LINKAGES AMONG TOURISM DEMAND, HUMAN DEVELOPMENT, AND CO_2 EMISSIONS IN THAILAND

Pimonpun Boonyasana[1,*] and Warattaya Chinnakum[2]

Abstract

This study investigates the linkages between international tourism demand, human development, and CO_2 emissions in reference to Thailand, throughout the period from 1995 to 2018, using a Three-Stage Least Squares analysis and Seemingly Unrelated Regression Estimation. The empirical results indicate a unidirectional causal link without feedback effects from tourism demand to human development. This implies that tourism contributes to human development. Meanwhile, bidirectional causality was found between tourism demand and CO_2 emissions, as well as between human development and CO_2 emissions. The results highlight that tourism demand and human development contribute to the reduction of emissions, while CO_2 emissions also contribute to the reduction of tourism demand and human development in terms of quality of life. The findings suggest that a green growth policy such as investment in eco-friendly infrastructure to secure energy efficiency, emission control technologies, and access to renewable energy sources will encourage a greater tourism demand and improve human development in Thailand.

Keywords: Tourism demand, human development, CO_2 emissions, Thailand

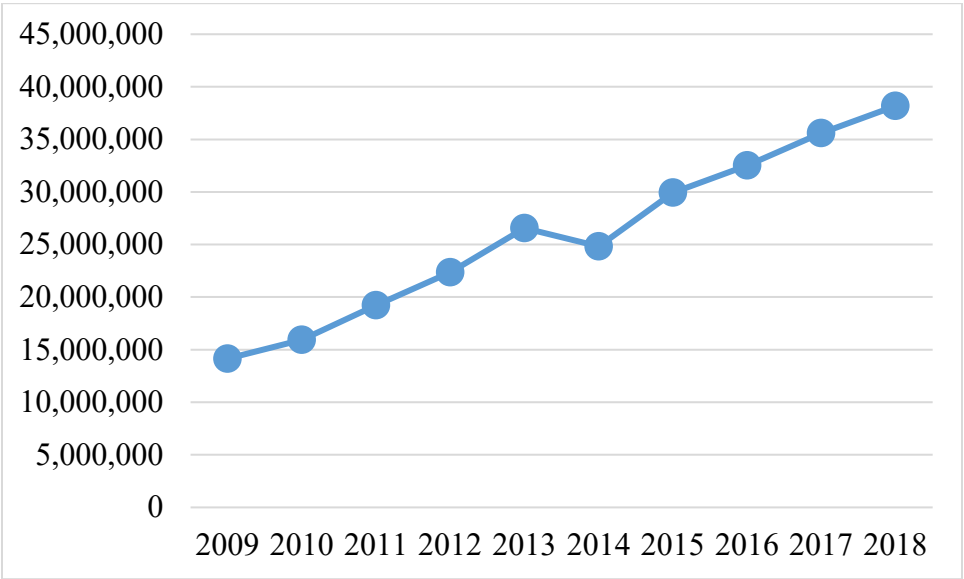
1. INTRODUCTION

Tourism is one of the most important sectors driving the economic development of Thailand. It also helps generate income in various relevant sectors of the country. According to the statistics collected by the Office of the Permanent Secretary, Ministry of Tourism and Sports (2020), the number of international tourists arriving to Thailand between 2009 and 2018 continuously increased from 14.14 million visitors in 2009 to 38.17 million visitors in 2018, as shown in Figure 1. As a result, Thailand earned

[1,*]Mrs. Pimonpun Boonyasana obtains a Master's degree in Economics from Faculty of Economics, Chiang Mai University, Thailand. Currently she is working as a researcher in the Faculty of Economics, Chiang Mai University. Email: pui.econ@gmail.com

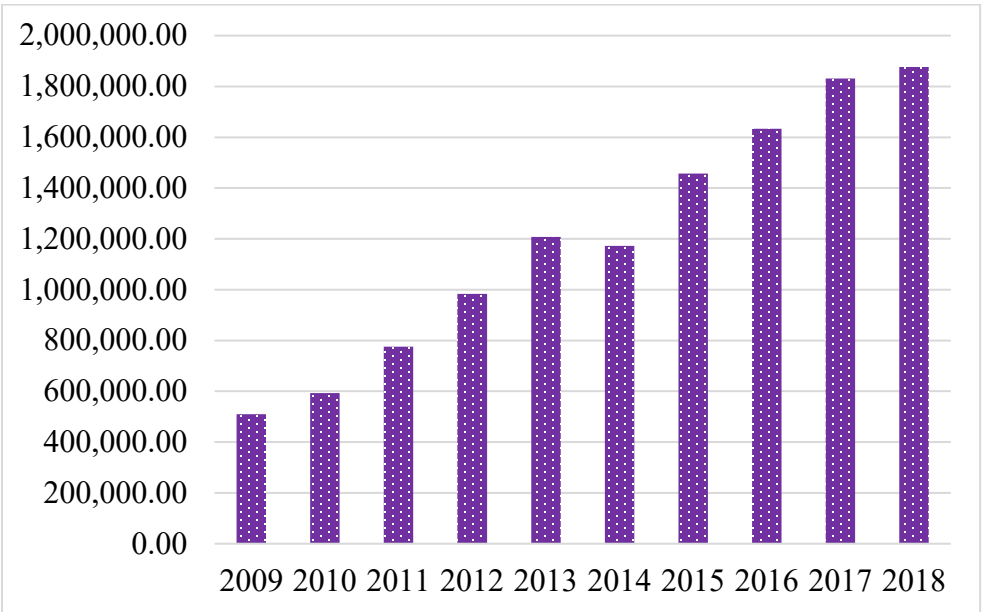
[2]Asst. Prof. Dr. Warattaya Chinnakum obtains a Ph.D. in Economics from the Faculty of Economics, Chiang Mai University, Thailand. Currently she is working as a lecturer in the Faculty of Economics, Chiang Mai University.

tourism receipts of 1,876,136.90 million baht (21.6 percent of GDP) in 2018 (Figure 2).



Source: Office of the Permanent Secretary, Ministry of Tourism and Sports

Figure 1: Number of Tourist Arrivals (Persons)

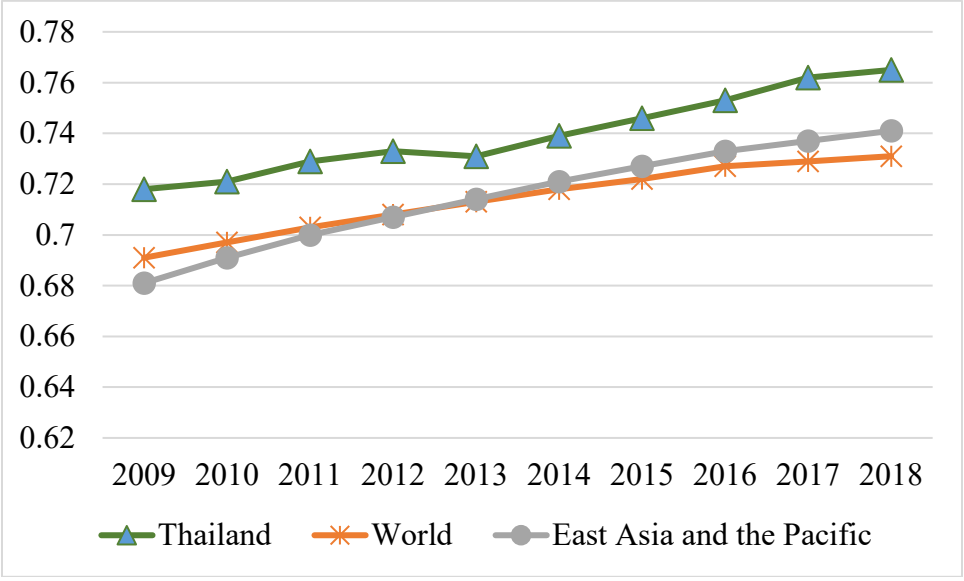


Source: Office of the Permanent Secretary, Ministry of Tourism and Sports

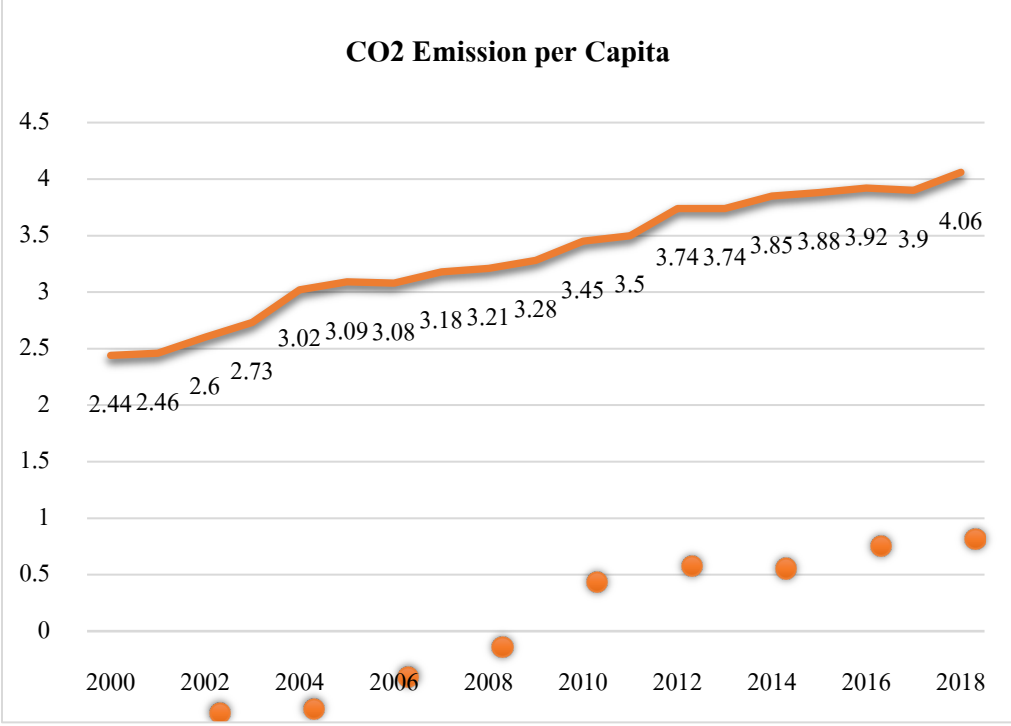
Figure 2: Tourism Receipts (Million baht)

The tourism sector of Thailand has directly generated income and created jobs for other related industries and economic segments such as the hotel business, transportation services, pleasure and recreation, tour guide services, gift shops, food shops, and even rural home-stay or farm-stay enterprises. Therefore, in most, if not all tourist attraction areas, the local standard of living can be improved with greater income and job opportunities. Having better income, in general, can be perceived as leading to an improved quality of life of the family in material terms and in other aspects of human development such as increased opportunities in gaining access to higher education levels or better health care services. Apart from local income and employment, tourism has been reflected on as playing an important part in improving the emotional well-being of residents and the community as a whole, which is also a trait of high quality of life and thus human development (Puczko and Smith, 2001). When it comes to the issue of assessing the level of human development, there are several possible approaches to this measurement. Previous studies, such as Biagi et al. (2017), Croes et al. (2020), and Fu et al. (2020) used the Human Development Index (HDI) as a proxy of the level of human development. The Human Development Index (HDI) is a composite index used to rank countries according to several development dimensions, such as life expectancy, education level, and standard of living. A country obtains a higher HDI score when its population has a higher life expectancy, education level, and standard of living. The HDI is an important mechanism that reflects the country's economic system. According to the Human Development Report Office (UNDP, 2020), in 2018, the Human Development Index for Thailand was 0.765, ranking 77th in the world. The Human Development Index of Thailand increased from 0.718 in 2009 to 0.765 in 2018 (Figure 3). Thailand's 2018 HDI of 0.765 is above the global average of 0.731 for individual countries, and above the average of 0.741 for countries in East Asia and the Pacific.

In general, it is well documented in the previous literature that the tourism sector plays an important role in economic growth, employment opportunities, raising income from abroad, and socio-economic development. However, the tourism sector is often blamed for its negative impact on the environment. The number of tourists and national income can also increase or decrease by environmental factors in the destination country. As a result of this, a number of countries have started to aim for sustainable tourism, meaning that the industry is committed to making a positive impact on the environment, society, and economy.



Source: UNDP (2020)
Figure 3: Human Development Index (HDI)



Source: Energy Policy and Planning Office (EPPO)
Figure 4: Thailand CO_2 Emissions per Capita

Thailand continuously requires energy for driving its economy. Due to continually increasing energy demands, CO_2 emissions are increasing. As shown in Figure 4, Thailand's per capita CO_2 emissions increased from 2.44 metric tons in 2000 to 4.06 metric tons in 2018, growing at an average annual rate of 2.13 %. In 2018, the transport sector was the largest energy-consuming sector, accounting for 40.0 % of the country's total energy consumption. The industrial sector was the second largest energy-consuming sector. As the tourism sector is closely linked with the transport sector, an increase in tourism demand will increase the demand for transportation services and consequently lead to increased carbon emissions. Related literature provides evidence that there is a significant relationship between CO_2 emissions and many factors, such as economic growth, urbanization, energy consumption, openness of trade, population growth, and financial development (Cetin, et al., 2018; Dong et al., 2018; Li and Lin, 2015; Park et al., 2018). However, there is less empirical evidence regarding the exact relationship between the tourism sector and CO_2 emissions, and the problem of rapid increases in CO_2 emissions has not been sufficiently considered in tourism research attempts (Solarin, 2014). On the contrary, the nexus of economic growth and CO_2 emissions has been investigated quite extensively, but without considering the notion that economic growth does not in itself guarantee an increase in living standards (Ouedraogo 2013, p. 29) which is an element of human development. Therefore, this study aims to focus on the relationship between the Human Development Index and CO_2 emissions.

A sustainable tourism industry is one committed to making a low impact on the environment and local culture while helping to generate future employment for local people. In the absence of disruptions caused by politics, epidemics, or other natural disasters, sustainable tourism is attainable within a country, accompanied by continued improvement in three dimensions, namely the increased income of all stakeholders and business sub-sectors related to the tourism industry, an improved quality of life for residents in the destination country, and a declining negative environmental impact from tourism activities. However, previous empirical studies have tended to analyze only variables in the economic and social domains, using different indicators to represent each dimension. Therefore, this study builds a theoretical and empirical bridge between tourism and the broader agenda of sustainable tourism. The contribution of this paper is a simultaneous analysis of the links between tourism demand, human development, and CO_2 emissions, allowing for more effective tourism policymaking and destination management. Specifically, this study investigates the linkage between the international demand for tourism, human development, and CO_2 emissions in Thailand, covering

the period from 1995 to 2018. For this purpose, a Three-Stage Least Squares analysis, and Seemingly Unrelated Regression Estimation (SURE) are employed. Moreover, this paper will benefit policymakers in terms of increasing the effectiveness and sustainability of the strategic plan to promote Thailand as a top tourist destination.

The remainder of the paper is organized as follows: Section 2 contains a brief literature review. Section 3 describes the data and methodology used in the analysis, while the estimated models and empirical results are discussed in Section 4. Finally, a discussion and conclusion are found in Section

2. LITERATURE REVIEW

The relationship between tourism demand and human development, the relationship between tourism demand and CO_2 emissions, and the relationship between human development and CO_2 emissions, have been extensively studied by numerous scholars over the last few decades, but with mixed results. A summary of this research can be found in Table 1. However, few studies have analyzed the linkages between international tourism demand, human development, and CO_2 emissions, and there is no similar study which has been conducted in Thailand.

2.1 Definition of Tourism Demand, Human Development, and CO_2 Emissions

Tourism demand is a broad term that covers the factors affecting the level of demand, types of demand, and the motivation for making such demands. According to a definition of tourism proposed by the World Tourism Organization (WTO), "*tourism is the activities of persons traveling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes not related to the exercise of an activity remunerated from within the place visited*". It also offers a definition of tourists as "*the temporary visitors staying in a place outside their usual place of residence, for a continuous period of at least 24 hours but less than one year, for leisure, business or other purposes*" (UNWTO, 2012). In this study, international tourism demand is defined as the number of international tourist arrivals, as this is the most frequently used measurement in previous studies (Sheldon, 1993; and Song et al., 2009). According to Sheldon (1993), the measurement of tourism demand by international tourist arrivals serves a great purpose to suppliers of products and services. This measurement can be used to adjust the supply capacity, for example investing in new hotels or buying new aircraft, according to the volume of recorded arrivals.

Development refers to a change based on social status, community attitudes, or institutions (Todaro, 2011). Human development grew out of the global discussion on the links between economic growth and economic development (UNDP, 2020). Human development can be defined as a process of progressive changes in people's lives over time, that enables them to adapt more effectively to their environments. In this study, the Human Development Index (HDI) is used to measure the level of human development. The HDI is a statistic developed and collected by the United Nations to measure various countries' levels of social and economic development. Three basic references in measuring HDI are standard of living, knowledge, and a long and healthy life. This index is a tool used to follow changes in development levels over time and to compare the development levels of different countries.

Carbon emission is often referred to when discussing climate change and global warming issues. Carbon emission is related to human activities such as transportation, production, and consumption, including activities in the tourism sector. These activities include the burning of fossil fuels, deforestation, land-use changes, livestock, and fertilization of land, which result in a net increase in carbon emissions. In this study, CO_2 emission rates from biomass were estimated from the production of power generation and suitable emission factors.

2.2 Literature Review on Tourism and Human Development

Tourism is a complex industry. It generates income and provides employment opportunities, also supporting diversity in the economy. It also supports the development of the quality of life of residents (Puczko & Smith, 2001). Along with the growth of tourism and related industries, the relationships between tourism and other related variables such as economic growth, openness in trade, energy consumption, and investment have been investigated by many tourism economists. Some studies have investigated the link between tourism and quality of life (Table 1, A). Aref (2011), Kim et al. (2013), and Ridderstaat et al. (2016) investigated the effect of tourism on residents' quality of life and found the effect to be positive. Ridderstaat et al. (2016) in particular, found that tourism development has both direct and indirect impacts on residents' quality of life, and that the improvement in the quality of life of local people, which reflects economic development, has an indirect effect on tourism development.

Moreover, most of the prior studies use the Human Development Index (HDI) as a proxy of the level of human development. For example, Biagi et al. (2017) analyzed the relationship between tourism and the HDI for 63 selected countries from 1996 to 2008. They found that tourism is positively associated with human development, but in small and developed countries, this relationship

tends to be negative. This suggests that above a certain threshold, tourism development produces some types of negative externalities. Croes et al. (2020) investigated the relationship between tourism competitiveness and human development and found unidirectional causality from human development to tourism competitiveness. Fu et al. (2020) investigated the links between tourism demand and Hong Kong residents' quality of life represented by the Human Development Index. They found that tourism markets are heterogeneous with their interaction with the economy and residents' quality of life. Improvements in residents' quality of life had a positive impact on tourism demand for Hong Kong, while tourism demand had no impact on Hong Kong residents' quality of life.

2.3 Literature Review on Tourism and CO_2 Emissions

Regarding climate change and global warming, various studies have focused on the relationship between tourism and the environment (Table 1, B). A number of studies have confirmed the presence of unidirectional causality between CO_2 emissions and tourism demand. Zaman et al. (2015) examined the long-run linkages among tourism transportation expenditure, carbon dioxide emissions, energy consumption, and growth factors of 11 transition economies. Their results showed that international tourism transportation expenditures have a significantly positive relationship with CO_2 emissions, which implies that higher international tourism transportation expenditures, which occur as a result of increased tourism demand, can bring about an increase in CO_2 emissions. Dogan and Aslan (2017) examined the linkages between emissions, economic growth, and tourism, in 25 European Union and candidate countries covering the period from 1995 to 2011. Their empirical results suggested that economic growth and tourism reduce emissions. This is because, when economic growth continues, people will spend their income on improving the environment by improving air quality and cleaning water. Meanwhile, an increase in tourism demand will lead to an increased tourism investment in eco-friendly infrastructure to achieve energy efficiency, emission control technologies, and access to renewable energy sources which lead to carbon reduction in the long run. However, some studies found evidence of bidirectional causality between CO_2 emissions and tourism (Yazdi et al. (2014), Zhang and Gao (2016). However, Liu et al. (2019) examined the relationship between CO_2 emissions and international tourism income in Pakistan and found no causal relationship between tourism income and CO_2 emissions.

2.4 Literature Review on Human Development and CO_2 Emissions

Many previous studies have investigated the relationship between economic growth and CO_2 emissions. However, while economic growth is an important factor contributing to better living standards, it does not guarantee an increase in human well-being (Ouedraogo 2013, p. 29). Therefore, in recent years focus has been placed on the HDI, as seen in studies such as Steinberger and Roberts (2010), Bedir and Yilmaz (2015), Asongu (2018), and Mohmmed et al. (2019) (Table 1, C). Steinberger and Roberts (2010) indicated that a high level of human development can be achieved at moderate energy and CO_2 emission levels. Asongu (2018) examined the impact of CO_2 emissions on human development in 44 Sub-Saharan African countries and found that CO_2 emissions have a negative impact on human development. A higher level of CO_2 will contribute to a poorer air quality with harmful implications on human health and life expectancy which is one of the human development dimensions. Similarly, Mohmmed et al. (2019) explored the drivers of carbon dioxide (CO_2) emissions (million metric tons) in the top 10 emitting countries (China, the United States of America, India, the Russian Federation, Japan, Germany, South Korea, Iran, Canada, and Saudi Arabia). Their results showed that the Human Development Index has positive and statistically significant effects on agricultural CO_2 emissions and Bunker fuel emissions. This implies that increases in human development can lead to rapid growth in energy consumption and an increase in agricultural CO_2 emissions and Bunker fuel emissions.

Table 1 Summary of some Selected Literature on CO_2 Emissions, Tourism, and Human Development

Author	Study period	Country	Method	Long-run linkage
A.Tourism and human development				
Aref (2011)	2011	Shiraz, Iran	Descriptive statistics	TOUR→HD
Kim et al. (2013)	1990-2000	Virginia	Multiple regression	TOUR→HD
Biagi et al.(2017)	1996-2008	63 selected countries	OLS with FE and RE	TOUR→HD
Croes et al. (2020)	1998-2014	10 South American countries	Mixed-effect regression model, Panel regression	TOUR↔HD
Fu et al. (2020)	1980–2016	Hong Kong	Unit root, cointegration testing, Three-Stage Least Squares	TOUR←HD

Author	Study period	Country	Method	Long-run linkage
B. Tourism and CO_2 emissions				
Katircioglu et al. (2014)	1970-2009	Cyprus	ARDL, conditional Granger causality	TOUR→CO_2
Yazdi et al. (2014)	1975-2011	Iran	ARDL, conditional Granger causality	TOUR↔CO_2
Zhang and Gao (2016)	1995-2011	China	FMOLS	TOUR→CO_2 (Central and Western regions) TOUR↔CO_2 (Eastern region)
Zaman et al. (2016)	1995-2013	11 transition economies	FE	TOUR→CO_2
Shakouri et al. (2017)	1995-2013	12 Asia-Pacific countries	GMM, Granger causality	TOUR→CO_2
Dogan and Aslan (2017)	1995-2011	25 EU and candidate countries	OLS with FE, FMOLS, DOLS, Emirmahmutoglu-Kose panel Granger causality	TOUR→CO_2
Liu et al. (2019)	1980-2016	Pakistan	ARDL	no causal relationship
Zhang and Liu (2019)	1995-2014	10 Northeast and Southeast Asian countries	FMOLS, AMG	TOUR→CO_2
Akadiri et al. (2020)	1995-2014	16 small islands developing countries	Panel Granger causality	TOUR→CO_2
C. Human development and CO_2 emissions				
Bedir and Yilmaz (2015)	1992-2011	33 OECD	Panel granger causality	HDI↔CO_2 (Iceland, Norway, Portugal, and Switzerland) HDI→CO_2 (Chile, Czech Republic, Estonia, Finland, France, Greece, Mexico, and New Zealand) HDI←CO_2 (Denmark, Ireland, Israel, Italy, Japan, Korea, Luxemburg, Poland, Spain, Slovakia, Turkey, and the U.S.)

Author	Study period	Country	Method	Long-run linkage
Asongu (2018)	2000-2012	44 Sub-Saharan African countries	FE and Tobit regressions	HDI←CO_2
Mohmmed et al. (2019)	1991-2014	Top 10 emitting countries	Panel OLS	HDI→CO_2

Source: compilation by authors.

Note: TOUR-international tourism; ARDL-autoregressive distributed lag; FMOLS-fully modified ordinary least squares; FE-fixed effect; RE-random effect; AMG-augmented mean group; DOLS- dynamic ordinary least squares; EU- European Union; OECD- Organization for Economic Co-operation and Development.

3. DATA AND METHODOLOGY

3.1 Data

The aim of the present paper is to explore the links between international demand for tourism in Thailand, human development of the Thai people, and Thailand's CO_2 emissions, during the period from 1995 to 2018. For the tourism component, visitor arrival statistics concerning the top 8 source markets, namely Hong Kong, China, Malaysia, Japan, India, Korea, Germany, and the United Kingdom, were obtained from the Ministry of Tourism and Sports, Thailand (2020). Visitor number is a widely used indicator in tourism demand analysis (Song & Li, 2008; Song, Witt, & Li, 2009). The second data series, reflecting the quality of life or human development is the measured Human Development Index or HDI taken primarily from the Human Development Reports of the United Nations Development Programme (UNDP, 2020). The third data set was that of CO_2 emissions as a measure of environmental degradation which is harmful to both human and economic health. This study also considered three dummy variables namely the Asian crisis of 1997–1999, the avian flu crisis of 2004-2007, and the global financial crisis of 2008–2010 to control their qualitative influences on the dependent variable. Thus, the coefficients of dummy variables help to determine whether a different effect exists between "crisis" and "normal" periods. The collected data (except for the dummy variables) were first transformed into logarithms before estimation. Table 2 presents a quantitative summary of the key variables.

Table 2 Descriptive Statistics

Variable	Description	Mean	Std. Dev.	Min	Max
TD_{it}	Tourism demand from country i to Thailand at time t	1,870,253	2,825,170	138,447	15,682,234
HDI_t	Thailand's Human Development Index at time t	0.694	0.046	0.610	0.760
$CO2_t$	Thailand's CO_2 emissions at time t	240,287.8	46,434.97	161,153.7	316,212.8
D1997	Dummy for the Asian Financial Crisis of 1997-1999	0.125	0.331	0	1
D2004	Dummy for the avian flu crisis of 2004–2007	0.167	0.374	0	1
D2008	Dummy for the global financial crisis of 2008–2010	0.167	0.374	0	1

3.2 Methodology

The methodology involves several procedures. First, the data were analyzed for stationarity using three panel unit root tests including Levin-Lin-Chu (2002) or LLC, Im-Pesaran-Shin (2003) or IPS, and Fisher-type (Choi, 2001) or Fisher-PP. For all tests the given null hypothesis is that all the panels contain a unit root. Testing for stationarity is a requirement to avoid spurious or nonsense regression results (Gujarati & Porter, 2009).

The second step involves estimating the linkage between $\ln TD_{it}$, $\ln HDI_t$, and $lnCO2_t$. For this purpose, a three-stage least squares (3SLS) approach was employed to estimate the system of equations by the Seemingly Unrelated Regression Estimation (SURE) technique. The three-stage least squares analysis is a

combination of SUR (seemingly unrelated regression) and 2SLS analysis; it provides more efficient estimates for linear regression models where the predictor variables are correlated with the error term. The models applied in the study were:

$$\Delta \ln TD_{i,t} = \beta_0 + \beta_1 \Delta \ln HDI_t + \beta_2 \Delta \ln CO2_t + \beta_3 \ln TD_{i,t-1} + \beta_4 D1997 + \beta_5 D2004 + \beta_6 D2008 + \varepsilon_{2t} \quad (1)$$

$$\Delta \ln HDI_t = \alpha_0 + \alpha_1 \Delta \ln TD_{it} + \alpha_2 \Delta \ln CO2_t + \alpha_3 \ln HDI_{t-1} + \alpha_4 D1997 + \alpha_5 D2004 + \alpha_6 D2008 + \varepsilon_{1t} \quad (2)$$

$$\Delta \ln CO2_t = \gamma_0 + \gamma_1 \Delta \ln TD_{it} + \gamma_2 \Delta \ln HDI_T + \gamma_3 \ln CO2_{t-1} + \gamma_4 D1997 + \gamma_5 D2004 + \gamma_6 D2008 + \varepsilon_{3t} \quad (3)$$

where

Δ = First difference;

i = tourism demand from a specific country of origin (Hong Kong, Mainland China, Malaysia, Japan, India, South Korea, Germany, the United Kingdom);

t = time

4. EMPIRICAL RESULTS AND DISCUSSIONS

To examine the relationship between international tourism demand in Thailand, human development, and CO_2 emissions. The tools employed include panel unit root test, the three-stage least squares (3SLS) approach, and the Harvey LM Test for autocorrelation. The detailed procedures are given below.

4.1 Panel Unit Root Test Results

Table 3 presents the estimated results of the unit root tests by LLC, IPS, and Fisher-PP criteria at various levels and the first differences for all three variables in the data set. It can be seen by level, that for each variable, the null hypothesis of a unit root cannot be rejected at the 1% level; while by first difference, the alternative hypothesis of no unit root is accepted. Thus, the null hypothesis of non-stationarity at the 1% level of significance was rejected, and the unit root tests show data integration at the first difference. Given the latter outcome, the analysis was continued using the variables in the first difference form.

Table 3 Panel Unit Root Tests

Variable	Level/ First-Difference	LLC	IPS	Fisher-PP	Integration
$\ln TD_{it}$	Level	-1.123	3.736	-1.671	
	First-Difference	-10.409***	-7.709***	33.628***	I(1)
$\ln HDI_t$	Level	-4.260***	-0.915	-0.375	
	First-Difference	-14.097***	-9.944***	75.049***	I(1)
$\ln CO2_t$	Level	-3.930	-0.958	-0.326	
	First-Difference	-11.004***	-7.594***	27.428***	I(1)

Notes: *** indicate statistical significance at 1% level.

4.2 Estimation Results

With these findings, the study can determine the links between TD_{It} (total demand of tourism), HDI_t (Thailand's Human Development Index), and $CO2_t$ (Thailand's CO_2 emissions). Table 4 provides the results of the 3SLS with SURE. Each table contains the results interchangeably considering each of the three constructs as a dependent variable. With $\ln TD_{It}$ as the dependent variable, $\ln HDI_t$ was determined to be not statistically significant from zero, implying that human development had no impact on international tourism demand in Thailand (Table 4, equation (1)). However, the findings also reveal that any change in emissions would affect international tourism demand for Thailand. The lagged dependent variable ($\ln TD_{it-1}$) came out statistically significant, implying that the total tourism demand for Thailand is structurally affected by its past values. D1997 and D2008 are also negatively statistically relevant explanators of $\ln TD_{It}$, implying that the Asian financial crisis of 1997-1999 and the global financial crisis of 2008–2010 were disadvantageous for international tourism demand for Thailand.

With $\ln HDI_t$ as the dependent variable, the results show that $\ln CO2_t$ or CO_2 emissions had a statistically negative impact on the Human Development Index (Table 4, equation (2)). This result implies that CO_2 emissions decrease the value of human development. Furthermore, the results show that tourism is positively associated with human development. The statistically significant outcome of the lagged dependent variable indicates a possible structural dependency of $\ln HDI_t$ on its past-period values. The dummy variables are statistically relevant explanators of $\ln HDI_t$. Most effects of the dummy variables (the Asian financial crisis and the global

financial crisis) on $\ln HDI_t$ are negative, implying that both crises were harmful for residents' quality of life in Thailand.

With $\ln CO2_t$ being the dependent variable, the findings indicate that both $\ln TD_{It}$ and $\ln HDI_t$ are statistically significant and negative determinants (Table 4, equation (3)). Tourism demand and human development may lead to environmental improvement. The lagged dependent variable ($CO2_{t-1}$) came out statistically significant, implying that Thailand's CO_2 emissions are structurally affected by its past values. D1997 is also a statistically significant negative explanator of $CO2_t$, implying that the Asian financial crisis was brought down for Thailand's CO_2 emissions.

Table 4 Estimated outcomes (Aggregate tourism demand) under 3SLS with seemingly unrelated regression.

Equation	**Dep.**	**RMSE**	**R^2**	**F**	**p-value**
1	$\Delta \ln TD_{I,t}$	0.149	0.037	2.10	0.050
2	$\Delta \ln HDI_t$	0.008	0.341	17.25	0.000
3	$\Delta \ln CO2_t$	0.048	0.349	18.49	0.000
Equation 1 (dep.=$\Delta \ln TD_{It}$)	**Coefficient**	**Equation 2 (dep.=$\Delta \ln HDI_t$)**	**Coefficient**	**Equation 3 (dep.=$\Delta \ln CO2_t$)**	**Coefficient**
$lnTD_{it-1}$	0.010*	$\Delta \ln TD_{It}$	0.006*	$\Delta \ln TD_{It}$	-0.044**
$\Delta \ln HDI_t$	-1.584	$\ln HDI_{t-1}$	-0.101***	$\Delta \ln HDI_t$	-1.134***
$\Delta \ln CO2_t$	-0.338*	$\Delta \ln CO2_t$	-0.001***	$\ln CO2_{t-1}$	-0.216***
D1997	-0.072**	D1997	-0.017***	D1997	-0.110***
D2004	-0.002	D2004	0.002	D2004	0.007
D2008	-0.079**	D2008	-0.004**	D2008	0.014
cons	0.252	cons	0.024***	cons	2.718***
Harvey LM Test for autocorrelation (H_0: No overall system autocorrelation)					
	$Harvey\ LM\ Tesy(p-value)$				
Equation 1	0.068 (p=0.794)				
Equation 2	0.333 (p=0.563)				
Equation 3	0.552 (p=0.457)				

Note: ***, **, * indicate significance at, respectively, 1%, 5%, and 10%.

The results are best summarized using Fig. 5.

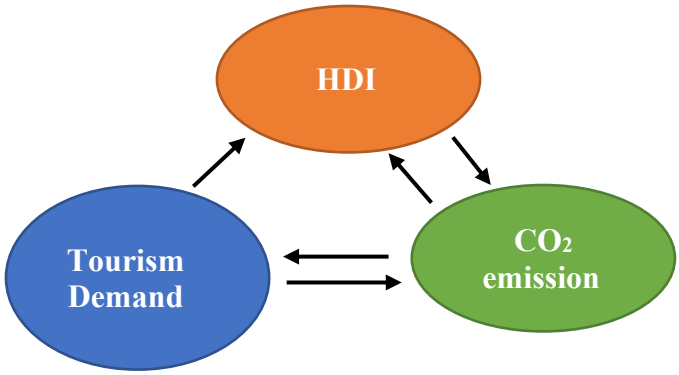


Figure 5. Visual findings

4.3 Model Statistics

The additional statistics following the estimated regression models show acceptable outcomes. The Root Mean Square Errors (RMSE), the standard deviation of the residuals, are lower than 0.32, while the F-statistics are all statistically relevant, indicating that at least one of the applied variables is relevant for fitting the data. The Harvey LM tests for autocorrelation are statistically not relevant, indicating no rejection of the null hypothesis of no system autocorrelation.

5. CONCLUSION AND RECOMMENDATIONS

This study explored the relationship between international tourism demand, human development, and CO_2 emissions, all in respect of Thailand and covering the period from 1995 to 2018. For this purpose, the study applied a three-stage least squares (3SLS) approach to estimate a system of equations by the Seemingly Unrelated Regression Estimation (SURE).

The results revealed that tourism has a positive effect on human development, while human development has no impact on tourism demand. This positive impact can refer to the increase in jobs, a higher quality of life for locals, and an increase in the wealth of residents in the destination. The results are similar to the findings of Aref (2011), Kim et al. (2013), Biagi et al. (2017), and Fu et al. (2020) in providing a view that tourism not only stimulates a destination country's income, but is also a catalyst for stimulating all areas of activity having direct and indirect contact in the tourism industry.

Bidirectional causality was additionally found between tourism demand and CO_2 emissions, indicating that any change in the number of tourist arrivals in Thailand is expected to affect environmental quality, while any change in the degree of pollution is also expected to impact the number of tourist arrivals. An increase in tourism demand could

bring about an increase in eco-friendly investment in tourism infrastructure, facilitating energy efficiency, emission control technologies, and access to renewable energy sources, and therefore leading to carbon reduction in the long run. This result also implies that CO_2 emissions decrease the level of tourism demand. Tourists prefer places where pollution is low or decreasing. These findings which support the interrelationship between tourism and CO_2 emissions, are similar to the results obtained by Yazdi et al. (2014) and Zhang and Gao (2016). The findings establish that tourism has a negative effect on CO_2 emissions. These results indicate that the growth of tourist arrivals can contribute to lowered CO_2 emissions in the long-run. In other words, the rather stable increase in tourism demand can induce tourism investment in eco-friendly infrastructure to secure energy efficiency, emission control technologies, and access to renewable energy sources, all of which will help to reduce carbon emissions from this sector in the long run. Thus, policymakers should specify certain policies targeting adaptation toward sustainable tourism such as making optimal use of environmental resources, support for investment in eco-friendly infrastructure, or encouraging domestic tour operations to promote green and clean vacations.

The results also indicate the existence of a bidirectional relationship between human development and CO_2 emissions. This means that an increase in CO_2 emissions directly affects human development, and human development depresses CO_2 emissions in Thailand. This result is consistent with that of Bedir and Yilmaz (2015) who found bidirectional causality between CO_2 and HDI in Iceland, Norway, Portugal, and Switzerland. The negative impact of CO_2 emissions on human development indicates that policymakers should focus on green growth strategies by creating incentives for greater efficiency in the use of natural resources, and reducing waste and energy consumption, helping to reduce CO_2 emissions and improve residents' quality of life. The negative impact of human development on CO_2 emissions also indicates that improvements in the income, health, and education level of residents will lead to rapid growth in the pursuit of energy efficiency which can lower CO_2 emissions.

The main limitation of this study is its small sample size, and scholars are encouraged to use another indicator of economic development such as poverty rate, or inequality, as this could be more helpful in guiding tourism policies for improving the quality of life of residents in developing countries.

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