İSTANBUL UNIVERSITY PRESS

Journal of Tourismology
JOT 2024; 10 (2), 108–120
DOI: 10.26650/jot.2024.10.2.1480684

RESEARCH ARTICLE

Turkey's Convergence Analysis of Selected OECD Countries in the Tourism Sector

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ABSTRACT
Tourism is a crucial source of foreign income for many developed and developing countries and is a sector required for development. Turkey is a competitive country in the tourism sector because of its strategic geopolitical location. Therefore, Turkey has become one of the top destinations for international tourist arrivals and tourism revenues. In this context, international arrivals and tourism revenues are critical to a country's economic activities and competitiveness. This study tests Turkey's convergence hypothesis with OECD countries by using tourism revenues and the number of international arrival data. The linearity tests of Harvey and Leybourne (2007) and Harvey et al. (2008), as well as Fourier-Kruse (2019), and a new unit root test developed as an extension of the test, are used. The results demonstrate that the convergence hypothesis is not valid. This result supports the statistics that Turkey has a more competitive advantage in the tourism sector than selected OECD countries and is a top international destination for tourism.

Keywords: Tourism, Linearity test, Unit root test, Convergence hypothesis, Fourier

Introduction

Tourism is a key factor contributing to the economic growth of developed and developing countries (Paramati et al., 2017; Danish and Wang, 2018). Revenue from tourism activities creates exports, employment, and sources of foreign exchange. Important tourism indicators for all countries include international arrivals, an increase in tourist arrivals, and tourism expenditure. In this context, tourism provides a significant source of income, supports sustainable development, and contributes to the progress of tourism in developing countries' tourism sectors (UNWTO, 2023). The other hand, tourism positively impacts economic growth in less developed countries (Antonakakis et al., 2019).

Worldwide, tourism is considered one of the main economic activities with high employment generation potential and as a source of income. In the pre-pandemic years, the tourism sector was an essential economic factor, contributing 10.4% of global GDP in 2019. However, in the years following the pandemic, although lower than in 2019, the tourism sector contributed 9.1% to global GDP in 2023, an increase of 23.2% compared to 2022. In addition, tourist expenditures from abroad increased by 82% from 2022 to 2021 (World Travel and Tourism Council (WTTC), 2023). In pre-pandemic years, tourism accounted for 4.4% of the GDP in selected OECD countries. However, due to the COVID-19 shock, the average direct contribution of tourism to GDP fell to 2.8% in 2020. This is equivalent to an average decline of 1.9 percentage points from pre-2019 (OECD, 2022).

Turkey, a member of the OECD is one of the most attractive tourist destinations in strategic locations worldwide. Therefore, the tourism sector significantly contributes to the developing Turkish economy. In recent years, tourism revenues totalled USD 41.3 billion in 2019, representing approximately 5.4% of GDP. However, this revenue decreased by 67% in 2020, falling to USD 13.6 billion, representing 1.9% of GDP. Tourism revenues increased by 110% in 2021, reaching 28.6 billion USD.

The number of tourists travelling to Turkey reached 51.2 million in 2019. Compared with 2019, this number decreased by 69% in 2020, and the number of visitors declined to 15.9 million. However, the increase in the number of tourists travelling continued to increase in the years after the pandemic. The number of visitors increased by 88% in 2021 compared with the previous year, reaching 30 million people, and continued to grow with 50 million international arrivals in 2022 (OECD, p.19, 2024; UN Tourism, 2024). According to the OECD (2022) data, these figures show the importance of tourism for the Turkish economy. Changes in

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Submitted: 08.05.2024 • **Revision Requested:** 17.07.2024 • **Last Revision Received:** 28.07.2024 • **Accepted:** 05.08.2024 • **Published Online:** 27.09.2024

tourist arrivals, tourism revenues, and per tourist were evaluated. Among 150 countries between 2000 and 2017, Japan, Thailand, and Turkey were the most competitive tourist arrivals. However, regarding tourist revenues, Turkey is the least competitive country.

This study tests the convergence hypothesis with OECD countries using tourism revenues and the number of foreign visitor. Harvey and Leybourne (2007) and Harvey et al. (2008) used linearity tests, Fourier-Kruse (2019), which consider breaks in time series, and a new unit root test, which was developed as an extended version of the test. Study is important for several reasons. Tourism revenues and the number of foreign visitors are the main drivers of income, and it is possible to measure their impact on countries' competitiveness. Our study is to provide an analysis of tourism revenues in addition to tourist arrivals. Moreover, Turkey's performance in the tourism sector compared with developed countries and its competitiveness and economic convergence process are evaluated. The unit root tests provide more accurate and reliable results by considering breaks. In this way, the study contributes to improving Turkey's strategies in the tourism sector.

The remainder of this study is organised as follows. Section 2 provides a literature review and an overview theoretically of tourism in Turkey and the convergence hypothesis. Section 3 presents the methodology and data, and Section 4 presents the test findings of the convergence hypothesis. Finally, Section 5 concludes the study.

Tourism in Turkey and Convergence Hypothesis

Literature Review

Many studies in the literature show that despite its economic benefits, tourism has a significant impact on energy consumption, environmental pollution, and many other factors. Dogru et al. (2019), Gössling et al. (2012), Hall et al. (2015), and Lenzen et al. (2018) emphasised that current economic practises, greenhouse gas emissions (CO2) from tourism, and human activities have negative impacts on climate change. Similarly, Katircioğlu (2014), Katircioglu et al. (2014), and Paramati et al. (2017) investigated how tourism indirectly affects the environment as an essential indicator of energy consumption leading to climate change. In particular, the impact of tourism on economic growth has been addressed by Isik et al. (2017), Armenski et al. (2018), Antonakakis et al. (2019), Calero and Turner (2020), Nunkoo et al. (2020), Roudi et al. (2019); Santamaria and Filis (2019), and Vergori and Arima (2020). Tourism is the key to both developed and developing countries' economic activities. Consequently, countries experiencing financial difficulties can also benefit from the tourism sector and experience rapid growth in different sectors (Dogru & Bulut, 2018).

Many recent studies in the literature have analysed the convergence of tourism. Abbot et al. (2012) analysed convergence in Turkey's tourism markets using Pesaran (2007) and Pesaran et al. (2009) tests. The results indicate that long-term convergence between markets is not present. Yilanci and Eris (2012) Becker have analysed the convergence of 14 tourism markets in Turkey. Enders and Lee (2006) concluded that convergence exists for 10 markets as a result of Fourier stationarity tests. Voljinovic, Brezovnik, and Oplotnik (2016) applied sigma (σ) and beta (β) convergence analysis. In this analysis, per capita tourist arrival and stays in five Central and Eastern European countries and five Western European countries are considered. Beta (β) convergence has not been found for both series. Radić et al., (2021) have analysed the convergence of EU member states in tourism and economic growth and found that tourism does not contribute to economic convergence to the expected extent. Haller et al., (2021) analysed the convergence of tourism revenues to economic growth in EU-28 member states between 2021 and 2018. It is concluded that the tourism sector has not experienced strong convergence contrary to expected convergence. Alper et al., (2024). They tested the challenges faced by Turkey's tourism sector and the validity of the convergence hypothesis. The results show that the convergence hypothesis is valid for most major tourism markets in the pre-pandemic period, but this validity decreases in the post-pandemic period. Hepsag (2016) conducted seasonal unit root analysis using monthly data on seasonally adjusted tourist arrivals. The results show that tourism markets converge over the long term in January, March, April, April, May, July, September, and October. However, convergence is not effective for visitor arrivals in February, June, August, and November.

Turkey and Tourism

People temporarily leave their residence places and travel to other countries or regions for various purposes, such as sightseeing, recreation, entertainment, or learning. This process is called tourism and significantly affects developed and developing economies (Turgut et al. 2021, p.144). Tourism is the entire set of interactions that occur when individuals move away from their permanent residence areas and show demand for products and services offered by tourism enterprises. These interactions are evaluated as tourism income for countries that attract tourists (Karakaş Türkseven, 2022, p. 343).

Worldwide, tourism is a rapidly developing sector. This sector encourages collective capital investments in line with goals such as making economic growth more sustainable and increasing employment in certain regions. In line with these objectives, countries have taken various steps, such as hosting international organisations and organising scientific, cultural, and sports events.

In addition, countries aim to make their countries more attractive by emphasising their natural, cultural, and historical heritage and thus promote their countries to a vast mass of people (Kızılkaya et al., 2016, p.203-204).

The tourism sector is one of the fields where variability and competition are intensely experienced due to its structure. Tourism, a definite part of the service sector, stands out with its human-oriented structure and is open to continuous development because of this feature. It could be an important source of income for countries in the future. As an important part of the service sector, tourism is of great economic importance to many countries regarding economic contribution (Dalgın et al., 2015, p.176). While the sector is considered a sector that positively affects economic income for developed countries, it is also considered a sector that provides new employment opportunities and is a primary source of economic revenue for developing countries. This indicates the difference in the various objectives developed and developing countries aim to achieve through tourism. Generally, all countries seek to create employment, increase economic welfare, keep inflation low, and consequently have a strong economy (Bagci and Karatosun, 2023, p.98).

Turkey is one of the world's most important habitats because of its geographical features. Acting as a bridge between Asia and Europe, Turkey has territories on two continents. It exists in a region in which the mainland is densely populated with economic activities and vibrant political relations. Turkey's geographical location makes it a country with many political, military, financial, and sociocultural preferences. These factors make Turkey an attractive destination for tourism (Doğan & Sertkaya Doğan, 2022, p.322-328).

Turkey's bright times in tourism started in the 1980s. Between 1983 and 1990, Turkey experienced rapid growth and development in tourism worldwide. The main reason for this success is seen, in particular, in the incentives offered by the Tourism Bank. Since 1983, Turkey has shown a significant increase in tourism infrastructure, the number of tourists, and tourism revenues and has maintained an upward trend, within the framework of 9. Development Plan: Turkey has developed the "Turkey Tourism Strategy" targeting the year 2023 to ensure long-term and sustainable development of the tourism industry (Ministry of Culture and Tourism, 2007). This strategy aims to protect and utilize Turkey's natural, cultural, historical, and geographical values and to increase tourism diversity to increase the country's share in tourism revenues (Kaygısız, 2023, p.127).

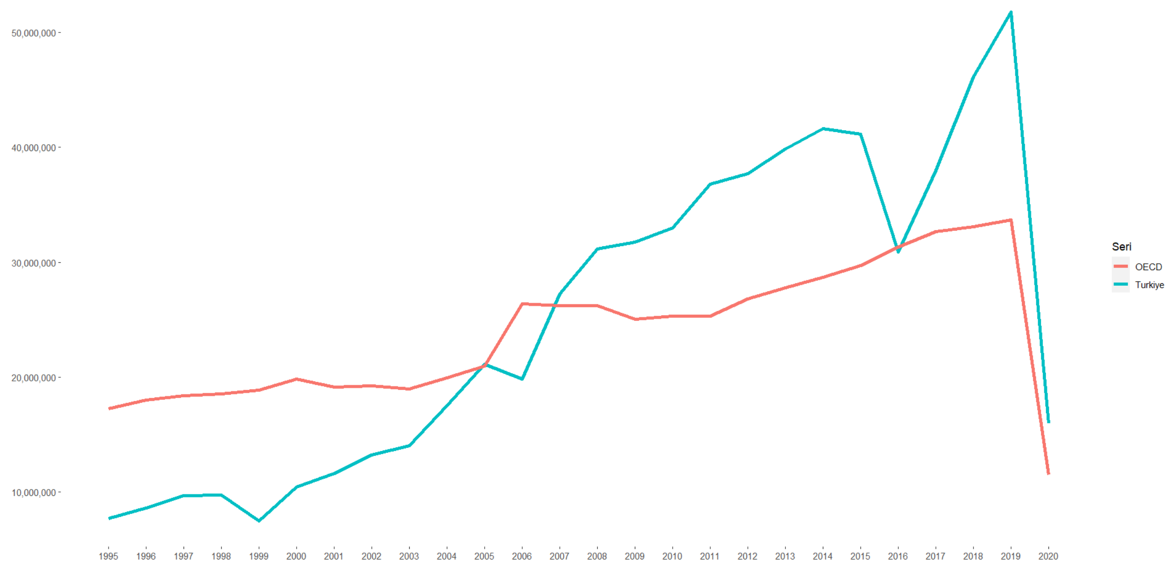

Figure 1. Number of International Arrivals to Turkey and OECD (1995-2020)

Note: The data used in this figure were obtained from the Central Bank of Turkey (https://evds2.tcmb.gov.tr/).

Figure 1 shows the total number of international arrivals to Turkey between 2008 and 2023, and Figure 2 shows Turkey's total travel revenues between 2003 and 2023. As shown in Figures 1 and 2, there was no decrease in the number of visitors and total travel revenues until 2016. However, in 2016, there was a decrease in both. The reason for this may be the conflict between Turkey and Russia following the downing of the Russian jet in November 2015 and the decline in the number of Russian tourists, especially in the summer months of 2016. In addition, the impact of the Syrian civil war, along with the increase in geopolitical risks in the region and the rise in security concerns following the attacks in Turkey, led to a decline in the number of foreign tourists. After 2016, the number of foreign visitors increased again. However, like all countries worldwide, Turkey experienced a significant decline in international arrivals and total travel revenues in 2020 because of the COVID-19 pandemic."

Figure 2. Total Tourism Revenue in Turkey and the OECD (Million USD /2005-2020)

Note: The data used in this figure were obtained from the Central Bank of Turkey (https://evds2.tcmb.gov.tr/).

Convergence Hypothesis

The neoclassical growth model developed by Solow (1956) assumes that compared with rich countries, poor countries tend to grow faster.

This model is based on the convergence hypothesis. It has been one of the most famous studies in the macroeconomics literature since the 1980s (Tıraşoğlu, 2013, p.91). While the convergence hypothesis claims that poor countries are experiencing faster growth than rich countries, it argues that the prosperity difference between the two groups of economies will decrease over time (Solow, 1956).

While evaluating the international growth dynamics of the Neoclassical Growth Model, recent assumptions added to the model by researchers and discussions have emerged various convergence concepts. These terms are listed as follows (Islam, 2003, p.312).

1. Convergence between countries and between regions
2. Growth rate convergence and per capita income convergence
3. β-(Beta) convergence - σ-(Sigma) convergence
4. Absolute convergence-Conditional convergence
5. Global convergence: Club convergence
6. Income convergence-Total factor productivity convergence
7. Deterministic convergence convergence

Deterministic Convergence-Stochastic Convergence

The origins of testing the convergence hypothesis were determined by horizontal cross-section regression analysis. However, due to the restrictions of this method, researchers have focused on time series-based studies (Konat et al., 2019, p.66).

Improvements in time series analysis techniques have played an essential role in forming deterministic and stochastic convergence terms, and these developments have increased their use in testing the convergence hypothesis. While deterministic convergence refers to the stationarity of the logarithm of the relative variable, stochastic convergence indicates the stationarity of the logarithm of the ratio of the variable to the group mean. The fact that the process is stationary (i.e., does not contain a unit root) means that the shocks to the series have a non-permanent effect. Therefore, there is convergence (Esenyel, 2017, p.43; Narayan, 2007, p.994). Unit root tests were used to examine the stationarity of the variables.

Methodology

Data

In this section of the study, the validity of the convergence hypothesis is tested using the variables of Turkey's tourism revenues (TR) and the number of international arrivals (IA). The data sources from which the variables for the analysis were obtained and the period considered are presented in Table 1.

Table 1. Variable names, data sources, and periods

Variables	Source	Period
Tourism Revenues (TR)	Worldbank Database	2005-2020
International Arrivals (IA)	Worldbank Database	1995-2020

Due to missing data for OECD countries (38), Germany, Austria, Belgium, Belgium, Denmark, Denmark, the United Kingdom, the Netherlands, Spain, Italy, Sweden, Iceland, Canada, New Zealand, Estonia, Lithuania, and Latvia are not included in the group average for tourism revenue. At the same time, concerning the number of international arrivals, Denmark, France, Ireland, Switzerland, Canada, Greece, the Czech Republic, Poland, Slovakia, Chile, Estonia, Israel, and Lithuania are not included in the group average. To test stochastic convergence, the following transformation was applied to the data.

$$TR_i = ln(\frac{TR_{Turkey}}{\overline{TR}_{OECD}})$$

$$IA_i = ln(\frac{IA_{Turkey}}{\overline{IA}_{OECD}})$$

Various unit root tests are applied to the series obtained from this transformation. Rejecting the unit root hypothesis implies the validity of the convergence hypothesis, whereas not rejecting the unit root hypothesis means that the convergence hypothesis is not accepted.

Table 2. Descriptive Statistics

Variables	Number of Observations	Mean	Median	Minimum Value	Maximum Value	Standard Deviation	Kurtosis	Skewness
Tourism Revenues	16	0.340709	0.371175	0.076053	0.523030	0.118760	2.808.570	-0.463006
International Arrivals	26	-0.08724	0.022042	-0.924836	0.429096	0.441597	1.770.156	-0.487894

Tests Based on Nonlinear Time-series Models

This study analyzes whether Turkey has converged to OECD countries. For this purpose, unit root tests are used to test stochastic convergence. The unit root tests determine whether the series are stationary or not and the hypothesis of convergence is valid for a stationary series. Determining the series structure is important for the reliability of the study results. Therefore, linearity tests should be performed to determine whether the series has a linear or nonlinear structure. In this section, the concepts of linearity, linearity tests, and unit root tests used in this study are explained.

Concept and Source of Nonlinearity

Linearity is a mathematical phenomenon, and econometric models are usually estimated and interpreted using this aspect. This is because of the convenience provided by linear models during the estimation and interpretation stages. However, in econometric research, nonlinear relationships between variables may also exist. Therefore, nonlinear models can also be used. In the presence of nonlinear relationships between variables, it is essential to determine an appropriate nonlinear model because correctly determining the model's functional form increases the reliability of the estimation results (Güris, 2020; Güris & Caglayan, 2010, p. 275).

Whether a series is linear is analysed from two different perspectives regarding parameters and variables. The linearity of parameters is related to the mathematical structure of the model parameters. The presence of any force on the parameters of a model or the expression of parameters as quotients implies that the parameters. Similarly, the mathematical structure of the model variables may also cause nonlinearity. If the variables are not included in the Equation as products, quotients, or exponents, it means that the Equation is linear concerning the variables (Tatoğlu, 2020, p.12). Linearity in parameters and variables can be achieved by performing some transformations. However, the results of the transformation to variables may differ from those of the transformation to parameters. Nonlinear models may appear nonlinear when their mathematical structure is examined, however, operations such as logarithms and variable transformations allow these models linear. In practise, these models are called linear models. Nonlinear models cannot be linearised no matter which transformation is performed. In this case, model parameters are estimated by iterative methods (Güriş, 2020, pp. 2-3).

A stochastic time series is defined as a linear time series if it can be written as follows (Tsay & Chen, 2019, p.3):

$$Y_t = \mu + \Sigma_{i=0}^{\infty} \psi_i \alpha_{t-i} \tag{1}$$

where μ is the constant term, ψ_i : ψ_0=1 is the real numbers, α_t is the random variables distributed i.i.d. The model is mathematically represented in the following form:

$$Y_t = f(a_t, a_{(t-1)}, \ldots.) \tag{2}$$

Any nonlinearity in f(.) results in a nonlinear model. Therefore, whether the model is linear depends on the functional form of f(.). Given that F_{t-1} is the sum of the linear combinations of ($\gamma_{t-1}, \gamma_{t-2}$,) and ($\alpha_{t-1}, \alpha_{t-2}, \ldots$), the conditional mean and variance of γ_t are denoted as follows:

$$\mu_t = E(\frac{Y_t}{F_{t-1}}) \equiv g(F_{t-1}) \tag{3}$$

$$\sigma_t^2 = Var\frac{Y_t}{F_{t-1}}) \equiv h(F_{t-1}) \tag{4}$$

Then g(.) and h(.) are fully defined functions and h(.)>0. The model is rewritten in the following form.

$$Y_t = g(F_{t-1}) + \sqrt{h(F_{t-1})\varepsilon_t)} \tag{5}$$

In this form, $\varepsilon_t = \alpha_t/\sigma_t$ denotes the standardised shock. In expressed form, the nonlinearity of g(.) implies nonlinearity in the mean, and the nonlinearity of h(.) implies nonlinearity in variance (Tsay, 2002, pp.126-127).

Harvey and Leybourne (2007) Linearity Test

Harvey and Leybourne (2007) developed a test that is different from other tests to test the null hypothesis against the alternative hypothesis. The null hypothesis indicates linearity, whereas the alternative hypothesis indicates nonlinearity. In this test, the linearity of the series is tested without assuming the order of stationarity, $I(0)$ or $I(1)$. In this study, the stationary and non-stationary data generation processes are expressed using the second-order Taylor expansion (Harvey & Leybourne, 2007).

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 y_{t-1}^2 + \beta_3 y_{t-1}^3 + \varepsilon_t \tag{6}$$

$$\Delta y_t = \beta_0 + \beta_4 \Delta y_{t-1} + \beta_5 (\Delta y_{t-1})^2 + \beta_6 (\Delta y_{t-1})^3 + \varepsilon_t \quad (7)$$

Equation (6) shows the I(0) process, and Equation (7) shows the I(1) process. The test's null hypothesis is linearity, and the alternative hypothesis is nonlinearity. The stationary and non-stationary processes under the null hypothesis are written as follows.

$H_0 : \beta_2 = \beta_3 = 0$ (stationary process)
$H_0 : \beta_5 = \beta_6 = 0$ (non-stationary process)

Equation (8) simultaneously allows for the existence of stationary and non-stationary processes.

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 y_{t-1}^2 + \beta_3 y_{t-1}^3 + \beta_4 \Delta y_{t-1} + \beta_5 (\Delta y_{t-1})^2 + \beta_6 (\Delta y_{t-1})^3 + \varepsilon_t \quad (8)$$

Using this equation, the following null and alternative hypotheses are proposed:

$H_0 : \beta_2 = \beta_3 = \beta_5 = \beta_6 = 0$

H_1: At least one parameter is different from zero

The test statistic provided by Harvey and Leybourne (2007) is given as follows:

$W_T^* = exp(-b|DF_T|^{-1})W_T,$

$$W_T = \frac{RSS_1 - RSS_0}{RSS_0/T)} \quad (9)$$

Where b≠0, DF_T is the standard t statistic of ADF obtained from the restricted regression. RSS_i, H_i is the sum of squares of the error term for the null hypothesis (i=0,1), and T is the number of observations. Equation (10) obtains the same critical values for stationary $I(0)$ and non-stationary $I(1)$ processes.

$$P(W_0 > c_a) = P(exp(-b|DF_T|^{-1})W_1 > c_a = a \quad (10)$$

$W_T^* \sim \chi^2(4)$

The test statistic distributes to the χ^2 where 4 is the number of restrictions in the null hypothesis.

Harvey et al. (2008) Linearity Test

Harvey et al. (2008) introduced a new nonlinearity test that requires no information about the degree of series integration. Under the assumption that the time series is an I(0) process, the model to be used is expressed as follows (Harvey et al., 2008):

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 y_{t-1}^2 + \beta_3 y_{t-1}^3 + \Sigma_{j=1}^{p} \beta_{4,j} \Delta y_{t-j} + \varepsilon_t \quad (11)$$

where Δ is the difference operator, and p is the number of lags. To calculate the maximum number of lags, p_{max}=$int(8(T/100)^{\frac{1}{4}})$. The hypotheses for the test are as follows:

$H_{0,I(0)} : \beta_2 = \beta_3 = 0$

$H_{1,I(0)} : \beta_2 \neq 0 and/or \beta_3 \neq 0$

where the null hypothesis is linearity and the alternative hypothesis is nonlinearity. Equation (12) defines the test statistic.

$$W_0 = T\frac{RSS_0^r}{RSS_0^u} - 1) \quad (12)$$

where RSS_0^r and RSS_0^u are the sums of the squares of the error term in the restricted and unrestricted models, respectively, and

T is the number of observations. The model and hypotheses under the assumption that the series involves the I(1) process are as follows:

$$\Delta y_t = \lambda_1 \Delta y_{t-1} + \lambda_2 (\Delta y_{t-1})^2 + \lambda_3 (\Delta y_{t-1})^3 + \Sigma_{j=1}^{p} \lambda_{4,j} \Delta y_{t-j} + \varepsilon_t \tag{13}$$

$H_{0,I(1)} : \lambda_2 = \lambda_3 = 0$

$H_{1,I(1)} : \lambda_2 \neq 0 ve/veya\, \lambda_3 \neq 0$

where the main hypothesis is linearity and the alternative hypothesis is non-linearity. The test statistic can be written as follows:

$$W_1 = T(\frac{RSS_1^r}{RSS_1^u} - 1) \tag{14}$$

RSS_1^r and RSS_1^u are the sums of squares obtained from the restricted and unrestricted model and T is the number of observations. Given that the stationarity properties of the time series are not known, the following test statistic can be calculated using these two test statistics:

$$W_\lambda = \{1 - \lambda\} W_0 + \lambda W_1 \tag{15}$$

where the W_λ test statistic is distributed by χ^2, and 2 is the number of restrictions.

Nonlinear Unit Root Tests

Nonlinear models can be analysed in two categories based on their nonlinearity to the mean or nonlinearity of variance. In this section, unit root tests based on time-series models that are nonlinear in mean are discussed.

Güris Fourier-Kruse (2019) Unit Root Test

Nonlinear unit root tests play an important role in the analysis of a series with evidence of nonlinearity. The unit root literature assumes the presence of one or two structural breaks in the level or trend of the analysed time series. However, the break dates and number of breaks were not known in the applied studies. Furthermore, it is assumed that structural breaks are instantaneous and cause sudden increases in the mean value and slope.

This assumption may need to be revised in many cases. Therefore, it is important to consider unit root tests that allow for breaks to ensure that the deterministic component of the model transitions smoothly (Enders & Lee, 2004, p.2). Fourier unit root tests that include Fourier functions in the estimation equation were developed in this context. These tests provide unit root analysis without requiring assumptions about the form and number of structural breaks.

The Fourier-Kruse (2019) unit root test, introduced in the literature by Guris (2019), simultaneously considers structural breaks and nonlinearity in the testing process. This test procedure does not predetermine the nature, number, and date of breaks. However, structural breaks are modelled using the Fourier function, and nonlinearity is expressed by an exponential smooth transition autoregressive (ESTAR) model. The test process consists of three phases:

First step: Identify nonlinear deterministic components.

In this stage, the following models are written:

$$y_t = \alpha_0 + \alpha_1 sin\left(\frac{2\pi k^* t}{T}\right) + \alpha_2 cos\left(\frac{2\pi k^* t}{T}\right) + v_t \tag{16}$$

Furthermore,

$$y_t = \alpha_0 + \alpha_1 sin\left(\frac{2\pi k^* t}{T}\right) + \alpha_2 cos\left(\frac{2\pi k^* t}{T}\right) + \beta_t + v_t \tag{17}$$

where (16) and (17) are models with constant term and trend. In the models, k^* is the optimum frequency, and k is assigned values ranging from 1 to 5. Then, equation is estimated using the least squares method, and the k that minimises the sum of the residual squares, is obtained. The residuals from the estimated Equation with optimal k are as follows:

$$v_t = y_t - \alpha_0 - \alpha_1 sin\left(\frac{2\pi k^* t}{T}\right) + \alpha_2 cos\left(\frac{2\pi k^* t}{T}\right) \quad (18)$$

Second step: Calculate test statistics.

The method is based on estimating the following Equation using the residuals obtained in the first stage:

$$\Delta v_t = \delta_1 v_{t-1}^3 + \delta_2 v_{t-1}^2 + \Sigma_{j=1}^{p} \phi_j \Delta v_{t-j} + \varepsilon_t \quad (19)$$

In Equation (19), the null hypothesis $H_0 : \delta_1 = \delta_2 = 0$ is tested against the alternative hypothesis $H_1 : \delta_1 < 0, \delta_2 \neq 0$. The test statistic was calculated following Kruse (2011):

$$\tau = t^2_{\delta_2^{\perp}=0} + 1(\delta_1 < 0) t_{\delta}{}^2_{1=0} \quad (20)$$

Third Step: Testing hypotheses

The critical values are compared with the calculated test statistic, and if the null hypothesis is rejected, the series is stationary with a deterministic function with breaks. Critical values are presented in Becker, Enders, and Lee (2006) (Guris, 2019, p.3).

New Nonlinear Unit Root Test (2023)

Guris (2019) introduced the Fourier-Kruse unit root test to the literature. A new nonlinear unit root test was developed as an extension of this test. This test is based on the inclusion of a new model in addition to the models considered by Guris (2019). The deterministic trend component was added to the model as a multiple of the sine and cosine terms in the new model. The model is called "Case 3" and is shown in the figure below (Yavuz, 2023, s.69):

$$y_t = \alpha_0 + \alpha_1 sin\left(\frac{2\pi k^* t}{T}\right)\alpha_2 cos\left(\frac{2\pi k^* t}{T}\right) + \alpha_3 trend * sin\left(\frac{2\pi k^* t}{T}\right) + \alpha_4 trend * cos\left(\frac{2\pi k^* t}{T}\right) + \varepsilon_t \quad (21)$$

The testing process was the same as that in Guris (2019). The process starts by estimating the optimum number of frequencies in the model, and k^*, giving the minimum residual sum of squares, is chosen as the optimum number of frequencies. The residuals are obtained from the model estimated with the optimal number of frequencies, and the Kruse (2011) unit root test is applied to the residuals. If the null hypothesis of a unit root is rejected, the next step is to test the statistical significance of the coefficients of the trigonometric terms using the *F* test.

Empirical Results

Linearity Test Results

Analysing a series with a nonlinear structure using linear methods can lead to biassed results. In addition, the nonlinearity of the data generation process may reduce the statistical power of the linear unit root tests. Therefore, we use the linearity tests developed by Harvey and Leybourne (2007) and Harvey et al. (2008). Table 3.3 provides the outputs of the tests.

Table 3. Results of Linearity Test

Variables	Harvey et al. (2008)	Harvey ve Leybourne (2007)		
		1%	5%	10%
Tourism Revenues	6.81^{**}	-8.23	-8.31	-8.44
International Arrivals	11.46^{***}	8.41	8.50	8.65^{*}

Note: Harvey and Leybourne's (2007) nonlinearity test critical values are 13.27, 9.48, and 7.77 for 1%, 5%, and 10%, respectively. Harvey et al. (2008) stated that the critical values of nonlinearity tests are 9.21, 5.99, and 4.60 for 1%, 5%, and 10%, respectively. ***, **, and * indicate that the null hypothesis of linearity is rejected for 1%, 5%, and 10%, respectively.

In Table 3, Harvey and Leybourne's (2007) linearity test results indicate that the null hypothesis for the tourism revenue series is not rejected at the 1%, 5%, and 10% significance levels. For the number of international arrivals, the null hypothesis is rejected at the 10% significance level. The results of the linearity test by Harvey et al. (2008) indicate that both series have a nonlinear structure.

Fourier-Kruse (2019) Unit Root Test and New Developed (2023) Unit Root Test Results

Table 3 indicates that tourism revenues and the number of international arrivals are nonlinear. Therefore, we used a new unit root test, developed as an extension of the Fourier-Kruse (2019) test, which simultaneously tests for nonlinearity and structural breaks in variables. The results are presented in Table 4.

Table 4. Results of Nonlinear Unit Root Test

	Fourier-Kruse (2019)		
International Arrivals	**Case 1**	**Case 2**	**New Model (2023)**
Optimum k	1	1	1
Test Statistic	5.372316	9.848049	29.18777
Critical Value (5%)	14.72	18.38	21.26
Decision	Unit root	Unit root	Stationary
	Fourier-Kruse (2019)		
Tourism Revenues	**Case 1**	**Case 2**	**New Model (2023)**
Optimum k	1	3	3
Test Statistic	7.86129	3.407222	3.028723
Critical Value (5%)	14.72	13.96	12.74
Decision	Unit root	Unit root	Unit root

The critical values of the test statistics were calculated for hypothesis tests that Guris (2019) and Yavuz (2023) obtained. The F test was applied to the International Arrivals series, which was foundto be stationaryy according to the new unit root test result, and the calculated statistic was compared with the critical values tabulated in Becker, Enders, and Lee (2006). Because of the comparison, the trigonometric terms are statistically significant at all levels of significance.

The findings in Table 4 show that the number of international arrivals is unit-rooted compared with the Fourier-Kruse unit root test developed by Guris (2019). Therefore, the convergence hypothesis is not valid. According to the new unit root test, the series was found to be stationary. This finding supports the validity of the convergence hypothesis. When the results for the income series are investigated, they show that the series is unit-rooted in both tests. Therefore, the convergence hypothesis is not valid.

Conclusion and Discussion

Our study aims to analyse the convergence of Turkey to OECD countries based on tourism revenues and the number of international visitors. In the analysis, Turkey's tourism revenues between 2005 and 2020, annual data on international arrivals from 1995 to 2020, and data on selected OECD countries are used. We have analysed the linearity of the variables using Harvey & Leybourne (2007) and Harvey et al. (2008). Following the linearity test, we used unit root tests that take breaks into account. The results indicate that the convergence hypothesis is valid for the number of visitors but not for the new unit root test.

For this reason, it is not possible to predict the number of visitors based on our test results. Turkey has significant changes in the visitor numbers of countries in the years before and after the pandemic. According to the OECD (2024), Turkey is ranked among the top five global destinations in international tourism in 2021 post-pandemic. Moreover, Turkey has a strategic position compared to competitive countries. However, the non-convergence situation is consistent with the fact that Turkey has a competitive advantage in the tourism sector compared to selected OECD countries and it is one of the leading tourism destinations worldwide, according to statistics. Regarding tourism revenues, both unit root tests indicate that the convergence hypothesis is not valid.

Previous studies in the literature have analysed convergence by considering different country groups. In these studies, tourism factors are correlated with economic growth, and the results reveal that expected convergence does not occur. Similar findings were obtained in the present study, supporting the literature. In the literature on Turkey's tourism markets, it was concluded that the number of tourists followed an unbalanced pattern and that there was convergence in some periods but not in the post-pandemic years. Therefore, it is recommended that tourism policies be reviewed and more strategic plans developed. Our study also highlights tourism revenues. Although Turkey has been at the top of the rankings in recent years and has a high number of tourist arrivals, it has not reached convergence with OECD countries regarding tourism revenues. Many reasons could be responsible for this inconsistency. OECD countries are generally developed economies with high-income levels. Therefore, income from tourists is also high. Since Turkey has experienced high inflation recently, tourists' spending and preferences may be negatively affected. Turkey should increase its competitiveness within the OECD and implement policies to attract high-income tourists. In conclusion, this study analyzes the convergence of tourist arrivals and tourism revenues. Although tourist arrivals provide results that support the literature, our study indicates that convergence in tourism revenues requires further investigation in the future.

Peer Review: Externally peer-reviewed.
Conflict of Interest: The authors have no conflict of interest to declare.
Grant Support: The authors declared that this study has received no financial support.
Author Contributions: Conception/Design of study: Y.Y., S.C.; Data Acquisition: Y.Y.; Data Analysis/Interpretation: Y.Y.; Drafting Manuscript: Y.Y., S.C., M.E.; Critical Revision of Manuscript: Y.Y., S.C., M.E.; Final Approval and Accountability: Y.Y., S.C., M.E

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How cite this article

Yavuz, Y., Caglayan, S., Erkan, M. (2024). Turkey's convergence analysis of selected OECD countries in the tourism sector. *Journal of Tourismology, 10*(2), 108-120. https://doi.org/10.26650/jot.2024.10.2.1480684