TOURISM AS A LONG-RUN ECONOMIC GROWTH FACTOR:
AN EMPIRICAL INVESTIGATION FOR GREECE
USING CAUSALITY ANALYSIS

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Abstract

This paper examines empirically the tourism impact on the long-run economic growth of Greece by using the causality analysis among real gross domestic product, real effective exchange rate and international tourism earnings. A multivariate autoregressive VAR model is applied for the examined period 1960:1 – 2000:IV. The results of cointegration analysis suggested that there is one cointegrated vector among real gross domestic product, real effective exchange rate and international tourism earnings. Granger causality tests based on error correction models (ECM), have indicated that there is a “strong Granger causal” relation between international tourism earnings and economic growth, there is a “strong causal” relation between real exchange rate and economic growth, while the relation between economic growth and international tourism earnings is simply a “causal relation” and lastly the relation between real exchange rate and international tourism earnings is simply a “causal relation” as well.

keywords: tourism earnings, economic growth, Granger causality

JEL O10,C22
1. Introduction

The growth of tourism in broad terms refers to the gradual evolution of tourism which is considered to be a factor of the productivity of a country’s economy and it is being accomplished, basically, with the complete evaluation and the rational exploitation of tourism resources, with the increase of tourism productivity and its qualitative improvement, but above all, with its adjustment to the needs or desires of tourists.

The role of tourism to the economic growth and to the progress of modern societies has become a common awareness in political authorities worldwide. For this reason many attempts are being made in order to develop tourism, being amongst the most important sectors of economic activity, to the benefit of their economies as quickly and as effectively as possible. The fact that tourism is an economic activity of primary value and importance for many countries is an accepted fact by all. Developing countries such as Greece consider tourism as a sector that could potentially cover their needs in foreign currency Dritsakis and Athanasiadis (2000), Payne and Mervvar (2002).

The contribution of the tourist sector is beneficial for a country’s economy due to its influence on sectors other than the foreign exchange sector, like:

- The employment sector and especially in the tourist periphery, with the direct consequence of restraining the propensity to immigrate and keeping the population in its place.

- The business sector, through the expansion of the industrial and agricultural production so as to meet the increasing tourist wave, as well as the mobilization of
the international and domestic trade and the activities of various service-related industries like transportation, telecommunications, banking, travel agencies, etc.

- The income sector, through its contribution to the country’s aggregate income. The tourist income seems to be distributed throughout a wider population stratum, enhancing the income of residents of less developed areas that rely heavily on tourism during the summer months. This constitutes a factor of primary importance towards strengthening the development of the periphery in developing countries. Undoubtedly, there is a close linkage between employment and income effects but it is not so ultimate. The direct employment and income can easily be distinguished from the indirect employment and income. There is a proportionate relation between income derived from tourism and employment but they are not of equal magnitude and also they are not created contemporaneously.

- The cultural sector since in addition to the improvement of the living standards of populations in areas with increased tourism, there is also significant improvement in their cultural standards.

- In the fiscal sector it must finally be emphasized that the tourist activity exerts beneficial results on public economics and especially at the local level.

The development of tourism in a country leads to increased income for the economically active part of the population that is employed in tourist enterprises, as well as for that part of the population, which is not employed in tourist enterprises directly but in those enterprises that their economic survival depends on tourism in a large or small scale.

A balanced and harmonic growth of tourist economy in relation to the others sectors of economic activity and mainly the most basic sectors, agricultural and industrial
economy, ensures with the types of nutrition and the capital equip the production of tourist products, which are necessary for the satisfaction of tourist needs or wishes.

A characteristic feature that makes Greece so special is its importance as an international tourist destination as well as the relative weight that foreign exchange income has in its economy.\(^1\) In fact, the earnings from tourism have represented an important source of compensation to the Greek Foreign Trade Account imbalances in the last four decades.

The main objective of this paper is to examine to what extent the Greek economic growth responded to the evolution of external international tourist activity during the period 1960-2000. The background on this question is referred to the literature of the export-led growth hypothesis and to the recent theoretical methods, which only consider non-traded goods such as tourism.

As in the export-led growth hypothesis, a tourism-led growth hypothesis would postulate the existence of various arguments for which tourism would become a main determinant of overall long-run economic growth. In a more traditional sense it should be argued that tourism brings in foreign exchange, which can be used to import capital goods in order to produce goods and services leading in turn to economic growth Mckinnon, (1964).

Tourist growth provides a remarkable part of the necessary financing for the country to import more products than to export ones. If those imports are capital goods or basic inputs for producing goods in any area of the economy, then it can be said that earnings from tourism are playing a fundamental role in economic development. On

\(^1\) The United States remains as the main recipient of international tourist revenues. Italy, France, Spain and Greece are the other important tourist countries as far as foreign exchange earnings from tourism is concerned. It is important to take into consideration that the relative weight of tourism in the Greek economy is larger than the one in the other three countries. During 1996 for example, the income from tourism represented 0.9% of the United States’ gross domestic product (GDP), 1.9% of France’s, 2.5% of Italy’s, 4.8% of Spain’s whereas for Greece it represented 5.2% of its GDP (World Tourism Organization).
the other hand, international tourism would contribute to an income increase as the export-led growth hypothesis postulates, by enhancing efficiency through competition between local firms with the ones corresponding to the other international tourist destinations Bhagwati and Srinivasan, (1979), Krueger (1980) and facilitating the exploitation of scale economies in local level Helpman and Krugman, (1985).

Taking into account that a large proportion of tourist expenditures are spent on the consumption of nontraded goods and services in the host country, there exist factors, which can have either a positive role or an unfavorable impact on economic growth. Non-traded goods and services are not exportable in the traditional sense, because their price is not determined in the international market, but in the local market Balaguer and Cantavella (2002).

Despite the fact that tourism industry is, nowadays, of major importance for the world economy and that for many countries is one of the largest single employers and exporting services sector, economists have paid little attention to the empirical examination of possible contributions of this sector to a country’s economy as Papatheodorou (1999) argues in his paper.

Hazari and Ng (1993) examining the relationship between tourism and welfare showed that tourism may be welfare reducing in a monopoly power, while Hazari and Kaur (1995) argued that tourism is always welfare improving using a Komiya (1967) type first-best model. More recently Hazari and Sgro (1995) developed a dynamic model in which a favorable impact of a buoyant world demand for tourism would have a positive effect on the long-run growth of a small open economy. This favorable impact is generated by tourism behavior as a time saving device, which allows domestic population to consume today more than in the future, due to the requirement of a lower saving rate.
The aim of this paper is to investigate possible causal relationships between the examined variables in order to provide plausible answers to the following causal hypotheses to draw conclusions for economic growth of the studied country.

In this study the causal hypotheses to be tested are:

- Do international tourism earnings cause economic growth?
- Does real effective exchange rate cause international tourism earnings?
- Does economic growth cause real effective exchange rate?
- Do international tourism earnings cause real effective exchange rate?
- Does real effective exchange rate cause economic growth?
- Does economic growth cause international tourism earnings?

The remainder of the paper proceeds as follows: Section 2 describes the data that are used in causal relationship among gross domestic product, real effective exchange rate, international tourism earnings of the economy in Greece, as 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 analyses the error correction models. Finally, section 6 provides the final concluding remarks of this paper.

2. Data specification of the model

In order to test the causal relationships discussed above (introduction) we specify the following three – variable VAR model:

\[ U = ( \text{GDP, ITR, EXR}) \] (1)

---

2 The specification of a multivariate equation in a causality analysis is a major departure from the bivariate equations that have been widely used in the literature to examine the causal relationships. The bivariate studies have been considered to suffer from specification error.
where

GDP is real gross domestic product

ITR is international tourism earnings in real terms

EXR is the real effective exchange rate (a proxy variable of external competitiveness)

Further, based on the results of the above sets of causal hypotheses, the corresponding bi-directional hypotheses can be examined.

To investigate the causal relationships a vector autoregressive VAR, model popularized by Sims (1980) is formulated of the vector U defined in equation 1. A unique advantage of the VAR model is that it treats each variable is the system as potentially endogenous and relates each variable to its own past values and to past values of all other variables included in the model.

Engle and Granger (1987) and Granger (1988) pointed out that a VAR model in levels with nonstationary variables may lead to spurious results and a VAR model in first differences with cointegrated variables is misspecified. In the latter case the error correction term, ECT, which represents the long run relationship between the variables is reintroduced back into the VAR and the resulting model is known as the vector error correction model VECM.

A three-variable unrestricted VAR model with the deterministic term can be written as:

$$U_t = A_0 + A(L)U_t + e_t$$

(2)

where $A(L) = [a_{ij}(L)]$ is a 3 X 3 matrix of the polynomial

$$a_{ij}(L) = \Sigma a_{ij1}L^1$$

---

3 Cooley and LeRoy (1985) have criticized the VAR, being a system of unrestricted reduced form equations. See also Runkle (1987) for the controversy surrounding this methodology. However all agree that there are important uses of the VAR model.
m_{ij} is the degree of the polynomial

A_0 = (a_{10} a_{20} a_{30}) is a constant

e_t is a 3 X 1 vector of random errors.

Model (2) can be rewritten as a VECM assuming there exists at least one cointegrating vector

\[ \Delta U_t = A_0 + A(L)\Delta U_{t-1} + \delta E_{Ct-1} + \mu_t \]  

where EC_t is the error correction term

\mu_t is a 3 X 1 vector of white noise errors, E(\mu_t) = 0 and (\mu_t \mu_{t-1}) = \Omega, for t = s and zero otherwise.

After normalizing the cointegrating vector, the economic growth equation can be written as:

\[ \ln GDP_t = \beta_1 \ln ITR_t + \beta_2 \ln EXR_t \]  

The error correction term is obtained from equation (4) as:

\[ EC_t = \ln GDP_t - \beta_1 \ln ITR_t - \beta_2 \ln EXR_t \]  

Finally, the economic growth equation in detailed form for model (3) is written as:

\[ \Delta LGDP_t = a_0 + \sum a_{1j} \Delta LGDP_{t-j} + \sum a_{2j} \Delta LITR_{t-j} + \sum a_{3j} \Delta LEXR_{t-j} + \delta EC_{t-1} + e_t \]  

where EC_{t-1} represents the deviation from equilibrium in period t and the coefficient \( \delta \) represents the response of the dependent variable in each period to departures from equilibrium.

In the above model (6) a dummy should be included for seasonal effects. Since the seasonality is an important factor for tourist arrivals, which in turn effect on economic
growth of destination country Lim and McAller (2000). The use of these seasonal dummies as suggested by Johansen (1995), effects only the mean but not the trend in tourist arrivals and extensively to economic growth. The dummies are not statistically significant and for this reason are not included in model (6).

As Granger (1988) pointed out that there are two channels of causality. One channel is through the lagged values of $\Delta LITR$ and $\Delta LEXR$, i.e., $a_{i1}, a_{i2}, \ldots, a_{im}$ are jointly significant, and the other is if $\delta$ is significant. If $\delta$ is significant in equation (5) then international tourism earnings, and the real effective exchange rate also causes economic growth the second channel.

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

All data are expressed in logarithms in order to include the proliferative effect of time series 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 some guidance for which variables appear to have a stochastic trend and when these trends are common among the examined variables as well.

For the analysis of the multivariate time series that include stochastic trends, the augmented Dickey-Fuller (1979) (ADF) and Kwiatkowski et al. (1992) (KPSS) unit root tests are used for the estimation of individual time series, with intention to provide evidence for when the variables are integrated.
3. **Unit root tests**

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 standard 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) (1979, 1981), and Kwiatkowski et al. (1992).

3.1 **Augmented Dickey-Fuller (ADF) test**

The augmented Dickey-Fuller (ADF) (1979) test is referred to the t-statistic of $\delta_2$ coefficient on the following regression:

$$\Delta X_t = \delta_0 + \delta_1 t + \delta_2 X_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta X_{t-i} + u_t \quad (7)$$

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:

$$H_0 : \delta_2 = 0 \quad H_a : \delta_2 < 0$$
This paper follows the suggestion of Engle and Yoo (1987) using the Akaike information criterion (AIC) (1974), to determine the optimal specification of Equation (7). The appropriate order of the model is determined by computing Equation (7) 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.

3.2 Kwiatkowski, Phillips, Schmidt, and Shin’s (KPSS) test

Since the null hypothesis in Augmented Dickey-Fuller test is that a time series contains a unit root, this hypothesis is accepted unless there is a strong evidence against it. However, this approach may have low power against stationary near unit root processes. In contrast Kwiatkowski et al (1992) present a test where the null hypothesis is that a series is stationary. The KPSS test complements the Augmented Dickey-Fuller test in that concerns regarding the power of either test can be addressed by comparing the significance of statistics from both tests. A stationary series has significant Augmented Dickey-Fuller statistics and insignificant KPSS$^4$ statistics.

According to Kwiatkowski et al (1992), the test of KPSS assumes that a time series can be composed into three components, a deterministic time trend, a random walk and a stationary error:

$$y_t = \delta t + r_t + \epsilon_t$$

where $r_t$ is a random walk: $r_t = r_{t-1} + u_t$. The $u_t$ is iid $(0, \sigma_u^2)$.

The stationary hypothesis implies that $\sigma_u^2 = 0$.

Under the null, $y_t$, is stationary around a constant ($\delta = 0$) or trend-stationary ($\delta \neq 0$). In practice, one simply runs a regression of $y_t$ over a constant (in the case of level-stationarity) or a constant plus a time trend (in the case of trend-stationary). Using the residuals, $\epsilon_t$, from this regression, one computes the LM statistic

$$LM = T^{-2} \sum_{t=1}^{T} S_e^2 / S_u^2$$

where $S_e^2$ is the estimate of variance of $\epsilon_t$. 

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$^4$ According to Kwiatkowski et al (1992), the test of KPSS assumes that a time series can be composed into three components, a deterministic time trend, a random walk and a stationary error:
Table 1 presents the results of the ADF and KPSS tests of real gross domestic product, international tourism earnings and the effective real exchange rate. The results of ADF test are compared with critical values we obtained from Mackinnon (1991) tables. The results of ADF statistic for the examined time series exceed the critical values, because the null hypothesis of a unit root is not rejected. Taking first differences renders each series stationary, with the ADF statistics in all cases being less than the critical value at the 1%, 5% and 10% level of significance.

The results of KPSS statistics are reported for lag – truncation parameters, since it is unknown how many lagged residuals should be used to construct a consistent estimator of the residual variance. The KPSS test rejects the null hypothesis of level and trend stationarity for lag truncation parameter (l = 1)\(^5\). The KPSS statistics does not reject the I(0) hypothesis for the first differences of the series at different levels of

\[
S_t = \sum_{i=1}^{l} e_i, \quad t = 1,2,\ldots,T
\]

The distribution of LM is non-standard: the test is an upper tail test and limiting values are provided by Kwiatkowski et al (1992), via Monte Carlo simulation. To allow weaker assumptions about the behaviour of \(\varepsilon_t\) one can rely, following Phillips (1987) and Phillips and Perron (1988) on the Newey and West (1987) estimate of the long-run variance of \(\varepsilon_t\) which is defined as:

\[
S^2(l) = T^{-1} \sum_{i=1}^{T} e_i^2 + 2T^{-1} \sum_{s=1}^{l} w(s,l) \sum_{i=s+1}^{T} e_i e_{i-k}
\]

where \(w(s,l) = 1 - s / (l+1)\). In this case the test becomes

\[
\nu = T^{-2} \sum_{t=1}^{T} S_t^2 / S^2(l)
\]

which is the one considered here. Obviously the value of the test will depend upon the choice of the ‘lag truncation parameter’, \(l\). Here we use the sample autocorrelation function of \(\Delta e_t\) to determine the maximum value of the lag length \(l\).

\(^5\) The KPSS statistics are known to be sensitive to the choice of truncation parameter \(l\) and tend to decline monotonically as \(l\) increases. In addition the test is performed for truncation parameter. Although the statistics may differ in the level of significance, the qualitative result remains the same.
significance. Therefore, the combined results from both tests (ADF, KPSS) suggest that all the series under consideration appear to be integrated of order 1, I(1).

4. Cointegration Test

Following the maximum likelihood procedure of Johansen (1988) and Johansen and Juselious (1990), a p-dimensional (p×1) vector autoregressive model with Gaussian errors can be expressed by its first-differenced error correction form as:

$$\Delta Y_t = \mu + \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \ldots + \Gamma_{p-1} \Delta Y_{t-p+1} + \Pi Y_{t-1} + u_t$$  \hspace{1cm} (8)

where:

- $Y_t$ is a p×1 vector containing the variables.
- $\mu$ is the p×1 vector of constant terms.
- $\Gamma_i = -I + A_1 + A_2 + \ldots + A_i \hspace{1cm} (i = 1, 2, \ldots, p-1)$ is the p×p matrix of coefficients.
- $\Pi = I - A_1 - A_2 - \ldots - A_p$ is the p×p matrix of coefficients.
- $u_t$ is the p×1 vector of the disturbance terms coefficients.

The $\Pi$ matrix conveys information about the long-run relationship between $Y_t$ variables and the rank of $\Pi$ is the number of linearly independent and stationary linear combinations of variables studied. Thus, testing for cointegration involves testing for the rank of $\Pi$ matrix $r$ by examining whether the eigenvalues of $\Pi$ are significantly different from zero. Johansen (1988) and Johansen and Juselious (1990) propose two test statistics for testing the number of cointegrating vectors (or the rank of $\Pi$) in the
VAR model. These are the trace (Tr) test and the maximum eigenvalue (L-max) test.

The likelihood ratio statistic for the trace test is:

\[-2\ln Q = -T \sum_{i=r+1}^{p} \ln(1 - \hat{\lambda}_i)\]  \hspace{1cm} \text{(9)}

where \(\hat{\lambda}_{r+1}, \ldots, \hat{\lambda}_p\) are the estimated \(p - r\) smallest eigenvalues. The null hypothesis to be tested is that there are at most \(r\) cointegrating vectors. That is, the number of cointegrating vectors is less than or equal to \(r\), where \(r\) is 0, 1, or 2, and so forth. In each case, the null hypothesis is tested against the general alternative.

Alternatively, the L-max statistic is:

\[-2\ln Q = -T \ln(1 - \hat{\lambda}_{r+1})\]  \hspace{1cm} \text{(10)}

In this test, the null hypothesis of \(r\) cointegrating vectors is tested against the alternative hypothesis of \(r+1\) cointegrating vectors. Thus, the null hypothesis \(r = 0\) is tested against the alternative that \(r = 1\), \(r = 1\) against the alternative \(r = 2\), and so forth. It is well known the cointegration tests are very sensitive to the choice of lag length. The Schwarz Criterion (SC) and the likelihood ratio test are used to select the number of lags required in the cointegration test.

\textbf{INSERT TABLE 2}

The results that appear in Table 2 suggest that the number of statistically significant normalized cointegration vectors is equal to 1 and are the following:
LGDP = 0.31290LITR + 4.8690LEXR \hspace{1cm} (11)

From the above cointegrated vector we can infer that in the long-run tourist earnings and real exchange rate have a positive effect on gross domestic product. The two other cointegrated vector models presented the same positive relationship when the real exchange rate and international tourism earnings were used as a dependent variable.

According to the signs of the vector cointegration components and based on the basis of economic theory the above relationships can be used as an error correction mechanism in a VAR model.

5. A VAR model with an error correction mechanism

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 (equation 3) is used to investigate the causal relationships among the variables real gross domestic product, international tourism earnings and the effective real exchange rate (GDP, ITR, EXR). Such analysis provides the short – run dynamic adjustment towards the long – run equilibrium. The significance levels of the F – statistics for the lagged variables and the t – statistics for the coefficient \( \delta \) of EC\(_{t-1} \) are used to test for Granger causality. The numbers in parentheses are the lag lengths determined by using the Akaike criterion.
As discussed earlier in section 2, there are two channels of causality Granger (1988). These are called channel 1 and channel 2. If lagged values of a variable (except the lagged value of the dependent variable) on the right hand side in equation 3 are jointly significant then this is channel 1. On the other hand, if the lagged value of the error correction term is significant, then this is channel 2. The results are summarized in table 3.

**INSERT TABLE 3**

For convenience in discussing the results, let us call the relationships a “strong causal relation” if it is through both channel 1 and channel 2 and simply a “causal relation” if it is through either channel 1 or channel 2.

From the results of table 3 we can infer that coefficient $\delta$ is statistically significant only in case we use economic growth as an endogenous variable so we have then the channel one which means that international tourism earnings and real exchange rate effect on economic growth. Also, the coefficients of lagged variables are statistically significant in case that economic growth and international tourism earnings are used as a dependent variable (channel 1), which means that economic growth and real exchange rate effect on international tourism earnings.

The results of table 4 present causality test through these channels

**INSERT TABLE 4**

From the results of Table 4 we can infer that there is a “strong Granger causal” relation between international tourism earnings and economic growth, there is a “strong causal” relation between real exchange rate and economic growth, while the relation between economic growth and international tourism earnings is simply a
“causal relation” and lastly the relation between real exchange rate and international tourism earnings is simply a “causal relation” as well.

6. Concluding remarks

In this paper an effort was made in order to examine the relationship among international tourism earnings, real exchange rate and economic growth in one tourist country par excellence, such as Greece, through the analysis of multivariate causality based on an error correction model. For empirical testing of these variables, we used the Johansen cointegration test and then Granger causality tests based on a vector error correction model.

The results of the cointegration analysis suggest the existence of cointegration relationship between the three variables. This indicates the presence of common trend or long-run relationships among these variables.

The results of the causality analysis denote that international tourism earnings and real exchange rate cause economic growth with a “strong causal” relationship, while economic growth and real exchange rate cause international tourism earnings with a “simply causal” relationship.

Since the hypotheses set at the beginning of this paper have been answered, as a final concluding remark we can infer that the significant impact of tourism on the Greek economy justifies the necessity of public intervention aimed, on the one hand, at promoting and increasing tourism demand, and, on the other hand, providing and fostering the development of tourism supply. The intense state intervention for tourism growth and especially for tourist economy, arises either directly from the performance of tourist infrastructure works or indirectly from the mechanism of funds and incentives. Generally, this is a characteristic feature of modern tourism, but also it
is factual evidence that the state tries to develop tourism, which is regarded as one of the most important sectors of economic activity.

ACKNOWLEDGEMENTS

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References


Table 1. Tests of unit roots hypothesis

<table>
<thead>
<tr>
<th></th>
<th>Augmented Dickey-Fuller</th>
<th>KPSS</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\tau_\mu$</td>
<td>$\tau_\iota$</td>
<td>$\kappa$</td>
<td>$l=1$</td>
</tr>
<tr>
<td>LGDP</td>
<td>-1.5006</td>
<td>-1.0461</td>
<td>2</td>
<td>3.125***</td>
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<tr>
<td>LITR</td>
<td>-0.7414</td>
<td>-2.2231</td>
<td>4</td>
<td>1.942***</td>
</tr>
<tr>
<td>LEXR</td>
<td>-2.3981</td>
<td>-2.3266</td>
<td>4</td>
<td>2.436***</td>
</tr>
<tr>
<td>ΔLGDP</td>
<td>-3.5531**</td>
<td>-3.7750**</td>
<td>4</td>
<td>0.019</td>
</tr>
<tr>
<td>ΔLITR</td>
<td>-8.9237***</td>
<td>-9.4916***</td>
<td>4</td>
<td>0.021</td>
</tr>
<tr>
<td>ΔLEXR</td>
<td>-6.7626***</td>
<td>-6.7897***</td>
<td>4</td>
<td>0.033</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 $\tau_\iota$ 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 $\tau_\iota$ respectively.

The lag-length structure of $\eta_\iota$ of the dependent variable $x_t$ is determined using the recursive procedure in the light of a Langrange 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.

$\eta_\iota$ and $\eta_\tau$ are the KPSS statistics for testing the null hypothesis that the series are I(0) when the residuals are computed from a regression equation with only an intercept and intercept and time trend, respectively. The critical values at 1%, 5% and 10% are 0.739, 0.463 and 0.347 for $\eta_\iota$ and 0.216, 0.146 and 0.119 for $\eta_\tau$ respectively (Kwiatkowski et al., 1992, table 1).

Since the value of the test will depend upon the choice of the ‘lag truncation parameter’, $l$. Here we use the sample autocorrelation function of $\Delta x_t$ to determine the maximum value of the lag length $l$.

***, **, * indicate significance at the 1, 5 and 10 percentage levels.
Table 2. Cointegration tests based on the Johansen and Johansen and Juselious approach (LGDP, LITR, LEXR, VAR lag = 4)

<table>
<thead>
<tr>
<th>H0: r = 0</th>
<th>Trace test</th>
<th>5% critical value</th>
<th>10% critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>42.1185</td>
<td>24.0500</td>
<td>21.4600</td>
</tr>
<tr>
<td>H0: r ≤ 1</td>
<td>4.3561</td>
<td>12.3600</td>
<td>10.2500</td>
</tr>
<tr>
<td>H0: r ≤ 2</td>
<td>1.6837</td>
<td>4.1600</td>
<td>3.04000</td>
</tr>
</tbody>
</table>

Notes:
- Critical values are taken from Osterwald – Lenum (1992).
- r denote the number of cointegrated vectors.
- Schwarz Criteria (SC) was used to select the number of lags required in the cointegration test. The computed Ljung – Box Q – statistics indicate that the residuals are white noise.

Table 3 – Causality test results based on vector error – correction modeling

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<thead>
<tr>
<th>Dependent Variable</th>
<th>F – significance level</th>
<th>t – statistic u_t-1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ALGDP</td>
<td>ALITR</td>
</tr>
<tr>
<td>ALGDP</td>
<td>0.236 (2)</td>
<td>0.001*** (2)</td>
</tr>
<tr>
<td>ALITR</td>
<td>0.013** (3)</td>
<td>0.346 (3)</td>
</tr>
<tr>
<td>ALEXR</td>
<td>0.198 (2)</td>
<td>0.137 (2)</td>
</tr>
</tbody>
</table>

Notes: * , **, and *** indicate 10%, 5%, and 1% levels of significance. Number in parentheses are lag lengths.

Table 4 – Summary of causal relations

<table>
<thead>
<tr>
<th>LGDP→LITR</th>
<th>LGDP→LEXR</th>
<th>LITR→LGDP</th>
<th>LITR→LEXR</th>
<th>LEXR→LGDP</th>
<th>LEXR→LITR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>1,2</td>
<td>1,2</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>