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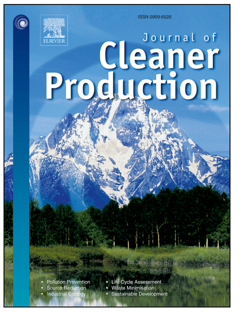

Revisiting the role of tourism and globalization in environmental degradation in China: Fresh insights from the quantile ARDL approach

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Revisiting the Role of Tourism and Globalization in Environmental Degradation in China: Fresh Insights from the Quantile ARDL Approach

Abstract: Ascertaining sustainable development is a major issue across the globe, and the economic growth pattern achieved is a predominant reason behind this. The globalization-led economic growth achieved by the emerging economies might not be ecologically sustainable, as globalization might not have been utilized as a policy tool. Moreover, a sound policy calls for considering the entire data spectrum for the analysis, which is largely ignored in the literature. This research contributes to the literature by proffering a policy framework for the emerging economies by analyzing the impact of globalization and tourism on environmental degradation, by considering the Chinese context as a sample. Following the quantile autoregressive distributed lag model, the impact of economic growth, globalization, and tourism on greenhouse gas emissions, carbon dioxide emissions, and the ecological footprint in China over 1978Q1-2017Q4 are analyzed. The results demonstrate that economic growth stimulates environmental degradation, while the presence of Environmental Kuznets Curve is also validated. Moreover, tourism has been found to exert positive environmental externalities, while globalization exerts negative environmental externalities. Based on the outcomes of the research, a comprehensive policy framework has been suggested, following which the Chinese economy might be able to attain the objectives of Sustainable Development Goals 7, 8, and 13.

Keywords: Tourism; Globalization; EKC; China; QARDL.

1. Introduction

With the rise in industrialization, the economic growth pattern achieved by the nations is proving be more unsustainable in nature, as the report on Sustainable Development Goals 2018 (United Nations, 2018) reflects that worldwide, emerging economies are facing issues in addressing the objectives of SDG 13, i.e. the goals of climate action. One of the major reasons behind this issue is the pattern of industrialization-led economic growth in these nations. While attaining this echelon of economic growth, the cross-border movement of resources had been eased gradually, and it was possible through globalization. In 1983, Theodore Levitt first proposed the concept of "globalization" (Theodore, 1983); economic globalization is the process of forming a unified market for goods, services, capital, knowledge, and production factors across the world. Different countries undertake different international divisions of labor, including production processes, production phases, and production models. As globalization has a direct impact on the production process, therefore, it has a direct influence on environmental quality. Globalization catalyzes the demand and supply scenario in the international market through the exchange of merchandise and services, and thereby, the production processes in the economies are affected accordingly. Now, for being competitive in the international market, nations focus on being cost-effective, and in this pursuit, firms try to utilize fossil fuel-based solutions, consumption of which leads to deterioration of environmental quality. While traversing along this growth path, nations find it difficult to achieve the objectives of SDG 7, i.e. green and inexpensive power, and nonfulfillment of this objective might eventually lead towards the departure from attaining the objectives of SDG 8, i.e. decent work and economic growth. In such a scenario, rise in globalization might pose a serious threat to the foundation of sustainable development in emerging economies.

In the context of globalization, while considering the cross-border movement of resources, the tourism industry needs a special mention. Tourism plays a key role in the socio-cultural transformation of the nations, while being one of the fastest-developing industries in the World (Geary, 2018). Through core and allied industrial activities, tourism contributes to economic growth by creating several vocational opportunities. However, with global growth in per capita income, tourists have increased swiftly, and this development of the tourism sector is reflected in the related energy utilization and subsequent environmental degradation (Kalayci and Hayaloglu 2018; Tang et al. 2018). For example, in 2013, greenhouse gas emissions from global tourism accounted for 8% of global carbon emissions (Lenzen et al. 2018). Moreover, the emergence of ecotourism is considered to be one of the major reasons behind the displacement of animal habitats and the faster depletion of natural resources at the destinations (Fletcher, 2019). Therefore, while tourism contributes to the economic growth of a nation, it can simultaneously affect the basis of the same through degrading environmental quality.

Following this discussion, it might be said that attaining sustainable development is a crucial task for an emerging economy, and the economic growth pattern enabled by globalization and the tourism sector might create predicaments on the way of this achievement. Therefore, from the perspective of policymaking, globalization and tourism might be considered as two potential determinants of environmental degradation in the emerging nations. In order to have a comprehensive idea about the environmental degradation, greenhouse gas (GHG) emissions, carbon dioxide (CO_2) emissions, and the ecological footprint (EFP) can be chosen as indicators for measuring environmental degradation (Olale et al. 2018; Hassan et al. 2019). To assess this association, China is chosen as a context. After the execution of the reform and opening-up policy in China, EFP, CO_2 emissions, and GHG emissions increased gradually (Friedlingstein et al. 2014; Lv et al. 2014; Ma et al. 2016). Between 1978 and 2017, GHG emissions in China increased from 2,726,399.89 to 13,492,834.30 kiloton of CO_2 equivalent, CO_2 emissions increased from 1.53 to 7.53 metric tons per capita, and EFP increased from 1.34 to 3.58 per capita (World Bank, 2019). During this period, the globalization index in China grew from 26.72 to 64.50. While international trade development stimulated economic growth and increased production efficiency, globalization-led unrestricted trade liberalization resulted in environmental degradation in China. In 2017, China's merchandise exports of US$2,263.35 billion accounted for 12.8% of world exports, while the export of manufactured goods was US$2,125.12 billion, accounting for 17.5% of world exports (World Bank, 2019). This rise in the manufacturing sector in China was an outcome caused by the demand in the international market, which was a consequence of globalization. Now, growth in the manufacturing sector creates the demand for commercial energy, which consequently causes environmental degradation in various forms. On the other hand, between 1978 and 2017, the tourist arrivals in China increased from 716.00 thousand to 60,742.30 thousand (UNWTO, 2019). This growth in the Chinese tourism sector is complemented by the transportation sector, which is the most important contributor to tourism carbon emissions. Furthermore, tourist accommodations also contribute to environmental degradation through faster depletion of natural resources, and the generation of exhaust gasses (Wang et al., 2019; Bianco, 2020). Several tourism-led sports and other recreational activities lead to the displacement of animal habitats, depletion of natural resources, and generation of GHGs (Chen et al., 2018). Along with tourism, the allied industries formed in the destinations also add to this ecological predicament. Being faced with such a condition, the 13th 5-Year disposition for Tourism Development of Beijing aimed at endorsing green energy-fueled transport for tourism (UNWTO, 2018). In such a context-setting, it might be crucial to evaluate the influence of economic growth, enabled by globalization and tourism, on environmental degradation, as the learning from this contextual analysis might help in designing the policies for promoting sustainable tourism and attaining SDGs.

Following this discussion, the present study aimed at analyzing the influence of globalization, tourism development, and economic growth on environmental degradation. This analysis is carried out for China over the period of 1978-2017. This study aimed at analyzing the impact of economic growth and its drivers on environmental degradation, therefore it would help in designing the policies for attaining sustainable development through a policy framework, and thereafter realigning allied economic and developmental policies. As China is one of the leading emerging economies of the world, therefore, designing the policy framework for China might help other emerging economies to realign their policies for ascertaining sustainable development. Bringing economic growth, globalization, tourism development, and environmental degradation within a framework might help in building a comprehensive policy framework for addressing SDG 7 and SDG 13, and thereafter SDG 8. However, in designing the policy framework, a phase-wise approach might be used, as a sound and robust policy should encompass the entire spectrum of the environmental degradation, and hence, a phase-wise multipronged SDG framework can be suggested. By far, this approach to address environmental degradation has not been adopted in the literature, and there lies the policy level contribution of the research.

Now, a policy level framework by considering the entire spectrum of the target variable requires a suitable methodological approach. To evaluate the influence of policy parameters across the entire spectrum of the target policy variable necessitates the analysis to be carried out in the quantile modeling framework. In this pursuit, quantile autoregressive distributed lag (QARDL) is employed in this study. This method is capable of simultaneously describing the relationship between multiple time series of conditional quantiles at multiple quantile points. Moreover, this method demonstrates that the impacts of explanatory policy parameters differ in terms of level, mode, and response period. For designing a robust policy, the differential impacts of the explanatory policy parameters must be assessed across the entire spectrum of the target policy variable, and this objective is fulfilled through the application of the QARDL approach. On the other hand, capturing environmental degradation through a single variable might not reflect the proper scenario, and hence, from the policymaking perspective, three indicators of environmental degradation, i.e. ecological footprint (EFP), emissions from GHG and carbon dioxide (CO_2) have been chosen. Inclusion of these indicators has given the study a flexibility to illustrate the contextual scenario in a much detailed manner, and therefore, the expected test outcomes might be able to suggest nearly true consequences in the Chinese context, which can be replicated for the other emerging economies of the world. This approach might be considered as the analytical contribution of the study.

Remaining portion of the study is structured as follows. Section 2 reviewed the influence of economic development, globalization, and tourism on the environment and carbon emissions. Section 3 introduced the methodology. Section 4 described the data analysis and interpretation. Section 5 discussed the policy framework of the study based on the results. Section 6 provided conclusions and allied policy implications.

2. Literature review

As environmental issues become severer, the influence of globalization and tourism on carbon emissions has become a niche research area. Based on the relevant literature, the impact of economic growth, globalization, and tourism on environmental degradation are reviewed. The review followed three strands based on the associative directionality among the environmental degradation and its explanatory variables chosen in this study. At the end of every strand, suitable research gaps were identified, and the contribution of the study was discussed.

2.1. Economic growth and the environment

A large number of studies have examined the connection between economic growth and greenhouse gases, carbon dioxide, and the ecological footprint (Appiah, 2018; Salahuddin et al., 2018; Destek and Sinha, 2020). Hamit-Haggar (2012) examined the relationship among emissions from GHG, energy usage, and economic growth for Canadian industrial sectors from 1990 to 2007, and the results showed that the environmental Kuznets curve (EKC) prevails between greenhouse gas emissions and economic growth. Holtz-Eakin and Selden (1995) tested the relationship between economic growth and CO_2 emissions and found that with increases in the gross domestic product (GDP) per capita, the marginal propensity CO_2 emissions are reduced. Balsalobre-Lorente et al. (2018) examined the nexus between economic growth and emissions from CO_2 in the European Union 5 (EU-5) countries, which include Germany, France, Italy, Spain, and the United Kingdom, from 1985 to 2016. The results verified an N-shaped relationship between economic growth and CO_2 emissions in the EU-5 countries. Mikayilov et al. (2018) used the EKC hypothesis to test the association between economic growth and emission from CO_2 in Azerbaijan from 1992 to 2013. Galli et al. (2012) disclosed that the ecological footprint experienced a rapid increase in China over the past 45 years that has outstripped its gains in income. However, the ecological footprint has shrunk slightly in India. Khan et al. (2018) used the generalized method of moments (GMM) to observe the nexus between economic progress and environmental sustainability in 43 countries, and the result demonstrates that carbon emissions can influence economic growth. Wang et al. (2018) employed the relationship between urbanization, energy usage, economic development, and CO_2 emissions in various income levels of 170 countries from 1980 to 2011. Borhan et al. (2018) tested the nexus of CO_2 and economic growth in the eight Association of Southeast Asian Nations (ASEAN) countries. Mbarek et al. (2018) examined the nexus among economic growth, renewable energy consumption, energy consumption, and CO_2 emissions in Tunisia from 1990 to 2015 and showed that a unidirectional relationship exists between economic growth and CO_2 emission in both the short- and long-run. Besides, some research has estimated the link between economic growth and the environment, including Sinha et al. (2017) for Next 11 nations, Baloch (2018) and Zhang et al. (2018) for Pakistan, Kahouli (2018) for Mediterranean countries, Bekun et al. (2019) for South Africa, and Dong et al. (2018) for China, Sinha, and Shahbaz (2018) for India, Sharif et al. (2020) for Turkey. Hafeez et al. (2019) explored the impact of financial growth on the carbon footprint in the One Belt and Road Initiative (BRI) region from 1990 to 2017 and inferred that economic growth and utilization of energy caused environmental deterioration by augmenting the carbon footprint. Shahbaz and Sinha (2019) have given a detailed account of this association.

This brief review of the nexus between economic growth and environmental degradation suggests that economic growth pattern might have a possible impact on environmental degradation. Yet, these studies were silent about the definitiveness of the associative directionality of this association, as it can be seen that the directions vary according to the level of development in the sample nations, and therefore, policy decisions based on these associations can prove to be inconclusive in nature. If these associations could have been analyzed across the spectrum of the data, then the nature of the associative directionality among both of the parameters might have been understood effectively. This study addressed this gap in the literature by analyzing the association following a quantile modeling approach, which not only allowed analyzing the association across the entire spectrum of the data, but also allowed the differential impact of the explanatory variables on the target policy parameter.

2.2. Globalization and environment

Previous studies considered globalization to have a significant effect on the environment and climate variation (Allena and Fracchia 2017; Shahbaz et al. 2018; Shahbaz et al. 2019; Wang et al. 2019). Jorgenson and Kick (2006) linked environmental consequences with global economic processes. Shahbaz et al. (2015) examined the nexus between globalization and CO_2 emissions in India from 1970 to 2012, and suggested that globalization upsurges CO_2 emissions. Acheampong et al. (2019) used foreign direct investment (FDI) and trade openness to assess the impact of globalization on carbon emissions in 46 sub-Saharan African countries from 1980 to 2015, and discovered that FDI decreases carbon emissions, while trade openness worsens environmental quality. Ahmed et al. (2019) estimated the nexus among globalization and the ecological footprint in Malaysia from 1971-2014. The outcome revealed that globalization had added significantly to the ecological carbon footprint, and economic growth motivates changes to the ecological footprint. Sabir and Gorus (2019) tested the influence of globalization on environmental degradation and found that globalization to be a cause of environmental degradation in South Asian countries. Zafar et al. (2019a) probed the effects of globalization and financial development on environmental quality for the Organization for Economic Cooperation and Development (OECD) countries from 1990 to 2014. Salahuddin et al. (2019) studied the impacts of urbanization and globalization on CO_2 emissions in 44 sub-Saharan African countries from 1984 to 2016. Khan and Ullah (2019) applied the autoregressive distributed lag (ARDL) model to examine the nexus between globalization and CO_2 emissions in Pakistan and indicated that if globalization upsurges by 1%, CO_2 emissions upsurge by 0.38%. Xu et al. (2018) discovered bidirectional causality between globalization and CO_2 emissions in Saudi Arabia from 1971 to 2016. Zaidi et al. (2019) inspected the nexus among financial development, globalization, and CO_2 emissions in Asia Pacific Economic Cooperation (APEC) nations from 1990 to 2016. Balsalobre-Lorente et al. (2020) found globalization to have negative impact on CO_2 emissions arising out of tourism.

This brief review of the association between globalization and environmental degradation suggests that globalization might have a possible influence on environmental degradation. Still, these studies could not provide any conclusive evidence on the associative directionality between these two model parameters, as the sample and period of analysis were largely different from each other. Perhaps that is the reason behind any congruence in the policy implications emerging out of these studies. Bringing entire spectrum of data within an empirical framework might address this shortcoming in policy design, and there lies the research gap this study intends to address. In this study, this association was analyzed following a quantile modeling approach, which considered the entire spectrum of the data of the model parameters, and therefore, could bring forth additional insights about the association at various levels of the data.

2.3. Tourism and the environment

With the increase in global climatic shift and energy security issues, tourism is an important social and economic industry, and many scholars have explored the impact of tourism on environmental emissions from carbon (Gössling 2002; Dwyer et al. 2010; Paramati et al. 2017; Mishra et al., 2019b). Katircioglu et al. (2014) suggested that the arrival of international tourists has a significant positive influence on the consumption of energy and emissions from the carbon in Cyprus. Balli et al. (2019) estimated that this impact has a positive long-run nexus with tourism with respect to CO_2 emissions in Mediterranean countries. Eyuboglu and Uzar (2019) demonstrated that in both the long-run and short-run, tourism growth had a positive influence on carbon emissions in Turkey from 1960 to 2014.

Numerous studies have shown that tourism transportation and accommodation are two important components of tourism carbon emissions (Schafer and Victor 1999; Rico et al. 2019). Perch-Nielsen et al. (2010) suggested that air transport is a major factor in greenhouse gas emissions in the Swiss tourism industry. Becken et al. (2001) showed that the energy utilization in accommodation accounts for 0.4% of the total energy consumption in New Zealand. Besides, the cooking food is an essential part of the tourism process (Hall and Sharples, 2008; Boniface 2017). Gössling et al. (2011) argued that food management could contribute to reducing the ecological footprint of tourism and mitigating climate variation. Perch-Nielsen et al. (2010) estimated that GHG emissions of tourism foods and beverages account for 52,000 tons of CO_2

equivalents or 2% of total tourism carbon emissions in Switzerland. Shaheen et al. (2019) examined the association among international tourism, energy demand, CO_2 emissions, and economic growth in the top 10 tourism nations from 1995 to 2016 and emphasized the importance of eco-tourism to reduce carbon emissions. Sajjad et al. (2014) explored the link between air pollution and tourism development in South Asia, North Africa, the Middle East sub-Saharan Africa, the Pacific regions, and East Asia from 1975 to 2012. Based on these studies, growth in the tourism industry might lead to environmental degradation and biodiversity loss (e.g. Mikayilov, Mukhtarov et al. (2019) for Azerbaijan, Malik et al. (2016) for Austria, Katircioglu et al. (2018) for the main tourist destination countries, and Sharif et al. (2019c) for China).

This brief review of the association between tourism and environmental degradation suggests that tourism might have a possible impact on environmental degradation. This impact could be designated as either positive or negative, based on the choice of tourism indicator, the context of the study, and study duration. This might be the reason behind the incongruence in the nature of the association between these two parameters, and hence, an incongruence of a similar kind was visible among the policy designs provided by these studies. In order to design a robust policy covering the maximum possible scenarios require the empirical model to be designed across the entire spectrum of the data, and there lies the contribution of the existing study. The current study is based on the quantile modeling approach, which is capable of considering the entire data spectrum by dividing it into quantiles.

3. Methodology

To formulate a robust policy measure, it is needed to assess the impacts of policy parameters on target policy variables across the entire spectrum of data. The traditional least square-based panel models assess this impact at the median of the variables, and this might defeat the policy-oriented objective of the study. Moreover, even across the spectrum of the data, the impacts of the policy parameters on the target policy variable might not be symmetric. Therefore, the choice of methodological adaptation should comply with these two conditions, while complementing the policy-level contribution of the study.

To examine the nonlinear association between three variables that are related to China (e.g., economic growth (GDP), tourism (TOR), and globalization (GLO) with environmental degradation (ED)), QARDL model explored by Cho et al. (2015) has been utilized. This model allows for testing the quantile long-run equilibrium influence of EKC, globalization, and tourism on environmental degradation. QARDL is an advanced form of the ARDL model, through which prospective asymmetries between economic growth, globalization, and tourism and environmental degradation can be analyzed. The time period-varying integration association was also examined through the Wald test to verify the steadiness of integrating coefficients throughout the quantiles. This will assist in evaluating long- and short-run symmetry. The elementary form of ARDL is as follows:

$$ED_t = \mu + \sum_{i=1}^{P} \varphi_i ED_{t-i} + \sum_{i=0}^{q} \omega_i GDP_{t-i} + \sum_{i=0}^{r} \lambda GDP^2{}_{t-i} + \sum_{i=0}^{s} \theta_i TOR_{t-i} + \sum_{i=0}^{U} \psi_i GLO_{t-i} + \varepsilon_t \quad (1)$$

where ε_t signifies the error (residual) term which is expounded as $ED_t - \mathrm{E}[ED_t/\gamma_{t-1}]$ where γ_{t-1} being the smallest σ-field generated by $\{\mathrm{ED_t}, \mathrm{GDP_t}, \mathrm{GDP^2}_\mathrm{t}\ \mathrm{TOR_t}, \mathrm{GLO_t}, \mathrm{ED_{t-1}}, \mathrm{GDP_{t-1}}, \mathrm{GDP^2}_{\mathrm{t-1}}, \mathrm{TOR^2}_{\mathrm{t-1}}, \mathrm{GLO_{t-1}}\}$ and *p*, *q*, *r*, *s*, and *u* are lag orders according to the Schwarz information criteria (SIC). In the above Equation (1), ED, GDP, GDP^2, TOR and GLO are environmental degradations (i.e., CO2 emission, ecological footprint, and greenhouse gas emission), GDP, and GDP^2 are the gross domestic product (EKC), tourism, and globalization.

The model stated in Equation (1) was further extended by Cho et al. (2015) in the shape of quantile and recommended the QARDL (p, q, r, s, u) form as mentioned below:

$$Q_{ED_t} = \mu(\tau) + \sum_{i=1}^{P} \varphi_i(\tau)\, ED_{t-i} + \sum_{i=0}^{q} \omega_i(\tau) GDP_{t-i} + \sum_{i=0}^{r} \lambda(\tau) GDP^2{}_{t-i} + \sum_{i=0}^{s} \theta_i\,(\tau) TOR_{t-i} + \sum_{i=0}^{U} \psi_i(\tau) GLO_{t-i} + \varepsilon_t(\tau) \quad (2)$$

where, $\varepsilon_t(\tau) = ED_t - Q_{EDt}\ (\ \tau/\delta_{t-1}\ )$ (Kim and White, 2003) and $0 > \tau < 1$ shows quantile. Due to the probability of serial correlation, the QARDL model presented in the above Equation (2) is generalized as shown below

$$Q_{\Delta ED_t} = \mu + \rho ED_{t-1} + \varphi_{GDP} GDP_{t-1} + \varphi_{GDP^2} GDP^2{}_{t-1} + \varphi_{TOR} TOR_{t-1} + \varphi_{GLO} GLO_{t-1} + \sum_{i=1}^{P-1} \varphi_i \Delta ED_{t-1} + \sum_{i=0}^{q-1} \omega_i \Delta GDP_{t-1} + \sum_{i=0}^{r-1} \lambda_i \Delta GDP^2{}_{t-1} + \sum_{i=0}^{s-1} \theta_i \Delta TOR_{t-1} + \sum_{i=0}^{U} \psi_i \Delta GLO_{t-1} + \vartheta(\tau) \quad (3)$$

The generalized reformulated version of Equation (3) which shows the QARDL-ECM model is given below:

$$Q_{\Delta ED_t} = \mu(\tau) + \rho(\tau)(ED_{t-1} - \beta_{GDP}(\tau) GDP_{t-1} - \beta_{GDP^2}(\tau) GDP^2{}_{t-1} - \beta_{TOR}(\tau) TOR_{t-1} - \beta_{GLO}(\tau) GLO_{t-1}) + \sum_{i=1}^{P-1} \varphi_i(\tau) \Delta\, ED_{t-1} + \sum_{i=0}^{q-1} \omega_i(\tau) \Delta GDP_{t-1} + \sum_{i=0}^{r-1} \lambda_i(\tau) \Delta GDP^2{}_{t-1} + \sum_{i=0}^{s-1} \theta_i(\tau) \Delta TOR_{t-1} + \sum_{i=0}^{U} \psi_i(\tau) \Delta GLO_{t-1} + \varepsilon_t(\tau) \quad (4)$$

By using the delta method, the cumulative short-run impact of the preceding degradation on contemporary degradation is determined by $\varphi_* = \sum_{i-1}^{p-1} \partial\, \varphi_j$, while the cumulative short-run influence of the preceding and existing levels of GDP, GDP^2, TOR, and GLO is determined by $\omega_* = \sum_{i-1}^{q-1} \partial\, \omega_j$, $\lambda_* = \sum_{i-1}^{r-1} \partial\, \lambda_j$, $\theta_* = \sum_{i-1}^{s-1} \partial\, \theta_j$ and $\psi_* = \sum_{i-1}^{u-1} \partial\, \psi_j$ respectively.

The parameters that are related to long-run for GDP, GDP^2, TOR, and GLO are calculated as $\beta_{GDP*} = -\frac{\beta_{GDP}}{\rho}$, $\beta_{GDP^2*} = -\frac{\beta_{GDP^2}}{\rho}$, $\beta_{TOR*} = -\frac{\beta_{TOR}}{\rho}$ and $\beta_{GLO*} = -\frac{\beta_{GLO}}{\rho}$. It shall be noted that the ECM parameter ρ should be significantly negative. To evaluate the short and long-run asymmetric influence of GDP, GDP^2, TOR, and GLO on economic degradation, the researchers have executed the Wald test to investigate the null hypotheses ρ_* parameter as stated below.

$$H_0: \rho_*(0.05) = \rho_*(0.1) = \rho_*(0.2) = \ldots\ldots\ldots = \rho_*(0.95)$$

Contrary to an alternative one

H_0: $\exists\, i \neq j /\ \rho(i) \neq \rho(j)$

Similarly, these hypotheses are examined on β_{GDP}, $\beta_{GDP^2,}$ β_{TOR} and β_{GLO} and on the remaining short-run parameter i.e. ω_* , λ_* , θ_* and ψ_i.

While explicating the methodological schema of QARDL, it is also needed to point out the shortcoming of the method. The only limitation of this method is that it is incapable of analyzing the estimates of model parameters at the quantile-on-quantile level. However, this shortcoming of the method was ignored for this study, as the research objective of the study did not call for a quantile-on-quantile analysis, but an asymmetric inter-quantile analysis. Therefore, despite having this shortcoming, QARDL was chosen for the study.

4. Results

This study consisted of six constructs, i.e., Carbon dioxide emission (CO_2), Ecological footprint (EFP), Greenhouse gas emission (GHG), Economic growth (GDP), Tourist arrivals (TOR) and globalization (GLO). We used quarterly data series of China from 1978Q1 to 2017Q4. The data of CO2 emission, GDP, and GHG emission are collected from World development Indicators, managed by the World Bank (2019). Besides, the data of tourist arrivals, globalization, and ecological footprint are collected from the official website of the World Tourism Organization, KOF Swiss Economic Institute, and Global Footprint Network respectively. Finally, the yearly information is converted into quarterly information by selecting quadratic match sum method following (Godil et al., 2020; Sharif et al. 2019a; Arain et al. 2019; Shahbaz et al. 2018). The process is beneficial to transform the low-frequency data into high-frequency data as it permits amendments for seasonal deviation by dropping end-to-end data deviation. The descriptive analysis of all the variables is revealed in Table I.

Table-I: Result of Descriptive Statistics

Variables	Mean	Min	Max	Std. Dev.	JB Test	P-Value
Carbon Dioxide Emission	-0.236	-1.013	0.639	0.556	14.045	0.001
Ecological Footprint	-0.666	-1.121	0.070	0.364	16.337	0.000
Greenhouse Gas Emission	14.151	13.420	15.040	0.538	13.371	0.001
Gross Domestic Product	5.918	4.319	7.533	0.981	10.314	0.006
Tourist Arrivals	6.157	2.789	7.331	1.118	29.112	0.000
Globalization	2.440	1.898	2.785	0.315	16.482	0.000
Source: Authors Estimation						

Minimum, as well as maximum mean values of all the constructs, are positive (i.e., GHG (1.053-1.684), GDP (2.408-2.841), TOR (1.407-1.907) and GLO (1.707-2.030)) except for CO2 and EFP which shows negative results, i.e. CO2 (3023-3.313), EFP (2.786-3.080). The normality of data was analyzed through the Jarque-Bera test. Its result depicts that data is not normal, and hence researcher can proceed towards the quantile estimations (Troster et al. 2018; Sharif et al. 2019 a, b; Mishra et al. 2019a).

Table-II: Results of Unit root test						
Variables	**ADF (Level)**	**ADF (Δ)**	**ZA (Level)**	**Break Year**	**ZA (Δ)**	**Break Year**
Carbon Dioxide Emission	-6.009***	-10.174***	-4.025***	2006 Q1	-5.583***	2008 Q4
Ecological Footprint	-7.543***	-9.950***	-6.258***	2002 Q3	-8.207***	2003 Q1
Greenhouse Gas Emission	0.328	-6.324***	-1.821	1997 Q1	-8.223***	1992 Q3
Gross Domestic Product	2.392	-4.256***	0.229	1995 Q4	-6.286***	1984 Q4
Tourist Arrivals	-0.872	-6.216***	-1.099	2013 Q2	-7.118***	2016 Q2
Globalization	-2.198	-5.321***	-2.077	2009 Q4	-6.017***	2015Q4
Note: The values in the table specify the statistical values of the ADF and ZA tests. The asterisk ***, **, and * represent a level of significance at 1%, 5%, and 10%, respectively.						

Furthermore, Table-II describes the results of the unit root test for which ADF, i.e. Zivot and Andrews (1992) test and ADF, i.e., Dickey-Fuller, were utilized. The results of the ZA test also include structural breaks in the figures, which are considered as one of the benefits of this test. It is evident from the outcomes that the test qualifies the data for the application of QARDL as all the figures are stationary at a 5% or 10% significant level.

The analysis related to QARDL is presented in Table III, Table IV, and Table V. Table III shows the outcomes of CO_2 emission. Statistically, the value of ρ, the speed of adjustment parameter should be negative, and the same has been achieved here; however, it is significant from the lower side of quantile 0.10 to the middle side of quantile 0.60. The long-run nexus of GDP-CO_2 is significant and also positive at low intensity, i.e. from quantile (0.05-0.50), which means that even with small or moderate economic growth in China, CO_2 emission will increase. The nexus between GDP^2-CO_2 and TOR-CO_2 is insignificant. Globalization is significant at the higher intensity level of quantiles, i.e. (0.80-0.95), and the positive sign shows that as globalization increases at a higher pace in china it will result in the emission of CO2 at high volume. This segment of results might suggest significant insights regarding the economic growth pattern in China. The economic growth in China is majorly dependent on fossil fuel-based solutions, and therefore, the economic growth itself is having a direct impact on the CO_2 emissions, even at its lowest quantiles. However, at the higher quantiles of CO_2 emissions, several other factors might contribute to the emissions, and therefore, the industrialization-led growth has become insignificant. This finding falls in similar lines with the finding of Chen et al. (2019). With the rise in CO_2 emissions, the EKC hypothesis turns out to be linear, as the squared term becomes insignificant. A reflection of this is seen in the impact of globalization on CO_2 emissions. With the rise in globalization, the rise in trade volume is having a more significant impact on CO_2 emissions, and therefore, the impact of globalization on CO_2 emissions can be visible only at higher quantiles. This impact can also be owing to the rise in the urban population, which can be attributed to the rise in vocational opportunities created as a result of globalization. This particular segment of results refutes the finding of Zhu and Jiang (2019). In such a scenario, areas with low CO_2 emissions might be an attraction of international tourists, and the policymakers will aim to keep the emission levels low to sustain the inflow of tourists. This segment of results falls in similar lines with the finding of Mishra et al. (2019).

Table-III: Results of Quantile Autoregressive Distributed Lag (QARDL) for CO2

Quantiles (τ)	$\alpha_*(\tau)$	$\rho_*(\tau)$	$\beta_{GDP}(\tau)$	$\beta_{GDP}{}^2(\tau)$	$\beta_{TOR}(\tau)$	$\beta_{GLO}(\tau)$	$\varphi_0(\tau)$	$\omega_0(\tau)$	$\lambda_0(\tau)$	$\theta_0(\tau)$	$\psi_0(\tau)$
0.05	2.433**	-0.032	0.260***	-0.129	-0.234***	0.243	0.628**	4.729*	-2.707**	-0.213***	0.037***
	(1.125)	(0.021)	(0.041)	(0.038)	(0.053)	(0.826)	(0.277)	(2.461)	(1.170)	(0.052)	(0.009)
0.10	2.180*	-0.024*	0.309***	-0.154	-0.224***	-0.449	0.743***	3.333	-1.818	0.230***	0.097***
	(1.186)	(0.014)	(0.066)	(0.040)	(0.055)	(0.557)	(0.160)	(2.413)	(1.228)	(0.034)	(0.029)
0.20	0.788	-0.012**	0.226***	-0.113	0.096	0.155	0.898***	3.725	-1.845	0.241***	-0.212
	(0.998)	(0.005)	(0.030)	(0.099)	(0.275)	(1.219)	(0.101)	(2.437)	(1.184)	(0.035)	(0.138)
0.30	0.882	-0.011*	0.281***	-0.140	0.074	0.794	1.008***	3.894*	-1.885	0.301***	-0.152
	(1.006)	(0.006)	(0.034)	(0.118)	(0.287)	(1.093)	(0.096)	(2.350)	(1.187)	(0.036)	(0.121)
0.40	0.423	-0.013**	0.113***	-0.056	0.123	0.678	0.963***	3.213**	-1.603*	0.304***	-0.138
	(0.909)	(0.007)	(0.024)	(0.121)	(0.185)	(0.595)	(0.088)	(1.623)	(0.802)	(0.027)	(0.115)
0.50	0.511	-0.014**	0.127***	-0.063	0.078	0.419	0.944***	2.783*	-1.372*	-0.001	-0.132
	(0.821)	(0.007)	(0.021)	(0.111)	(0.176)	(0.674)	(0.099)	(1.630)	(0.799)	(0.021)	(0.124)
0.60	0.126	-0.013**	0.036	-0.018	0.102	0.039	0.890***	1.290	-0.671	-0.002	-0.159
	(0.817)	(0.006)	(0.202)	(0.105)	(0.297)	(1.083)	(0.096)	(1.663)	(0.822)	(0.026)	(0.121)
0.70	0.168	-0.013	0.048	-0.024	0.268	0.792	0.926***	0.346	-0.119	0.009	-0.071
	(0.908)	(0.008)	(0.244)	(0.137)	(0.432)	(1.310)	(0.114)	(1.162)	(0.589)	(0.028)	(0.122)
0.80	-0.428	-0.005	-0.288	0.144	1.411	2.619***	0.926***	1.019***	-0.570***	0.019	-0.061
	(1.517)	(0.009)	(1.294)	(0.388)	(2.409)	(0.805)	(0.099)	(0.273)	(0.125)	(0.029)	(0.150)
0.90	-1.316	-0.009	-0.498	0.249	0.552	1.281***	0.796***	2.619***	-1.344***	-0.021	-0.088
	(1.596)	(0.011)	(0.712)	(0.517)	(1.155)	(0.341)	(0.091)	(0.230)	(0.150)	(0.023)	(0.170)
0.95	-2.410	-0.023	-0.343	0.172	0.389	1.301***	0.993***	6.464***	-3.415***	0.017	-0.114
	(1.847)	(0.019)	(0.408)	(0.252)	(0.675)	(0.275)	(0.127)	(1.457)	(0.854)	(0.035)	(0.305)

Note: The table reports the quantile estimation results. The t-statistics are between brackets. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.
Source: Author Estimations

Table-IV: Results of Quantile Autoregressive Distributed Lag (QARDL) for EFP

Quantiles (τ)	$\alpha_*(\tau)$	$\rho_*(\tau)$	$\beta_{GDP}(\tau)$	$\beta_{GDP}{}^2(\tau)$	$\beta_{TOR}(\tau)$	$\beta_{GLO}(\tau)$	$\varphi_1(\tau)$	$\omega_0(\tau)$	$\lambda_0(\tau)$	$\theta_0(\tau)$	$\psi_0(\tau)$
0.05	-2.315	-0.030***	0.251***	-0.126	-0.103***	0.006	0.748***	2.767	-1.374	-0.015***	-0.195
	(2.232)	(0.010)	(0.081)	(0.218)	(0.035)	(0.014)	(0.250)	(5.599)	(2.814)	(0.003)	(0.228)
0.10	0.504	-0.034**	0.054	-0.027	-0.146***	-0.001	0.774***	5.910*	-2.954**	-0.022***	0.073
	(0.838)	(0.017)	(0.088)	(0.065)	(0.039)	(0.007)	(0.192)	(3.017)	(1.461)	(0.006)	(0.140)
0.20	0.985*	-0.038***	0.392***	-0.196	-0.166**	0.014	0.567***	2.481***	-1.231***	-0.033***	0.024
	(0.521)	(0.012)	(0.069)	(0.423)	(0.085)	(0.035)	(0.155)	(0.753)	(0.401)	(0.009)	(0.064)
0.30	0.635	-0.031***	0.683***	-0.342	-0.073	0.353***	0.533***	2.066***	-1.049***	-0.039***	0.009
	(0.426)	(0.007)	(0.058)	(0.102)	(0.694)	(0.076)	(0.119)	(0.626)	(0.295)	(0.010)	(0.036)
0.40	0.463	-0.001	1.215***	-0.610	0.372	0.138***	0.490***	0.396	-0.251	-0.008	-0.009
	(0.314)	(0.008)	(0.086)	(0.186)	(4.484)	(0.038)	(0.108)	(1.225)	(0.591)	(0.019)	(0.046)
0.50	0.380	-0.002	0.846***	-0.425	-0.202	0.116***	0.554***	0.921	-0.525	-0.013	-0.033
	(0.326)	(0.008)	(0.095)	(0.139)	(1.035)	(0.037)	(0.112)	(1.218)	(0.590)	(0.018)	(0.064)
0.60	0.135	0.003	0.164	-0.083	0.231	-0.067	0.594***	0.034	-0.066	-0.020	0.054
	(0.345)	(0.008)	(0.586)	(0.514)	(1.192)	(0.161)	(0.102)	(1.381)	(0.683)	(0.017)	(0.075)
0.70	-0.123	0.009	0.049	-0.024	-0.080	-0.031	0.569***	0.138	-0.002	-0.016	0.031
	(0.598)	(0.008)	(0.220)	(0.105)	(0.169)	(0.029)	(0.097)	(1.710)	(0.852)	(0.019)	(0.067)
0.80	-0.379	0.023*	0.058	-0.028	-0.075	-0.018**	0.423***	0.524	-0.344	-0.013	0.013
	(1.231)	(0.012)	(0.171)	(0.064)	(0.158)	(0.008)	(0.125)	(2.637)	(1.309)	(0.020)	(0.067)
0.90	-2.350**	0.025	0.312	-0.156*	-0.101	-0.014	0.580**	2.612	-1.205	-0.003	-0.031
	(1.186)	(0.015)	(0.238)	(0.086)	(0.216)	(0.010)	(0.264)	(3.770)	(1.903)	(0.035)	(0.151)
0.95	-0.118	0.031	0.017	-0.008	-0.234	-0.007	0.750***	2.767	-1.521	0.014	-0.028
	(2.073)	(0.029)	(0.220)	(0.084)	(0.212)	(0.008)	(0.255)	(5.415)	(2.721)	(0.051)	(0.165)

Note: The table reports the quantile estimation results. The t-statistics are between brackets. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.
Source: Author Estimations

Table-V: Results of Quantile Autoregressive Distributed Lag (QARDL) for GHG

Quantiles (τ)	$\alpha_*(\tau)$	$\rho_*(\tau)$	$\beta_{GDP}(\tau)$	$\beta_{GDP}{}^2(\tau)$	$\beta_{TOR}(\tau)$	$\beta_{GLO}(\tau)$	$\varphi_1(\tau)$	$\omega_0(\tau)$	$\lambda_0(\tau)$	$\theta_0(\tau)$	$\psi_0(\tau)$
0.05	3.561	-0.013	0.886***	-0.443***	-0.530***	1.921	0.686***	4.728***	-2.390***	-0.029***	-0.040
	(2.563)	(0.027)	(0.223)	(0.145)	(0.143)	(6.040)	(0.164)	(1.093)	(0.664)	(0.009)	(0.233)
0.10	2.491*	0.009	0.915***	-0.458***	-0.330***	2.609	0.601***	2.958***	-1.490***	-0.042***	0.038
	(1.388)	(0.016)	(0.246)	(0.130)	(0.093)	(4.806)	(0.117)	(0.932)	(0.402)	(0.012)	(0.181)
0.20	2.113**	-0.013	0.511***	-0.255***	-0.584***	1.181	0.611***	-2.747	1.465	-0.019	0.141
	(0.969)	(0.012)	(0.163)	(0.080)	(0.174)	(1.861)	(0.112)	(2.514)	(1.222)	(0.025)	(0.137)
0.30	0.886	-0.016	0.165	-0.082	-0.130***	-0.627	0.714***	-0.793	0.476	-0.013	-0.025
	(1.059)	(0.011)	(0.281)	(0.097)	(0.032)	(0.557)	(0.129)	(2.443)	(1.133)	(0.021)	(0.123)
0.40	0.558	-0.009	0.183	-0.091	-0.139***	0.862***	0.726***	-0.610	0.428	-0.010	-0.030
	(0.919)	(0.009)	(0.478)	(0.150)	(0.031)	(0.253)	(0.127)	(1.991)	(0.915)	(0.018)	(0.115)
0.50	0.006	-0.010	0.013	0.007	-0.152	0.248***	0.686***	0.421	-0.084	-0.013	-0.033
	(0.882)	(0.011)	(0.304)	(0.082)	(0.071)	(0.064)	(0.125)	(1.612)	(0.771)	(0.019)	(0.100)
0.60	0.058	-0.013	0.000	0.000	-0.109	1.088***	0.668***	0.133	0.033	-0.013	-0.010
	(1.080)	(0.014)	(0.278)	(0.081)	(0.156)	(0.326)	(0.128)	(1.620)	(0.815)	(0.017)	(0.109)
0.70	-0.023	-0.020	0.019	0.010	0.002	0.217	0.704***	1.151	-0.441	-0.001	0.025
	(0.929)	(0.017)	(0.151)	(0.060)	(0.096)	(0.587)	(0.168)	(2.063)	(1.019)	(0.019)	(0.081)
0.80	-0.489	-0.019***	0.101	-0.050	0.046	0.029	0.682***	4.233***	-1.945***	-0.012	-0.004
	(1.036)	(0.005)	(0.187)	(0.088)	(0.164)	(1.520)	(0.199)	(0.901)	(0.633)	(0.028)	(0.084)
0.90	-0.845	-0.028***	0.119	-0.060	0.136	-1.491	0.896***	5.535***	-2.554***	-0.034***	0.075
	(1.861)	(0.007)	(0.206)	(0.119)	(0.204)	(1.233)	(0.255)	(1.215)	(0.673)	(0.009)	(0.080)
0.95	1.385	-0.030	0.139	-0.069	0.162	-2.658	0.998***	0.738***	-0.155***	-0.028**	0.037
	(2.200)	(0.020)	(0.277)	(0.141)	(0.334)	(2.531)	(0.213)	(0.236)	(0.035)	(0.014)	(0.124)

Note: The table reports the quantile estimation results. The t-statistics are between brackets. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.
Source: Author Estimations

Here the short-run dynamics depict that the current emissions of CO_2 are positively and significantly affected by their preceding levels at all the quantiles. The contemporary and earlier variations in GDP has a positive significant influence at the majority of quantiles, while, GDP^2 has a negative significant influence on contemporary emissions of CO_2 at quantiles (0.05), (0.40-0.50) and (0.80-0.95). Furthermore, preceding and contemporary variations in TOR has a negative significant influence on contemporary emissions of CO_2 at quantiles (0.05), but positive significant influence from quantiles (0.10-0.40), whereas globalization depicts the similar influence i.e. positive at quantiles (0.05-0.10). Table IV shows the outcomes of EFP. Statistically, the value of ρ, the speed of adjustment parameter should be negative, and the same has been achieved here along with its significance at the lower side of quantile (0.10-0.30), however, except for quantile (0.80) where it is significant and positive, all other level shows that either it is insignificant with a negative or positive sign. The long-run nexus of GDP-EFP is significant and also positive at low to middle intensity, i.e., from quantile (0.05-0.50), which means that with even with small or moderate economic growth in China, EFP will also increase. The nexus between GDP^2-EFP is insignificant. The long-run relationship between TOR-EFP is again significant but positive at low intensity, i.e. from quantile (0.05-0.20), which means that with low arrival of tourists in China, EFP might decrease. Globalization is significant and positive from a lower-middle intensity level, i.e. quantiles (0.30-0.50), but it is negative at high-intensity quantile, i.e. (0.80). The positive sign, along with lower middle quantile shows that as china is getting globalized at a moderate rate, EFP might also be affected positively, where if it is globalized at a higher pace, it might decrease EFP. Like in the case of CO_2 emissions, this segment of results might suggest significant insights regarding the economic growth pattern in China. The dependence on fossil fuel-based solutions reduces the carrying capacity of the earth, and it is reflected in the negative impact of economic growth on EFP. This is reflected by the catalytic impact of economic growth on EFP at its lowest to middle quantiles. The non-existence of the EKC for EFP also substantiates the claim regarding the ecological unsustainability of the economic growth pattern. This segment of the results refutes the finding of Yang and Yang (2019). A reflection of this situation can also be seen in the case of the impact of globalization, which is having a catalytic impact of EFP at the lower quantiles. However, at the higher levels of EFP, globalization might create positive environmental externalities through the nature of technologies being traded. These two differential impacts of globalization fall in similar lines with the findings of Yang et al. (2019). Like in the case of CO_2 emissions, in this scenario also, policymakers might aim to keep the level of EFP low to sustain the inflow of tourists. This segment of results addresses the issues outlined by Dong et al. (2019). The short-run dynamics depicts that EFP is positively and significantly affected by its preceding levels at all the quantiles. The contemporary and earlier variations in GDP have a positive significant influence whereas GDP^2 has a negative significant influence on contemporary EFP from quantiles (0.10-0.30). Furthermore, preceding and contemporary variations in TOR has a negative significant influence on contemporary EFP at quantiles (0.05-0.30). The preceding and contemporary variations in globalization have no significant influence on contemporary EFP in the short-run.

Table V shows the outcomes of GHG emissions. As discussed in both previous models, the value of ρ, the speed of adjustment parameter should be negative, and the same has been achieved here; however, it is significant only at two levels, quantile 0.80 and quantile 0.90. The long-run nexus between GDP-GHG emissions is significant and also positive at low intensity, i.e., from quantile (0.05-0.20), which means that with a small economic growth in China, GHG emission will increase. The nexus between GDP^2-GHG emission and TOR-GHG is significant but negative at quantile (0.05-0.20) and quantile (0.05-0.40), respectively. The TOR-GHG nexus shows that low tourist arrival in China will decrease GHG emissions. globalization is significant and positive at the middle-intensity level of quantiles, i.e. (0.40-0.60), which shows that with moderate globalization in China GHG emission will increase. Compared to the cases of CO_2 emissions and EFP, the impact of economic growth patterns on GHG emissions is proving to be different. Though the economic growth pattern turns out to be insignificant at the higher quantiles of GHG emissions, at the lower quantiles, the economic growth pattern is turning out to be effective, as the evidence of EKC is found at the lower quantiles of GHG emissions. This segment of results supports the finding of Song et al. (2018). The globalization pattern takes a departure from this stage, as it shows a catalytic impact on GHG emissions at the middle quantiles. This segment of the results extends the finding of Wu and Han (2020). Like the previous two cases, the impact of tourism on GHG emissions is negative at the lower quantiles. This result extends the finding of Li et al. (2020). The short-run dynamics depict that the current GHG is positively and significantly affected by its preceding levels at all the quantiles. The contemporary and earlier variations in GDP have a positive significant influence from quantiles (0.05-0.10) and (0.80-0.95). The contemporary and earlier variations in GDP^2 and TOR have a negative significant influence on contemporary GHG from quantiles (0.05-0.10) and (0.80-0.95) for GDP^2 and from quantiles (0.05-0.10) and (0.90-0.95) for TOR. The preceding and contemporary variations in globalization have no significant influence on contemporary GHG in the short-run.

Table VI: Results of the Wald test for the constancy of parameters

Variables	Carbon Dioxide Emission	Ecological Footprint	Greenhouse Gas Emission
ρ^*	5.392*** [0.000]	6.323*** [0.000]	4.797*** [0.000]
β_{GDP}	4.953*** [0.000]	3.392*** [0.000]	4.797*** [0.000]
β_{GDP2}	15.386*** [0.000]	27.339*** [0.000]	16.644*** [0.000]
β_{TOR}	6.752*** [0.000]	7.433*** [0.000]	3.468*** [0.000]
β_{GLO}	3.304*** [0.000]	4.211*** [0.000]	3.547*** [0.000]
φ_1	2.230** [0.016]	3.492*** [0.000]	1.371 [0.197]
ω_0	6.347*** [0.000]	2.989*** [0.001]	0.731 [0.689]
λ_0	2.481*** [0.008]	3.483*** [0.000]	1.211 [0.286]
θ_0	3.295*** [0.000]	2.185** [0.018]	0.238 [0.999]
ψ_0	4.229*** [0.000]	1.850* [0.055]	0.591 [0.820]

Source: Authors Estimation

Table VI states the outcomes of Wald tests, through which asymmetric effect under short- and long-run situations are checked. Overall, ρ, the speed of adjustment parameter under all situations is significant, further under all three models significant long-run asymmetric relationship exists e.g. for economic growth, (β_{GDP} – CO2 emission, β_{GDP} – EFP, β_{GDP} – GHG emission), for tourism, (β_{TOR} – CO2 emission, β_{TOR} – EFP, β_{TOR} – GHG emission) and for globalization ((β_{GLO} – CO2 emission, β_{GLO} – EFP, β_{GLO} – GHG emission, which means that null hypothesis of parameter dependability is rejected at all quantiles. However, the short-run relationships among variables show a different picture, i.e. in case of deterioration in environmental quality (CO_2, EFP, and GHG), the outcomes confirm that the null hypothesis related to parameter constancy is rejected. In the case of economic growth, tourism, and globalization, the asymmetric relationship is significant with just two variables i.e. CO_2 and EFP, which means that current and previous impact of all these three variables (GDP, TOR, and GLO) is significant for CO_2 model, as well as for EFP model. On the other hand, all these variables show an insignificant relationship with GHG emission, which means that the association is symmetric in this case. The results obtained from this segment of analysis fall in similar lines with Ahmad et al. (2018), Atil et al. (2018), and Lahiani (2020).

5. Discussion on sustainability

By far, the impact of globalization, tourism, and economic growth have been analyzed on three indicators of environmental degradation in China. It can be seen that the economic growth pattern has a catalytic impact on CO_2 emissions and EFP, whereas its impact on GHG emissions has demonstrated an inverted U-shaped EKC form. Tourism has demonstrated a positive impact on environmental quality, whereas the impact of globalization has largely been found to be negative. Looking at the present growth trajectory achieved by China, these outcomes can be utilized to develop certain policies for ascertaining sustainable development, through realignment of the existing policies and development of new policies. These policies need to be designed to internalize the negative externalities caused by the existing policies. In this pursuit, the common thread between the model outcomes should be analyzed, followed by the suggestion of policies (Roy et al., 2018). To start with, it is evident that the economic growth pattern in China is one of the major reasons behind the rise in CO_2 emissions. Saying this, it also needs to be seen that the impact is visible at lower quantiles of CO_2 emissions. This particular segment of the result might be aligned with the impact of globalization on CO_2 emissions. Owing to the rise in globalization, the rise in vocational opportunities in China has increased, and thus, the rise in CO_2 emissions can be attributed to the rise in population in the urban regions. A similar case was visible in the case of the EFP also, as the rise in population pressure in the urban centers might have caused pressure on urban infrastructure, and thus, bringing forth negative consequences to the carrying capacity of the region. This pressure might have been felt at the later stages of economic growth, and perhaps that is the possible reason behind the insignificant impact of economic growth pattern on the CO_2 emissions and EFP at their higher quantiles, as the pressure on the urban infrastructure through rising population started to emerge as a bigger ecological predicament compared to economic growth itself. This specific issue was identified by Liu and Bae (2018) also.

This argument is further validated by the influence of the economic growth pattern on GHG emissions. The acceptance of the EKC hypothesis, in this case, indicates that economic growth might not be the only reason, because of which environmental degradation is rising in China. On the other hand, the impact of globalization can be seen at various levels of environmental degradation, and this indicates that the driver of economic growth might be responsible for the ecological stress experienced by China. Therefore, it might be assumed that the creation of globalization-led vocational opportunities in China is majorly focused at urban centers, while those locations might not be capable of handling the rising population pressure. One of the major problems of this disproportionate urbanization is the consumption of commercial electricity and other natural resources, which might cause a rise in CO_2 emissions and EFP. Therefore, the rise in CO_2 emissions and EFP beyond a level might not be the consequence of economic growth, but the globalization. This argument is further validated in incidence of the impact of economic growth on other GHG emissions. In light of this argument, it might be stated that more than the economic growth pattern, the pattern of globalization needs to be monitored.

Now, if the nature of globalization is analyzed following Dreher (2006), then it can be assumed that the nature of globalization discussed in the background of environmental degradation is the economic globalization. If the aspect of social globalization is analyzed, then the growth of the tourism industry might be attributed to it. Tourism is having a positive influence on environmental quality, across all the three indicators of environmental degradation. Hence, it might be said that social globalization is trying to internalize the negative ecological externalities caused by economic globalization. In such a scenario, the energy and other allied policies need to be realigned with the globalization pattern, so that globalization can be utilized as a policy tool to attain sustainable development. Now, to begin with, the government should first look into the issues of rising energy demand at the domestic level, which is translated at the industrial level. To address this issue, policymakers should ponder upon the implementation of renewable energy solutions as a viable replacement for fossil fuel-based solutions. However, this replacement should be a phase-wise process, as overnight replacement of energy sources might cause harm to the economic growth pattern itself (Zafar et al., 2019b). Therefore, the households should be provided with renewable energy solutions at a discounted rate, and these solutions might be availed from the government at a pro-rata rental rate. This pro-rata rate might be decided based on the level of income. The economic loss incurred in this process might be recovered from the renewable energy solutions provided to the industrial sector. This will help the nation to streamline the process of renewable energy implementation while making it affordable to all the citizens (see Sinha et al., 2020a, b). This policy move will help them to attain the objective of SDG 7. Now, to sustain this solution, policymakers must scrutinize the import of technologies, so that the betterment of environmental quality can be retained. In order to sustain this move, in the next phase, the government should look into improving the urban infrastructure. In doing so, the expansion of residential facilities, green buildings, and proper sanitation facilities can be implemented. This will help the nation to achieve the objectives of SDG 11.

While implementing this set of policies, the policymakers should also look into the unemployment scenario to be generated in the mining and thermal energy generation sector, as the demand for this energy will be gradually reduced (Cai et al., 2014). In this case, the government should look into the rehabilitation of the laborers working in this sector through proper training. Now, it is evident that the prevailing renewable energy generation sector might not be able to absorb this workforce entirely. In this case, the government should encourage the people-public-private partnerships, so that entrepreneurship ventures can be initiated for not only catering to the rising demand of energy but also to absorb the skilled and unemployed workforce (Roy and Singh, 2017). While saying this, the policymakers should also remember that the technology transfer via the globalization route should not be used as a tool to replace the laborers with technology, as this might aggravate the issue of unemployment (Arrow et al., 1961). Once the laborers start getting a job in the renewable energy generation sector, then the stability of the policies designed in the previous phase can be stabilized. During this phase, the objectives of SDG 8 can be attained.

Alongside economic globalization, the policymakers should also be interested in utilizing the aspect of social globalization, as this policy move might help the policymakers in recovering the economic losses incurred during renewable energy application. In this pursuit, the policymakers should promote tourism-related activities, as it has been found to have a positive impact on environmental quality. This initiative should be backed by the 13^{th} 5-Year disposition for Tourism Development of Beijing in terms of utilization of green energy in tourism-related activities, so that tourism can create positive environmental externalities (UNWTO, 2018). Moreover, it will also help to create additional vocational opportunities, which will supplement the policy decisions already discussed. In this way, the objectives of SDG 13 can be attained, while keeping with the attainment of the objectives of SDG 7. Now, if the people-public-private partnerships are promoted by the government, then a series of awareness campaigns can be run at various tourism destinations so that the overconsumption of natural resources and electricity can be avoided. The tourists will become aware of responsible consumption, and this awareness might have a trickledown effect on the residents and businesses in those destinations. This will help the nation to achieve the objectives of SDG 12.

6. Conclusion and Policy Implications

The present research examines the influence of three variables (i.e., economic growth, tourism, and globalization) on CO_2 emissions, EFP, and GHG emissions in the context of China. The QARDL technique of Cho et al. (2015) was utilized by collecting quarterly data from the 1st quarter of 1978 to the 4th quarter of 2017. This study contributes to the literature by suggesting the association among the model parameters through quantile modeling. Mixed results were found in all three models. As far as economic growth is concerned, all three models showed significant and positive relations with CO2 emissions, EFP, and GHG emissions from the lower to middle quantiles, which shows that even economic growth at a moderate level will trigger the positive impact on CO2 emissions, EFP, and GHG emissions. GDP^2 was significant but negative in GHG emissions, while in the other two models it was insignificant. For tourism, two models (i.e., EFP and GHG) showed significant but negative relations at low quantiles, which means that low tourist arrivals in China will decrease both EFP and GHG emissions. Last, the result of globalization is quite mixed. A higher pace of globalization in China will increase CO2 emissions, whereas if globalization is at a moderate level, it will affect positively both EFP and GHG emissions.

Considering the case of the Chinese economy, this is the first study to take a comprehensive methodology towards policy recommendations for achieving the SDG objectives, while reflecting upon globalization and tourism as facilitators of sustainable development. Based on the results, the policy framework suggested by the study to achieve the SDG objectives is a contribution to the literature. This study has shown a way following which primarily the objectives of SDG 7, SDG 13, and SDG 8 can be achieved, through reducing environmental degradation, promoting green energy, boosting tourism, and creating employment opportunities through people-public-private partnership. Globalization can be utilized as a policy tool to attain the objectives of SDGs while promoting sustainable tourism and the policies designed based on the results of this study have shown an introductory way to achieve it.

While laying out the policy framework, it needs to be remembered that there are some assumptions, without which the policy framework might not be successful. First, technologies imported via the trade route should not be environmentally harmful, as it will create negative environmental externalities, along with departing from the objectives of SDG 13. Second, the technologies imported via the trade route should not be used as a total replacement of manual labors, as without job creation, the foundation of the entire policy framework might be harmed. Third, the implementation of renewable energy solutions should be carried out in a phase-wise manner, as a total replacement of fossil fuel solutions in a single phase might cause harm to the economic growth pattern. Fourth, a successful policy implementation for sustainable development necessitates the involvement of the citizens, and therefore, the people-public-private partnership should be encouraged, as this particular move might help the policymakers to reach the grassroots level.

These assumptions might be considered in keeping with tourism development, as tourism has also been considered as one of the policy variables within this framework. In keeping with the aim of the Chinese policymakers to promote sustainable tourism through the promotion of green energy, tourism-related industries should also come under this promotion. Ascertaining people-public-private partnership might help policymakers to ensure abiding of the environmental regulation by the inbound tourists. Moreover, this move might also help in monitoring the tourism-related industries in their environmental performance. However, while the results reflect upon the impact of low penetration of tourism on environmental quality, it should be considered that aggregate tourism arrivals were considered in this study so that a brief idea about the possible impact of tourism within this framework can be assessed. While this is a limitation of the study, the future study on this direction should consider various forms of tourism, or different kinds of tourist arrivals, as that segregation might enrich the policy suggestions provided in this study. While saying this, an extrapolation of the study outcome can be in terms of promoting more environment-friendly forms of tourism, such as eco-tourism. Initiatives like this will comply with the policy framework suggested in this study.

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Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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