

# Nexus Among Tourism, Environmental Degradation, Inward FDI and Economic Growth: Fresh Evidence from ASEAN Countries

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## Research

**Keywords:** Tourism, CO2 emissions, FDI, economic growth, PMG, ASEAN

**Posted Date:** December 1st, 2020

**DOI:** <https://doi.org/10.21203/rs.3.rs-114620/v1>

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**Nexus among tourism, environmental degradation, inward FDI and economic growth:  
Fresh Evidence from ASEAN countries**

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**Abstract**

This study aims to investigate the linkage among tourism, foreign direct investment, environmental degradation by CO<sub>2</sub> emissions and economic growth in five countries from Association of Southeast Asian Nations (ASEAN) over 1995–2017. The outcomes of pooled mean group (PMG) estimator reveal that FDI and international tourism arrivals have a significantly positive influence on economic growth both in the short-run and the long-run. The association between growth and CO<sub>2</sub> emissions is found negative and significant. The Granger causality result reveals that there is bidirectional causality between FDI and growth, tourism and growth and FDI and tourism. A unidirectional causal link is found between CO<sub>2</sub> emissions and growth, tourism and population and population and CO<sub>2</sub> emissions. These findings suggest enhance more inward FDI, control environmental pollution, but also necessary to attract more tourists towards these countries, which in turn, generate revenue and boost up economic growth and development.

**Keywords:** Tourism; CO<sub>2</sub> emissions; FDI; economic growth; PMG; ASEAN

**JEL Classification Codes:** F21; O13; O47; Z32

## 1. Introduction

Sustainable economic development refers to the process of human development in a manner by which natural resources and the environment is sustained and preserved for future generations. Development is said to be sustainable when it fulfills the requirements of the current generation without disturbing the capability of upcoming generations to meet their requirements (World Commission, 1987). Development is a multifaceted course, which possesses the capability of a national economy, to produce and maintain yearly progress of macroeconomic indicators (Caracota & Caracota, 2004). According to Marin et al. (2012), sustainable development is the association between environmental sustainability, economic development and human development. In this regard, tourism is considered as a significant pillar of sustainable development (Gössling, 2002). Tourism plays a fundamental role in encouraging the economic development (ED) of a country and grants foreign revenue to the country (Oh, 2005). According to Zaei and Zaei (2013), tourism plays an essential part in the progress of emerging economies. In the view of Archer (1995), tourism has multiple impacts since it creates employment, improves the balance of payments and also increases the level of gross savings. Tourism not only contributes to per capita GDP but it also contributes towards human development and investment in infrastructure (Fayissa, Nsiah, & Tadesse, 2011).

Likewise, FDI inflows are also considered a significant factor of economic development, as Makki and Somwaru (2004) observes the influence of FDI on the EG of 66 developing economies and found that FDI has a positive influence on the EG. Similarly, Nosheen (2013) also exposed a positive nexus between FDI and EG in case of Pakistan. The causal link among FDI and EG is found bidirectional for 17 countries (Abdouli & Hammami, 2017). FDI is useful for less industrial economies as it is a very important source of employment creation, augmenting labor productivity, organizational growth, export expansion and improvement in the production of domestic firms (Aziz & Mishra, 2016; World Bank, 2013).

The current study attempts to investigate the connection among CO<sub>2</sub> emissions and EG. According to Martínez-Zarzoso and Bengochea-Morancho (2004), CO<sub>2</sub> emissions is inversely related to economic development in low-income countries while this relationship becomes positive in case of high-income countries. Similarly, Boopen and Vinesh (2011) concluded that CO<sub>2</sub> emission is inversely linked with economic development. In their study, Han and Lee (2013) found an opposite relationship between EG and CO<sub>2</sub> emission for G-20 nations. Also, Twerefou et al. (2016) examined the nexus between pollution and EG in Ghana and exposed a negative link among CO<sub>2</sub> emissions and EG in Ghana. Bekun and Agboola (2019) also found an inverse connection among CO<sub>2</sub> emissions and ED in 16 EU countries.

As far as the tourism sector is concerned, it plays an incredibly imperative role in a country's development. Tourism growth stimulates feasible economic opportunities, which helps in economic expansion and employment generation. Tourism has several encouraging impacts on economic growth but it also has adverse effects on the atmosphere in the form of CO<sub>2</sub> emissions. According to the "United Nations World Tourism Organization", the tourism sector emits 5% of total CO<sub>2</sub> emissions, mostly from the accommodation, transportation and other tourism activities. (UNWTO, 2017). In their study, Danish and Wang (2018) found a positive association, whereas it has a considerably depressing effect on environmental degradation (ED) in BRICS economies during 1995-2014.

Kadir and Karim (2012) found that tourism positively contributes to the economic development of Malaysia. The findings of Ardra and Martawardaya (2017) study revealed that tourism has a positive along with significant effect on HDI and ED and it also has a considerable effect on poverty reduction in selected ASEAN countries between 1998 and 2013. Almasaied et al. (2008) observed a positive link among FDI and ED in five ASEAN countries. .On the other side, Saudi et al. (2017) analyzed the nexus among ED and CO<sub>2</sub> emissions and exposed positive nexus among them. Prior studies have analyzed the nexus among tourism, EG, FDI, and carbon emissions and found mixed evidence regarding their interrelationships. Thus, this study is carried out to get fresh insights into the effects of tourism growth, inward FDI, environmental degradation, and EG in the context of five ASEAN economies. The current study contributes to the existing empirical literature by investigating the said issue using the latest available data for five ASEAN economies. Further, this study bifurcates the impact of said predictors in the short-run and long-run separately using PMG estimators.

This article is prearranged as follows: section 2 offers insights into the existing literature regarding the linkage among tourism, FDI, CO<sub>2</sub> emissions, and ED. The variables of the study, model, and data description are presented in section 3. The estimation techniques are illustrated in section 4 followed by the empirical findings and discussion and conclusion in the Fifth section of the study.

## **2. Literature Review**

The literature review is categorized with respect to the linkages of tourism, FDI inflows, CO<sub>2</sub> emissions, and economic development.

### **2.1 Nexus between tourism and economic growth**

Tourism plays a vital role in the economic progress of the host country. In this regard, Ashley et al. (2007) pointed out that tourism improves economic growth and also creates employment opportunities and reduces poverty, especially in developing countries. Likewise, Brida and Risso (2009) studied the impact of tourism on the EG of Chili during 1986–2007 and found that tourism is positively linked with the ED of Chili. According to Belloumi (2010), tourism is significantly related to economic development in Tunisia during 1970–2007. He pointed out that a long-run causality runs from tourism receipts to economic development in Tunisia. The revenues generated from tourism play an extremely crucial role in the EG of India, Pakistan, China, and Russia (Tiwari, 2011). Ohlan (2017) examines the nexus among tourism and the EG of India during 1960–2014. The outcome of his study reveals that tourism is completely linked to EG. Similarly, Balli et al. (2019) found a direct linkage among tourism and ED. They studied the link among tourism, EG and CO<sub>2</sub> emissions in Mediterranean countries and concluded that tourism is significantly linked with economic progress and CO<sub>2</sub> emissions. In their study, Manzoor et al. (2019) found that tourism is positively linked with EG and employment in Pakistan during 1990–2015..

### **2.2 Nexus between FDI and economic growth**

A voluminous literature addresses the nexus between FDI and EG in different contexts. For instance, Nair-Reichert and Weinhold (2001) revealed in their study that FDI is significantly linked with ED. Likewise, according to Buckley et al. (2002), FDI not only covers the saving-investment discrepancy but also enhances tax revenue and human capital along with the

prerequisite of technology for the production of goods and services. Likewise, Makki and Somwaru (2004) found a significant connection among FDI and EG in 66 emerging economies. Moreover, Li and Liu (2005) found a strong links between FDI and ED not only in industrial countries but also in developing economies. Likewise, Hansen and Rand (2006) exposed a significant nexus between FDI and EG of 31 emerging economies during 1970–2000. The outcome of Abbas et al. (2011) study reveals a significant nexus among FDI and EG in SAARC countries. Another study found strong nexus among FDI and EG in 54 counties (Omri et al., 2014). Further, Koojaroenprasit (2012) studied the influence of FDI on ED in Korea from 1980 to 2009 and found a significantly significant and positive effect. Similarly, Shahbaz and Rahman (2010) investigated the association between FDI and EG for Pakistan and found a significant relationship. Besides, Abdouli and Hammami (2017) studied the nexus among FDI and EG of 17 countries and concluded that there exists a two-way causal link between FDI and ED. In a study by Phuyal and Sunuwar (2018), exposed a significant nexus is found between FDI and ED in Nepal during 2007–2016. Similarly, Dinh et al. (2019) found a positive nexus among FDI and EG.

### **2.3 Nexus between CO<sub>2</sub> emissions and economic growth**

Carbon emissions are inversely related to EG in low-income countries whereas the relation of CO<sub>2</sub> emissions with economic development becomes positive in case of high-income countries. Likewise, Arouri et al. (2012) examined the connection between energy use, CO<sub>2</sub> emissions, and ED and their results reveals that CO<sub>2</sub> emission is negatively associated to EG in selected MENA countries. Besides, Halicioglu (2009) also explored the nexus among FDI, energy use, CO<sub>2</sub> emissions, and EG in Turkey and found a causality among CO<sub>2</sub> emissions and EG. A one-way causal nexus among CO<sub>2</sub> emissions and EG is found for Tunisia from 1961 to 2004 (Fodha & Zaghdoud, 2010). While Azam et al. (2016) found an inverse link between energy utilization, CO<sub>2</sub> emissions, and EG in Japan, USA, India, and China during 1971-2013. Similarly, Bekun and Agboola (2019) also found a negative nexus among CO<sub>2</sub> emissions and progress of the economy in 16-EU countries. On the other hand, Richmond and Kaufmann (2006) found no association between CO<sub>2</sub> emissions and EG. In a similar vein, Zhang and Cheng (2009) also found no connection among CO<sub>2</sub> emissions and EG in China. While Lau et al. (2014) discovered a positive association among CO<sub>2</sub> emissions and ED in Malaysia from 1984 to 2008.

### **2.4 Nexus between tourism and CO<sub>2</sub> emissions**

The tourism sector increases energy utilization in several ways including increased use of transportation, accommodation, construction, and other activities resulting in increased air pollution and environmental degradation (Becken et al., 2001; Nawaz & Hassan, 2016). Likewise, Scott et al. (2010) also pointed out that the tourism sector is associated with lots of economic activities that make tourism a probable threat to the environment through high CO<sub>2</sub> emissions. According to Aref and Redzuan (2009), tourism has a deteriorating effect on the environment in the form of air pollution, noise pollution, traffic jamming, and demolish the natural environment. While Al-Mulali et al. (2015) studied the association between tourist arrivals and CO<sub>2</sub> emissions in the top 48 tourist economies. The results of their study revealed that a CO<sub>2</sub> emission is increasing due to the arrivals of international tourists in these selected countries. Also, Zhang and Gao (2016) surveyed the connection between tourism, EG, environmental pollution, and energy utilization in China and concluded that tourism inversely affects the atmosphere. Besides, Kolawole et al. (2016) studied the ecological effects of tourism

on people's quality of life and found a significantly negative link between tourism and people's quality of life. While Dogan et al. (2017) concludes that energy utilization and tourism increase the intensity of CO<sub>2</sub> emissions in OECD countries.

## 2.5 Prior studies on ASEAN countries

A lot of work is also done on the linkage among tourism, CO<sub>2</sub> emissions, FDI, and ED in ASEAN countries. As according to Ashley et al. (2007), tourism is one of the most important sources of economy in ASEAN countries, as it is professed as an active industry, which increases the state revenue and creates job opportunities in ASEAN countries. The result of Holik (2016) study reveals that tourism significantly contributes to EG in these five ASEAN countries. According to the study of Chulaphan and Barahona (2018), tourism plays a crucial part in the economic development of Thailand during 2008–2015. The tourist arrivals from Southeast Asia enhance the growth rate in Thailand. Likewise, Azam et al. (2019) observed the link between tourism and environment and concluded that tourism augments environmental pollution in Malaysia while in the context of Thailand and Singapore, the impact of tourism on environmental pollution is found negative throughout the study period. Vo and Le (2019) found no connection between CO<sub>2</sub> emissions, energy use, and renewable energy (RE) utilization in five ASEAN countries.. While in the case of Indonesia, one-way causality from EG to energy utilization and CO<sub>2</sub> emission is found.

The following conclusion can be drawn from accessible literature. The link between tourism and EG is very clear that tourism is one of the most imperative factors of ED. Likewise, the effect of FDI on economic progress is also found to be positive in several prior studies. The linkage among CO<sub>2</sub> emissions and ED is inconclusive since one strand of literature found a significant nexus among CO<sub>2</sub> emissions and EG either positive or negative. Several studies found an insignificant nexus between environmental degradation and EG. This study attempts to fill this gap in the literature by presenting fresh evidence using the latest data on the nexus of tourism growth, CO<sub>2</sub> emissions, FDI inflows and EG in ASEAN countries. Some more recent studies are tabulated in Table 1.

**Table 1** Previous studies on the nexus among tourism, FDI, CO<sub>2</sub>, and economic growth

Authors	Sample period; country(s)	Methods	Variables	Causality Results
Udemba, Magazzino, and Bekun (2020)	1995–2016 China	ARDL	GDP Per capita, CO <sub>2</sub> , Tourism arrival, FDI, Pop, Energy use	FDI→CO <sub>2</sub> ENG→CO <sub>2</sub> FDI→GDP CO <sub>2</sub> →GDP TR→GDP ENG→GDP ENG ↔ CO <sub>2</sub>
Jebli et al. (2019)	1995–2010 22 South and Central American economies	Panel cointegration, FMOLS, and DOLS	GDP, CO <sub>2</sub> , RE, Trade openness, International tourism, and FDI	RE→CO <sub>2</sub> IT →FDI IT→TO GDP→RE GDP→IT

Azam (2019)	1981–2015 4 BRICS Countries	FMOLS, RLS, Durmitrescu- Hurlin Panel Causality Test	Per capita GDP, Energy utilization, Physical capital, Human Capital, Environmental pollution, Financial Development	ENG↔CO <sub>2</sub> CO <sub>2</sub> ↔GDP FDI↔ENG ENG↔FD CO <sub>2</sub> ↔FDI HK↔GDP HK↔FDI HK↔FD
Mustafa (2019)	1977–2017 Sri Lanka	ECM, Cointegration and Granger Causality	GDP, Tourism receipts, FDI and Economic freedom	GDP→TR GDP→FDI
Ssali et al. (2019)	1980–2014 6 SS African Countries	ARDL, PMG	CO <sub>2</sub> , GDP, FDI, Energy consumption	ENG→CO <sub>2</sub> GDP→CO <sub>2</sub> CO <sub>2</sub> →FDI
Ohlan (2017)	1960–2014 India	ARDL, VECM	GDP, international tourism and Financial development	IT→GDP
Saudi et al. (2017)	1980–2010 5 ASEAN countries	Panel cointegration, and VECM	GDP and CO <sub>2</sub>	GDP → CO <sub>2</sub>
Abdouli & Hammami (2017)	1990–2012 17 MENA Countries	Panel GMM	GDP Per capita, FDI, Energy use, Pop, CO <sub>2</sub> , Financial Development, Capital stock, and Trade openness	FDI ↔ GDP ENG↔ GDP ENG → FDI
Gökmenoğlu and Taspinar (2016)	1974–2010 Turkey	ARDL	CO <sub>2</sub> , GDP, ENG, FDI	CO <sub>2</sub> ↔FDI ENG↔CO <sub>2</sub> GDP→FDI ENG→ FDI
Tang (2016)	1980–2010 Cambodia	ARDL	GDP, Energy use, Oil use, electricity utilization, and CO <sub>2</sub>	GDP→ ENG GDP↔CO <sub>2</sub>

Source: Authors compilation

### 3. Data and Empirical Methodology

#### 3.1. Data and its sources

In the current study, panel data on five ASEAN countries has been used over the period of 1995-2017. All the data were taken from World Development Indicators (WDI) 2020, the World Bank. GDP per capita (constant 2010 US\$) represent economic growth and tourism, FDI, CO<sub>2</sub> emissions, and population growth are also used in this study.

#### 3.2. Correlation matrix and descriptive statistics

The summary of descriptive statistics and correlation matrix of selected ASEAN countries are presented in Table 2. The statistics show a huge variation due to the dimensions of the selected five ASEAN countries. The economy of Vietnam achieved the highest per capita GDP growth rate of 7.6991 in 1995, whereas the lowest per capita GDP growth rate of -14.3506 was found in Indonesia in 1998. The average per capita GDP growth (annual %) is 3.4989 and its standard deviation is 3.2232. The maximum value of FDI is 9.7131, which is recorded in the economy of Vietnam in 1996, while its lowest value of -2.7574 is found in Indonesia in 2000. FDI has an

average value of 3.0504 with a standard deviation of 2.2118. International tourism is at the peak in Thailand during the year of 2017 with the maximum value of 17.3876, although hits lowest value is 14.1164, which is found in Vietnam during 1995. The average value of tourism is 15.7377 with a standard deviation of 0.8383. The average value of CO<sub>2</sub> emissions is 195108 kt and its standard deviation is 124551.5 kt. CO<sub>2</sub> emission is highest in Indonesia during 2012 with a value of 637078.9 kt while it is found minimum in the economy of Vietnam in 1995; its minimum value is 29090.31 kt. The annual growth rate of the population growth rate is very high at about 2.5608%, which is recorded in the economy of Malaysia in 1997, while the minimum growth rate of population is 0.3452% and it is found in Thailand in 2017. The population growth rate has an average value of 1.3906% and the standard deviation is 0.5452%.

**Table 2.** Descriptive statistics and correlation matrix

Statistics/ Variables	GDP per capita growth (GDPP <sub>it</sub> )	Foreign direct investment (FDI <sub>it</sub> )	Tourism sector (ITR <sub>it</sub> )	Carbon emissions (CO2 <sub>it</sub> )	Population growth (PG <sub>it</sub> )
Mean	3.4989	3.0504	15.7377	195108	1.3906
Median	4.1513	2.8291	15.7395	166910.8	1.3480
Maximum	7.6991	9.7131	17.3876	637078.9	2.5608
Minimum	-14.3506	-2.7574	14.1164	29090.31	0.3452
Std.Dev	3.2232	2.2118	0.8383	124551.5	0.5452
Skewness	-2.7716	0.5965	0.0618	1.167622	0.1861
GDP per capita growth (GDPP <sub>it</sub> )	1.0000				
Foreign direct investment (FDI <sub>it</sub> )	0.3199	1.0000			
Tourism sector (ITR <sub>it</sub> )	-0.0434	-0.0427	1.0000		
Carbon emissions (CO2 <sub>it</sub> )	-0.0135	-0.3004	-0.5128	1.0000	
Population growth (PG <sub>it</sub> )	-0.1429	-0.1107	-0.3534	-0.3666	1.0000

### 3.3. Theoretical framework and empirical model

The current study follows the growth literature and develops the growth model, first proposed by Samuelson and Solow (1956) and amplified by Mankiw and Romerand (1992), Barro et al. (1995), and Barro (2013). According to Solow (1956), the growth rate depends upon three main factors namely, labor, physical capital, and technological progress. The mathematical form of the Solow growth model is given below:

$$Y_{(t)} = f(K_{(t)}, A_{(t)}, L_{(t)}) \quad \dots \quad (1)$$

Where, 't' shows time period, 'Y' represent productivity, 'K' indicates capital, 'L' represent labor and 'A' represent knowledge.

Tourism, as a regressor, is used by Holik (2016) for five ASEAN countries, Ohlan (2017) for India, Manzoor et al. (2019) for Pakistan, Mustafa (2019) for Sri Lanka and Shaheen et al. (2019) for top-10 tourist countries. Inward FDI is also considered an essential factor for EG, and in a lot of studies, FDI is used as a key factor of economic progress. As in some previous studies of Choong (2009), Moudatsou and Kyrkilis (2011), Abdouli and Hammami (2017), Phuyal and Sunuwar (2018), Mustafa (2019), and Dinh et al. (2019), FDI was utilized as a determinant of EG. The CO<sub>2</sub> emissions and ED nexus is also studied in many prior studies like Azam et al. (2016), Saudi et al. (2017), Balli et al. (2019), Azam (2019) used CO<sub>2</sub> emissions in their studies. The current study also utilized population growth in order to check its effect on EG in selected ASEAN countries. Based on the Solow (1956) growth model and previous literature, this study develops the following model with little modification, presented in Equation (2).

$$Y_{it} = \beta_0 + \beta_1 FDI_{it} + \beta_2 ITR_{it} + \beta_3 CO_{2it} + \beta_4 PG_{it} + \mu_{it} \quad \dots \quad (2)$$

where,  $i = 1, 2, \dots, N$  indicates panel members and  $t = 1, 2, \dots, n$  indicates time. Similarly,  $\beta_0 - \beta_4$  are the coefficients,  $Y$  represents per capita GDP growth,  $FDI$  is foreign direct investment,  $ITR$  is international tourism,  $CO_2$  is carbon dioxide emission,  $PG$  is population growth and  $\mu$  is the error term.

Equation (2) states that FDI plays a decisive part in achieving higher economic development and it is used widely in previous literature as a determinant of ED. Previous studies such as Makki and Somwaru (2004), Shahbaz and Rahman (2010), Azam (2016) and Dinh et al. (2019) used FDI as a determinant of EG and found a positive along with significant effect of FDI on ED. International tourism is considered as a pillar to sustainable development. According to Ashley et al. (2007), tourism enhances EG and create employment opportunities and also shrink poverty, especially in emergent economies of the world. Belloumi (2010) and Ohlan (2017) also exposed a positive nexus among tourism and ED. The current study anticipates a positive nexus among tourism and EG. Environmental pollution is inversely linked with economic progress and it negatively affects the growth and development Martínez-Zarzoso and Bengochea-Morancho (2004); Arouri et al. (2012); Azam et al. (2016); Bekun and Agboola (2019). Population growth has also some influence on the economic development of every country and a rapid increase in population growth reduces the growth of the economy. As per the findings of Siddiqui and Mahmood (1998), Yao et al. (2013) and Zhang (2015), population growth is negatively linked with economic growth.

**Table: 3** Variables definitions

Variables	Definitions	Source	Expected Sign
Dependent variable: Y	GDP Per Capita Growth (Annual %)	WDI (2020)	
Independent variables: FDI	net foreign direct investment, inflows as percentage of GDP	WDI (2020)	+
	Tourism Number of Arrivals	WDI (2020)	
ITR			+
CO <sub>2</sub>	CO2 emissions (kt)	WDI (2020)	-
PG	Population Growth (Annual %)	WDI (2020)	-

## 4. Estimation procedure

### 4.1 Panel unit root tests (PURT)

There is criticism on the classical unit root tests due to their low power in case of small samples. Therefore, PURTs are used in this study. This study employs the most popular and reliable PURTs proposed by Levin, Lin, and Chu (2002), and the ADF- Fisher Chi-square proposed by Maddala and Wu (1999) are utilized.

### 4.2 PMG estimator

Since this study has found the evidence of mixed order of integration among study variables, therefore, PMG estimator proposed by Pesaran and Shin (1998) is utilized for estimating the model coefficients. Johansen (1998) and Phillips and Hansen (1990) are of the view that long-term association is merely found in the perspective of cointegration among variables of the similar order of integration. While Pesaran, Shin, and Smith (2001) are of the view that the Autoregressive Distributed Lag (ARDL) method as proposed by Pesaran and Shin (1998) is appropriate irrespective of the integration order of the variables. The PMG estimator gives consistent coefficients regardless of the existence of endogeneity.

The dynamic panel ARDL model proposed by Pesaran, Shin, and Smith (1999) is utilized in this study is as follows:

$$gdppc_{it} = \sum_{j=1}^p \beta_{1i,j} gdppc_{i,t-j} + \sum_{j=1}^q \gamma_{1i,j} X_{i,t-j} + \mu_i + \varepsilon_{it} \quad \dots \quad (3)$$

The  $gdppc$  is the growth rate of per capita GDP (dependent variable);  $X_{it}$  ( $K \times 1$ ) is the vector of regressor (independent variables) with foreign direct investment, tourism arrivals, CO<sub>2</sub> emissions and population growth.  $\mu_i$  indicates the fixed effect,  $\beta_{ij}$  represents the coefficients of the response variable,  $\gamma_{ij}$  are ( $K \times 1$ ) coefficient vectors of the regressors and  $\varepsilon_i$  is the error term.

Assuming that the variables will respond to any deviation from the long-run equilibrium, the error-correction model of the model presented in Equation (3), for capturing the short-run dynamics and short-run coefficients, is presented in Equation (4) as follows:

$$\Delta gdppc_{it} = \phi_{1i} (gdppc_{i,t-1} - \theta_{1i} X_{it}) + \sum_{j=1}^{p-1} \delta_{1,ij} gdppc_{i,t-j} + \sum_{j=0}^{q-1} \partial_{1,ij} \Delta X_{i,t-j} + \mu_i + \varepsilon_{it} \quad \dots \quad (4)$$

where,  $\phi_i = -(1 - \sum_{j=1}^p \delta_{ij})$ ,  $\theta_i = \sum_{j=0}^q \frac{\partial_{ij}}{(1 - \sum_k \delta_{ik})}$ ,  $\delta_{ij} = -\sum_{m=j+1}^p \delta_{im}$

$$j = 1, 2, \dots, p-1, \quad \text{and} \quad \partial_{ij} = -\sum_{m=j+1}^q \partial_{im} \quad j = 1, 2, \dots, q-1$$

### 4.3 Panel Granger causality test

The granger causality test was proposed by Granger in 1969. It is a technique to check the causality among two variables in a time series (Granger, 1969). The procedure is a probabilistic version of causality; it utilizes empirical data set to discover the pattern of correlations and the direction of causality.

## 5. Results and Discussions

This study employs three well-known PURTs namely: LLC, IPS, and ADF for stationary checking, and the outcome of PURTs are presented in Table 4. The outcome shown in Table 4 illustrates that international tourism and CO<sub>2</sub> emissions are non-stationary at the level and it becomes stationary at first difference. However, other variables are stationary at the level. The outcomes of PURTs reveal mixed order of integration i.e.  $I(0)$  and  $I(1)$ .

**Table 4.** Panel unit root analysis

Tests	Variables	Level		1 <sup>st</sup> Difference	
		Constant	Constant + Trend	Constant	Constant +Trend
LLC	GDP per capita growth (GDPP <sub>it</sub> )	-5.0459*	-5.6399*	-8.8580*	-7.3356*
	Foreign direct investment (FDI <sub>it</sub> )	-2.2820**	-2.6825**	-6.3344*	-5.2546*
	Tourism Sector (ITR <sub>it</sub> )	3.3176	0.1250	-2.7448**	-4.2984*
	Carbon emissions (CO <sub>2it</sub> )	-0.6176	0.6554	-5.0209*	-3.2979*
	Population growth (PG <sub>it</sub> )	-3.5162*	-8.2821*	-11.7518*	-11.771*
IPS	GDP per capita growth (GDPP <sub>it</sub> )	-4.8074*	-5.0344*	-8.4566*	-7.1118*
	Foreign direct investment (FDI <sub>it</sub> )	-3.0672*	-2.6013**	-6.2314*	-5.0824*
	Tourism sector (ITR <sub>it</sub> )	5.4512	0.9282	-4.2191*	-5.2049*
	Carbon emissions (CO <sub>2it</sub> )	1.8309	0.5083	-5.5270*	-4.1180*
	Population growth (PG <sub>it</sub> )	-1.3221	-14.2558*	-12.3946*	-11.1799*
ADF Fisher Squares	GDP per capita growth (GDPP <sub>it</sub> )	42.2870*	41.3978*	74.3795*	57.8653*
	Foreign direct investment (FDI <sub>it</sub> )	28.0509*	25.4066*	54.1801*	41.9147*
	Tourism sector (ITR <sub>it</sub> )	0.9802	8.0304	36.5660*	42.9866*
	Carbon emissions (CO <sub>2it</sub> )	2.5338	6.1923	47.6818*	34.0577*
	Population growth (PG <sub>it</sub> )	27.0655*	307.919	156.264*	100.087*

Note: \*, \*\*and \*\*\*indicates 1%, 5% and 10% level of significance.

According to the nature of the data and outcome of PURTs, this study utilized the PMG estimator for empirical investigation. The results obtained from PMG estimator are presented in Table 5, which reveals that almost all variables are significant with their expected signs. The results obtained from PMG estimator are significant both in the short as well as long run.

FDI has a statistically significant effect on EG both in the long and short run. A one percent rise in FDI will boost up EG by 0.115% in the long run. This result is in line with past researches such as Makki and Somwaru (2004), Shahbaz and Rahman (2010), Azam et al. (2016), and Dinh et al. (2019). Tourism plays an incredibly crucial part of the economic progress of the host country. Tourism plays a decisive role to endorse the economic progress of the economy and provides foreign revenue to the host country. The connection between tourism and economic progress is also found positive, which means that as tourism improves in selected ASEAN countries, it will enhance EG. The impact of tourism on EG is found to be positive in the short as well as long term as well. The outcome of PMG about the linkage between tourism and

economic progress area similar to the findings of Brida and Risso (2009), Belloumi (2010) and Ohlan (2017).

Another variable utilized in the study is CO<sub>2</sub> emissions to verify its effect on economic development in ASEAN countries. The outcomes of PMG reveal that CO<sub>2</sub> emissions are inversely associated with economic development in selected ASEAN countries. From Table 5, it is confirmed that CO<sub>2</sub> emissions have a discouraging and harmful impact on EG, which means that as the level of CO<sub>2</sub> emissions increase, it will reduce the pace of economic progress. The inverse relationship between CO<sub>2</sub> emissions and economic progress is also found by Arouri et al. (2012), Azam et al. (2016) and Bekun and Agboola (2019).

The influence of population growth on EG is found positive in the long term while it is negative in short term. The effect of population growth is harmful in the short run, which means that as the population rate increases, it will damage EG. Our results are consistent with the finding by Azam et al (2020), while contradictory with the findings by Yao et al. (2013) and Zhang (2015) as these studies found an inverse nexus among population growth and economic progress.

**Table 5** Results of PMG estimator

Variables	Coefficient	Std. Error	t-statistic	p-value
<b><i>Long run equation</i></b>				
Foreign direct investment (FDI <sub>it</sub> )	0.11459**	0.0472	2.4231	0.0214
Tourism Sector (ITR <sub>it</sub> )	5.38247*	0.3742	14.3829	0.0000
Carbon Emissions (CO <sub>2</sub> <sub>it</sub> )	-3.65E-05*	3.58E-06	10.2143	0.0000
Population Growth (PG <sub>it</sub> )	0.82157*	0.2979	2.7572	0.0097
<b><i>Short-run equation</i></b>				
ECT	-2.05634*	0.4258	4.8292	0.0000
Δ(GDPP <sub>it-1</sub> )	0.55285*	0.1984	2.7863	0.0090
Δ(GDPP <sub>it-2</sub> )	0.04653	0.1941	0.2396	0.8122
Δ(FDI <sub>it</sub> )	0.28701	0.3739	0.7675	0.4486
Δ(FDI <sub>it-1</sub> )	0.16452	0.2819	0.5836	0.5637
Δ(FDI <sub>it-2</sub> )	0.74745	0.6488	1.1521	0.2581
Δ(ITR <sub>it</sub> )	6.37464	8.7796	0.7261	0.4732
Δ(ITR <sub>it-1</sub> )	10.92705	10.8699	1.0053	0.3226
Δ(ITR <sub>it-2</sub> )	7.89204	8.0945	0.9749	0.3371
Δ(CO <sub>2</sub> <sub>it</sub> )	0. <sup>0001</sup> *5	3.35E-05	4.3899	0.0001
Δ(CO <sub>2</sub> <sub>it-1</sub> )	-9.88E-07	5.22E-05	0.0189	0.9850
Δ(CO <sub>2</sub> <sub>it-2</sub> )	6.33E-05	3.96E-05	1.6004	0.1196
Δ(PG <sub>it</sub> )	76.16602	65.7782	1.1579	0.2557
Δ(PG <sub>it-1</sub> )	-216.008	210.0407	1.0284	0.3117
D(PG <sub>it-2</sub> )	219.877	264.3723	0.8317	0.4119
Constant	-155.8009	68.6292	5.4420	0.0000

Note: Asterisks \*, \*\* shows significant at 1% and 5% levels respectively

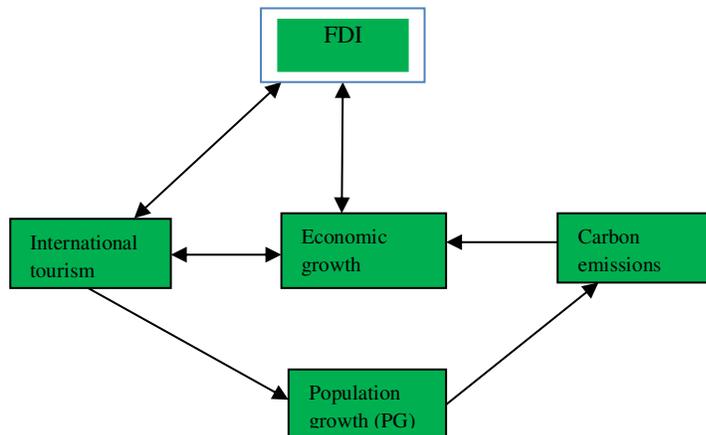
Furthermore, the pair-wise Granger causality has been mentioned in Table 6. The outcome demonstrates that there exist bidirectional causality among FDI and ED. This shows that as FDI

increase it will enhance economic progress and similarly, economic growth also causes FDI. Empirical findings of the bidirectional linkage between FDI and economic progress are alike to the findings of (Abdoul & Hammami, 2017). The outcomes of pair-wise Granger causality further demonstrate that there is a two-way causality among tourism and economic progress, and between tourism and FDI. A change in the number of international tourism arrivals brings a change in economic growth and it also causes FDI. In a similar vein, EG and FDI also cause international tourism; it may increase or decrease tourist arrivals. The results of Table 6 reveal that unidirectional causality is found between CO<sub>2</sub> emissions and ED, tourism and population growth and population growth and CO<sub>2</sub> emissions. Figure 2 shows direction of causality among economic growth, FDI, tourism, environmental pollution and population growth

**Table 6** Pairwise Granger causality tests (stacked test common coefficients granger causality tests)

Variables/statistics	$GDP_{it}$	$FDI_{it}$	$ITR_{it}$	$CO2_{it}$	$PG_{it}$
	-	17.3659*	6.5462*	3.4653*	0.9849
$GDP_{it}$		(0.0000)	(0.0020)	(0.0340)	(0.3764)
	11.8092*	-	23.3079*	0.5911	0.4134
$FDI_{it}$	(0.0000)		(0.0000)	(0.5557)	(0.6623)
	19.1785*	46.4039*	-	0.4948	1.3447
$ITR_{it}$	(0.0000)	(0.0000)		(0.6112)	(0.2645)
	0.6713	0.5488	0.2292	-	6.1562*
$CO2_{it}$	(0.5133)	(0.5794)	(0.7956)		(0.0021)
	1.2064	1.1106	3.4753*	0.6379	-
$PG_{it}$	(0.3029)	(0.3327)	(0.0341)	(0.5305)	

Null hypothesis: no causality; top values represents F-Statistic; p- values are in ( ). Asterisk \*, \*\* indicates statistical significant at the 1%, and 5 % level respectively.



**Figure 1.** Diagram of causality results of economic growth, FDI, tourism, environmental pollution and population growth

**Source:** Constructed by Authors

## **6. Conclusion**

The current study aims to discover the association among tourism, FDI, environmental pollution and ED in selected five ASEAN countries during 1995–2017. The following conclusion is drawn from this empirical analysis;

- The result reveals that some variables are stationary at a level while other variables are stationary at the first difference.
- The PMG estimator shows that FDI and economic progress are positively associated. It shows that the rise in FDI will enhance the EG.
- International tourism arrivals have a significant along with positive effect on ED. As the number of tourist arrivals improves, it will enhance the economic progress in ASEAN countries. The effect of tourism arrivals is found significant both in the short as well as long term.
- Environmental pollution is inversely related to EG, which shows that high intensity of CO<sub>2</sub> emissions will severely damage the pace of economic progress. The inverse linking between CO<sub>2</sub> emissions and ED is found both in the long as well as short run.
- Population growth has a depressing effect on economic progress in the short term while its impact becomes positive in the long term.
- The pairwise granger causality reveals a two-way causal link among FDI and economic progress, tourism and economic progress and tourism and FDI. A one way causality is found from CO<sub>2</sub> emissions to economic progress, tourism to population growth and population growth to CO<sub>2</sub> emissions.

Since FDI positively contributes to the EG of ASEAN economies, the policymakers in these countries must design their policies that attract foreign investments such as easing the business conditions, easing the visa restrictions, special business permits among others. Likewise, tourism positively contributes to the economic growth in ASEAN countries, policies to augment the tourism sector should be designed to enhance EG. These may include easing visa process (e-visa), visa on arrival, special tourism packages, and online facilitation regarding various kinds of tourism among others. The study has also revealed a negative impact of CO<sub>2</sub> emissions on EG, which calls for actions to mitigate CO<sub>2</sub> emissions to protect the environment. These policies may include increased use of REs sources such as wind and solar energy, eco-friendly growth policies, green financing etc. for achieving sustainable growth. Since population growth also adversely affects the EG in ASEAN countries, it is imperative to control the population growth in these countries to achieve a sustainable growth pattern.

## **DECLARATIONS**

### **-Ethical Approval and Consent to Participate**

There is no any issue of conflict of interest in our article/ The authors declare that they have no conflict of interest.

### **-Consent to Publish**

We all three authors are agree to publish our work in your esteemed journal

### **-Funding**

No funding was received from any funding agencies.

### **-Data Availability**

Data used in this study for empirical examination have been obtained from the World Development Indicators (2020), the World Bank database <https://data.worldbank.org/>

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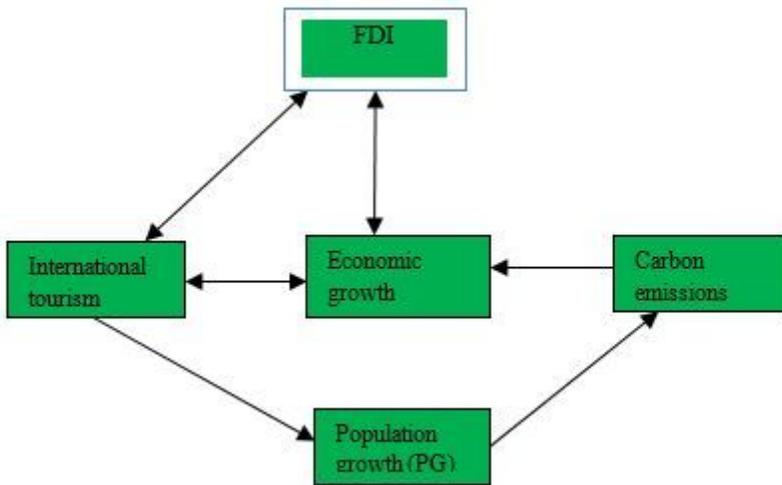
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# Figures



**Figure 1**

Diagram of causality results of economic growth, FDI, tourism, environmental pollution and population growth Source: Constructed by Authors