COINTEGRATION ANALYSIS OF TOURISM REVENUES BY
THE MEMBER COUNTRIES OF EUROPEAN UNION TO GREECE

Nikolaos Dritsakis                                            Katerina Gialetaki
Associate Professor                                             Assistant Professor
Department of Applied Informatics             Department of Tourist Administration
University of Macedonia             Technological Educational Institute of Amfissas

Abstract

The countries of Europe and especially European Union member countries are, traditionally, amongst the most important tourism markets for Greece. The purpose of this paper is to investigate the long-run changes in tourism revenues from European Union member countries to Greece. In order to explain tourism revenues we are using a number of leading macroeconomic variables, including the real income of 15 member-countries of EU, the exchange rate and some dummies, which examine the crises periods for tourism. The quarterly data that are used for this paper cover the period from 1960:1 to 2000:4. The augmented Dickey-Fuller for unit root is examined in the univariate framework and the Johansen’s maximum likelihood procedure is used to test the cointegration method and to estimate the number of cointegrated vectors of ‘VAR model’- Vector autoregressive processes. Error correction model is estimated to explain tourism revenues from European Union member countries to Greece. The results of this paper have shown that the real income of 15 member-countries of EU and the exchange rate have a positive effect on the tourism revenues of Greece, whereas some political crises have a negative effect on them.

Keywords: tourism revenues, cointegration analysis, error correction model

JEL O10, C22
1. Introduction

Nowadays, tourism includes a wide variety of economic and social activities on an international scale and covers all social classes. It is directly related to the development and growth of every modern society and aims at meeting the human needs to become acquainted with different cultures so as to create the conditions for advancing understanding and brotherhood amongst people worldwide and a better future for mankind.

The impact of tourism on the economy and its crucial role in the growth of modern societies has become a common knowledge worldwide. For this reason an important effort has been made for the rapid development of tourism being one of the most important sectors of economic activity Dritsakis (1995).

The developmental problems of tourism in local, regional, national and international level began to be one of the important issues concerning some major international organizations, such as the World Tourism Organization (WTO), the European Union (EU), the Organization of Economic Cooperation and Development (OECD), which sensitise public opinion.

Tourism impact on the economies of developing countries, which rely heavily on foreign exchange revenues, has been a major subject of general interest. It is therefore natural for governments to create incentives for these areas of economic activities that attract foreign exchange revenues.

Tourism growth is not only related to enhanced employment opportunities to different sub-sectors of economic activity related to tourism (e.g. lodging, eating and drinking, services etc.), but also in other economic sectors such as agriculture, industry, trade, etc.
The growth of tourism economy in any level that is being performed must be directed by an attentively organized tourist policy. The determination of this policy should not disregard the ideas and principles of human welfare and happiness and mainly these should not be sacrificed to the shrine of easy and rapid profit no matter how large it can be Igoumenakis (1991).

International tourism, undoubtedly, belongs to these productive activities, which are affected decisively by international political and economic factors. If someone tries to make a thorough examination to the evolution of tourist arrivals during the last 40 years, he will infer that the stagnancy or the decrease of tourist arrivals coincides with the political and economical facts, which took place to these destination countries or other extensive geographical areas in which they belong. It is true, however, that when irregular conditions exist in destination countries or places worldwide these suffer mostly from lack of tourist activity. The basic reason is that the purpose of tourism is enjoyment, relaxation in a peaceful and safe environment.

Many researchers have been employed with tourist demand Uysal and Crompton (1984), Witt and Witt (1995), Papatheodorou (1999), Lim and McAleer (2000, 2001a), Dritsakis (2004) using tourist arrivals or the overnight stays as a dependent variable, as it happens also with the tourist development Andereck and Vogt (2000), Avcikurt and Soybali (2002). Fewer researchers such as Payne and Mervar (2002), Sastre, L. J. (2002). used tourism revenues as a dependent variable for the suggested models.

The importance of the tourism industry in Greece is well known by its share in the gross domestic product as well as its contribution to finance the endemic external deficit and by its intensive use of labour. In Fig. 1 we present the evolution of tourism revenues expressed in logarithms. Someone can perceive the upward trends of
revenues in the examined period, likewise the deduction of these revenues in other periods of time and last but not least the presence of seasonality. The low levels of tourism revenues in 1967 and 1974 correspond to the so-called crises periods for Greece with the abolition of democracy and the Cyprus issue. From 1960 until 1967 the average annual increase of revenues was 19.2%. In 1967 there was a sudden drop of tourist revenues by 11.9%. After 1967 a steady increase starts to become obvious reaching the point of 21.8% until the year of 1974. A drop of tourism revenues followed, catching up the point of 31.1%. This important drop of 1974 brought up an average annual rise of revenues by 2.9% until 1997, which is the year that Greece undertook the Olympic Games, and from that year until the end of the period that we examine the average annual increase of revenues is going up reaching the level of 27.9%. (It should be noted that when we estimated the average annual change of tourism revenues, we took into account the devaluation of drachma, which occurred, in the examined period).

INSERT FIG. 1

The aim of this paper is to examine the long-run relationship among tourism revenues, real income of 15 member countries of European Union and real exchange rate and to investigate if political, economical and military crises affect the arrivals of tourists and, by extension, tourism revenues.

The remainder of the paper proceeds as follows: Section 1 describes the importance of tourism revenues in the economy of each country, along with the process of these revenues to the country of Greece for the examined period. Section 2 describes the data that are used in tourism revenues analysis and also analyses the specification of the model. Section 3 presents the results of unit root tests. Section 4 summarises the cointegration analysis and Johansen cointegration test. Section 5 reports VAR model
with the error correction mechanism. Finally, section 6 provides the final concluding remarks of this paper.

2. Data and specification model

The traditional theoretical approach to obtain the international demand of tourist services is based on the assumption that the elasticity of supply of tourist services is infinite, therefore the prices of the tourist services are considered exogenous.

In order to analyze the relationship among tourism revenues, real income of 15 member countries of European Union and real exchange rate index, we use the trivariate VAR model:

\[ ITR = f(Y, EXR, D_1, D_2, D_3) \]  \hspace{1cm} (1)

where

ITR are international tourism revenues in real terms.

Y is a measure of real income of the tourist-generating or origin country at time t (15 member countries of European Union). In this paper gross domestic product is used as a proxy for the real income in constant prices (set as a base year 1996).

According to economic theory the coefficient of this variable is expected to be positive Lim and McAleer (2001b), Kulendran and Witt (2003).

EXR is real exchange rate. Given the unavailability of the data relating to travel costs and cost of living for foreign tourists in destination countries, real exchange rate as a measure of relative purchasing power is used as a proxy for respective values. Real exchange rate is defined as a ratio of domestic currency to foreign currencies Martin
and Witt (1987), Witt and Witt (1995), Turner et al. (1997). Namely the more Greek drachma corresponds to one unit of foreign currency, the cheaper will tourist products and services be in Greece and the larger will tourism demand and tourist revenues be. Consequently, the coefficient of this variable is expected to be positive.

D1, D2, D3, are the periods of tourism crises in Greece (period of Greek dictatorship and uprising of the military junta in Greece 1967:2, Cyprus problem 1974:3, Gulf war 1991:2 war in Yugoslavia 1999:2), where these dummies obtain value 1 for these periods and value 0 for all the remainder periods and also have a negative effect on tourism revenues Enders et al (1992), Witt and Witt (1992, 1995), Dritsakis and Athanasiadis (2000).

Another repercussions on the tourism revenues of Greece are considered to be periods of tourist crises such as terrorist attacks, Greek-Turkish conflicts, the Gulf war and the war in former Yugoslavia. However, none of them were statistically significant in equation (1).

The data that are used in this analysis are quarterly, covering the period 1960:I-2000:IV regarding 1996 as a base year and are obtained from the database of Bank of Greece, International Monetary Fund (IMF), OECD (Business Sector Data Base).

All data are expressed in logarithms to capture multiplicative time series effects and are symbolized with the letter L preceding each variable name.

If these variables share a common stochastic trend and their first differences are stationary, then they can be cointegrated. Economic theory scarcely provides guidance as to which variables appear to have a stochastic trend and when these trends are common among the examined variables.

For the analysis of the multivariate time series that include stochastic trends, the Augmented Dickey-Fuller (ADF) (1979) unit root test is used for the estimation of
individual time series, with intention to provide evidence for when the variables are integrated.

3. Unit root test

Testing for cointegration among several variables necessitates a test for the presence of unit roots of individual series. Many macroeconomic time series contain unit roots dominated by stochastic trends as developed by Nelson and Plosser (1982). Unit roots are important in examining the stationarity of a time series, because a non-stationary regressor invalidates many empirical results. The presence of a stochastic trend is determined by testing the presence of unit roots in time series data. In this study, unit root test is tested using Augmented Dickey-Fuller (ADF).

The augmented Dickey-Fuller (ADF) test is referred to the \( t \)-statistic of \( \delta_2 \) coefficient on the following regression:

\[
\Delta X_t = \delta_0 + \delta_1 t + \delta_2 X_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta X_{t-i} + u_t
\]  

The ADF regression tests for the existence of unit root of \( X_t \), namely in the logarithm of all model variables at time \( t \). The variable \( \Delta X_{t-i} \) expresses the first differences with \( k \) lags and final \( u_t \) is the variable that adjusts the errors of autocorrelation. The coefficients \( \delta_0, \delta_1, \delta_2 \), and \( \alpha_i \) are being estimated. The null and the alternative hypothesis for the existence of unit root in variable \( X_t \) is:

\[ H_0 : \delta_2 = 0 \quad \text{and} \quad H_e : \delta_2 < 0 \]
This paper follows the suggestion of Engle and Yoo (1987) using the Akaike information criterion (AIC) (1974), to determine the optimal specification of equation (2). The appropriate order of the model is determined by computing equation (2) over a selected grid of values of the number of lags $k$ and finding that value of $k$ at which the AIC attains its minimum. The distribution of the ADF statistic is non-standard and the critical values tabulated by Mackinnon (1991) are used.

INSERT TABLE 1

4. Cointegration and Johansen test

If time series variables are non-stationary in their levels, they are integrated (of order one) and their first differences are stationary. These variables may also be cointegrated if there exists one or more linear combinations among them that are stationary. If these variables are cointegrated, then there is a stable long run or equilibrium linear relationship among them. For instance, if tourism revenues and real income of 15 member countries of European Union were not cointegrated, then the tourism revenues would drift above or below real income of 15 member countries of European Union in the long run. Engle and Granger (1987 p.264) prescribed that ‘it may not be so easy to test whether a set of variables are cointegrated before estimating a multivariate dynamic model’.

If the hypothesis of a unit root is not rejected, then a test for cointegration is performed. The hypothesis being tested is the null of non-cointegration against the alternative of cointegration, using Johansen’s maximum likelihood method. A
vector autoregression approach is used to model each variable (which is assumed to be jointly endogenous) as a function of all the lagged endogenous variables in the system.

All variables that have been used in the model reported in the last section as international tourism revenues (LITR), real income of 15 member countries of European Union (LY), and real exchange rate (LEXR) are integrated of order 1, I(1). Therefore, they can be cointegrated on a VAR model up to four lags. As the lag intervals are specified as range pairs, this means that lags of the first differences are used, the highest lag in their levels is order 5. Thus, if lag intervals 1 to 4 are chosen the VAR model applies the regression analysis $\Delta X_t$ on $\Delta X_{t-1}, \Delta X_{t-2}, \Delta X_{t-3}, \Delta X_{t-4}$ and contains three variables. In implementing the Johansen procedure, a linear deterministic trend and intercept are included in the cointegrating equation.

The order of $r$ is determined by using the likelihood ratio (LR) trace test statistic suggested by Johansen (1988).

$$\lambda_{\text{trace}}(q,n) = -T \sum_{i=q+1}^{k} \ln(1 - \hat{\lambda}_i)$$

for $r = 0, 1, 2, \ldots, k-1$,

$T =$ the number of observation used for estimation

$\hat{\lambda}_i =$ is the $i$th largest estimated eigenvalue.

Critical values for the trace statistic defined by above equation are 34.87 and 31.93 for $H_0: r = 0$ and 20.18 and 17.88 for $H_0: r \leq 1$ at the significance level 5% and 10% respectively as reported by Osterwald-Lenum (1992).

The maximum eigenvalue LR test statistic as suggested by Johansen is:
The trace statistic and maximum eigenvalue either reject the null hypothesis of no cointegration among the variables (r=0) or do not reject the null hypothesis that there is one cointegrated relation between the variables (r≤1). Table 2 presents the results for all systems of equations, each with one cointegrated relation, in which the coefficients of the variables are significant at the 5% level and have the correct signs. As AIC tends to select the larger lag length and SBC the more parsimonious VAR, an LR test was used to select the appropriate lag length. The null hypothesis that a system is generated by a Gaussian VAR with p_0 lags, against the alternative specification of p_1>p_0 is tested by the LR test statistic, which is computed as:

\[ LR = -2(l_0 - l_1) \]

where \( l_i \) (i = 0,1) is the log-likelihood reported in the VAR model with p_i (i = 0, 1) lags. Under \( H_0 \), the LR test statistic is asymptotically distributed as \( X^2 \), with \( n^2(p_1 - p_0) \) degrees of freedom. The null hypothesis imposes \( n^2(p_1 - p_0) \) restrictions, where n = number of variables.

Based on the smallest AIC and SBC values, the trace test results in one cointegrating equation involving three variables are presented in table 2. When normalized for a unit coefficient on tourism revenues (LITR) the most appropriate cointegrating regression of the long-run tourism revenues, is given by VAR (2) models as follows (with absolute asymptotic t-ratios in parentheses):
\[ \text{LITR} = -12.557 + 1.1989 \text{LY} + 1.2899 \text{LEXR} \]
\[ (-2.6596) \quad (3.1989) \quad (2.2732) \]

INSERT TABLE 2

The coefficient estimates in the equilibrium relationship, which are basically the estimated long-run elasticities with respect to tourism revenues, show that real income of 15 member countries of European Union and real exchange rate are both elastic for tourism revenues from European Union countries to Greece.

5. A VAR model with an error correction mechanism

If \( z \) is, in turn, the cointegrating residual from the above equation, this residual should be included as an error correction term in tourism revenues VAR model, where \( z \) can be interpreted as the extent to which the system is out of equilibrium. The cointegrating residual for tourism revenues is:

\[ z = 12.557 – 1.1989 \text{LY} – 1.2899 \text{LEXP} \]

After determining that the logarithms of the model variables are cointegrated, we must estimate then a VAR model in which we shall include a mechanism of error correction model (MEC). The error-correction model arises from the long-run cointegration relationship and has the following form:

\[ \Delta \text{LITR}_t = \text{lagged}(\Delta \text{LITR}_t, \Delta \text{LY}_t, \Delta \text{LEXR}_t) + \lambda u_{t-1} + V_t \quad (3) \]

where \( \Delta \) is reported to all variables first differences
\( u_{t-1} \) are the estimated residuals from the cointegrated regression (long-run relationship) and represents the deviation from the equilibrium in time period \( t \).

\(-1 < \lambda < 0\) short-run parameter

\( V_t \) white noise disturbance term.

One difficulty, which a researcher faces with the estimation of an autoregressive VAR model, is the appropriate specification of the model. Specially, the researcher has to decide which deterministic components should be included and which number of lags should be used as well.

Since arbitrarily selected specifications of the autoregressive VAR model are possible to produce unreliable results, we use the selection criterion of a database model in order to specify the autoregressive VAR model for tourism revenues. Among the different selection criteria of the model the one that suggested by Schwartz (1978), known as Schwartz Bayesian information criterion, seems to outperform other alternative solutions (Mills and Prasad 1992). Therefore the specification of the autoregressive VAR model is based on the Schwartz Bayesian information criterion. Also, second order specification of the model VAR (2) is selected with a constant and a time trend.

The final form of the Error-Correction Model was selected according to the approach suggested by Hendry (Maddala 1992). The initial order of time lag for the model is 4 because it is large enough to enclose the system’s short-run dynamic.

We also apply a number of diagnostic tests on the residuals of the model. We apply the Lagrange test for the residuals’ autocorrelation, the heteroscedasticity test and the Bera-Jarque (1981) normality test. We also test the functional form of the model according to the Ramsey’s Reset (1969) test. Error correction model is appeared in table 3.
We do not reject the estimations, which are based on the results of table 3 according to the statistical and diagnostic tests. The percentage of the total variation of the dependent variable that is described in our model is high enough (68%). The Error-Correction Term is statistically significant and has a negative sign, which confirms the long-run equilibrium relation between the independent and dependent variables. Their relative price -0.11253 (-2.4173) denotes a satisfactory convergence rate to equilibrium point per period.

From the results of table 3 we can infer that the coefficient of variable of Y expressed by real income of 15 member countries of European Union is positive and statistical significant at 5% level of significance implying that tourism revenues are highly sensitive to Y of 15 European Union member countries. This coefficient can be interpreted as a measure of elasticity and ranges between the measures of elasticities 0.372 - 6.645 referred to this investigation Witt and Witt (1995).

The coefficient of variable of EXR expressed by the exchange rate is positive and statistical significant at 5% level of significance. In this regression is implied that an increase of 1% on real exchange rate keeping the other variables constant will lead to an increase of 1.19% on tourism revenues. The coefficient of elasticity 1.19 ranges between 0.637 - 2.258 of exchange rate measures Witt and Witt (1995).

For tourist crises occurred in Greece and worldwide in this examined period, only the dummies D1 and D2 have negative sign and are statistical significant, implying that tourism revenues in Greece have been influenced by these crises only in these specific periods.
6. Conclusions

The relationships among tourism revenues, real income and real exchange rate have received considerable attention in empirical tourism research. For a recent review see Payne and Mervar (2002), Sastre (2002). **Most empirical studies have estimated static models in logarithmic levels using ordinary least squares (OLS). This practice leads to invalid inferences. As a result, cointegration provides a method of avoiding deceptive inferences associated with a spurious regression (Kulendran 1996, Morley 2000).**

Cointegration techniques permit the estimation and testing of long-run equilibrium relationships, as suggested by economic theory. Vector error correction models (VEC) provide a way of combining both the dynamics of the short-run changes and long-run levels of adjustment processes simultaneously. Using data of tourist revenues from Greece the long-run economic relationships among those tourism revenues, real income of the 15 member-countries of EU and the real exchange rate have been estimated. This paper has consider the extent to which quarterly tourism revenues of Greece are related with variations in some important economic variables such as real income of 15 member-countries of EU and exchange rate.

Prior to testing for cointegration among a set of variables, the ADF test of non-stationarity is performed to determine the order of integration of every time series. Johansen’s maximum likelihood procedure, based on vector autoregressive models, is used for estimation and testing of the cointegrating relations. The methods used and the innovative results presented in this paper, provide some useful insights into the effects of real income of 15 member-countries of EU, the real exchange rate and also the effects of some political, economical and military crises. The existence of a long-
run equilibrium relationship among tourism revenues, real income of 15 member-
countries of EU and exchange rate appears to be supported by the quarterly data for
Greece for the examined period.

According to the theory of cointegration, the estimated cointegrating residuals should
appear with the form of error correction term in a dynamic VEC (Vector Error
Correction) model. An important finding from the dynamic model presented is that
the error correction term is statistically significant Even though not all the regressors
in the VEC model (Vector Error Correction) are statistically significant, there is no
evidence of any problems associated with serial correlation, heteroscedasticity, non-
normal errors, parameter instability or predictive inaccuracy.

Given a significant error correction term in the dynamic VEC (Vector Error
Correction) model, it can be interpreted as evidence supporting cointegration, which
suggests the existence of an equilibrium long-run relationship among important
economic variables and facts determining tourism revenues from member-countries
towards Greece.

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References


Fig. 1. Tourism revenues in real terms

Table 1. Tests of unit roots hypothesis

<table>
<thead>
<tr>
<th></th>
<th>Augmented Dickey-Fuller</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\tau_\mu$</td>
<td>$\tau_\tau$</td>
</tr>
<tr>
<td>LITR</td>
<td>-0.7414</td>
<td>-2.2231</td>
</tr>
<tr>
<td>LY</td>
<td>-1.5006</td>
<td>-1.0461</td>
</tr>
<tr>
<td>LEXR</td>
<td>-2.3981</td>
<td>-2.3266</td>
</tr>
<tr>
<td>ΔLITR</td>
<td>-8.9237***</td>
<td>-9.4916***</td>
</tr>
<tr>
<td>ΔLY</td>
<td>-3.5531**</td>
<td>-3.7750**</td>
</tr>
<tr>
<td>ΔLEXR</td>
<td>-6.7626***</td>
<td>-6.7897***</td>
</tr>
</tbody>
</table>

Notes: $\tau_\mu$ is the t-statistic for testing the significance of $\delta_2$ when a time trend is not included in equation 2 and $\tau_\tau$ is the t-statistic for testing the significance of $\delta_2$ when a time trend is included in equation 2. The calculated statistics are those reported in Dickey-Fuller (1981). The critical values at 1%, 5% and 10% are –3.61, -2.94 and –2.60 for $\tau_\mu$ and –4.21, -3.53 and –3.19 for $\tau_\tau$ respectively.

The lag-length structure of a $I$ of the dependent variable $x_t$ is determined using the recursive procedure in the light of a Lagrange multiplier (LM) autocorrelation test (for orders up to four), which is asymptotically distributed as chi-squared distribution and the value t-statistic of the coefficient associated with the last lag in the estimated autoregression.

Table 2. Johansen and Juselious trace test for one Cointegration equation

Variables LITR, LY, LEXR
Maximum lag in VAR = 2

<table>
<thead>
<tr>
<th>Trace Statistic</th>
<th>Critical Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Null $r = 0$</td>
<td>Alternative $r = 1$ Trace 37.9134 34.8700 31.9300 AIC 906.28 SBC 883.12</td>
</tr>
<tr>
<td>$r \leq 1$</td>
<td>$r \geq 2$</td>
</tr>
</tbody>
</table>
Table 3. Error Correction Model

\[ \Delta \text{LITR}_t = 0.62342 + 0.41245 \Delta \text{LITR}_{t-2} + 1.10345 \Delta \text{LY}_{t-1} + 0.34287 \Delta \text{LY}_{t-2} \]
\[ + 1.19387 \Delta \text{LEXR}_{t-1} + 0.39562 \Delta \text{LEXR}_{t-2} - 0.64874 \text{D}_1 - 0.37856 \text{D}_2 - 0.11253 \text{u}_{t-1} \]

\[ R^2 = 0.6812 \quad F(9,163) = 117.6005 \quad DW = 2.0453 \]

Diagnostic Tests

A: X^2[1] = 0.1723 [0.713]  
B: X^2[1] = 3.6742 [0.048]  
C: X^2[2] = 1.3743 [0.638]  
D: X^2[1] = 0.7324 [0.418]  
E: X^2[7] = 11.294 [0.142]  
F: X^2[7] = 2.5217 [0.721]  

Notes:

\( \Delta \): Denotes the first differences of the variables.
\( R^2 \): Coefficient of multiple determination adjusted for the degrees of freedom (d.f).
\( DW \): Durbin-Watson statistic.
\( F(n, m) \): F-statistic with n,m d.f respectively.
A: X^2(n) Lagrange multiplier test of residual serial correlation, following x^2 distribution with n d.f.
B: X^2(n) Ramsey’s Reset test for the functional form of the model, following x^2 distribution with n d.f.
C: X^2(n) Normality test based on a test of skewness and kurtosis of residuals, following x^2 distribution with n d.f.
D: X^2(n) Heteroscedasticity test, following x^2 distribution with n d.f.
E: X^2(n) Chow’s second test for predictive failure, following x^2 distribution with n d.f.
F: X^2(n) Chow’s first test of stability of the regression coefficients, following x^2 distribution with n d.f.

( ) = We denote the t-ratio for the corresponding estimated regression coefficient.
[ ] = We denote prob. levels.