Environmental Science and Pollution Research (2020) 27:27721–27737
https://doi.org/10.1007/s11356-020-09057-9

RESEARCH ARTICLE

Examining the asymmetric effects of globalization and tourism on pollution emissions in South Asia

Muhammad Zubair Chishti[1] · Sana Ullah[1] · Ilhan Ozturk[2] · Ahmed Usman[3]

Received: 22 January 2020 / Accepted: 27 April 2020 / Published online: 12 May 2020

Abstract
The asymmetrical impacts of globalization and tourism on pollution emissions of 5 South Asian countries for the period from 1980 to 2018 are examined through a non-linear autoregressive distributed lag (NARDL) technique, which shows that both short and long-run coefficients are asymmetric. The findings suggest that positive and negative shocks in globalization affect carbon emissions differently in the case of Bangladesh, India, and Pakistan, while similar results are found in the case of Nepal and Sri Lanka in the long run. Furthermore, positive tourism shock, in the long run, ameliorates the environmental quality by reducing carbon emissions in Nepal and Sri Lanka, however, increases the carbon emissions in Bangladesh, India, and Pakistan. While negative tourism shock has an adverse effect on positive shock on carbon emissions in South Asia. The phenomena of globalization and tourism can exert a severe impact in aggravating the pollution emissions that policymakers should forecast and oppose. Based on these findings, some policy suggestions are proposed for South Asian economies.

Keywords Globalization · Tourism · Carbon emissions · Non-linear ARDL · South Asia

Introduction

At present, the notable variations have been observed by the scientists in the climate system of the globe. The global surface temperature, according to the report of "State osf Climate", was 0.38–0.48° C (0.68–0.86° F) above the 1981-2010 average (Blunden and Arndt 2019). Since the pre-industrial period, the global temperature, on average, has risen by 1.1° C as compared with 2011–2015, and the highest average temperatures are recorded during the last 10 years, i.e., 2010–2019 (World Meteorological Organization 2019). Furthermore, the report highlights that, as a prime contributor to global warming, the level of global carbon dioxide has practically quadrupled after the 1960s. Besides, the Intergovernmental Panel on Climate Change (IPCC 2018) underlines that the world climate is enduring significant changes such as the rising lengths of seasons and the level of seas, the declining amount of ice and snow, and fluctuations in global precipitation patterns. This exigency demonstrates pernicious effects on lifestyle, politics, and social, geopolitical, and economic development (Bilgili et al. 2016). Additionally, millions of people have experienced water shortages, hunger, floods, and disease on account of climate change and global warming (Atzori et al. 2018). Currently, the instantaneous CO_2 emissions induced by the inhabitants of this planet during the last 60–70 years, as the majority of the scientists and the researchers have consensus, is the predominant reason for the climate change and global warming (Anderson et al. 2016; Mossler et al. 2017; Koçak et al. 2020).

Nowadays, climate change and global warming are some of the crucial topics that are being widely covered by researchers, scientists, and policy-makers. Also, to explore the determinants of carbon dioxide has become a leading area of

Responsible Editor: Eyup Dogan

✉ Ahmed Usman
voice.of.usman.au@gmail.com

Muhammad Zubair Chishti
chishtimz9@gmail.com

Sana Ullah
sana_ullah133@yahoo.com

Ilhan Ozturk
ilhanozturk@cag.edu.tr

1 School of Economics, Quaid-i-Azam University, Islamabad, Pakistan

2 Faculty of Economics and Administrative Sciences, Cag University, 33800 Mersin, Turkey

3 Department of Economics, Government College University Faisalabad, Faisalabad, Pakistan

interest for the research scholars. The pertinent literature gathers that there are several factors, including but not limited to, financial development, FDI, trade, energy consumption, population, urbanization, and economic growth which exhibit a significant impact on CO_2 emissions (Li and Lin 2015; Cetin et al. 2018; Dong et al. 2018; Nasrollahi et al. 2018; Park et al. 2018).

The tourism sector stimulates economic development by creating jobs, generating income, improving lifestyle and societies, offsetting trade imports through enhancing export function, and transforming the economy as a whole (UNWTO 2017; Sinha et al. 2017; Balsalobre-Lorente et al. 2018). Also, the inflow of international tourists leads to an increase the per capita income and enhancement of the power and transportation sectors through rising socio-economic goods and services (Akadiri et al. 2018; Chon et al. 2013). Therefore, it is theoretically accurate that tourism, along with thriving economic activities, has a close relationship with environmental quality through increasing the quantity of CO_2 emissions via accruing the energy consumption level. The relevant literature reports equivocal findings regarding the link between tourism and the environment. Perhaps, Bach and Gößling (1996) are the first who endeavor to divulge the nexus between tourism and the environment and argue that tourism significantly contributes to environmental degradation by increasing CO_2 emissions. The same findings are also suggested by Goudie and Viles (2013). Besides, the water is used excessively, and natural resources become scanty, and the amount of the waste is increased at natural sites that may lead to the erosion of soil, the surge in the land, water, and air pollution, and eventually may devastate the natural beauty of the globe on account of increasing outflow of tourists (Chan et al. 2018; Latif et al. 2018). Due to the use of electricity, housing facilities, and transports, tourism causes to increase the ratio of CO_2 emissions (Nepal et al. 2019).

In contrast, some researchers advocate that the tourism industry generates favorable effects on the environment by providing indispensable services and promoting innovation and energy efficiency for the country's development. Hence, tourism is deemed as an instrument of climate protection (Gössling and Hall 2006; Imran et al. 2014; Naradda Gamage et al. 2017; Dogan and Aslan 2017; Paramati et al. 2018; Akadiri et al. 2018). Furthermore, the tourism sector may create a more positive impact on the environmental quality if the authorities of the global economies adopt eco-friendly strategies (Ahmad et al. 2019).

Globalization is also an essential driver of the CO_2 emissions that has a significant association with the climate change since it affects the economic growth through enhancing international trade, foreign direct investment, transfer of technology, and tourism (Akadiri et al. 2018) that requires an enormous use of energy which results in higher the level of CO_2 emissions (Shahbaz et al. 2018; Figge et al. 2017). Many researchers argue that globalization has a direct relationship with CO_2 emissions by degrading environmental quality. For instance, Figge et al. (2017), Kwabena Twerefou et al. (2017), Shahbaz et al. (2018), and Salahuddin et al. (2019) confirm that the global environment endures deterioration in quality on account of the increasing trend in globalization since globalization induces the global economies to attain economic growth swiftly through enhancing foreign trade and FDI. It leads to increase industrialization in which traditional methods are employed for energy consumption; consequently, the quality of the environment declines (Navarro 1998; Sharma 2011; Lau et al. 2014; Acquaye et al. 2017; Ullah et al. 2020).

However, the findings of many studies disclose that climate quality improves as more globalization occurs among world countries, as Turner and Witt (2001) find that the detrimental effects of CO_2 emissions reductions on account of the higher level of globalization that also boosts the access of tourism. Another research evidence by Cavlovic et al. (2000) infers that globalization can control the emission of carbon dioxide by driving knowledge and innovation that brings economic efficiency; consequently, the globalization moderates the quality of the environment.

Since the world has become a global village, so globalization is playing a pivotal role in improving the economic growth and tourism sector. Furthermore, both indicators, i.e., globalization and tourism, possess the notable effects of environmental quality; thereby, it motivates to study whether both variables predict the environmental quality or not. Although there exists an association between globalization, tourism, and the environment, the ample body of literature focuses on investigating the impact of globalization and tourism on CO_2 emissions separately. Less attention is given to the connection of these factors together so far. Therefore, we choose the South Asian region that has a remarkable contribution to the world economic market and also has the most beautiful and breathtaking places which attract the world's tourists, as Fig. 1 depicts some most visited places.

The contribution of our study to the existing literature is fourfold: First, all the previous studies explore the effects of globalization and tourism on CO_2 emissions separately, while the current study considers both drivers in a single model. Second, the majority of the studies employ panel data to examine the dynamic effects that may suffer from the exigency of aggregation bias (Meo et al. 2018). To account for this aggregation bias, our study does the multi-country analysis at the disaggregated (country) level. Third, to the best of our knowledge, this is the first study for the region of South Asian economies that analyzes the dynamic association between globalization, tourism, and CO_2 emissions. Lastly, all the relevant studies deploy the symmetric modeling for seeking the nexus among the interested variables; however, the asymmetric modeling has more power to unveil more detailed and reliable findings (Katrakilidis and Trachanas 2012; Li et al.

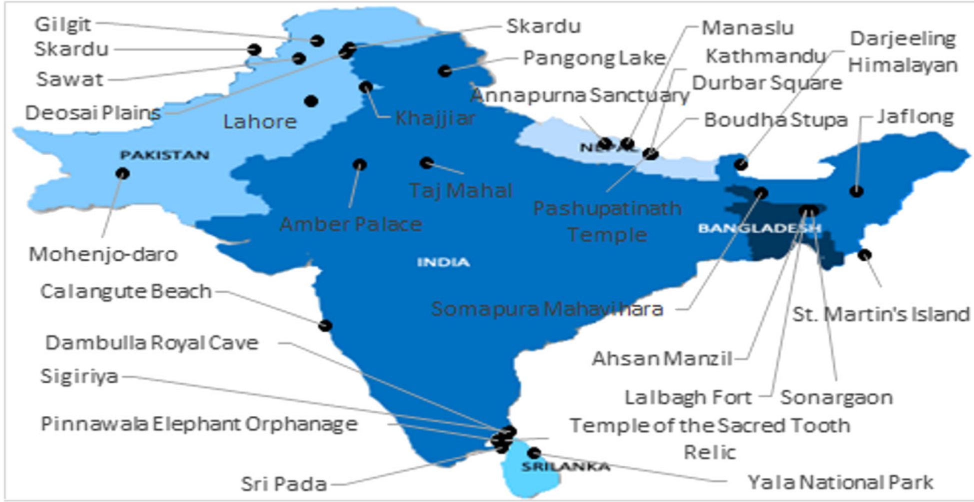


Fig. 1 Frequently visited places in South Asian economies

2019; Marques et al. 2019). Moreover, in the real world scenario, the asymmetric effects of variables seem more practical, as the behavior of people cannot be predicted with certainty. Therefore, the asymmetric approach of modeling is a more plausible choice in comparison with symmetric one. So, this is the first study that contributes to the literature by inspecting the asymmetric effects of globalization and tourism on CO_2 emissions for the South Asian region economies.

The rest of the study is organized as follows. The "Literature review" section gives a complete literature review on globalization, tourism, and CO_2 emissions. The "Model and methodology" section shows the methodology, variables definition, and data descriptive statistics. The "Results and discussion" section gives the symmetric and asymmetric ARDL results of the short and long run with economic implications. The "Conclusion and policy implication" section concludes the paper with some implications.

Literature review

Since the world has become a global village, the role of globalization in upgrading the tourism sector and GDP growth is pivotal. Furthermore, along with enhancing economic growth, globalization and tourism create considerable effects on environmental quality through increasing the level of energy consumption, via boosting the activities of power and transportation sectors, etc. (Roudi et al. 2019; Akadiri et al. 2018). Therefore, it is crucial to consider the effects of globalization and tourism on CO_2 emissions.

Globalization and environmental pollution

A plethora of literature is available that explores the dynamic association between globalization and CO_2. These studies can be classified into two bunches, panel and time-series data studies. As for the studies which deploy the panel data, Lv and Xu (2018) take the panel of 15 emerging economies from 1970 to 2012 and apply advanced econometric panel approaches. They deduce that globalization ameliorates the deleterious repercussions of carbon dioxide emissions. Likewise, You and Lv (2018) verify the spatial correlation in carbon dioxide among selected 83 economies and the outcome reports that globalization is environmentally friendly since the ratio of CO_2 emissions shrinks on account of the upward trend of globalization in the selected panel. Another study by Lim et al. (2015) for 89 selected countries also confirms that the globalization plays a notable role in enhancing the atmosphere quality.

However, Shahbaz et al. (2018) investigate the nexus between CO_2 and globalization for 25 advanced economies and argue that environmental pollution accrues as the countries become more globalized. Similarly, Salahuddin et al. (2019) use the data of 44 SSA economies and confirm that globalization is one of those factors which escalate the level of CO_2 emissions. Also, Kwabena Twerefou et al. (2017) apply the GMM technique and infer that globalization shows a significant impact on environmental degradation. Le et al. (2016) inspects the CO_2-globalization nexus for selected 98 economies and employ trade openness as a proxy for globalization. The findings suggest that the environmental quality worsens as the economies adopt the trade-openness policy. Furthermore, Li et al. (2015) take the panel of 134 economies and conclude that globalization declines the climate quality while deploying the air visibility for environmental quality measurement.

Besides, many researchers suggest the globalization is a mixed blessing for the global environment due to having mixed effects on CO_2 emissions. The findings of Figge et al. (2017), employing the mega set of 171 economies, unveil that social globalization has a negative association with environmental deterioration while its ratio increases due to economic globalization. Another study by Doytch and Uctum (2016) deploys FDI as a proxy for globalization and indicates that the sectorial FDI exhibits positive as well as the negative impact on CO_2 emissions. Additionally, Dreher (2006) use different environmental proxies and explore that the harmful effects of water pollution and sulfur dioxide reduce on account of globalization; however, it has no significant impact on round wood production and CO_2. Many other researchers (See; Frankel and Romer 1999; Antweiler et al. 2001; Baek et al. 2009; Managi and Kumar 2009; Boulatoff and Jenkins 2010; Shahbaz et al. 2012; Shahbaz and Leit 2013) take the sample of different economies and also affirm that globalization exhibits mixed impact on CO_2. Intriguingly, the results of Martens and Raza (2010) reveal that globalization possesses an insignificant association with the environment when they utilize the different environmental sustainability indexes for 150 economies.

As far as the time-series studies are concerned, Shahbaz et al. (2018) disclose that globalization, energy consumption, and economic growth are the cause to degrade the environment by increasing the CO_2 emissions in Japan. Likewise, Shahbaz et al. (2015) check the effects of globalization for India and support that globalization enlarges the pernicious impact of carbon dioxide in both periods. Besides, some researchers report the mixed impact of globalization on the global environment. Shahbaz et al. (2016) take the data of 19 African economies and deduce that globalization demonstrates the mixed effects on CO_2. Applying the ARDL approach for the period of 1971–2014, Ahmed et al. (2019) also find that globalization has no association with the ecological footprint, while it aggravates the environment of the Malaysian economy by surging carbon footprint. However, Xu et al. (2018) assess the impact of globalization on Saudi Arabia, and the findings indicate that CO_2 emissions have no significant link with globalization. Since the findings of all relevant studies are mixed, therefore, it is transparent that the effects of globalization on the global environment are inconclusive.

Tourism and environmental pollution

Again, a large number of studies are available that analyze the effects of the tourism sector on CO_2 emissions. Also, these studies can be categorized into two groups, panel data, and time-series studies. Whereas the panel data studies are concerned, Koçak et al. 2020) explore the CO_2-tourism nexus for top 10 visited economies and gather that the tourism industry produces favorable effects on the quality of the environment. Paramati et al. (2018), Dogan and Aslan (2017), and Lee and Brahmasrene (2013) take different data samples for EU economies to divulge the dynamic association between CO_2 and tourism. All these studies reach a consensus that tourism developments have a significant decreasing effect on carbon dioxide emissions. Also, Akadiri et al. (2018) report the same findings for 16 small developing economies, deploying panel Granger causality testing technique.

On the other hand, Paramati et al. (2017a, b), Zaman et al. (2017), and León et al. (2014) argue that the upward trend of tourism in selected developed and developing economies is environmentally unfriendly. Likewise, the results by Shakouri et al. (2017) indicate that Southeast Asian economies endure climate degradation on account of the increasing ratio of foreign tourists. Moreover, Dogan and Aslan (2017) and Zaman et al. (2017) also suggest that the improvement in the tourism sector has an increasing association with CO_2 emissions in OECD and transition economies, respectively. Interestingly, Paramati et al. (2017a, b) employ the sample of Western and Eastern European economies from 1995 to 2013 and conclude that tourism development has increasing and decreasing effects on CO_2 emissions in Eastern Europe and Western Europe, respectively.

Considering the studies that use the time-series data, Nepal et al. (2019) scrutinize the nexus between CO_2 and tourism industry employing the data for 1975–2014. The findings unveil that the climate gets worse due to CO_2 emissions as more tourists visit Nepal. Taking the monthly data of the USA for 1996–2015, Raza et al. (2017) also research the effects of tourism on CO_2 by using the Wavelet transforms method. They confirm that tourist arrivals are the significant cause of increasing carbon dioxide. Similarly, For Greece, Işik et al. (2017) deploy the ARDL technique and conclude that financial development, trade, and tourism affect the environment adversely.

Likewise, Sharif et al. (2017), employing the data for the period of 1972–2013, report that CO_2 emissions surge on account of the upward trend of tourist arrivals in Pakistan. Also, De Vita et al. (2015) inspect the dynamic association between CO_2 and tourism industry in Turkey. The results reveal that the environmental quality degrades as CO_2 emissions rise due to tourist arrivals. Besides, Katircioglu (2014) apply the ARDL approach to inquire about the relationship between CO_2 and the tourism sector. The outcome discloses that the ratio of carbon dioxide accrues as more foreigners visit Cyprus. Another study by Solarin (2014) also uses the ARDL technique and confirms that the Malaysian tourism sector significantly deteriorates the quality of climate.

On the contrary, Naradda Gamage et al. (2017) examine the impact of tourism on carbon dioxide, taking the sample for the period of 1974–2013. Applying the DOLS method, they argue that the tourism industry plays a notable role in enhancing the environment quality by decreasing CO_2. Besides, some researchers find mixed findings such as Azam et al. (2018) use the sample of three economies and deduce in Malaysia, CO_2 emissions demonstrate a direct association with tourism. However, the environment of Singapore and Thailand gets better as more people visit these economies. Similarly, Sghaier et al. (2019) infer that the detrimental effects of CO_2 emissions decline and increase in Egypt and Tunisia, respectively, due to tourist arrivals, while the study suggests no significant nexus between CO_2 and tourism in Morocco.

The aforementioned literature regarding tourism-CO_2 nexus reveals the inconclusive results. Furthermore, most of the studies employ panel data that may be suspected of aggregation bias (Saeed Meo et al. 2018; Nosheen et al. 2019); thus, the country-level analysis may bring more productive results. Also, less attention is given to the South Asian economies, and the ample body of the pertinent literature deploys symmetric modeling; however, asymmetric modeling has more power to explore more detailed and reliable findings (Bildirici and Turkmen 2015; Saeed Meo et al. 2018). Therefore, considering the potential asymmetric effects of globalization and tourism in the South Asian economies, the current study contributes to the existing literature by exploring the asymmetric impacts of tourism and globalization on CO_2 emissions for South Asian region countries at the disaggregated level (Table 1).

↓, ↑, and × indicate the negative, positive, and no impact of the focused variable on CO_2, respectively

Model and methodology

In this study, we first want to see the impact of globalization and international tourism on CO_2 emission by using a linear approach. To this end, following the literature, we have constructed model 1 as given below:

$$CO_{2,t} = \beta_0 + \beta_1 \text{Glob}_t + \beta_2 \text{Tour}_t + \beta_3 \text{GDP}_t + \varepsilon_t \quad (1)$$

According to Eq. 1, annual CO_2 emission in Pakistan depends upon the globalization (Glob_t) and international tourism (Tour_t), GDP per capita (GDP_t), and error term (ε_t). However, Eq. 1 is a long-run model and it only gives us long-run estimates irrespective of methodology. To get short-run estimates, we redesign Eq. 1 into a format of error correction as specified in Eq. 2.

$$\begin{aligned}\Delta CO_{2,t} = {} & \beta_0 + \sum_{k=1}^{p} \theta_k \Delta CO_{2,t-k} + \sum_{k=0}^{P} \pi_k \Delta \text{Glob}_{t-k} \\ & + \sum_{k=0}^{P} \delta_k \Delta \text{Tour}_{t-k} + \sum_{k=0}^{P} \lambda_k \text{GDP}_{t-k} \\ & + \alpha_1 CO_{2,t-1} + \alpha_2 \text{Glob}_{t-1} + \alpha_3 \text{Tour}_{t-1} \\ & + \alpha_4 \text{GDP}_{t-1} + \varepsilon_t \quad (2)\end{aligned}$$

Equation 2 is commonly known as the ARDL model presented by Pesaran et al. (2001). The coefficients attached to Δ signs give us short-run results. On the other hand, the coefficients α_2–α_4, normalized on α_1, give us long-run findings. This method is quite beneficial in the sense that it gives both short-run and long-run estimates in a single equation. Moreover, we do not need to worry about whether our concerned variables are of $I(0)$, $I(1)$, or mixture of both, as this method can take care of the integrating properties of variables.

Next, in this study, our foremost objective is to find the asymmetric impact of Glob_t and Tour_t on CO_2 in Pakistan. For this purpose, Shin et al. (2014) suggested the breaking down of relevant variables into its positive and negative parts. Hence, following the same procedure, in this study, we have broken down our related variables into positive (Glob^+, Tour^+) and negative (Glob^-, Tour^-) sections.

$$\text{Glob}^+_t = \sum_{n=1}^{t} \Delta \text{Glob}^+_t = \sum_{n=1}^{t} \max\left(\Delta \text{Glob}^+_t, 0\right) \quad (3a)$$

$$\text{Glob}^-_t = \sum_{n=1}^{t} \Delta \text{Glob}^-_t = \sum_{n=1}^{t} \min\left(\Delta \text{Glob}^-_t, 0\right) \quad (4a)$$

$$\text{Tour}^+_t = \sum_{n=1}^{t} \Delta \text{Tour}^+_t = \sum_{n=1}^{t} \max\left(\Delta \text{Tour}^+_t, 0\right) \quad (3b)$$

$$\text{Tour}^-_t = \sum_{n=1}^{t} \Delta \text{Tour}^-_t = \sum_{n=1}^{t} \min\left(\Delta \text{Tour}^-_t, 0\right) \quad (4b)$$

After breaking down the variables, we will then put these positive and negative shocks into Eq. 2 in place of our standard variables, and this equation takes the form of non-linear ARDL model as depicted below in Eq. 5.

$$\begin{aligned}\Delta CO_{2,t} = {} & \beta_0 + \sum_{k=1}^{P} \theta_k \Delta CO_{2,t-k} + \sum_{k=0}^{P} \psi_k \Delta \text{Glob}^+_{t-k} \\ & + \sum_{k=0}^{P} \pi_k \Delta \text{Glob}^-_{t-k} + \sum_{k=0}^{P} \delta_k \Delta \text{Tour}^+_{t-k} \\ & + \sum_{k=0}^{P} \eta_k \Delta \text{Tour}^-_{t-k} + \sum_{k=0}^{P} \lambda_k \text{GDP}_{t-k} \\ & + \alpha_1 CO_{2,t-1} + \alpha_2 \text{Glob}^+_{t-1} + \alpha_3 \text{Glob}^-_{t-1} \\ & + \alpha_4 \text{Tour}^+_{t-1} + \alpha_5 \text{Tour}^-_{t-1} + \alpha_6 \text{GDP}_{t-1} \\ & + \varepsilon_t \quad (5)\end{aligned}$$

Equation 5 is commonly known as non-linear ARDL model of Shin et al. (2014). It works in the same way as the linear ARDL model. The NARDL has several advantages over the traditional cointegration techniques, including the following: first, it can produce efficient findings even for the small sample size. Second, it does not require the stationary test for modeled variables. Last, it estimates effective coefficients even if the proposed variables are integrated at $I(0)$, $I(1)$, or $I(0)$ and $I(1)$. Once we get the estimates from Eq. 5, we need to perform an additional test, i.e., the Wald test to check the validity of asymmetry in the effects of variables, in the short and long run. In the short run, the Wald test confirms the presence of combined asymmetry in the effects of short-run estimates if $\Sigma_k \neq \Sigma\pi_k$ and $\delta_k \neq \eta_k$. Similarly, the long-run asymmetries are approved by the Wald test if ${}^{\alpha_2^+}/_{\alpha_1} \neq {}^{\alpha_3^-}/_{\alpha_1}$, ${}^{\alpha_4^+}/_{\alpha_1} \neq {}^{\alpha_5^-}/_{\alpha_1}$.

Table 1 Summary of literature

Author(s)	Country/region	Time span	Technique	Outcome
Part A: Globalization and CO_2 emissions				
Lv and Xu (2018)	15 emerging economies	1970–2012	FE & RE	↑
You and Lv (2018)	83 selected economies	1985–2013	Panel ECM	↑
Lim et al. (2015)	89 selected economies	1980–2005	Panel ARDL	↑
Shahbaz et al. (2018)	25 advanced economies	1970–2014	Threshold ARDL	↓
Salahuddin et al. (2019)	44 SSA economies	1984–2016	Panel Granger causality	↓
Kwabena Twerefou et al. (2017)	36 SSA economies	1990–2013	GMM technique	↓
Le et al. (2016)	98 economies	1990–2010	Panel ARDL	↓
Figge et al. (2017)	171 economies		FMOLS	Mixed
Doytch and Uctum (2016)	191 economies	1984–2011	GMM technique	Mixed
Dreher et al. (2006)	123 economies	1970–2000	Panel Granger causality	Mixed
Managi and Kumar (2009)	76 economies	1963–2000	Panel ARDL	Mixed
Martens and Raza (2010)	117 economies	1970–2005	OLS	×
Shahbaz et al. (2018)	Japan	1970–2014	VECM	↓
Shahbaz et al. (2015)	India	1970–2012	ARDL	↓
Ahmed et al. (2019)	Malaysia	1971–2014	ARDL	Mixed
Xu et al. (2018)	Saudi Arabia		ARDL	×
Shahbaz et al. (2012)	Pakistan	1971–2009	ARDL	Mixed
Shahbaz et al. (2013)	Portugal	1970–2009	OLS	Mixed
Part B: Tourism and CO_2 emissions				
Paramati et al. (2018)	EU economies	1990–2013	Panel ARDL	↑
Dogan and Aslan (2017)	EU economies	1995–2011	FMOLS, DOLS	↑
Lee and Brahmasrene (2013)	EU economies	1988–2009	FE	↑
Akadiri et al. (2018)	16 small developing economies	1995–2014	3SLS	↑
Paramati et al. (2017a, b)	26 developed and developed economies	1995–2012	FMOLS	↓
Zaman et al. (2017)	11 selected economies	1995–2013	FE	↓
León et al. (2014)	Selected developing economies	1998–2006	STIRPAT approach	↓
Nepal et al. (2019)	Nepal	1975–2014	ARDL	↓
Raza et al. (2017)	USA	1996–2015	Wavelet transforms method	↓
Işik et al. (2017)	Greece	1970–2014	ARDL	↓
Sharif et al. (2017)	Pakistan	1972–2013	ARDL	↓
De Vita et al. (2015)	Turkey	1960–2009	ARDL	↓
Naradda Gamage et al. (2017)	Sri Lanka	1974–2013	DOLS	↑
Azam et al. (2018)	Malaysia, Thailand, and Singapore	1990–2014	FMOLS	↑
Sghaier et al. (2019)	Tunisia, Egypt, and Morocco	1980–2104	ARDL	↑

Data

Data employed for this analysis cover the period 1980–2018 for five selected South Asian countries, i.e., Bangladesh, India, Nepal, Pakistan, and Sri Lanka. This group of South Asian countries was selected for one reason because these regions have well-experienced rapid globalization and tourism industry with significant emissions of carbon. The data were obtained from three sources: the World Bank and KOF. The detailed variable descriptions are described in Table 2. The data has one dependent (CO_2), two independent variables (Glob and Tour), and one control variable (GDP). The detailed descriptive statistics are given in Table 3. The statistics indicate that India is generating the highest carbon emissions with the highest value of 1.101 metric tons per capita, while Sri Lanka is generating the lowest mean value of 0.215 metric tons per capita every year, which shows that India is at the top for carbon emitters in South Asian countries. Moreover, 55.91 is the highest, and 40.55 is the lowest mean value of the globalization of Sri Lanka and Nepal, respectively. There is a significant fluctuation observed in international tourism receipts, which is from 111.471 (lowest value) in Bangladesh

Table 2 Variables description and source

Variables	Symbol	Definition	Data source
Carbon dioxide emissions	CO_2	Carbon dioxide emissions (Metric tons per capita)	World Bank
Overall Globalization	Glob	Overall KOF Index of Globalization (includes economic, social, and political globalization)	KOF Index
International tourism	Tour	International tourism, receipts(receipts include any payment made for goods or services received in the destination country)	World Bank
GDP per capita	GDP	GDP per capita (constant 2010 US $)	World Bank

and 11,759.04 (highest value) in India. The mean values of GDP per capita vary from 470.911 (Nepal) to 1984.517 (Sri Lanka).

Results and discussion

For traditional unit root tests, ADF and PP tests were executed to decide the stationarity property of the series in Table 4. ADF and PP tests have the null hypothesis of non-stationary and the alternative hypothesis of stationary, while all variables are accepted the null at the level. This implies that all the variables are stationary at the first difference $I(1)$. Thus, the ARDL methodology is assumed in this study.

Regarding cointegration, the outcomes specified in Table 5 show that the F-statistics is lying between the lower bound and upper bound values in the symmetric ARDL model in Bangladesh, India, Nepal, Pakistan, and Sri Lanka. This implies that there is no cointegration existing in the linear ARDL model while the null hypothesis of no cointegration has been rejected for asymmetric ARDL in all South Asian countries, suggesting the cointegration exists only in non-linear ARDL model.

The asymmetric ARDL findings of South Asian countries are reported in Table 6. In results, short-run globalization results show that positive change has a significant positive impact on pollution in Nepal and Pakistan, while negative impact in India. It indicates that 1% increase in globalization would increase environmental pollution to 0.316% and 0.711% in Nepal and Pakistan; however, environmental pollution 0.810% would fall in India in the short run. While negative shock has adverse positive results in India and Sri Lanka, negative shocks have a significant negative impact on carbon emissions in Pakistan. Similarly, the results also indicate that 1% fall in globalization would increase environmental pollution to 0.091% and 0.443% in India and Sri Lanka, while environmental pollution would fall by 0.020% in Pakistan in the short run. The past values of positive and negative shocks of globalization on carbon emissions have significance in sign and magnitude. In how many South Asian countries' short-term impacts convert into significant and meaningful long-run effects? Therefore, the long-run results of panel B provide the answer and as we observed that positive shocks of globalization maintained the results for India and Nepal. While positive shocks of globalization effects are lost in Bangladesh, Pakistan, and Sri Lanka, the negative shock of globalization effects is also maintained in Bangladesh, India, and Sri Lanka.

The long-run coefficients of $Glob^+$ are − 0.417, − 0.600, and − 0.087 in Bangladesh, India, and Pakistan, respectively. These results show that positive shocks have an adverse influence on carbon emissions. For instance, 1% increases in $Glob^+$ shrunk carbon emission by 0.417% in Bangladesh, 0.600% in India, and 0.087% in Pakistan. A similar result is found in OECD and developed countries (Tamazian et al. 2009; Balsalobre-Lorente et al. 2019) noted that positive shock in globalization is more environment friendly, possibly because globalization is considered as a tool for improving technical

Table 3 Descriptive statistics

	CO_2	Glob	Tour	GDP
Bangladesh				
Mean	0.370	44.540	111.471	598.150
Std. dev.	0.112	6.689	102.902	236.699
India				
Mean	1.101	54.498	11,759.04	945.734
Std. dev.	0.097	8.123	8975.230	478.750
Nepal				
Mean	0.215	40.559	346.417	470.911
Std. dev.	0.119	6.395	190.350	149.235
Pakistan				
Mean	0.817	50.830	793.833	848.874
Std. dev.	0.086	4.378	194.579	167.025
Sri Lanka				
Mean	0.260	55.912	1567.917	1984.517
Std. dev.	0.047	5.460	1659.039	948.580

Table 4 Unit root tests

	ADF test $I(0)$	$I(1)$	Decision	PP test $I(0)$	$I(1)$	Decision
Bangladesh						
CO_2	0.3299	− 4.9046***	$I(1)$	0.3299	− 3.6872**	$I(1)$
Glob	− 0.3861	− 3.8043**	$I(1)$	0.2669	− 3.8377**	$I(1)$
Tour	− 0.5297	− 3.8210**	$I(1)$	0.866	− 3.8170**	$I(1)$
GDP	0.2455	− 2.7702*	$I(1)$	0.2911	− 0.2759*	$I(1)$
India						
CO_2	0.854	− 3.9701***	$I(1)$	1.001	− 3.9701***	$I(1)$
Glob	− 1.7133	− 4.2200***	$I(1)$	− 1.6392	− 4.2200***	$I(1)$
Tour	0.0613	− 3.3670***	$I(1)$	0.0527	− 3.2685**	$I(1)$
GDP	0.431	− 4.2088***	$I(1)$	0.9744	− 4.3397***	$I(1)$
Nepal						
CO_2	− 1.6276	− 4.9456***	$I(1)$	− 1.7572	− 4.9456***	$I(1)$
Glob	0.3355	− 4.2629***	$I(1)$	0.2457	− 4.2579***	$I(1)$
Tour	− 0.9563	− 4.2878***	$I(1)$	− 0.7231	− 4.6691***	$I(1)$
GDP	0.2699	− 4.0222***	$I(1)$	0.7115	− 4.2099***	$I(1)$
Pakistan						
CO_2	0.0066	− 4.9696***	$I(1)$	0.2411	− 4.9700***	$I(1)$
Glob	− 2.0987	− 3.1553**	$I(1)$	− 2.0342	− 3.1390**	$I(1)$
Tour	− 0.6623	− 3.5002**	$I(1)$	− 0.7167	− 3.5002**	$I(1)$
GDP	0.1582	− 4.6024***	$I(1)$	− 0.052	− 4.5371***	$I(1)$
Sri Lanka						
CO_2	0.2175	− 5.5495***	$I(1)$	− 0.0366	− 10.938***	$I(1)$
Glob	− 1.286	− 3.0608*	$I(1)$	− 1.3435	− 3.0429**	$I(1)$
Tour	1.2808	− 4.0959***	$I(1)$	1.4761	− 4.0959***	$I(1)$
GDP	1.2819	− 3.5043**	$I(1)$	1.3352	− 3.5043**	$I(1)$

***, **, and * denote significance levels at 1%, 5%, and 10%, respectively

Table 5 Asymmetric cointegration

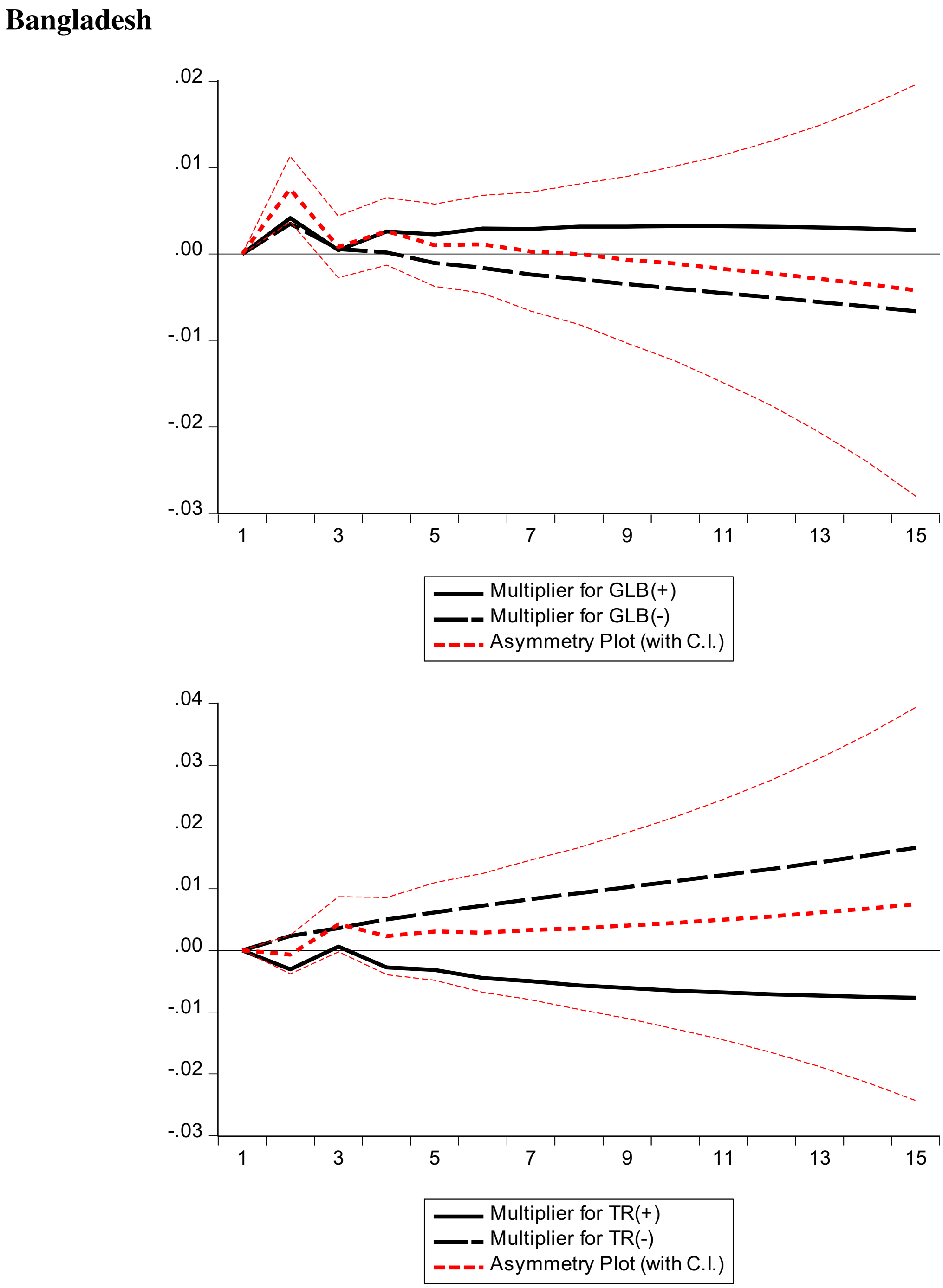
	F-statistic	Lower bound 95%	Upper bound 95%	Decision
Bangladesh				
Symmetric ARDL	3.79	3.77	5.10	Inconclusive
Asymmetric ARDL	13.77	3.19	4.49	Cointegration
India				
Symmetric ARDL	3.93	3.22	4.77	Inconclusive
Asymmetric ARDL	9.21	2.96	4.39	Cointegration
Nepal				
Symmetric ARDL	2.99	2.97	4.57	Inconclusive
Asymmetric ARDL	11.72	2.69	4.38	Cointegration
Pakistan				
Symmetric ARDL	3.44	2.81	5.01	Inconclusive
Asymmetric ARDL	16.39	2.08	3.94	Cointegration
Sri Lanka				
Symmetric ARDL	4.01	3.21	5.35	Inconclusive
Asymmetric ARDL	12.07	2.33	4.72	Cointegration

Table 6 Short and long-run estimates

	Bangladesh	India	Nepal	Pakistan	Sri Lanka
Panel A: Short-run estimates					
$\Delta Glob_t^+$	0.173	− 0.810**	0.316***	0.711**	− 0.706
	(0.149)	(0.343)	(0.107)	(0.331)	(0.501)
$\Delta Glob_{t-1}^+$	− 0.218**				− 0.011***
	(0.091)				(0.002)
$\Delta Glob_t^-$	0.212	0.091***	0.007	− 0.020***	0.443***
	(0.912)	(0.034)	(0.104)	(0.003)	(0.061)
$\Delta Glob_{t-1}^-$		0.218***			
		(0.074)			
$\Delta Tour_t^+$	− 0.470***	− 0.233	0.291***	− 0.437***	0.189*
	(0.101)	(0.661)	(0.102)	(0.092)	(0.101)
$\Delta Tour_{t-1}^+$	− 0.591***	− 0.417***	0.108*		0.011***
	(0.082)	(0.095)	(0.061)		(0.002)
$\Delta Tour_t^-$	0.013*	1.118	− 0.005***	0.173	0.221
	(0.007)	(0.791)	(0.001)	(0.812)	(0.511)
$\Delta Tour_{t-1}^-$		0.413*		0.501***	
		(0.211)		(0.103)	
ΔGDP_t	− 0.610***	0.973**	0.712***	0.330**	− 0.587***
	(0.071)	(0.411)	(0.119)	(0.145)	(0.082)
ECM_{t-1}	− 0.430***	− 0.331***	− 0.570***	− 0.491***	− 0.711***
	(0.107)	(0.093)	(0.164)	(0.105)	(0.113)
Panel B: Long-run estimates					
$Glob^+$	− 0.417***	− 0.600***	0.718*	− 0.087***	0.714***
	(0.081)	(0.091)	(0.325)	(0.009)	(0.088)
$Glob^-$	0.200*	0.208**	0.487***	0.031	0.005*
	(0.104)	(0.101)	(0.124)	(0.183)	(0.003)
$Tour^+$	− 0.609***	− 0.549***	0.504***	− 0.174**	0.643***
	(0.118)	(0.167)	(0.081)	(0.075)	(0.121)
$Tour^-$	0.009	0.077*	− 0.103***	0.901***	− 0.344**
	(0.008)	(0.044)	(0.022)	(0.321)	(0.172)
GDP	0.336***	0.410***	0.330*	0.503***	− 0.400***
	(0.041)	(0.071)	(0.181)	(0.091)	(0.071)
Panel C: Diagnostic tests					
Adj. R^2	0.96	0.93	0.97	0.98	0.94
LM	0.412	0.522	0.619	0.387	0.323
Jarque-Bera Test	0.342	0.411	0.453	0.501	0.333
BPG Test	0.592	0.639	0.592	0.493	0.444
RESET Test	0.432	0.428	0.613	0.529	0.477
CUSUM	Stable	Stable	Stable	Stable	Stable
CUSUMQ	Stable	Stable	Stable	Stable	Stable
WALD SR-Glob	2.571**	0.999***	3.221**	4.317*	0.441
WALD LR-Glob	1.812***	2.901*	0.491	3.001*	2.050**
WALD SR-Tour	4.088*	0.033	1.800**	5.111*	3.666*
WALD LR-Tour	2.003**	5.773*	3.999*	2.996**	4.228*

***, **, and * denote significance levels at 1%, 5%, and 10%, respectively. The critical values for LM, RESET, and Wald tests are significant at 5% (10%) level is 3.84 (2.71) and three statistics are distributed as χ^2 with one degree of freedom

Fig. 2 Dynamic multiplier graphs of South Asian countries



progress. It implies that globalization enables developing economies to achieve energy-saving advanced technology from developed nations with low amount of CO_2 discharges.

While long-run coefficients of $Glob^+$ in Nepal and Sri Lanka are 0.718 and 0.714, it signifies that a positive shock of globalization has a positive effect on carbon emissions. The results suggest that 1% increase in globalization escalated carbon emission by 0.718 % in Nepal and 0.714% in Sri Lanka. These results are consistent with the findings of Koengkan et al. (2019) for Latin America and the Caribbean economies, who noted that positive shocks of globalization have a negative influence on environmental quality. Moreover, Sabir and Gorus (2019) have similar results found in Bangladesh, India, Nepal, Pakistan, and Sri Lanka, which noted that globalization slows down environmental quality globally as well in South Asia. The positive shock of globalization has a positive influence on carbon emissions. It suggests that globalization leads to higher pressure on the

India

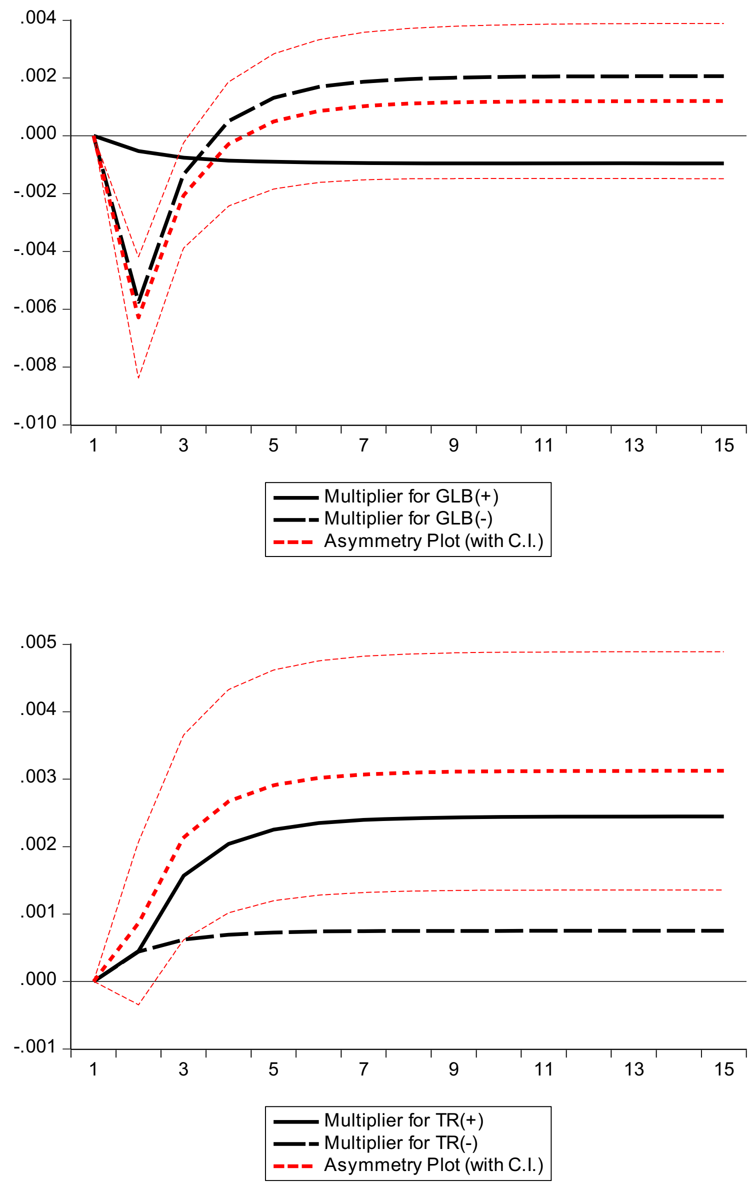


Fig. 2 continued.

environment. The examined results indicated that globalization leads to the formation of pollution-intensive industries in developing countries due to weaker environmental law enforcement (Copeland and Taylor 2004). The examined results also suggested that globalization depletes and destroys the natural resources that cause environmental quality.

The negative shock of $Glob^{-}$ has a positive influence on carbon emissions in Bangladesh, India, Nepal, and Sri Lanka, except Pakistan. The negative shocks estimated of Bangladesh, India, Nepal, and Sri Lanka are 0.200, 0.208, 0.487, and 0.005, respectively. Therefore, 1% decrease in globalization raised carbon emission by about 0.200%, 0.208%, 0.487%, and 0.005% in Bangladesh, India, Nepal, and Sri Lanka, respectively. However, this result is reserved by the globalization theory and is also reliable with Koengkan et al. (2019) for Latin America and the Caribbean economies.

In the short run, positive shock ($\Delta Tour_t^{+}$) has mixed results on carbon emission in South Asian countries, indicating that 1% increase in tourism would lead to an increase in pollution of 0.291% in Nepal and 0.189% in Sri Lanka while falling environmental pollution 0.470% in Bangladesh and 0.437 in Pakistan. The tourism negative shock ($\Delta Tour_t^{-}$) also shows that environmental pollution increases by 0.013% in Bangladesh while the adverse result is found in Nepal and fall in 0.005% in Nepal. From all South Asian non-linear model in panel B, we see that positive globalization effects are

Nepal

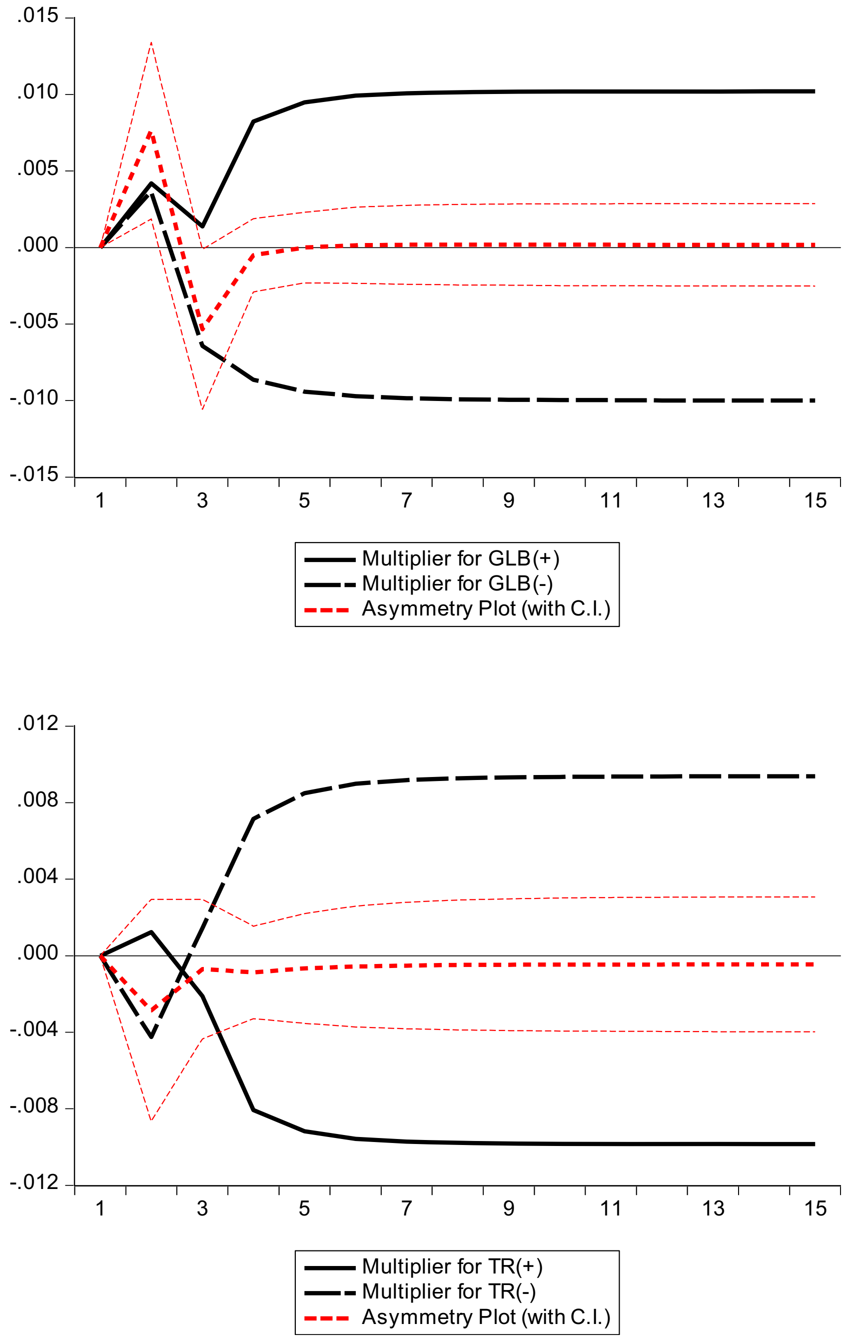


Fig. 2 continued.

maintained, while the impact of negative globalization shock does not exist in Nepal.

Therefore, long-run outcomes show that increased tourism has a significant negative effect on carbon emission in Bangladesh, India, and Pakistan. Therefore, 1% increases in tourism reduced CO_2 by about 0.609%, 0.549%, and 0.174% in Bangladesh, India, and Pakistan. Our results on tourism gain support from Lee and Brahmasrene (2013), Zhang et al. (2016), and Paramati et al. (2017a, b), who noted that tourism has a positive impact on the environment quality. The possible reason for this finding is that tourism is a sub-sector of the service sector, and it is cleaner than the agricultural and industrial sectors because the tourism is comparatively less energy consuming than other sectors (Begum et al. 2015; Bilgili et al. 2017). The findings advise that carbon emissions start to decrease as an economy moves from the agricultural and industrial sectors to the service sector. As the economy then improvements from an industrial to services, carbon emissions

Pakistan

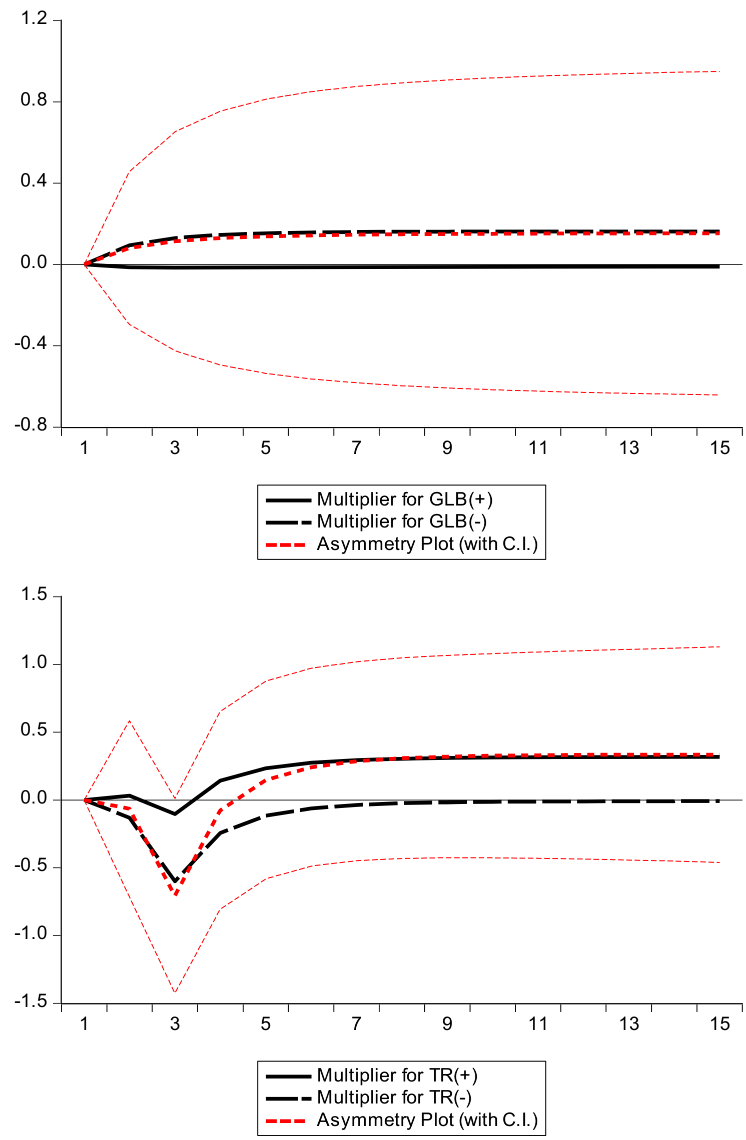


Fig. 2 continued.

begin to decline. Adverse results are found in Nepal and Sri Lanka. The possible reason of negative shock is that tourism increases the arrivals and departures of tourists and drives more public transport services (Dogan and Aslan 2017; Sharif et al. 2017). It implies that transportation is the leading factor in CO_2 emissions. One of another justification is tourists demand a variety of infrastructure services such as restaurants, accommodation, hotels, roads, airports, ports, railways, and telecommunications. It concludes that infrastructure contributes significantly to increase carbon emissions (Lee and Brahmasrene 2013).

Furthermore, long-run estimates show that the effect of negative changes in tourism on CO_2 is significantly positive in Bangladesh, India, and Pakistan, while significantly negative in Nepal. The results suggest that 1% fall in tourism raised CO_2 by about 0.009%, 0.077%, and 0.901% in Bangladesh, India, and Pakistan, respectively, but reduced CO_2 in Nepal by about 0.091%. The outcomes suggest that globalization enables the tourism industry that has direct, indirect, as well as complementary negative effects on carbon emissions. The result implies that tourist demands clean, green natural beauty, and that raises the environmental quality. A possible reason for Nepal's results is that the tourist activities produce various kinds of waste, including water waste, littering, damage to the natural sites, and depletion of natural resources, therefore resulting to negative shock causing risk in environmental quality, especially in the LDCs (Michailidou et al. 2016). Similarly, long-run results further show that GDP significantly contributed to an increase in carbon emissions in Bangladesh, India, Nepal, and Pakistan, while GDP is reducing carbon

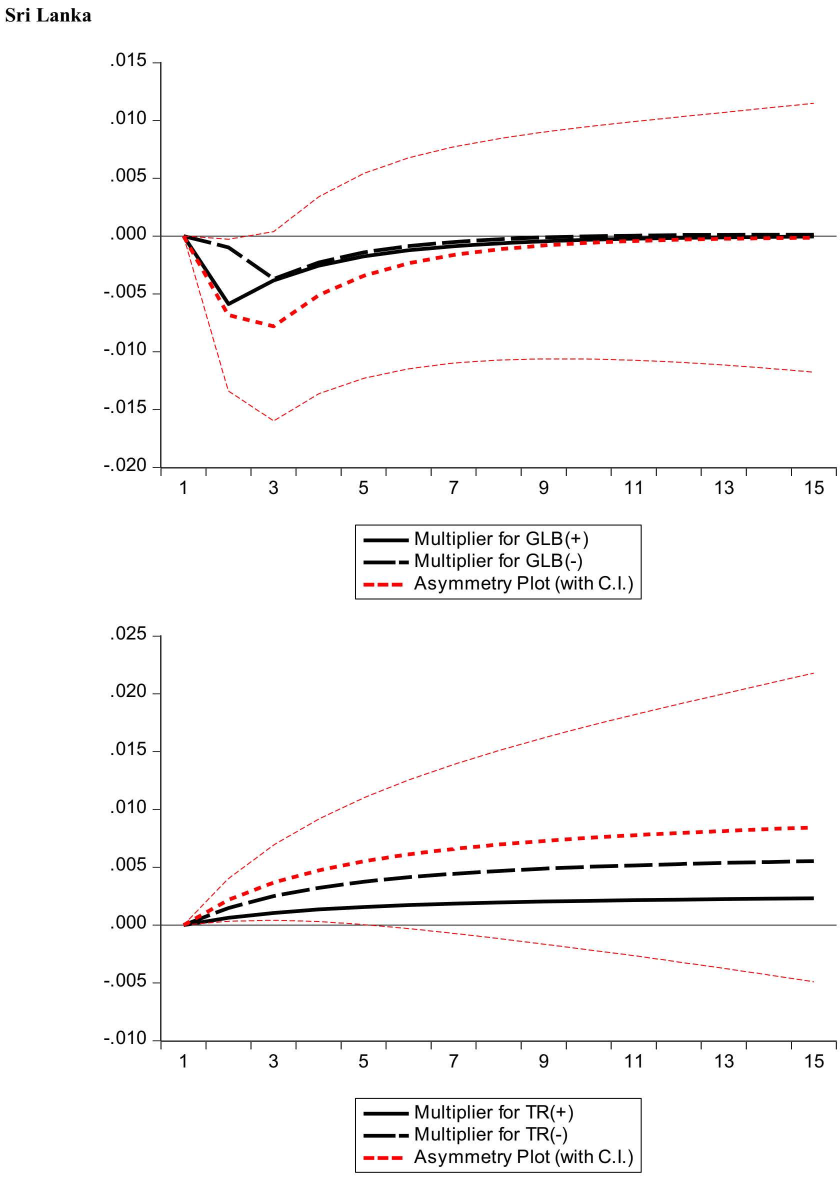


Fig. 2 continued.

emissions in Sri Lanka. Almost all GDPs have similar results on carbon emissions in the short run, except Bangladesh.

The error correction term (ECT) is negatively significant with coefficients equal to − 0.430, − 0.331, − 0.570, − 0.491, and − 0.711 for the Bangladesh, India, Nepal, Pakistan, and Sri Lanka. These values entail that the speed of adjustment towards the long-run equilibrium is about 43% over each year for Bangladesh, 33% for India, 57% for Nepal, 49% for Pakistan, and 71% for Sri Lanka. However, diagnostic numbers endorse that the asymmetric models are usable and reliable. For instance, the Jacque-Bera (JB), LM, Breusch-Godfrey (BG), RESET test statistics indicate normality of the residuals, free of autocorrelation and heteroscedasticity problems, and correct functional form in NARDL model. Also, CUSUM and CUSUM square tests endorse the stability of NARDL-estimated models. In the Wald test, globalization and tourism variables hold short and long-run asymmetric assumptions in South Asian countries except for two measures. The dynamic multiplier graphs, based on the aforementioned NARDL model, are illustrated in Fig. 2. The asymmetry curves show the non-linear mixture of the dynamic multipliers due to positive and negative shocks of globalization and tourism.

Conclusion and policy implication

The complexities of the asymmetrical effects of globalization and tourism on environment quality were studied for five South Asian countries, from 1980 to 2018 by using the non-linear ARDL approach. The results indicate that globalization components have an asymmetric impact on carbon emissions.

The positive shock of globalization exerts a positive impact on CO_2 emissions in Nepal, Sri Lanka, and Pakistan while the adverse effect is found in Bangladesh, India, and Pakistan in the long run. The phenomena of the negative shock of globalization could exert a positive effect on carbon emissions in Bangladesh, India, and Sri Lanka, while an insignificant adverse result is found in Pakistan. Nevertheless, while the asymmetric effects were statistically significant in South Asia, they were different in magnitude and direction. Besides, a 1% increase in globalization decreased carbon emission by 0.417% in Bangladesh, 0.600% in India, and 0.087% in Pakistan while it increased 0.718% in Nepal and 0.714% in Sri Lanka.

These results of asymmetry suggest that positive and negative fluctuations in tourism affect carbon emissions differently. Indeed, positive fluctuations in tourism are positive signs on pollution in the case of Nepal and Sri Lanka while negatively significant in Bangladesh, India, and Pakistan in the long run with anticipated economic signs. Besides, a 1% increase in tourism can be decreased 0.609% in Bangladesh, 0.211% in India, and 0.174% in Pakistan while it increased carbon emissions by 0.504% in Nepal and 0.643% in Sri Lanka. Negative0 fluctuations in tourism are statistically significant, with a positive sign in the long term in Bangladesh, India, and Pakistan while adverse on carbon emissions in Nepal. The short-run asymmetric results of globalization and tourism also have significance.

Based on the short run, our finding recommends that governments integrate the rule and regulation of environmental pollution with globalization policies in Nepal and Pakistan. Similarly, Nepal and Sri Lanka governments make tourism polices in short run that reduce the pollution that may be possible if governments ban private transports and start only green transport in tourist places. Therefore, the green transport approach is a solution for environmental authorities. A tight environmental policy could be helpful to decline environmental hazards in Nepal, Pakistan, and Sri Lanka in the short run.

Based on the long run, our finding suggested that the government should encourage foreign investors to invest in green and clean energy projects in Nepal and Sri Lanka to protect environmental quality through innovation and international collaborations. Policymakers also consider "globalization" as a key instrument in their environmental policy context to improve the quality of environmental health in Bangladesh, Nepal, and Sri Lanka in the long run. Countries like Bangladesh, Nepal, and Sri Lanka should take incentives from developed countries in the transportation and construction sector. Nepal and Sri Lanka governments should redesign the transportation and infrastructure policy in the long term. Also, transport and construction rules which are well defined in tourism regions may be adopted to upgrade the environmental quality. Developed and South Asian countries have significant differences in terms of social, economic, institutional, infrastructure, human capital, technological, and environmental awareness (Chan et al. 2018). Therefore, the tourism sector should plan and develop low-carbon tourism products in South Asia and other developing regions based on developed countries. Furthermore, clean energy is the best option to reduce pollution in tourism regions. India and Pakistan could improve the tourism sector by lowering the environmental pollution. The South Asian region could attract clean and green technology from the developed countries. This study left a potential conclusion from different quantiles that is an avenue for future research. One direction of future research work is environmental pollution asymmetries, which can be investigated with macroeconomic indicators in South Asia.

References

Acquaye A, Feng K, Oppon E, Salhi S, Ibn-Mohammed T, Genovese A, Hubacek K (2017) Measuring the environmental sustainability performance of global supply chains: a multi-regional input-output analysis for carbon, sulphur oxide and water footprints. J Environ Manag 187:571–585

Ahmad F, Draz MU, Su L, Rauf A (2019) Taking the bad with the good: the nexus between tourism and environmental degradation in the lower middle-income Southeast Asian economies. J Clean Prod 233:1240–1249

Ahmed Z, Wang Z, Mahmood F, Hafeez M, Ali N (2019) Does globalization increase the ecological footprint? Empirical evidence from Malaysia. Environ Sci Pollut Res 1-18

Akadiri SS, Lasisi TT, Uzuner G, Akadiri AC (2018) Examining the causal impacts of tourism, globalization, economic growth and carbon emissions in tourism island territories: bootstrap panel Granger causality analysis. Curr Issues Tourism 1-15

Anderson TR, Hawkins E, Jones PD (2016) CO2, the greenhouse effect and global warming: from the pioneering work of Arrhenius and Callendar to today's Earth System Models. Endeavour 40(3):178–187

Antweiler W, Copeland BR, Taylor MS (2001) Is free trade good for the environment? Am Econ Rev 91(4):877–908

Atzori R, Fyall A, Miller G (2018) Tourist responses to climate change: potential impacts and adaptation in Florida's coastal destinations. Tour Manag 69:12–22

Azam M, Alam MM, Hafeez MH (2018) Effect of tourism on environmental pollution: further evidence from Malaysia, Singapore and Thailand. J Clean Prod 190:330–338

Bach D, Gößling N (1996) Klimaökologische Auswirkungen des Flugverkehrs. Geogr Rundsch 48:54–59

Baek J, Cho Y, Koo WW (2009) The environmental consequences of globalization: a country-specific time-series analysis. Ecol Econ 68(8-9):2255–2264

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

Balsalobre-Lorente D, Driha OM, Bekun FV, Osundina OA (2019) Do agricultural activities induce carbon emissions? The BRICS experience. Environ Sci Pollut Res 26(24):25218–25234

Begum RA, Sohag K, Abdullah SMS, Jaafar M (2015) CO2 emissions, energy consumption, economic and population growth in Malaysia. Renew Sust Energ Rev 41:594–601

Bildirici ME, Turkmen C (2015) Nonlinear causality between oil and precious metals. Res Policy 46:202–211

Bilgili F, Koçak E, Bulut Ü, Kuşkaya S (2017) Can biomass energy be an efficient policy tool for sustainable development? Renew Sust Energ Rev 71:830–845

Bilgili F, Öztürk İ, Koçak E, Bulut Ü, Pamuk Y, Muğaloğlu E, Bağlıtaş HH (2016) The influence of biomass energy consumption on CO 2 emissions: a wavelet coherence approach. Environ Sci Pollut Res 23(19):19043–19061

Blunden J, Arndt DS (2019) State of the Climate in 2018. Bull Am Meteorol Soc 100(9):Si–S306

Boulatoff C, Jenkins M (2010) Long-term nexus between openness, income, and environmental quality. Int Adv Econ Res 16(4):410–418

Cavlovic TA, Baker KH, Berrens RP, Gawande K (2000) A meta-analysis of environmental Kuznets curve studies. Agr Resour Econ 29(1): 32–42

Cetin M, Ecevit E, Yucel AG (2018) The impact of economic growth, energy consumption, trade openness, and financial development on carbon emissions: empirical evidence from Turkey. Environ Sci Pollut Res 25(36):36589–36603

Chan APC, Darko A, Olanipekun AO, Ameyaw EE (2018) Critical barriers to green building technologies adoption in developing countries: the case of Ghana. J Clean Prod 172:1067–1079

Chon, K. S. (2013). Tourism in Southeast Asia: A new direction. Routledge, New York

Copeland BR, Taylor MS (2004) Trade, growth, and the environment. J Econ Lit 42(1):7–71

De Vita G, Katircioglu S, Altinay L, Fethi S, Mercan M (2015) Revisiting the environmental Kuznets curve hypothesis in a tourism development context. Environ Sci Pollut Res 22(21):16652–16663

Dogan E, Aslan A (2017) Exploring the relationship among CO2 emissions, real GDP, energy consumption and tourism in the EU and candidate countries: evidence from panel models robust to heterogeneity and cross-sectional dependence. Renew Sust Energ Rev 77: 239–245

Dong K, Sun R, Dong X (2018) CO2 emissions, natural gas and renewables, economic growth: assessing the evidence from China. Sci Total Environ 640:293–302

Doytch N, Uctum M (2016) Globalization and the environmental impact of sectoral FDI. Econ Syst 40(4):582–594

Dreher A (2006) Does globalization affect growth? Evidence from a new index of globalization. Appl Econ 38(10):1091–1110

Figge L, Oebels K, Offermans A (2017) The effects of globalization on ecological footprints: an empirical analysis. Environ Dev Sustain 19(3):863–876

Frankel JA, Romer DH (1999) Does trade cause growth? Am Econ Rev 89(3):379–399

Gössling S, Hall C M (2006) An introduction to tourism and global environmental change. In Tourism and global environmental change (pp. 15-48). Routledge.

Goudie AS, Viles HA (2013) The earth transformed: an introduction to human impacts on the environment. John Wiley & Sons

Imran S, Alam K, Beaumont N (2014) Environmental orientations and environmental behaviour: perceptions of protected area tourism stakeholders. Tour Manag 40:290–299

IPCC (2018) Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. Retrieved from https://www.ipcc.ch/sr15/

Işik C, Kasımatı E, Ongan S (2017) Analyzing the causalities between economic growth, financial development, international trade, tourism expenditure and/on the CO2 emissions in Greece. Energy Sources B: Econ Plann Policy 12(7):665–673

Katircioglu ST (2014) International tourism, energy consumption, and environmental pollution: the case of Turkey. Renew Sust Energ Rev 36:180–187

Katrakilidis C, Trachanas E (2012) What drives housing price dynamics in Greece: new evidence from asymmetric ARDL cointegration. Econ Model 29(4):1064–1069

Koçak E, Ulucak R, Ulucak ZŞ (2020) The impact of tourism developments on CO2 emissions: an advanced panel data estimation. Tour Manag Perspect 33:100611–100701

Koengkan M, Poveda YE, Fuinhas JA (2019) Globalisation as a motor of renewable energy development in Latin America countries. GeoJournal:1–12

Kwabena Twerefou D, Danso-Mensah K, Bokpin GA (2017) The environmental effects of economic growth and globalization in Sub-Saharan Africa: a panel general method of moments approach. Res Int Bus Financ 42(C):939–949

Latif MT, Othman M, Idris N, Juneng L, Abdullah AM, Hamzah WP et al (2018) Impact of regional haze towards air quality in Malaysia: a review. Atmos Environ 177:28–44

Lau LS, Choong CK, Eng YK (2014) Investigation of the environmental Kuznets curve for carbon emissions in Malaysia: do foreign direct investment and trade matter? Energy Policy 68:490–497

Le TH, Chang Y, Park D (2016) Trade openness and environmental quality: international evidence. Energy Policy 92:45–55

Lee JW, Brahmasrene T (2013) Investigating the influence of tourism on economic growth and carbon emissions: evidence from panel analysis of the European Union. Tour Manag 38:69–76

León CJ, Arana JE, Hernández Alemán A (2014) CO2 Emissions and tourism in developed and less developed countries. Appl Econ Lett 21(16):1169–1173

Li K, Lin B (2015) Impacts of urbanization and industrialization on energy consumption/CO2 emissions: does the level of development matter? Renew Sust Energ Rev 52:1107–1122

Li Z, Xu N, Yuan J (2015) New evidence on trade-environment linkage via air visibility. Econ Lett 128:72–74

Li XL, Li X, Si DK (2019) Asymmetric determinants of corporate bond credit spreads in China: evidence from a nonlinear ARDL model. N Am J Econ Financ 7:101109

Lim S, Menaldo V, Prakash A (2015) Foreign aid, economic globalization, and pollution. Policy Sci 48(2):181–205

Lv Z, Xu T (2018) Is economic globalization good or bad for the environmental quality? New evidence from dynamic heterogeneous panel models. Technol Forecast Soc Change 137:340–343

Managi S, Kumar S (2009) Trade-induced technological change: analyzing economic and environmental outcomes. Econ Model 26(3):721–732

Marques AC, Fuinhas JA, Tomás C (2019) Energy efficiency and sustainable growth in industrial sectors in European Union countries: a nonlinear ARDL approach. J Clean Prod 239:118045

Martens P, Raza M (2010) Is globalisation sustainable? Sustainability 2(1):280–293

Meo MS, Chowdhury MAF, Shaikh GM, Ali M, Masood Sheikh S (2018) Asymmetric impact of oil prices, exchange rate, and inflation on tourism demand in Pakistan: new evidence from nonlinear ARDL. Asia Pac J Tour Res 23(4):408–422

Michailidou AV, Vlachokostas C, Moussiopoulos N (2016) Interactions between climate change and the tourism sector: multiple-criteria decision analysis to assess mitigation and adaptation options in tourism areas. Tour Manag 55:1–12

Mossler MV, Bostrom A, Kelly RP, Crosman KM, Moy P (2017) How does framing affect policy support for emissions mitigation? Testing the effects of ocean acidification and other carbon emissions frames. Glob Environ Chang 45:63–78

Naradda Gamage SK, Hewa Kuruppuge R, Haq IU (2017) Energy consumption, tourism development, and environmental degradation in Sri Lanka. Energy Sources B: Econ Plann Policy 12(10):910–916

Nasrollahi Z, Hashemi MS, Bameri S, Taghvaee VM (2018) Environmental pollution, economic growth, population, industrialization, and technology in weak and strong sustainability: using STIRPAT model. Environ Dev Sustain:1–18

Navarro V (1998) Neoliberalism,"globalization," unemployment, inequalities, and the welfare state. Int J Health Serv 28(4):607–682

Nepal R, al Irsyad MI, Nepal SK (2019) Tourist arrivals, energy consumption and pollutant emissions in a developing economy–implications for sustainable tourism. Tour Manag 72:145–154

Nosheen M, Iqbal J, Hassan SA (2019) Economic growth, financial development, and trade in nexuses of CO 2 emissions for Southeast Asia. Environ Sci Pollut Res 26(36):36274–36286

Paramati SR, Alam MS, Chen CF (2017a) The effects of tourism on economic growth and CO2 emissions: a comparison between developed and developing economies. J Travel Res 56(6):712–724

Paramati SR, Shahbaz M, Alam MS (2017b) Does tourism degrade environmental quality? A comparative study of Eastern and Western European Union. Transp Res Part D: Transp Environ 50:1–13

Paramati SR, Alam MS, Lau CKM (2018) The effect of tourism investment on tourism development and CO2 emissions: empirical evidence from the EU nations. J Sustain Tour 26(9):1587–1607

Park Y, Meng F, Baloch MA (2018) The effect of ICT, financial development, growth, and trade openness on CO 2 emissions: an empirical analysis. Environ Sci Pollut Res 25(30):30708–30719

Pesaran MH, Shin Y, Smith RJ (2001) Bounds testing approaches to the analysis of level relationships. J Appl Econ 16(3):289–326

Raza SA, Sharif A, Wong WK, Karim MZA (2017) Tourism development and environmental degradation in the United States: evidence from wavelet-based analysis. Curr Issue Tour 20(16):1768–1790

Roudi S, Arasli H, Akadiri SS (2019) New insights into an old issue–examining the influence of tourism on economic growth: evidence from selected small island developing states. Curr Issue Tour 22(11):1280–1300

Sabir S, Gorus MS (2019) The impact of globalization on ecological footprint: empirical evidence from the South Asian countries. Environ Sci Pollut Res 26(32):33387–33398

Saeed Meo M, Hafeez M, Shaikh GM, Shahid M (2018) Asymmetric effect of gold and oil prices on stock market performance in Pakistan: new evidence from asymmetric ARDL cointegration. J Bus Strateg 12(2):43–64

Salahuddin M, Ali MI, Vink N, Gow J (2019) The effects of urbanization and globalization on CO 2 emissions: evidence from the Sub-Saharan Africa (SSA) countries. Environ Sci Pollut Res 26(3):2699–2709

Sghaier A, Guizani A, Jabeur SB, Nurunnabi M (2019) Tourism development, energy consumption and environmental quality in Tunisia, Egypt and Morocco: a trivariate analysis. GeoJournal 84(3):593–609

Shahbaz M, Leit ÃNC (2013) Portuguese carbon dioxide emissions and economic growth: a time series analysis. Bull Energy Econ 1(1):1–7

Shahbaz M, Lean HH, Shabbir MS (2012) Environmental Kuznets curve hypothesis in Pakistan: cointegration and Granger causality. Renew Sust Energ Rev 16(5):2947–2953

Shahbaz M, Mallick H, Mahalik MK, Loganathan N (2015) Does globalization impede environmental quality in India? Ecol Indic 52:379–393

Shahbaz M, Loganathan N, Muzaffar AT, Ahmed K, Jabran MA (2016) How urbanization affects CO2 emissions in Malaysia? The application of STIRPAT model. Renew Sust Energ Rev 57:83–93

Shahbaz M, Shahzad SJH, Mahalik MK (2018) Is globalization detrimental to CO 2 emissions in Japan? New threshold analysis. Environ Model Assess 23(5):557–568

Shakouri B, Khoshnevis Yazdi S, Ghorchebigi E (2017) Does tourism development promote CO2 emissions? Anatolia 28(3):444–452

Sharif A, Afshan S, Nisha N (2017) Impact of tourism on CO2 emission: evidence from Pakistan. Asia Pac J Tour Res 22(4):408–421

Sharma SS (2011) Determinants of carbon dioxide emissions: empirical evidence from 69 countries. Appl Energy 88(1):376–382

Shin Y, Yu B, Greenwood-Nimmo M (2014) Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In Festschrift in honor of Peter Schmidt. Springer, New York, pp 281–314

Sinha A, Shahbaz M, Balsalobre D (2017) Exploring the relationship between energy usage segregation and environmental degradation in N-11 countries. J Clean Prod 168:1217–1229

Solarin SA (2014) Tourist arrivals and macroeconomic determinants of CO2 emissions in Malaysia. Anatolia 25(2):228–241

Tamazian A, Chousa JP, Vadlamannati KC (2009) Does higher economic and financial development lead to environmental degradation: evidence from BRIC countries. Energy Policy 37(1):246–253

Turner LW, Witt SF (2001) Factors influencing demand for international tourism: tourism demand analysis using structural equation modelling, revisited. Tour Econ 7(1):21–38

Ullah S, Ozturk I, Usman A, Majeed MT, Akhtar P (2020) On the asymmetric effects of premature deindustrialization on CO2 emissions: evidence from Pakistan. Environ Sci Pollut Res:1–11

UNWTO (2017) World Tourism Organization. UNWTO Tourism Highlights. UNWTO, Madrid

World Meteorological Organization (2019) Global Climate in 2015-2019: Climate change accelerates. Retrieved from https://public.wmo.int/en/media/press-release/global-climate-2015-2019-climate-change-accelerates

Xu Z, Baloch MA, Meng F, Zhang J, Mahmood Z (2018) Nexus between financial development and CO 2 emissions in Saudi Arabia: analyzing the role of globalization. Environ Sci Pollut Res 25(28):28378–28390

You W, Lv Z (2018) Spillover effects of economic globalization on CO2 emissions: a spatial panel approach. Energy Econ 73:248–257

Zaman K, Moemen MAE, Islam T (2017) Dynamic linkages between tourism transportation expenditures, carbon dioxide emission, energy consumption and growth factors: evidence from the transition economies. Curr Issue Tour 20(16):1720–1735

Zhang C, Singh AJ, Yu L (2016) Does it matter? Examining the impact of China's vacation policies on domestic tourism demand. J Hosp Tour Res 40(5):527–556