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Effect of tourism on economic growth of Sri Lanka: accounting for capital per worker, exchange rate and structural breaks

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Abstract We explore the nexus between tourism, exchange rate and economic growth in Sri Lanka over the period 1980–2014. Using the augmented Solow (Q J Econ 70(1):65–94, 1956) framework and the ARDL bounds procedure whilst accounting for structural breaks using Bai and Perron (J Appl Econ 18(1):1–22, 2003) multiple break tests, the short-run and long-run association and impacts are examined. The results confirm the presence of a long-run association between tourism receipts (% of GDP), exchange rate, capital per worker and output per worker. The regression results show a 1% increase in tourism receipts results in a 0.03 and 0.06% increase in output per worker in the short-run and long-run, respectively. A unidirectional causality is noted from tourism to output per worker;

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from exchange rate to output per worker and capital per worker; and from output to capital, in per worker terms. Finally, we note that although structural breaks periods have negative association with economic growth, they are not statistically significant.

Keywords Tourism · Economic growth · Elasticity · Cointegration · Causality · Structural breaks · Sri Lanka

1 Introduction

Tourism has experienced an unprecedented expansion in many developed and developing countries. In these countries, the tourism sector has become one of the leading drivers of socio-economic change and progress. The expansion in international tourist numbers is also underscored by the United Nations World Tourism Organization (UNWTO) which projects tourist arrivals on aggregate to grow by 3.3% a year to reach 1.8 billion by 2030.[1] The growth momentum and the resilience of the sector is supported by concurrent expansion in tourist arrivals in the emerging and advanced economies which is expected to grow by 4.4 and 2.2%, per annum, respectively. In a recent report released by the UNWTO for the first half of 2015, a robust growth in international tourism is noted for Europe, Asia and the Pacific, the Middle East and the Americas.[2]

In this paper, we examine the nexus between tourism and economic growth in Sri Lanka. The international tourist arrivals to Sri Lanka have noted a phenomenal growth over the last three decades. The visitor arrivals in 1980 were 321,780 and in 2014, the figure increased to 1524,153. Similarly, the official tourism receipts increased from US$ 110.70 million (in current dollars) or US$ 271.2 million (in 2014 US$) to US$ 2.43 billion (in current dollars) over the same period.[3] Furthermore, as of 2014, the sector employed 129,790 people directly and 170,100 people indirectly, and contributed 11.1, 10.0 and 21.3% to GDP, employment and exports, respectively.

Amidst these developments, it must be noted that in the period from July 1983 to May 2009, there was a fierce civil war between the government and the Liberation Tigers of Eelam (LTTE) which slowed the progress of the country (Gamage et al. 1997). Moreover, because the civil war was interrupted by different cease fires, we can split the periods into four phases. The Eelam War I from July 1983 to 1987, II from June 1990 to January 1995, III from April 1996 to September 2002, and IV from July 2006 to May 2009, respectively. The civil war was mainly characterised as asymmetric because of the military dominance of the national forces. Furthermore, the LTTE committed bomb and suicide attacks on policy-makers, military personnel, public buildings, infrastructure, and civilian massacres. On the

[1] A tourist is "as an individual who, for leisure or other purposes, temporarily leaves the place of residence for being hosted in a destination, activating successive economic effects that are worth investigating." Candela and Figini (2012, p.18–19).

[2] http://dtxtq4w60xqpw.cloudfront.net/sites/all/files/pdf/unwto_barom15_04_august_excerpt__0.pdf.

[3] The calculation is based on deflators published by the US Government's Bureau of Economic Analysis.

other hand, the government, who represented mostly the interests of the Sinhalese majority, did not interfere against massacres committed by Sinhalese mobs. As a consequence, the estimated total death toll was somewhere between 60,000 and 100,000 people, around 150,000 Tamil refugees, and an estimated number of 1,000,000 internally displaced persons, resulting in huge economic losses for the country.

Some scholars have estimated the cost of the war. For instance Grobar and Gnanaselvam (1993) estimate the economic loss to be equivalent of 20% of the GDP for the period 1983–1988. In another study, Arunatilake et al. (2001) estimate the accumulated loss from 1983 to 1996 to be more than 160% of the GDP in 1996 using a constant interest rate of 5%. Yet in a more recent study, Ganegodage and Rambaldi (2014) estimate the loss to be equivalent of annual decline of 9% of the GDP for the conflict period between 1960 and 2008. The country was also hit strongly by the destructive tsunami in December 2004, which killed some 30,000 people, and faced repercussions of the 2007–2008 global financial crises.

Accordingly, in this study, we explore short-run and long-run impact of the tourism sector and exchange rate on the economic growth of Sri Lanka whilst accounting for the structural events. Moreover, it must be noted that despite the huge role of tourism in the economy, there are limited studies which consider the tourism-growth nexus in Sri Lanka (Wickremasinghe and Ihalanayake 2006; Srinivasan et al. 2012). We also note that these studies do not explicitly account for the role of the capital stock, labour force, real exchange rate and structural breaks in the series, which are important to accurately identify co integration, magnitude impacts and the direction of causality.

Although we acknowledge that tourism development in Sri Lanka has a huge economic impact, we are also cognizant of the fact that there are other sectors and factors (*inter alia*, trade and manufacturing (Gordon and Rankaduwa 1992; Athukorala 2000), textiles, institutions, and other hard infrastructure (Chaffai et al. 2012), foreign remittances (Siddique et al. 2012); tea, transportation services, and rubber-based products (Samaranayake et al. 2013)) that are equally important ingredients of economic growth in the country. Therefore, constrained by data availability on these factors, we use a reduced-form augmented Solow (1956) model, to examine the impact of tourism on the economic growth of Sri Lanka. At best, given the unprecedented growth in tourism, we hypothesise that tourism development for Sri Lanka is growth enhancing (Bandara and Tisdell 2003; Fernando et al. 2013).[4] Therefore, by including the role of capital and labour, and treating tourism development and exchange rate as shift parameters in the augmented Solow (1956) framework, we can more accurately estimate the contribution of tourism in the economy.[5] Subsequently, the main contributions of the paper are to: (1) estimate of the elasticity of income with respect to tourism whilst controlling for capital and labour, real exchange rate and correcting for

[4] Note that there can be growth retarding drivers such as crime, terrorism, political instability and the like.

[5] We sincerely thank an anonymous reviewer for insisting that we include the exchange rate in the model specification.

structural breaks in the series; and (2) find plausible support for the tourism-led growth hypothesis for Sri Lanka.

The rest of the paper is outlined as follows. In Sect. 2, we briefly refer to notable development and growth theories and present a summary of studies pertaining to tourism and economic growth. In Sect. 3, we discuss the modelling strategy and data; and in Sect. 4, we present the results. Section 5 concludes with some policy deliberations.

2 A brief literature survey

The literature on tourism-growth nexus has proliferated since at least as far as the three decades. While growth and development has been an important focus in economic science (Rosenstein-Rodan 1943; Prebisch 1950; Singer 1950; Nurske 1953; Lewis 1954; Myrdal 1957; Hirschman 1958; Rostow 1960; Kuznets 1934; Hueting 1974; Daly and Cobb 1989; Nordhaus and Tobin 1972; Hicks 1965) for decades, and contemporary literature on economic growth acknowledges that tourism development is a crucial driver of economic activities for many developed and developing countries.

Although Ghali (1976) originally examined the relationship between tourism receipts and income, it is the pioneering works of Lanza and Pigliaru (2000) that began the succession of empirical investigations surrounding tourism, economic growth and the tourism led growth hypothesis (H1). Prior to these studies, greater attention was paid towards the estimation of tourism demand by applying single equation methods (Archer 1976; Johnson and Ashworth 1990; and Sheldon 1990, 1997; Sinclair 1998). Mckinnon (1964) noted that the foreign exchange earnings from tourism can be used to import capital goods which could then lead to growth of income. Ghali (1976) used an ordinary least squares method and data over the periods 1953–1970 to examine the importance of tourism for the Hawaiian economy. He concluded that without the presence of a vibrant tourism sector, Hawaii would have had a 17% lower income. Furthermore, the study of Cazes (1992) indicated that the ability of tourism to generate economic growth depends on the degree of the linkage between tourism and other sectors of the economy. Adding on, tourism, as export of services entails other advantages, namely, the gains from economies of scale, the loosening of binding foreign exchange constraints, positive spill over effects and the ability to spur ancillary industry investment (Durbarry 2004).

The studies focusing on tourism-growth nexus has proliferated especially due to the fact that international tourism has been growing and has bounced back to higher levels despite momentary shocks. The tourism-growth literature mainly looks at the causal relationship between tourism and growth, and at the economic impacts caused by tourism. From these considerations two different hypotheses can be derived. Firstly, the tourism led growth hypothesis (H1) which is confirmed, when tourism demand is identified as a driving force of growth and creates positive externalities in the economy. Secondly, the growth led tourism hypothesis (H2), which is validated if the tourism sector evolves in the presence and as a

consequence of effective government policies and institutions, adequate investment in both physical and human capital, and a stable tourism demand. To our knowledge from the literature, the majority of the studies confirm either H1 or both H1 and H2. The studies supporting H1 include Balaguer and Cantavella-Jordá (2002) for Spain, Fayissa et al. (2008) for 42 African countries, Brida et al. (2008) for Mexico, Brida et al. (2009) for Colombia, Proença and Soukiazis (2008) for Portugal, Lee and Chang (2008) for OECD countries, Brida and Risso (2009) for Chile, Brida et al. (2010) for Uruguay, Narayan et al. (2010) for Fiji, Solomon Islands, Papua New Guinea and Tonga, Payne and Mervar (2010) for Croatia and Tang and Tan (2015a) and (b) for Malaysia.[6] The studies which find evidence of both H1 and H2 include: Dritsakis (2004a) and (b) for Greece, Durbarry (2004) for Mauritius, Cortez-Jimenez and Paulina (2006) for Italy and Spain, Massidda and Mattana (2013) for Italy, Oh (2005) for Korea, Kim et al. (2006) for Taiwan, Nowak et al. (2007) for Spain, Lee and Chang (2008) for non-OECD countries, Seetanah (2011) for 19 island economies, Shahbaz et al. (2015) for Malaysia, and Kumar et al. (2016) for Cook Islands. It must be noted that Pablo-Romero and Molina (2013) provides a detailed review of the literature on tourism-growth hypothesis and one of the outcomes is that the importance and affordability of tourism has spread nearly all over the world in the last 70 years.

Our study is situated in the arena of the tourism-growth literature where we focus on the developing South Asian economy of Sri Lanka, which has witnessed an unprecedented growth in tourism in the last three decades. Our study attempts to identify the impact of tourism on the real income in the country whilst accounting for the structural breaks, a large part of which is characterized by the civil war and ethnic tensions for most parts of the last three decades. While there are studies within the literature that take into account brief periods of political instability, a few to our knowledge, attempt to verify the tourism led growth (H1) hypothesis in a country which has witnessed turmoils for extended periods of time (BBC News 2016). In this regard, a study of Sri-Lanka is well placed. Additionally, we examine the effects of tourism on income and growth whilst taking into account, the capital and labour stock which are important determinants of growth (Durbarry 2004; Jin 2011; Kumar and Kumar 2012). Most studies within this stream of literature tend to focus on real output, tourism and the exchange rate [as noted in Pablo-Romero and Molina (2013)] and only a few studies explicitly account for the capital and labour dynamics within the tourism led growth studies.

3 Modelling strategy, data, & methodology

3.1 Modelling framework

We use an approach used by Sturm (1998) and Rao (2010) and which is related to Solow's (1956) methodology which is becoming an appealing theoretical

[6] The studies which confirm H2 includes: Kumar and Kumar (2012) for Fiji, Kumar (2014a)and (b) for Vietnam and Kenya.

framework (for example, see Shahiduzzaman et al. 2015; Kumar and Stauvermann 2016). The general equation is given as:

$$Y_t = A_t K_t^{\alpha} L_t^{\beta} \tag{1}$$

where A represents the stock of technology, K and L are the capital and labour stock, respectively; α and β are capital and labour shares respectively. Hence assuming constant returns to scale ($\beta = 1 - \alpha$), and dividing (1) by L, we get:

$$y_t = A_t k_t^{\alpha}, \alpha > 0 \tag{2}$$

The model assumes that the evolution of technology is given by:

$$\Phi_t = \mathrm{A}_0 e^{gt} \tag{3}$$

where A_0 is the initial stock of knowledge and t is time. We introduce tourism receipts (% of GDP) and real exchange rate as shift variables (Rao 2010).

$$\Psi_t = f(TUR, EXR) = TUR_t^{\theta} EXR_t^{\emptyset} \tag{4}$$

where $\theta > 0$ represents the elasticity of tourism, respectively. Hence:

$$A_t = \Phi_t \Psi_t = \mathrm{A}_0 e^{gt} TUR_t^{\theta} EXR_t^{\emptyset} \tag{5}$$

Finally, including this information in (2), we get:

$$y_t = \left(\mathrm{A}_0 e^{gt} TUR_t^{\theta} EXR_t^{\emptyset}\right) k_t^{\alpha} \tag{6}$$

Taking the log of (6), we derive the basic model for estimation as:

$$\ln y_t = \pi + \delta Trend + \vartheta Break + \alpha \ln k_t + \theta \ln TUR_t + \emptyset \ln EXR_t + \varepsilon_t \tag{7}$$

where π is the constant, δ and μ are the coefficient of time trend (*Trend*) and structural break dummy (*Break*) respectively; and the lag estimate equation is expressed as:

$$\begin{aligned} Iny_t = {} & \phi_1 + \phi_2 Trend + \phi_3 Break + \sum_{i=1}^{p_1} \gamma_{2i} In\, y_{t-i} + \sum_{i=0}^{p_2} \zeta_{2i} In\, k_{t-i} \\ & + \sum_{i=0}^{p_3} \omega_{2i} In\, TUR_{t-i} + \sum_{i=0}^{p_4} \tau_{2i} In\, EXR_{t-i} + u_t \end{aligned} \tag{8}$$

Hence, using (8), we can derive the long-run coefficients in (7) as: $\pi = \frac{\phi_1}{1-\sum_{i=1}^{p_1} \gamma_{2i}}$, $\delta = \frac{\phi_2}{1-\sum_{i=1}^{p_1} \gamma_{2i}}$, $\vartheta = \frac{\phi_3}{1-\sum_{i=1}^{p_1} \gamma_{2i}}$, $\alpha = \frac{\sum_{i=0}^{p_2} \zeta_{2i}}{1-\sum_{i=1}^{p_1} \gamma_{2i}}$, $\theta = \frac{\sum_{i=0}^{p_3} \omega_{2i}}{1-\sum_{i=1}^{p_1} \gamma_{2i}}$, $\emptyset = \frac{\sum_{i=0}^{p_4} \tau_{2i}}{1-\sum_{i=1}^{p_1} \gamma_{2i}}$, and $\varepsilon_t = \frac{u_t}{1-\sum_{i=1}^{p_1} \gamma_{2i}} \sim N(0, \sigma^2)$.

3.2 Estimation technique

3.2.1 ARDL bounds procedure

The autoregressive distributed lag (ARDL) bounds procedure (Pesaran et al. 2001) is widely used in the empirical literature (Shahbaz et al. 2012; Joarder et al. 2015). The procedure is preferable because unlike other cointegration methods such as Engle and Granger (1987) and Johansen and Juselius (1990), the bounds approach does not require that all the variables are I(1) as long as none of the variables are I(2), the latter can be examined by some traditional unit root tests. Another advantage of the ARDL procedure is that it is considered relatively simple and less sensitive to a small sample size. For the purpose of bound testing approach to cointegration, we capture the relationship of Eq. (7) by specifying the following ARDL equation:

$$\begin{aligned}\Delta \ln y_t = {} & \beta_{10} + \beta_{11} \ln y_{t-1} + \beta_{12} \ln k_{t-1} + \beta_{13} \ln TUR_{t-1} + \beta_{14} \ln EXR_{t-1} + \phi_{10} Break \\ & + \varphi_{10} Trend + \sum_{i=1}^{p} \alpha_{11i} \Delta \ln y_{t-i} + \sum_{i=0}^{p} \alpha_{12i} \Delta \ln k_{t-i} + \sum_{i=0}^{p} \alpha_{13i} \Delta \ln TUR_{t-i} \\ & + \sum_{i=0}^{p} \alpha_{14i} \Delta \ln EXR_{t-i} + \varepsilon_{1t} \end{aligned} \tag{9}$$

The dummy variable (*Break*) in the ARDL Eq. (9) represents the period of structural changes in the economy. Next, the co-integration is identified in two steps. First, Eq. (9) is estimated using the ordinary least squares technique. The second step requires testing the null hypothesis of no co-integration (H_{NULL}: $\beta_{11} = \beta_{12} = \beta_{13} = \beta_{14} = 0$) against the alternative hypothesis of the existence of a long run relationship (H_{ALT} : $\beta_{11} \neq 0; \beta_{12} \neq 0; \beta_{13} \neq 0; \beta_{14} \neq 0$). The existence of a long run co-integration relationship is examined by reviewing the corresponding F- and W- statistics, respectively, against its respective upper and lower bounds. We reject the null hypothesis of no co-integration when the F-statistics is above the upper bound $\left\{F - stat > \mathrm{I}(1)_{critical}\right\}$ and do not reject the null when the F-statistics is below the lower bound $\left\{F - stat < \mathrm{I}(0)_{critical}\right\}$. In the case when the F-statistics is within the upper and lower bounds, $\left\{\mathrm{I}(0)_{critical} < F - stat < \mathrm{I}(1)_{critical}\right\}$, the outcome is inconclusive. After confirming the cointegration, the next step is to estimate the long-run and short-run results, and examine the respective diagnostic tests to ensure the model's dynamic stability.

3.2.2 Causality analysis

Although the ARDL procedure accounts endogeneity among variables and hence provides a robust result in terms of magnitude impacts, further insights on the predictive powers of the variables are gained by examining the direction of causality. For the latter, we use the Granger non-causality test of Toda and Yamamoto (1995). The advantage of this method is that: (a) we can examine

causality among variables which are I(0), I(1) or I(2), and not co-integrated or co-integrated of an arbitrary order; and (b) the method fits well with the ARDL procedure given that part of the information such as the lag-length and maximum optimum order of integration are used to carry out this analysis. To examine the causality, the following vector autocorrelation regression (VAR) equations are specified:

$$\begin{aligned}\ln y_t = {} & \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} \ln y_{t-i} + \sum_{j=k+1}^{d\max} \alpha_{2j} \ln y_{t-j} + \sum_{i=1}^{k} \eta_{1i} \ln k_{t-i} \\ & + \sum_{j=k+1}^{d\max} \eta_{2j} \ln k_{t-j} + \sum_{i=1}^{k} \phi_{1i} \ln TUR_{t-i} + \sum_{j=k+1}^{d\max} \phi_{2j} \ln TUR_{t-j} \\ & + \sum_{i=1}^{k} \rho_{1j} \ln EXR_{t-i} + \sum_{j=k+1}^{d\max} \rho_{2j} \ln EXR_{t-j} + \lambda_{1t}\end{aligned} \tag{10}$$

$$\begin{aligned}\ln k_t = {} & \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} \ln k_{t-i} + \sum_{j=k+1}^{d\max} \alpha_{2j} \ln k_{t-j} + \sum_{i=1}^{k} \eta_{1i} \ln y_{t-i} \\ & + \sum_{j=k+1}^{d\max} \eta_{2j} \ln y_{t-j} + \sum_{i=1}^{k} phi_{1i} \ln TUR_{t-i} + \sum_{j=k+1}^{d\max} phi_{2j} \ln TUR_{t-j} \\ & + \sum_{i=1}^{k} \rho_{1j} \ln EXR_{t-i} + \sum_{j=k+1}^{d\max} \rho_{2j} \ln EXR_{t-j} + \lambda_{2t}\end{aligned} \tag{11}$$

$$\begin{aligned}\ln TUR_t = {} & \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} \ln TUR_{t-i} + \sum_{j=k+1}^{d\max} \alpha_{2j} \ln TUR_{t-j} + \sum_{i=1}^{k} \eta_{1i} \ln y_{t-i} \\ & + \sum_{j=k+1}^{d\max} \eta_{2j} \ln y_{t-j} + \sum_{i=1}^{k} \phi_{1i} \ln k_{t-i} + \sum_{j=k+1}^{d\max} \phi_{2j} \ln k_{t-j} \\ & + \sum_{i=1}^{k} \rho_{1j} \ln EXR_{t-i} + \sum_{j=k+1}^{d\max} \rho_{2j} \ln EXR_{t-j} + \lambda_{3t}\end{aligned} \tag{12}$$

$$\begin{aligned}\ln EXR_t = {} & \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} \ln EXR_{t-i} + \sum_{j=k+1}^{d\max} \alpha_{2j} \ln EXR_{t-j} + \sum_{i=1}^{k} \eta_{1i} \ln y_{t-i} \\ & + \sum_{j=k+1}^{d\max} \eta_{2j} \ln y_{t-j} + \sum_{i=1}^{k} \phi_{1i} \ln k_{t-i} + \sum_{j=k+1}^{d\max} \phi_{2j} \ln k_{t-j} \\ & + \sum_{i=1}^{k} \rho_{3j} \ln TUR_{t-i} + \sum_{j=k+1}^{d\max} \rho_{3j} \ln TUR_{t-j} + \lambda_{4t}\end{aligned} \tag{13}$$

Hence in (10), Granger causality from *lnk*, $\ln TUR$ and $\ln EXR$ to $\ln y$, respectively, implies $\eta_{1i} \neq 0 \forall i$, $\phi_{1i} \neq 0 \forall i$ and $\rho_{1i} \neq 0 \forall i$. Similarly, in (11) $\ln y$,

ln *TUR* and ln *EXR* Granger causes ln *k* if $\eta_{1i} \neq 0 \forall i$, $\phi_{1i} \neq 0 \forall i$ and $\rho_{1i} \neq 0 \forall i$, respectively; in (12) ln *y*, ln *k* and ln *EXR* Granger causes ln *TUR* if $\eta_{1i} \neq 0 \forall i$, $\varphi_{1i} \neq 0 \forall i$ and $\rho_{1i} \neq 0 \forall i$, respectively; and finally, in (13) ln *y*, ln *k* and ln *TUR* Granger causes ln *EXR* if $\eta_{1i} \neq 0 \forall i$, $\varphi_{1i} \neq 0 \forall i$ and $\rho_{1i} \neq 0 \forall i$, respectively . The maximum lag length for the Toda and Yamamoto (1995) Granger non-causality test is calculated as the sum of the maximum order of integration and the lag length selected for the ARDL estimation based on a set of criteria for lag-length testing. It is important to examine the properties of the inverse roots of the AR (auto-regressive) characteristics polynomial diagram to ensure dynamic stability of the ARDL model. In calculating the causality test robustness, the inverse roots,I_R, should lie within the positive and negative unity i.e. $-1 \leq I_R \leq 1$. However, where it is noted that the inverse roots are outside the unit circle, this can be corrected by including/excluding (a) appropriate lags greater than those of endogenous variables, (b) a trend variable and/or (c) structural break or 'pulse' dummies as exogenous (instruments) variables in the VAR system.

4 Data and results

4.1 Data description

For the purpose of analysis, we use a total of 35 years of annual data over the periods 1980–2014. The GDP at constant 2005 USD per capita, employment rates and gross fixed capital formation at constant 2005 USD (proxy for investment) are sourced from *World Development Indicators and Global Development Finance* database (World Bank 2015). Data on tourism receipts in current USD, and real exchange rate are taken from the *Sri Lanka Tourism Development Authority* (http://www.sltda.lk/statistics). Subsequently, the tourism receipts as a percent of GDP and the Sri Lankan Rupees per USD adjusted for inflation as the real exchange rate is used as a measure of tourism development and exchange rate, respectively. An increase in the real exchange rate therefore implies relative depreciation of the Sri Lankan rupees. The capital stock data is subsequently created using the perpetual inventory method: $K_t = (1-)K_{t-1} + I_t$. We use the perpetual inventory method to build data for capital stock. We set the depreciation rate (δ) to 0.08 and the initial capital stock (K_0) to 1.05 times the real GDP (gross domestic product) of 1969 in 2005 USD prices.[7] The labour stock, L_t (number of workers) is computed as average employment rate times the population. The descriptive statistics and correlation matrix of all variables in its original form over the sample periods 1980–2014 are represented in Table 1. As noted, there is a strong positive and statistically significant correlation between output per worker and capital per worker (0.99), and between real exchange rate and tourism receipts (0.42). Moreover, a small negative

[7] While the choice of the depreciation rate and the factor used for initial capital stock are arbitrary, care is taken to ensure that the plot of capital per worker exhibits concavity and hence diminishing returns to scale. We noted that considering the sample from 1970 to 2014, the capital share becomes grossly distorted and meaningless. Therefore, to restrict the analysis to theoretically justifiable results, we used sample size from 1980 to 2014.

Table 1 Descriptive statistics and correlation matrix (1980–2014). *Source* Authors' estimation in Eviews 9

Variables	y_t	k_t	TUR_t	EXR_t
Panel A: descriptive statistics				
Mean	2031.498	3380.010	1.719386	0.021369
Median	1819.981	2855.032	1.547994	0.016695
Maximum	4158.137	7615.977	3.244011	0.060482
Minimum	1058.207	1275.171	0.784746	0.007657
SD	853.5553	1674.355	0.615006	0.014377
Skewness	0.935059	0.948532	0.951381	1.075047
Kurtosis	2.921791	3.029094	3.267979	3.211034
Jarque-Bera	5.109210	5.249563	5.384632	6.806688
Probability	0.077723	0.072456	0.067724	0.033262
Panel B: correlation matrix				
y_t	–			
k_t	0.9984[a]	–		
	(<0.001)			
TUR_t	−0.0347	−0.0553	–	
	(0.843)	(0.752)		
EXR_t	−0.7725[a]	−0.7809	0.4150[b]	–

p values are provided in brackets

[a, b] Statistical significance at 1 and 5% level, respectively

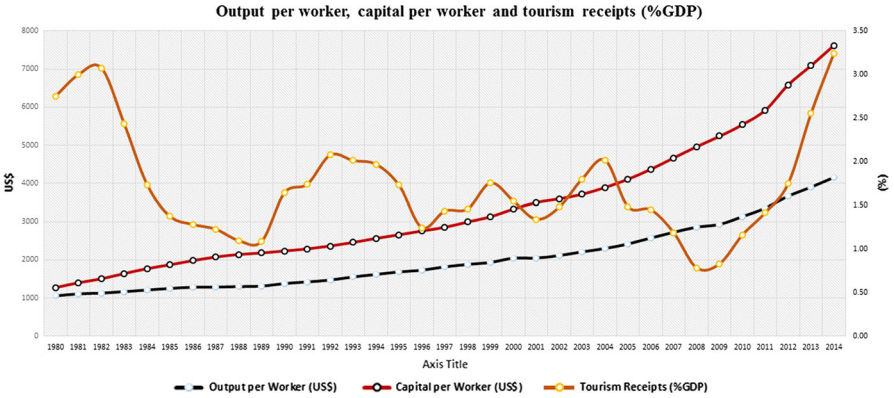

Fig. 1 Output per worker, capital per worker and tourism receipts (%GDP). *Source* World Bank (2015) and Sri Lanka Tourism Development Authority (http://www.sltda.lk/statistics)

and not statistically significant correlation between tourism revenue (% GDP) and output per worker (−0.03), and capital per worker (−0.06) are noted; the exchange rate is negatively correlated with output per worker (−0.77) and capital per worker (−0.78). However, it must be noted that although correlation does not necessarily imply cointegration or similar association in the long-run or short-run, the strength of the correlation, measured by the correlation coefficient and the level of significance, can influence the statistical significance of the association. For the purpose of regression analysis, all the variables are transformed into natural logarithmic form.

In Fig. 1, the trends in the output and capital per worker in constant 2005 USD (left axis) and the tourism receipts (as a percent of GDP) (on the left axis) are provided.

4.2 Unit root results

Table 2 presents the conventional unit root tests based on the Augmented Dickey-Fuller (ADF) (1979), the Phillips and Perron (PP) (1988) and the Kwiatkowski et al. (KPSS) (1992) tests. We note that the variables are stationary in their first differences and that the maximum order of integration is one. Based on the results of the unit root tests we conclude that the respective series are stationary in their first difference and that their maximum order of integration is one.

4.3 Structural break unit root tests

To examine the break in series, the multiple break tests of Bai and Perron (2003) is applied (Table 3). Examining the breaks in the dependent variable and capturing the structural periods as part of the explanatory variable can provide important insights on the behaviour of the dependent variable, especially for countries which have a history of major structural changes (Ahmad and Aworinde 2015; Das et al. 2014). Furthermore, including the break periods can influence the cointegration results and

Table 2 Unit root tests. *Source* Authors' estimation in Eviews 9

Variables	ADF		PP	
	Level	1st Diff.	Level	1st Diff.
With constant and trend				
$\ln y_t$	1.2017[0]	−4.7722[0]^{a}	1.0866[2]	−4.7497[1]^{a}
$\ln k_t$	−1.7885[1]	−2.4479[0]	−2.1007[4]	−2.4758[9]
$\ln TUR_t$	−4.2703[4]^{a}	−3.7822[0]^{b}	−1.3811[1]	−3.7468[2]^{b}
$\ln EXR_t$	−5.3741[0]^{a}	−10.163 [0]^{a}	−5.3722[1]^{a}	−12.530[4]^{a}
With constant only				
$\ln y_t$	4.1860[0]	−3.4888[0]^{b}	3.9627[1]	−3.5640[3]^{b}
$\ln k_t$	1.1133[1]	−2.6749[0]^{c}	−0.2971[4]	−2.6706[1]^{c}
$\ln TUR_t$	−2.8587[1]^{c}	−3.6108[0]^{a}	−2.0005[2]	−3.6294[1]^{b}
$\ln EXR_t$	−2.2915[1]	−10.283[0]^{a}	−3.8894[4]^{a}	−12.698[4]^{a}
Without constant and trend				
$\ln y_t$	3.5795[1]	−0.4725[1]	9.4572[3]	−0.7589[2]
$\ln k_t$	2.3476[1]	−1.5505[0]	7.7851[4]	−1.5715[2]
$\ln TUR_t$	−1.2429[1]	−3.6574[0]^{a}	−0.9332[2]	−3.6748[1]^{a}
$\ln EXR_t$	0.0731 [1]	−10.416[0]^{a}	0.0847[6]	−12.748[4]^{a}

Critical values of the ADF and PP tests are based on Mackinnon (1996). The optimal lag and bandwidth used is based on the Schwarz Information Criterion (SC). The null hypothesis for the ADF and the PP unit root test is the presence of a unit root in the series

$^{a, b, c}$ Stationarity at the 1, 5 and 10% levels, respectively

Table 3 Multiple breakpoint tests: $\ln y_t$. *Source* Authors' estimation using Eviews 9

Break test	*F* statistics	Scaled *F* statics	Critical value[#]	Repartition break dates
0 vs. 1[a]	12.767	25.534	11.47	1988
1 vs. 2[a]	112.22	224.43	12.95	1997
2 vs. 3[a]	35.710	71.421	14.03	2004
3 vs. 4[a]	15.953	31.907	14.85	2009
4 vs. 5	<0.001	<0.001	15.29	–

Breaking variables include both constant and trend

[a] Denotes significant at the 0.05 level [#] Refers to Bai and Perron (2003) critical values

where the break periods are significant, the outcomes on the cointegration can be relatively more supportive. We show the difference by examining the cointegration with and without the breaks.

In our case, we identify the period of instability in 1988, 1997, 2004 and 2009. To account for this, a dummy variable (*Break*) is set to one for these periods. The break periods signify a number of events that caused a damaging effect on the economy. These include the intensive and ongoing civil war (the Eelam Wars), which continued even after the ceasefire agreement in 2002, and the violence which ended with a defeat of the Tamil Tigers in 2009 (Ravinthirakumaran et al. 2015); the extreme tsunami in 2004 (Becchetti and Castriota 2010); the 2007/2008 global financial crisis which affected the real economy and services sector including the tourism industry and resulted in the knock-on effect on the economy (Hemachandra 2011). Upon including the breaks, we check the stability of the estimated model using the CUSUM and CUSUM of squares tests and examine the cointegration, short-run and long run coefficients.

4.4 Lag length and ARDL specification selection criterion

Following the results of the respective unit root tests, we examine the lag-length tests based on a number of criteria (Table 4). We note that all the criteria (LR, FPE, AIC, SC and HQ) supports the use of maximum lag-length of 1 (Clarke and Mirza

Table 4 Lag selection criterion. *Source* Authors' estimation in Eviews 9

Lag	LL	LR	FPE	AIC	SC	HQ
0	66.122	–	0.00179	−3.4927	−3.2705	−3.4159
1	100.184	56.447[a]	0.00027[a]	−5.3820[a]	−5.1153[a]	−5.2899[a]
2	100.190	0.0096	0.00029	−5.3252	−5.0141	−5.2178
3	100.192	0.0021	0.00030	−5.2681	−4.9126	−5.1454

A–significance at 5% level

LL log likelihood, *LR* sequential modified LR test statistic, *FPE* Final prediction error, *AIC* Akaike information criterion, *SC* Schwarz information criterion, *HQ* Hannan-Quinn information criterion

[a] Lag order selected by the various selection criteria

'–' indicates not applicable

2006). Subsequently, using the lag-length of 1, we note the optimal result is achieved with the ARDL (1, 1, 0, 0).

4.5 Bounds Test for co-integration

Next, we apply the ARDL Bounds procedure to examine the co-integration. We note that inclusion of break periods neither improve nor change the conclusion on the long-run association (Table 5, Panels a and b). In both cases (with and without structural breaks), we note that co-integration holds at 1% level of statistical significance. The confirmation of co-integration enables us to examine the long run results based on the ARDL model and the dynamic results to identify the short-run effects.

4.6 Dynamic stability of the model

The break adjusted CUSUM and CUSUMSQ plot is presented in Fig. 2 (panels a and b) for the ARDL (1,1,0,0) lag estimates in Table 6. We review the diagnostic tests from the ARDL lag estimates and parameter stability in the model based on CUSUM and CUSUMQ plots. The tests include: the Lagrange multiplier test of residual serial correlation (χ^2_{sc}), the Ramsey's RESET test using the square of the fitted values for correct functional form (χ^2_{ff}), the normality test based on the test of skewness and kurtosis of residuals (χ^2_{n}) and the heteroscedasticity test based on the regression of squared residuals on squared fitted values (χ^2_{hc}). The results in general show the equation has performed relatively well as the disturbance terms is normally distributed and serially uncorrelated with homoscedasticity of residuals.

4.7 Short-and long-run estimates

The estimated short-run and long-run coefficients of variables in the model are presented in Table 8 (panels a, and b). Notably, the coefficient of tourism is statistically significant at the 1% level, both in the short-run ($\Delta \ln TUR_t = 0.0305$)

Table 5 Bounds test of ARDL (1,1,0,0). *Source* Authors' estimation in Eviews 9

Panel a			Panel b		
$\ln y \mid \ln k, \ln TUR, \ln EXR, Constant, Trend, TB$			$\ln y \mid \ln k, \ln TUR, \ln EXR, Constant, Trend$		
Test statistic	*Value*		*Test statistic*	*Value*	
F-statistic	6.03[a]		*F-statistic*	6.19[a]	
Critical value bounds			*Critical value bounds*		
Significance	I0 *bound*	I1 *bound*	*Significance*	I0 *bound*	I1 *bound*
1%	4.30	5.23	5%	3.38	4.23
2.5%	3.80	4.68	10%	4.30	5.23

Critical bounds automatically determined by Eviews 9 based on Pesaran et al. (2001)

[a] Significance at 5% level

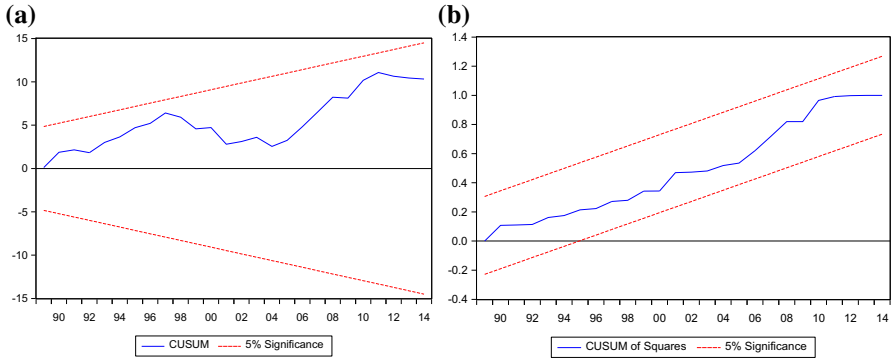

Fig. 2 CUSUM & CUSUMQ after adjusting for structural breaks. **a** Cumulative sum of recursive residuals (CUSUM), **b** cumulative sum of squares of recursive residuals (CUSUMQ). The *straight lines* represent critical bounds at 5% significance level. *Source* Authors' estimation in Eviews 9

Table 6 ARDL (1,1,0,0) Lag estimates. *Source* Authors' estimation in Eviews 9

Variable	Coefficient	SE	t-Statistic	Probability
$\ln y_{t-1}$	0.6270[a]	0.0654	9.5825	<0.001
$\ln k_t$	0.9073[a]	0.0983	9.2264	<0.001
$\ln k_{t-1}$	−0.7224[a]	0.0639	−11.297	<0.001
$\ln TUR_t$	0.0212[a]	0.0059	3.5663	0.001
$\ln EXR_t$	0.0021	0.0021	0.9748	0.338
Break	−0.0031	0.0050	−0.6217	0.539
Constant	1.1385[a]	0.2776	4.1010	<0.001
Trend	0.0067[a]	0.0016	4.0469	<0.001

Lag estimate selected is based on AIC

$R^2 = 0.999$; $\bar{R}^2 = 0.998$; SER = 0.0126; SSR = 0.00427; F-Stat. (7,27) = 7788.981; $\overline{\ln y_t} = 7.538$ 7.538; $\hat{\sigma}_{\ln y} = 0.394$ 0.394; AIC = 100.031; LL =108.031; SBC = 93.809; DW = 1.864;$\chi^2_{sc} : \chi^2(1) = 0.176$ [p = 0.675]; $F_{sc} : F(1,26) = 0.132$ [p = 0.720]; $\chi^2_{ff}(1) = 4.965$ [p = 0.026]; $F_{ff} : F(1,26) = 4.298$ [p = 0.048]; $\chi^2_n(2) = 9.5461$ [p = 0.008]; $\chi^2_{hc}(1) = 0.003$ [p = 0.957]

[a] Statistical significance at 1% level

and the long-run ($\ln TUR_t = 0.0568$). This implies that a 1% increase in tourism receipts will increase output per worker by 0.03 and 0.06% in the short-run and long-run, respectively. Furthermore, the short-run and long-run elasticity of capital per worker is 0.88,($\Delta \ln k_t = 0.8781$) and 0.50 ($\ln k_t = 0.4959$), respectively. Notably, the long-run capital share is slightly more than the stylised value of one third (Ertur and Coch 2007; Gollin 2002; Rao 2007 and 2010) which nevertheless is expected for some developing countries (Bosworth and Collins 2008; Breuss 2010; Guerriero 2012).[8]

[8] Also see Kumar and Stauvermann (2014) and the references therein for possible reasons for differences in capital share.

Table 7 Estimated long run and error correction representation. *Source* Authors' estimation in Eviews 9

Variable	Coefficient	Std. error	t-Statistic	Prob.
Panel a: Long-run				
$\ln k_t$	0.4959[a]	0.0664	7.4726	<0.001
$\ln TUR_t$	0.0568[a]	0.0067	8.4892	<0.001
$\ln EXR_t$	0.0056	0.0054	1.0306	0.3119
$Break^{LR}$	−0.0084	0.0143	−0.5901	0.5600
Trend	0.0179[a]	0.0034	5.2603	<0.001
Panel b: Short-run				
$\Delta \ln k_t$	0.8781[a]	0.1253	7.007	<0.001
$\Delta \ln TUR_t$	0.0305[a]	0.0098	3.1133	0.004
$\Delta \ln EXR_t$	0.0032	0.0023	1.4211	0.167
$Break^{SR}$	−0.0044	0.0043	−1.0337	0.311
Constant	1.0841[a]	0.1748	6.2028	<0.001
ECM_{t-1}	−0.3527[a]	0.0580	−6.079	<0.001

$R^2 = 0.6733$; $\bar{R}^2 = 0.5886$; DW = 1.8644; $\overline{\Delta \ln y_t} = 0.0402$; $\hat{\sigma}_{\Delta \ln y} = 0.0196$; SER = 0.0043

[a] Statistical significance at 1% level

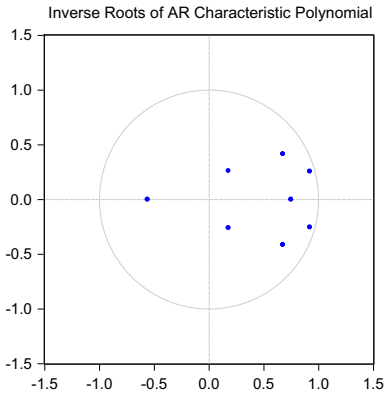

Fig. 3 Inverse roots of AR characteristic polynomial. *Source* Authors' estimation using Eviews 9

Furthermore, the coefficient of the exchange rate is positive however not statistically significant both the short-run and long-run. Similarly, we note the structural break periods has a negative impact both in the short-run ($Break^{SR} = -0.004$) and long run ($Break^{LR} = -0.008$), but they are not statistically significant, which also partly explains the relatively smaller cointegration F-statistic obtained whilst accounting for the break period. Finally, the error correction term (ECT_{t-1}), which measures the speed of adjustment to the long-run equilibrium given the previous period shocks, is −0.35, ($ECT_{t-1} = -0.3527$) and statistically significant at 1% level. In other words, about 35% of any disequilibrium caused by shocks from the previous period is corrected in the current period (Table 7).

Table 8 Granger non-causality test based on χ^2. *Source* Authors' calculation using Eviews 9

Dependent variable (Y)				
$X \underbrace{\rightarrow}_{\text{causes}} Y$	$\ln y$	$\ln k$	$\ln TUR$	$\ln EXR$
$\ln y$	–	5.421 (0.067)	0.298 (0.862)	0.832 (0.660)
$\ln k$	4.468 (0.107)	–	0.618 (0.736)	1.402 (0.496)
$\ln TUR$	5.715 (0.057)[c]	4.413 (0.110)	–	0.637 (0.727)
$\ln EXR$	12.383[a] (0.002)	8.250[b] (0.016)	0.501 (0.778)	–
Combined	18.754[b] (0.005)	20.344[a] (0.002)	2.240 (0.896)	2.204 (0.90)

[a, b, c] The presence of causality at 1, 5 and 10% level of statistical significance, respectively; degrees of freedom = 2; p values are given in brackets ()

4.8 Causality analysis

The maximum lag-length selected for a robust causality results based on the Toda and Yamamoto (1995) approach requires information on the optimal maximum lag and the maximum order of integration which we derive from the ARDL estimate ($k = 1$) and the unit root test results ($\delta_{max} = 1$), respectively. Hence, we use the maximum lag 2 ($l = k + \delta_{max} \leq 2$). In addition, we ensured dynamic stability of the VAR model by ensuring that the inverse roots of the autoregressive polynomial are within the positive and negative unity i.e. $-1 \leq I_R \leq 1$ (Fig. 3).

Based on the conventional levels of statistical significance, the results (Table 8) show a unidirectional causality from output per worker to capital per worker ($\ln y \rightarrow \ln k$); from tourism to output per worker ($\ln TUR \rightarrow \ln y$); and from real exchange rate to output per worker ($\ln EXR \rightarrow \ln y$) and capital per worker ($\ln EXR \rightarrow \ln k$), respectively. While the regression estimates only support the statistically significant (positive) association of tourism with economic growth, the causality results suggests that both tourism and exchange rate are important predictors of economic growth in Sri Lanka. In this regard, at best, we can argue that predicting the economic growth of Sri Lanka would require careful analysis of the effects of tourism receipts (%GDP) and the real exchange rate effects on investment and economic growth.

5 Conclusion

In this paper, we explore the nexus between tourism, exchange rate and economic growth. We use the augmented Solow (1956) framework and the ARDL bounds procedure whilst accounting for structural break in series. The short-run and long-run elasticity coefficients and the direction of causality are examined. The results show that the elasticity of income with respect to tourism in the short-run and long-run are 0.03 and 0.06 respectively. Although the structural break periods (which have negative association) and the exchange rate (which has a positive association) with economic growth, we note they are not statistically significant. Moreover, the causality analysis shows support for tourism-led growth hypothesis and that exchange rate has plausible influence on the economic growth in the country.

Finally, the new evidence from the study highlights that the impact of tourism on growth has positive contribution to the economic growth in Sri Lanka both in the short- and long-run. This becomes clear when we account for the contribution of capital per worker and structural breaks and exchange rate to assess the real impact of tourism on growth. This impact has been overestimated in the past possibly because too simplistic models being used, thus discounting the role of capital and labour, structural breaks and real exchange rate. Subsequently, in general, a careful assessment of the contribution of tourism and other growth-enhancing sectors to economic growth should necessarily account for the role of capital, labour to derive meaningful results to facilitate policy discussions.

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