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Effect of Inbound Tourism on The Rising of CO2 Emission (Evidence from 6 Top Destination SIDS Countries)

Mellani Indrie Pramudita[1], Dedy Yuliawan[2]

[1, 2] Program Studi Ekonomi Pembangunan, Fakultas Ekonomi dan Bisnis, Universitas Lampung, Jl. Prof. Dr. Soemantri Brodjonegoro No. 1, Lampung, Indonesia
mellaniindrie14@gmail.com

Abstract

The goal of this study is to examine the impact of the international tourist industry on Small Island Developing States (SIDS) nations, including the rise in gross domestic product (GDP) per capita due to international travel, which indirectly affects carbon dioxide emissions. In this work, panel data from 6 small island developing states between 2011 and 2019 were analyzed using the Two Stage Least Square (2SLS) analysis approach. Total CO2 Emissions (CO), Gross Domestic Product (GDPC) Growth, Tourist Arrivals (TOU), Population (POP), Energy Consumption (ENE), International Tourism Receipts (REC), and Unemployment Rate (UNE) are variables considered in this study. The study's findings show that while the variables Gross Domestic Product Per Capita Growth, Tourist Arrivals, Population, and Energy Consumption all have a positive impact on CO2 emissions, the variable Gross Domestic Product Per Capita Growth has a negative impact. Additionally, between 2011 and 2019 in 6 Small Island Developing States (SIDS) countries, CO2 emissions and international tourism receipts have a positive impact on GDP per capita growth whereas the unemployment rate has a negative impact.
Keywords: Inbound Tourism, Carbon Emission, Environmental Kuznets Curve, Two Stage Least Square

Abstrak

Tujuan dari penelitian ini adalah untuk mengkaji dampak sektor pariwisata internasional di negara-negara Small Island Developing States (SIDS), termasuk kenaikan produk domestik bruto (PDB) per kapita akibat perjalanan internasional, yang secara tidak langsung mempengaruhi emisi karbon dioksida. Dalam penelitian ini, data panel dari 6 negara berkembang pulau kecil antara 2011 dan 2019 dianalisis menggunakan pendekatan analisis Two Stage Least Square (2SLS). Total Emisi CO2 (CO), Pertumbuhan Produk Domestik Bruto Per Kapita (GDPC), Kedatangan Wisatawan (TOU), Populasi (POP), Konsumsi Energi (ENE), Penerimaan Pariwisata Internasional (REC), dan Tingkat Pengangguran (UNE) adalah variabel yang dipertimbangkan dalam penulisan ini. Temuan penelitian menunjukkan bahwa variabel Kedatangan Wisatawan, Penduduk, dan Konsumsi Energi semua memiliki dampak positif terhadap emisi CO2, sedangkan Pertumbuhan Produk Domestik Bruto Per Kapita memiliki dampak negatif terhadap jumlah emisi CO2 di 6 negara Small Island Developing States. Selain itu, antara tahun 2011 dan 2019 di 6 negara Negara Berkembang Pulau Kecil (SIDS), emisi CO2 dan penerimaan pariwisata internasional berdampak positif terhadap pertumbuhan PDB per kapita sementara tingkat pengangguran berdampak negatif terhadap pertumbuhan PDB per kapita.
Kata kunci: Inbound Tourism, Emisi Karbon, Environmental Kuznets Curve (EKC), Two Stage Least Square

Corresponding author: Mellani Indrie Pramudita
Email Address: mellaniindrie14@gmail.com (Jl. Prof. Dr. Soemantri Brodjonegoro No. 1, Lampung, Indonesia)
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INTRODUCTION

Changes in environmental quality have developed into a complicated issue and a global crisis facing mankind in this century, and probably for the next few centuries, as a result of the diverse repercussions created by human activities that continuously constitute a threat to the environment. Since 1901, the contiguous 48 states' average surface temperature has risen on average 0.17°F every decade. Since the late 1970s, when the average temperature increased by 0.32 to 0.55°F every decade

since 1979 (Epa & Change Division, n.d.), this increase has been increasingly rapid. The burning of fossil fuels, which emits carbon dioxide (CO2) and retains heat in te atmosphere, is a major cause of these shifts. Climate models predict that throughout the course of the 21st century, the average surface temperature will climb by 1.1 °C to 6.4 °C as these CO2 emissions continue to rise (Campbell et al., 2007). Because the environment is one of the key concepts in the Sustainable Development Goals (SDGs), environmental quality is a crucial topic to research in the public economy (Fajriani et al., 2023)

It is undeniable that there is a direct correlation between economic growth and carbon dioxide emissions. However, despite the fact that more economic activity may promote economic growth through the production of more goods and services, there is a tendency for the amount of emissions produced to increase (Aida et al., 2022). Thus, in order to attain sustainability, scientists have studied a variety of factors during the past several decades that contribute to environmental degradations. However, additional study should be given to how energy and climate change relate to certain economic sectors or subsectors. One of them is global tourism. Growth in tourism increases energy capacity, but on the other hand, growth in tourism (tourist arrivals and tourism-related economic activities) has the potential to increase pollution levels, whereas the energy sector's reliance on oil is one of the main causes of pollution (Fethi & Senyucel, 2021). An increase in tourism-related activities is mostly accompanied by an increase in the energy needed for a variety of operations, including transportation, catering, lodging, and management of tourist attractions. In this regard, growth in the tourism industry has the potential to revive infrastructural quality, technological advancement, and human capital capability (Shahzad et al., 2017) also due the fact that the majority of tourism-related activities require energy, either directly from the usage of fossil fuels or indirectly from electricity, which is frequently produced using coal, natural gas, or oil (Paramati et al., 2017). The significance of energy for the tourist industry is undeniable because a rise in transportation and tourism activities also results in an increase in energy demand. Thus, both policies must aware and anticipate when the tourism grows, its reliance on energy will increase. Consequently, it can result in an increase in energy usage. Additionally, there has been an increase in energy usage in addition to an increase in international visitor arrivals.

This paper contributes to the literature by investigating the role of inbound tourism, energy consumption, population towards environmental degradation as measured by carbon dioxide emission in Small Island Developing States. These nations were selected given that industries like tourism can account for more than half of the GDP of tiny island economies, biodiversity is a crucial concern for many SIDS' ability to survive. Although biodiversity offers aesthetic and spiritual value for many island populations, the significance of these natural resources goes beyond the economy. The main source of foreign exchange for the Small Island Developing States is tourism. Significant foreign exchange inflows from tourism are necessary to fund large imports for capital investment objectives. Economic growth relies heavily on the direct effects of tourism on employment and income

(Cannonier & Burke, 2019). Despite all the encouraging economic growth tendencies in the tourism industry, it can't be denied that SIDS face constraints and challenges due to their location, topography, population, size, and economic structure. Small Island Developing States (SIDS), including those in the Caribbean and Pacific, are a particular class of small nations that are distinguished, among other things, by their high susceptibility to environmental and economic shocks (Mcelroy & Medek, 2006). In order to create sustainable tourism and environmental sustainability, the consideration of the Environmental Kuznets Curve (EKC) concept, which examines the issue of gross domestic product per capita through the tourism sector with environmental degradation is therefore considered important, especially for nations that rely heavily on the tourism industry, such as the Small Island Developing States.

METHODS

The data used in this study is an annual data that was collected in 6 Small Island Developing States (SIDS) countries from the year of 2011-2019, these 6 top destination countries are Bahamas, Barbados, Fiji, Jamaica, Maldives, and Mauritius. The information utilized in this investigation was culled World Development Indicators produced by the World Bank and Energy Information Administration (EIA). Carbon dioxide emission, growth domestic product per capita, tourist arrivals, population, energy consumption, international tourism receipts, and unemployment are considered potential variables in this investigation. The data in this paper were derived through interpolation using Eviews 10 from annual data. Two Stage Least Square is used as the analysis method applied to this research.

Table 1. Data Indicators and Sources

Indicator	Variable Used	Symbol	Unit	Source
Carbon dioxide emission	Co2 Emission	lnCO	Kilo ton (kt)	World Bank
Economic Growth	Growth Domestic Product Per Capita	GDPC	Percentage	World Bank
Inbound Tourism	Tourist Arrivals	lnTOU	Million	World Bank
	International Tourism Receipt	lnREC	Billion	World Bank
Population	Total Population	lnPOP	Billion	World Bank
Energy Consumption	Total Energy Consumption	ENE	British Thermal Unit (BTu)	Energy Information Administration
Unemployment	Unemployment Rate	UNE	Percentage	World Bank

The simultaneous model has a two-way relationship between the variables due to the interdependence between them. Not only may variable independent effect variable dependent, but variable dependent can also affect variable independent. The variables in the simultaneous equation model are referred to as endogenous variables and predetermined variables since the dependent variable in one equation may also appear as an independent variable in another equation. Both

exogenous and endogenous past variables can be predetermined past variables. To produce parameter estimators in the simultaneous equations that are both consistent and unbiased, unique techniques are required (Romika, 2004). An order condition test is carried out to ensure the data is overidentified. Then a simultaneity test was carried out to ensure that the two endogenous variables had simultaneity problems, then an Ordinary Least Square test was carried out for each equation. The two stage least square test is the next step in the research process that needs to be done. The following is a formulation that can be arrived at to the problem of determining the connection between CO2 emission (CO) and growth domestic product per capita (GDPC) as follows:

To analyze the effect of Gross Domestic Product Per Capita Growth (GDPC) on the CO2 Emission (CO), the equation is:

$$lnCO = \alpha + \beta(GDPC) + \beta(lnTOU) + \beta(lnPOP) + \beta(ENE) + \varepsilon 1 \qquad (3.1)$$

To analyze the effect of CO2 Emission (CO) on the Gross Domestic Product Per Capita Growth (GDPC), the equation is:

$$GDPC = \alpha + \beta(lnCO) + \beta(lnREC) + \beta(UNE) + \varepsilon 2 \qquad (3.2)$$

CO = CO2 Emission
GDPC = Growth Domestic Product Per Capita
TOU = Tourist Arrivals
POP = Population
ENE = Energy Consumption
REC = International Tourism Receipts
UNE = Unemployment Rate
α = Constant
B = Parameters
ε = error term

RESULT AND DISCUSSION

Model Identification

The identification method is a method that can determine whether a simultaneous equation can be estimated or not. In this study, the identification methods used is Order Condition with three categories namely exactly identified, over identified and unidentified by using the formula:

$$K\text{-}k > m\text{-}1$$

Where (K) is the number of exogenous variables in a system of simultaneous equations, (k) is the number of exogenous variables in a certain equation, and (m) is the endogenous variable in a certain equation.

Table 2. Order Condition of CO2 Emission andGross Domestic Product Per Capita Growth Equations

Equation	K-k	Criteria	m-1	Category
CO2 Emission	5-3	>	2-1	Overidentified
GDP Per Capita	5-2	>	2-1	Overidentified

Source: Analyzed

Both CO2 emission equations and GDP per capita growth are overidentified equations,

meaning that both equations can be estimated using the Two Stage Least Square (2SLS) method.

Simultaneity Test

To be more certain that the two equations have a simultaneous relationship, it is necessary to do a simultaneity test by seeing whether the endogenous variables are related to the disturbance variables. The endogenous variables to be tested are carbon dioxide emissions and growth of gross domestic product per capita

Table 3. Simultaneity Test of CO2 Emission andGross Domestic Product Per Capita Growth

Variable	**Coefficient**	**T-statistic**	**Probability**
GDPC	0,479591	5,152380	0,0000
CO	3,155657	3,645469	0,0006

Source: EViews 10 Output

By comparing the t-statistic value (5.152380) > t-table (2.009575) 5% for the variable growth of gross domestic product per capita and the t-statistic value (3.645469) > t-table (2.008559) 5%, it can be concluded that these two variables have simultaneity problems.

Classical Assumptions

Table 4. Classical Assumptions Test of CO2 Emission andGross Domestic Product Per Capita Growth

Classical Assumptions	**Equation**	**Variable**	**Value**	**Result**
Normality Test	CO	Variables included in CO Equation	0,374353	Normally Distributed
	GDPC	Variables included in GDPC Equation	0,972939	Normally Distributed
Multicollinearity Test	CO	GDPC	1,350317	Low Multicollinearity
		TOU	1,408940	
		POP	1,960187	
		ENE	2,099490	
	GDPC	CO	1,383825	Low Multicollinearity
		REC	1,221077	
		UNE	1,236365	
Heteroscedasticity Test	CO	GDPC	0,7763	Homoscedastic
		LNTOU	0,1152	
		LNPOP	0,6072	
		ENE	0,8867	
	GDPC	CO	0,0045	CO and UNE are homoscedastic, but REC is heteroscedastic
		LNREC	0,5766	
		UNE	0,7096	
Autocorrelation Test	CO	Variables included in CO Equation	26,178066	No Autocorrelation
	GDPC	Variables included in GDPC Equation	26,738856	No Autocorrelation

The normality test has the objective of knowing whether the independent variable and dependent variable in the regression model can both have a normal distribution or a good absolute regression. The provisions are if the probability value is higher than α = 0.05 then the data is normally distributed. From the results of normality test above, it is known that both CO2 emission and gross domestic product per capita growth (GDPC) equations' probability values are higher than α = 0.05. Thus, it can be concluded that the two equations are normally distributed.

Then, multicollinearity test has been carried out to see whether there is a relationship between each independent variable. The Variance Inflation Factor (VIF) method is a method used to detect multicollinearity problems in this study. Based on the result above, it can be seen the Variance Inflation Factor (VIF) for each variable is below 5. This means that in this study the variables are free from multicollinearity problems or have low multicollinearity.

Furthermore, heteroscedasticity test is intended to test in the regression equation whether there is an inequality of residual variance or vice versa. Based on the test results, there is no heteroscedasticity in tourist arrivals, population, energy consumption in carbon dioxide emission equation. However, based on the test result above, in growth domestic product per capita equation; carbon dioxide emission shows there is heteroscedasticity because the probability value is below α = 0.05.

Autocorrelation test is used to see the relationship between each noise variables. The Breusch-Godfrey method is used to counteract autocorrelation in this paper, based on the Breusch-Godfrey method with n*R^2 formula, of total panel data observations are 54, the R^2value is 0.484779 for carbon dioxide emission equation, then (54*0.484779). The calculated Chi-square result (26.178066) is greater than the table Chi-square value (9.488), thus we can conclude there are no autocorrelation in this equation. Furthermore, the value of R^2 is 0.495164 for the growth gross domestic product per capita (54*0.473696) with calculated Chi-square results (26.738856) or greater than the table Chi-square value (7.815), we can conclude there is no autocorrelation in this equation.

Hypothesis Test

1. T-test

Testing the model with a partial regression coefficient test is carried out to see the level of significance of the independent variables individually in influencing the variance of the dependent variable by assuming other variables are constant. In this test, we can compare the t-stat and t-table values of each variable.

Table 5. T-test of CO2 Emission and Gross Domestic Product Per Capita Growth Equations

Equation	Variable	t-Statistic	t-tabel	Prob.	Category
	GDPC	-0,244146	2,009575	0,8081	Insignificant
CO	TOU	3,955266	2,009575	0,0002	Significant
	POP	3,986445	2,009575	0,0002	Significant
	ENE	0,990800	2,009575	0,3267	Insignificant
GDPC	CO	1,664579	2,008599	0,1023	Insignificant

	REC	1,143338	2,008559	0,2583	Insignificant
	UNE	-6,662666	2,008559	0,0000	Significant

Source: EViews 10 Output

Based on the test results, it can be seen that in CO2 emission equation, growth in gross domestic product per capita has negative and significant effect on carbon dioxide emissions in 6 Small Island Developing States from 2011 to 2019. Meanwhile, tourist arrivals and population have a positive and significant effect, and energy consumption has an insignificant positive effect towards CO2 emisson. Additionally, for gross domestic product per capita growth equation, carbon dioxide emissions and international tourism receipts have a positive and insignificant effect, while unemployment rate has a negative and significant effect on gross domestic product per capita growth in 6 Small Island Developing States from 2011 to 2019.

2. F-test

The F-test is used to test the estimated coefficients whether the independent variables jointly affect the dependent variable simultaneously.

Table 12. F-test of CO2 Emission and Gross Domestic Product Per Capita Growth Equations

Equations	**F-table**	**F-statistic**	**Prob.**
CO	2.561124	11,52622	0,000001
GDPC	2,79001	15,00073	0,000000

Source: Analyzed

With the result obtained an F-statistic value of 11.52622 and an F-table of 2.561124 (F-statistics > F-table) with a probability value of 0,0000 < 0.05 for the carbon dioxide emission equation and F-statistic value of 15,00073 and F table of 2,79001 (F-statistics > F-table) with a probability value of 0.00000 <0.05 for the growth domestic product per capita, thus we can conclude that all variables are jointly correlated and significant to total carbon dioxide emissions and domestic product per capita growth with a confidence level of 95 percent.

Simultaneous Equation Parameter Result

In order to examine the effects of rising gross domestic product per capita on carbon dioxide emissions and vice versa in six small island developing states, simultaneous equation parameter estimates are utilized. The estimation outcomes are represented by the following two structural equations.

Table 11. Simultaneous Equation Parameter of CO2 Emission Equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-7.703565	2.812237	-2.739302	0.0086
GDPC	-0.039018	0.047098	-0.828454	0.4114
TOU	0.462864	0.140188	3.301741	0.0018
POP	0.655304	0.174941	3.745864	0.0005
	Weighted Statistics			
R-squared	0.460359	Mean dependent var		1.413157
Adjusted R-squared	0.416307	S.D. dependent var		0.204506
S.E. of regression	0.156242	Sum squared resid		1.196172
F-statistic	14.56125	Durbin-Watson stat		1.225461

Prob(F-statistic)	0.000000	Second-Stage SSR	1.012762
Instrument rank	6	Prob(J-statistic)	0.498428

Source: EViews 10 Output

Based on the simultaneous parameter estimation result on CO2 emission equation, population and tourist arrivals variables have a positive impact and significantly affect carbon dioxide emissions, while energy consumption affects CO2 emission positively significant, gross domestic product per capita has a negative impact on carbon dioxide emission. Additionally, the coefficient of determination (R^2) for this equation is 0,460359, which means 46,03%. This indicates that, overall, the exogeneous variables can account for 46,03 percent of the total carbon dioxide emissions in 6 Small Island Developing States countries, while the remaining, 53,97 percent being explained by other variables that are not taken into this equation.

Table 12. Simultaneous Equation Parameter of Gross Domestic Product Per Capita Growth Equation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-12.95952	11.67756	-1.109780	0.2724
CO	0.759649	0.431429	1.760773	0.0844
REC	0.611412	0.593115	1.030847	0.3076
UNE	-0.484053	0.072638	-6.663911	0.0000
R-squared	0.472836	Mean dependent var		1.660149
Adjusted R-squared	0.441207	S.D. dependent var		2.134222
S.E. of regression	1.595384	Sum squared resid		127.2626
F-statistic	15.21405	Durbin-Watson stat		1.913546
Prob(F-statistic)	0.000000	Second-Stage SSR		126.2048
Instrument rank	6	Prob(J-statistic)		0.170757

Source: EViews 10 Output

Based on the simultaneous parameter estimation result on gross domestic product per capita growth equation, carbon dioxide emissions and international tourism receipts do not significantly affect the growth of gross domestic product per capita, but carbon dioxide emission and international tourism receipts affect the dependent variable positively, however, unemployment rate has a negative and significant impact on GDP per capita growth. Additionally, the coefficient of determination (R^2) for this equation is 0,472836, which means 47,28%. This indicates that, overall, the exogeneous variables can account for 47,28% percent of total gross domestic product per capita growth in 6 Small Island Developing States countries, while the remaining, 52,72 percent being explained by other variables that are not taken into this equation.

CONCLUSION

According to the estimation results, the amount of carbon dioxide emissions in 6 Small Island Developing States between 2011-2019 have a negative impact and does not significantly affects the growth of gross domestic product per capita. Given that these nations are among those that offer nature as a tourist attraction, this confirms the Environmental Kuznets Curve (EKC)'s claim that Small Island Developing States are in the post-industrial or service economy stage. Additionally, the population,

energy use, and tourist arrivals all have a positive impact on the amount of carbon dioxide emissions because these three factors all result in increased emissions as a result of increased energy demand.

Additionally, the growth of the gross domestic product (GDP) per capita in 6 Small Island Developing States between 2011-2019 has been positively impacted by the amount of carbon dioxide emissions. This is because more and more waste and residue are being released into the environment, which will cause the economic growth to increase. It cannot be denied that Small Island Developing States are dependent on tourism for their economies. As a result, the income of the local population is obtained more through the expenditure of inbound tourism in these countries. International tourism receipts have a positive but not significant effect on the growth of gross domestic product per capita. While the increase of gross domestic product (GDP) per capita is negatively and significantly impacted by the unemployment rate. According to the endogeneity test results, there is a two-way relationship between the increase in gross domestic product (GDP) per capita and total of carbon dioxide emissions in 6 Small Island Developing States (SIDS) between 2011 and 2019.

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