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Does Tourism Lead to Environmental Impact? Cross-National Static and Dynamic Evidence from the Ecological Footprint

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Abstract: *At present, public consciousness on respecting and safeguarding the environment is declining rapidly. On that note, this study assumes that growing tourism has negative environmental implications. To satisfy tourism demand, overconsumption, and overexploitation through the development of tourism-related facilities have generated waste that destroy ecosystem functions. Ecological footprint is used to study the environmental impact of tourism activities by including the role of governance in our model. The outcome reveals that the environment is significantly affected by tourism pressure and good governance is essential for environmental protection.*

Keywords: Tourism; Environment; Tourism and development; Ecological economics; Ecosystem services
JEL Classification: C50, 010, Q01, Q57

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1. Introduction

Public consciousness on respecting and safeguarding the environment is rapidly decreasing. Modifying the environment to satisfy human needs has led to a higher ecological footprint, and this trend will only continue as the population grows. Ecological footprint is defined as "the area of biologically productive land and water required to produce the resources consumed and to assimilate the wastes generated by humanity, under the predominant management and production practices in any given year" (Wackernagel et al., 2002). It tracks human demand on nature by quantifying the biologically productive areas needed to satisfy competing demands, such as food, fibre, timber, roads, accommodation, as well as waste products, especially carbon dioxide (CO_2) emissions from fossil fuel combustion.[1]

The tourism sector has been identified as one of the driving forces behind a higher ecological footprint. Tourism demand has grown significantly over the years due to the increase in global income and population. This trend of increasing global international tourist arrivals has led to the development of tourism related facilities by using natural resources. Rapid exploitation of nature to support tourism demand and prolonged overconsumption of natural resources are putting pressure on the ecology and environment. In addition, the operations of tourism facilities are also associated with high energy consumption, various forms of pollution, and waste that degrade and alter the ecosystem functions. Given these developments, it is important to mitigate the impact of tourism on the environment.

Finding the right solution to balance the benefits that tourism brings to the economy and its potential threat to the ecology requires the consideration of various parameters related to the ecology and environment, one of which is governance. Effective and high institutional quality at all levels characterises good governance, which includes the laws, practices, policies and institutions that define how humans interact with the environment. Better institutional quality is a combination of laws, rights, and decision-making processes carried out by organisations that place a greater emphasis on environmental quality. It acts as a key driver for the achievement of environmental protection by reducing tensions within and between countries over the exploitation of natural resources. Institutions are also developed to promote sustainable development and rights of future generations, so that intergenerational benefits are not disrupted (Abid, 2016).

Extensive research has been conducted to examine the impact of tourism on the environment. Several environmental indicators, such as CO_2/ greenhouse gas (GHG) emission (Narayan & Narayan, 2010; Zafar et al. 2019), threatened species (Din et al., 2014; Habibullah et al., 2016; Habibullah et al., 2018), deforestation (Habibullah et al., 2019; Ahmed et al., 2015; Arshad et al., 2020), water and air pollution (Gedik & Mugan-Ertugral, 2019; Saenz-de-Miera & Rosselló, 2014), land degradation (Garcia & Servera, 2003; Bajocco et al., 2012), species richness (Laiolo & Rolando, 2005; Huhta & Sulkava, 2014), carrying capacity (Armono et al., 2017) as well as trampling effect (Lynn & Brown, 2003; Pinn & Rodgers, 2005; Rossi et al., 2006) have been used to illustrate this relationship.

Ozturk et al. (2016) and Uzar (2021) state that it is important to utilise a detailed assessment in quantifying environmental impact. Because it combines the multi-dimensional impact of environmental deterioration, ecological footprint is a powerful indicator in gauging sustainability and environmental quality (Neumayer, 2004). The use of ecological footprint in this study not only reflects the carrying capacity in destination countries, but also quantitatively measures the ecosystem impact from the growing tourism sector at a global level. This is due to the fact that continuous change or disturbance to the environment will have a major impact on repeat visitations in the future. The usage of this indicator could also address strategies to strike a balance between the growing tourism industry and environmental sustainability. Since most countries rely on tourism to boost their economic performance, clarity in understanding the other important determinants of environmental degradation is also provided here with the inclusion of other variables, such as governance, income, population, and climate.

Other than that, studies that use panel data analysis to analyse static and dynamic environmental impact caused by an increase in international tourist arrivals and the role of institutional quality are still uncommon. The present study highlights the importance of governance efficiency in protecting the environment. Due to the data limitation, this study aims to investigate the impact of tourism on the environment and how good institutional quality can mitigate environmental degradation in 65 countries, using average data from 2003 to 2017.

This information is, in return, significant for international agencies, local governments, as well as for policymakers to prepare new policies or to reform existing ones by including sustainable tourism measures as well as minimising environmental impact. Disruption in the supply of nature could ruin the services provided by tourism-related facilities that affect the public image and reputation of tourist destinations. Furthermore, gauged by the World Bank's six governance indicators—voice and accountability, political stability and absence of violence/terrorism, government effectiveness, regulatory quality, rule of law, and control of corruption—institutional quality can be seen to mitigate environmental impact. Poor governance with illegal systems that fail to ensure compliance with contracts and other forms of operating regulations will not only lead to high-productivity industries in the tourism sector to become irresponsible with environmental protection, but also cause countries to face greater environmental challenges.

To discuss this issue further, this paper is structured as follows: Section 2 discusses the theoretical and empirical literature, while Section 3 presents the empirical model and methodology. The empirical results are discussed in Section 4; and Section 5 presents the conclusion and policy recommendations.

2. Literature Review

2.1 Theoretical framework

The longstanding debates on environmental impact have focused on the treadmill of production theory (Gould et al., 1996, 2004, 2008) and ecological modernisation theory (Mol et al., 2014). The treadmill of production theory stresses how economic growth has a negative, escalating influence on the environment. The ecological modernisation theory, on the other hand, asserts that there is no conflict between economic expansion and environmental damage, with the latter tending to decline once societies have reached a particular degree of wealth and undergone specific institutional and cultural changes (Jorgenson & Clark, 2012; Givens et al., 2016).

The relationship between social and ecological systems is explained by the classic environmental sociology hypothesis, proposed by Marx, Weber, and Durkheim. It has been officially recognised as a subfield in sociology in late 1976 (Gould & Lewis, 2009). This theory highlights the fragility of the biosphere coupled with great harm caused by humans through material extraction and industrial pollution (Pellow & Nyseth, 2013). Neo-Malthusian theory has long argued that a growing population will impact the environment. According to Malthus (1798), changes in demographics lead to environmental degradation, due to extraction, consumption, and production.

2.2 Review of empirical studies

Empirically, a positive relationship between tourism and a carbon footprint was found in 160 countries where transportation, shopping, and food are the major contributors. The input-output analysis from 2009 to 2013 reveals that the footprint increase from tourism was four times higher than previously estimated. Overall, it is responsible for around 8% of global GHG emissions, with the majority of the impact being felt in high-income countries (Lenzen et al., 2018).

A positive relationship between tourism and ecological footprint has also been found in Azerbaijan (Mikayilov et al., 2019). The study used a time-varying coefficient cointegration (TVC) approach, combined with fully modified ordinary least square (FMOLS) and autoregressive distributed lag (ARDL), and showed that a 1% increase in international tourism receipts led to a 0.19% increase in the ecological footprint. The association between tourism and both ecological footprint and GHG emissions is found to be negative, statistically significant, and at low quantiles in China. By utilising quarterly data from 1978 to 2017 and a quantile autoregressive distributed lag (QARDL) approach, the study showed that a lower number of tourists could reduce the ecological footprint and GHG emissions (Sharif et al., 2020).

Lee and Chen (2021) explored the relationship between ecological footprint and tourism development in 123 countries from 1992 to 2016 using quantile regression. Generally, the study confirmed that although the ecological footprint initially increases when tourism goes up, it decreases as tourism rises through improvement in environmental conservation in grazing land and forest land.

However, the effects of tourism on the ecological footprint are found to be different across country income level. The estimation is regressed from 1988 to 2008 for 144 countries, with the gross domestic product (GDP) from the tourist sector as a tourism proxy, using a generalised method of moments (GMM) approach. Ozturk et al. (2016) found that in upper middle- and high-income nations, an inverted U-shaped link between tourism and ecological footprint was more prevalent than in lower middle- and low-income countries. The finding is consistent with the study conducted by Al-Mulali et al. (2015). Both fixed effect (FE) and GMM outcomes depict that a further increases in tourism do not reduce environmental deterioration in low- and lower middle-income nations. Therefore, an inverted U-shaped relationship only appears in high- and upper middle-income countries.

Likewise, an inverted U-shaped relationship between ecological footprint and tourism is also found in Asean countries. Further increases in tourism do not generate negative consequences on the environment due to an increase in the environmental awareness (Kongbuamai et al., 2020). Moreover, Katircioglu (2014) also concludes that the continued development of tourism does not cause a positive impact on CO_2 emissions in the long run. In short, tourism does not lead to environmental degradation in Singapore, substantiating the inverted U-shaped relationship between tourism and the environment.

There are also studies relating institutional quality to environmental impact. For instance, Apergis and Ozturk (2015) find that democracy, control of corruption, and political and civil liberties significantly reduced CO_2 levels in Asian countries. This reveals that institutional elements are important in supporting technological diffusion and transfer, information sharing on energy efficiency and emission reduction, as well as capacity building in Asian countries. The coefficients show that increases in institutional quality led to a reduction in emissions by 0.13%, 0.11%, and 0.07% respectively.

Sah (2021) also shows that better institutional quality reduces environmental impact in the Economic and Monetary Community of Central Africa (CEMAC) countries. Governance indicators developed by the World Bank were used to measure institutional quality in these countries from 1996 to 2017. The results obtained suggest that with every one-point increase in institutional quality, CO_2 decreases by 0.38 metric tons per capita. Nguyen and Su (2021) also discovered that a 1% rise in press freedom reduces CO_2 emissions by 0.086% in the nations ranking the highest in the Press Freedom Index, such as Norway, Finland, Denmark, Sweden, Netherlands, Jamaica, Costa Rica, Switzerland, New Zealand, and Portugal. Strict environmental policies could also reflect better institutional quality in mitigating environmental degradation. By using a series of the advanced econometric methods, the ecological footprint in Brazil, Russia, India, China, and South Africa (BRICS) decreased by 0.086% for every 1% increase in environmental policy stringency (Kongbuamai et al., 2021).

Kamah et al. (2021) use governance effectiveness and regulatory quality to study inclusive growth and environmental sustainability in sub-Saharan Africa. Using the GMM method, the researchers found negative coefficients of institutional quality indicators at 1% and 5% significance levels, implying that environmental quality may be obtained with a functional institutional framework. Uzar (2021), in a study on the relationship between institutional quality and ecological footprint in seven emerging countries, finds that the literature focuses more on CO_2 emissions to proxy environmental quality. The study notes that measuring ecological footprint, a more comprehensive indicator for environmental degradation, could reflect the impact of massive development. Uzar found that for both augmented mean group and the common correlated effects mean group estimators for these seven countries, a 1% increase in institutional quality lowered the ecological footprint by 0.09% and 0.06%.

It can be seen from previous studies that the relationship between tourism and environmental impact, with the inclusion of institutional quality in panel data context, is still uncommon. Better institutional quality, with the ability to increase enforcement, for example, would mitigate environmental degradation. Therefore, this study is needed to fill the gap. Table 1 provides a summary of the literature dealing with the impact of tourism on the environment, as well as the role of institutional quality in mitigating degradation.

Table 1: Summary of Empirical Literature

Author	Sample	Year	Method	Result
		Tourism and environment		
Lenzen et al. (2018)	160 countries	2009 to 2013	Input-output analysis	Yes
Mikayilov et al. (2019)	Azerbaijan	1996 to 2014	TVC, ARDL and FMOLS co-integration approaches	Yes
Sharif et al. (2020)	China	1978Q1-2017Q4	Quantile ARDL approach	Yes
Lee & Chen (2021)	123 countries	1992 to 2016	Quantile regression approach	Mixed results
Ozturk et al. (2016)	144 countries	1988 to 2008	GMM approach	Mixed results
Al-Mulali et al. (2015)	93 countries	1980 to 2008	FE and GMM approaches	Mixed results
Kongbuamai et al. (2020)	Asean countries	1995 to 2016	Driscoll-Kraay panel regression	No
Katircioglu (2014)	Singapore	1971 to 2010	DOLS approach	No

Author	Sample	Year	Method	Result
Institutional quality and environment				
Apergis & Ozturk (2015)	14 Asian countries	1990 to 2011	GMM approach	Yes
Sah (2021)	Cemac countries	1996 to 2017	DOLS approach	Yes
Nguyen & Su (2021)	134 countries	2002 to 2015	GMM approach	Yes
Kongbuamai et al. (2021)	BRICS countries	1995 to 2016	Dynamic seemingly unrelated regression (DSUR) method	Yes
Kamah et al. (2021)	Sub-Saharan Africa	2001 to 2018	GMM approach	Yes
Uzar (2021)	Seven emerging countries	1992 to 2015	Augmented mean group and the common correlated effects mean group estimators	Yes

Source: Compiled by authors.

3. Methodology

The neo-Malthusian theory of population is used in this study to represent the environmental impact of the growing tourism sector. This theory is rarely applied in analysing the relationship between tourism and environmental impact. The development of tourism-related facilities has altered the ecosystem function, which supports large number of plant and animal species. Thus, this theory is applied to examine the availability of natural resources used to develop tourism-related facilities and infrastructure, as well as to absorb waste generated from their operations.

The functional form of the environmental model, adapted from Ozturk et al. (2016), Habibullah et al. (2018), and Kongbuamai et al. (2020), is identified as follows:

ecological footprint = f (tourist, governance, income, population, climate) (1)

All variables are transformed into a natural logarithm. The log-linear form is more frequently employed than the basic linear functional form because of its relationship to elasticities and better empirical findings (Uysal

& Crompton, 1984; Johnson & Ashworth, 1990; Crouch, 1994). Therefore, the estimated model can be represented as:

$$lecologicalfootprint_{it} = \pi_0 + \pi_1\, ltourist_{it} + \pi_2\, lgovernance_{it} + \pi_3\, lincome_{it} + \pi_4\, lpopulation_{it} + \pi_5\, lclimate_{it} + \varepsilon_{it} \quad (2)$$

where $lecologicalfootprint_{it}$ equals ecological footprint consumption for country i at time t, a proxy for the environment, $ltourist_{it}$ equals international tourist arrivals for country i at time t, a proxy for tourism demand, $lgovernance_{it}$ equals governance indicators, a proxy for the institutional quality for country i at time t, $lincome_{it}$ equals GDP per capita for country i at time t, a proxy for economic development, $lpopulation_{it}$ equals population growth for country i at time t, a proxy for demographic change, $lclimate_{it}$ equals temperature change for country i at time t, a proxy for climate change. The parameters π_1, π_2, π_3, π_4 and π_5 represent the coefficients or elasticities for the independent variables, and ε indicates the error term. Furthermore, t symbolises the study period (2003 to 2017), and i stands for country index (*1*, *2*, *3*, …, *65*).

Numerous studies have been conducted to examine the relationship between tourism and environmental degradation using ecological footprint as an indicator. The ecological footprint variable has been established as a measurement to quantify human pressure on nature's capacity to provide life-supporting resources as well as sequester human waste. It comprises carbon, fishing grounds, cropland, built-up land and grazing land. This indicator can be used to monitor unfavourable activities caused by the tourism sector and long-term environmental sustainability.

Tourism is measured by the number of international tourist arrivals. In comparison with other tourism measurements, such as tourism receipts, travels durations, length of stay, the number of tourist arrivals are a better indicator of the volume of tourism and is widely adopted in the tourism context (Din et al. 2014; Habibullah et al. 2016 & Habibullah et al. 2018). Additionally, this study uses the World Bank's Worldwide Governance Indicators developed by Kaufman et al. (2008) that captures a broad governance dimension covering six elements, as shown in Table 2.

In line with previous environmental studies, this study also considers traditional environmental pressure from human demand measured by income and population growth, as highlighted in the past studies, including Ahmed et al. (2015), Alam et al. (2016), and Khan et al. (2021).

Table 2: Summary of Variables

Variables	Measurement	Sources	Expected sign
Ecological footprint	Ecological footprint (total consumption in gha)	Global Footprint Network	-
Tourist	Number of international tourist arrivals	WDI	Positive
Governance	Governance index on voice and accountability, political stability and absence of violence/terrorism, government effectiveness, regulatory quality, rule of law, and control of corruption	WGI	Negative
Income	Real GDP growth (%)	WDI	Positive
Population	Population growth (%)	WDI	Positive
Climate	Temperature change (°C)	FAOSTAT	Positive

Notes: WDI: World Development Indicators, FAOSTAT: Food and Agriculture Organisation statistics, WGI: Worldwide Governance Indicators.

Climate is one of the most important factors that influences soil formation, especially in growth, usage, and management. It affects the management of soil in terms of soil structure, stability and topsoil water holding capacity, as well as nutrient availability and erosion (Daba et al., 2018). Therefore, since land cover is heavily dependent on climate, this study also tries to illustrate climate change factors by using temperature change as an explanatory variable in modelling ecological footprint, as highlighted by several studies, such as Simonneaux et al. (2015), and Mondal et al. (2015).

All variables are subject to three years' average data. The data were taken from Global Footprint Network for ecological footprint; World Development Indicators (WDI) for tourists, income, and population; Food and Agriculture Organisation statistics (FAOSTAT) for temperature change; and Worldwide Governance Indicators (WGI) for governance index.[2]

4. Methods of Estimation

There are two methods applied in this study which are static and dynamic panel approaches. Based on Equation (2), the following model can simply be tested using pooled ordinary least square (POLS).

$$lecologicalfootprint_{it} = \pi_0 + \pi_1\, ltourist_{it} + \pi_2\, lincome_{it} + \pi_3\, lpopulation_{it} + \pi_4\, lclimate_{it} + \pi_5\, lgovernance_{it} + \varepsilon_{it} \tag{3}$$

By regressing Equation (3), the ecological footprint model is assumed to have a similar intercept and slope across countries and time. However, this result may lead to heterogeneity bias. The fundamental concept of heterogeneity or known as the individual specific effect is that all countries are heterogenous, which clearly signify why the slope and intercept for each country should be different. To accommodate the effect, consider the following model:

$$lecologicalfootprint_{it} = \pi_0 + \pi_1\, ltourist_{it} + \pi_2\, lincome_{it} + \pi_3\, lpopulation_{it} + \pi_4\, lclimate_{it} + \pi_5\, lgovernance_{it} + \lambda_i + \mu_{it} \tag{4}$$

where ε_{it} is now being decomposed into individual specific effect λ_i and remainder error term μ_{it}. Allowing for different slope and intercept, the Equation (4) can be regressed by using another static panel approach, the random effect (RE) and fixed effect (FE) methods. The individual specific effect also is a time-invariant; therefore, it will not change across time. The RE approach assumes that it is drawn independently from some probability distribution while the FE approach treats the specific effect as constant or fixed. Hence, from Equations (5) and (6), the presence of individual specific effect is a part of the error term in the RE model, and it is a part of the constant in the FE model.

$$lecologicalfootprint_{it} = \pi_0 + \pi_1\, ltourist_{it} + \pi_2\, lincome_{it} + \pi_3\, lpopulation_{it} + \pi_4\, lclimate_{it} + \pi_5\, lgovernance_{it} + \lambda_i + \mu_{it} \tag{5}$$

$$lecologicalfootprint_{it} = \pi_0 + \lambda_i + \pi_1\, ltourist_{it} + \pi_2\, lincome_{it} + \pi_3\, lpopulation_{it} + \pi_4\, lclimate_{it} + \pi_5\, lgovernance_{it} + \mu_{it} \tag{6}$$

The Breusch-Pagan LM (BPLM) test, developed by Breusch and Pagan (1980), and Hausman test, developed by Hausman (1978), needs to be conducted to choose between these three static models. The rejection of the BPLM test simply indicates that the RE model is preferable compared to the POLS model, and the rejection of the Hausman test suggests that the FE model is favourable compared to the RE model.

The static panel frequently exhibits serial correlation and heteroscedasticity issues. Thus, to tackle this issue, the ecological footprint model also can be tested using GMM approach developed by Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998, 2000), which allows for the lagged level of ecological footprint, where:

$$lecologicalfootprint_{it} = \pi_1 + \pi_2(lecologicalfootprint)_{it-1} + s\,\pi_3(ltourist)_{it} + \pi_4(lincome)_{it} + \pi_5(lpopulation)_{it} + \pi_6(lclimate)_{it} + \pi_7(lgovernance)_{it} + \lambda_i + \mu_{it} \quad (4a)$$

and *lecologicalfootprint*$_{it\text{-}1}$ is the lagged dependent variable that is correlated with the individual specific effect λ_i. To eliminate this endogeneity issue, the estimation of the GMM approach introduced the instrumental variable, whereby it is only correlated with explanatory variables. However, the GMM approach is based on the difference GMM and system GMM that have one-step and two-step variants.

The GMM approach can also eliminate the endogeneity issue due to the presence of individual effects in the model. Usually, the estimation of GMM approach by Arellano-Bond begins with transforming all independent variables through differencing or difference GMM. Furthermore, instead of differencing, the data transformation also could be done by using the forward orthogonal deviations transform, proposed Arellano and Bover (1995). There is also an additional assumption to augment Arellano-Bond, where the correlation between the first difference of instrumenting variables and the FE is zero. This may help to improve efficiency, as it allows for the introduction of more instruments, and create a system of two equations that consist of both original equation and transformed equation that is called system GMM.

In contrast with difference GMM, system GMM estimates both level and transformed equations in one model, where the lagged differences of the regressors are used as an additional instrument for a level equation. However, the system GMM estimator performs much better with less bias and higher efficiency (Soto, 2009) especially when the series is persistent while the difference GMM may lead to an incorrect inference (Arellano & Bover, 1995). Hence, this study intends to focus on the two-step system GMM to discuss the results, since it is always efficient, compared to the one-step system GMM.

However, the GMM estimates can have large bias and inefficiency in small samples. The model also needs to pass the three tests of consistency of the GMM estimators—the Sargan, Hansen, and Arellano-Bond test. Failure to reject the null hypothesis of the Sargan test proves the existence of heteroscedasticity issue in the model.

The list of 65 countries included in the study is presented in Table 3.

Table 3: List of Countries

Algeria	Burkina Faso	India	Morocco	Switzerland
Angola	Cambodia	Israel	Myanmar	Tanzania
Argentina	China	Japan	Nicaragua	Thailand
Armenia	Colombia	Jordan	Nigeria	Togo
Australia	Costa Rica	Kazakhstan	Norway	Tunisia
Bahamas	Croatia	Kenya	Paraguay	Turkey
Bangladesh	Czech Republic	Korea, Rep.	Peru	Uganda
Belarus	Denmark	Madagascar	Philippines	Ukraine
Benin	Dominican Republic	Malawi	Poland	United Kingdom
Bolivia	Ecuador	Malaysia	Romania	United States
Botswana	Egypt, Arab Rep.	Mali	South Africa	Uruguay
Brazil	Haiti	Mauritius	Sri Lanka	Vietnam
Bulgaria	Honduras	Mexico	Sweden	Zambia

4. Results

This study compiled a cross-national of 65 countries using average data from 2003 to 2017. Table 4 provides the descriptive statistics using non-transformed data for dependent and independent variables. The centre of the data is determined by the mean value and the extremes are determined by the minimum and maximum value. The statistics reveal that the maximum value of ecological footprint is 522,000,000, and the minimum 1,239,164. Meanwhile, governance is a low volatile variable, with the maximum and minimum values 3.0 and 21.33. Similarly, the other variables are relatively low volatiles, indicated by low values of standard deviation.

Table 4: Descriptive Statistics

Variable	Unit	Obs	Mean	Standard deviation	Min	Max
Ecological footprint	gha	325	236,000,000	67,800,000	1,239,164	522,000,000
Tourist	number of persons	325	8,025,093	13,200,000	36,500	87,000,000
Rule of law	index	325	3.42	2.90	-3.02	21.33
Income	%	325	5.02	4.37	-5.05	30.44
Population	%	325	1.65	1.83	-3.09	14.92
Climate	°C	325	0.98	0.36	0.17	2.24

The correlation matrix is presented in Table 5 using log variables for both dependent and independent variables. Generally, all variables show positive association with ecological footprint, except for population. The correlation coefficients between all independent variables are no greater than 0.7. Notice that several of the correlation coefficients in the table are statistically significant at $\alpha = 0.01$. However, the full estimation regression results of this study are presented in Tables 6 to 8.

Table 5: Correlation Matrix

Variables	Ecological footprint	Tourist	Rule of law	Income	Population	Climate
Ecological footprint	1.000					
Tourist	0.671***	1.000				
Rule of law	0.101*	0.383***	1.000			
Income	0.237***	0.035	0.059	1.000		
Population	-0.083	-0.313***	0.007	0.383***	1.000	
Climate	0.001	0.142**	0.115**	0.057	-0.041	1.000

Notes: *** p<0.01, ** p<0.05, * p<0.1.

For this purpose, several static and dynamic approaches have been employed. Every static estimation depicts that the ecological footprint is positively affected by tourism (Table 6). For instance, in the POLS model, a 1% increase in international tourist arrivals leads to a 0.77% increase in the ecological footprint. Interestingly, all the explanatory variables in the POLS model show a significant impact on ecological footprint at 1% and 10%

significance levels. The role of governance seems to be highly significant in safeguarding and protecting the environment, since the estimated coefficient is negative. In line with the economic development and growing human demand, an increase in income and higher population growth contributes to a higher footprint at 0.11% and 0.12% respectively. However, the coefficient sign of climate variable is contradicted by previous studies, where the ecological footprint is negatively affected by 0.39% with a 1% increase in temperature change.

Table 6: Results of Tourism Impact on Ecological Footprint Using Static Approaches, 2003-2017

	POLS	Random effect (RE)	Fixed effect (FE)	FE robust standard error
$Tourism_{it}$	0.7664***	0.3955***	0.3191***	0.3191**
	(0.0437)	(0.0306)	(0.0324)	(0.1227)
Rule of law_{it}	-0.3104***	-0.2501***	-0.2830***	-0.2830**
	(0.0649)	(0.0529)	(0.0545)	(0.1205)
$Income_{it}$	0.1147***	0.0105	0.0001	0.0001
	(0.0245)	(0.0127)	(0.0125)	(0.0194)
$Population_{it}$	0.1246*	0.2938***	0.3853***	0.3853***
	(0.0661)	(0.0468)	(0.0494)	(0.1267)
$Climate_{it}$	-0.3860*	-0.1106**	-0.0646	-0.0646
	(0.1577)	(0.0560)	(0.0545)	(0.0821)
Constant	5.9850***	11.578***	12.634***	12.634***
	(0.6766)	(0.4563)	(0.4570)	(1.6998)
$\bar{R}^2$	0.5348			
RMSE	1.0584			
BPLM test	0.000			
Hausman test		0.000		
Heteroscedasticity test			0.000	
CSD test			0.000	
Number of groups		65	65	65
Number of observations	325	325	325	325

Notes: Figures in the parentheses are standard errors. $\bar{R}^2$ denotes as adjusted R-squared, RMSE denotes as root mean square error, BPLM denotes as Breusch–Pagan LM test, and CSD denotes as cross-sectional dependence. All the BPLM test, Hausman test, Heteroscedasticity test, and CSD test are reported in p-values. *, **, and *** indicate the respective 10%, 5%, and 1% significance levels.

Similarly, except for income, the outcome of the RE estimation also shows that ecological footprint is significantly affected by the tourist arrivals, population growth, climate and governance indicators. Although the coefficient sign of the climate variable is still contradicted, the higher footprint is positively affected by 0.40% and 0.29%, with a 1% increase in the number of international tourist arrivals and population growth. Again, improved governance would reduce the footprint, where the estimated coefficient is 0.25%.

The results of the FE model are quite similar to the RE model, where the role of income is still not significant in explaining a higher ecological footprint. The estimated coefficient of climate appears to be insignificant as well, where a higher amount of footprint is not affected by the change in temperature. However, the remaining variables remain significant and positively contribute to a higher footprint, except for governance indicator.

Nevertheless, the BPLM test needs to be conducted to choose the optimal estimation between the POLS and the RE models. Since the null hypothesis of the BPLM test cannot be accepted, the RE estimation is favoured compared to the POLS estimation. Subsequently, the selection of the FE model in this study fulfils the requirement to accept the alternative hypothesis of the Hausman test. For diagnostic checking purposes, the cross-sectional dependence and heteroscedasticity tests are also needed in this short panel study. Since the p-value of both tests are equal to 0.000, the result of the FE model cannot be presented in this study. Ignoring the cross-sectional dependence can affect the standard panel estimators' first-order properties (unbiasedness and consistency) along with model misspecifications (Sarafidis & Wansbeek, 2012). The problem of heteroscedasticity, on the other hand, is an indication that the variance of the residuals has a non-constant pattern. Since there are cross-sectional dependence and heteroscedasticity problems in the FE model, the result of the FE robust standard error estimator is chosen with corrected standard error to explain the ecological footprint model.

Based on the FE robust standard error outcome, it is hypothesised that the environment is significantly affected by the pressure of growing tourism. For instance, a 1% increase in the number of international tourist arrivals leads to a 0.32% increase in ecological footprint. This finding is consistent with Lenzen et al. (2018), and Mikayilov et al. (2019). In these studies, the findings show that growing tourism has contributed to a higher footprint through a higher amount of natural resource consumption, limited carrying capacity, and the development of tourism-related facilities in a particular destination.

The negative estimated coefficient for governance indicator shows that a 1% increase in the regulatory quality seems to thwart the ecological footprint by 0.28%. Therefore, good governance can formulate and implement sound policies and regulations that promote environmental protection, and this is how environmental conservation takes place (Din et al., 2014; Habibullah et al., 2018).

The outcome also reveals that income and temperature factors have failed to determine the ecological footprint model. Since most of the countries in this study are categorised as developing, the insignificant relationship between income and ecological footprint is consistent with the finding by Chen and Chang (2016). Moreover, the insignificant relationship between climate and ecological footprint in this study does not support the results by Simonneaux et al. (2015) and Mondal et al. (2015). On the other hand, the ecological footprint is significantly explained by the growth of population and governance indicators. The positive and notable result of population growth and ecological footprint indicates that the negative environmental effect is subject to a higher human demand, and this finding supports the outcome in prior studies by Alam et al. (2016), and Khan et al. (2021).

As for the robustness test provided in Table 7, this study found that the use of the tourism indicator, measured by the number of international tourist arrivals, is strong in the ecological footprint model. For this purpose, several governance indicators are added as control variables; however, all the estimated coefficients are highly significant at 1%.

Table 7: Results of Tourism Impact on Ecological Footprint Using Static Approach (with robust), 2003-2017

	Rule of law (GI)	**Government effectiveness (GI)**	**Regulatory quality (GI)**	**Voice accountability (GI)**	**Control of corruption (GI)**	**Political stability (GI)**
$Tourism_{it}$	0.3191**	0.3247**	0.3191**	0.3232**	0.3099**	0.3335**
	(0.1227)	(0.1247)	(0.1227)	(0.1289)	(0.1206)	(0.1370)
Governance indexit (GI)	-0.2830	-0.1996*	-0.2830**	-0.1446	-0.2964**	-0.0981
	(0.1205)	(0.1151)	(0.1205)	(0.1164)	(0.1387)	(0.0778)
$Income_{it}$	0.0001	0.0028	0.0001	0.0039	0.0020	0.0089
	(0.0194)	(0.0199)	(0.0194)	(0.0205)	(0.0197)	(0.0222)
$Population_{it}$	0.3853***	0.3955***	0.3853***	0.3985***	0.3802***	0.3630**
	(0.1267)	(0.1288)	(0.1267)	(0.1327)	(0.1211)	(0.1468)
$Climate_{it}$	-0.0646	-0.0820	-0.0646	-0.0911	-0.0806	-0.0947
	(0.0821)	(0.0801)	(0.0821)	(0.0774)	(0.0785)	(0.0877)
Constant	12.634***	12.547***	12.634***	12.559***	12.758***	12.416***
	(1.6998)	(1.7258)	(1.6998)	(1.7827)	(1.6779)	(1.8722)
Number of groups	65	65	65	65	65	65
Number of observations	325	325	325	325	325	325

Notes: *, **, and *** indicate the respective 10%, 5%, and 1% significance levels.

Furthermore, an insignificant coefficient of the lagged dependent variable provided in the two-step system GMM outcome indicates the short-run ecological footprint impact does not exist. In the case of the focal variable, the dynamic result in Table 8 also proves that tourism leads to environmental pressure, where a 1% increase in international tourist arrivals is associated with a 0.43% increase in the ecological footprint. In contrast, the remaining independent variables appear to be insignificant in explaining the ecological footprint except for population. This dynamic model also does not pass the three tests of consistency of the GMM estimators—the Sargan, Hansen, and Arellano-Bond tests. Hence, the failure to reject the null hypothesis of the Sargan test proves existence of a heteroscedasticity issue in the model.

Table 8: Results of Tourism Impact on Ecological Footprint Using Dynamic Approaches, 2003-2017

	One-step difference GMM	**Two-step difference GMM**	**One-step system GMM**	**Two-step system GMM**
Ecological Footprint$_{it-1}$	-0.3509**	-0.1642	0.0103	-0.0012
	(0.1781)	(0.1781)	(0.0775)	(0.0814)
Tourism$_{it}$	0.7762***	0.6420**	0.3514**	0.4258***
	(0.2864)	(0.3014)	(0.1525)	(0.1785)
Rule of law$_{it}$	-1.3066**	-0.4771	-0.1884	-0.0445
	(0.5679)	(0.7077)	(0.1654)	(0.2325)
Income$_{it}$	-0.0437*	-0.0120	0.0029	0.0288
	(0.0248)	(0.0337)	(0.0428)	(0.0431)
Population$_{it}$	-0.2859	0.1286	0.4059**	0.5483**
	(0.4223)	(0.5353)	(0.2409)	(0.2327)
Climate$_{it}$	-0.5283**	-0.3390	-0.1457	-0.1392
	(0.2536)	(0.2511)	(0.1296)	(0.1458)
Constant			11.937***	10.683***
			(2.2589)	(1.9155)
Number of instruments	9	9	16	16
Number of groups	65	65	65	65
Number of observations	195	195	260	260
AR (1)	0.034	0.518	0.012	0.133
AR (2)	0.841	0.723	0.800	0.429
Sargan test	0.008	-	0.000	-
Hansen test	-	0.041	-	0.015

Notes: Figures in the parentheses are standard errors. All the AR(1), AR(2), Sargan test, and Hansen test are reported in p-values. *, **, and *** indicate the respective 10%, 5%, and 1% significance levels.

5. Conclusion

This research was conducted to validate the environmental impact from growing tourism, and to examine how institutional quality could mitigate this. The failure of consistency tests, together with an insignificant estimated coefficient of the lagged dependent variable in the GMM approach, demonstrates that the GMM model is not preferred in this study.

This simply indicates that the outcome of this study reveals that a static approach is preferable compared to a dynamic approach. Moreover, due to the rejection of the null hypothesis of the BPLM and the Hausman test for the selection of the optimal static panel, the FE model is then selected in this study. The further diagnostic test, however, confirms the existence of both cross-sectional dependence and heteroscedasticity issues, and it is important to present the FE robust standard error outcome in explaining the ecological footprint model.

Overall, the predicted results of the FE robust standard error suggest that tourism poses a threat to the environment, and that effective governance is critical to minimise the effects. Failure in environmental awareness along with prolonged trend of overconsumption and overexploitation of natural resources has put us at the utmost urgency to protect the environment in the future.

Programmes and policies should also be emphasised to reduce environmental impact. Identifying tourism countries that already exceed carrying capacity and slow down the development is also necessary in this case. In addition, taxes and fines can be effectively enforced on developments that fail to comply with the environmental policies and regulations. In terms of fund allocation, priority should be given to green financing projects to support more sustainable tourism development.

Elliot (1997) notes that "most good policy formulation requires considerable research and inputs from those who are implementing policy at the grass roots or impact level." This signifies that it is the government's responsibility to develop and enforce sound policies and regulations to balance economic, environmental, and social growth for future consumption.

Notes

[1] Source: Global Footprint Network (2021), FAQs, and website: https://www.footprintnetwork.org/faq/

[2] All data that support the findings of this study are openly available and taken from https://data.footprintnetwork.org/#/, https://databank.worldbank.org/source/world-development-indicators, http://www.fao.org/faostat/en/#data, https://datacatalog.worldbank.org/dataset/worldwide-governance-indicators.

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