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USING MALMQUIST TOTAL FACTOR PRODUCTIVITY METHOD FOR TOURISM SECTOR OF MIKTA COUNTRIES

Murat Taha BİLİŞİK* **Deniz Dilara DERELİ****

***Assoc.Prof.Dr., İstanbul Kültür University, Department of Business Administration, m.bilisik@iku.edu.tr
**Assoc.Prof.Dr., İstanbul Kültür University, Department of Economics, d.dereli@iku.edu.tr

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ABSTRACT

Total Factor Productivity is defined as the ratio of the total output obtained as a result of a certain production activity to the production factors used in obtaining this output. MIKTA is a diverse and cross-regional grouping of powers that brings together Mexico, Indonesia, the Republic of Korea, Turkey, and Australia. MIKTA countries are significant economic powers, and all are members of the Group of Twenty. By the way, over the decades, tourism has experienced continued growth and deepening diversification to become one of the fastest-growing economic sectors in the world. Modern tourism is closely linked to development and encompasses a growing number of new destinations. In this study, international tourism expenditures and international tourism arrivals are used as inputs, while the output is evaluated as international tourism receipts. The 2018-2019 period for MITKA countries is examined by Malmquist Total Factor Productivity Method, which shows the productivity of the tourism sector in these countries.

Keywords: Productivity, Growth, Malmquist Factor Productivity
JEL Clasifications: C81, C61, C67

1. INTRODUCTION

Tourism is currently one of the leading sectors that are rapidly developing and constitutes an important part of the world economy. According to the World Tourism Organization, international travel and tourism provide 319 million direct and indirect jobs and contribute US$8.8 trillion to the global economy, surpassing the growth of the world economy. If domestic tourism is also taken into account, the size of the sector will be revealed more clearly. Therefore, efficiency in tourism has always been the focus of attention. However, investigating the dynamic changes of productivity increases and decreases with non-parametric numerical methods has been limited (UNWTO, 2019, Gül and Arslan, 2021: 1083).

In 2023, international tourist arrivals reached 80% of the pre-pandemic period, with a significant increase, especially in the Middle East and Europe, compared to the 66% improvement in 2022. In the first quarter of 2023, the sector grew by 86 percent compared to the same period of the previous year (UNWTO, 2023). While benefits such as increasing employment in the country and obtaining an international income source point to the increasing importance of tourism, it is inevitable that the competition in the sector will intensify around the world. For this reason, it will be possible for countries to reach their targets faster with the programs to be created to increase efficiency in the sector (Barišic and Cvetkoska, 2020:168).

Today, the tourism business is one of the fastest-growing sectors in the world and represents about 10% of the world's economic activity. In many countries, tourism accounts for a significant portion of GDP and employs a significant portion of the workforce. In addition, international revenues from tourism also contribute significantly to the financing of the current account deficit. At the regional level, tourism can help solve the problem of unemployment and replace activities that have lost their competitive advantage, like the agricultural sector. Moreover, the tourism sector has direct and indirect spillover effects on many economic activities such as transportation, trade, construction, accommodation, food and beverage industries and other services. Therefore, investment in touristic areas, especially in tourism buildings, has great potential (Radovanov et al., 2020: 1, Proença and Soukazis, 2008: 791-792, Zhou et al., 2017: 1973, Altındağ and Akay, 2021: 399). For these reasons, it is important to determine the efficiency of the sector and to increase it with the policies to be created, and it is of great importance for the national economies.

In the study, firstly literature review is shared, methodology information is given, the productivity of the tourism sector in MITKA countries is examined with Malmquist Total Factor Productivity Analysis, and suggestions are made on the determined productivity levels.

2.LITERATURE REVIEW

Different studies have been carried out examining the tourism sector in different countries or country groups for different periods. Malmquist Total Factor Productivity Method and Data Envelopment Analysis are commonly used methods for this measurement. Selected studies conducted by various methods at national and international level and their results are given in Table 1.

Table 1: Selected Empirical Studies

Authors	Method	Results
Gül and Arslan (2021)	Malmquist Total Factor Productivity	Investigated the tourism efficiency for black sea region between 2011-2018 and found that the tourism efficiency of provinces in the region has increased %9.6 sourced with technological development.
Bariši´c and Cvetkoska (2020)	Data Envelopment Analysis	13 of 28 EU member states are found efficient in 2017 while remaining 15 EU member states are relatively inefficient
Bayrak (2018)	Malmquist Total Factor Productivity	Fluctuations in efficiency values are determined for OECD countries between 2011-2015. While Czech Republic experienced efficiency loss, UK experienced increase in efficiency. USA, Japan, Turkey and New Zealand experienced no loss either.
Yakut, Harbalıoğlu, Pekkan (2015)	Data Envelopment Analysis and Malmquist Total Factor Productivity	9 tourism companies in Turkey are evaluated for 2009-2013 period, efficient and non-efficient ones are determined according to the selected criteria. In the given period only 3 companies achieved high efficiency score.
Uyar and Alış (2014)	Data Envelopment Analysis	37 accommodation businesses are evaluated for 2013 and 5 business are found efficient in Alanya.

Toma (2014)	Data Envelopment Analysis	The findings of study indicates in 2012 northwest and northeast regions of Romania are more effective regions in terms of tourism than the southeast and regional center.
Zengin et.al. (2013)	Data Envelopment Analysis	7 of 9 tourism business is found efficient in Turkey between 2009-2010
Oliveira et.al. (2013)	Data Envelopment Analysis	As a result of the study, it has been determined that 5-star hotels are more effective than 4-star hotels in Portuguese
Keskin Benli (2012)	Data Envelopment Analysis and Malmquist Total Factor Productivity	According to study results for 2007-2010 period accommodation businesses in Mediterranean and Aegean Region are more preferable and developed than accommodation businesses in West and East of Marmara Region. In addition, none of the cities and accommodation businesses are more efficient than others in the examined period.
Babacan and Özcan (2009)	Data Envelopment Analysis	10 hotel is found efficient while remaining 9 hotels are inefficient in Alanya.
Cracolici et.al. (2006)	Data Envelopment Analysis	Significant financial performance increase is found only at 10 regions in Italy between 1998-2001
Hwang and Chang (2003)	Data Envelopment Analysis	For 1994-1998 period Hotel chains in Taiwan is more efficient than independent hotels
Tarım et.al.(2000)	Data Envelopment Analysis	Findings of study indicates that 4 star hotel are more efficient than five star hotels in Alanya

3. DATA ENVELOPMENT ANALYSIS and MALMQUIST PRODUCTIVITY INDEX

Productivity, in general, is the relation between the output produced by a service or production system and the input used to obtain this output (Prokopenko, 1998: 3). Total factor productivity (TFP) is calculated by dividing the total output obtained from a certain production activity to the production factors used to get this output (Kuruüzüm and Kaya, 2011: 344).

Before proceeding further, the authors feel that the concepts of technical, pure technical, and scale efficiencies need some elaboration. Technical efficiency (TE) relates to the productivity of inputs (Sathye, 2001). The technical efficiency of a nation is a comparative measure of how well it actually processes inputs to achieve its outputs as compared to its maximum potential for doing so, as represented by its production possibility frontier (Barros and Mascarenhas, 2005). A measure of technical efficiency under the assumption of constant returns-to-scale (CRS) is known as a measure overall technical efficiency (OTE). The OTE found by the CCR measure helps to determine inefficiency due to the input/output configuration as well as the size of operations. In DEA, the OTE measure has been decomposed into two mutually exclusive and non-additive components: pure technical efficiency (PTE), found by the BCC measure, and scale efficiency (SE). This decomposition allows insight into the source of inefficiencies. The

PTE measure is obtained by estimating the efficient frontier under the assumption of variable returns-to-scale. It is a measure of technical efficiency without scale efficiency and purely reflects the managerial performance in organizing the inputs in the production process. Thus, the PTE measure has been used as an index to capture managerial performance. The ratio of OTE to PTE provides the SE measure. The measure of SE provides the ability of the management to choose the optimum size of resources, i.e., to decide on the nation's size, or, in other words, to choose the scale of production that will attain the expected production level. Inappropriate size of a production (too large or too small) may sometimes be a cause of technical inefficiency.

Change in total factor productivity (CTFP) is sepertaed into two categories: change in technical efficiency and change in technology. High technical efficiency and technological progress boost total factor productivity. The most frequently used method to measure total factor productivity is the Malmquist productivity index.

DEA (data envelopment analysis) is used to calculate the Malmquist productivity index. This method was developed by Charnes, Cooper and Rhodes in 1978. The method compares the units of production that are assumed to be homogeneous among themselves. After accepting the best observation as the efficiency limit, the other observations are evaluated according to this most effective observation.

DEA can be used for any given time. However, the Malmquist Efficiency Index is used for a time series. This index is a powerful method used to measure the performance of public sector and non-profit organizations.

The Malmquist productivity index is obtained by adding distance functions to the Farrel technical efficiency criterion. The index measures the change in TFP of two observations as the ratio of the distances to a common technology. The distance function is used for this measurement. This index was first discovered by Malmquist in 1953 and developed by Caves, Christensen, Dievert, Fare, and Groskopf. Index is superior to traditional total factor productivity indices because it uses data on quantities, requires fewer assumptions, measures inefficiency, does not require econometric estimation, and is easier to use.

The Malmquist total factor productivity index measures the change in total factor productivity of two observations as the ratio of the distances to a common technology. The "distance function" is used for this measurement. This index, developed by Caves et al., was named Malmquist after Sten Malmquist, who first suggested the idea of indexing with the help of distance functions. (Caves, Christensen, Diewert, 1982a:73-86; Caves, Christensen, Diewert, 1982b:1394-1414; Malmquist, 1953:209-242). The distance function is used to describe multi-input multi-output production technologies without specifying goals such as cost minimization or profit maximization. Distance function to the output

$$d(x, y) = \min\{\delta : (y/\delta) \in S\} \tag{1}$$

The values of the distance function d(x,y) will be 1.0 if the vector y is on the limit S (production limit); >1.0 if vector y describes a technically inactive point in S; and <1.0 if the vector y describes an impossible point other than S.

According to the output between the base period s and the following period t, following Mouse et al., the Malmquist TFVD index, within the framework of the "distance function", is,

$$m(Y_s, X_s, Y_t, X_t) = \sqrt{\left[\frac{d^s(Y_t, X_t)}{d^s(Y_s, X_s)} \times \frac{d^t(Y_t, X_t)}{d^t(Y_s, X_s)}\right]} \tag{2}$$

Here in (2), $d^s(X_t, Y_t)$ expresses the distance of the t-period observation from the s-period technology.

If the value of the m(.) function is greater than 1.0, it indicates that there is an increase in TFP from the s period to the t period, and if it is less than 1.0, when the same periods are taken into account, there is a decrease in the TFP. The above equation can be written as :

$$m(Y_s, X_s, Y_t, X_t) = \frac{d^t(Y_t, X_t)}{d^s(Y_s, X_s)} \sqrt{\left[\frac{d^s(Y_t, X_t)}{d^t(Y_t, X_t)} \times \frac{d^s(Y_s, X_s)}{d^t(Y_s, X_s)}\right]} \quad (3)$$

The first term on the right-hand side of the equation is the measure of Farrell's change in total technical efficiency between period s and period t. The expression in parentheses represents the technical change. Hence, the change in technical efficiency is

$$\frac{D_o^t(x^t, y^t)}{D_o^s(x^s, y^s)} \quad (4)$$

Then, the change in technological efficiency is

$$\left[\left(\frac{D_o^s(x^t, y^t)}{D_o^t(x^t, y^t)}\right)\left(\frac{D_o^s(x^s, y^s)}{D_o^t(x^s, y^s)}\right)\right] \quad (5)$$

Technological change (TED) measures the change in technology between two periods. The TED index gives the degree of progress resulting from innovations between the two periods. At the same time, the production frontier curve shows technological change (innovation). The value of this index is greater than 1 in case of increase in efficiency between two periods, and less than 1 in case of decrease in efficiency. In order to be able to calculate for two consecutive periods in an empirical study, all four distance functions must be found. This calculation can be done with mathematical programming. A comprehensive review of the Malmquist TFV index was done by Fare et al.

Mathematical programming models developed by Fare et al., which is the most used approach today in the calculation of distance functions used for the TFP index, are given below with matrix notation: (Fare, Grosskopf, Norris, Zhang, 1994: 66-83).

$$\begin{aligned} &[d^t(y_t, x_t)]^{-1} = \max_{\phi,\lambda} \phi \\ &st \\ &-\phi y_{it} + Y_t\lambda \geq 0 \\ &x_{it} - X_t\lambda \geq 0 \\ &\lambda \geq 0 \end{aligned} \qquad \begin{aligned} &[d^s(y_s, x_s)]^{-1} = \max_{\phi,\lambda} \phi \\ &st \\ &-\phi y_{is} + Y_s\lambda \geq 0 \\ &x_{is} - X_s\lambda \geq 0 \\ &\lambda \geq 0 \end{aligned} \quad (6)$$

$$\begin{aligned} &[d^t(y_s, x_s)]^{-1} = \max_{\phi,\lambda} \phi \\ &st \\ &-\phi y_{is} + Y_t\lambda \geq 0 \\ &x_{is} - X_t\lambda \geq 0 \\ &\lambda \geq 0 \end{aligned} \qquad \begin{aligned} &[d^s(y_t, x_t)]^{-1} = \max_{\phi,\lambda} \phi \\ &st \\ &-\phi y_{it} + Y_s\lambda \geq 0 \\ &x_{it} - X_s\lambda \geq 0 \\ &\lambda \geq 0 \end{aligned} \quad (7)$$

Calculating the distance values defined above for all periods and observations requires the solution of n(3t-2) linear programming models.

3. Application

In the application, data for MIKTA countries throughout 2018 and 2019 from the World Bank has been used. Relevant data is given below in Table 2. Here, "international tourism expenditures" and "international tourism arrivals" are inputs. "International tourism receipts" is the output. By the way, international tourism arrivals are an uncontrolled input. This is shown below in figure 1.

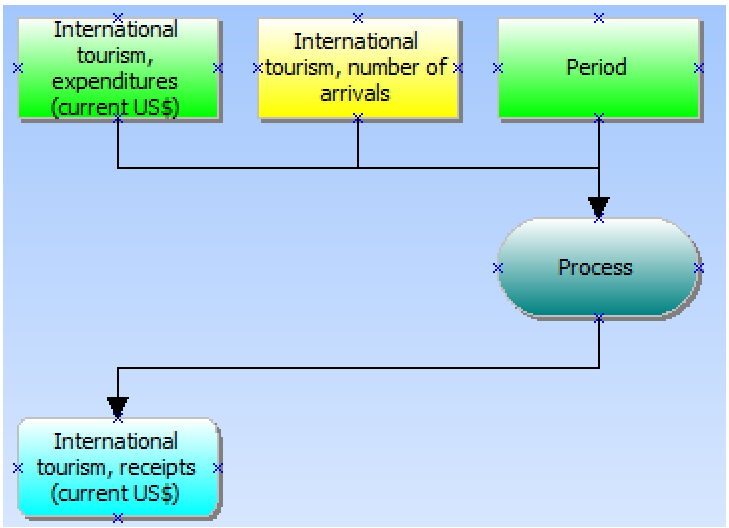


Figure 1. Input-Output Diagram

Table 2. Data Collected From World Bank

Country Code	International tourism, expenditures (current US$)	International tourism, number of arrivals	International tourism, receipts (current US$)	Year
TUR	6072000000	46113000	36751000000	2018
MEX	14074000000	96497000	23802000000	2018
IDN	13171000000	15810000	17915000000	2018
KOR	38022000000	15347000	23104000000	2018
AUS	8815000	9246000	9466000	2018
TUR	4900000000	51747000	42350000000	2019
MEX	12300000000	97406000	25847000000	2019
IDN	14462000000	16107000	18404000000	2019
KOR	34844000000	17503000	26217000000	2019
AUS	43975000000	47327000000	47953000000	2019

TUR: Turkey, MEX: Mexico, IDN: Indonesia, KOR: Korea, AUS: Australia

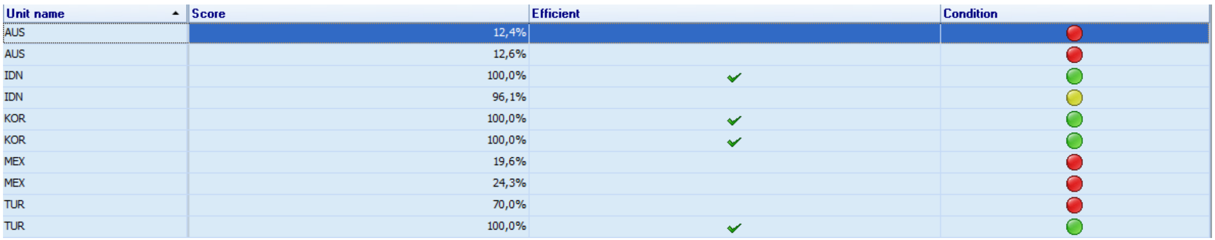
Next, data has been uploaded on Banxia Frontier Analyst Software, and analysis has been done based on the CCR technique, which is based on constant returns to scale, and the BCC technique, which is based on varying returns to scale.

In the next section, efficiency scores for both the CCR and BCC have been computed as follows on Table 3:

Table 3: Efficiency Scores for MIKTA

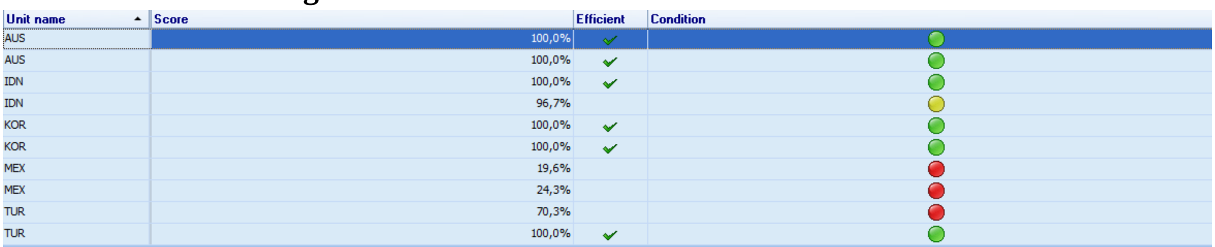
Country	Year	CCR	BCC	Scale Efficiency
Australia	2018	0,124	1	0,124
Australia	2019	0,126	1	0,126
Indonesia	2018	1	1	1
Indonesia	2019	0,961	0,967	0,994
Korea	2018	1	1	1
Korea	2019	1	1	1
Mexico	2018	0,196	0,196	1
Mexico	2019	0,243	0,243	1
Turkey	2018	0,7	0,703	0,996
Turkey	2019	1	1	1

The table above shows each country's performance based on three measures. Here, scale efficiency is found by dividing CCR by BCC.



Unit name	Score	Efficient	Condition
AUS	12,4%		
AUS	12,6%		
IDN	100,0%	✔	
IDN	96,1%		
KOR	100,0%	✔	
KOR	100,0%	✔	
MEX	19,6%		
MEX	24,3%		
TUR	70,0%		
TUR	100,0%	✔	

Figure 2. CCR scores and Conditon of Countries



Unit name	Score	Efficient	Condition
AUS	100,0%	✔	
AUS	100,0%	✔	
IDN	100,0%	✔	
IDN	96,7%		
KOR	100,0%	✔	
KOR	100,0%	✔	
MEX	19,6%		
MEX	24,3%		
TUR	70,3%		
TUR	100,0%	✔	

Figure 3. BCC scores and Condition of Countries

In the figures 2 and 3 above, good results, which are 1, are shown by green; satisfactory results, which are close to 1, are shown by yellow and poor results are shown by red.

In figure 2 above, Australia's first- and second-year results are very poor and shown by the red circle. By the way, Mexico's first- and second-year CCR scores are bad. In the same analysis, Turkey's first year is not good. However, Turkey improves its performance the following year and turns green. These CCR scores show both technical and scale efficiency at the same time. In figure 2 above, the BCC scores for Mexico are bad. Turkey's first year is not good, but the country improves its performance the following year and turns green. These BCC scores in Figure 2 depend on varying returns and measure technical efficiency. Looking at both numbers in the two figures, Korea is by far the best country, followed by Indonesia, Turkey, Mexico, and Australia. The reason of Australia showing bad CCR results is certainly because of scale efficiency. (0,124 and 0,126).

When we want to look at the Malmquist Indices on Table 4, we see that Korea, Australia, Mexico, and Turkey increase their productivity with respect to the previous year, as found by "catch up" multiplied by "frontier shift". On the other hand, Indonesia experiences a drop in Malmquist productivity change.

Table 4. Malmquist Indices for 2018-2019

Unit name	Malmquist index	Catchup	Frontier shift
AUS	1,0155	0,7111	1,428
IDN	0,9904	1	0,9904
KOR	1,0335	1	1,0335
MEX	1,1085	1,0403	1,0655
TUR	1,2219	1	1,2219

What about Mexico and Australia? If they want to be as productive as other MIKTA countries, what should they do? In Table 5 below, an improvement summary is given for these countries.

Table 5. Improvement Summary for Unproductive Countries

Unit name	Actual International tourism, expenditures (current US$)	Actual International tourism, number of arrivals	Actual International tourism, receipts (current US$)	Target International tourism, expenditures (current US$)	Target International tourism, number of arrivals	Target International tourism, receipts (current US$)	Percent International tourism, number of arrivals	Percent International tourism, receipts (current US$)
AUS 2018	8815000	9246000	9466000	8815000	66944,35	53353106,88	-99,3	463,6
AUS 2019	43975000000	47327000000	47953000000	43975000000	464402923,5	3,8007E+11	-99	692,6
MEX 2018	14074000000	96497000	23802000000	14074000000	96497000	77561352290	0	225,9

MEX 2019	12300000 000	97406000	25847000 000	12300000 000	97406000	80959375 169	0	213,2

According to these tables, Australia in 2019 should have to reduce tourism arrivals by 99 percent and increase receipts by 692 percent to become productive. For Mexico in 2019, all inputs being stable, the country should increase international tourism receipts by 213 percent. So far, all research indicates that there is a significant problem for two countries, namely Australia and Mexico. So, why is that?

5.CONCLUSION

According to the analysis results, Korea is technically efficient by ensuring efficiency in terms of both pure technical efficiency and scale efficiency. Turkey's efficiency improved in 2019 due to the effect of improvements in pure technical efficiency and scale efficiency together, which indicates improvement in management and organizational skills and better investment planning. In Australia and Mexico, inefficiency appeared in 2018 and 2019. While Mexico's performance is low in terms of pure technical efficiency and scale efficiency for each year, only low pure technological efficiency performance is effective on the technical efficiency of Australia in 2018 and 2019. Indonesia experienced a decline in 2019 driven by a decline in pure technical efficiency and scale efficiency. The Malmquist index score of Indonesia also shows a negative change in the total productivity of the tourism sector. For the remaining countries, total productivity increases have occurred.

In order to increase productivity in Mexico and Indonesia, new technologies should be adopted for production processes in the tourism sector, new investments should be realised to determine the needed scale of production, and administrative and organizational abilities should be improved. In Austria, also, new technology adaptation and identification of required investments to determine an appropriate scale of production should be realised.

Two countries that are by far showing the worst results are Mexico and Australia. According to findings, Mexico should increase international tourism receipts by %213 by increasing investments in the sector. For Australia, a %692 increase in tourism receipts and a %99 decrease in tourism arrivals will lead to an increase in the total productivity of the tourism sector. Re-evaluation of service pricing by increasing the quality of hotel services and structuring investments to create the opportunity to generate more income by providing more qualified services and facilities will be appropriate to increase productivity.

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