Energy Research Centre

WORKING PAPER SERIES

Working Paper 2016-04

Dynamic Inter-Relationships among Tourism, Economic Growth and Energy Consumption in INDIA

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ABSTRACT

This study attempts to explore the dynamic causal and inter-relationships among tourism, economic growth and energy consumption in India. This study covers the annual data from 1971 to 2012. This study applies the cointegration and generalised variance decomposition methods to verify the relationship. The bounds testing approach to cointegration and the Gregory-Hansen test for cointegration with structural break consistently reveal that energy consumption, tourism and economic growth in India are cointegrated. We find that tourism and economic growth strongly affects energy consumption in the long-run. Additionally, we also find that tourism and economic growth in India are inter-related, but the causal effect of tourism on economic growth is stronger than the other way around in both the short- and long-run. Therefore, this study concludes that the tourism-led growth hypothesis is valid but the energy-led growth hypothesis is invalid in India. With such findings, we can confirm that tourism is an important catalyst of growth to the Indian economy. Therefore, policymakers should promote and expand tourism industry in order to sustain the process of economic growth and development in India.

Keywords: Cointegration; Economic growth; Energy consumption, Tourism; Variance decomposition

1. INTRODUCTION

Over the past decades, many studies pertaining to the engines of growth have been conducted with respect to developing countries. This is mainly due to the reason that they attempt to find an effective pillar to upgrade their status to developed countries. From our reading, we observe that energy and tourism are two common factors that hotly debated in the economic growth literature. Numerous studies have been conducted to verify the role of energy consumption and tourism in economic growth. However, their efforts failed to find a consistent causal relationship among economic growth, tourism and energy consumption. Some studies suggested that energy consumption and tourism stimulate long-term economic growth (e.g. Lean and Smyth, 2010; Lean and Tang, 2010; Hye and Khan, 2013; Tang and Shahbaz, 2013; Soares et al., 2014; Tang et al., 2016), while other studies claimed the other way around or not related at all (e.g. Cheng, 1999; Ghosh, 2002; Oh, 2005; Katircioğlu, 2009; Alam et al., 2011; Ghosh, 2011; Ozturk and Acaravci, 2009). Therefore, it is very hard to derive a useful guideline for policymakers elsewhere to design appropriate growth policies for their economies.

Apart from the ambiguity in the results, almost all existing studies likely to look at the impacts of energy consumption and tourism on economic growth separately, where these variables should be inter-related in nature. For example, tourism-related infrastructures and facilities require energy (e.g. oil and electricity) to operate them and energy is also one of the inputs of production that may link to economic growth. On the other hand, an increase in output and tourism demand such as tourist arrivals would increase the demand for energy. Then, an increase in international tourist arrivals would also affect economic growth through its impact on foreign exchange revenue, investment on new infrastructure for tourism and creating more employment opportunities. Certainly, economic growth, tourism and energy consumption should be inter-dependent and earlier studies that analysed such impacts separately may have lost the information on dynamic inter-relationships among the variables.

As far as India is of concern, only a few studies have covered this topic. For example, only Cheng (1999), Ghosh (2002, 2009), Paul and Bhattacharya (2004), Wolde-Rufael (2010), Vidyarthi (2013) and Srinivasan and Ravindra (2015) have examined the relationship between energy consumption and economic growth in India. However, only Ghosh (2011) have empirically investigated the tourism-growth nexus in India. Additionally, none of the earlier studies has tested the relationship between energy consumption and tourism in India. According to the United Nation World Tourism Organisation (UNWTO), India is one of the top emerging tourism destinations in Asia and the Pacific region from 1995 to 2004. In 1995, international tourist arrivals in India are 2.1 million visitors, and then it increases more than 65 per cent to approximately 3.5 million visitors in 2004. In terms of tourism receipts, India alone consistently covered about 75 per cent of the total tourism receipts of South Asia region from 1990 to 2005. In addition, UNWTO (2015) showed that tourism receipts of India consistently stand at the position of top 10 from 2010 up to 2014 in Asia and the Pacific region with the total tourism receipts of USD14490 million in 2010 and USD19700 million in 2014. Apart from that, the energy consumption in India is also among the highest in South Asia region. Srivastava and Shukla (2004) documented that the energy consumption in India jumped nearly five folds from 1971 to 2001, thus ranked as the sixth large energy consumer in the world with the energy consumption of 314 MTOE in 2001. Energy Information Administration (EIA, 2013) documented that apart from China, India is the also the major consumer of energy in Asia. Additionally, International Energy Agency, (IEA, 2013) projected that India will surpass China to be the main source of growth in energy consumption after 2020. Owing to rapid growth in energy consumption and the impressive achievement in attracting international tourists, we believe that the Indian economy is an appropriate case study for us to analyse the dynamic inter-relationships between tourism, energy consumption and economic growth. In addition, the findings for Indian economy would also be generalised to other developing countries, especially those located in the South Asia region.

In order to achieve the objective of this study, we employ the bounds testing approach to cointegration proposed by Pesaran et al. (2001) to analyse the existence of a long-run relationship between economic growth, energy consumption and tourism in India from 1971 to 2012. Unlike the earlier works that based upon the conventional Granger causality test, this study attempts to utilise the innovation accounting approach, namely variance decomposition to ascertain the causal and the inter-relationships among the tourism, energy consumption and economic growth in India. Therefore, the results of this study are expected provide more information and relatively more robust than the earlier studies because it considered the dynamic inter-relationships among economic growth, energy consumption and tourism in India.

The balance of this study is organised as follows. Section 2 provides the relevant literature review. Section 3 discusses the methodological framework and data used in this study. Section 4 reports and also discusses the estimation results of this study. Finally, the conclusion and policy implication will be presented in Section 5.

2. REVIEW OF PAST STUDIES

The primary aim of this study is to analyse the dynamic association among tourism, energy consumption and economic growth. In light of this, the focus of this section is to discuss the past studies on the energy-growth nexus, the tourism-growth nexus as well as the energy-tourism nexus. Based upon our reading, research on the energy-tourism nexus might be limited but there are voluminous of works have been published on the energy-growth and the tourism-growth nexuses. Therefore, it might be impossible to review all the studies here. To conserve space and avoid overlapping, we only reviewed 46 relevant studies and they are summarised in Table 1. According to the aim of this study, the review will be segregated into three major themes as follows:

INSERT TABLE 1 HERE

2.1 Studies on the nexus of energy consumption and economic growth

We have reviewed 20 relevant studies on the energy-growth nexus as presented in Table 1. Based on the findings, we can categorise the studies into four plausible hypotheses, namely growth hypothesis, conservation hypothesis, feedback hypothesis and neutrality hypothesis. First, the growth hypothesis refers to uni-directional causality from energy consumption to economic growth. Under this hypothesis, policy on energy conservation will deteriorate the process economic growth of a country. Therefore, energy is the catalyst for growth. So, energy exploration policies should be appreciated to sustain economic growth for a long span of time. Apergis and Payne (2009) for OECD economies, Lean and Smyth (2010) for ASEAN economies, Wolde-Rufael (2010) for India, Tang and Shahbaz (2013) for Pakistan, Chandran and Tang (2013) for India, Soares et al. (2014) for Indonesia, Tang and Abosedra (2014) for MENA economies and Tang et al. (2016) for Vietnam are the excellence examples of studies that supporting the growth hypothesis. Unlike the growth hypothesis presented earlier, the second hypothesis that is conservation hypothesis refers to the case where energy consumption is the result rather than the cause of economic growth, i.e. uni-directional causality from economic growth to energy consumption. In the review of earlier studies, we find that most of the studies on lower-middle-income economies such as

Bangladesh, India and Pakistan are likely to support the conservation hypothesis (e.g. Cheng, 1999; Ghosh, 2002; 2009; Paul and Uddin, 2011; Chandran and Tang, 2013). The findings of these studies reveal that energy conservation policies may not have detrimental impacts on economic growth.

Feedback hypothesis is the third hypothesis suggesting the bi-directional causality findings between energy consumption and economic growth. This hypothesis noted that energy consumption and economic growth is inter-dependent. Among the selected studies under review, we notice that only 3 studies on Indian economy supporting the feedback hypothesis. Among them are Paul and Bhattacharya (2004), Vidyarthi (2013) and Srinivasan and Ravindra (2015). Additionally, Shahbaz and Lean (2012) for Pakistan, Chandran and Tang (2013) for China, Tang and Tan (2013a) for Malaysia and Mudarissov and Lee (2014) for Kazakhstan also yield the same findings regardless of the model specification. However, very few studies reach the evidence to support the neutrality hypothesis – energy consumption and economic growth are unrelated. According to Table 1, only Alam et al. (2011) that used multivariate model and found no causal relationship between energy consumption and economic growth in India. For the sake of brevity, the variation of causality among studies under review may be due to the differences in method, data, model specification and the stage of development which are consistent with the pointed raised by Apergis and Tang (2013) and Ozturk (2010).

2.2 Studies on the nexus of tourism and economic growth

In this sub-section, this study attempts to discuss the findings of previous studies on tourism-growth nexus. Similar to the energy-growth nexus, studies on the impact of tourism and economic growth has been debated for decades using varieties of models, methods and data. However, the findings of previous studies remain controversial. For example, Balaquer and Cantavella-Jorda (2002) conducted a study in Spain to analyse the validity of tourism-led growth hypothesis using a tri-variate model. They found that tourism Granger-cause economic growth in Spain but not evidence of reverse causation. Likewise, Katircioğlu (2010, 2011) and Lee and Hung (2010) for Singapore, Jalil et al. (2013) and Hye and Khan (2013) for Pakistan, Tang and Tan (2013a) for Malaysia, Tang and Abosedra (2014) for MENA countries, and Hatemi-J (2015) for the United Arab Emirates (UAE) also yield the same causality results that support the tourism-led growth hypothesis. However, another group of studies seem against the tourism-led growth hypothesis. In the case of South Korea, for example, Oh (2005) found that tourism is the result rather than the causing factor of economic growth. Tang (2011) examined the tourism-led growth hypothesis in Malaysia using disaggregated tourism market data. The author claimed that although tourist arrivals from some selected countries are generating economic growth in Malaysia, but the majority of them support the growth-driven tourism hypothesis. Therefore, the study concluded that the tourism-led growth hypothesis is not strong enough in the case of Malaysia. Similarly, Ghosh (2011) for India and Lee (2012) for Singapore also failed to find persuasive evidence to support the tourism-led growth hypothesis.

On the contrary, we notice that 6 out of 20 studies of the tourism-growth nexus under review found that tourism and economic growth are inter-related because they are Granger-cause each other. Khalil et al. (2007), Kadir and Karim (2012), Tang (2013), Al-mulali et al. (2014), Kumar (2014), Tang and Tan (2015), Tang and Abosedra (2016) are among the studies that found evidence of bi-directional causality between tourism and economic growth regardless of model specification (i.e. bi-variate, tri-variate or multivariate models).

2.3 Studies on the nexus of energy consumption and tourism

Based upon our reading, there are limited of literature on the relationship between tourism and energy consumption. Kelly and Williams (2007) noted that the impact of tourism on global energy consumption only recently gains little attention from academic and institution. Empirical works on the relationship between energy consumption and tourism are not as extensive as energy-growth and tourism-growth studies. Lai et al. (2011), Tiwari et al. (2013), Katircioglu (2014a, 2014b), Katircioğlu et al. (2014) and Yorucu and Mehmet (2015) are among the examples of studies that touched on the link between tourism and energy consumption. Lai et al. (2011) employed the Johansen cointegration and Granger causality tests to assess the association among electricity consumption, tourism and other control variables in China. They discovered that tourism seems not playing any significant role in China's electricity consumption and thus they removed tourism from the model.[1] Tiwari et al. (2013) setup a tri-variate panel vector autoregression model to analyse the links between energy consumption, tourism and CO_2 emissions in OECD economies. In contrast to Lai's et al. (2011) findings, they found that tourism has a significant positive impact on energy consumption in OECD economies.

Katircioğlu (2014a) examined the association between energy consumption, tourism, CO_2 emission and economic growth in Turkey using the bounds testing approach to cointegration, impulse response function (IRF) and variance decomposition (VD) analyses. The study found that these variables are cointegrated. Additionally, both IRF and VD analyses suggest that shock in tourism explain the variation in energy consumption more than the other way around. Therefore, the study surmised that tourism is a significant contributor to energy consumption in Turkey. Similarly, Katircioğlu (2014b) and Yorucu and Mehmet

[1] Apart from the issue of insignificant of tourism variable, they also found that model that include tourism variable tends not to pass the diagnostic tests, particularly the stability test.

(2015) discovered the same results in Singapore and Turkey respectively. However, Katircioğlu et al. (2014) examined whether tourism expansion induces energy consumption and/or CO_2 emissions in Cyprus. The bounds testing approach to cointegration and Granger causality tests are employed in the study. Generally, they found that tourism, energy consumption and CO_2 emissions can form a meaningful long-run equilibrium relationship (i.e. cointegrated). Nonetheless, the study discovered that tourism and energy consumption in Cyprus are Granger-cause each other. Therefore, they concluded that tourism has a direct implication on long-term energy consumption in the Cypriot economy.

3. METHODOLOGY AND DATA

3.1 Cointegration analysis

We employ the bounds testing approach to cointegration developed by Pesaran et al. (2001) to explore the existence of a long-run equilibrium relationship among the series. The bounds testing approach to cointegration has several advantages. It yields consistent long-run estimators even when the right-hand side variables are endogenous. By using appropriate lag order, it is possible to simultaneously correct the serial correlation problem and the problem of endogenous regressors (Pesaran and Shin, 1999). Unlike other widely used cointegration techniques (e.g. Engle and Granger, 1987; Johansen, 1988), this approach can be applied irrespective of whether the explanatory variables are purely $I(0)$ or purely $I(1)$. Moreover, a dynamic unrestricted error-correction model (UECM) can be derived through a simple linear transformation. The UECM equation integrates the short-run dynamics with the long-run equilibrium without losing any long-run information. To implement the bounds testing approach to cointegration, we estimate the following UECM equations using ordinary least squares (OLS) estimator:

$$\Delta \ln EC_t = \alpha_1 + \delta_1 \ln EC_{t-1} + \delta_2 \ln TOUR_{t-1} + \delta_3 \ln GDP_{t-1} + \sum_{i=1}^{p} \phi_i \Delta \ln EC_{t-i} + \sum_{i=0}^{q} \varphi_i \Delta \ln TOUR_{t-i}$$
$$\sum_{i=0}^{r} \gamma_i \Delta \ln GDP_{t-i} + \varepsilon_{1t} \quad (1)$$

$$\Delta \ln TOUR_t = \alpha_2 + \delta_1 \ln EC_{t-1} + \delta_2 \ln TOUR_{t-1} + \delta_3 \ln GDP_{t-1} + \sum_{i=1}^{p} \varphi_i \Delta \ln TOUR_{t-i} + \sum_{i=0}^{q} \phi_i \Delta \ln EC_{t-i}$$
$$\sum_{i=0}^{r} \gamma_i \Delta \ln GDP_{t-i} + \varepsilon_{2t} \quad (2)$$

$$\Delta \ln GDP_t = \alpha_3 + \delta_1 \ln EC_{t-1} + \delta_2 \ln TOUR_{t-1} + \delta_3 \ln GDP_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta \ln GDP_{t-i} + \sum_{i=0}^{q} \phi_i \Delta \ln EC_{t-i}$$
$$\sum_{i=0}^{r} \varphi_i \Delta \ln TOUR_{t-i} + \varepsilon_{3t} \quad (3)$$

where Δ is the first difference operator, ln denotes the natural logarithm and ε_{it} are the error term that assumed to be normally distributed and white noise. $\ln EC_t$ is the per capita energy consumption, $\ln TOUR_t$ is the tourism indicator measure by international tourist arrivals and $\ln GDP_t$ is the per capita real GDP. *p*, *q* and *r* are the maximum numbers of lagged first difference regressors. The optimal lag structures of the first difference explanatory variables are selected based upon Akaike Information Criteria (AIC) due to its superior performance in small sample study (Lütkepohl, 2005). To examine the presence of a long-run equilibrium relationship, Pesaran et al. (2001) suggested using the joint significance F-test on the coefficients of the one period lagged level variables (i.e. $H_0: \delta_1 = \delta_2 = \delta_3 = 0$ versus $H_A: \delta_1 \neq \delta_2 \neq \delta_3 \neq 0$). With respect to cointegration inference, Pesaran et al. (2001) provided two set of asymptotic bounds critical values i.e. lower bound critical values by assuming that the explanatory variables are stationary at level, *I*(0) and upper bound critical value if the explanatory variables are integrated of order one, *I*(1). Owing to the availability of such critical values, the bounds testing approach to cointegration can be used even though the explanatory variables are not consistently $I(1)$ as a condition required by the conventional tests for cointegration. However, Narayan (2005) and Turner (2006) argued that the bounds critical values provided by Pesaran et al. (2001) are not suitable for small sample study. Therefore, we used the response surfaces procedure suggested by Turner (2006) to derive the bounds critical values for the small sample. If the calculated F-statistics exceed their respective upper bound critical value for the small sample, the null hypothesis can be rejected and we can conclude that energy consumption, tourism and economic growth in India are cointegrated. Otherwise, these variables are not cointegrated.

3.2 Variance decomposition analysis

Shahbaz et al. (2012) and Wolde-Rufeal (2009) documented that Granger causality test is an in-sample test and are not able to measure the relative strength of causal effects among the variables, especially beyond the selected sample period. Shan (2005) noted that variance decomposition analysis can be used as an alternative test for Granger causality among the variables of interested. Following Shahbaz et al. (2012), Wolde-Rufeal (2009) and Shan (2005), this study employs the generalised variance decomposition approach introduced by Pesaran and Shin (1998) to investigate the causal and inter-relationships among economic growth, tourism and energy consumption in India. Generalised variance decomposition approach is the choice of this study because it allow one to quantify how much feedback exists from one variable to the other and also to assess the relative strength of the causal effects beyond the sample period (Wolde-Rufeal, 2009). Moreover, this approach is also superior to the orthogonalised variance decomposition because it is invariant to the ordering of the variables in the vector autoregression (VAR) system.

One can justify the direction of causality based upon the relative strength of Granger-causal chain or degree of exogeneity among the variables beyond the selected sample period.

For instance, if energy consumption explains most of the variations in the forecast error variance of economic growth but only a small portion of variation in the forecast error variance of energy consumption can be explained by a shock in economic growth, then we can conclude that there is uni-directional causality running from energy consumption to economic growth. On the other hand, there is evident of bi-directional causality between energy consumption and economic growth if a large portion of variations in forecast error variance of these two variables can be explained by each other. Finally, energy consumption and economic growth are not related if only a very small portion of variation in the forecast error variance can be explained by each other. The same procedure can be applied to the tourism-growth nexus and the tourism-energy nexus.

In order to examine the dynamic inter-relationship between energy consumption, tourism and economic growth in India using variance decomposition, we follow Shan (2005) by estimating the vector autoregression (VAR) system as below:

$$V_t = \sum_{i=1}^{k} \theta_i V_{t-i} + \eta_t \tag{4}$$

where $V_t = \left(\mathrm{EC}_t, \mathrm{TOUR}_t, \mathrm{GDP}_t\right)$, $\eta_t = \left(\eta_{\mathrm{EC}}, \eta_{\mathrm{TOUR}}, \eta_{\mathrm{GDP}}\right)$, θ_i are the estimated coefficients and η_t is a vector of disturbance terms.

3.3 Data

This study covers annual time series from 1971 to 2012. The data of per capita energy consumption, per capita real GDP and international tourist arrivals are extracted from *World Development Indicators* (WDI) provided by World Bank and *Yearbook of Asia and the*

Pacific published by the United Nations. All series have been converted into natural logarithms to induce stationarity.

4. EMPIRICAL RESULTS

The results of descriptive statistics and correlation matrix are reported in Table 2. We find that energy consumption, tourism, and economic growth in India are positively correlated. Specifically, the strength of correlation varied among the variables and they are ranged from 0.934 to 0.994. Additionally, none of the variables is non-spherically distributed.

INSERT TABLE 2 HERE

Before we proceed to perform the cointegration, it is necessary to determine the order of integration of each variables using unit root tests to ensure that none of the variables is integrated of an order higher than one. This is because the bounds testing approach to cointegration cannot be used if any of the variables is integrated of order two, $I(2)$. In light of this, we begin by testing the order of integration using the augmented Dickey-Fuller (ADF) unit root test. According to the unit root test results presented in Table 3, we find that none of the variables is integrated of an order higher than one. Specifically, the results of ADF test suggest that the variables under investigation are integrated of order one. However, the ADF unit root test may provide biassed and spurious results when the structural break occurred in a series. To circumvent this problem, we then apply the one structural break unit root test proposed by Zivot and Andrews (1992) to verify the unit root results. Based on the results of Zivot-Andrews unit root test reported in Table 3, we notice that the test finds no additional evidence against the null hypothesis of a unit root relative to the ADF test. Therefore, we can conclude that all variables are $I(1)$ and we proceed to examine the presence of a long-run equilibrium relationship using bounds testing approach to cointegration.

INSERT TABLE 3 HERE

Since the result of bounds test for cointegration is sensitive to the choice of lag length, selection of appropriate lag length is necessary. With respect to this issue, we select the optimal lag length using AIC statistic because Lütkepohl (2005) pointed out that it is superior to small sample study. The results of bounds testing approach to cointegration and the diagnostic tests are reported in Panel A of Table 4. We find that when energy consumption and economic growth are the dependent variables for India, the calculated F-statistics $F_{\mathrm{EC}}\left(\mathrm{EC}\middle|\mathrm{TOUR},\mathrm{GDP}\right)=8.049$ and $F_{\mathrm{GDP}}\left(\mathrm{GDP}\middle|\mathrm{EC},\mathrm{TOUR}\right)=7.975$ are higher than the 5 per cent upper bound critical value for the small sample. Nevertheless, the calculated F-statistic $F_{\mathrm{TOUR}}\left(\mathrm{TOUR}\middle|\mathrm{EC},\mathrm{GDP}\right)=2.935$ is less than the 5 per cent upper bound critical value when tourism is the dependent variable. These results suggest that the null hypothesis of no cointegration can be rejected for India only when energy consumption and economic growth are the dependent variables.

INSERT TABLE 4 HERE

Next, this study also performs the residuals-based test for cointegration with one structural break suggested by Gregory and Hansen (1996) to check the robustness the cointegration relationship among energy consumption, tourism and economic growth in India. The results of Gregory-Hansen test for cointegration are presented in Panel B of Table

4. We find that the results of Gregory-Hansen test are generally consistent with those from the bounds testing approach to cointegration. Therefore, we conclude that the variables are cointegrated and the evidence of cointegration among energy consumption, tourism and economic growth for India are robustness.

Having established the variables are cointegrated, the analysis of this study will be extended to investigate the causal and inter-relationship among energy consumption, tourism and economic growth in India using the generalised variance decomposition method in a level VAR framework.[2] The results are presented in Table 5. In the short-run (i.e. 3 years), we find that a shock in tourism explains only 4.9 per cent of the variation in energy consumption but it explains approximately 17.1 per cent of the variation in economic growth. Besides, the results show that a shock in economic growth explains only 7.8 per cent and nearly 12.6 per cent of the variation in energy consumption and tourism in India respectively. On the contrary, we find a shock in energy consumption only explains a small portion of variation in economic growth (0.26 per cent) and tourism (0.36 per cent) in the short-run. Based on these findings, we can conclude that not much of the variables are connected to each other except a slightly strong uni-directional causality evidence from tourism to economic growth in the short-run.

INSERT TABLE 5 HERE

[2] One may doubt about the use of level VAR to assess the Granger-causal chain among the variables, especially when the variables are cointegrated. Engle and Granger (1987) narrated that the VAR system at level can be used if the variables are cointegrated because the long-run constraints will be satisfied asymptotically. Fanchon and Wendel (1992) added that forecasting model with VAR in level yield the best forecast compared to Bayesian VAR and vector error-correction model (VECM). As the generalised variance decomposition method is to assess the dynamic inter-relationships among energy consumption, tourism and economic growth but not to obtain the parameters, the use of VAR in level remain appropriate and should not be worried, especially when the variables are cointegrated as the case of the present study. Based upon our reading, we notice that many of the earlier studies also used VAR in level model for cointegrated variables (e.g. Ibrahim, 2005; Ramaswamy and Slok, 1998).

Turning to the long-run causality (i.e. 30 years), we find that economic growth and tourism together explain most of the variations in the forecast error variance in energy consumption, but energy consumption only explains less than 9 per cent of the variations in economic growth and tourism. Specifically, a shock in economic growth and tourism explain approximately 41 per cent and 54 per cent of the variation in energy consumption respectively. With reference to these findings, we conclude that there is a strong long-run uni-directional causality running from economic growth and tourism to energy consumption in India rather than the other way around. These results are corroborated by the findings of Cheng (1999), Ghosh (2002), Chandran and Tang (2013), Katircioğlu (2014a, 2014b), and Yorucu and Mehmet (2015) but contrary to the results obtained by Alam et al. (2011), Lai et al. (2011), and Tiwari et al. (2013). In terms of the tourism-growth nexus, our empirical results suggest that there is evident of long-run bi-directional causality between tourism and economic growth in India. However, we find that the strength causal effect from tourism to economic growth is relatively higher compared to the reverse causal effect. For example, a shock in tourism explains about 42 per cent of the variation in economic growth, but a shock in economic growth only explains about 25 per cent of the variation in tourism. Despite tourism and economic growth are Granger-cause each other, when considering the relatively strength of the two causal effects, the results are more likely to be uni-directional causality running from tourism and economic growth which is in line with the findings of Lee and Hung (2010), Hye and Khan (2013), Jalil et al. (2013), and Tang and Abosedra (2014).

5. CONCLUSION AND POLICY IMPLICATIONS

This paper explored the dynamic inter-relationships among energy consumption, tourism and economic growth in India over the period of 1971 to 2012. We applied the bounds testing approach to cointegration and the Gregory-Hansen test for cointegration with a structural break to examine the presence of long-run equilibrium relationship among energy consumption, tourism and economic growth. Unlike the earlier studies, we examine the causal relationship between the variables of interest using the generalised variance decomposition method. From our estimation results, both cointegration tests consistently confirm that energy consumption, tourism and economic growth in India are cointegrated. In terms of causality, our empirical results show that tourism and economic growth are inter-related but there is strong evidence of uni-directional causality running from tourism to economic growth in both the short- and long-run. Apart from that, we also find strong uni-directional causality running from economic growth and tourism to energy consumption especially in the long-run. For the sake of brevity, our empirical results show strong support the tourism-led growth hypothesis but reject the energy-led growth hypothesis in the case of India.

Several policy recommendations can be derived from the findings of the present study. Since we find that tourism is a catalyst of growth for the Indian economy, policymakers in India should give priority to improving the tourist-related infrastructures such as setting more tourist information centre, providing better accommodation and transportation as they are the key elements to facilitate the growth of tourism industry. In fact, the higher education institutions such as universities and colleges may also play very important role in attracting international tourist arrivals by organising more international conferences and educational programmes because these kind educational activities would attract international students and researchers to visit India. As a result, the number of international tourist arrivals to India will increase tremendously which in turn lead to the rapid development of the Indian economy. Additionally, long-term economic growth can be sustained and India could become the best choice of tourism destination, particularly in South

Asia region. Furthermore, as the findings of this study suggest that India is not an energy-dependent economy, policymakers may implement energy conservation policy to reduce environmental degradation and protect the environmental quality without any serious adverse implication on the process of economic growth and development in India.

It is important to note that no scientific research is perfect including the presence study. This study finds the association between energy consumption, tourism and economic growth in India at the macro level but neglecting those sectors that heavily dependent on energy and comparison of impacts among industries in India. The findings might be varied when segregated the data for sectoral analysis. However, a solid answer to this research question is an important avenue for future study.

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Table 1: The summary of selected studies on energy-growth, tourism-growth and energy-tourism nexuses

No.	Author(s)	Sample	Country	Methodology	Variables	Main causality results
Energy-Growth studies:						
1.	Cheng (1999)	1952-1995 (A)	India	Johansen-Juselius; Hsiao's causality	EG; EC; K; L	EG → EC
2.	Ghosh (2002)	1950-1997 (A)	India	Johansen-Juselius; Granger causality – VAR	EG; EC	EG → EC
3.	Paul and Bhattacharya (2004)	1950-1996 (A)	India	Johansen-Juselius; Granger causality – VECM	EG; EC; K; L	EG ↔ EC
4.	Apergis and Payne (2009)	1980-2004 (A)	Central America	Pedroni's cointegration test; Panel Granger causality – VECM	EG; EC; K; L	EC → EG
5.	Ghosh (2009)	1971-2006 (A)	India	ARDL; Granger causality – VECM	EG; EC; L	EG → EC
6.	Lean and Smyth (2010)	1980-2006 (A)	ASEAN	Panel Johansen cointegration test; Panel Granger causality – VECM	EG; EC; CO2	EC → EG
7.	Wolde-Rufael (2010)	1969-2006 (A)	India	ARDL; TYDL causality - AVAR	EG; EC; K; L	EC → EG
8.	Paul and Uddin (2011)	1971-2010 (A)	Bangladesh	IRF; VD; Granger causality – VAR	EG; EC	EG → EC
9.	Alam et al. (2011)	1971-2006 (A)	India	GIRF; TYDL Granger causality – AVAR	EG; EC; CO2; K; L	EG --- EC
10.	Shahbaz and Feridun (2012)	1971-2008 (A)	Pakistan	ARDL; Granger causality – VECM; TYDL causality – AVAR	EG; EC	EG → EC
11.	Shahbaz and Lean (2012)	1972-2010 (A)	Pakistan	ARDL; Granger causality – VECM	EG; EC; K; L	EG ↔ EC
12.	Tang and Shahbaz (2013)	1972-2010 (A)	Pakistan	Johansen-Juselius; TYDL causality – AVAR	EG; EC; K; L	EC → EG
13.	Chandran and Tang (2013)	1965-2009 (A)	China	Combined cointegration test; Granger causality – VECM	EG; EC; CO2	EG ↔ EC
			India	Combined cointegration test; Granger causality – VAR	EG; EC; CO2	EG → EC
14.	Vidyarthi (2013)	1971-2009 (A)	India	Johansen-Juselius; Granger causality – VECM	EG; EC; CO2	EG ↔ EC
15.	Tang and Tan (2013a)	1970-2009 (A)	Malaysia	ARDL; Granger causality – VECM	EG; EC; P; TE	EG ↔ EC
16.	Mudarissov and Lee (2014)	1990-2008 (A)	Kazakhstan	Johansen-Juselius; Granger causality – VECM	EG; EC	EG ↔ EC
17.	Soares et al. (2014)	1971-2010 (A)	Indonesia	Johansen-Juselius; Granger causality – VECM	EG; EC	EC → EG
18.	Tang and Abosedra (2014)	2001-2009 (A)	MENA	Statis panel data approach; Generalised method of moment (GMM)	EG; EC; TOUR; PS; K	EC → EG
19.	Srinivasan and Ravindra (2015)	1970-2012 (A)	India	Gregory-Hansen; VD; Granger causality – VECM	EG; EC; CO2; XM	EG ↔ EC
20.	Tang et al. (2016)	1971-2011 (A)	Vietnam	Johansen-Juselius; TYDL causality – AVAR	EG; EC; FDI; DI	EC → EG
Tourism-Growth studies:						
21.	Balaguer and Cantavella-Jorda (2002)	1975-1997 (Q)	Spain	Johansen-Juselius; Granger causality – VECM	EG; TOUR; RER	TOUR → EG
22	Oh (2005)	1975-2001 (Q)	South Korea	Engle-Granger; Granger causality – VAR	EG; TOUR	EG → TOUR
23.	Khalil et al. (2007)	1960-2005 (A)	Pakistan	Engle-Granger; Granger causality – VECM	EG; TOUR	EG ↔ TOUR
24.	Katircioğlu (2010)	1960-2007 (A)	Singapore	ARDL; Granger causality – VECM	EG; TOUR; RER	TOUR → EG
25.	Lee and Hung (2010)	1978-2007 (A)	Singapore	ARDL; Granger causality – VECM	EG; TOUR: GHE	TOUR → EG
26.	Ghosh (2011)	1980-2006 (A)	India	ARDL; Johansen-Juselius	EG; TOUR; RER	EG --- TOUR

27. Katircioğlu (2011)	1960-2007 (A)	Singapore	ARDL; Granger causalituy – VECM	EG; TOUR; RER	TOUR → EG
28. Tang (2011)	1995-2009 (M)	Malaysia	ECM-based t-test; Granger causality – VECM	EG; TOUR	EG → TOUR
29. Kadir and Karim (2012)	1998-2005 (A)	ASEAN	Pedroni's cointegration test; Panel Granger causality – VECM	EG; TOUR	EG ↔ TOUR
30. Lee (2012)	1980-2007 (A)	Singapore	ARDL; Granger causality – VECM	EG; TOUR; IM; EX	EG → TOUR
31. Jalil et al. (2013)	1972-2011 (A)	Pakistan	ARDL; Granger causality – VECM	EG; TOUR; K; XM; P	TOUR → EG
32. Tang (2013)	1974-2009 (A)	Malaysia	ARDL; Granger causality – VECM	EG; TOUR; RER	EG ↔ TOUR
33. Tang and Tan (2013b)	1995-2009 (M)	Malaysia	Combined cointegration test; rolling causality	EG; TOUR	TOUR → EG
34. Hye and Khan (2013)	1971-2008 (A)	Pakistan	ARDL; Johansen-Juselius	EG; TOUR	TOUR → EG
35. Al-mulali et al. (2014)	1985-2012 (A)	Middle East	Pedroni's cointegration test; Panel Granger causality – VECM	EG; TOUR; RER; XM	EG ↔ TOUR
36. Kumar (2014)	1980-2010 (A)	Vietnam	ARDL; TYDL causality – AVAR	EG; TOUR; K, TE; FD	EG ↔ TOUR
37. Tang and Abosedra (2014)	2001-2009 (A)	MENA	Statis panel data approach; Generalised method of moment (GMM)	EG; EC; TOUR; PS; K	TOUR → EG
38. Hatemi-J (2015)	1995-2014 (A)	UAE	TYDL causality – AVAR	EG; TOUR	TOUR → EG
39. Tang and Tan (2015)	1975-2011 (A)	Malaysia	Johansen-Juselius; Granger causality – VECM	EG; TOUR; PS; GNS	EG ↔ TOUR
40. Tang and Abosedra (2016)	1995-2011 (M)	Lebanon	TYDL and rolling causalities – AVAR	EG; TOUR; RER	EG ↔ TOUR
Energy-Tourism studies:					
41. Lai et al. (2011)	1999-2008 (Q)	Macao (China)	Johansen-Juselius; Granger causality – VECM	EG; EC; TOUR; L	TOUR --- EC
42. Tiwari et al. (2013)	1995-2005 (A)	OECD	Panel VAR; Panel IRF; Panel VD	EC; TOUR; CO2	EC → TOUR
43. Katircioğlu (2014a)	1960-2010 (A)	Turkey	ARDL; IRF; VD	EG; EC; TOUR; CO2	TOUR → EC
44. Katircioğlu (2014b)	1971-2010 (A)	Singapore	Multiple break cointegration test; VD; Granger causality - VECM	EG; EC; TOUR; CO2	TOUR → EC
45. Katircioğlu et al. (2014)	1970-2009 (A)	Cyprus	ARDL; Granger causality – VECM	EC; TOUR; CO2	EC ↔ TOUR
46. Yorucu and Mehmet (2015)	1960-2010 (A)	Turkey	ARDL; Granger causality – VECM	EC; TOUR; CO2	TOUR → EC

Note: EC = Energy consumption, EG = economic growth (GDP or GNP), K = capital, L = labour force (population), CO2 = Carbon dioxide emission, P = Price, TE = Technology innovation, XM = Total trade (Export plus import), FDI = Foreign direct investment, DI = Domestic direct investment, TOUR = Tourism, RER = Real exchange rates, GHE = Government spending on health, IM = Import, EX = Export, FD = Financial development, PS = Political stability, and GNS = Gross national savings. ARDL = Autoregressive distributed lag, VAR = Vector autoregression, AVAR = Augmented VAR, VECM = Vector error-correction model, IRF = Impulse response function, VD = Variance decomposition, GIRF = Generalised IRF, TYDL = Toda-Yamamoto-Dolado-Lütkepohl, and ECM = Error-correction model. The notations "→" represents uni-directional causality, "↔" represents bi-directional causality and "---" represents neutral causality.

Table 2: Summary of descriptive statistics and correlation analysis

Statistics	$\ln EC_t$	$\ln GDP_t$	$\ln TOUR_t$
Mean	5.934	10.309	7.434
Median	5.924	10.208	7.468
Maximum	6.436	11.204	8.791
Minimum	5.621	9.774	5.707
Standard deviation	0.239	0.437	0.819
Skewness	0.438	0.555	–0.332
Kurtosis	2.169	2.112	2.475
Jarque-Bera	2.553	3.538	1.255
(Probability)	(0.279)	(0.171)	(0.534)
Observation	42	42	42

Variables	$\ln EC_t$	$\ln GDP_t$	$\ln TOUR_t$
$\ln EC_t$	1.000	0.994	0.947
$\ln GDP_t$	0.994	1.000	0.934
$\ln TOUR_t$	0.947	0.934	1.000

Table 3: The results of unit root tests

Variables	ADF	Zivot-Andrews unit root test with one break			
	Test statistics	Model A		Model C	
		Break date	Test statistics	Break date	Test statistics
Level:					
$\ln EC_t$	–0.279 (0)	2006	–2.635 (0)	2001	–3.769 (0)
$\ln GDP_t$	–1.281 (0)	1979	–2.772 (0)	1993	–3.006 (0)
$\ln TOUR_t$	–2.403 (0)	1990	–3.025 (0)	1983	–2.590 (0)
First difference:		Critical values#			
$\Delta\ln EC_t$	–6.172 (0)***	Model A:		Model C:	
$\Delta\ln GDP_t$	–4.687 (3)***	1 per cent	–5.340	1 per cent	–5.570
$\Delta\ln TOUR_t$	–5.539 (0)***	5 per cent	–4.800	5 per cent	–5.080

Notes: *** and ** denote rejection at the 1 and 5 per cent significance levels, respectively. Δ is the first difference operator. (.) indicates the optimal lag length for ADF and Zivot-Andrews tests as determined by Akaike's Information Criterion (AIC). # Critical values for the Zivot-Andrews unit root test with break are obtained from Zivot and Andrews (1992).

Table 4: The results of cointegration tests

Panel A: Bounds testing approach to cointegration			
	$F_{EC}(EC \mid TOUR, GDP)$	$F_{TOUR}(TOUR \mid EC, GDP)$	$F_{GDP}(GDP \mid EC, TOUR)$
Optimal lags	(5, 0, 2)	(1, 3, 1)	(5, 5, 5)
F-statistics	8.049**	2.935	7.975**
Significant level	Critical values (T = 42)#		
	Lower bounds $I(0)$	Upper bounds $I(1)$	
1 per cent	7.685	8.823	
5 per cent	5.234	6.157	
10 per cent	4.198	5.017	
Diagnostic tests	Statistics	Statistics	Statistics
R^2	0.674	0.527	0.818
Adjusted- R^2	0.505	0.351	0.559
F-statistics	3.970***	3.003**	3.156**
χ^2_{NORMAL}	1.173	0.619	1.260
χ^2_{SERIAL}	[2]: 4.668	[2]: 1.644	[2]: 2.703
χ^2_{ARCH}	[2]: 0.226	[2]: 1.378	[2]: 2.824
χ^2_{RESET}	[2]: 3.057	[2]: 0.392	[2]: 1.663

Panel B: Gregory-Hansen test for cointegration						
	$(EC \mid TOUR, GDP)$		$(TOUR \mid EC, GDP)$		$(GDP \mid EC, TOUR)$	
Models	ADF	Break	ADF	Break	ADF	Break
2 – (C)	–4.61	2001	–4.15	1977	–4.87*	1999
3 – (C/T)	–4.39	1998	–4.90	1977	–5.03*	2003
4 – (C/S)	–5.40*	1999	–5.11	1979	–5.80**	1998

	Critical values (m = 2)♣		
Models	1 per cent	5 per cent	10 per cent
2 – (C)	–5.44	–4.92	–4.69
3 – (C/T)	–5.80	–5.29	–5.03
4 – (C/S)	–5.97	–5.50	–5.23

Note: The asterisks ***, ** and * denote the significant at 1, 5 and 10 per cent levels, respectively. The optimal lag structure is determined by AIC. The parenthesis [ ] is the order of diagnostic tests. # Bounds critical values are computed using a surface response procedure provided by Turner (2006). ♣ Critical values are obtained from Gregory and Hansen (1996) and m refers to the number of explanatory variables.

Table 5: The results of generalised variance decomposition

Relative variance of lnEC			
Year	lnEC	lnGDP	lnTOUR
1	97.24	2.24	0.52
2	93.27	4.62	2.11
3	87.26	7.84	4.90
4	79.51	11.71	8.78
5	70.56	15.98	13.46
10	28.99	33.98	37.03
15	10.69	40.65	48.66
20	5.65	41.82	52.53
25	5.01	41.41	53.58
30	5.68	40.66	53.66
Relative variance of lnGDP			
Year	lnEC	lnGDP	lnTOUR
1	0.33	86.82	12.85
2	0.22	84.80	14.98
3	0.26	82.68	17.06
4	0.42	80.53	19.05
5	0.68	78.38	20.94
10	2.58	68.74	28.68
15	4.61	61.42	33.97
20	6.34	56.05	37.61
25	7.75	52.07	40.18
30	8.89	49.05	42.06
Relative variance of lnTOUR			
Year	lnEC	lnGDP	lnTOUR
1	0.14	11.38	88.48
2	0.24	11.96	87.80
3	0.36	12.56	87.08
4	0.50	13.15	86.35
5	0.66	13.73	85.61
10	1.63	16.53	81.84
15	2.78	19.04	78.18
20	3.96	21.25	74.79
25	5.10	23.15	71.75
30	6.16	24.78	69.06

Note: The variances presented about are re-scaled into 100.