



Research Article

A hierarchical cluster analysis of Türkiye's tourism revenues and expenditures (1963–2022)

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Abstract

Purpose: This study investigates whether hierarchical cluster analysis can identify distinct structural regimes in Türkiye's tourism revenues and expenditures between 1963 and 2022

Design/methodology/approach: The analyses were performed using NCSS statistical software. The dataset consists of annual observations covering the period from 1963 to 2022, obtained from the Turkish Statistical Institute (TurkStat), the Ministry of Culture and Tourism (KTB), and the Central Bank of the Republic of Türkiye (CBRT). The optimal number of clusters was determined by jointly considering the dendrogram breakpoint, the Elbow method, and the Silhouette score

Results: The clustering results revealed different structural patterns for tourism revenues and expenditures. Tourism revenues were classified into three distinct clusters: the early period (1963–1996), the growth and crisis period (1997–2018 together with 2020–2021), and the pre-pandemic peak and rapid recovery period (2019 and 2022). Conversely, tourism expenditures were grouped into two main clusters: the modern era and post-pandemic recovery period (2003–2019 and 2022) and the early development and crisis period (1963–2002 together with 2020–2021)

Discussion: The findings indicate that tourism revenues and expenditures followed different long-term structural trajectories and were highly sensitive to major economic, political, and health-related shocks, which generated significant structural breaks. These findings provide a long-term analytical framework for understanding the evolution of Türkiye's tourism sector and offer evidence to support crisis-oriented tourism policies.

Keywords: Hierarchical Clustering Analysis, Tourism Revenues, Tourism Expenditures, Turkish Tourism

Introduction

Tourism has been a very important subject for many scholars and decision-makers because of its contribution to world economic growth in the 21st century. It has turned into a competitive, global sector due to its key role in the strategic part of national progress (Sari Hassoun, Adda and Sebbane, 2021). Globalization, new advances in transport and communication technologies, and rising travel habits have put tourism right at the heart of economic growth for both rich and poor countries (Sharma and Raman, 2014; Balıbey and Türkyılmaz, 2015). Travel and tourism are expected to grow faster than the global economy in the coming period. It is estimated that the tourism sector's contribution to GDP, exports and employment worldwide will gradually increase. Travel and tourism, which has performed stronger than other sectors in recent years, contributes a total of 10% to global GDP. This impact is expected to increase by an average of 4% annually over the next 10 years. Tourism's share of global GDP is projected to reach 11.4%. In addition, travel and tourism revenues, which currently account for 6.6% of global goods and services exports, are projected to rise to 7.1% of total world exports by the end of the period (T.C. Kalkınma Bakanlığı, 2018). In terms of jobs, the World Travel and Tourism Council (WTTC) says that the travel and tourism industry, which makes up about 10% of all jobs in the world, is expected to add about 9 million new jobs each year for the next ten years. This sector is also

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expected to employ around 414 million people by 2028. International tourism has gone up in recent years and is expected to keep growing in the future. The UNWTO says that international tourist arrivals are expected to grow by an average of 2.8% each year until they reach around 1.5 billion by 2023 and about 1.8 billion by 2030. (T.C. Kalkınma Bakanlığı, 2018).

Similarly, Türkiye has placed tourism at the center of its development policies due to its capacity to generate high added value and employment in the short term in exchange for low investment costs. The profits generated by the sector show a tendency to shift from developed countries to developing and less developed countries, supporting the convergence process between countries (İçöz, 2005; Proença and Soukiazı, 2008; Usta, 2009; Bahar and Bozkurt, 2010; Akıncı and Yüzbaşıoğlu, 2015; Akın, 2018).

Tourism has a real economic impact through the employment effect of labor-intensive production techniques as well as the potential to solve some structural problems like chronic unemployment and the current account deficit (Korzay, 1992). The Keynesian multiplier effect, export-led growth strategies, and policies supporting sectoral diversification all help keep tourism in a central position for development (Toskay, 1989; Çeken, 2016; Bahar and Kozak, 2018). Most developing countries face financial problems when they are economically developing because of foreign exchange shortages. For those developing countries that have structural weakness, export diversification and import restriction are seen as very important instruments to help close the current account deficit (Fayissa, Nsiah and Tadasse, 2008; Usta, 2009; Kreishan, 2010; Ansari, 2025).

Based on the review of literature, the "Tourism-Led Growth Hypothesis" (TLGH) is an offshoot of the export-led growth hypothesis which posits tourism as a significant factor in economic growth and tourism as providing economic growth. It was tested under the framework of an export-led growth hypothesis that allows for economic growth through increased exports. The Tourism-Led Growth Hypothesis (TLGH) has been discussed in relation to several studies that have provided an enabling environment for trade liberalization, export promotion, and transformation among various sectors of the economy (Balaguer and Cantavella-Jordá, 2002; Gündüz and Hatemi, 2005; Fayissa et. al., 2008; Hye and Khan, 2013; Ahad, 2016; Adeleye, Adam, Ahmad and Ola-David, 2022; Wu, Wu, Liu and Wu, 2023; Sekreter, Mert and Çetin, 2025).

Four different hypotheses based on research and varying results have developed the relationship between economic growth and tourism. The first hypothesis, the Tourism-Led Growth Hypothesis (TLGH), asserts that tourism enhances foreign exchange flows while simultaneously enhancing employment; therefore, it achieves economic growth (Lickorish and Jenkins, 2007; Balıbey and Türkyılmaz, 2015, Mahmood and Ahmed, 2017). The second hypothesis is called the Economic Driven Tourism Growth Hypothesis and expresses a unidirectional causal relationship from economic growth to tourism. It is also known as the Growth-Led Tourism Hypothesis. The third hypothesis involves reciprocal causality between tourism and economic growth. This is referred to as Bidirectional Causality Hypothesis (BCH). The fourth and final hypothesis is what is known as neutrality; that there exists no causation between tourism and economic growth (Mallick, Mallesh and Behera, 2016; Gwenhure and Odhiambo, 2017). Most of the literature has been concerned with short-run shocks and causality analysis while ignoring long-run structural transformations. However, it can be said that most of the existing studies are concentrated on short-run shocks and causality analyses; long-run structural transformations as well as cyclical regime transitions have been largely ignored. There is a need for models that truly capture the dynamic nature of the relationship between tourism revenues -which are considered one of Türkiye's most important revenue drivers- and economic growth. The historical development of Türkiye's tourism sector is also very significant in this regard. The process that began with public investments in the 1950s gained strategic significance in the 1980s with the outward-oriented growth model, and then in the 2000s, it contributed to the country's rise in the global tourism rankings through incentive mechanisms and infrastructure investments (Akova, 1997; İnancılı and Konak, 2011; Seghir, Mostefa, Abbes and Zakarya 2015; İşcan and Derebağ, 2024). Tourism in the 21st century has not only generated foreign exchange and employment but has also created a positive spillover effect in more than 50 sub-sectors and has been at the center of the economic ecosystem. The "safe tourism" practices developed during the COVID-19 process have also demonstrated the sector's capacity to adapt to crises and its resilience (Cinnioğlu, 2021; Sekreter et al., 2025). Therefore, considering the historical development process of tourism, long-term structural breaks must be modeled statistically.

This study aims to empirically classify structural regimes by applying hierarchical clustering analysis to Türkiye's tourism revenues and expenditures for the period 1963–2022. The long-run structural transformation in the tourism-growth nexus will be examined this study, which intends to improve methodological approaches used in literature as well as provide an analytical framework for policy-makers that could help them steer strategic decisions. The article is organized as follows: Section 2 reviews macroeconomic impacts of tourism

revenues and expenditures, their micro dynamics, and crisis-related periodization; Section 3 presents the research methodology; Section 4 discusses empirical findings while Section 5 gives concluding remarks along with policy implications.

Conceptual Framework

The Turkish economy has structural dynamics that are typical for economies in the process of development, and one area that very much shows this vulnerability is its dependence on foreign exchange inflows. The import-based production structure complicates the foreign trade balance and makes current account deficits a chronic problem. At this point, tourism plays an important role in financing the current account deficit as well as supporting economic growth by generating foreign exchange. Besides generating foreign exchange, it creates jobs and increases investment volume and strengthens production capacity by interacting with different sectors (Uslu, 2020; Balaguer and Cantavella-Jordá, 2002; Gündüz and Hatemi, 2005). Thus, there will be developed a conceptual framework based on the analysis of how tourism revenues and expenditures relate to Türkiye's micro and macro-economic structure.

The Macroeconomic Effects of Tourism Revenues and Expenditures

Tourism revenue, included in the international services section of the current account, is a significant revenue source for countries. Tourism revenue contributes to national income growth and the development of countries. Tourism, considered a significant source of income, is of great importance in terms of the foreign exchange revenues it provides and its contribution to financing countries' external and budget deficits (Katırcıoğlu, 2009; Kaygısız, 2015; Bozgeyik and Yoloğlu, 2015; Şahin, 2018). Furthermore, it creates employment opportunities and has significant impacts on reducing the burden of unemployment. The development of sectors that serve these purposes increases the international competitiveness of countries (Brida and Pulina, 2010; Bahar and Kozak, 2018; Kayakuş, Erdoğan and Terezioğlu, 2023).

Increasing tourism revenues in recent years have strengthened foreign exchange reserves and helped maintain macroeconomic balances. According to TÜİK's tourism statistics for the second quarter of 2025 (April, May, June), tourism revenue increased by 8.4 % compared to the same period of the previous year, reaching \$16,284,322,000. Of this, \$16,095,247,000 came from visitors, and \$189,075,000 from transfer passengers. Visitor expenditures comprised \$11,100,829,000 for personal expenses, and \$4,994,418,000 for package tours. Package tour expenditures accounted for 31 % of total tourism revenue, followed by food and beverage expenditures at 19.4 % and international transportation expenditures at 12.8 %. Compared to the previous year, international transportation expenditures increased by 13.8 %, food and beverage expenditures by 13.7 %, and tour services expenditures by 12.5 %. In the first half of 2025, tourism revenues reached US\$25.8 billion, a 7.6 % increase compared to the same period in 2024 (TUIK, 2025).

Tourism expenditures can be considered within the scope of foreign passive tourism. Foreign passive tourism is the travel of people living in one country to other countries for tourism purposes. From the perspective of the sending country, tourism expenditures create an import effect for that country. When a country sends tourists abroad, it results in an outflow of funds, and this outflow is recorded as tourism expenditure. Analysis of expenditures also reflects the sector's performance and the direction of economic policies (Marin, 1992; Li, Song and Witt, 2005; Witt and Witt, 1995; Hassan, 2000; Brida and Scuderi, 2012; Stoeckl and Chaiechi, 2013; Usmani, Akram and Praveen, 2021; Sarıdoğan, 2020; Ayaz and Tümer, 2024).

In 2010, revenues were \$24.9 billion and expenses were \$5.8 billion (TURSAB, 2010). In 2019, revenues were recorded as \$34.5 billion and expenses as \$4.4 billion. It was determined that revenues were approximately eight times greater than expenses (TUIK, 2019). With the COVID-19 pandemic, tourism revenues contracted by over 65% in 2020, falling to \$14.8 billion. While both revenues and expenses decreased, a positive balance was maintained, with revenues still approximately 11 times expenses (TUIK, 2021). In the following period, with increased per capita spending and the sector's recovery, revenues rose again and exceeded 2019 levels (OECD, 2022). Türkiye has long enjoyed a positive tourism balance, with revenues exceeding expenditures. Tourism expenditures, comprised of expenditures by citizens residing in Türkiye and visiting other countries, increased by 32.3 percent in the third quarter of 2025 compared to the same quarter of the previous year, reaching \$2,479,210,000. Of this, \$2,034,647,000 was for personal expenditures, while \$444,563,000 was for package tours. During the same period, the number of citizens visiting abroad increased by 3 percent annually, reaching 3,383,353, with an average per capita expenditure of \$733. In the second quarter of 2025, revenues remained approximately six times greater than expenditures, maintaining a positive balance (TUIK, 2025).

Micro Dynamics of Tourism Revenues: Consumer Behavior and Spending Trends

Most of the studies that look into tourism's big effects on growth, jobs, and the balance of payments also study how economic growth connects with money from tourism. To know these effects, one needs to look at tourist actions at a smaller level. The tourism product is a complicated mix of services that come together to offer tourists from different market segments all over the world. Therefore, it is highly advisable to conduct research in the area of tourism with due regard to multidisciplinary issues, such as socially oriented disciplines. The demographic characteristics and consumption habits, travel motivations, and expenditures per capita will determine how well this sector performs economically. The role of target audience analysis in destination management should be stressed more so that it can contribute better to the local economy. (Crouch, 1994; Wang and Davidson, 2010; Bel, Lacroix, Lyser, Rambonilaza and Turpin, 2014; Bingöl, Pehlivan and Han, 2020).

A variety of variables related to tourism expenditures have been considered as antecedents of tourism expenditures, including economic, social, cultural, environmental (e.g., climate), sociodemographic, psychological, and travel-related factors (Hong, Morrison and Cai, 1996; Abbruzzo, Brida and Scuderi, 2014; Gholipour and Tajaddini, 2014; Gholipour, Tajaddini and Al-mulali, 2014). Social environment, perception of security, and psychosocial factors shape behavior (Decrop, 2006). Micro-level analyses are critical for determining the competitive advantage of destinations, including marketing strategies, public policies, and competitive advantage (Woodside and Martin, 2008; Park, Nicolau and Fesenmaier, 2013).

The sustainability of tourism revenue and spending behavior is closely linked to micro-scale preferences and macro-level crises and seasonal fluctuations. For example, during the global financial crisis, travel distances shortened, the trend toward low-cost accommodations increased, and per capita spending decreased. In this context, micro-dynamics directly impact global economic fluctuations (Bronner and Hoog, 2012; Hociung and Francu, 2012; Pizam, 2009).

Crises in Tourism and the Impact of Seasonality

Like other industries, the tourism industry is influenced by crises. A review of crises in tourism reveals that tourism has been affected by numerous crises, including epidemics, natural disasters, terrorist acts, and fluctuations in foreign exchange rates (Okumuş 2001; Okumuş and Çiçek 2002). In this context, an examination of the literature reveals that the crises experienced in the tourism industry differ in terms of their diversity and impact. Oil crises, economic crises, natural disasters, and pandemics all result not only in immediate losses but also cause long-term structural changes within the sector (Ritchie and Jiang 2019; Hall Scott and Gössling 2020). Particularly in Türkiye, the 1973 Oil Crisis, the 1999 Marmara Earthquake, the 2008 Global Financial Crisis, the 2016 Coup Attempt and the 2020 COVID-19 pandemic created significant contractions in the tourism sector (Adıgüzel, 2020; Cinel, 2020; Koyuncu and Meçik, 2020; Wen, Liu and Yu, 2020; Boone, Haugh, Pain and Salins, 2020; Trimble, Kyte and McDermott, 2020). Such crises not only cause direct income loss; they also necessitate analytical studies to understand the nature of recovery processes and the sector's resilience capacity. The use of quantitative analysis methods is important at this point to evaluate the different dimensions of crises comparatively and to reveal common patterns. In this context, hierarchical clustering analysis enables the systematic classification of similarities and differences between crisis periods and statistically reveals indicators of vulnerability and resilience in the sector by grouping crises with similar characteristics into the same cluster (Balaguer and Cantavella-Jordá, 2002; Dritsakis, 2012; Chou, 2013; Saçık, Akar and Gülmez, 2019; Saridoğan, 2020; Ballı, Sigeze and Coşkun, 2020; Arslan and Çetiner, 2020).

In this context, Hierarchical Cluster Analysis (HCA) was chosen to analyze the long-term trend of tourism revenues and expenditures during the period 1963–2022. While other unsupervised learning methods (e.g., k-means, PCA) reduce data size or perform classification based on a fixed number of clusters, HCA reveals similarities between periods at a hierarchical level and allows for the examination of the historical sequence of structural breaks. In this respect, the study evaluates the evolutionary patterns in Türkiye's tourism revenue-expenditure dynamics from a different perspective than time series analyses. For example, the 1999 Marmara Earthquake and the 2020 COVID-19 pandemic can be evaluated in the same category. Thus, Türkiye's tourism potential is analyzed holistically in the context of the interaction between consumer spending at the micro level and economic growth at the macro level. In this context, the main research question of this study is to determine the structural differences in Türkiye's tourism revenues and expenditures over time and to reveal the relationship between these differences and economic regime transitions.

Method

Cluster analysis is a multivariate analysis method employed across various scientific disciplines, including sociology, astronomy, medicine, and psychology. It enables the extraction of useful summary information by consolidating units with analogous characteristics from comprehensive datasets (Yavan and Gazeloğlu, 2022).

The term '**cluster analysis**' was first used by Tryon in 1939. Subsequently, in 1963, the seminal work, "The Foundations of Numerical Classification" by Sokal and Sneath, made significant contributions to this field (Anderberg, 1973). The general purpose of cluster analysis is to classify ungrouped data according to their similarities and to assist the researcher in obtaining appropriate and useful summative information. In cluster analysis, the number of clusters is unknown and it cannot be used in the future since it only gives results regarding the current state of the data. Although there is a normality assumption in cluster analysis, as in multivariate analyses, the normality assumption remains in principle, and the normality of the distance values is deemed sufficient (Tatlıdil, 2002)

Clustering methods can be classified into two principal categories: The two main categories of clustering methods are hierarchical and non-hierarchical. In contrast to hierarchical clustering methods, which perform analyses based on both similarity and distance criteria, non-hierarchical clustering methods are not required to utilise these criteria and can instead operate with raw data. Non-hierarchical clustering analysis is typically employed when preliminary information is available regarding the number of clusters that the data set will be divided into. (Yavan and Gazeloğlu, 2022).

In this study, Euclidean Distance measure was used as the distance measure. In addition, the intergroup connection method was used as the clustering method.

Euclidean Distance, $d(x_i, x_j) = \sqrt{\left(\sum_{k=1}^p (x_{(ik)} - x_{(jk)})^2\right)}$ (Yavan and Gazeloğlu, 2022). While x_i and x_j in Equation 1 show the observation vectors, $d(x_i, x_j)$ shows the distance value. **Intergroup Connection Method;** It is the most commonly used clustering method among hierarchical clustering analyses. The method basically starts by merging the units that are closest to each other and then creates clusters by merging the next unit that is closest to the units it has combined. In this way, by continuing the operations one after the other, the clusters created at each stage are expanded. In the method i. and j. assuming units are merged, k of the merged cluster. The distance measure to the cluster is calculated by the formula given in equation 2.

$$d_{(k(ij))} = \text{Min}(d_{(ki)}, d_{(kj)}) \quad (2)$$

(i,j) : k. previously formed i of the cluster. and j. distance from clusters

d : k. j of the cluster. distance to the cluster,

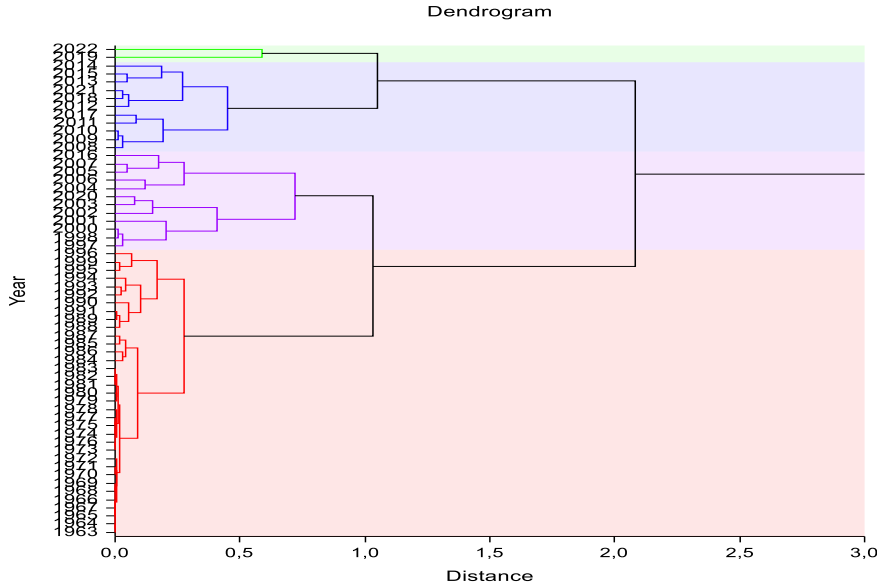
d : It refers to the distance of the kth cluster from the ith cluster.

The analyses conducted in the study were carried out using the NCSS statistical software package. The dataset covers the years 1963–2022 and draws on data from the Turkish Statistical Institute (TÜİK), the Ministry of Culture and Tourism (KTB), and the Central Bank of the Republic of Türkiye (TCMB). During the data pre-processing stage, log-transformation was applied in order to normalise the distribution of the variables, and missing observations were imputed using linear interpolation. The determination of the number of clusters was evaluated jointly using the dendrogram, the Elbow method, and the Silhouette score. Based on these criteria, the optimum number of clusters was determined to be three.

Results

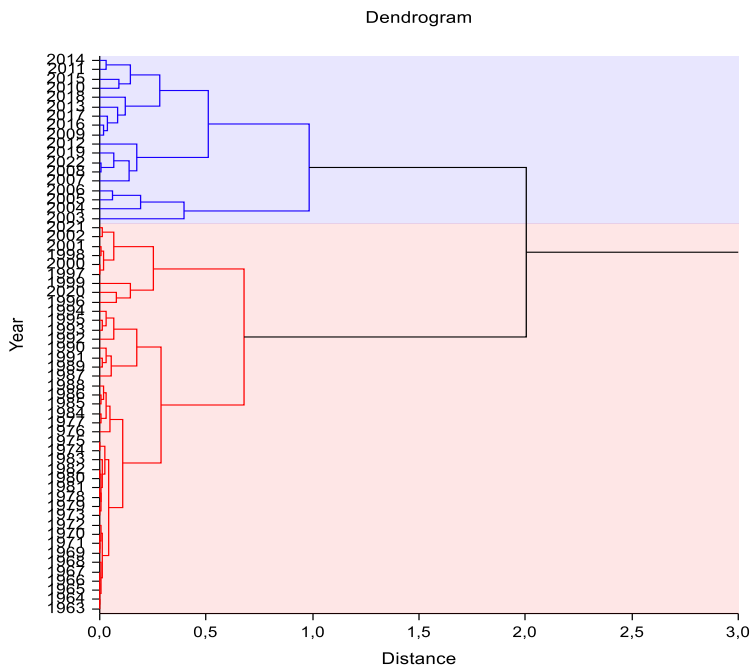
The dataset shows tourism receipts and expenditure in Türkiye between 1963 and 2020. All values in the dataset should be considered as multiples of USD 1,000. As the survey could not be conducted in the 2nd quarter of 2020 due to the COVID-19 pandemic, the values for 2020 are from the 1st, 3rd and 4th quarters. Detailed information on the dataset can be found in internet source 1 in the references

Figure 1. Dendrogram of Year-Based Tourism Revenues

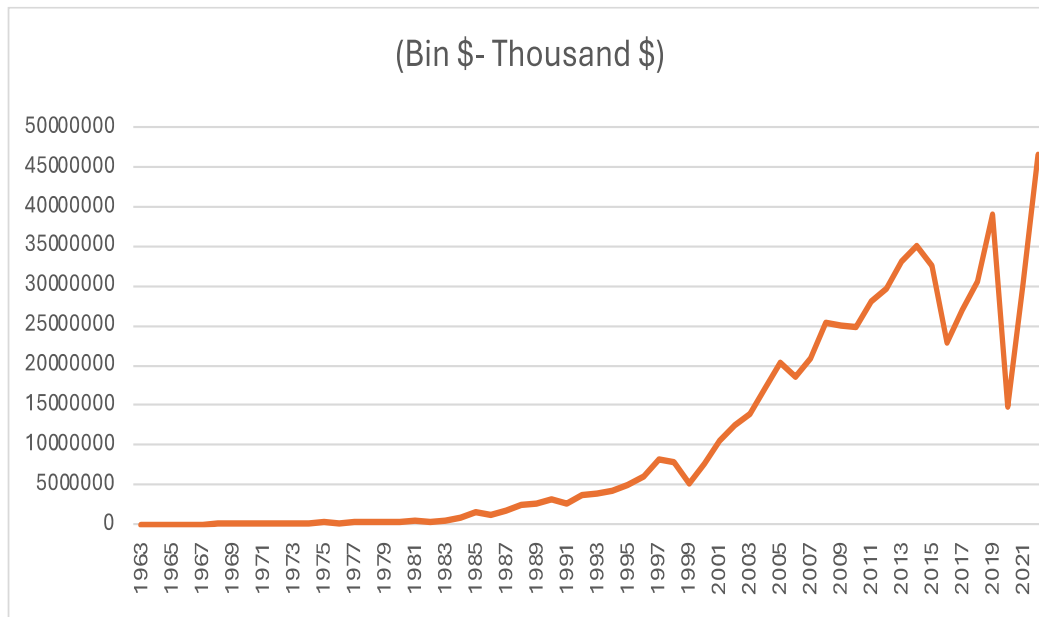
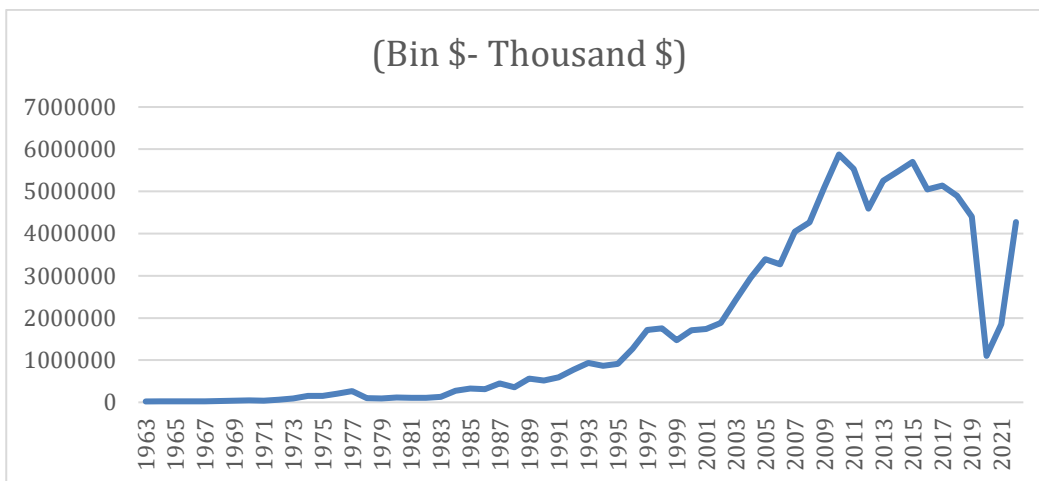
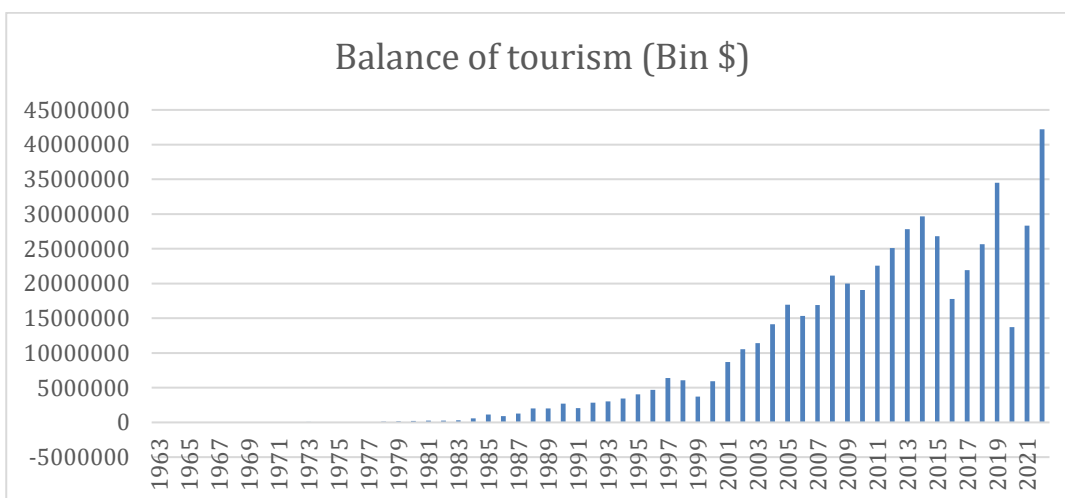


The results of the analysis are presented in the form of a figure, which illustrates the clustering of tourism revenues between the years 1963 and 2022. The dendrogram indicates that the data set comprises three clusters. The first cluster encompasses the years 2019 and 2022. The second cluster includes the years 1997-2018 and 2020-2021. The third and final cluster is comprised of the years 1963-1996.

Figure 2. Dendrogram of Year-Based Tourism Expenses



The dendrogram, created through the application of hierarchical clustering analysis to tourism expenditure data in Türkiye between 1963 and 2022, illustrates the formation of two distinct clusters. The initial cluster encompasses the years 2003 to 2019 and 2022, while the second cluster comprises the years 1963 to 2002, 2020, and 2021.

Figure 3. Türkiye Tourism Income for the Year 1963-2022**Figure 4. Türkiye Tourism Expenses for the Year 1963-2022****Figure 5. Türkiye Tourism Expenses and Expense Balance for the Year 1963-2022**

The clustering results indicated the presence of three distinct periods in Türkiye's tourism revenue and expenditure dynamics over the 1963–2022 period: an early development phase (1963–1982), a rapid growth and crisis phase (1983–2008), and a post-digitalisation / post-pandemic phase (2009–2022). The intra-cluster

similarity and distance analyses were corroborated by the within-cluster and between-cluster distance values obtained in NCSS. These values demonstrate a strong degree of separation between the clusters. Furthermore, the results of the analysis of variance (ANOVA) revealed that between-cluster differences were statistically significant ($p < 0.05$). The Pearson correlation coefficient between the revenue and expenditure series was found to be 0.82, indicating a strong positive association between the two variables. This finding substantiates the idea that tourism revenues and expenditures have historically tracked each other closely.

Conclusion

Türkiye's tourism sector has a fragile structure that is directly affected by economic, political, and social crises at both the national and global levels. In this situation, it is very important to review the long-term patterns of the sector comprehensively, its weaknesses during crises, and how it comes back to normal for both academic literature and policymakers. This study goes beyond the current literature which mostly deals with yearly seasonal changes or short-term impacts of crises by revealing structural and cyclical differences in Türkiye's tourism revenues and expenditures over an extended period of almost sixty years through hierarchical cluster analysis. It thus allows tracking the long-term impacts of these shocks on the sector through similar period clusters instead of focusing on particular economic or political shocks. Moreover, by showing structural similarities between crises such as earthquakes, coups, global financial fluctuations, and pandemics it provides a new analytical framework for developing strategies for managing crises. In this way, using the "periodization" approach it gives a fresh viewpoint to literature concerning tourism cycle analysis.

In this study, annual data on tourism revenues and expenditures in Türkiye for the period 1963-2022 were compiled from bulletins of TÜİK, KTB, and the Central Bank. Revenue data includes foreign visitors' accommodation, food and beverage, transportation, and other tourism expenditures; expenditure data covers domestic travelers' travel, overseas accommodation, and cultural expenditures.

In analysis via hierarchical clustering, tourism revenues fell into three clusters and tourism expenditures into two clusters. The revenue clusters represent the historical development of Turkish tourism in three periods: the early period (1963-1996), growth and crisis (1997-2018 and 2020-2021), and post-pandemic recovery years (2019 and 2022). The expenditure clusters have been categorized into two primary classes: modern period and post-pandemic recovery (2003-2019 and 2022) versus early period with crisis years (1963-2002 and 2020-2021).

The clusters represent socio-economic and historical periods with close similarities in the revenue and expenditure dynamics of Turkish tourism. The characteristic properties of clusters are discussed below under headings. The main reason for choosing 1963 as the starting year of the study is that this date symbolizes the beginning of the planned development period in Türkiye and marks a fundamental transformation in the tourism sector. Indeed, the period from 1923 to 1963, before the transition to a planned economy, was a phase of very limited development for tourism, characterized by inadequate infrastructure and negative external factors such as the 1929 Great Depression and World War II (Oktayer, Susam and Çak, 2007). There were some first institutional initiatives recorded like: The opening of an office within the Ministry of Economy for tourism in 1934; Public works activities during the 1950s; The acceptance of Tourism Promotion Law in 1953; And starting up with a separate Ministry for Tourism in 1957 but it is quite clear that a major breakthrough and systematic development took place after 1963 which actually started a new period (Sağlam, 1976; Olalı, 1990).

The dendrogram indicates that three meaningful clusters exist in the tourism revenue dataset: **Cluster One: 1963–1996 (Early Period)**. The years 1963–1996 represent a period when Turkish tourism was not yet institutionalized and revenue levels were quite low. It coincides with sharp fluctuations in tourism demand due to such events as the 1973 oil crisis and the 1990 Gulf War. Therefore, these years can be described as a period directly influenced by international politics and global economic fluctuations when tourism policies had not yet been institutionalized (Sönmez, 1998). Analyses indicated that the total share decline of OECD countries which are known for their high average spending within Türkiye's tourism revenues has resulted in huge losses for the sector. This has resulted not only in a decline of total tourism revenues but also an investment decline into accommodation facilities heavily preferred by tourists from these countries (Sönmez, 1998). The years from 1990 to 1993 may be regarded as the period when the sector sustained its highest historical losses. It was found that income losses persisted between 1994 and 2001, despite a relatively lesser degree of crisis effects (Bahar and Erdoğan, 2011; Erdoğan, 2018). In the year of an economic crisis declared for 1994, foreign tourist arrivals posted an increase of 2.61% over the previous year and tourism revenue recorded an increase of 8.97%.

During this national economic crisis period, one important factor to contribute to an increase in tourism revenue was the devaluation of Turkish lira by losing its value up to 146% within one year (Köse, 2000).

Cluster Two: Years Between 1997–2018 and 2020–2021 (Growth and Crisis Period): This cluster merges two periods that are entirely different in their dynamics:

1997–2018 (Growth Period): The early 2000s stand for a time of change for Turkish tourism, marked by macroeconomic stability, structural reforms, and proactive demand management policies. The fiscal discipline applied post-2001 crisis, deregulation within civil aviation as well as promotional campaigns from the Ministry of Culture and Tourism have enhanced Türkiye's competitiveness and market share (Çolak, 2001; Seneger, 2014; Gerede, 2015). Moreover, the spread of low-cost airlines together with an increase in charter flights made it easier to popularize tourism among different income groups (Taşlıgil, 1997; Gerede, 2015). Yet even though shocks such as the global financial crisis of 2008 and coup attempt in Türkiye on July 15th resulted only temporarily contraction for the sector. Resilience has improved due to government fiscal incentives promotional activities search for new markets (KTB-2017). Another characteristic feature of this period is increased diversification concerning Türkiye's tourism demand away from Europe into alternative markets like Russia Middle East Asia (Seckelmann, 2002; Okumuş, Altınay and Arasli, 2005). Tourism revenues amounted to 2.6% of GDP in 1998 and rose to 3.9% by 2018, indicating that a higher tourism revenue-to-GDP ratio corresponds with stronger integration of tourism with economic growth (TURSAB, 2020). Hierarchical clustering analysis grouped this period into one common cluster because long-term stable growth trends increased income plus similar mechanisms concerning resilience against crises though short-term crises were experienced reflecting capacity adaptation by the sector toward macroeconomic fluctuations plus structural transformation.

2020-2021 Period (Crisis of the Pandemic): The COVID-19 pandemic brought about a swift and severe disruption to tourism worldwide due to border closures and travel restrictions. Revenues from tourism mirrored this trend. The revenues from tourism, which were at \$34.5 billion in 2019, fell drastically to \$12 billion by 2020, making it a period that could be described as a “cluster of crises.” Once again, it proved the high sensitivity of tourism towards shocks. A significant reduction in foreign visitors has seen an equivalent drop in tourism revenue from US\$34.5 billion in 2019 down to US\$12 billion for the year 2020; this reflects a loss of approximately 65% revenue for that sector (TURSAB, 2020). In response to this crisis, the Turkish Ministry of Culture and Tourism has worked with the United Nations World Tourism Organization (UNWTO) to develop alternative tourism programs. The two organizations have come together for one goal: safety in communities and the recovery of the local tourism sector devastated by COVID-19. Türkiye's 2020 tourism statistics revealed that revenues did not even reach half of what they were in 2019 and all indicators were down by 75% (TURSAB, 2020; TÜİK, 2021).

Cluster Three: Years Between 2019 and 2022 (Pre-Pandemic Peak and Rapid Recovery): This cluster has been formed because the pre-pandemic normalization and post-pandemic strong recovery dynamics exhibit similar demand structures. 2019 (pre-pandemic normative peak) was a historic peak year for Türkiye, with approximately 52 million foreign visitors and \$34.5 billion in tourism revenue. That year is considered the “normative reference year” for global tourism prior to the pandemic (TÜİK, 2020; UNWTO, 2020). In 2022 (the year of recovery), a strong recovery was experienced thanks to increased vaccination rates, the easing of travel restrictions, and policies aimed at destination safety. The number of foreign tourists has exceeded 44 million, tourism revenues have reached \$37 billion, and approached pre-pandemic levels (OECD, 2022; TÜİK, 2023). Analyses show that the uninterrupted high-volume tourism season in 2019 and the strong post-pandemic recovery trend in 2022 exhibit similar demand structures and therefore belong to the same cluster.

The dendrogram shows that the tourism expenditure dataset consists of two main clusters: **Cluster One (2003–2019 and 2022):** The Modern Era and Post-Pandemic Recovery Economic reforms implemented in Türkiye since the early 2000s, macroeconomic stability policies, and rising income levels have supported Turkish citizens' travel abroad. Financial liberalization and the expansion of credit opportunities have also played a decisive role in the increase in foreign tourism expenditures (Yeldan, 1994; Taşar, 2010; Kol and Karaçor, 2012). The expansion of the middle class, the proliferation of low-cost airlines, and the diversification of package tours have accelerated travel abroad; this trend is directly reflected in Türkiye's total tourism expenditures (Eğilmez and Kumcu, 2001; Seckelmann, 2002; Şanlıoğlu and Özcan, 2017). In addition to increasing integration with the European Union, visa facilitation and developments in transportation infrastructure have made travel abroad possible for different socioeconomic groups (Bahar and Kozak, 2005; Bahar and Sarı, 2006; Akan, Arslan and Işık, 2008; Çeken, 2016). Turkish citizens' overseas travel spending

picked up again in 2022 after the decline due to COVID-19 pandemic as leisure and business travels were both nearing pre-pandemic levels (UNWTO, 2022; OECD, 2022).

Cluster Two (1963–2002 and 2020–2021): Early years and crisis years This cluster includes two separate sub-periods marked by low spending levels. The first period, 1963 to 2002, was when Türkiye's tourism sector was growing and developing, and during this time, overseas travel expenses were not very high. Even though the 1982 Tourism Promotion Law brought in foreign investments, sped up infrastructure projects, and promoted mass tourism, spending on foreign tourism was still low compared to today (Demirtaş, 2000; Çımat and Bahar, 2003; Yamak, Tanrıöver and Güneysu, 2012). Limited promotion efforts, weak international competitiveness, and geopolitical changes are the main factors for this (1990 Gulf War; 1999 Marmara Earthquake) (Güleryüz, 2022).

The second sub-period, 2020–2021, was not due to structural deficiencies but rather an external shock that impacted the entire globe. International tourism came to a standstill with the COVID-19 pandemic and in 2020 global tourist arrivals declined by 74 percent. This was the largest contraction of modern history for tourism (UNWTO, 2020). In comparison to 2019, the number of tourists in Türkiye has decreased by 69 percent along with a drastic reduction in foreign travel spending (KTB, 2021). Pre-pandemic levels have yet to be achieved even though some recovery took place during 2021. For similar reasons of "external shocks despite developed infrastructure" but under a different spending profile, this period was classified together with the former under "structural underdevelopment and low capacity."

Based on the dendrogram analysis of annual tourism revenues and expenditures, hierarchical clustering analysis results indicate that the dynamics of tourism in Türkiye form different subgroups over time. The results show that 2019 and 2022 have been separately clustered due to their clear differences from all other periods as a result of global pandemics and other external shocks, while the period between 2003 and 2018 has been placed in the same cluster because it reveals a consistent upward trend in both tourism revenues and expenditures with relatively rapid recovery capacity in case of external shocks. This proves that long-term resilience exists for the tourism sector of Türkiye but structural vulnerabilities are exposed during sudden crises.

The observed patterns are not unique to Türkiye. Comparable studies from other countries and regions yield analogous results. For example, Song and Lin (2010) demonstrated that external disturbances such as financial crises and the SARS outbreak produced seasonal divergences in the tourism market within Southeast Asian nations. Similarly, Lazarević and Stanišić (2023) highlighted pronounced divergences between revenue and expenditure trajectories during crises in European tourism markets, noting that these discrepancies correlated with varying degrees of economic resilience and tourism dependence across countries. Consequently, hierarchical clustering analyses yield consistent findings both at the national level and in international comparisons. Methodologically, this approach advances by grouping periods with akin revenue–expenditure patterns and by categorizing years characterized by crises, shocks, or extraordinary conditions into distinct clusters. The resulting evidence strongly supports the need for flexible and dynamic intervention packages tailored to specific periods in tourism policy design. In summary, sustainable tourism sector growth requires not only long-term development strategies but also effective crisis-management policies capable of addressing abrupt shocks.

Administrative and Policy Recommendations: The seasonal variations revealed by hierarchical cluster analysis clearly demonstrate that the Turkish tourism sector has changing revenue-expenditure dynamics in different phases. This finding indicates that sectoral policies should be designed within the framework of proactive, flexible, and target-oriented intervention packages that take into account periodic differences rather than uniform and static strategies. Flexible policy options to be implemented in response to external shocks such as sudden demand contractions, economic crises, or global health threats are critical for the sector's long-term sustainability (Blake and Sinclair, 2003; Ritchie, 2004). Similar findings are also present in the international literature: Financial stimulus packages, subsidies, and tax breaks implemented in OECD countries during crises plus periodic updating of such support mechanisms have played a role in accelerating recovery processes within tourism sectors (OECD 2020; UNWTO 2021). However as emphasized in literature it is most times impossible to prevent a crisis from happening; what is really important is being able to detect a crisis early enough so that one can apply good strategies for dealing with it and thus reduce its effects.

International experiences have clearly shown the impact of crisis management policies on the tourism sector. For instance, during the 1997 Asian Crisis and 2003 SARS when fiscal incentives and demand-stimulating promotional campaigns were quickly applied by Southeast Asian countries, they immediately offset a decline

in tourism demand that contributed to recovery in this sector (Henderson, 2003; Kulshrestha and Pandey, 2021). Likewise, employment protection policies subsidy support and liquidity facilities introduced to European Union countries during the 2008 global financial crisis helped keep tourism businesses running through the crisis thereby enhancing resilience within that sector (OECD, 2011; Hall, 2012). In this regard, fiscal incentives and credit support as well as intensive promotional campaigns plus market diversification strategies which would periodically be invoked in Türkiye will amount to effective policy instruments within those vulnerable periods as identified by hierarchical clustering analysis. It is thus possible to attain sustainable growth not just by containing losses during crisis periods but also through continued long-term competitiveness.

Changes in tourism spending are usually seen as reflections of shifts in macroeconomic indicators. Building early warning systems that can effectively and promptly identify the leading indicators of crisis periods is vital for public authorities and private sector actors to be able to react adequately. Indeed, the World Tourism Organization has placed particular emphasis on the need for data-based early warning systems to mitigate the impacts of possible crises. In this situation, the Tourism Confidence Index created by the UNWTO intends to predict trends concerning international tourism via expert panels and works as an orientation for short-term forecasts. The SAFE-D initiative also run by UNWTO at a European level is one application that underlines how functional early warning systems are in processes related to preparedness for crises, response, and recovery. Moreover, the Statistical Framework for Measuring Sustainability in Tourism gives an opportunity for early risk identification within this field through data-based indicators formed at the sub-national level.

Furthermore, in the literature, signal detection approaches that exceed the classical early and late indicators tradition and seek to anticipate potential crises are beginning to appear. The PPDC (Projection Pursuit Dynamic Cluster) model, developed through mathematical modeling, can classify early warning levels by taking into account various factors such as epidemic risks, unemployment rates, or political instability. Also within the scope of sustainability indicators defined by UNWTO crime rate elements; tourist satisfaction; occupancy rate; environmental condition – all these are also known as integral components for early warning mechanism (Zhong, Lou and Lai 2023).

The use of big data and artificial intelligence-based analytical approaches in the tourism sector enables the faster and more effective detection of sudden fluctuations in revenues and expenditures. Recent studies have shown that big data-based forecasting methods increase the accuracy of tourism demand forecasts (Li, Hu and Li, 2020) and improve the forecasting capacity of decision makers (Mariani, Baggio, Fuchs and Höpken, 2018). Strategies aimed at digitalization not only improve forecasting abilities but also help create a stronger framework in the tourism industry against emergencies. Smart tourism policies based on digitalization, especially those used in European Union member states, have greatly enhanced the process of investing and using resources and have shown good results in managing destinations, diversifying markets, and improving the tourist experience (Buhalis and Amaranggana, 2015; Gretzel, Sigala, Xiang and Koo, 2015; ITU and UNWTO, 2022).

Results from the Hierarchical clustering analysis reveal that to ensure sustainability in maintaining a balance between revenues and expenditures within the tourism sector, it is necessary to reduce seasonality risk, increase market diversification, promote alternative destinations that contribute to regional development, establish early warning mechanisms for crisis periods, and implement flexible policy sets sensitive to seasonal variations. Such strategies allow the sector to attain a stable structure and enhance its resilience against economic shocks by enabling tourism revenues to be distributed evenly throughout the year (Tavmergen and Oral, 1999; Butler, 2001; Croce, 2016; UNWTO, 2020).

The results of the analysis also reveal that crisis conditions sharply distinguished tourism revenues and expenditures, particularly in the 2020–2021 period. This makes it imperative to put in place comprehensive support mechanisms that will enhance the resilience of SMEs. Job protection, easier access to financing, and grant programs are critical measures in compensating for sudden income losses. As reiterated by UNWTO (2020) and IMF (2021), financial support and incentives used during the post-pandemic recovery process have been very important for increasing the resilience of the tourism sector. The study by Colmekcioglu, Dineva and Lu (2022) further reiterates that government support has a strategic importance in post-crisis recovery processes of tourism businesses.

Limitations of the Study: The present study sought to apply hierarchical clustering to analyze Türkiye's tourism revenues and expenditures from 1963–2022. However, findings must be interpreted under a set of limitations. First, conducting the analysis at the country level precludes micro-level dynamics that could

manifest in particular cities or regions; hence it is impossible to assess more fully contributions by sub-destinations toward variations in local performance. Longitudinal methodological changes, variations in classifications, and updates of statistics on tourism data also tend to compromise the integrity of this long time series data set to some degree regarding comparability between years. The methodology does not allow for thorough consideration of economic, political, and environmental variables that shape how crises impact the sector since it is based solely on revenue and expenditure series. Lastly, multidimensional impacts from digitalization, sustainability creativity, etc., which have recently gained importance in the tourism sector cannot be discussed within this current data set comprehensively. Henceforth, it would be advisable that such a topic should be discussed more extensively during future periods by applying multivariate statistical methods along with integrating various data sources.

Future research should examine the variations in tourism income and spending at a more detailed level, such as city, region, or business analyses. This will allow for better support in local policymaking. Besides this, by advancing from the hierarchical clustering method used in this research, regular interactions and potential cause-effect links can be studied more thoroughly using other multivariate statistical methods and artificial intelligence techniques based on supervised machine learning and dynamic panel data analysis. Using similar clustering methods on competing destinations especially within the Mediterranean basin or on different countries would provide another opportunity to compare the tourism dynamics of Türkiye with global trends and regional differences. Empirically measuring the impacts of state support mechanisms and incentive programs that have been particularly applied since 2020 to business performance and employment will show how effective the policy designs are. Finally, watching how sustainability initiatives as well as digitalization policies - which become increasingly important in tourism - affect revenues and expenditures over a long period through time series analysis will open up new significant research areas for understanding changes within this industry sector.

Ethical Statement: This study does not require ethical approval as it utilizes publicly available secondary data consisting of annual observations covering the period from 1963 to 2022 obtained from the Turkish Statistical Institute (TurkStat), the Ministry of Culture and Tourism (KTB), and the Central Bank of the Republic of Türkiye (CBRT). No experimental or survey-based procedures involving human or animal subjects were conducted. Should any such circumstance be identified, the Journal of Gastronomy, Hospitality and Travel (JOGHAT) shall bear no responsibility. Full responsibility shall lie solely with the author(s) of the manuscript.

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