.874062	0.94181	0.928065
Germany	0.797825	0.91598	0.871007
Poland	0.784224	0.905498	0.86607
Sweden	0.784067	0.815725	0.96119
France	**0.693369**	**0.950037**	**0.729834**
Ireland	0.687786	0.699745	0.98291
Denmark	0.677246	0.69615	0.972845
Greece	**0.637635**	**0.948411**	**0.672319**
Czech Republic	0.612969	0.838419	0.731101
Slovakia	0.61016	0.651081	0.937149
Spain	**0.603962**	**0.929054**	**0.650083**
Romania	0.574865	0.669149	0.859098
Netherlands	0.537881	0.664738	0.809161
Latvia	0.510987	0.871458	0.586358
Estonia	0.502432	0.801238	0.62707
Belgium	0.49648	0.540835	0.917989
Portugal	**0.484829**	**0.841703**	**0.57601**
Lithuania	0.478451	0.582051	0.822009
Austria	0.449417	0.482006	0.932388
Slovenia	**0.432647**	**0.447471**	**0.966872**
Croatia	**0.382398**	**0.557277**	**0.68619**

Hungary	0.340715	0.376641	0.904616
Malta	**0.30388**	**0.907292**	**0.33493**
Italy	**0.26883**	**0.520178**	**0.516805**
Bulgaria	0.247234	0.38804	0.637136

Source: Authors

As shown in Table 6, Cyprus comes closest to full relative efficiency in all three categories, although the significant drop in efficiency after the Covid-19 pandemic is notable. It's worth noting that technical efficiency had already fallen in several EU member states before the pandemic (Graph 1). This decline was particularly pronounced in some Mediterranean countries in 2017, namely France, Croatia and Greece, due to the disproportionate increase in input compared to output. Italy and Malta have the lowest average of relative efficiency. Although this may seem unusual given their well-established tourism sectors with numerous destinations and high numbers of overnight stays, this analysis evaluates relative efficiency rather than effectiveness, focusing on the relationship between resources invested and output achieved in terms of observed DMUs. All countries in terms of TE (overall efficiency), recorded a decline in efficiency throughout the analysis period with the Covid-19 outbreak (Graph 1). PTE serves as a measure of managerial efficiency, which is influenced by management strategies, technology and external factors. It involves the application of a variable return to scale (VRS) along the efficiency spectrum (Huguenin, 2012). Of the Mediterranean countries, Cyprus, France and Greece are closest to the relative efficiency frontier in terms of average PTE. Conversely, Slovenia, Italy and Croatia have the lowest values for average PTE. SE is the ratio between TE and PTE and provides information on the optimal size of resources (Iqbal & Awan, 2015). The Mediterranean countries that come closest to the SE frontier in the observed EU sample are Cyprus and Slovenia, while the lowest efficiency in terms of SE in the observed period is achieved by Malta, Italy and Portugal. The values for technical efficiency (TE) are presented for the main regions of Europe on the basis of the United Nations Geoscheme (United Nations Statistics Division, 1999).

Graph 1: **TE across the main regions of Europe from 2014 to 2021 (average by term)**



Source: Authors

The table 7 shows the efficiency of the Mediterranean EU member states according to the categories of TE, PTE and SE. As in the previous analysis, a value of 1 represents relatively efficient DMUs, while a value between 0 and 1 stands for relatively inefficient DMUs.

Table 7: **Two samples' perspectives for the average results of TE, PTE and SE in the Mediterranean countries for the period from 2014 to 2021**

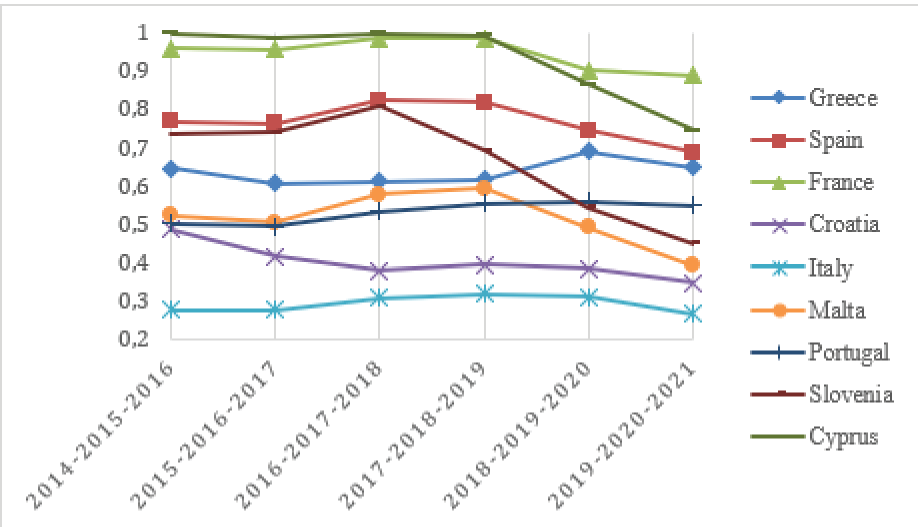
Mediterranean	TE		PTE		SE		EU	TE	PTE	SE
France	0.886298	↑	0.957783	↔	0.925364	↑	Cyprus	0.931896	0.955729	0.975062
Spain	0.666435	↑	0.953150	↑	0.699192	↑	France	0.693369	0.950037	0.729834
Cyprus	0.634617	↓	0.955805	↔	0.663961	↓	Greece	0.637635	0.948411	0.672319
Greece	0.593133	↓	0.954393	↔	0.621477	↑	Spain	0.603962	0.929054	0.650083
Portugal	0.541344	↑	0.875727	↑	0.618165	↑	Portugal	0.484829	0.841703	0.57601
Slovenia	0.474172	↑	0.685208	↑	0.692012	↓	Slovenia	0.432647	0.447471	0.966872
Malta	0.327341	↑	0.921910	↑	0.355069	↑	Croatia	0.382398	0.557277	0.68619
Croatia	0.309560	↓	0.586111	↑	0.52816	↓	Malta	0.30388	0.907292	0.33493
Italy	0.242452	↓	0.598900	↑	0.404829	↓	Italy	0.26883	0.520178	0.516805

Source: Authors

A comparison of the results of the two samples generally shows that the level of average TE remains relatively consistent at country level. However, notable deviations can be observed in France and Cyprus in particular, albeit in the opposite direction. In the sample comprising the EU Member States, France shows a relatively lower efficiency and ranks 7th, although it still performs better than the other Mediterranean countries, with the exception of Cyprus. In a comparison with the Mediterranean countries only, France achieves the most favorable result, although it's far from being an efficient country. Conversely, Cyprus (2nd place) is only just behind the leader Finland in the EU sample, with a result that indicates its position close to the efficiency frontier. Although Cyprus performs better compared to the EU member states, its performance is lower when compared only to the Mediterranean countries. The differences in the results between France and Cyprus can be attributed to the SE, i.e., the fact that the DMU is not operating at the optimal size compared to its peers. Each sample forms its own efficiency frontier as it's a relative measure, i.e., the tourism sectors are compared with each other and not with the theoretical best practice. Nevertheless, the ranking of the countries in the two samples remains similar.

The analysis of TE by country based on the average result through six windows (Graph 2), each covering three years, shows that France and Cyprus come closest to full relative efficiency. Italy has the lowest relative efficiency and Croatia is the second worst country in TE. Croatia is characterized by a decrease in the TE level throughout the observation period, and Greece has the highest relative TE level during the Covid-19 pandemic period, while all other countries within the observed sample show a decrease in the TE level.

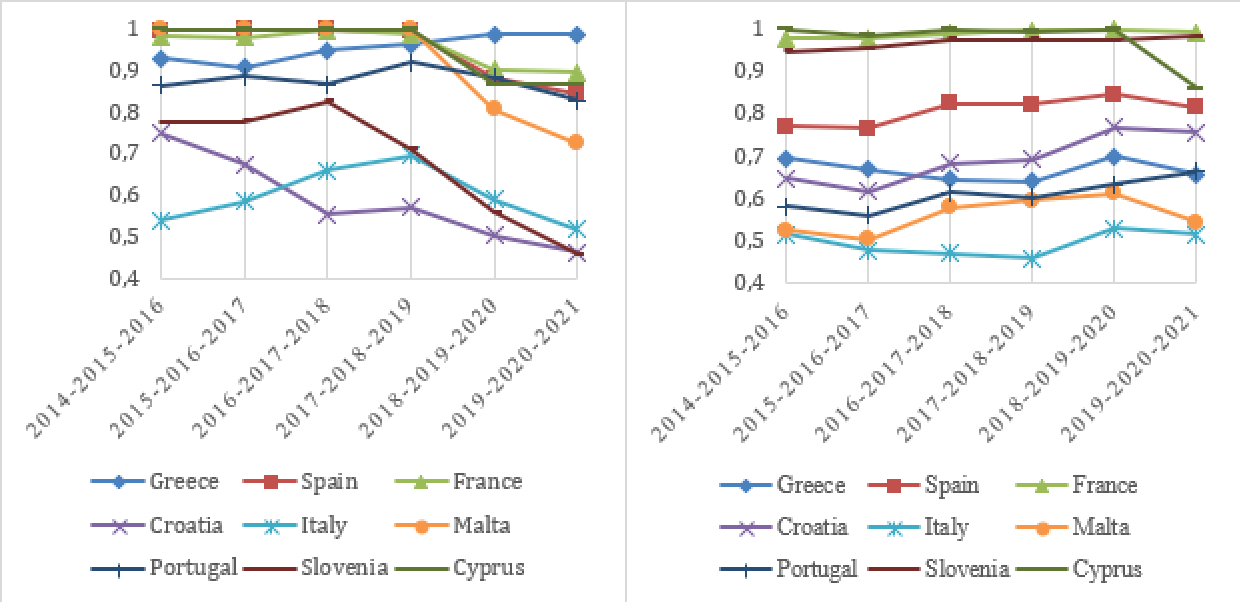
Graph 2: **Technical efficiency (TE) through windows in Mediterranean countries**



Source: Authors

To determine the causes of inefficiency, PTE and SE are shown in the Graph 3. PTE is influenced by management, technology and other exogenous factors. Malta and Spain are closest to the PTE efficiency frontier, and Greece, unlike the other countries, again reaches the highest PTE values in the Covid-19 pandemic period. Italy has the lowest PTE efficiency, followed by Croatia, which ranks second to last among the Mediterranean countries. At the same time, Croatia shows a downward trend in PTE during the observation period, with the exception of 2019. The SE measures the ratio between TE and PTE and provides information on the optimal size of resources. The countries closest to the relative efficiency frontier in terms of scale efficiency during the observed period are: France, Cyprus and Slovenia. Italy and Malta have the lowest values of scale efficiency. Croatia shows a high efficiency level at the beginning of the observed period, but it decreases during the whole observed period.

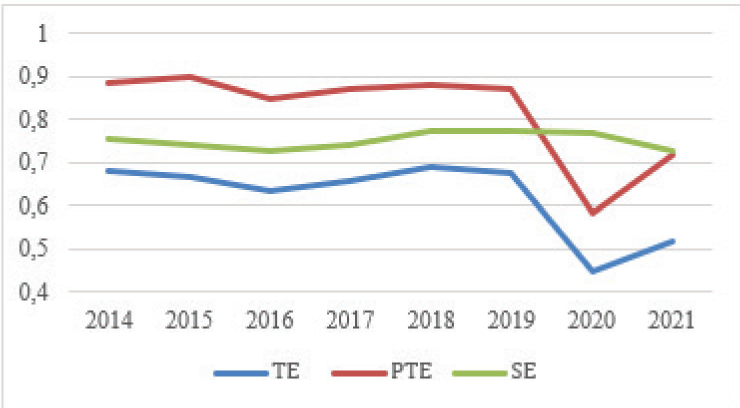
Graph 3: **Pure technical efficiency (PTE) and Scale efficiency (SE) through windows in Mediterranean countries**



Source: Authors

If we look at the data for the tourism sector in the Mediterranean countries on average, we see a sharp decline in TE (overall efficiency) in 2020. In order to determine the cause of this decline in efficiency, the PTE and the SE are presented (Graph 4).

Graph 4: **Average TE, PTE and SE in Mediterranean countries (average by term)**

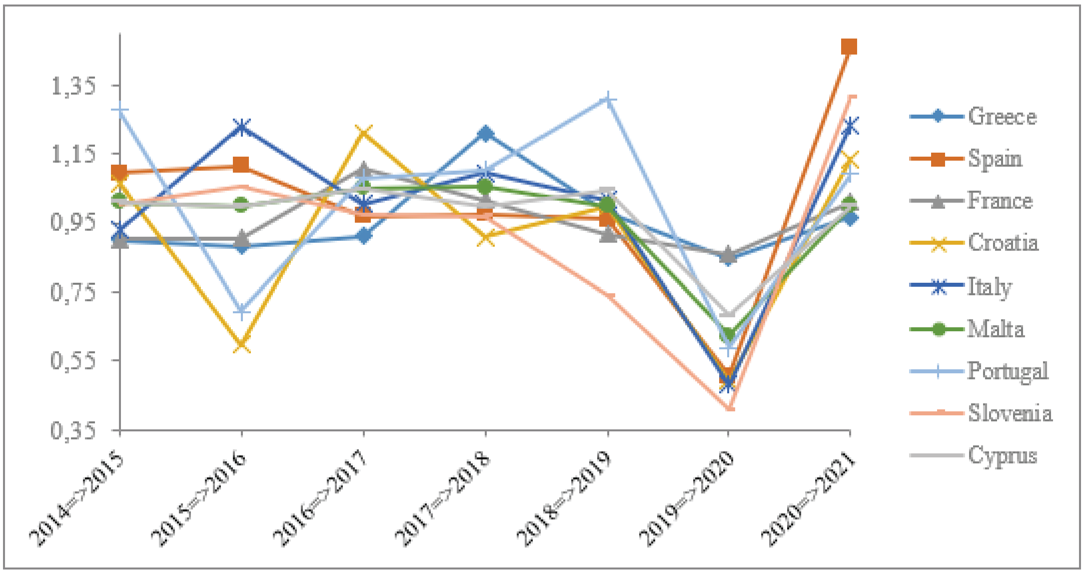


Source: Authors

Due to the Covid-19 pandemic in 2020, the indicator of PTE, which depends on management, technology, and other exogenous factors, drops dramatically. In 2021, the indicator gradually improves. In all observed years, the average SE is higher than the average PTE. The average values of these indicators move dynamically in the same way as in the analysis at the level of all EU member states.

The MPI evaluates the changes in DMU efficiency over time and is defined as the result of the efficiency change "catch-up" (TEC), which indicates how the efficiency of the individual DMU changes over time, and the technological change "frontier shift" (TC), which indicates the shift in the efficiency frontier around the DMU between two time periods. The graph below shows the MPI for each Mediterranean country.

Graph 5: **MPI for Mediterranean countries**



Source: Authors

It can be seen that all countries observed experienced a sharp decline from 2019 to 2020 due to the pandemic. Two countries, including Croatia and Portugal, experienced a decline in productivity from 2015 to 2016, mainly due to the decline in TEC, to which the decline in tourism consumption was the main contributor.

Results for MPI, TC, TEC, PTEC and SEC for Mediterranean countries during the period from 2014 to 2021 are presented on the following table.

Table 8: **TEC, TC and MPI for Mediterranean countries**

Period	Malmquist productivity indeks (MPI)	Technological change (TC)	Technical efficiency change (TEC)	Pure technical efficiency change (PTEC)	Scale efficiency change (SEC)
2014 → 2015	1.0226	1.0084	1.0436	1.0156	1.0275
2015 → 2016	0.9423	1.0086	0.9344	0.9363	0.9979
2016 → 2017	1.400	1.0323	0.9757	1.0079	0.9680
2017 → 2018	1.0374	1.0102	1.1125	1.0266	1.0836
2018 → 2019	0.9969	0.9951	0.9370	1.0038	0.9334
2019 → 2020	0.6099	0.6165	1.1903	0.9822	1.2119
2020 → 2021	1.1353	1.1470	1.1157	0.9938	1.1227
Geo. Average	0.9692	0.9740	1.0442	0.9952	1.0492
Max	1.0211	0.9966	1.1832	1.0423	1.1352
Min	0.9166	0.9562	0.9334	0.9397	0.9933
SD	0.0363	0.0134	0.0751	0.0341	2.2036

Source: Authors

The tourism sector of selected Mediterranean countries has a minimum average score of 0.9166, while the maximum average score is 1.0211. The geometric average is 0.97, which means that the MPI has fallen by 3.08% on average. The reason for this decline is both the change in technical efficiency (0.48%) and technological change (2.59%). Looking at productivity over the entire observation period, there is a sharp decline of 39.01% from 2019 to 2020, which is due to Covid 19. This decline is largely due to a technological decline (38.35%) and, to a lesser extent, a decline in technical efficiency (1.78%).

DISCUSSION AND CONCLUSION

In the Mediterranean region, tourism is one of the most important economic sectors, as shown by indicators such as the share of tourism in GDP, which is above the EU average in all Mediterranean countries. It is therefore important to identify the sources of inefficiency, as tourism makes a significant contribution to the economy, society and the environment. The WDEA was used to assess the efficiency of the tourism sector in nine Mediterranean countries: Spain, Greece, Cyprus, Slovenia, Croatia, Malta, France, Italy and Portugal. A tourism sector is considered technically efficient if it produces maximum output with the given resources such as land, labor and capital. The decomposition analysis has shown that the main cause of inefficiency before the Covid-19 pandemics was that countries were not able to operate at their optimal scale (SE). During the observation period, France, Cyprus and Slovenia proved to be the countries closest to the relative efficiency frontier in terms of scale efficiency. Conversely, Italy and Malta had the lowest levels of scale efficiency. Croatia initially had a high level of efficiency, but this declined continuously over the course of the observation period. The "sun, sand and sea" (3S) tourism sector in the Mediterranean suffers in particular from the fact that it operates at suboptimal scales despite its robust and growing demand (Cirer-Costa, 2023). In addition, seasonality is a major challenge for tourism in the Mediterranean, leading to inefficiencies in resource utilization, income volatility and fluctuations in employment levels (Suštar & Laškarin Ažić, 2020).

Efficiency and sustainability in tourism are closely linked concepts that are important for the development of the tourism industry, emphasizing the need for efficient use of resources and consideration of environmental aspects for long-term sustainable tourism development. Studies have shown the importance of addressing challenges such as CO2 emissions (Paramati et al. 2017), water consumption and biodiversity loss (Baloch et al. 2023), energy consumption in the service sector (Trinajstić et al. 2022) in order to achieve environmentally sustainable tourism. This is all the more true as the integration of agriculture and tourism has been shown to improve the eco-efficiency of agriculture, contribute to agricultural sustainability and emphasize the interconnectedness of different sectors in promoting overall sustainability (Wang et. al. 2024).

The EU recognizes the goal of achieving sustainable tourism in the long term. Efforts are being made to identify the most appropriate strategies for conserving natural and cultural assets, minimizing negative environmental impacts, mitigating the environmental impacts of transport, managing negative impacts on local communities, ensuring accessibility for tourism and similar efforts (European Commission, n.d.). In order to move from 3S tourism to sustainable tourism development, the country should consider the long-term impact of economic activities. This should be done through an integrated approach to tourism planning and management that incorporates different aspects such as tourist flows, environmental impacts, community engagement and sustainable regional development to address challenges such as overcrowding, negative visitor experiences and environmental degradation. This approach emphasizes the importance of coordination and cooperation between the different levels of tourism management, including the regional, sectoral and local levels. It also recognizes the importance of continuous data collection and analysis to improve decision-making processes (Shabankareh, et al., 2023). Frameworks for integrated tourism planning and management should consider areas such as the distribution of visitors, their attitudes and activities, biodiversity monitoring, environmental risks, community involvement and income generation. With an integrated approach, destinations can develop strategies that combine different forms of tourism, such as health, gastronomy and educational tourism, to promote a more diverse and sustainable tourism experience. Cultural heritage plays an important role in the diversification of destinations as it revolves around aspects such as local authenticity, distinctive regions, urban environments, historical layers and landmarks, indigenous traditions, myths and practices, and geographical and environmental assets (Đokić et al. 2008, p. 84). Successful examples of integrated tourism management can be found in national parks such as Croatia's Plitvice Lakes National Park (McCool et al, 2021), where comprehensive approaches have been used to regulate visitor use and improve the visitor experience.

This paper makes an important contribution to filling a gap in the existing literature by taking an innovative approach and focusing specifically on the efficiency of the tourism sector in the EU Mediterranean countries. It challenges the assumption that popular destinations are inherently more efficient and thereby provides new insights into the operational dynamics of the tourism sector in different regions. The study is characterized by the fact that two different samples are analyzed: EU Member States as a whole and a subset consisting of EU Mediterranean countries. This two-sample approach allows for a comparative analysis that highlights the differences in tourism efficiency between the Mediterranean countries and other EU countries. As the study focuses specifically on the Mediterranean countries that are heavily dependent on tourism, it addresses an important niche area that has not yet been comprehensively investigated in previous research. Furthermore, the use of Window Data Envelopment Analysis (WDEA) to measure the efficiency of the tourism sector represents a methodological strength. The WDEA enables a dynamic analysis over time, which is more informative than static methods. In addition, the use of the Malmquist Productivity Index (MPI) to assess productivity changes over time adds a temporal dimension to the analysis, which increases the robustness and depth of the results. There are no studies on the dynamic efficiency of tourism at country level that specifically consider Mediterranean countries as tourism-oriented units separately.

The main limitation of this study is that it does not take into account the environmental impact or establish a link between the efficiency of tourism and sustainable practices. It merely emphasizes the need for wise use of resources for sustainable tourism development. We recommend that future research should focus on testing the link between tourism efficiency and sustainability. This could be done through a second stage analysis using Tobit regression to examine the relationship between the various factors of sustainable development and the efficiency of the tourism industry. This could confirm the need to increase the efficiency of sustainable tourism development in the EU Mediterranean countries.

ACKNOWLEDGEMENTS

This scientific article was created and financially supported by the University of Rijeka as a part of the project "People-centred and integrated care: a solution for the sustainable health and well-being" (ZIP-UNIRI-2023-5) financially supported by the Faculty of Economics and Business, University of Rijeka.

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Please cite this article as:
Arbula Blecich, A., Dukić Samaržija, N. & Justinić, K. (2025). Measuring the Efficiency and Productivity of Mediterranean Tourism: A Window DEA Analysis. Tourism and Hospitality Management, 31(1), 1-15, https://doi.org/10.20867/thm.31.1.1