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## Relationship between CO2 emissions, tourism receipt, energy use and international trade in Pakistan

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# Relationship between CO<sub>2</sub> emissions, tourism receipt, energy use and international trade in Pakistan

## Introduction

The tourism industry has developed over the years; the number of tourists crossing international borders in January and June 2016 increased by 4%, compared to the same period last year UNWTO, (2017). Similarly, its indicator shows about 21 million international tourists in the year 2016, much increased than that of in 2015 and bringing the total international tourists to 561 million in 2016 destinations worldwide. Additionally, Asia had the highest increase in international tourist arrivals in 2016 which was 9% followed by Africa 5%, 4% America, and 3% in Europe. Also, the report also shows that there is about a 9% decrease of international tourists to the Middle East between January and June 2016. (UNWTO World Tourism Barometer, 2016<sup>1</sup>). World development indicators on travel and trade in 2013, created a share of 6.1% of the total exports and international tourist's receipts amounted to over US\$ 1.381 billion World Bank., (2015)<sup>2</sup>. As an export category, the UNWTO promoted that after fuels, chemicals and food tourism ranks fourth worldwide WTO, (2015)<sup>3</sup>. According to the United Nations World Tourism Organization report, (2018), a 7.0% increase in international tourists recorded in 2017, which was the highest since the global economic crisis in 2008, and the report predicts about 3.8% increase per year for the period 2010 to 2020. In 2016, a total of 1326 million international tourists were recorded worldwide which were increased in 2017 over 86 million .these results were encouraged by continuous travel for the destinations of all over the world, including the restoration of the people of security challenges in recent years.

According to World Travel and Tourism Council (WTTC, 2018)<sup>4</sup>, The overall shares of tourism in GDP were US\$ 832.1 million in Pakistan, which is 2.9% of total GDP in 2017 and it is likely to rise by 5.9% in 2018. Similarly, in 2017 tourism contributes to 1,493,000 jobs, which are 2.5% of total employment (UNWTO, 2017)<sup>5</sup>.

The current study explores the potential impact of tourism, economic growth, energy consumption and trade openness on CO<sub>2</sub> emission in Pakistan over the period of 1980-2017. Many researchers have investigated the link between tourism development and economic growth along with other determinants but there is no clear picture as the results are inconsistent. This study is an attempt to complement the literature related to tourism and economic growth along with other variables. Thus, there is a dire need to investigate the role of the tourism sector in the economy that either it is sustainable or not.

## Literature Review

Numerous studies have examined both theoretical and empirical sides about tourism and its determinants which determine different kinds of results. This section focuses on the main relationship between the key features that describe tourism attractiveness and the factors which

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<sup>1</sup> United Nations World Tourism Organization [UNWTO]. (2016). Retrieved from <http://www.unwto.org>.

<sup>2</sup> World Bank. (2015). *World Bank Development Indicators: Travel and Tourism*. Author.

<sup>3</sup> World Tourism Organization. (2015). *UNWTO Annual Report 2014*. Madrid: Author.

<sup>4</sup><https://www.wttc.org/-/media/files/reports/economic-impact-research/regions-2017/world2017.pdf>

<sup>5</sup> <https://www.wttc.org/-/media/files/reports/economic-impact...2018/world2018.pdf>

affect tourism growth in economic development. Some of the previous studies are presented as follows:

### **Tourism and CO<sub>2</sub> Emission**

Tourism is considered helpful in boosting the world economies by creating new jobs and opening new areas for investment, but it also put environmental pressure by emitting huge amount of CO<sub>2</sub> emissions as it involves high energy consumption due to transport, air travel, food etc. Therefore, it is stated that being growth friendly, tourism at the same time could be harmful for environmental quality in the host countries (Paramati, Alam & Chin, 2017; Paramati, Alam & Lau, 2018; Raza, Sharif, Wong, & Karim, 2017; Shi et al., 2019). He et al. (2020) evaluates the energy efficiency of the tourism industry in 30 regions of China, covering the period 2005–2013. They found that tourism's energy efficiency was lower than the industry as a whole.

On the other hand, in the case of Pakistan, Liu, Kumail, Ali and Sadiq (2019) concluded that there is no significant relationship between tourism and CO<sub>2</sub> emission during the period of 1980-2016. Moreover, Zhang, Khan, Kumar, Golpîra & Sharif, (2019) revealed that logistics and transport-related activities are positively associated with inbound tourism and fossil fuel and carbon emissions have a negative impact on tourism abroad in the context of Thailand. Shi et al. (2019) investigated the multi-relationship between economic growth, CO<sub>2</sub> emissions, tourism, and primary energy use and revealed that CO<sub>2</sub> emissions in low-income countries are more elastic to an increase in per capita tourist expenditures as compared to lower and high-income countries. On the same note, Eyuboglu and Uzar (2019) explored the relationship between CO<sub>2</sub> emissions, tourist arrivals, energy use and economic growth in Turkey and concluded that tourism, energy use, and growth impede environmental quality by increasing the concentrations of CO<sub>2</sub> emissions in the country.

### **Tourism & Energy Consumption**

Both energy and tourism are connected through possible yet a variety of channels. The tourism industry may demand higher energy production and consumption, as both go hand in hand. However, due to the complexity in the tourism sector, energy demand may vary from place to place. According to Isik, Dogan, and Ongan (2017), the rapid increase in the tourism sector may affect tourists' choices or even change them towards higher-intensive transportation and non-renewable energy sector, which ultimately can result in global GHG emission of about 5%. Nižić, Grdić, and Hustić (2017) say that since tourism activities have a higher demand for energy, energy is indispensable for the tourism sector.

In a study of eight regions of the Asia Pacific, Meng and Niu (2011) found that there is a long-term association between CO<sub>2</sub> emissions, energy consumption, and economic growth. Similarly, from a study of 27 OECD countries, Saboori and Sulaiman (2013) revealed bilateral nexus in energy consumption, transportation CO<sub>2</sub> emissions and economic growth in the road transport sector. Moreover, Ali, Abdullah and Azam (2017a, 2017b) investigated the environmental Kuznets curve (EKC) in the case of Malaysia and concluded that energy consumption and economic growth are important indicators of CO<sub>2</sub> emissions. Research has revealed the existence of two-dimensional relationships between CO<sub>2</sub> emissions and energy consumption, while economic growth and other variables cause non-directional Granger CO<sub>2</sub> emissions.

## Data Methodology and Model Specification

### Sources of Data Collection

The present analyzes the time series data to investigate the long-run and causal relationship between the variables from 1980-2017 for Pakistan. The current study collected the annual time series data by the World Bank database and Economic Survey of Pakistan.

### Model Specification

The current study indicates that tourism development is a major contributor to the levels of environmental impacts. Therefore, we specify an econometrically estimable equation, following (Liu et al., 2019; Ali et al., 2017 and Katircioglu, 2018 ), as follows:

$$CO_2 = F(CGDP, TR, EC, TO) \quad (1)$$

To get the direct elasticities of coefficients and to make easy the process of estimating the current study followed the work of Ali, Azam and Abdullah (2017b) and took the natural log of the variables of the study. Thus, our model can be rewritten as follows:

$$y_t = \alpha + \beta_1 \ln CGDP_t + \beta_2 \ln TR_t + \beta_3 \ln E_t + \beta_4 \ln TO_t + \mu_t \quad (1)$$

where  $y_t$  is the natural log of  $CO_{2t}$ ,  $TR_t$  is the natural log of tourism receipt,  $E_t$  is the natural log of per capita energy consumption,  $TO_t$  is the natural log of trade openness (% of GDP),  $CGDP_t$  is GDP per capita which is a proxy for economic growth and  $u$  is Gaussian error term.

### Estimation techniques

After inspecting the data, this study uses Autoregressive Distributed Lag (ARDL) bounds testing approach to cointegration by Pesaran, Shin, and Smith (2001) to examine the long-run relationship between the variables of the study. The ARDL technique has various advantages over other cointegration tests. These cointegration tests can be used irrespective of the stationary variables whether they are  $I(0)$ ,  $I(1)$  or the correlation of both (Pesaran and Shin 1998). The ARDL method has worked out small sample properties (Haug 2002). The ARDL exceeded the Johansen and Juselius technique because of its small sample properties (Pesaran, Shin, and Smith 2001). There is no endogeneity problem in the ARDL approach and is free from residual correlation because of the selection of suitable lag selection. The ARDL method made easy to distinguish between dependent and independent variables. Therefore, for  $I(2)$  variables the Computed F-statistics of Pesaran and Shin, (2001) table will be invalid (Ouattara 2004).

The present study applied the ARDL method to identify the existence of a long-run relationship.

$$\begin{aligned} \Delta \ln CO_2 = & \beta_0 + \sum_{i=1}^p \beta_1 \Delta \ln CO_{2t-i} + \sum_{i=1}^p \beta_2 \Delta \ln CGDP_{t-i} + \sum_{i=1}^p \beta_3 \Delta TR_{t-i} + \sum_{i=1}^p \beta_4 \Delta \ln EC_{t-i} \\ & + \sum_{i=1}^p \beta_5 \Delta \ln Trade_{t-i} + \lambda_1 \ln CO_{2t-i} + \lambda_2 \ln CGDP_{t-i} + \lambda_3 TR_{t-i} + \lambda_4 \ln EC_{t-i} \\ & + \lambda_5 \ln Trade_{t-i} + \lambda_6 \ln GDP_{t-i} + \varepsilon_t \end{aligned} \quad (2)$$

where  $\beta_0$  is a constant term and  $\varepsilon_t$  is the error term. The error correction dynamics is signified by the term with summation sign while the next part of the calculation links the long-run relationship and is represented by  $\lambda$ . Therefore, after the selection of model estimation and lag length, if the long-run exists then the error correction model is represented as follows:

$$\Delta \ln CO_2 = \beta_0 + \sum_{i=1}^p \beta_1 \Delta \ln CO_{2t-i} + \sum_{i=1}^p \beta_2 \Delta \ln CGDP_{t-i} + \sum_{i=1}^p \beta_3 \Delta TR_{t-i} + \sum_{i=1}^p \beta_4 \Delta \ln EC_{t-i} + \sum_{i=1}^p \beta_5 \Delta \ln Trade_{t-i} + \theta ECT_{t-i} + \varepsilon_t \quad (3)$$

where the  $ECT_{t-1}$  is the shock in the short-term and it represent the speed of long-term adjustment towards equilibrium. Similarly, serial correlations, functional form, diagnostic tests, normality tests including heteroscedasticity tests for testing the reliability of the model are performed. The study applied the cumulative sum and the cumulative sum of squares tests to check the stability of the model introduced by (Brown et al., 1975). It is argued that if CUSUM and CUSUMSQ figures cannot reject the null hypothesis and the critical bound is within a 5% level, then the regression will be considered as stable.

## Results and Discussion

The first step in determining that, whether the model is ready for regression or not is to find out the stationarity properties of the series under investigation. The current study used the ADF, PP and DF-GLS Unit root tests to investigate the level of stationarity of all the variables of the study to further move towards regression analysis. The study applied these unit root tests in their intercept form and intercept and trend form to find out which type of unit root is there in the data. The study applied this method to the series in the model and concluded that all the variables having unit roots in their level forms as there is no such clear trend in the series.

**Table: 1**  
**ADF, PP, and DF-GLS Unit Root Test**

| Variables      | ADF Level   |                    | PP Level    |                    | DF-GLS Level |                    |
|----------------|-------------|--------------------|-------------|--------------------|--------------|--------------------|
|                | Intercept   | Trends & Intercept | Intercept   | Trends & Intercept | Intercept    | Trends & Intercept |
| InCO2          | -4.10754*** | -0.147957          | -4.55189*** | 0.208851           | -0.28166     | -0.315666          |
| InCGDP         | -3.84954*** | -3.859262***       | -3.81388*** | -3.816206***       | -2.27189     | -3.464763          |
| InTR           | -1.33723    | -3.353247**        | -1.0257     | -2.371159          | -0.83145     | -3.453753          |
| InE            | -3.25873*** | -0.224708          | -3.13586*** | -0.2369            | -0.29223     | -0.435472          |
| TO             | -1.57122    | -2.250424          | -1.64321    | -2.374587          | -1.52669     | -2.499848          |
| Ist Difference | Intercept   | Trends & Intercept | Intercept   | Trends & Intercept | Intercept    | Trends & Intercept |
| InCO2          | -2.14476    | -8.077967***       | -5.52149*** | -7.820629***       | -2.0332      | -8.263465          |
| InCGDP         | -7.55833*** | -7.57035***        | -10.8139*** | -16.27762***       | -6.48988     | -7.454162          |
| InTR           | -4.98225*** | -4.754741***       | -3.66902*** | -3.14103           | -4.25265     | -4.076432          |
| InE            | -4.50372*** | -5.530712***       | -4.55443*** | -5.524774***       | -3.99737     | -5.636602          |
| TO             | -7.34488*** | -7.428989***       | -7.34946*** | -7.477542***       | -6.97641     | -7.510417          |

Note: \*, \*\*, and \*\*\* represent the significance level at 10%, 5%, and 1% respectively.

After knowing the stationarity level and making the data stationary is to look for the presence of any correlation between the variables in the long-term. The study, thus, applied the ARDL bounds test to investigate the presence of a long-run relationship between the variables of the study.

**Table: 2**  
**ARDL Bounds Test**

| Test Statistic                                              | Value             |                   |
|-------------------------------------------------------------|-------------------|-------------------|
| <b>F-statistic</b>                                          | 9.692206***       |                   |
| Critical Value Bounds                                       |                   |                   |
| Significance                                                | <b>I(0) Bound</b> | <b>I(1) Bound</b> |
| <b>10%</b>                                                  | 2.45              | 3.52              |
| <b>5%</b>                                                   | 2.86              | 4.01              |
| <b>1%</b>                                                   | 3.74              | 5.06              |
| Remarks: <b>Cointegration</b>                               |                   |                   |
| Note: *, **, *** indicates cointegration at 10%, 5% and 1%. |                   |                   |

### The ARDL Long-run and Short-run results

The long-term results of ARDL show that tourism demand is negatively significant, which indicates that the growth of tourism demand in Pakistan is negatively related to the long-term CO<sub>2</sub> emission. This main finding shows that the tourism development in Pakistan under inspection does not lead to a deterioration in the quality of the environment, thus, Pakistan's tourism demand is said to be harmless to the environment. The results of this study are consistent with Katircioglu (2018a). This outcome means that the current tourism industry in Pakistan is developing well within the boundaries of environmental sustainability and is productive both on economic and environmental fronts. This means that tourism is one of the most important industry which can promote the growth of the country without harming the environmental quality.

**Table: 3**  
**ARDL Long Run Coefficients**

| Variable      | Coefficient | Std. Error | t-Statistic | Prob.     |
|---------------|-------------|------------|-------------|-----------|
| <b>LNCGDP</b> | 0.03485     | 0.01323    | 2.634164    | 0.0151**  |
| <b>LNTR</b>   | -0.245323   | 0.12956    | 1.893499    | 0.0715*   |
| <b>LNE</b>    | 0.257014    | 0.018303   | 14.042374   | 0.0000*** |
| <b>LNTO</b>   | 0.023442    | 0.012441   | 1.884269    | 0.0728*   |
| <b>C</b>      | 0.799534    | 0.11086    | 7.212138    | 0.0000    |

\*Note: p-values and any subsequent tests do not account for model selection

The result of the short-run is also similar to the long run. However, there is only one major difference between both which is the magnitude. The former has a relatively lower magnitude than that of the latter. This study shows that the variables selected by us have a higher impact on the foreign tourist's receipt in the longer-run.

In the short term, tourism development once again has a negative and significant impact on Pakistan's CO<sub>2</sub> emission, this indicates that the tourism activities in Pakistan are negatively correlated with the CO<sub>2</sub> emission, which means that they show an increase in pollution resistance. In the short-run even, the tourism-related activities are not harmful to the environment and could lead to sustainable economic growth in the country. The results of this study support the literature of pioneers who believe that tourism has a sustainable relationship with the environment (Hunter and Greene, (1995); Lukashina et al. (1996); Butler, (2000) among them.

**Table: 4**  
**ARDL ECM Cointegrating Form Model**

| Variable           | Coefficient | Std. Error | t-Statistic | Prob.     |
|--------------------|-------------|------------|-------------|-----------|
| <b>D(LNCGDP)</b>   | 0.0409      | 0.019      | 2.152631    | 0.0427**  |
| <b>D(LNTR)</b>     | -0.0458     | 0.0135     | 3.392592    | 0.0027*** |
| <b>D(LNE)</b>      | 0.0178      | 0.0171     | 1.040935    | 0.3088    |
| <b>D(LNTO)</b>     | 0.00438     | 0.001947   | 2.249591    | 0.0348**  |
| <b>CointEq(-1)</b> | -0.1868     | 0.0578     | -3.231833   | 0.0038    |

Note: \*, \*\*, and \*\*\* represent the significance level at 10%, 5%, and 1% respectively

The study also applied diagnostic tests to confirm that there is no problem with the estimation of results, and the model is overall stable. The study further checks the viability of the functional form of the model and concluded that the functional form of the model is the correct one as the probability value of the test is higher than the rejection level at 5%.

**Table: 5**  
**Diagnostic Tests**

|                     |               |                             |                  |
|---------------------|---------------|-----------------------------|------------------|
| R-squared           | 0.890007      | Durbin-Watson stat          | 1.90913          |
| Adjusted R-squared  | 0.835011      | Serial Correlation (Chi SQ) | 1.526039(0.2167) |
| S.E. of regression  | 0.001364      | Functional Form (Chi SQ)    | 1.037583(0.3200) |
| RSS                 | 0.000041      | Jarque-Bera (Chi SQ)        | 0.690041         |
| F-statistic (Prob.) | 16.183(0.000) | Heteroscedasticity (Chi SQ) | 11.65511(0.3901) |

### Granger Causality

The current study finds long-run connectivity between CO<sub>2</sub> emission, international tourism, economic growth, energy consumption, and trade openness in Pakistan. Furthermore, after applying the ARDL cointegration test the direction of causality is not clear. Hence, to find the direction of causality we conduct a Granger causality test. The result shows that there is a unidirectional causal relationship from tourism receipt, energy consumption, economic growth and trade openness to CO<sub>2</sub> emission.

**Table: 6**  
**Granger Causality Tests**

| Null Hypothesis:                                | F-Statistic | Prob.  |
|-------------------------------------------------|-------------|--------|
| LNCGDP does not Granger Cause LNCO <sub>2</sub> | 3.56195     | 0.0409 |
| LNTR does not Granger Cause LNCO <sub>2</sub>   | 4.22773     | 0.0245 |
| LNE does not Granger Cause LNCO <sub>2</sub>    | 8.31586     | 0.0013 |
| LNTO does not Granger Cause LNCO <sub>2</sub>   | 1.23175     | 0.3061 |

Note: \*, \*\*, and \*\*\* represent the significance level at 10%, 5%, and 1% respectively

Furthermore, this study used DOLS by applying leads and lags to confirm the long-run results of the ARDL model. Thus, the outcomes of the ARDL model are robust as supported by the DOLS results.

**Table: 7**  
**Dynamic Least Squares (DOLS)**

| Variable           | Coefficient | Std. Error         | t-Statistic | Prob.     |
|--------------------|-------------|--------------------|-------------|-----------|
| LNCGDP             | 0.005231    | 0.000851           | 6.147288    | 0.0000*** |
| LNTR               | -0.4744     | 0.087728           | -5.407601   | 0.0001*** |
| LNE                | 0.322353    | 0.00781            | 41.27293    | 0.0000*** |
| LNTO               | 0.006008    | 0.014756           | 0.407154    | 0.6893    |
| C                  | 0.442761    | 0.083897           | 5.277457    | 0.0001*** |
| R-squared          | 0.997006    | Mean dependent var |             | 2.440371  |
| Adjusted R-squared | 0.994012    | S.D. dependent var |             | 0.03962   |
| S.E. of regression | 0.003066    | Sum squared resid  |             | 0.00015   |
| Long-run variance  | 9.45E-06    |                    |             |           |

## Conclusion

This detailed study related to tourism studies and examined the potential impact of CO<sub>2</sub> emission, tourist's receipt, economic growth including international trade, and energy consumption in Pakistan from the year 1980 to 2017. In this, many methods and theories were applied to find out the potential of the tourism field in Pakistan.

The study adopted the Autoregressive Distributed Lagged (ARDL) model to investigate the short and long-run estimates simultaneously. The study further applied Granger causality to find out the direction of causalities. To arrive at long-run robust estimates, the study employed Dynamic Ordinary Least Squares (DOLS) model. Last but not least, the current study also used an innovative accounting approach i.e. Variance decomposition and Impulse production function. The results found that economic growth has a significant impact on CO<sub>2</sub> emission while, tourism receipt, CGDP, energy consumption and international trade are also the main determinants of tourism in Pakistan. The study found unidirectional causality from tourism receipt, GDP, energy consumption and trade openness towards CO<sub>2</sub> emission. The outcomes of ARDL model are also supported by the DOLS results. The innovative accounting approach further strengthens the results of the study. In a nutshell, overall results indicate that CO<sub>2</sub> emission, CGDP, tourist receipts, energy consumption, and trade openness are interlinked. Thoroughly observing and examining sundry of methods and techniques lead us to the conclusion that there are a highly positive coexistence and the relationship between CGDP, the openness of trade, consumption of energy, but there is highly negative significant impact of tourism receipt on CO<sub>2</sub> emission in longrun as well as in shortrun.

Granger causality's findings support the long-run impact of CO<sub>2</sub> emission and its determinants for Pakistan. Also, Granger causality results conclude that economic growth and trade openness are had wider implications on the tourism industry. In other words, when a country promotes its tourism sector and provides incentives to the very field, it will attract more and more foreign tourists and ultimately help boost forex reserves and economic growth. More international tourist means more investments and more inflow of wealth. In this way, it will also benefit the lower class, unskilled job workers and villagers of the related tourists' areas and locations. In this era of economic boom and globalization, it highly recommended for every nation especially for those engulfed with poverty and unemployment should work out on the tourism sector as it can benefit not only the economy but also promotes soft image of the country.

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