

Thach, Nguyen Ngoc; Ngoc, Bui Hoang

Article

Nexus between tourism and ecological footprint in RCEP: Fresh evidence from Bayesian MCMC random-effects sampling

Cogent Business & Management

Provided in Cooperation with:

Taylor & Francis Group

Suggested Citation: Thach, Nguyen Ngoc; Ngoc, Bui Hoang (2023) : Nexus between tourism and ecological footprint in RCEP: Fresh evidence from Bayesian MCMC random-effects sampling, Cogent Business & Management, ISSN 2331-1975, Taylor & Francis, Abingdon, Vol. 10, Iss. 1, pp. 1-17, <https://doi.org/10.1080/23311975.2023.2208703>

This Version is available at:

<https://hdl.handle.net/10419/294416>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<https://creativecommons.org/licenses/by/4.0/>

Nexus between tourism and ecological footprint in RCEP: Fresh evidence from Bayesian MCMC random-effects sampling

Nguyen Ngoc Thach & Bui Hoang Ngoc

To cite this article: Nguyen Ngoc Thach & Bui Hoang Ngoc (2023) Nexus between tourism and ecological footprint in RCEP: Fresh evidence from Bayesian MCMC random-effects sampling, Cogent Business & Management, 10:1, 2208703, DOI: [10.1080/23311975.2023.2208703](https://doi.org/10.1080/23311975.2023.2208703)

To link to this article: <https://doi.org/10.1080/23311975.2023.2208703>



© 2023 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.



Published online: 07 May 2023.



Submit your article to this journal [↗](#)



Article views: 982



View related articles [↗](#)



View Crossmark data [↗](#)



Citing articles: 1 View citing articles [↗](#)



Received: 14 February 2023
Accepted: 25 April 2023

*Corresponding author: Bui Hoang Ngoc, Ho Chi Minh City University of Food Industry, 140 Le Trong Tan Street, Tan Phu District, Ho Chi Minh City, Vietnam
E-mail: ngocbh@hufi.edu.vn

Reviewing editor:
Liukai Wang, Beijing University of Technology, China

Additional information is available at the end of the article

MANAGEMENT | RESEARCH ARTICLE

Nexus between tourism and ecological footprint in RCEP: Fresh evidence from Bayesian MCMC random-effects sampling

Nguyen Ngoc Thach¹ and Bui Hoang Ngoc^{2*}

Abstract: In recent years, environmental protection has been a priority goal in tourism policies worldwide, including the regional comprehensive economic partnership (RCEP). This study is conducted to explore the impact of tourism, economic growth, globalization, and human capital on environmental degradation in RCEP countries during 1995–2016. By adopting Bayesian random-effects regression to capture individual variations across countries, the findings show that tourism development improves environmental quality, while economic growth and globalization positively drive environmental degradation. The empirical result also finds that the influence of human capital on environmental damage is positive but not significant. These findings are expected to strengthen the belief of RCEP policymakers in promoting sustainable tourism.

Subjects: Environmental Economics; Economics; Tourism

Keywords: Bayesian MCMC random-effects sampling; ecological footprint; RCEP; sustainable tourism; economic growth



Nguyen Ngoc Thach

ABOUT THE AUTHORS

Nguyen Ngoc Thach is a Doctor of Sciences (Dr. Sci. in Economics). His area of research includes macroeconomic analysis, economic growth modeling, institutional analysis, Bayesian, quantum, machine learning, and other non-frequentist statistical methods. He has published more 200 research papers in these expert fields.

Bui Hoang Ngoc is a Lecturer at the Faculty of Business Administration, Ho Chi Minh City University of Food Industry, Vietnam. He studies applied and theoretical econometrics. His research interests include: tourism development, energy consumption, environmental pollution, institutions quality, sustainable development, and poverty. His research has chiefly been in the areas of the use of high-dimensional statistical methods in economic applications, by using dynamics spatial regression, autoregressive distributed lag, non-linear ARDL, Quantile ARDL, Quantile on Quantile, and Wavelet approaches. He has published 27 articles in journal listed in the SSCI, SCIE and Scopus database.

PUBLIC INTEREST STATEMENT

The current study analyzes the effects of tourism, economic growth, globalization, and human capital on the ecological footprint index representative for environmental degradation in the Regional Comprehensive Economic Partnership (RCEP) countries for 1995–2016. With the use of a Bayesian random-effects regression through a MCMC sampling algorithm, the research results in an interesting finding that the tourism sector is likely to positively contribute to the environment quality in RCEP countries. This and several others findings obtained in this study are expected to support policy-makers to design a sustainable tourism development policy.

1. Introduction

Government policies play a crucial role in sustainable development, wherein an environmental perspective is vital. All policies for boosting economic growth without influencing environmental quality are discussed. However, this goal is always challenging because economic activities are based mainly on natural exploitation and generate a high level of emissions (Danish & Zhaohua, 2019; Zaidi et al., 2019). Globalization connected developed and developing nations in terms of trade and capital flows, stimulating demand for tourism worldwide. Muhammad et al. (2020) and Kongbuamai, Viet, et al. (2020) argued that tourism improve the environment in the Association of South East Asian Nations (ASEAN). On the contrary, many studies (Azam et al., 2018; Godil et al., 2020; Villanthenkodath et al., 2021) showed that several tourism activities, such as transportation, building, catering, and lodging, enhance not only economic growth but also raise doubt about air emissions, energy consumption, loss in biodiversity, and environmental degradation. Villanthenkodath et al. (2022) found that tourism is a carbon-intensive category and so it might negatively affect environmental quality in visited countries. The influence of tourism activities on environmental problems has been proved in many different nations and regions (Lee & Chen, 2021; S. P. Nathaniel & Adedoyin, 2020). However, decreasing tourism growth might be a poor intention because it does not help generate new jobs, improve the income of the pro-poor, and might reduce economic growth (Khoi et al., 2021; Nguyen et al., 2020). Therefore, investigating the influence of tourism on environmental quality provides a comprehensive understanding of sustainable tourism policymaking.

This topic is essential for the RCEP countries because its 15 members account for nearly one-third of the world population and approximately 30% of global GDP in 2020, making the RCEP the largest trade deal in history. With the RCEP signed, it is expected to eliminate a range of tariffs (about 90%) on imports within 20 years, thus increasing regional activities such as intellectual property, telecommunications, financial services, e-commerce, and internal supply chains. With a vast population, the RCEP is the biggest tourism market, which meets approximately 20% of the world's tourism demand. However, the rapid growth of domestic and international tourism arrivals puts immense pressure on this community's environmental quality, which raises risks of environmental degradation and loss of biodiversity. Thus, it is utterly important to understand the linkage between tourism and environmental degradation to promote unified policy decisions among RCEP members. Until recently, no study on this relationship in the RCEP has been published, making this organization an interesting context to foster an understanding of how tourism influences environmental quality.

Many scholars (Ansari et al., 2021; Ayad et al., 2022; Baz et al., 2020) have analysed the relationship between economic growth, globalization, human capital, and environmental quality. While economic growth causes environmental issues, human capital is expected to alleviate these harmful impacts. The influence of globalization on environmental degradation seems unpredictable because its effects are mediated through international trade and investment. The environment can be improved thanks to the use of environment-friendly technologies and the composition effects of trade (Alvarado et al., 2021; Ibrahim & Ajide, 2021). On the contrary, foreign direct investment projects may deteriorate environmental quality by energy-intensive technologies and exploiting natural resources (Chowdhury et al., 2021). Some possible explanations for the positive impact of economic activities on environmental problems are given: first, the majority of economic activities are based on natural exploitation, and thus rapid economic growth might intensify natural resource use and cause a loss in biodiversity; second, an undesirable consequence of economic activities is the uncontrollableness of waste, water emissions, and air pollution. Therefore, an investigation of the impacts of economic growth, globalization, and human capital on environmental quality provides policymakers in the RCEP with insights into current environmental regulations, helping to design more suitable tourism policies.

Despite the abundance of earlier studies, this work is expected to contribute to the existing literature and regulation practices as summarized:

- (i) Plenty of previous studies utilized carbon dioxide (CO₂) emissions to proxy environmental degradation. However, Dogan et al. (2020) argued that a CO₂ emissions index is not a perfect measure of the damage caused by human activities to nature. This study employs the ecological footprint (EF) index to proxy environmental quality. According to Erdogan and Okumus (2021), the EF has emerged as a more holistic and comprehensive measure of environmental degradation because it covers land, forest, and air quality.
- (ii) Some issues in panel data analysis might be present, such as cross-sectional dependence, endogenous problems, and slope heterogeneity. The RCEP economic community includes ten members of ASEAN (Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam) and its five major trade partners (Australia, China, Japan, New Zealand, and South Korea). Hence, the RCEP might involve the three issues above. Frequentist methods can solve the above issues by the spatial regression or cross-sectional autoregressive distributed lag approaches. However, if some estimated coefficients may be not significant, policy implications might be inefficient. In addition to overcoming the three problems in panel data analysis, Bayesian inference can explore the effects of all the non-significant and significant variables included in terms of probability. So, in this study, the Bayesian random-effects regression is employed to supply straightforward interpretations of the various effects of tourism development as well as economic growth, globalization, and human capital on the EF. By updating prior knowledge with the available data, the Bayesian approach gives consistently estimated coefficients with more balanced, robust, and reliable results (Lemoine, 2019; Long & Ngoc, 2022; Ngoc & Awan, 2021; Thach, 2020). The findings draw a comprehensive picture of how tourism development, economic growth, globalization, and human capital are associated with the EF in the RCEP. Based on this evidence, the study also suggests practical implications for the RCEP policymakers in improving environmental quality and boosting sustainable tourism.

2. Literature review

2.1. Impact of tourism on EF

Theoretically, the effects of tourism on the EF may be considered as two sides of a coin. On the one hand, researchers have argued that the growth of tourism reduces the EF (i.e., improves environmental quality; Muhammad et al., 2020). The tourism sector introduces various opportunities and benefits for countries and regions, including economic development (Brida et al., 2014; Comerio & Strozzi, 2018), increases in available employment (Gokmenoglu & Eren, 2019), innovative technologies (Kongbuamai, Viet, et al., 2020), and green and renewable energy (Adedoyin et al., 2020). Tourism also improves community awareness of environmental protection and green tourism practices (Danish & Zhaohua, 2019). On the other hand, some researchers have raised concerns regarding the excessive development of the tourism industry, which will raise the EF, leading to environmental damage (Acar & Asici, 2015; Ansari & Villanthenkodath, 2021). Such concerns arise from the fact that tourism leads to increasing natural resources usage (Ozturk et al., 2016), a loss in biodiversity (Qureshi et al., 2019), changes in land use, and decrements in forest areas (Destek et al., 2018). Furthermore, tourism growth increases non-renewable energy usage across various activities, such as catering, accommodations, and transportation (Mikayilov et al., 2019).

Empirical estimates support the reported advantages (Croes et al., 2021; Muhammad et al., 2020) and disadvantages (Godil et al., 2020; Koçak et al., 2020) of tourism. In terms of the former (i.e. a decrease in the EF), Muhammad et al. (2020) adopted the augmented mean group approach for the panel data of the 20 highest emitting countries from 1995 to 2017, to understand the long-term impact of tourism on the EF; their study revealed that the environmental Kuznets curve (EKC) hypothesis is not validated, and tourism decreases EF, while financial development and energy consumption increase it. Similarly, Kongbuamai, Viet, et al. (2020) used the non-causality test techniques of Driscoll and Kraay (1998) and Dumitrescu and Hurlin (2012) on panel data between 1995 and 2016. They reported that tourism reduced the EF in the ASEAN. A similar result was also

obtained by Khan and Hou (2021) in the context of the 38 International Energy Agency (IEA) countries from 1995 to 2018, using the fully modified ordinary least square (FMOLS) approach and a Granger causality test. In contrast, the disadvantages of tourism (i.e. an increase in EF) were documented by Adedoyin et al. (2020); they applied FMOLS and the Dumitrescu and Hurlin non-causality test techniques in the context of the top 10 earners of international tourism for 1995–2015, determining a positive correlation between tourism and the EF. In India, Villanthenkodath et al. (2021) revealed that tourism development worsens the quality of the environment while economic growth improves it. More specifically, a 1% increase in tourist arrivals leads to a 0.08% and 0.113% increase in carbon dioxide emissions in the short and long run, respectively. Similarly, Ansari and Villanthenkodath (2021) employed a panel non-linear autoregressive distributed lag (ARDL) approach to explore a potential asymmetric effect of tourism on the EF in most visited countries from 1995 to 2017. Their findings also affirmed a long-term positive impact of tourism arrivals on the EF, while tourism receipts are negatively associated with environmental degradation. More interestingly, their findings revealed the influence of tourist arrivals on the EF is asymmetric, where the impact of negative changes in tourism is greater than positive changes. However, their results reported that while tourist receipts improve the environment, economic growth, energy consumption, and urbanization positively contribute to environmental degradation. Similarly, by adopting the EKC framework, Liu et al. (2022) found an inverted U-shaped relationship between travel and tourism and the EF in Pakistan. More precisely, the turning point was shown at 207.082 million U.S dollars, and boosting tourism development is harmful to the EF. Recently, Villanthenkodath et al. (2022) applied the ARDL and Wavelet approach to confirm that changes in tourism lead to changes in India's pollution level at different frequencies and periods, especially in the long term. An analogous finding was reported by Godil et al. (2020), where a quantile ARDL method was used to elucidate that tourism increased the EF in Turkey during 1986–2018. Likewise, Koçak et al. (2020) used the continuously updated fully modified (CUP-FM) and the continuously updated bias-corrected (CUP-BC) techniques on the panel data of the most visited countries from 1995 to 2014, confirming that there was a positive effect of tourism on the EF.

Notably, tourism has become one of the largest industries, and it is also a key determinant of sustainable development in many countries and regions. Thus, tourism at high growth rates will inevitably accelerate the overall advancement of each country and region. Consequently, the negative and positive impacts of tourism on the environment converge into one significant point: sustainable tourism (i.e., developing tourism while increasing environmental quality; Cotterell et al., 2019; Danish & Wang, 2019; Sharpley, 2020). This means that every region (e.g., RCEP) needs to evaluate the linkage between tourism and the EF. In cases where the tourism sector elevates the EF, sustainable development policies should be enhanced to improve environmental health. Such an understanding is meaningful to the RCEP countries, and highlights the need for analysing the relationship between tourism and the EF.

2.2. Impact of economic growth on EF

A majority of previous studies have suggested that there is a trade-off between economic growth and environmental quality (Alola et al., 2019; S. Nathaniel & Khan, 2020; Sharma et al., 2020); as such, economic growth has led to environmental deterioration owing to the following reasons. First, economic growth generates an unprecedented rise in energy demand, particularly in terms of excessive utilization of non-renewable energy such as fossil fuels (S. Nathaniel & Khan, 2020; Udemba, 2020; Zafar et al., 2019). Second, economic growth increases job opportunities, prompting a rural to urban migration and urbanization in different countries (Ahmed et al., 2020b). This migration and urbanization places pressure on the existing urban infrastructure and ecological balance in urban environments (Sharma et al., 2020). The empirical findings from previous studies support the conceptualization of this trade-off. Alola et al. (2019) reported a positive impact of economic growth on the EF among 16 European Union (EU) countries, using the ARDL method on panel data spanning 1997–2014. Ahmed et al. (2020b) produced analogous results by adopting the CUP-FM and CUP-BC techniques using panel data from 1971 to 2014 for G7 countries. S. Nathaniel

and Khan (2020) utilized the panel data of ASEAN countries from 1990 to 2016, and reported that the economic growth increased the EF.

Sharma et al. (2021) argued that the persistent increase in the per capita income has challenged the environmental conservation drive in most developing nations. They used the EKC hypothesis to explore the impact of GDP, renewable energy consumption, and population density on the EF in eight developing countries of South and South East Asia during 1990–2015. The empirical result from the cross-sectional ARDL (CS-ARDL) approach showed that the association between per capita income and the EF is N-shaped. However, S. P. Nathaniel (2021), who indicated that the impact of GDP on the EF is different for each country, found that economic expansion mitigates environmental deterioration in Colombia, South Africa, and Turkey, but increases pollution in Egypt, Indonesia, and Vietnam.

Hussen (2005) suggested that, when a country is at its early stage of development, rudimentary and inefficient industries produce scale effects and pollution. Eventually, there is a transition towards the service sector, generating composition effects and causing reduced levels of pollution. When economic growth reaches a peak, higher technologies and service-oriented production are typically adapted in industrial production; this creates a technical effect on environmental degradation, known as the EF. When the per capita income level grows, residents tend to demand cleaner policies to protect and improve environmental health (Balsalobre-Lorente et al., 2018). This reasoning may be used to understand the findings of Usman et al. (2020), who investigated 33 upper- to middle-income countries (UMICs) from Africa, Asia, Europe, and America during 1994–2017; they determined that there was a negative correlation between economic growth and the EF in Africa and Europe. Similarly, this reasoning may be applied to understand the results from Hassan et al. (2019); they found that, in Pakistan, economic growth initially contributed to the rising the EF, and then decreased the EF from 1970 to 2014.

2.3. Impact of globalization on EF

Some researchers (Antweiler et al., 2001) have suggested that globalization deteriorates the environment via the income effect (i.e., increases foreign trade and foreign investment, *ceteris paribus*), scale effect (i.e., the integration of production factors among different international markets), and composition effect (i.e., a transition towards more carbon-intensive consumption). Shahbaz et al. (2017) postulated that globalization was a source of global warming, leading to reduced access to natural resources. Antweiler et al. (2001) emphasized that globalization would prompt governments to reduce production costs by neglecting or sacrificing the environment. Ghosh (2010) also reported on the negative effect of globalization, arguing that countries with low institutional quality and environmental standards would be vulnerable to environmental degradation owing to their acceptance of unsustainable technologies and products. This argument has been consistent with the “pollution haven” hypothesis, stating that globalization is likely to result during industrial flight that may give rise to the environmental problems (Salahuddin et al., 2019). A literature review demonstrated that globalization increases the EF in different regions, such as South Asian countries from 1975 to 2017 (Sabir & Gorus, 2019), 13 Middle East and North Africa (MENA) countries between 1990 and 2014 (Kassouri & Altintas, 2020), or Central and Eastern European Countries during 1995–2015 (Destek, 2020).

In contrast, the “California effect” hypothesizes that globalization has improved environmental quality as globalization-induced trade liberalization has potentially facilitated the transfer of innovative and clean technologies from developed to developing countries (Christmann & Taylor, 2001). It may also have facilitated greater and faster access to information and knowledge as well as rapid information dissemination. Therefore, globalization may potentially increase awareness on ecological issues, and enable countries to adopt environment-friendly technologies (Salahuddin et al., 2019). These arguments have also been corroborated by Porter and Van der Linde (1995), who postulated that countries are more likely to be successful in implementing environmental regulations with a greater increase in income from globalization. Hence, globalization may offer

greater opportunities to access more environment-friendly productions and technologies, potentially reducing pollution and improving environmental quality. There is also empirical evidence supporting the negative influence of globalization on the EF in various contexts, including selected one-belt-one-road initiative countries between 1990 and 2014 (Saud et al., 2020), and top renewable energy economies during 1991–2016 (Ansari et al., 2021).

2.4. Impact of human capital on EF

There has been limited attention directed to human capital for research on issues related to environmental sustainability; this is a somewhat underestimated problem (Kassouri & Altintas, 2020). Some researchers have considered human capital as a sustainable development determinant because it may enable countries to establish a sustainable future. This argument is based on human capital being involved in long and healthy living, education and welfare, and good living standards (Türe & Türe, 2020). These outcomes play a primary role in promoting the adoption of technological change for sustainable economic growth (Ackah & Kizys, 2015; Consoli et al., 2016), and in generating awareness towards environmental quality and sustainability (Ulucak et al., 2020). From this perspective, human capital positively contributes to increased environmental quality. Other researchers, such as Croes et al. (2021), have argued that economic growth in some countries is critically reliant on exploiting natural resources and assets; as such, there may be considerably insufficient investment in human capital. Based on this, human capital does not exert a significant effect on sustainable development. This argument is in line with Dietz et al. (2007), who demonstrated that different aspects of human capital are unrelated to environmental impact. Finally, Kassouri and Altintas (2020) indicated that human capital increases the EF in MENA countries. A potential cause of this may be that human capital in developing countries has increased income, resulting in economic growth and ultimately causing environmental damage (S. P. Nathaniel et al., 2020). In contrast, human capital in developed countries has increased consumption among individuals (Moran et al., 2008).

This may be one of the first studies investigating the impact of the tourism sector on the EF in the RCEP using a Bayesian approach. Certainly, the above-mentioned studies do not present a complete review of the literature on the linkage between tourism, economic growth, globalization, and human capital on environmental degradation. Importantly, the integration of these variables has not been explored in studies on tourism in the RCEP. It is crucial to examine this linkage in the heterogeneous RCEP to design a unified and efficient sustainable tourism strategy for all of its members. Indeed, along with tourism, economic growth, and globalization, incorporating human capital in a Bayesian analysis will provide a reliable empirical basis for effective measures of promoting eco-tourism in this region.

3. Methodology and model specification

Since the 1990s, the assessability and popularity of the Bayesian paradigm in social science has been increasing in the context of a severe crisis occurring in frequentist statistics during the rapid development of computer science (An & Schorfheide, 2007; Azzimonti et al., 2014; Dong, 2020; Thach & Ngoc, 2021). There are several advantages of the Bayesian setting over the more traditional frequentist inference. Firstly, Bayesian and frequentist settings differ in philosophy. If the parameters in Bayesian modelling are random quantities, then they are unknown; however, these parameters are fixed in frequentist inference. Based on these attributes, while frequentist methods result in point estimates, Bayesian estimation provides an entire posterior probability distribution of a coefficient of interest, reducing model uncertainty. Bayesian methods facilitate capturing the effects of potential explanatory factors dropped out of analysis due to low statistical power in frequentist estimation (Zondervan Zwijnenburg et al., 2019). Secondly, the posterior distribution in Bayesian analysis, resulting from combining the prior distribution with the likelihood distribution, irrespective of sample size, is able to present the probability of the parameter values. Prior distributions represent the knowledge about model parameters before seeing the data. As a greater amount of prior information is accessed, the prior distribution becomes narrower; this has a greater impact on posterior distribution, which also becomes narrower and more

informative. It may also be postulated that there is an increase in statistical power. Prior distributions are also more likely to avoid inadmissible estimates and convergence problems; this is not possible using typical frequentist methods in empirical studies. In short, when prior information is available, Bayesian simulation with informative priors provides a more precise outcome, even in small sample research (Kim, 2002). In this case, the Bayesian estimation results are more balanced, accurate, and consistent. Finally, the Bayesian approach allows for probability statements, such as a variable is likely to affect another variable or the 90% or 95% probability—stating that a particular coefficient falls into a prespecified range.

In this study, to model clustered data, the flexible Bayesian paradigm was applied to the mixed-effects regression to account for variability across the studied RCEP countries. A linear mixed-effects model for a continuous response is a generalization of linear regression, where random variations, other than those related to the overall variance component, are incorporated. In matrix notation, the model may be written as

$$Y = \beta X + \alpha U + \varepsilon \quad (1)$$

where, Y represents the $m \times 1$ vector of responses; β represents the $m \times p$ design/covariate matrix for the fixed effects, X ; and α represents the $m \times p$ design/covariate matrix for the random effects, U . The $m \times 1$ vector of errors, ε , is supposed to be the multivariate normal with a zero mean and the variance matrix, $\sigma_\varepsilon^2 R$. βX is the fixed portion that is comparable to the linear combination in a simple ordinary least squares (OLS) regression model, with β as the regression coefficient; $\alpha U + \varepsilon$ is the random portion of the model. It is assumed that U has a variance-covariance matrix, G , and that U is orthogonal to ε , such that

$$\text{Var} \begin{bmatrix} U \\ \varepsilon \end{bmatrix} = \begin{bmatrix} G & 0 \\ 0 & \delta_\varepsilon^2 R \end{bmatrix} \quad (2)$$

In a mixed-effects model, the grouping structure of the data is composed of multiple levels of nested groups, where both random intercepts and random coefficients are incorporated in the model. The random intercepts are initial conditions varying across countries, while the random slopes (coefficients) are differences between the countries with regard to all or some dimensions of interest. The advantage of mixed-effects models is their ability to predict the values of a response, although the OLS regression may also be used to achieve this outcome. However, by including country deviations in a model, the model may be better fitted to the data. This study included random intercepts, while random slopes were specified only for the variable of interest, i.e. tourism.

There is uncertainty as to whether tourism has a non-linear effect on ecological sustainability. This is because tourism activities in an advanced country (e.g. strong environmental policies, environmental awareness among stakeholders, and presence of tourism infrastructure) tend to be more sustainable with regards to the ecological aspect. On the contrary, tourism is likely to positively influence the EF indicator in less-developed countries. Therefore, polynomial random-effects and intercept-only regression models were specified for consideration; in these models, there is a non-linear relationship between the predictor of tourism and the response of the EF. Furthermore, based on the potential that random effects may linearly influence the model outcome, a full random-effects model was fitted. Then, through a sensitivity analysis conducted, the three chosen models were compared to identify the best model.

Prior choice is essential in Bayesian simulation owing to the subjective viewpoint of researchers; researchers may specify different models for the same relationship. There are common guidelines for prior choice. First, the prior distribution must not overwhelm the data distribution in simulation studies with a large sample. For instance, when a sample size is sufficiently large, weakly informative priors could be set. Second, when a small sample is encountered, the abuse of non-informative priors may lead to inflated Type II error (Zondervan Zwijnenburg et al., 2019). To address this, Lemoine (2019) recommends adopting fairly informative priors. Block et al. (2011)

applied a normal (0,1) prior in the Gaussian distribution for parameters. So, in this study, Bayesian simulations with a normal (0,1) prior to all the structural parameters were conducted. A sensitivity analysis of the estimation results was performed to inspect the robustness of the results.

During the simulations, the target Markov chain Monte Carlo (MCMC) sample size of 3,000 was specified, and the first 2,500 iterations during the burn-in period were discarded from the MCMC sample. The parameter values, which were simulated during burn-in, were used only for adaptation purposes. To avoid the high autocorrelation of the simulated MCMC sample in a high-dimensional mixed-effects model, a thinning of 50 was set. Therefore, the total number of iterations for the Metropolis-Hastings algorithm was 152,451. In employing a Monte Carlo technique, sequence convergence diagnostics need to be implemented before proceeding to inference. If the MCMC chain converged to a stationary distribution, the estimation results are considered reliable for inference.

The general econometric model may be written as

$$EF_{it} = \beta_0 + \beta_1 \cdot \ln TO_{it} + \beta_2 \cdot \ln GDP_{it} + \beta_3 \cdot Global_{it} + \beta_4 \cdot HDI_{it} + \alpha \cdot u_i + \varepsilon_{it} \quad (3)$$

where, i (1,2,...,15) is an index of countries, including Brunei, Cambodia, Indonesia, Laos People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, South Korea, Thailand, Vietnam, Australia, Japan, New Zealand, and Mainland China. t is the study period (from 1995 to 2016). EF , as the proxy for environmental degradation, is the ecological footprint index (unit: gha per capita), which was collected from the Global Footprint Network. TO variable is total international visitor arrivals (unit: person/year), which was obtained from the World Tourism Organisation. GDP , as a proxy for economic growth, is the income per capita (unit: U.S. dollar at the fixed 2010 price) obtained from the database of the World Bank. Two variables (TO and GDP) were transformed into natural logarithms to smooth data. The $Global$ variable represents the KOF of globalization (unit: percentage), which was obtained from the Swiss Economic Institute. HDI , as a proxy for human development, is the human capital per person index (unit: point), which was collected from the database of the Federal Reserve Bank of St. Louis (FRED). Furthermore, β is a vector of coefficients; α is a coefficient; u is the random effects; and ε is the error term.

4. Bayesian results and discussion

4.1. Sensitivity analysis

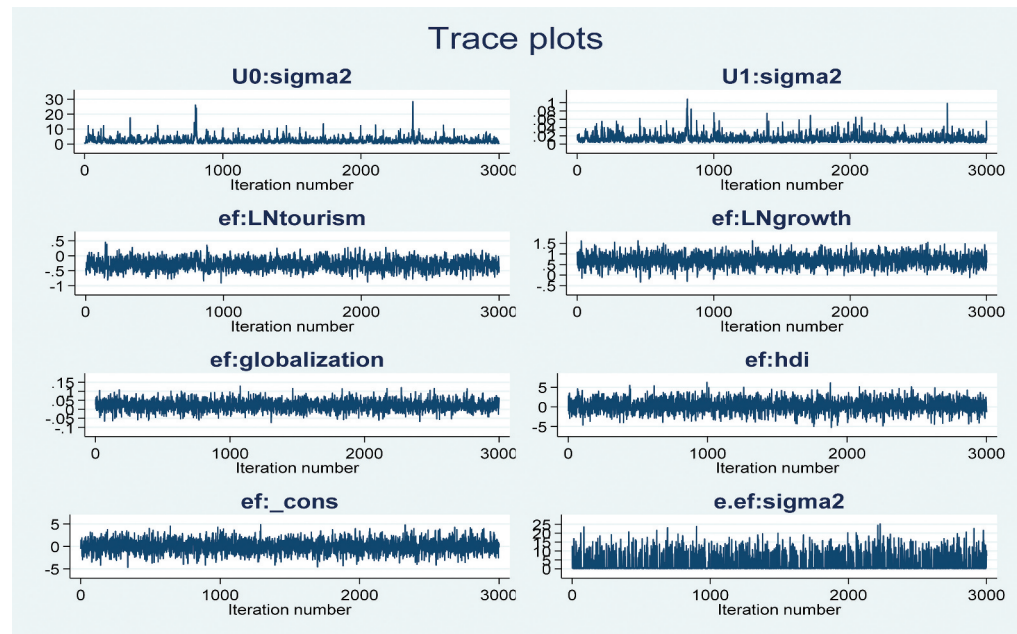
As described in Section 2, the study implemented a Bayes-factor test to compare three regression models, i.e. polynomial random-effects, polynomial intercept-only, and full random-effects. The results showed that the random-effects model, where a linear relationship existed between the tourism variable and the EF variable, was the best fit. Specifically, this chosen model incorporated random intercepts and random slopes. Table 1 shows that the random-effects model obtained the smallest deviance information criterion (DIC), largest log (ML) estimates, and highest P(My) value.

4.2. MCMC convergence tests

The performance of MCMC algorithms requires the verification of chain convergence to confirm model robustness. Typically, numerous tests are employed in practice, such as trace plots, cusum plots; generally, trace plots are considered the most useful (Kalli & Griffin, 2018; Strachan & Inder, 2004). The initial indicators as acceptance rate and efficiency usually critically affect MCMC convergence. All the mentioned visual and formal tests were conducted in this study. All plots for the model parameters showed signs of good mixing of MCMC. These signs included the trace plots showing no trends and traversing rapidly through the domain of the posterior distributions; and the jagged cusum plots crossing the X-axis (Figures 1, 2). Thus, it may be concluded that the MCMC chains converged to a desired distribution.

Table 1. Bayesian information criteria and Bayesian model tests					
	DIC	log(ML)	log(BF)	P(M)	P(My)
Polynomial random-effects model	457.399	-239.784	.	0.333	0.0017
Polynomial intercept-only model	377.835	-251.653	-11.868	0.333	0.0000
Random-effects model	488.145	-233.429	6.3546	0.333	0.9983

Figure 1. Trace plots.



Furthermore, the rate of acceptance and efficiencies were examined. The acceptance rate was 0.71, while minimum, average, and maximum efficiencies were 0.19, 0.65, and 1, respectively. According to Koop and Potter, these values are reasonable for an MCMC algorithm.

4.3. Estimation results

Table 2 presents the posterior summaries for the random-effects model, which is selected as the best among the three candidate models. The posterior summaries of the random-effects model, which are reported in Table 2, indicate that, for all the parameters, the standard deviations, which were interpreted as per frequentist statistics, were sufficiently small for the preciseness of the parameters. Similarly to frequentist standard errors, the smaller the standard deviations, the less biased the posterior estimates in Bayesian estimation. Concerning this statistic, there is a similarity between Bayesian and frequentist estimation, that is, the standard deviation (and standard error) for variable *Global* obtains the lowest estimate, while that for variable *HDI* the highest. Differently from the standard deviation, the Monte Carlo standard error (MCSE) is a specific statistic in the Bayesian setting, which indicates the preciseness of the posterior results. When a MCSE value is lower, the accuracy of the coefficient parameter estimate is higher. In this approximation, the estimated MCSEs, close to one decimal, were admissible for an MCMC sampler. Furthermore, Bayesian estimation also captures all independent variables included in the model, and in terms of probability, affects the dependent variable with an arbitrage magnitude of impact. In contrast, frequentist inference dropped statistically non-significant factors out of analysis. In the Bayesian context, all independent variables

Figure 2. Cusum plots.

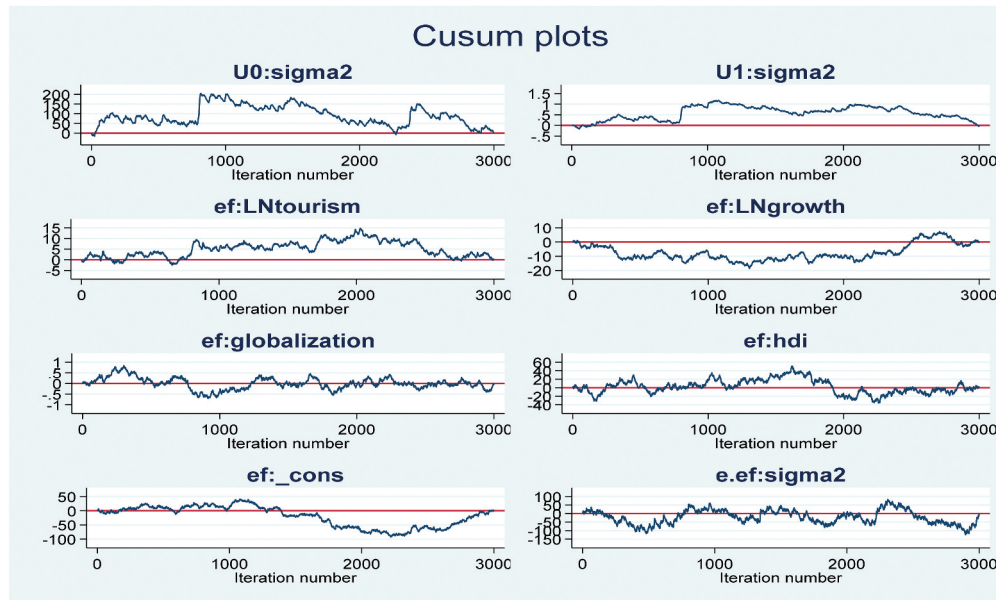


Table 2. Bayesian posterior estimates

	Mean	Std. Dev.	MCSE	Median	Equal-tailed [95% Cred. Interval]
Dependent variable: <i>EF</i>					
<i>lnTO</i>	-0.2862	0.1841	0.0052	-0.2900	[-0.6313; 0.0784]
<i>lnGDP</i>	0.6931	0.2719	0.0063	0.6932	[0.15958; 1.2228]
<i>Global</i>	0.0223	0.0274	0.0006	0.0224	[-0.0322; 0.0768]
<i>HDI</i>	0.2499	1.5605	0.0285	0.2268	[-2.8775; 3.3568]
<i>Intercept</i>	0.0597	1.3932	0.0263	0.0552	[-2.7305; 2.8972]
<i>id</i>					
U_0 : sigma2	2.2630	1.9697	0.0835	1.7689	[0.3494; 7.0812]
U_1 : sigma2	0.0134	0.0093	0.0004	0.0109	[0.0036; 0.0037]
<i>e.EF</i>					
sigma2	2.7395	4.6724	0.0853	0.3792	[0.2048; 15.393]
MCMC sample size = 10000		Acceptance rate = 0.71			

(*lnTO*, *lnGDP*, *Global*, and *HDI*) have significant various effects on the dependent variable *EF* (see Table 2); meanwhile, with the data sample used in this analysis, frequentist estimation results in non-significance for the *Global* and *HDI* variables, though these variables potentially impact on the response (see Table 3). Similarly to frequentist regression coefficients, the Bayesian means as a key measure of central tendency are taken to reflect a point estimate for the parameters of interest. However, a discrepancy is that, in Bayesian estimation, the mean estimates are not fixed, but display

Table 3. Mixed-effects ML regression

Variables	Coef.	Std. Err.	z	P > z	Conf. Interval
Dependent variable: <i>EF</i>					
<i>lnTO</i>	-0.1846	0.0835	-2.21	0.027	[-0.3483; -0.0209]
<i>lnGDP</i>	0.4399	0.1249	3.52	0.000	[0.1950; 0.6848]
<i>Global</i>	0.0102	0.0098	1.03	0.302	[-0.0091; 0.0293]
<i>HDI</i>	1.1354	1.7796	0.64	0.523	[-2.3525; 4.6234]
<i>Intercept</i>	0.7914	0.9854	0.80	0.422	[-1.1399; 2.7227]

Table 4. The results of interval hypothesis tests

Variables	Mean	Std. Dev.	MCSE
<i>lnTO</i>	0.9343	0.2477	0.0062
<i>lnGDP</i>	0.9947	0.0728	0.0014
<i>Global</i>	0.7987	0.4011	0.0077
<i>HDI</i>	0.5557	0.4969	0.0091
<i>Intercept</i>	0.5150	0.4999	0.0091

a probability distribution of the parameter values. In this study, frequentist and Bayesian estimation provides similar results (Tables 2 and 3).

Contrary to the frequentist framework, Bayesian analysis provides an intuitive and direct interpretation of posterior summaries. This includes credible intervals, where a 95% credible interval implies that the mean estimates of the parameter of interest (e.g. *lnTO*) are between -0.63 and 0.078 with a 95% probability (see Table 2). Differing from the frequentist confident intervals, Bayesian analysis offered a probabilistic interpretation of the effect of an independent factor on the dependent variable. In this study, the estimated mean of variable tourism was negative, while the relevant 95% credible interval is zero. The *Global* and *HDI* variables were positive, while the credible intervals for their means are zero. These empirical findings highlight the need for further analysis. An interval test is required to determine which probability of the independent variables should be correlated to the dependent variable. According to Table 4, with a 93.43% probability, *lnTO* generates a strong negative effect on the *EF* response, while the *lnGDP* and *Global* variables have strong positive effects; however, the impact of globalization is a bit weaker with a 79.87% probability. Specifically, with a 55.57% probability, the impact of the *HDI* variable is weak, even ambiguous. From Table 4, the *Global* and *HDI* variables, which acquired a low probability of effect on the *EF* response, are excluded from the ML model owing to non-significance.

4.4. Discussion

This study indicates that tourism has a negative effect on the *EF*, suggesting that the development of the tourism industry increases environmental quality among the RCEP countries. These findings were consistent with several studies, such as Muhammad et al. (2020). Likewise, by adopting the environmental Kuznets curve framework, Liu et al. (2022) found an inverted U-shape relationship between travel and tourism and the *EF* in Pakistan. That means tourism improves the environment in the long run. However, these results are contradicted by other researchers. This includes Mikayilov et al. (2019) and Godil et al. (2020), who investigated the Azerbaijan and Turkey context, respectively; Adedoyin et al. (2020), who examined the relationship among the top 10 earners of international tourism; and Koçak et al. (2020), who focused on this relationship in most visited countries. The positive impact of

tourism on environmental degradation was also confirmed by Villanthenkodath et al. (2022) for the Indian economy, in which the results from the ARDL approach and a Wavelet analysis indicate that tourism development leads to an increase in environmental degradation, especially in the long run. Similarly, Yan et al. also revealed a significant coherence between tourism and air quality at different time–frequency domains. More precisely, they found out-phase coherence (negative impact) between tourism and air quality in the short run, and in-phase coherence (positive impact) in the long run. More interestingly, these relationships are investigated in the context of the COVID-19 pandemic in Hawaii. In sum, the results from Bayesian inference through mixed-effects regression exhibited a very strong negative and linear connection between tourism and the EF. Some possible reasons are given to explain the findings: first, the current tourism development policies of the RCEP countries are more likely to promote environmental quality and sustainable development by adapting innovative technologies, and green and renewable energy, and by increasing the community awareness on environmental protection and green tourism practices (Danish et al., 2019). Several RCEP countries (i.e. Singapore, Japan, Thailand) have good experience in tourism activities management. So, many behaviours that cause environmental pollution will be punished by regulations (Khoi et al., 2021). Second, tourism development can encourage local communities to adopt sustainable practices, such as reducing waste, conserving water, and using renewable energy sources. This can help to reduce environmental destruction and promote long-term sustainability (Nattapan Kongbuamai, Viet, et al., 2020). Third, tourism development can benefit local communities economically, such as reducing poverty and improving living standards. This can improve human capital, which helps to better understand and manage natural ecosystems (Ngoc, 2022).

The ML regression results suggested that economic growth had a positive effect on the EF, and Bayesian inference confirmed a very strong relationship between the two variables. This study's findings are consistent with Sharma et al. (2020), who investigated the influence of economic growth and demographic indicators on the EF in the eight developing countries of Asia from 1990 to 2015; and Destek and Sinha (2020), who focused on the 24 Organisation for Economic Co-operation and Development (OECD) countries; S. Nathaniel and Khan (2020) and Ahmed et al. (2020a), who examined the ASEAN and G7, respectively. Notably, some studies produced sharply contrasting results; for example (i.e., economic growth improves environmental quality and decreases the EF). These findings suggested that the RCEP countries, in general, are attempting to accelerate economic development without accounting for environmental consequences, such as the excessive use of non-renewable energies (S. Nathaniel & Khan, 2020; Udemba, 2020; Zafar et al., 2019) and high levels of urbanization (Ahmed et al., 2020b). This may result in additional pressures on biodiversity and the ecological balance (Sharma et al., 2020).

Although the ML regression results show the ambiguous roles of globalization and HDI in the EF, the complementary findings from the Bayesian approach suggest a moderate and positive impact of globalization on the EF in the RCEP. The positive impact of globalization on the EF was also confirmed by Sabir and Gorus (2019), among others. The results suggested that globalization in the RCEP countries is likely related to the “pollution haven” hypothesis (Salahuddin et al., 2019; Zaidi et al., 2019) or may be caused by the trade-off between reducing production costs and neglecting or sacrificing the environment (Antweiler et al., 2001). Finally, the ambiguous effect of the HDI on the EF was consistent with the findings of Dietz et al. (2007), who found that different aspects of the HDI were unrelated to the environmental impact. This may be because many RCEP economies greatly depend on exploiting natural resources, and the assets produced from this exploitation are not sufficiently invested in the HDI (Ahmed et al., 2021; Croes et al., 2021).

5. Concluding remarks and policy implications

5.1. Conclusion

Tourism is expected to positively influence the environment during the era of sustainability; however, empirical findings on the connection between tourism and environmental quality (proxied by EF) differ and are sometimes contradictory. This study estimated the effects of the tourism

sector on the EF for 15 heterogeneous member countries of the relatively new RCEP, while controlling for economic growth, globalization, and HDI. The Bayesian random-effects inference was applied to the research model comprising notable variables that provide meaningful results. The Bayesian approach, as a robust empirical approach, confirmed the impacts of tourism and economic growth, and was able to assess the potential influence of non-significant factors (globalization and HDI) on the EF. Consequently, the relationship between tourism and ecological sustainability was more linear than non-linear. Tourism had a strong negative effect on the EF, while the two other control variables, economic growth and globalization, were strongly and moderately positively correlated with the EF, respectively. That is because the majority of the RCEP countries have followed a sustainable tourism policy even though economic growth in the developing countries of RCEP is extensive and trade liberalization has made the economy a “pollution haven”. Many RCEP countries have increased environmental protection awareness; enhanced green tourism, eco-tourism, and community-based tourism practices; and minimized the negative effects of globalization. The effect of the HDI variable was positive, albeit relatively weak given a low probability, implying that there was a neutralizing effect of this variable on the EF. Thus, on a theoretical basis, in the current context of tourism development as a growth-leading sector, a suitable sustainable tourism policy is able to contribute greatly to the environment in integrated organizational structures such as the RCEP.

5.2. Policy implications

These findings show that tourism decreases the EF—that is, tourism improves environmental quality—hence, tourism industries among the RCEP countries are considered environmentally progressive. Tourism in these countries appears to facilitate sustainable environmental development under the guidance and regulation of suitable and effective policies. Regardless, there is always room to improve on existing policies, especially in circumstances where globalization and integration are occurring at an accelerated pace. Specifically, as tourism requires significant energy consumption for various activities, future policies should promote innovative technologies (Gokmenoglu & Eren, 2019), reduce carbon emissions (Ngoc & Hai, 2022a), promote renewable energy sources (Thanh et al., 2019), and encourage sustainable agriculture and forest management (Ngoc & Hai, 2022b). Furthermore, the RCEP countries should encourage green tourism practices (Long & Ngoc, 2022). There is also a need to promote eco-tourism or community-based tourism, wherein tourism activities are embedded into the local culture and natural resources (Collins & Cooper, 2016). Additionally, the RCEP members should reconsider the population structure and reduce population growth to balance ecological demand and biocapacity (Kongbuamai, Viet, et al., 2020). Finally, there are significant benefits in increasing awareness regarding environmental protection among stakeholders, including service providers and tourists; this may be achieved through sub-organizations of the government and tourism service partners (e.g., tourist agents). Importantly, the environmental awareness of locals plays a pivotal role in maintaining sustainable development (Danish et al., 2019). Therefore, although the impact of the HDI on the EF is not significant, we strongly urge all the RCEP countries to invest further in human development, including long and healthy living as well as welfare/good living standards and education in terms of sustainable development and the tourism industry in particular (Chen et al., 2020).

With ongoing economic growth and globalization, which will increase the EF among the RCEP countries, there is a need for considerable improvement to the policies related to these two factors. First, the positive link between economic growth and the EF may be mediated via the excessive consumption of non-renewable energy, and urbanization. To mitigate the stress of economic growth on the EF, as mentioned above, the RCEP countries should incentivize the utilization of renewable energy, while decreasing the use of non-renewable energies. In this case, environmental taxes and subsidies to eliminate harmful industries may prove to be a useful tool. For example, environmental taxes may be higher for polluted industries than environment-friendly industries. Alternatively, subsidies may be set to promote changes from obsolete technologies, which use non-renewable energy, to innovative and green technologies

that utilize renewable energy. Another solution is achieving a balance between urbanization because of economic growth and biodiversity. Key solutions to achieve this balance include capitalization amenities and the establishment of smart cities. Thus, policies in the RCEP countries should stimulate efficient, innovative, and sustainable lifestyles that are aligned with energy-saving, recycling, and the use of renewable energy instruments, such as hybrid vehicles and transportation, smart homes, and solar energy. Second, the increase in the EF owing to globalization may be understood from the perspective of reduced access to natural resources, a weak institutional regulatory context (Ghosh, 2010), or the trade-off between production costs and environment (Antweiler et al., 2001). Thus, the RCEP countries should invest in developing strong environmental policies that eliminate the import of dirty technologies and products, while fostering the inflow of knowledge on environmental sustainability, including innovative and green technologies during the free trade facilitated by globalization. Consequently, the RCEP countries would not be forced to trade between environmental quality and low-cost products.

Finally, even though significant empirical evidence is acknowledged in this study, we recognize that it still has some limits. In general, many macro-economic variables can affect environmental degradation in emerging countries. Thus, some related economic variables should be further considered, such as non-renewable energy consumption, institutional quality, and emissions taxes. Additionally, future research might extend our model to other developing countries to help policymakers systematically understand the role of tourism activities in environmental quality and strengthen the belief of administrators in sustainable and green development. We also suggest that several novel econometric techniques, such as Wavelet coherence, or quantile-on-quantile approach, can be applied.

Author details

Nguyen Ngoc Thach¹
ORCID ID: <http://orcid.org/0000-0001-8822-2633>
Bui Hoang Ngoc²
E-mail: ngocbh@hufi.edu.vn
ORCID ID: <http://orcid.org/0000-0002-1892-985X>

¹ Asian Journal of Economics and Banking, Ho Chi Minh University of Banking, Ho Chi Minh City, Vietnam.

² Faculty of Business Administration, Ho Chi Minh City University of Food Industry, Ho Chi Minh City, Vietnam.

Disclosure statement

No potential conflict of interest was reported by the authors.

Citation information

Cite this article as: Nexus between tourism and ecological footprint in RCEP: Fresh evidence from Bayesian MCMC random-effects sampling. Nguyen Ngoc Thach & Bui Hoang Ngoc, *Cogent Business & Management* (2023), 10: 2208703.

References

- Acar, S., & Asici, A. (2015). *Does income growth relocate ecological footprint?* <https://EconPapers.repec.org/RePEc:erg:wpaper:938>
- Ackah, I., & Kizys, R. (2015). Green growth in oil producing African countries: A panel data analysis of renewable energy demand. *Renewable and Sustainable Energy Reviews*, 50, 1157–1166. <https://doi.org/10.1016/j.rser.2015.05.030>
- Adedoyin, F. F., Nathaniel, S., & Adeleye, N. (2020). An investigation into the anthropogenic nexus among consumption of energy, tourism, and economic growth: Do economic policy uncertainties matter? *Environmental Science and Pollution Research*, 28(3), 2835–2847. <https://doi.org/10.1007/s11356-020-10638-x>
- Ahmed, Z., Zafar, M. W., Ali, S., & Danish. (2020a). Linking urbanization, human capital, and the ecological footprint in G7 countries: An empirical analysis. *Sustainable Cities and Society*, 55, 102064. <https://doi.org/10.1016/j.scs.2020.102064>
- Ahmed, Z., Zafar, M. W., Ali, S., & Danish. (2020b). Linking urbanization, human capital, and the ecological footprint in G7 countries: An empirical analysis. *Sustainable Cities and Society*, 55, 55. <https://doi.org/10.1016/j.scs.2020.102064>
- Ahmed, Z., Zhang, B., & Cary, M. (2021). Linking economic globalization, economic growth, financial development, and ecological footprint: Evidence from symmetric and asymmetric ARDL. *Ecological Indicators*, 121, 121. <https://doi.org/10.1016/j.ecolind.2020.107060>
- Alola, A. A., Bekun, F. V., & Sarkodie, S. A. (2019). Dynamic impact of trade policy, economic growth, fertility rate, renewable and non-renewable energy consumption on ecological footprint in Europe. *The Science of the Total Environment*, 685, 702–709. <https://doi.org/10.1016/j.scitotenv.2019.05.139>
- Alvarado, R., Ortiz, C., Jiménez, N., Ochoa-Jiménez, D., & Tillaguango, B. (2021). Ecological footprint, air quality and research and development: The role of agriculture and international trade. *Journal of Cleaner Production*, 288, 125589. <https://doi.org/10.1016/j.jclepro.2020.125589>
- Ansari, M. A., Haider, S., & Masood, T. (2021). Do renewable energy and globalization enhance ecological footprint: An analysis of top renewable energy countries? *Environmental Science and Pollution Research*, 28(6), 6719–6732. <https://doi.org/10.1007/s11356-020-10786-0>
- Ansari, M. A., & Villanthenkodath, M. A. (2021). Does tourism development promote ecological footprint? A nonlinear ARDL approach. *Anatolia*, 33(4), 1–13. <https://doi.org/10.1080/13032917.2021.1985542>
- An, S., & Schorfheide, F. (2007). Bayesian analysis of DSGE Models. *Econometric Reviews*, 26(2–4), 113–172. <https://doi.org/10.1080/07474930701220071>
- Antweiler, W., Copeland, B. R., & Taylor, M. S. (2001). Is free trade good for the environment? *The American*

- Economic Review*, 91(4), 877–908. <https://doi.org/10.1257/aer.91.4.877>
- Ayad, H., Sari-Hassoun, S. E., Usman, M., & Ahmad, P. (2022). The impact of economic uncertainty, economic growth and energy consumption on environmental degradation in MENA countries: Fresh insights from multiple thresholds NARDL approach. *Environmental Science and Pollution Research*, 30(1), 1806–1824. <https://doi.org/10.1007/s11356-022-22256-w>
- Azam, M., Mahmudul Alam, M., & Haroon Hafeez, M. (2018). Effect of tourism on environmental pollution: Further evidence from Malaysia, Singapore and Thailand. *Journal of Cleaner Production*, 190, 330–338. <https://doi.org/10.1016/j.jclepro.2018.04.168>
- Azzimonti, M., Francisco, E. D., & Quadrini, V. (2014). Financial globalization, inequality, and the rising public debt. *The American Economic Review*, 104(8), 2267–2302. <https://doi.org/10.1257/aer.104.8.2267>
- Balsalobre-Lorente, D., Shahbaz, M., Roubaud, D., & Farhani, S. (2018). How economic growth, renewable electricity and natural resources contribute to CO2 emissions? *Energy Policy*, 113, 356–367. <https://doi.org/10.1016/j.enpol.2017.10.050>
- Baz, K., Xu, D., Ali, H., Ali, I., Khan, I., Khan, M. M., & Cheng, J. (2020). Asymmetric impact of energy consumption and economic growth on ecological footprint: Using asymmetric and nonlinear approach. *The Science of the Total Environment*, 718, 137364. <https://doi.org/10.1016/j.scitotenv.2020.137364>
- Block, J. H., Jaskiewicz, P., & Miller, D. (2011). Ownership versus management effects on performance in family and founder companies: A Bayesian reconciliation. *Journal of Family Business Strategy*, 2(4), 232–245. <https://doi.org/10.1016/j.jfbs.2011.10.001>
- Brida, J. G., Cortes-Jimenez, I., & Pulina, M. (2014). Has the tourism-led growth hypothesis been validated? A literature review. *Current Issues in Tourism*, 19(5), 394–430. <https://doi.org/10.1080/13683500.2013.868414>
- Chen, L., Cai, W., & Ma, M. (2020). Decoupling or delusion? Mapping carbon emission per capita based on the human development index in Southwest China. *The Science of the Total Environment*, 741, 741. <https://doi.org/10.1016/j.scitotenv.2020.138722>
- Chowdhury, M. A. F., Shanto, P. A., Ahmed, A., & Rumana, R. H. (2021). Does foreign direct investments impair the ecological footprint? New evidence from the panel quantile regression. *Environmental Science and Pollution Research*, 28(12), 14372–14385. <https://doi.org/10.1007/s11356-020-11518-0>
- Christmann, P., & Taylor, G. (2001). Globalization and the environment: Determinants of firm self-regulation in China. *Journal of International Business Studies*, 32(3), 439–458. <https://doi.org/10.1057/palgrave.jibs.8490976>
- Collins, A., & Cooper, C. (2016). Measuring and managing the environmental impact of festivals: The contribution of the ecological footprint. *Journal of Sustainable Tourism*, 25(1), 148–162. <https://doi.org/10.1080/09669582.2016.1189922>
- Comerio, N., & Strozzi, F. (2018). Tourism and its economic impact: A literature review using bibliometric tools. *Tourism Economics*, 25(1), 109–131. <https://doi.org/10.1177/1354816618793762>
- Consoli, D., Marin, G., Marzucchi, A., & Vona, F. (2016). Do green jobs differ from non-green jobs in terms of skills and human capital? *Research Policy*, 45(5), 1046–1060. <https://doi.org/10.1016/j.respol.2016.02.007>
- Cotterell, D., Hales, R., Arcodia, C., & Ferreira, J. -A. (2019). Overcommitted to tourism and under committed to sustainability: The urgency of teaching “strong sustainability” in tourism courses. *Journal of Sustainable Tourism*, 27(7), 882–902. <https://doi.org/10.1080/09669582.2018.1545777>
- Croes, R., Ridderstaat, J., Bqk, M., & Zientara, P. (2021). Tourism specialization, economic growth, human development and transition economies: The case of Poland. *Tourism Management*, 82, 104181. <https://doi.org/10.1016/j.tourman.2020.104181>
- Danish, Hassan, S. T., Baloch, M. A., Mahmood, N., & Zhang, J. (2019). Linking economic growth and ecological footprint through human capital and biocapacity. *Sustainable Cities and Society*, 47, 101516. <https://doi.org/10.1016/j.scs.2019.101516>
- Danish, & Wang, Z. (2019). Dynamic relationship between tourism, economic growth, and environmental quality. *Journal of Sustainable Tourism*, 26(11), 1928–1943. <https://doi.org/10.1080/09669582.2018.1526293>
- Danish, & Zhaohua, W. (2019). Investigation of the ecological footprint's driving factors: What we learn from the experience of emerging economies. *Sustainable Cities and Society*, 49(8), 101626. <https://doi.org/10.1016/j.scs.2019.101626>
- Destek, M. A. (2020). Investigation on the role of economic, social, and political globalization on environment: Evidence from CEECs. *Environmental Science and Pollution Research*, 27(27), 33601–33614. <https://doi.org/10.1007/s11356-019-04698-x>
- Destek, M. A., & Sinha, A. (2020). Renewable, non-renewable energy consumption, economic growth, trade openness and ecological footprint: Evidence from organisation for economic Co-operation and development countries. *Journal of Cleaner Production*, 242, 118537. <https://doi.org/10.1016/j.jclepro.2019.118537>
- Destek, M. A., Ulucak, R., & Dogan, E. (2018). Analyzing the environmental Kuznets curve for the EU countries: The role of ecological footprint. *Environmental Science and Pollution Research*, 25(29), 29387–29396. <https://doi.org/10.1007/s11356-018-2911-4>
- Dietz, T., Rosa, E. A., & York, R. (2007). Driving the human ecological footprint. *Frontiers in Ecology and the Environment*, 5(1), 13–18. [https://doi.org/10.1890/1540-9295\(2007\)5\[13:DTHEF\]2.0.CO;2](https://doi.org/10.1890/1540-9295(2007)5[13:DTHEF]2.0.CO;2)
- Dogan, E., Ulucak, R., Kocak, E., & Isik, C. (2020). The use of ecological footprint in estimating the environmental kuznets curve hypothesis for BRICST by considering cross-section dependence and heterogeneity. *The Science of the Total Environment*, 723, 138063. <https://doi.org/10.1016/j.scitotenv.2020.138063>
- Dong, D. (2020). The impact of financial openness on public debt in developing countries. *Empirical Economics*, 60(5), 2261–2291. <https://doi.org/10.1007/s00181-020-01839-x>
- Driscoll, J. C., & Kraay, A. C. (1998). Consistent covariance matrix estimation with spatially dependent panel data. *The Review of Economics and Statistics*, 80(4), 549–560. <https://doi.org/10.1162/003465398557825>
- Dumitrescu, E. -I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. *Economic Modelling*, 29(4), 1450–1460. <https://doi.org/10.1016/j.econmod.2012.02.014>
- Erdogan, S., & Okumus, I. (2021). Stochastic and club convergence of ecological footprint: An empirical analysis for different income group of countries. *Ecological Indicators*, 121, 121. <https://doi.org/10.1016/j.ecolind.2020.107123>

- Ghosh, S. (2010). Examining carbon emissions economic growth nexus for India: A multivariate cointegration approach. *Energy Policy*, 38(6), 3008–3014. <https://doi.org/10.1016/j.enpol.2010.01.040>
- Godil, D. I., Sharif, A., Rafique, S., & Jermisittiparsert, K. (2020). The asymmetric effect of tourism, financial development, and globalization on ecological footprint in Turkey. *Environmental Science and Pollution Research*, 27(32), 40109–40120. <https://doi.org/10.1007/s11356-020-09937-0>
- Gokmenoglu, K. K., & Eren, B. M. (2019). The role of international tourism on energy consumption: Empirical evidence from Turkey. *Current Issues in Tourism*, 23(9), 1059–1065. <https://doi.org/10.1080/13683500.2019.1574723>
- Hassan, S. T., Xia, E., Khan, N. H., & Shah, S. M. A. (2019). Economic growth, natural resources, and ecological footprints: Evidence from Pakistan. *Environmental Science and Pollution Research*, 26(3), 2929–2938. <https://doi.org/10.1007/s11356-018-3803-3>
- Hussen, A. (2005). Principles of environmental economics and sustainability: An integrated economic and ecological approach. In R. Bouvier (Ed.) *Air pollution and per capita income, working paper series 84*. Political Economy Research Institute (PERI). Routledge. <https://doi.org/10.4324/9781351109116>
- Ibrahim, R. L., & Ajide, K. B. (2021). Trade facilitation and environmental quality: Empirical evidence from some selected African countries. *Environment, Development and Sustainability*, 24(1), 1282–1312. <https://doi.org/10.1007/s10668-021-01497-8>
- Kalli, M., & Griffin, J. E. (2018). Bayesian nonparametric vector autoregressive models. *Journal of Econometrics*, 203(2), 267–282. <https://doi.org/10.1016/j.jeconom.2017.11.009>
- Kassouri, Y., & Altintas, H. (2020). Human well-being versus ecological footprint in MENA countries: A trade-off? *Journal of Environmental Management*, 263, 110405. <https://doi.org/10.1016/j.jenvman.2020.110405>
- Khan, I., & Hou, F. (2021). The dynamic links among energy consumption, tourism growth, and the ecological footprint: The role of environmental quality in 38 IEA countries. *Environmental Science and Pollution Research*, 28(5), 5049–5062. <https://doi.org/10.1007/s11356-020-10861-6>
- Khoi, N. H., Le, N. H., & Ngoc, B. H. (2021). The effect of tourism development on the ecological footprint in Singapore: Evidence from asymmetric ARDL method. *Current Issues in Tourism*, 25(15), 2500–2517. <https://doi.org/10.1080/13683500.2021.1971165>
- Kim, J. -Y. (2002). Limited information likelihood and Bayesian analysis. *Journal of Econometrics*, 107(1–2), 175–193. [https://doi.org/10.1016/s0304-4076\(01\)00119-1](https://doi.org/10.1016/s0304-4076(01)00119-1)
- Koçak, E., Ulucak, R., & Ulucak, Z. Ş. (2020). The impact of tourism developments on CO2 emissions: An advanced panel data estimation. *Tourism Management Perspectives*, 33, 100611. <https://doi.org/10.1016/j.tmp.2019.100611>
- Kongbuamai, N., Viet, B. Q., Ullah, Y. M. A., & Yun, L. (2020). The impact of tourism and natural resources on the ecological footprint: A case study of ASEAN countries. *Environmental Science and Pollution Research*, 27(16), 19251–19264. <https://doi.org/10.1007/s11356-020-08582-x>
- Lee, C. -C., & Chen, M. -P. (2021). Ecological footprint, tourism development, and country risk: International evidence. *Journal of Cleaner Production*, 279, 123671. <https://doi.org/10.1016/j.jclepro.2020.123671>
- Lemoine, N. P. (2019). Moving beyond noninformative priors: Why and how to choose weakly informative priors in Bayesian analyses. *Oikos*, 128(7), 912–928. <https://doi.org/10.1111/oik.05985>
- Liu, Y., Sadiq, F., Ali, W., & Kumail, T. (2022). Does tourism development, energy consumption, trade openness and economic growth matters for ecological footprint: Testing the environmental kuznets curve and pollution haven hypothesis for Pakistan. *Energy*, 245, 123208. <https://doi.org/10.1016/j.energy.2022.123208>
- Long, N. T., & Ngoc, B. H. (2022). Is financial development good for ecological footprint a Bayesian multilevel mixed-effects analysis in ASEAN countries. *International Journal of Environment and Sustainable Development*, 1(1), 1. <https://doi.org/10.1504/ijesd.2022.10047562>
- Mikayilov, J. I., Mukhtarov, S., Mammadov, J., & Azizov, M. (2019). Re-evaluating the environmental impacts of tourism: Does EKC exist? *Environmental Science and Pollution Research*, 26(19), 19389–19402. <https://doi.org/10.1007/s11356-019-05269-w>
- Moran, D., Wackernagel, M., Kitzes, J., Goldfinger, S., & Boutaud, A. (2008). Measuring sustainable development — Nation by nation. *Ecological Economics*, 64(3), 470–474. <https://doi.org/10.1016/j.ecolecon.2007.08.017>
- Muhammad, U., Kousar, R., & Makhdam, M. S. A. (2020). The role of financial development, tourism, and energy utilization in environmental deficit: Evidence from 20 highest emitting economies. *Environmental Science and Pollution Research*, 27(34), 42980–42995. <https://doi.org/10.1007/s11356-020-10197-1>
- Nathaniel, S. P. (2021). Natural resources, urbanisation, economic growth and the ecological footprint in South Africa: The moderating role of human capital. *Quaestiones Geographicae*, 40(2), 63–76. <https://doi.org/10.2478/quageo-2021-0012>
- Nathaniel, S. P., & Adedoyin, F. F. (2020). Tourism development, natural resource abundance, and environmental sustainability: Another look at the ten most visited destinations. *Journal of Public Affairs*, 22(3). <https://doi.org/10.1002/pa.2553>
- Nathaniel, S., & Khan, S. A. R. (2020). The nexus between urbanization, renewable energy, trade, and ecological footprint in ASEAN countries. *Journal of Cleaner Production*, 272, 122709. <https://doi.org/10.1016/j.jclepro.2020.122709>
- Nathaniel, S. P., Nwulu, N., & Bekun, F. (2020). Natural resource, globalization, urbanization, human capital, and environmental degradation in Latin American and Caribbean countries. *Environmental Science and Pollution Research*, 28(5), 6207–6221. <https://doi.org/10.1007/s11356-020-10850-9>
- Ngoc, B. H. (2022). Do tourism development and globalization reinforce ecological footprint? evidence from RCEP countries. *SAGE Open*, 12(4), 215824402211433. <https://doi.org/10.1177/21582440221143310>
- Ngoc, B. H., & Awan, A. (2021). Does financial development reinforce ecological footprint in Singapore? Evidence from ARDL and Bayesian analysis. *Environmental Science and Pollution Research*, 29(16), 24219–24233. <https://doi.org/10.1007/s11356-021-17565-5>
- Ngoc, B. H., & Hai, L. M. (2022a). Time-frequency nexus between tourism development, economic growth, energy consumption, and ecological footprint in Singapore. *Journal of Reviews on Global Economics*, 11(1), 22–32. <https://doi.org/10.6000/1929-7092.2022.11.03>

- Ngoc, B. H., & Hai, L. M. (2022b). Time-frequency nexus between tourism development, economic growth, human capital, and income inequality in Singapore. *Applied Economics Letters*, 1–6. <https://doi.org/10.1080/13504851.2022.2130865>
- Nguyen, C. P., Schinckus, C., Su, T. D., & Chong, F. H. L. (2020). The influence of tourism on income inequality. *Journal of Travel Research*, 60(7), 1426–1444. <https://doi.org/10.1177/0047287520954538>
- Ozturk, I., Al-Mulali, U., & Saboori, B. (2016). Investigating the environmental Kuznets curve hypothesis: The role of tourism and ecological footprint. *Environmental Science and Pollution Research*, 23(2), 1916–1928. <https://doi.org/10.1007/s11356-015-5447-x>
- Porter, M. E., & Van der Linde, C. (1995). Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives*, 9(4), 97–118. <https://doi.org/10.1257/jep.9.4.97>
- Qureshi, M. I., Elashkar, E. E., Shoukry, A. M., Aamir, A., Mahmood, N. H. N., Rasli, A. M., & Zaman, K. (2019). Measuring the ecological footprint of inbound and outbound tourists: Evidence from a panel of 35 countries. *Clean Technologies and Environmental Policy*, 21(10), 1949–1967. <https://doi.org/10.1007/s10098-019-01720-1>
- Sabir, S., & Gorus, M. S. (2019). The impact of globalization on ecological footprint: Empirical evidence from the South Asian countries. *Environmental Science and Pollution Research*, 26(32), 33387–33398. <https://doi.org/10.1007/s11356-019-06458-3>
- Salahuddin, M., Gow, J., Ali, M. I., Hossain, M. R., Al-Azami, K. S., Akbar, D., & Gedikli, A. (2019). Urbanization-globalization-CO2 emissions nexus revisited: Empirical evidence from South Africa. *Heliyon*, 5(6), e01974. <https://doi.org/10.1016/j.heliyon.2019.e01974>
- Saud, S., Chen, S., Haseeb, A., & Sumayya. (2020). The role of financial development and globalization in the environment: Accounting ecological footprint indicators for selected one-belt-one-road initiative countries. *Journal of Cleaner Production*, 250, 119518. <https://doi.org/10.1016/j.jclepro.2019.119518>
- Shahbaz, M., Shahzad, S. J. H., & Mahalik, M. K. (2017). Is globalization detrimental to CO2 emissions in Japan? New threshold analysis. *Environmental Modeling & Assessment*, 23(5), 557–568. <https://doi.org/10.1007/s10666-017-9584-0>
- Sharma, R., Sinha, A., & Kautish, P. (2020). Examining the impacts of economic and demographic aspects on the ecological footprint in South and Southeast Asian countries. *Environmental Science and Pollution Research*, 27(29), 36970–36982. <https://doi.org/10.1007/s11356-020-09659-3>
- Sharma, R., Sinha, A., & Kautish, P. (2021). Does renewable energy consumption reduce ecological footprint? Evidence from eight developing countries of Asia. *Journal of Cleaner Production*, 285, 124867. <https://doi.org/10.1016/j.jclepro.2020.124867>
- Sharpley, R. (2020). Tourism, sustainable development and the theoretical divide: 20 years on. *Journal of Sustainable Tourism*, 28(11), 1932–1946. <https://doi.org/10.1080/09669582.2020.1779732>
- Strachan, R. W., & Inder, B. (2004). Bayesian analysis of the error correction model. *Journal of Econometrics*, 123(2), 307–325. <https://doi.org/10.1016/j.jeconom.2003.12.004>
- Thach, N. N. (2020). How to explain when the es is lower than one? A Bayesian Nonlinear mixed-effects approach. *Journal of Risk and Financial Management*, 13(2), 21–38. <https://doi.org/10.3390/jrfm13020021>
- Thach, N. N., & Ngoc, B. H. (2021). Impact of economic freedom on corruption revisited in ASEAN Countries: A Bayesian Hierarchical mixed-effects analysis. *Economies*, 9(1), 3. <https://doi.org/10.3390/economies9010003>
- Thanh, P. N., Phuong, N. D., & Ngoc, B. H. (2019). Economic Integration and environmental pollution Nexus in Asean: A PMG approach. *Beyond Traditional Probabilistic Methods in Economics*, 427–439. https://doi.org/10.1007/978-3-030-04200-4_31
- Türe, C., & Türe, Y. (2020). A model for the sustainability assessment based on the human development index in districts of Megacity Istanbul (Turkey). *Environment, Development and Sustainability*, 23(3), 3623–3637. <https://doi.org/10.1007/s10668-020-00735-9>
- Udemba, E. N. (2020). A sustainable study of economic growth and development amidst ecological footprint: New insight from Nigerian perspective. *The Science of the Total Environment*, 732, 732. <https://doi.org/10.1016/j.scitotenv.2020.139270>
- Ulucak, R., Danish, & Li, N. (2020). The nexus between economic globalization and human development in Asian countries: An empirical investigation. *Environmental Science and Pollution Research*, 27(3), 2622–2629. <https://doi.org/10.1007/s11356-019-07224-1>
- Usman, M., Kousar, R., Yaseen, M. R., & Makhdam, M. S. A. (2020). An empirical nexus between economic growth, energy utilization, trade policy, and ecological footprint: A continent-wise comparison in upper-middle-income countries. *Environmental Science and Pollution Research*, 27(31), 38995–39018. <https://doi.org/10.1007/s11356-020-09772-3>
- Villanthenkodath, M. A., Ansari, M. A., Shahbaz, M., & Vo, X. V. (2021). Do tourism development and structural change promote environmental quality? Evidence from India. *Environment, Development and Sustainability*, 24(4), 5163–5194. <https://doi.org/10.1007/s10668-021-01654-z>
- Villanthenkodath, M. A., Mahalik, M. K., & Arafath, K. M. I. Y. (2022). The role of tourism development in India's environmental degradation: Evidence from ARDL and wavelet coherence approaches. *Management of Environmental Quality: An International Journal*, 33(6), 1421–1438. <https://doi.org/10.1108/meq-10-2021-0248>
- Zafar, M. W., Zaidi, S. A. H., Khan, N. R., Mirza, F. M., Hou, F., & Kirmani, S. A. A. (2019). The impact of natural resources, human capital, and foreign direct investment on the ecological footprint: The case of the United States. *Resources Policy*, 63, 101428. <https://doi.org/10.1016/j.resourpol.2019.101428>
- Zaidi, S. A. H., Zafar, M. W., Shahbaz, M., & Hou, F. (2019). Dynamic linkages between globalization, financial development and carbon emissions: Evidence from Asia Pacific Economic Cooperation countries. *Journal of Cleaner Production*, 228, 533–543. <https://doi.org/10.1016/j.jclepro.2019.04.210>
- Zondervan Zwijnenburg, M., Depaoli, S., Peeters, M., & van de Schoot, R. (2019). Pushing the Limits: The performance of maximum likelihood and Bayesian estimation with small and unbalanced samples in a latent growth model. *Methodology*, 15(1), 31–43. <https://doi.org/10.1027/1614-2241/a000162>