

EXTENDED ABSTRACT

THE NEXUS BETWEEN CARBON DIOXIDE (CO₂) EMISSIONS AND INTERNATIONAL TOURIST ARRIVALS IN SRI LANKA

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Abstract

Environmental quality has a significant impact on tourism demand. In the study, environmental quality was proxied by carbon dioxide emissions, following previous empirical studies. The study aims to examine the effect of carbon dioxide emissions on international tourist arrivals in Sri Lanka from 1995–2019 using Johansen co-integration, Vector Error Correction, and Granger causality econometric models. According to the results of the Johansen co-integration test, there is a long-run relationship among the variables, and Vector Error Correction model confirmed that carbon dioxide emissions and the consumer price index affect international tourist arrivals negatively, and the gross domestic product and exchange rate affect international tourist arrivals positively for the Sri Lankan economy. However, the results confirm that carbon dioxide emissions cannot significantly explain the variation in tourism arrivals in the short run. According to the Granger causality test results, there is a unidirectional relationship between carbon dioxide emissions and international tourist arrivals in Sri Lanka. To attract more foreign visitors, the government should pay more attention to reducing and controlling carbon dioxide emissions.

Keywords: CO₂ Emissions, international tourist arrivals, ECM model

1. Introduction

Tourism growth plays a significant role in economic development and socio-economic progress in the world. “It has a significant role in boosting a nation’s economy” (Manzoor et al., 2019). The tourism industry is considered the third-largest foreign exchange earner and is regarded as one of the dynamic and progressive industries in Sri Lanka (Welgamage, 2015). Many factors influence international travel. Carbon dioxide emissions are an appropriate indicator for representing the level of environmental degradation. Tourists do not travel to polluted and dirty destinations, and they are more concerned with the environmental attractions in the destination country. In recent years, climate change in Sri Lanka has been a big issue, and CO₂ emissions are continuously rising (Mayoshi, 2021). Therefore, the study aims to examine the impact of CO₂ emissions on international tourist arrivals in Sri Lanka from 1995 to 2019 based on yearly data. A large number of previous studies have examined the effect of inbound or outbound tourism on CO₂ emissions. No study examines the influence of CO₂ emissions on international tourist arrivals in Sri Lanka using recent data and sophisticated econometric techniques. Therefore, the study is vital for a clear idea of the impact and causality between CO₂ emissions and international tourist arrivals in Sri Lanka.

To investigate the impact of CO_2 emissions on international tourist arrivals, GDP, official exchange rate, and consumer price index act as control variables. The gross domestic product is considered an essential determinant of international tourist arrivals. A country has a higher GDP that leads to the development of tourism infrastructure. Tugcu & Topcu (2018) explained that countries with a higher gross domestic product could better provide services. Those countries have an advantage in marketing and protecting tourist attractions relative to their competitors with less income. Numerous studies have shown gross domestic product positively impacted tourism development in many countries (Culiuc, 2014; Soofi et al., 2018; Aktas, 2019; Bin et al., 2019; Meyer 2019; Khan et al., 2020; Tavares, 2020). The exchange rate also impacts tourism demand, which influences the tourist choice for destination selection. When the currency at the tourist destination depreciates, it tends to decrease the prices of the accommodation, food, travel costs, and other services relative to other destinations. Gan (2016), Meyer (2019), Meo et al. (2018), Nisthar & Nufle (2019) found a depreciation of the domestic currency has a positive impact on tourism arrivals. High inflation leads to higher living costs. If the prices of goods and services in tourist destinations are higher than in the original country, the number of people who visit will decrease (Borhan & Arsad, 2016; Hanafiah & Harun, 2010; Meo et al., 2018). The central hypothesis is as follows:

H1= There is no co-integration relationship between CO_2 emission and tourist arrivals in Sri Lanka.

H2= There is no causal relationship between CO_2 emission and tourist arrivals in Sri Lanka.

2. Methodology

2.1 Model Specification and Estimation Technique

The study data was extracted from the World Development indicator covering the period from 1995 to 2019. The econometrics model could be specified as:

$$LTRN_t = \beta_0 + \beta_1 LCO_2_t + \beta_2 LGDP_t + \beta_3 LCPI_t + \beta_4 LEXR_t + \epsilon_t(1)$$

Table 1. Details of the variables

Variable	Description
LTRN	Log of International tourism (Annual data on the number of international tourist arrivals)
LCO2	Log of CO_2 emissions(Per capita CO_2 emissions)
LGDP	Log of Gross Domestic Product(Constant 2010 USD)
LCPI	Log of Consumer Price Index(2010=100)
LEXR	Log of Official exchange rate(LCU per USD)

To test the stationary property of the variables, the Augmented Dickey-Fuller Unit root test and Phillips Perron unit root tests were used in the model. If the variables are stationary at either level (I (0)) or first difference (I (1)), we can employ a co-integration test. It is the primary condition for operating a Johansen co-integration test. Then, to determine the number of co-integration vectors using the unrestricted co-integration rank test (Trace) and Max-Eigenvalue. The Vector Error Correction Model is employed to capture the short-run dynamics of the variables. The direction of the causality is examined using the Granger causality test. Finally, serial correlation, normality, heteroscedasticity, functional form tests and stability tests were conducted to check whether the results are robust. These tests were conducted using E-views (11) econometric software.

3. Results and Discussion

According to the ADF and PP unit root tests, no variables in the model are stationary at the level I (0). LTRN, LCO₂, LGDP, LEXR and LCPI variables are stationary at their first difference I (1), indicating that they are integrated with order one. This is the requirement to employ the Johansen co-integration technique for estimating the long-run relationship.

Table 2. Stationary tests

Variables	Augmented Dickey-Fuller Test		Phillips Perron Test		Order of the Integration
	Level (I(0))	1st Difference (I(1))	Level (I(0))	1stDifference (I(1))	
LTRN	-1.9547	-3.3782***	-2.3145	-3.4976***	I(1)
LCO ₂	-1.8880	-5.1050*	-1.9427	-5.1050*	I(1)
LGDP	-1.6173	-3.3833***	-1.6752	-3.3833***	I(1)
LEXR	-2.1415	-4.1363**	-2.1415	-4.1363**	I(1)
LCPI	-0.2005	-3.7649**	-0.2005	-3.7571**	I(1)

Note: *, **, and *** marks show the rejection of the null hypothesis at 1%, 5%, and 10% levels of significance.

Source: Authors' Computation Using E-views 11

According to the Johansen co-integration test results, the Trace test statistic identified three co-integrating relations at a 5% significance level. The Maximum Eigenvalue implies one co-integration equation at a 5% level of significance, indicating a long-run relationship between variables.

Table 3. Johansen co-integration test results

Hypothesized No. of CE(s)	Trace Statistic	t Critical Value	Hypothesized No. of CE(s)	Max-Eigen Statistic	t Critical Value
None *	89.4227	69.8189*	None *	34.7833	33.8769*
At most 1*	54.6395	47.8561*	At most 1	23.1024	27.5843
At most 2*	31.5371	29.7971*	At most 2	16.4539	21.1216
At most 3	15.0831	15.4947	At most 3	9.7512	14.2646
At most 4*	5.3319	3.8415*	At most 4*	5.3319	3.8415*

Note: * mark shows rejection of the hypothesis at the 0.05 level.

Source: Authors' Computation Using E-views 11

The results of the long-run relationship are given below in equation 2:

$$\text{LTRN} = 157.1294 - 0.6278 \text{ LCO}_2 + 7.2956 \text{ LGDP} + 2.0733 \text{ LEXR} - 4.3944 \text{ LCPI}$$

$$(-2.3224)^{***} \quad (15.8441)^* \quad (6.3092)^* \quad (-14.0467)^*$$

Note:*, **, and *** marks show the rejection of the null hypothesis at 1%, 5% and 10%, level of significance and. t values are given in parenthesis.

According to the results of the long-term relationship, two variables are negatively associated with tourist arrivals, namely carbon dioxide emissions (LCO_2) and consumer price index (LCPI). Meanwhile, the variables of gross domestic product (LGDP) and exchange rate (LEXR) are positively associated with international tourist arrivals. According to the long-term results, an increase of one percent in the variable carbon dioxide (LCO_2) emissions reduces the number of international tourist arrivals (LTRN) by 0.63%. This finding is consistent with previous result of Tugcu & Topcu (2018).

The consumer price index negatively influenced international tourist arrivals in Sri Lanka throughout the period. A one percent increase in the consumer price index (LCPI) variable reduced international tourist arrivals (LTRN) by 4.39%. This result is in line with studies of Borhan & Arsad, 2016; Hanafiah & Harun, 2010; Meo et al., 2018. A one percent increase in the GDP (LGDP) variable increases international tourist arrivals (LTRN) by 7.30%. This result is in line with studies of Culiuc, 2014; Soofi et al., 2018; Aktas, 2019; Bin et al., 2019; Khan et al., 2020; Meyer, 2019; Tavares, 2020.

With a one percent increase in the exchange rate (LEXR), international tourist arrivals increased 2.07%. This means that the depreciation of one rupee has a positive effect on the arrival of foreign tourists. This result is consisted with previous studies conducted by Gan (2016), Meyer (2019), Meo et al., (2018), Nisthar & Nufle (2019).

Table 4: Long-run equilibrium

ECM (-1)	Decision
0.8473	Significant, Unexpected sign
[0.3126]	
(2.7106)	

Note: coefficient, standard error, and t value are in the table.

The speed of adjustment indicates how above model is adjusted towards long-run equilibrium after external shocks. The error correction term of the 0.8473 model is statistically significant at the 5% level. However, no negative sign is expected.

The exchange rate is the only factor explaining variation in foreign tourist arrivals in the short term. It has a positive and statistically significant effect on the arrival of tourists from abroad.

To check the direction of the causality, Pairwise Granger causality test was employed in the study.

Table 5: Pairwise Granger causality test

Direction of the causality		Probability	Outcomes
LTRN	LCO_2	0.1508	LTRN does not cause LCO_2
LCO_2	LTRN	0.0013	LCO_2 causes LTRN

Source: Authors' Computation Using E-views 11

The Granger causality test results suggest a unidirectional causal relationship between carbon dioxide emissions (LCO_2) and international tourist arrivals (LTRN) at a significant 1% level in Sri Lanka.

According to the diagnostic test results, the Breusch-Godfrey LM serial correlation test confirmed that the model does not have a serial correlation. Then the Jargu-Bera test confirmed that the residuals were distributed normally. The Breusch-Pagan-Godfrey test confirmed that the model was free of heteroscedasticity, and finally, the Ramsey reset test confirmed that the function was correct.

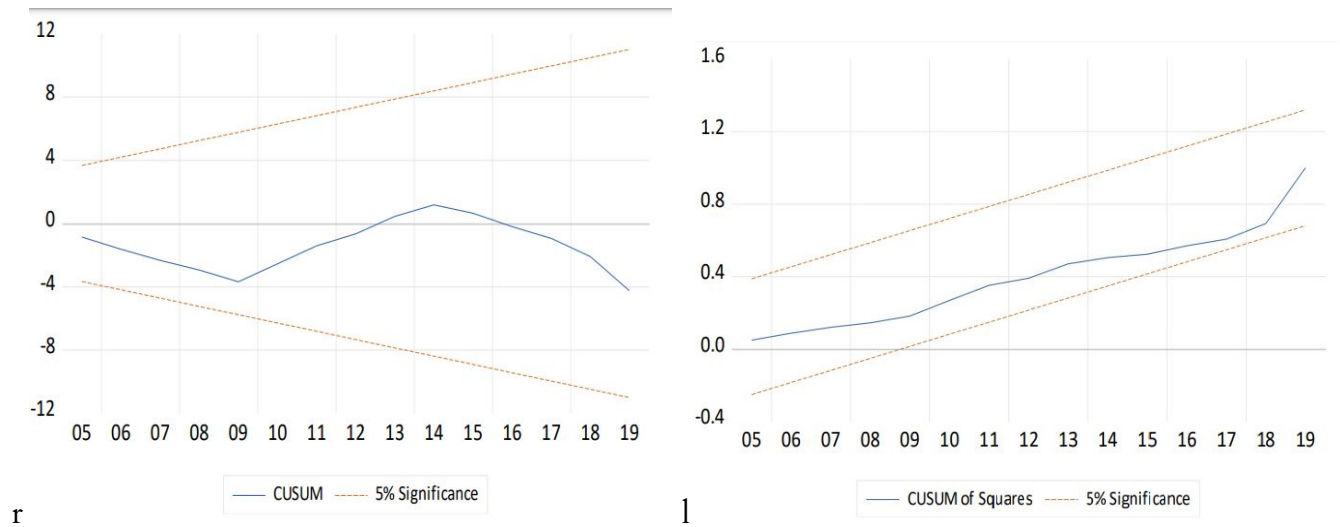


Figure 1. Stability tests

Source: Authors' Computation Using E-views 11

According to the results of the model, an increase in carbon dioxide emissions tends to decrease the number of international tourists arriving in the long-run, implying that tourists will not return to polluted, dirty and unattractive destinations.

4. Conclusion

Many studies highlight that inbound tourism is an essential driver of CO_2 emissions. However, this study aims to analyze how CO_2 emissions affect the number of international tourists arriving in Sri Lanka through econometric analysis during 1995–2019. ADF and PP unit root tests confirmed that all variables are stationary at first difference and the Johanson co-integration test confirmed the existence of long-run relationship. As the results, increases in carbon dioxide emissions and the consumer price index reduce international tourist arrivals. In contrast, an increase in gross domestic product and exchange rate contributes to a rise in international tourist arrivals in the long term. However, the results show that carbon dioxide emissions cannot explain the variation in tourist numbers quickly. The exchange rate positively affects the number of tourist arrivals in the short term, while other variables do not significantly explain the variation in tourist arrivals.

The Granger causality test result shows a unidirectional relationship between carbon dioxide emissions and international tourist arrivals in Sri Lanka. According to the study, the government must create and update existing policies and strict regulations to improve the quality of the environment by reducing carbon emissions to attract international tourists to Sri Lanka.

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