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Dynamic and causality linkages from transportation services and tourism development to economic growth and carbon emissions: New insights from Quantile ARDL approach

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Data Statement

Data and calculation tools are available from corresponding authors Yunpeng Sun (tjwade3@126.com) and Asif Razzaq (asifrazzaq@yahoo.com).

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Abstract

The current study intends to investigate the pathway toward sustainability in Malaysia while observing the effects of tourism and transportation services on economic growth and carbon emissions. For this purpose, the study applied the quantile autoregressive distributed lag approach during the period of 1970-2018 along with Granger causality to explore dynamic and asymmetric causal associations between the proposed variables. The empirical outcomes indicate that the error correction parameters are significant across major quantiles, confirming the presence of steady-state equilibrium in the long run. The results show that tourism and transportation services significantly contribute to economic growth in the long run; however, their contribution varies at different quantiles. On the other hand, tourism and transport services were found to mitigate carbon dioxide emissions mainly across higher emission quantiles, confirming the sustainability of the transport and tourism sector in Malaysia. We also observe a bidirectional causality between model variables. These results suggest important policy implications.

Key words: sustainable gateway, transport, tourism, economic growth, carbon emissions, QARDL

JEL Codes: P18, Z32, Q01

Key Points:

The study investigate the asymmetric trends of tourism and transport services using novel quantile ARDL framework. Tourism and transportation services significantly contribute to economic growth Tourism and transport services found to mitigate carbon dioxide emissions mainly across higher emissions quantiles Environmental impact of tourism and transport services is significantly varied across lower, medium, and higher quantiles

Introduction:

The growth dynamics of the world have changed drastically in the last decade. The agricultural and manufacturing sectors were considered paramount for economic growth; however, globalization has diversified, entrenching new contributors to economic growth. The role of tourism was often neglected considering it a nongrowth sector, hence attracting little attention from policymakers and economists (Papatheodorou, 1999 and Vanhove 2011). Currently, the growth paradigm is more inclusive, and tourism has become one of the fastest growing service sectors in the world (Kyrylov, Y et al. 2020).

Tourism is an important sector and contributes significantly to the gross domestic product (GDP) of Malaysia. As per the latest findings of DOSM (2019), it is observed that the tourism industry in the Malaysian economy has generated a revenue of more than RM 11.0 billion. Meanwhile, Gross Value Added of Tourism Industries (GVATI) has been recorded with a net contribution of 15.9% to GDP during 2019. This would justify the argument that both tourism and growth in the Malaysian economy are moving together, where the former contributes up to a significant level. Furthermore, the tourism sector is the largest contributor in the economy, as it attracts significant foreign exchange earnings, creates job opportunities and has other significant positive spillovers (Bhuiyan et al. 2011 and Wang W., Ma H. 2015; Lv et al. 2021). Malaysia has been developing the tourism industry for more than a decade, and its government realized the importance of the tourism industry in the mid-1980s. The petroleum industry was in crisis and it resulted in the overall global slowdown. For this reason, the government decided to explore other revenue streams that could sustain and diversify economic growth. They developed the Ministry of Culture, Arts and Tourism, which in 2004 was named Ministry of Tourism (Fateh, 2016).

After 2004, the government dispensed adequate resources to provide a fundamental foundation for the tourism industry. As a result, the tourism industry contributed RM 84.1 billion in 2018, which is 2.4% higher than the preceding year's recorded income (Statista, 2021). However, during the recent pandemic of COVID-19, a significant decline in the total value of tourism receipts in Malaysia declined to 12.7 million RM (Statista, 2021). Meanwhile, 25.8 million tourists visited Malaysia in 2018, which shows a decline of 25.9 million from the preceding year, but the amount of per capita expenditure of tourists increased from RM 3257 to RM 3266. Major components of this touristic spending were shopping, accommodations and food and beverages (Bernama 2019). Furthermore, as per the findings of the World Development Indicator (2021), during 1995, the total number of tourist arrivals in Malaysia was 7,469,000, compared to 26,10,1000 during 2019, hence showing significant growth over the last three decades.

The environmental framework has significantly changed worldwide in the last few decades (Wang et al. 2021). The American Meteorological Society published a report titled State of Climate Change in 2018 analyzing the worldwide surface temperature. The report shows that the top ten hottest years occurred after 1998, whereas the four hottest years occurred after 2014. The study provides ample evidence that the global temperature is rising, and the increased CO_2 emissions amplify the rise of worldwide surface temperature. Since the 1960s, the amount of CO_2 emitted has nearly quadrupled and results in dangerous atmospheric change (Blunden, Arndt, and Hartfield 2018). The

Intergovernmental Panel on Climate Change (IPCC 2018) analyzed different tropical changes with respect to climate change and concluded that rising ocean levels, deviations in the precipitation cycle and seasonal cycle are all effects of climate change. This climate change has a devastating impact on the economy, social structure, governmental role and ecological system (Bilgili et al., 2016; He et al. 2018; Chen et al. 2018).

The adverse effects of climate change have made the world more vulnerable to disasters and natural calamities. Individuals and societies are facing immense challenges due to climate change, and unnatural rain cycles are causing severe floods and water deficiencies (Escobar et al., 2009; Hu et al. 2020; Zhang et al. 2015). Concentrating to the determinants of rising worldwide temperature in recent decades, there is ample evidence that CO_2 emissions are the core factor behind these environmental changes (Anderson, Hawkins, and Jones, 2016; Mossler, *et al* 2017). More specifically, as per the findings of Our World in Data (2021), it is observed that for the Malaysian economy, the value of per capita CO2 emissions from the burning of fossil fuels for energy increased dramatically from 1.3 tons to 8.0 tons during 1970-2017. This would justify the argument that there has been an increasing trend in the environmental degradation of Malaysia over the last couple of decades.

In addition, various studies have also been covering the tourism-led-growth nexus both in developed and developing economies (Habibi, Rahmati, & Karimi, 2018; Manzoor, Wei, & Asif, 2019; Roudi, Arasli, & Akadiri, 2019; Saint Akadiri, Eluwole, Akadiri, & Avci, 2020); such studies argued that more investment from various stakeholders in the tourism industry is observed. Furthermore, as per the findings of the World Tourism Organization (2000), it is believed that the world tourism industry would have experienced a dramatic increase of 1602 million international tourists by the end of 2020. This significant growth in the tourism industry comes along with the tourism earnings of approximately 200 million USD. In addition, another interesting fact is that the contribution of the tourism industry to the global gross domestic product was approximately 10.5% during 2005, which increased more than 0.50 or up to 11% during the first half of the last decade (World Travel and Tourism Council report, 2005). In this regard, international tourism is regarded as a long-term contributor to growth and foreign exchange and it spurs investment in different sectors.

However, there are various sources, such as commercial and residential buildings, electricity generation, agricultural activities, and other industries, that are responsible for greenhouse gas emissions in the natural environment. However, the issue of a higher level of CO2 emissions in the economy of Malaysia is also linked to the transportation industry. For instance, during 2019, the level of CO2 emissions from the transport industry in Malaysia was 63 metric tons, which was only 4% in 1970. However, the increase in carbon emissions from the transportation industry was found to be higher at 31.15% in 2013 (Knomea, 2021). This would also indicate that there was an increasing trend of 2.03% during 2019 compared to 2018, where an upward shift of 1.43% was observed.

Since the 1990s, the environment- and energy-related problems brought by the tourism industry have attracted attention from different organizations, scholars, researchers, and policymakers. In 1995, the 21st convention of tourism and travel industry stated that both resource management and energy consumption were the key areas for the development of the tourism industry (WTTC et al., 1995; Peng et al. 2021). Since then, a number of scholars have investigated titles such as carbon emissions during the tourism process (Jermsittiparsert, 2019; Liu, Feng, & Yang, 2011; Pan, Weng, Li, & Li, 2021). More specifically, one of the significant contributions is provided by Gössling (2000), who conducted a systematic investigation of energy consumption and carbon emissions in the tourism industry. Furthermore, Gössling and his partners have proposed multiple aspects, such as voluntary carbon offset of air travel, eco-efficiency of the tourism sector, carbon neutral tourism destination, food management in tourism, and measurement of regional carbon emissions under the tourism industry.

The motivation behind the present study is to integrate tourism, economic growth, transportation structure, and climate change with the help of an innovative methodological approach that may provide some significant contribution to the theoretical and empirical literature of these variables. For this purpose, two different models are developed to understand this tradeoff and are examined using the quantile autoregressive distributed lag method (QARDL) approach, as suggested by Cho, Kim, and Shin (2015). The QARDL approach has several advantages compared to the linear autoregressive distributed lag models (ARDLs). For example, QARDL presents location asymmetries, i.e., quantile asymmetries in the long run and short run between tourism, transportation, economic growth and carbon emissions and other control variables.

The novelty of this method would be a value addition to the tourism economic growth and transportation-climate change literature. In addition, QARDL efficiently tackles the asymmetricity issues pertaining to the econometric model. Based on the stated approach, the research question under the present study would examine the nonlinear association between gross domestic product, carbon dioxide emissions, capitalization, labor, population, personal income, tourism and transportation in the region of Malaysia.

The study is broken down into five core sections. Section one is an introduction elaborating a brief background evolution of the tourism industry, its role in economic development, the importance of transportation infrastructure and a considerate view of negative spillover from a climate perspective. It also provides the core findings in terms of tourism specifically in the context of Malaysia. Section two strengthens the arguments with a critical review of the variables, as discussed in the relevant literature. Section three discusses the methodology employed and its salient features. Section four analyzes the results, whereas section five concludes the with findings, policy implications, limitations and suggestions for decision-making purposes.

Review of Literature:

The tourism industry is considered a development sector with the potential to improve the socioeconomic conditions of a country. It is accepted as a priority agenda in many countries, and policymakers are focusing on it as a growth-oriented sector. Decision-makers and government are approaching tourism as a sector for economic growth, but consideration has also been developed to minimize its adverse impact on climate (Razzaq et al. 2021a; An et al. 2021; Liu and Wall, 2006). The challenges for developing countries are greater, as they have already narrowed down the fiscal space to develop or enhance the tourism sector. Developing countries approach the tourism sector to enhance economic activities and overall social upliftment (Hall, 1995 and Wang W., Ma H. 2015). Countries with less fiscal space develop specific regions and towns to attract tourists. At the same time, policymakers assume tourism to be an attractive industry for job opportunities, regional development, social upliftment and foreign exchange earnings. It is also a good source to cope with the balance of payment shortfalls (Glasson et al. 1995).

In addition, the role and focus of government vary from country to country, but three core features of the tourism industry are employment opportunities, income generation and foreign exchange earnings. Countries focus on tourism according to their objectives and desired outcomes (Taleghani, 2010). Researchers have a broad consensus that there is a bidirectional relationship between tourism and economic growth (Ridderstaat, Croes, and Nijkamp 2014; Dogru and Bulut 2018); however, there are studies that identify this relationship in light of certain other factors, such as transportation infrastructure, institutional quality, and general income determinants (Tang and Tan 2018 and Du, Lew, and Ng 2016).

There is ample evidence that the tourism sector contributes to economic growth. Furthermore, to attract tourists, countries need to develop or upgrade infrastructure, such as transportation networks, water and sanitation utilities, accommodations and security which complement the tourism sector (Al-Mulali, Fereidouni, and Mohammed, 2015). Touristic influx has negative spillovers, and a country often faces this tradeoff of choosing tourism sector enhancement and the negative externality associated with it. Increased CO_2 emissions are one of the major negative externalities associated with tourism, and climate consideration is the largest tradeoff countries face while promoting the tourism sector (Sharif, Afshan, and Nisha, 2017; Zaman et al., 2017).

Zhang and Zhang (2020) examined the association between tourism and economic growth along with energy consumption and carbon emissions for the economy of China. Using Granger causality, the study confirms that there is a bidirectional causality between tourism and economic growth. Furthermore, these variables have their long-term equilibrium association. Dogru et al. (2020) have taken into account OECD economies while exploring the linkage between tourism, economic growth, carbon emissions, and energy consumption. However, their study findings show that there is a negative impact of tourism development on carbon emissions for Canada, Czechia, and Turkey and a positive impact of tourism development on CO2 emissions in Italy, Luxembourg, and the Slovak Republic. Gao, Xu, and Zhang (2021) tested the EKC hypothesis for the Mediterranean region (Razzaq et al. 2021).

Policymakers, governmental agencies, researchers, scientists, and civil society are keenly focusing on climate change and its implications. Having pivotal value in recent times, the determinants of climate change have been studied and are under consideration in every policy discourse. The main determinants identified by the researcher are increased CO_2 emissions, trade, urbanization, economic growth and population (Park, Meng, and Baloch, 2018; Cetin, Ecevit, and Yucel, 2018; Li and Lin, 2015; Nasrollahi, Hashemi, Bameri, and Mohamad Taghvaee, 2018; Dong, Sun, and Dong, 2018). Interestingly, there is an established relationship between tourism and environmental quality, but increased CO_2 emissions have not been angled by scientists as driving factors in the tourism literature (Solarin, 2014).

In contrast, studies are more focused on the negative impact of climate change and the tourism sector (Scott, Gössling, and Hall, 2012). Considering it as a push factor for travelers, studies are more focused on the climate conditions affecting the choice of destination of tourists, touristic activities and overall touristic experience (Hoogendoorn and Fitchett, 2018; Hamilton, Maddison, and Tol, 2005). Similarly, undesirable climatic conditions negatively affect tourism, whereas appropriate touristic conditions are desirable for tourist attraction (Amelung, Nicholls, and Viner, 2007).

There are other sides to this tourism climate nexus as well. Tourism also increases CO_2 emissions, and the tourism sector heavily relies on fossil fuel for transportation (either inter or intra) (Sun et al. 2021). All transportation needs are met by fossil fuel, which increases CO_2 emissions, resulting in increased global temperature (Gossling and Peeters 2015). Tourism infrastructure uses more fuel, as it is used for the transportation of tourists, their food supplies, and other needs which cater to their influx. Water and sanitation infrastructure are developed or upgraded to cater to seasonal demand. Tourist attractions are developed that generally consume high energy due to mechanized installations, such as theme parks. High energy consumption increases CO_2, which results in an adverse effect on global temperature and climate (Dwyer, Forsyth, Spurr, and Hoque, 2016; Raza, Sharif, Wong, and Karim, 2017).

The literature suggests that the effect of tourism on CO_2 emissions is substantial, and considering the explanation offered, it is paramount that empirical evidence is analyzed to develop tourism policy. Expecting tourism as a developing sector with contribution toward economic growth, countries must consider its implications on climate change (Park, Meng, and Baloch, 2018). Developing countries face this hard choice in tradeoffs, as their reliance on income, employment and foreign exchange earnings is heavily dependent on this sector. Climate considerations have huge economic and social costs for countries heavily dependent on its income (Ahn et al., 2002; An et al. 2021a).

In addition, the environmental impact of growth has also been observed with significant attention from researchers in recent decades. In this regard, one of the common assumptions specifies that environmental quality deteriorates during the early stage of economic growth however, it improves at some later stages along with economic development. This means that environmental pressure rises faster than growth during the early stages but slows down at some later time relative to growth in terms of gross domestic product (Dinda, 2004). This would justify a systematic relationship between change in the income level and quality of the environment, which is known as Environmental Kuznets Curve or EKC. Meanwhile, the logic of the EKC is very appealing because in the first stage of industrialization, there is rapid growth in pollution because of the higher level of priority given to material output and industrialization, where individuals are more interested in jobs and earnings than in clean environments (Dasgupta, Laplante, Wang, & Wheeler, 2002). The significant growth results in more utilization of natural resources along with the emission of pollution, hence more pressure on the natural environment as well (Dinda, 2004). In this regard, a range of studies have explored the EKC hypotheses in developed, developing and less developed economies. However, these studies deal with environmental pollution, macroeconomic variables, and energy consumption while taking both time series and panel data observations (Destek & Sarkodie, 2019). More specifically, Remuzgo and Sarabia (2015) supported the justification for the EKC while claiming that there is a decline of 22% in global CO2 emissions due to economic development. Ouyang and Lin (2015) stated that energy intensity is among the core contributors to higher levels of carbon emissions in the natural environment. Meanwhile, for the economies of China, the USA, India, and Japan, Azam, Khan, Abdullah, and Qureshi (2016) have observed a positive and significant relationship between economic growth and carbon emissions. Asumadu-Sarkodie and

Owusu (2017) provided empirical evidence that more energy consumption leads to more carbon emissions, whereas factors such as GDP and urbanization reduce the level of $CO2$ emissions in long-term estimation.

Although significant work has been done from both theoretical and empirical perspectives, specifically in the context of tourism and economic growth, one of the missing parts, as observed in the existing body of literature, suggests that the nexus between tourism, transportation, economic growth, capitalization, population, personal income, and carbon emissions is widely missing specifically in the region of Malaysia. Furthermore, the methodological implication in terms of QARDL is also found to be a missing part in the literature while exploring the nonlinear association between these variables. In this regard, this study develops a tourism-economic growth model while considering negative spillovers of tourism. Tourism has both positive and negative externalities, and to harness tourism, countries must consider both aspects of it. The study contributes a novel perspective on the sustainability of Malaysia using tourism as a pivotal contributor to economic growth, where the title of tourism is observed through the arrival of all tourists in the region of Malaysia during the study period. Based on the above literature, the following hypotheses have been suggested.

H_1 Gross domestic product is significantly determined by capitalization and labor, providing evidence that higher GDP is experienced with higher levels of capitalization and labor.

H_2 Gross domestic product is significantly determined by tourism and transportation, providing evidence that higher GDP is experienced with higher levels of tourism and transportation.

H_3 Carbon emissions are significantly determined by population and personal income, providing evidence that more CO2 emissions are experienced with higher levels of population and personal income.

H_4 Carbon emissions are significantly determined by tourism and transportation.

Methodology

Considering the existing literature, it is observed that there are mixed findings for the relationship between gross domestic product, carbon dioxide emissions, capitalization, labor, population, personal income, tourism and transportation. Furthermore, while working with the macroeconomic variables, it is observed that the issue of unit root is generally encountered in the time series analysis. In such analysis, the levels at which different variables are stationary are often used in the fact that association between the nonstationary series is observed as spurious, which causes a significant loss of information under long-run estimation. These issues may further lead to the development of some cointegration tests. Engle and Granger (1991) who developed a two-staged cointegration test, suggested that a series that contains the unit roots at its level and becomes stationary at the first difference can be regressed at its levels, and for this reason, the loss of information can reasonably be prevented. However, the condition for the implication of Engle and Granger cointegration specifies that there must be one cointegrated vector. On the other hand, the test developed by Johansen (1992) is based on the VAR model, which specifies the opportunity to determine more than one cointegration between the study variables.

In addition, the present study tries to investigate the nonlinear association between the gross domestic product, carbon dioxide emissions, capitalization, labor, population, personal income, tourism and transportation using QARDL, which has several advantages. For example, it helps predict both the long-term and short-term equilibrium effects of key explanatory variables on the carbon emissions and economic growth of Malaysia. Furthermore, the implication of the QARDL method is also very helpful to examine the heterogeneous effect of independent variables on GDP and carbon emissions for all three levels of quantiles (i.e., low, medium, higher). Meanwhile, it also helps us to confirm the effect of study variables such as tourism, transportation, labor, capitalization and income for checking the increasing/decreasing effect under all three levels of quantiles (Razzaq et al. 2121b).

In the general context of ARDL, the following Equation 1, describes the association between the variables of interest.

$$Y_t = \alpha + \sum_i^p \beta_1 Y_{t-i} + \sum_i^q \beta_2 X1_{t-i} + \sum_i^m \beta_3 X2_{t-i} + \sum_i^n \beta_4 X3_{t-i} + \sum_i^r \beta_5 X4_{t-i} + \epsilon_t \text{Equation (1)}$$

where the level of white noise error term ϵ_t is explained by the lowest field created by the study variables. Symbols such as p, q, n, and r show the lag orders in the study as suggested by the Schwarz Info Criterion (SIC). Meanwhile, variables such as Y indicate the main dependent variables, and Xs represent the explanatory variables as added in the model. After determining the general description of the variables, Equation 2 provides the context of quantiles as suggested under the present study through the QARDL framework.

$$Q_{Y_t} = \alpha(\tau) + \sum_i^p \beta_1 (\tau) Y_{t-i} + \sum_i^q \beta_2 (\tau) X1_{t-i} + \sum_i^m \beta_3 (\tau) X2_{t-i} + \sum_i^n \beta_4 (\tau) X3_{t-i} + \sum_i^r \beta_5 (\tau) X4_{t-i} + \epsilon_t(\tau) \text{Equation (2)}$$

where titles such as $\epsilon_t(\tau) = Y_t - Q_{Y_t}(\tau/\epsilon_{t-1})$ and $0 < \tau < 1$ reflect the quantiles of the study. Furthermore, our study has applied the subsequent pair of different quantiles ranging from 0.05th to 0.95th; meanwhile, due to probability of sequential correlation in the white noise error, the QARDL framework under Equation 2 can be redefined with the help of following the Equation 3:

$$Q_{\Delta Y_t} = \alpha(\tau) + \rho Y_{t-i} + \varphi_1 X1_{t-i} + \varphi_2 X2_{t-i} + \varphi_3 X3_{t-i} + \varphi_4 X4_{t-i} + \sum_i^p \beta_1(\tau) Y_{t-i} + \sum_i^q \beta_2(\tau) X1_{t-i} + \sum_i^m \beta_3(\tau) X2_{t-i} + \sum_i^n \beta_4(\tau) X3_{t-i} + \sum_i^r \beta_5(\tau) X4_{t-i} + \epsilon_t(\tau) \text{ Equation (3)}$$

In addition, after further modification in Equation 3 in terms of the error correction model for the QARDL framework, Equation 4 is achieved, which is given below:

$$Q_{\Delta Y_t} = \alpha(\tau) + \rho(\tau)(Y_{t-i} - \omega_1(\tau) X1_{t-i} - \omega_2(\tau) X2_{t-i} - \omega_3(\tau) X3_{t-i} - \omega_4(\tau) X4_{t-i}) + \sum_{i=1}^{p-1} \beta_1(\tau) \Delta Y_{t-i} + \sum_{i=0}^{q-1} \beta_2(\tau) \Delta X1_{t-i} + \sum_{i=0}^{m-1} \beta_3(\tau) \Delta X2_{t-1} + \sum_{i=0}^{n-1} \beta_4(\tau) \Delta X3_{t-i} + \sum_{i=0}^{r-1} \beta_5(\tau) \Delta X4_{t-i} + \epsilon_t(\tau) \text{ Equation (4)}$$

Furthermore, with the help of Δ,, our study examined the collective short-term effect of previous values of Y on the current values of Y, which were calculated with the help of $\beta_* = \sum_{i=1}^{p-1} \beta_1$. However, the collective short-term effect of contemporary and past values of X on the present value of Y are captured with the help of $\beta_* = \sum_{i=1}^{q-1} \beta_2$. In addition, the rest of the cumulative short-term impact of past and current values of Xs on the current values of Y I is estimated with the help of the same procedure. In addition, the term p in Equation 4 represents the speed of the adjustment coefficient, which should be negative and significant for the study quantiles. Meanwhile, our study considers the long-and short-term symmetric effect of Xs on the value of Y with the help of the Wald test while considering the null and alternative hypotheses for both long-term and short-term parameters. Based on the stated model of QARDL, it is expected that there will be a significant and dynamic nonlinear association between the study variables, where the role of transportation, tourism, economic growth, labor and population will be observed both under the long run and short run. Meanwhile, the stated approach of QARDL is also very beneficial to address the research question where nonlinear association between the study variables is examined.

In addition, one of the key points is to observe that under the first QARDL model, economic growth in terms of GDP is observed as the main dependent variable, whereas under the second QARDL model, carbon emissions are observed as the second dependent variable of interest. This is because both carbon emissions and GDP are interlinked with each other, yet we have followed the approach suggested by Paramati, Alam, and Chen (2017), where for the first model, GDP is observed as the main dependent variable, and under the second model, carbon emissions are observed as the dependent variable determined through PI and the rest of the explanatory variables.

After determining the dynamic nonlinear association between the study variables in the short-long run through QARDL, the next step is to examine the level of causality among them. For this purpose, the current study considers the Granger causality test with the help of the following Equation 5. The null hypothesis for the test is that lagged x-values do not explain the variation in y. In other words, it assumes that x(t) does not Granger-cause y(t), whereas the alternative stands opposite to it.

$$H_o^{X \nrightarrow Y}: F_Y(y \mid N_i^Y, N_i^x) = F_Y(y \mid N_i^Y), \text{ for all } y \in \mathbb{R} \qquad \text{Equation (5)}$$

where the assumed term $F_y(.|N_i^Y, N_i^X)$ shows the provisional distribution of Y, which considers (N_i^Y, N_i^X). As per the research findings of Sachs and Warner (2001), current research has applied the D_T check by classifying the QAR method $m(\cdot)$ for a complete $\pi \in \Gamma \subset [0,1]$; therefore, the null of the non-Granger association is described with the help of Equation 6 of the study.

$$QAR(1): m^1\left(N_i^Y, \partial(\pi)\right) = \lambda_1(\pi) + \lambda_2(\pi)X_{i-1} + \mu_t\Omega_{\Upsilon}^{-1}(\pi), \qquad \text{Equation (6)}$$

where the terms $\partial(\pi) = \lambda_1(\pi), \lambda_2(\pi)$ indicate the coefficients and μ_t are estimated by highest likelihood under the situation of equal points of the study quantiles. Additionally, $\Omega_{\Upsilon}^{-1}(.)$ means the opposite for the conventional basic distribution function in the study. However, to confirm the sign of causality among the study factors, the present research has applied the QAR method in Equation 6, based on the lagged factors to alternative factors. Therefore, the equation of QAR (1) can be reflected with the help of Equation 7.

$$Q_\pi^Y(Y_i \middle| N_i^Y, N_i^X) = \lambda_1(\pi) + \lambda_2(\pi)Y_{i-1} + \eta(\pi)X_{i-1} + \mu_t\Omega_{\Upsilon}^{-1}(\pi). \qquad \text{Equation (7)}$$

Results and Discussion

Table 1 shows the descriptive scores of the study covering the mean trend, standard deviation, minimum and maximum, along with normality verification through Jerque Berra test statistics. Descriptive scores provide some meaningful insight to examine the data trends over the study period. Furthermore, descriptive statistics also help to explore the data in terms of central location and dispersion in the observation. The data for the study variables, such as gross domestic product, transportation, tourism, labor, personal income, carbon emissions, and capitalization, are collected from the official data source of the world development indicator known as the WDI during the study period. All the study variables are measured by taking the natural log, as the highest mean score is reflected by TOR, followed by LAB and TRA reflectively. However, the mean trends in carbon dioxide emissions and gross domestic product validate that there is more air pollution in terms of CO2 in the natural environment of Malaysia compared to in Malaysia's mean trends in economic growth. However, the trends in capitalization in the economy of Malaysia are more comparable to gross domestic product but lower than the PI and TRA. In addition, the descriptive scores of all the study variables show a positive sign, where the highest deviation is recorded for capitalization. Additionally, our study provides the test score for the J-B states where the null hypothesis assumes the normal distribution of the variables. However, all variables show a significant J-B stat score of 1 percent, hence rejecting the justification for the normality of the data. Therefore, it is confirmed that the implication of the QARDL approach is quite evident under the present analysis.

To examine the unit root among the study variables, this research applies Zivot and Andrews (2002) along with the augmented Dicky-Fuller or ADF test, for which the findings are presented in Table 2. Various benefits for applying the ZA test are highlighted in the existing literature, such as accounting for the structural breaks in the dataset. The findings in Table 2 confirm that both the ADF and ZA tests have shown evidence for stationarity of the data either at the 1 percent or 5 percent level of significance but under ADF (Δ) and ZA (Δ) only. This would justify the argument that all the variables of interest have their unique order of integration, which is I(1).

The results for QRDL estimation for the long run and short run are provided in Tables 3 and 4, respectively. Under Table 3, it is observed that the values of p* are negative and significant, which was required in the same way. The value of the coefficient for the CAP is observed to be significantly positive under all the study quantiles except for the first two. This means that there is an upward trend long-run association between the CAP and GDP in maximum quantiles where the highest impact is observed under the 0.50^{th} quantile. Furthermore, the positive impact of capitalization in determining the GDP in the region of Malaysia specifies that more capitalization is a positive indication of increasing economic growth and vice versa. At the same time, economists look at capital to be among the core contributors toward economic growth because growth in stock market components also supports the justification of higher economic growth. At the same time, stock market capitalization helps in terms of the capital allocation process by providing a set of financial instruments to investors, which in return increases the productivity of capital toward higher economic growth (Dökmen et al., 2015). This would justify a good mechanism behind economic growth through market capitalization, and a similar result is observed under the present analysis. In-depth investigation of the existing literature also provides similar findings. For instance, Jalloh (2015) consider panel data modeling for African economies while studying the relationship between GDP and macroeconomic variables. The study findings confirm that there is a positive and significant impact of capitalization on economic growth in targeted economies.

Additionally, the long-run estimation also confirms that LAB and tourism are positively and significantly linked with GDP, specifically for the middle and upper quantiles. As tourism has become the leading economic sector, its contribution toward economic growth is not something which can be ignored. The mechanism behind the positive indication of tourism toward economic growth specifies that it creates various job opportunities, flow of foreign exchanges, sale of goods and services in the local market, stimulating investment in the infrastructure, increase in human capital, generating positive externalities, increasing income levels and various others (Andriotis, 2002; Blake, Sinclair, & Soria, 2006; Croes, 2006; Lee & Chang, 2008). These factors significantly highlight the mechanism by which the tourism industry contributes toward the economic growth in any economy. In addition, various authors have examined the dynamic linkage between the tourism industry and its contribution to economic growth. For instance, Fayissa, Nsiah, and Tadasse (2008) confirm that receipt from the tourism industry in the African region positively and significantly contributes to economic growth. Brida, Pereyra, and Devesa (2008) also confirm the contribution of tourism to economic growth while providing a meta-analysis for a range of studies. In addition, the findings for the long-run estimation between transportation and GDP have also confirmed their positive and significant association, but only for the lower-order quantiles, as shown in Table 3. This means that an increase in transportation and related activities results in an increase in the value of economic growth in Malaysia. Pradhan and Bagchi (2013), among other authors, also confirm the positive linkage between transportation and economic growth in the Indian economy through a vector error correction model (VECM). It is also suggested that expansion of infrastructure in the form of transportation may lead to substantial growth of the economy. Furthermore, transport is considered a significant sector in any economy and a common tool for development. The mechanism behind transportation leading to economic growth specifies that with an efficient transportation system, there are more well-organized social and economic opportunities that result in multiple benefits, such as better access to the market, employment, additional investment, reduction of the cost in the economy and, more importantly, the movement of goods and services. This would significantly justify the role of transportation in contributing to economic growth in any economy, and a similar result is observed for the Malaysian region.

Furthermore, the short-run estimation under QARDL for GDP reveals that the current and lagged values of gross domestic product are significantly and positively linked with the current and lagged values of GDP in all the study quantiles. However, this relationship is highly significant for the higher-order quantiles and only significant for the lower-order quantiles of the study. Meanwhile, the past lagged values of LAB show a positively insignificant relationship with the current and lagged values of GDP in all the study quantiles. However, this trend is significant and positive for the past and lagged values of tourism and transportation for both the lower- and medium-order quantiles of the study.

Table 4 predicts both long-run and short-run estimations for the nonlinear association between carbon dioxide emissions and other variables of interest. The results show that there is a significant and positive relationship between population and carbon emissions for the higher-order quantiles only. This means that a higher population leads to more carbon emissions in the economy of Malaysia. The mechanism behind the higher population leading to more carbon emissions specifies that a larger population level could result in more demand for energy and power, hence leading to more consumption of fossil fuel and related energy sources. Another mechanism behind population-led emissions specifies that more population is leads toward more destruction of forests, changes in land usage, and combustion of fuel wood, which ultimately lead to a higher level of carbon emissions. In this regard, Zhu and Peng (2012) specify that a change in the population structure is the key indicator of carbon dioxide emissions in Malaysia during 1978-2008. Yang, Zhao, Wang, and Shi (2015) also justify similar findings and claim that changes in the age structure of the population are positively linked with a higher level of carbon emissions. Additionally, the long-run estimation of the relationship between personal income and carbon dioxide emissions has provided evidence that this association exists only for the lower-order and higher-order quantiles. This means that an increase in personal income leads to more carbon dioxide emissions. Nag and Parikh (2000) also observe the fact that the income effect has been a major determinant of the increase in carbon emissions. Hailemariam, Dzhumashev, and Shahbaz (2020) also confirm that there is a direct linkage between the income factor and carbon dioxide emissions. Furthermore, the study findings for the long-run estimation between carbon dioxide emissions and tourism in Malaysia show that they have a negative linkage with each other for both middle-order and higher-order quantiles. However, this relationship is highly significant for the lower-order quantiles, specifically from the 0.80^{th} to 0.95^{th} quantiles of the study. In recent years, various studies have examined the relationship between tourism and carbon emissions (Akadiri, Akadiri, & Alola, 2019; Jermsittiparsert & Chankoson, 2019; Sharif, Afshan, & Nisha, 2017). However, the trends in the literature have provided evidence that a positive linkage exists between tourism and carbon dioxide emissions in different economies, which is contrary to our negative linkage findings.

After determining the trends under long-run estimation, the findings for the short-run estimation are also provided. The results show that past and lagged values of the carbon emissions in Malaysia are positively and significantly linked with the current and lagged values of carbon dioxide emissions. Similarly, the past and lagged values of population are observed as positively and significantly linked with the current value of CO2 emissions but only for the lower and higher quantiles. More specifically, lower quantiles show more significant findings than higher-order outcomes. Additionally, a significant and negative relationship between tourism and carbon dioxide emissions is observed but only for the lower-order quantiles. The rest of the findings have shown an insignificant association between the past values of TRA and carbon dioxide emissions under short-run estimation.

After determining the direction and significance of the association between the study variables with the help of QARDL, the Wald test was applied to check the asymmetries in the association among the variables. The results are shown in Table 5 for both GDP and CO2 emissions. In its general context, the Wald test helps to detect the instability for both the intercept and the coefficients of the study. Additionally, it also helps to determine the known and unknown structural breaks in the study data. More specifically, the findings in Table 5 for both GDP and CO2 emissions in the long run confirm that there are asymmetric associations with each of the exogenous variables, such as CAP, LAB, POP, PI, TOR, and TRA. These findings are confirmed with the help of the significance of long-term parameters for both GDP and CO2 emissions through study variables except for the POP and PI for GDP and for CAP and LAB for CO2 emissions. More specifically, the results for CAP, LAB, TOR, and TRA are significant at the 1 percent level for GDP, and POP, PI, and TRA are also significant at the 1 percent level of significance. In addition, the dependability of the parameters for the short-run association is also rejected because some coefficients are also significant for GDP and carbon dioxide emissions.

Finally, Table 6 shows the p-values for Granger causality in the quantiles test results of the study. Taking the overall quantiles, it is found that there is a bidirectional causality between all the study variables, except tourism and carbon dioxide emissions. In addition, the findings also confirm that there is a presence of two-way causality between the GDP-TOR and between the GDP-TRA. However, our study results found that there is a one-way causality running between TOR-CO2 and between TRA and CO2. All of these findings reasonably complemented the outcome under the QARDL test.

Conclusion and Policy Implications

The present study examines the impact of tourism along with some macroeconomic variables, such as transportation, personal income, capitalization, and labor, on gross domestic product and carbon dioxide emissions during the period of 1980-2018 in the region of Malaysia. For analysis purposes, this research applies the QARDL approach as suggested by Cho et al. (2015) because it examines how the range of quantiles for the study variables, such as transportation, labor, capitalization, personal income, and tourism, affects the level of carbon dioxide emissions and economic growth in Malaysia compared to some traditional methods, such as ordinary least square or simple quantile regression estimation. Furthermore, this research also investigates the causality in the quantiles to determine the causal association among the variables of interest. In this regard, the research findings shared by Jalloh (2015) are consistent with the present study, where the role of capitalization is found to be significant and positive toward economic growth. Fayissa, Nsiah, and Tadasse (2008) have also supported the justification for the positive association between the tourism industry and economic growth. Cai, Wang, and Du (2002) confirms the positive role of human capital (labor) in economic growth in China. In addition, Pradhan and Bagchi (2013) have supported the positive interaction between transportation and economic growth. Peterson (2017) also justified the direct linkage between population growth and economic growth. The findings through QARDL show that the error correction parameter is significant with the expected negative sign for most of the quantiles when GDP is observed as the main outcome variable. However, in the case of carbon dioxide emissions, only lower-order and medium-order quantiles are found to be statistically significant for the error correction model with the expected negative sign. In particular, the outcomes suggest that higher capitalization and labor in the economy of Malaysia are observed as positive and significant determinants of economic growth. The same is observed in the case of tourism and transportation, but it is significant only for the lower- and medium-order quantiles and lower-order quantiles, respectively. On the other hand, population and personal income are observed as direct sources of higher carbon emissions in Malaysia during the long-run estimation through QARDL. In this regard, Zhu and Peng (2012) supports the nexus between population and carbon emissions, and a similar result is justified by Yang, Zhao, Wang, and Shi (2015) as well. Similarly, income level is also a direct indicator of more carbon emissions, as observed in the present study and justified in the research work of Nag and Parikh (2000) and Hailemariam, Dzhumashev, and Shahbaz (2020), respectively.

If the empirical findings of the study are carefully analyzed, a range of policy implications for sustainable development in the economy of Malaysia can come into existence, which are also among the core contributions and filling the literature gap (Zhao et al. 2021). As the issue of environmental degradation is higher due to a higher level of personal income, it can be concluded that the growth trajectory achieved by the Malaysian government is not sustainable in the real sense. One of the core reasons behind the higher level of carbon emissions is the consumption of fossil fuel-based energy, which is a large source of air pollution. On the other hand, the negative impact of tourism on carbon dioxide emissions under different quantiles somehow indicates an effective implication of policies to control environmental degradation linked to the tourism industry of Malaysia. This can provide more fruitful outcomes if there is more consumption of some energy from renewable sources in the tourism industry of Malaysia. On the other hand, the growth trends in the economy are observed to be directly linked with capitalization, labor and tourism, which implies that more focus is required to continue this trend in the future. However, this can only be possible in the sense that more attention needs to be given to achieving more market capitalization in the economy of Malaysia, which requires some contemporary policies from the government. In addition, this study has also highlighted some limitations in terms of to providing guidelines for future studies. First, the present study has only considered the economy of Malaysia from the total sample of ASEAN economies that are interlinked with each other through a range of perspectives. Second, some factors, such as green bonds and green investment, have a significant contribution to economic growth and sustainable development, which are not observed in the present study. Third, along with the growth-environment nexus, there is a need to consider economic policy uncertainty, which is observed as a missing part of this research. Future studies are highly suggested to address these limitations so that a better generalization of the study findings would be possible in an appropriate manner.

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Table 1: Results of Descriptive Statistics					
Variables	**Mean**	**Min.**	**Max.**	**Std. Dev.**	**J-B Stats**
GDP	1.987	0.789	2.101	0.201	25.012***
CO2	3.654	2.104	4.201	1.010	19.101***
CAP	2.321	1.520	3.107	1.101	16.010***
LAB	4.159	3.013	5.125	0.021	33.011***
POP	3.010	2.451	4.001	1.020	22.201***
PI	5.357	4.301	6.241	0.001	19.109***
TOR	7.351	6.104	8.010	1.100	17.357***
TRA	4.145	3.021	5.013	0.012	35.010***

Note: The asterisk ***, ** and * represent level of significance at 1%, 5% and 10% respectively. GDP means gross domestic product (measure in terms of constant USD), CO2 means carbon dioxide emission (measure in terms of metric tons per capita), CAP means capitalization (measure in terms market capitalization of listed companies as % of GDP), LAB means labour (measure in terms of total labor force during the study period), POP means population (measure in total population during the study period), PI means personal Income (measure in terms of Adjusted net national income per capita (current US$)), TOR means tourism (measure in terms of International tourism, number of arrivals), TRA means transportation (measure in terms of Investment in transport with private participation (current US$)).
Source: Author Estimation

Table-2: Results of Unit root test						
Variables	**ADF (Level)**	**ADF (Δ)**	**ZA (Level)**	**Break Year**	**ZA (Δ)**	**Break Year**
GDP	-1.214	-6.225***	-0.843	2009 Q2	-8.318***	2015 Q1
CO2	-1.089	-5.374***	-0.559	2005 Q1	-6.631***	2009 Q1
CAP	-0.221	-5.058***	-0.441	2012 Q1	-6.741***	2015 Q1
LAB	-1.112	-6.841***	-0.940	2015 Q1	-7.108***	2004 Q1
POP	-0.564	-4.561***	-1.041	2017 Q4	-9.318***	2011 Q1
PI	-1.138	-5.344***	-1.443	2014 Q1	-7.433***	2003 Q4
TOR	-0.654	-6.681***	-1.008	2009 Q4	-9.391***	2004 Q1
TRA	0.118	-7.878***	-0.221	2014 Q1	-11.551***	2011 Q1

Note: The values in the table specify statistical values of the ADF and ZA test. The asterisk ***, ** and * represent level of significance at 1%, 5% and 10% respectively. GDP means gross domestic product (measure in terms of constant USD), CO2 means carbon dioxide emission (measure in terms of metric tons per capita), CAP means capitalization (measure in terms market capitalization of listed companies as % of GDP), LAB means labour (measure in terms of total labor force during the study period), POP means population (measure in total population during the study period), PI means personal Income (measure in terms of Adjusted net national income per capita (current US$)), TOR means tourism (measure in terms of International tourism, number of arrivals), TRA means transportation (measure in terms of Investment in transport with private participation (current US$)).
Source: Author Estimation

Table 3: Results of Quantile Autoregressive Distributed Lag (QARDL) for GDP

Quantiles (τ)	Constant	ECM	Long-Run estimations				Short-Run estimations					
	$\alpha_*(\tau)$	$\rho_*(\tau)$	$\beta_{CAP}(\tau)$	$\beta_{LAB}(\tau)$	$\beta_{TOR}(\tau)$	$\beta_{TRA}(\tau)$	$\varphi_1(\tau)$	$\omega_0(\tau)$	$\lambda_0(\tau)$	$\theta_0(\tau)$	$\acute{\varepsilon}_0(\tau)$	$\acute{\varepsilon}_1(\tau)$
0.05	0.010 (0.011)	-0.501*** (-3.010)	0.032 (0.803)	0.101 (0.002)	0.309*** (2.993)	0.120* (1.710)	0.342** (2.010)	0.043* (1.654)	0.012 (0.010)	0.051*** (3.010)	0.045*** (3.054)	0.045 (0.003)
0.10	0.001 (0.010)	-0.478*** (-2.991)	0.024 (1.020)	0.003 (0.010)	0.497*** (3.010)	0.181** (2.002)	0.280** (2.008)	0.073* (1.701)	0.011 (0.002)	0.042*** (2.992)	0.025*** (2.995)	0.039 (0.012)
0.20	0.002 (0.012)	-0.510*** (-3.003)	0.123** (2.010)	0.102 (0.520)	0.287*** (2.997)	0.202** (2.020)	0.230** (2.020)	0.052*** (3.005)	0.015 (0.003)	0.083*** (3.003)	0.044** (1.701)	0.025 (0.030)
0.30	0.020 (0.001)	-0.402** (-2.001)	0.231** (1.169)	0.120 (1.013)	0.404** (2.030)	0.125 (1.612)	0.225** (2.115)	0.079*** (2.997)	0.021 (0.007)	0.076** (2.070)	0.052** (2.020)	0.035 (0.028)
0.40	0.003 (0.010)	-0.395** (-1.995)	0.301** (2.003)	0.123* (1.653)	0.510** (2.010)	0.101 (1.013)	0.307*** (3.006)	0.020 (1.310)	0.030 (0.013)	0.024 (1.201)	0.031** (1.812)	0.011 (0.010)
0.50	0.013 (0.001)	-0.473** (-2.003)	0.330*** (3.010)	0.230* (1.703)	0.393 (0.129)	0.121 (1.004)	0.289*** (3.032)	0.024 (1.124)	0.029 (0.015)	0.016 (1.148)	0.073 (0.843)	0.011 (0.013)
0.60	0.014 (0.020)	-0.369* (-1.653)	0.290*** (2.993)	0.202** (2.020)	0.301 (1.014)	0.110 (0.810)	0.301*** (3.127)	0.025 (1.502)	0.035 (0.025)	0.015 (1.303)	0.014 (1.240)	0.017 (0.001)
0.70	0.021 (0.013)	-0.287* (-	0.301*** (3.015)	0.205** (2.031)	0.274 (1.021)	0.101 (0.513)	0.310*** (3.335)	0.071** (2.017)	0.013 (0.104)	0.022 (1.207)	0.017 (1.150)	0.031 (0.036)

		1.662)										
0.80	0.101 (0.002)	-0.172 (-1.142)	0.282*** (2.992)	0.210*** (3.104)	0.241 (1.013)	0.113 (0.414)	0.317*** (3.667)	0.031** (2.010)	0.022 (0.870)	0.012 (1.513)	0.013 (1.313)	0.052 (0.075)
0.90	0.103 (0.011)	-0.103 (-1.175)	0.311*** (3.110)	0.199*** (4.009)	0.202 (1.022)	0.184 (0.740)	0.306*** (3.701)	0.032** (2.023)	0.096 (1.065)	0.045 (1.406)	0.029 (1.179)	0.023 (0.101)
0.95	0.110 (0.102)	-0.132 (-1.101)	0.320*** (4.002)	0.201*** (3.050)	0.187 (1.032)	0.173 (1.031)	0.312*** (3.672)	0.045* (1.727)	0.075 (1.370)	0.018 (1.203)	0.040 (1.204)	0.015 (0.106)

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. GDP means gross domestic product (measure in terms of constant USD), CO_2 means carbon dioxide emission (measure in terms of metric tons per capita), CAP means capitalization (measure in terms market capitalization of listed companies as % of GDP), LAB means labour (measure in terms of total labor force during the study period), POP means population (measure in total population during the study period), PI means personal Income (measure in terms of Adjusted net national income per capita (current US$)), TOR means tourism (measure in terms of International tourism, number of arrivals), TRA means transportation (measure in terms of Investment in transport with private participation (current US$)).
Source: Author Estimations

Table 4: Results of Quantile Autoregressive Distributed Lag (QARDL) for CO_2 Emission

Quantiles (τ)	**Constant**	**ECM**	**Long-Run estimations**				**Short-Run estimations**					
	$\alpha_*(\tau)$	$\rho_*(\tau)$	$\beta_{POP}(\tau)$	$\beta_{PI}(\tau)$	$\beta_{TOR}(\tau)$	$\beta_{TRA}(\tau)$	$\varphi_1(\tau)$	$\omega_0(\tau)$	$\lambda_0(\tau)$	$\theta_0(\tau)$	$\theta_1(\tau)$	$\acute{\varepsilon}_0(\tau)$
0.05	0.202 (0.020)	-0.351*** (-4.106)	0.175 (0.011)	0.299*** (3.020)	-0.123 (-0.012)	-0.014 (-0.010)	0.431*** (3.010)	0.057 (0.656)	0.045 (0.994)	-0.090*** (-2.998)	-0.012 (-0.100)	-0.102 (-0.172)
0.10	0.204 (0.040)	-0.385*** (-3.981)	0.200 (0.916)	0.375*** (2.997)	-0.121 (-0.102)	-0.075 (-0.852)	0.284*** (4.012)	0.057 (0.731)	0.051 (1.101)	-0.098*** (-3.090)	-0.082 (-0.090)	-0.110 (-0.150)
0.20	0.195 (0.065)	-0.376*** (-4.015)	0.201 (1.351)	0.163 (1.010)	-0.120 (-1.120)	-0.042 (-1.101)	0.348*** (3.101)	0.065 (1.026)	0.063 (1.036)	-0.086*** (-4.003)	-0.072 (-0.101)	-0.120 (-0.130)

0.30	0.210 (0.080)	-0.364** (-2.004)	0.221 (1.420)	0.200 (1.570)	-0.145 (-1.299)	-0.103 (-1.191)	0.367** (2.110)	0.075 (1.070)	0.052 (1.204)	-0.051** (-2.001)	-0.053 (-0.121)	-0.099 (-0.099)
0.40	0.263 (0.075)	-0.308** (-2.698)	0.213 (1.531)	0.179 (0.969)	-0.255* (-1.655)	-0.155 (-1.205)	0.437 (1.097)	0.057 (1.191)	0.066 (1.303)	-0.026 (-0.979)	-0.022 (0.135)	-0.087 (-0.107)
0.50	0.181 (0.090)	-0.182 (-1.602)	0.199 (1.599)	0.132 (1.101)	-0.291* (-1.701)	-0.204 (-1.588)	0.282 (1.075)	0.068 (1.175)	-0.055 (1.050)	-0.027 (-0.874)	-0.023 (-0.202)	-0.101 (-0.089)
0.60	0.201 (0.101)	-0.163 (-1.613)	0.278* (1.887)	0.113 (1.556)	-0.283** (-1.963)	-0.245** (-2.105)	0.504 (1.101)	0.091* (1.710)	0.033 (1.392)	-0.051 (-0.790)	-0.017 (-0.260)	-0.081 (-0.069)
0.70	0.187 (0.110)	-0106 (-1.670)	0.290** (2.090)	0.132 (1.550)	-0.282** (-2.082)	-0.213** (-2.130)	0.323 (0.888)	0.082** (1.972)	0.048 (1.001)	-0.042 (-1.009)	-0.016 (-0.300)	-0.072 (-0.102)
0.80	0.165 (0.106)	-0.063 (-1.333)	0.287** (2.087)	0.237** (2.010)	-0.295*** (-2.995)	-0.262** (-2.599)	0.411* (1.651)	0.047** (2.003)	0.059 (0.857)	-0.020 (-1.002)	-0.020 (-0.280)	-0.054 (-1.001)
0.90	0.200 (0.115)	-0.065 (-1.303)	0.250** (2.597)	0.226** (2.696)	-0.290*** (-3.090)	-0.326** (-2.812)	0.601* (1.701)	0.057** (1.975)	0.037 (0.999)	-0.042 (-0.950)	-0.015 (-0.505)	-0.053 (-1.009)
0.95	0.191 (0.201)	-0.079 (-1.295)	0.605** (2.605)	0.332** (2.802)	-0.275*** (-2.997)	-0.351*** (-3.092)	0.512* (1.662)	0.046** (2.003)	0.041 (1.033)	-0.016 (-0.787)	-0.013 (-0.397)	-0.064 (-1.101)

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. GDP means gross domestic product (measure in terms of constant USD), CO2 means carbon dioxide emission (measure in terms of metric tons per capita), CAP means capitalization (measure in terms market capitalization of listed companies as % of GDP), LAB means labour (measure in terms of total labor force during the study period), POP means population (measure in total population during the study period), PI means personal Income (measure in terms of Adjusted net national income per capita (current US$)), TOR means tourism (measure in terms of

International tourism, number of arrivals), TRA means transportation (measure in terms of Investment in transport with private participation (current US$))..
Source: Author Estimations

Table 5: Results of the Wald Test for the constancy of parameters

Variables	Wald-statistics for GDP	Wald-statistics for CO_2 Emission
ρ	7.288*** [0.000]	9.210*** [0.000]
β_{CAP}	15.641*** [0.000]	-
β_{LAB}	6.518*** [0.000]	-
β_{POP}	-	6.158*** [0.000]
β_{PI}	-	3.947*** [0.000]
β_{TOR}	7.205*** [0.000]	1.297 [0.182]
β_{TRA}	4.004*** [0.000]	5.551*** [0.000]
φ_1	5.814*** [0.000]	3.488*** [0.000]
ω_0	1.247 [0.198]	1.779* [0.089]
λ_0	0.351 [0.999]	0.257 [0.999]
θ_0	3.995*** [0.000]	4.871*** [0.000]
θ_1	-	1.058 [0.259]
$\acute{\varepsilon}_0$	1.453 [0.158]	1.351 [0.165]
$\acute{\varepsilon}_1$	0.891 [0.215]	-
Cumulative short-term effect:		
θ^*	-	1.118 [0.208]
$\acute{\varepsilon}^*$	0.584 [0.720]	-

Note: The table reports the F-statistics value. The p-values are between square brackets. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. GDP means gross domestic product (measure in terms of constant USD), CO2 means carbon dioxide emission (measure in terms of metric tons per capita), CAP means capitalization (measure in terms market capitalization of listed companies as % of GDP), LAB means labour (measure in terms of total labor force during the study period), POP means population (measure in total population during the study period), PI means personal Income (measure in terms of Adjusted net national income per capita (current US$)), TOR means tourism (measure in terms of International tourism, number of arrivals), TRA means transportation (measure in terms of Investment in transport with private participation (current US$)).

Source: Author Estimations

Table 6: Granger Causality in Quantile Test Results								
Quantiles	**ΔGDP_t ↓ ΔTOR_t**	**ΔTOR_t ↓ ΔGDP_t**	**ΔGDP_t ↓ ΔTRA_t**	**ΔTRA_t ↓ ΔGDP_t**	**$\Delta CO2_t$ ↓ ΔTOR_t**	**ΔTOR_t ↓ $\Delta CO2_t$**	**$\Delta CO2_t$ ↓ ΔTRA_t**	**ΔTRA_t ↓ $\Delta CO2_t$**
[0.05-0.95]	0.000	0.000	0.000	0.000	0.689	0.000	0.115	0.000
0.05	0.000	0.000	0.000	0.000	0.218	0.000	0.015	0.000
0.10	0.000	0.000	0.000	0.000	0.330	0.000	0.138	0.000
0.20	0.000	0.000	0.000	0.000	0.394	0.000	0.206	0.000
0.30	0.000	0.000	0.000	0.000	0.438	0.000	0.315	0.000
0.40	0.000	0.000	0.000	0.000	0.556	0.000	0.441	0.000
0.50	0.000	0.000	0.000	0.000	0.617	0.000	0.373	0.000
0.60	0.000	0.000	0.000	0.000	0.489	0.000	0.295	0.000
0.70	0.000	0.000	0.000	0.000	0.401	0.000	0.223	0.000
0.80	0.000	0.000	0.000	0.000	0.351	0.000	0.194	0.000
0.90	0.000	0.000	0.000	0.000	0.263	0.000	0.125	0.000
0.95	0.000	0.000	0.000	0.000	0.228	0.000	0.015	0.000

Source: Authors Estimation, GDP means gross domestic product (measure in terms of constant USD), CO2 means carbon dioxide emission (measure in terms of metric tons per capita), CAP means capitalization (measure in terms market capitalization of listed companies as % of GDP), LAB means labour (measure in terms of total labor force during the study period), POP means population (measure in total population during the study period), PI means personal Income (measure in terms of Adjusted net national income per capita (current US$)), TOR means tourism (measure in terms of International tourism, number of arrivals), TRA means transportation (measure in terms of Investment in transport with private participation (current US$))..