The Causal Nexus of Urbanization, Industrialization, Economic Growth and Environmental Degradation: Evidence from Pakistan

Shabana Parveen, Abdul Qayyum Khan, Sohail Farooq

1 PhD Scholar, Department of Economics, Hazara University Mansehra, Pakistan. shabana_economist@yahoo.com
2 Associate Professor, Management Sciences Department, COMSATS University, Islamabad. qayyum72@ciitwah.edu.pk
3 Assistant Professor, Department of Economics, Hazara University Mansehra, Pakistan. thesohailfarooq@hotmail.com

ARTICLE DETAILS

ABSTRACT

The paper analyzes the causal relation between economic growth, urbanization, industrialization and environmental degradation of Pakistan. The study used time series data for the sample span of 1975-2017, retrieved from World Bank Development Indicators (WDI, 2017). Vector Auto Regressive (VAR) model is used for analyzing the causal link amongst the variables, namely economic growth, urbanization, industrialization and environmental degradation. The Granger causality test is used for identifying the order of the causal association. Before estimating VAR, Augmented Dickey Fuller (ADF) as well as Phillips Perron (PP) tests are used for confirming the stationarity characteristic of all variables, first with intercept and then, with intercept along with a linear deterministic trend. Akaike Information Criterion (AIC) is used for selection of optimum lag. The Johansen Cointegration test is adopted for identifying long run associations. The result of the VAR model reveals, if any innovation of one standard deviation from outside the model occurred, it will take about 13 years for CO2, 19 years for urbanization, 16 years for industrialization and about 12 years for economic growth in adjustment. These results further indicate that most of the variation in all variables is explained in their own. The study confirmed two unilateral causalities, that is runs from CO2 to urbanization as well as economic growth. The findings of the research work propose that policy makers required to develop policy helpful to the environment which will encourage verifiable economic growth in Pakistan. The policy makers need to plan for environmental issue while making policies regarding urbanization, industrialization and economic growth.

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JEL Classification: R11, R19

1. Introduction

Carbon Dioxide (CO2) emission is a major component of Green House Gas (GHGs) emissions that is a major factor behind global warming and degradation of natural environment. Environmental degradation
increases since the 19th century, with the increasing trend of urbanization and industrialization so the issue of environmental degradation and its relationship with urbanization and industrialization has got much attention from researchers both in developed and developing countries.

Pakistan is also facing a higher trend of urbanization with 207.77 million population, it has become the sixth most populous country in the world. The major reason behind the trend is the increase growth rate of population as well as migration. The rate of urbanization in Pakistan is 36.38%, which is projected to reach at 50% in the upcoming 15 years (Afzal et al., 2018). As much as industrial growth is concerned, it remains poor throughout the history. The government wants to achieve high growth rate of industrialization which is not satisfactory at present due to political instability, high tax burden and energy crisis. The economic growth of Pakistan remains volatile throughout the history (Pakistan Economic Survey, 2016-17). The main objective of the study is to analyze empirically causal link in economic growth, urbanization, industrialization with environmental degradation.

The rest of the paper is organized into five sections. Section 2 consists of the previous literature. Section 3 is about the data along with methodology. Section 4 presents the empirical results whereas Section 5 concludes the study and presents some policy implications.

2. Literature Review

Rich empirical work has been done on analyzing the causal link of many variables with CO₂ emissions like, Liu and Bae (2017) analyzed the causal association between industrialization, urbanization, per capita real GDP, intensity of energy with CO₂ emissions, and confirmed the long-term bidirectional causalities in industrialization, per capita real GDP with CO₂ emissions. Sarkodie and Owusu (2017) studied the causal link between industrialization, population, per capita GDP along with CO₂ emissions through the Granger causality test, and confirmed a unidirectional causal association of industrialization to per capita GDP, from population to industrialization as well as per capita GDP, from population towards CO₂ emissions. Al-Mulali and Ozturk (2015) confirmed the causal link in industrial development, urbanization and energy use both in the short and long time period. Kasman and Duman (2015) used data of new European Union member countries and confirmed a unidirectional causal association of urbanization with CO₂ emissions. Likewise, Liddle and Lung (2014) found the same association in CO₂ emissions and urbanization for 105 countries, but they were unable to find granger causality in case of urbanization and electricity consumption.

Another group of researchers studied the causal link in economic growth, urbanization, with CO₂ emissions like, Xuemei et al. (2012) found a close relationship between these variables as confirmed, economic growth promotes urbanization and vice versa. Yansui et al. (2016) used data of China for the period of 1997 to 2010, studied the link between CO₂ emissions with economic growth as well as urbanization. The work was based on Panel co-integration test along with granger causality. The result showed the studied variables increase CO₂ emissions there. The results also suggested a two-way long term association in the variables, meaning that urbanization has causal effect over economy growth in the long period and these have a causal association with CO₂ emissions too. Jebli et al. (2015) found two-way causal association for economic growth with CO₂ emissions for 24 economies in Sub Saharan Africa, in the span of 1980 to 2010. The analysis was based on panel co-integration technique. Mingxing et al. (2014) presented a two-way causality of urbanization with economic growth. The conclusion of Xuemei et al., (2012) were also the same. Most of the studies are conducted on panel data for analyzing the causal association between urbanization, economic growth with CO₂ emissions like, Al Mulali et al. (2015) used heterogeneous panel data of 129 states for the span of 1980 to 2011. The researchers used economic growth, financial growth, urbanization, as well as CO₂ emissions in analysis. Interestingly, the result of Granger causality showed that due to financial development, all the variables have a direct impact on the environment, in the short and long run meaning that these variables does not increase CO₂ emissions. Al Mulali and Ozturk (2015) worked for 14 MENA states for the span of 1996 to 2012. The results of Granger causality confirmed short term and long term causal link among urbanization, industrial
development and environmental degradation.

Literature also analyzed a causal link of energy use with CO$_2$ emissions based on the idea that economic growth increases energy use that results to CO$_2$ emissions increase. Wang et al. (2011) used data of 28 provinces of China and presented bidirectional causality in economic growth, energy use with CO$_2$ emissions. Li and Cheng (2006) confirmed two-way causality for urbanization and economic growth whereas a Shahbaz et al. (2014) confirmed, urbanization along with economic growth causes increase in CO$_2$ emissions. Likewise, Yazdi and Shakouri (2014) used data of 28 provinces of China and presented bidirectional causality in economic growth, energy use with CO$_2$ emissions. The study found a one-way causal linkage from urbanization towards CO$_2$ emissions. Vidyarthi (2014) worked on the data of five states of South Asian for the span of 1972 to 2009 and found a two-way association in economic growth with energy use, whereas a one-way causal association of CO$_2$ emissions with energy use. Omri (2013) used simultaneous equations model for studying the same association in MENA states, confirmed a two-way causal association for economic growth with energy use, whereas a one-way causal association of economic growth with CO$_2$ emissions. Likewise, Ang (2009) concluded that economic growth along with energy use contributes CO$_2$ emissions in China, Zhang and Cheng (2009) conducted a multivariate causal study in China and concluded a unidirectional causal association for energy use towards CO$_2$ emissions but not contributed towards economic growth.

In addition, Hwang and Yoo (2014) concluded in Indonesia a two-way causal association in energy use with CO$_2$ emissions. For Saudi Arabia, Alshehry and Belloumi (2015) whereas for French, Ang (2007), confirmed a causal association in energy usage, economic growth with CO$_2$ emissions. Apergis and Payne (2010) found this association in ASEAN economies.

Interestingly, Samuel and Abu (2017) found a trade-off for economic growth with CO$_2$ emissions for Nigeria. They found that whenever GDP per capita increases, it also increases CO$_2$ emissions while when CO$_2$ emissions increase, it did not contribute to economic growth. In Pakistan, studies like Mukhopadhyay and chakraborty, (2005); Bukhari, (2012) have done on the impact of macroeconomic variables such as trade openness, population growth, urbanization on environmental degradation. Aşjad and Aqeel (2014) found a one-way causal association among GDP, population growth, energy usage with CO$_2$ emissions.

In table 1 the summary of the previous research work done about the causality in economic growth, urbanization, industrialization with CO$_2$ emissions for developed as well as developing countries is presented. The purpose of the present work is to analyze the causal link in CO$_2$ emissions, urbanization, economic growth and industrialization in case of Pakistan.

Table: 1 Summary of research work done about causality in economic growth, urbanization, industrialization, and environmental degradation

| Authors            | Sample and time period | Variables                          | Methodology                        | Results                                                                 |
|--------------------|------------------------|------------------------------------|------------------------------------|-------------------------------------------------------------------------|
| Zhang and Cheng    | China (1960-2007)      | CO$_2$ emissions, GDP, energy use   | multivariate model, Granger causality test | Unidirectional causal association of GDP with energy use, of energy use with CO$_2$ emissions |
| (2009)             |                        |                                    |                                    |                                                                         |
| Hossain (2011)     | Newely industrialized countries (1971-2007) | CO$_2$ emissions, energy use, Economic growth, urbanization. | Fisher panel cointegration test, Granger causality test | Unidirectional relationship of urbanization with economic growth. Unidirectional relationship found of economic growth with CO$_2$ emissions, urbanization, as well as energy consumption |
| Authors                  | Countries/Periods                                                                 | Variables                                      | Methodology                                                                 | Findings                                                                                                                                                                                                 |
|-------------------------|----------------------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Omri (2013)             | Fourteen MENA Countries (1990-2011)                                              | CO₂ emissions, GDP, energy use.               | Simultaneous equations model                                                | Bidirectional causal association of energy use with GDP. Unidirectional causal association of CO₂ emissions with GDP.                                                                                     |
| Liddle and Lung, (2014).| 105 countries (1971-2009)                                                        | CO₂ emissions, Urbanization, electricity use  | Cointegration, Granger causality test                                      | Granger causality from urbanization to electricity usage.                                                                                                                                              |
| Vidyarthi (2014)        | Five Asian countries (1972-2009)                                                 | Energy use, CO₂ emissions, Economic growth.   | Granger causality test                                                     | Bidirectional causality for energy usage with economic growth. Unidirectional causal association in energy use with CO₂ emissions in long term.                                                      |
| Alshehry and Belloumi (2015) | Saudi Arabia                                                                     | CO₂ emissions, Economic growth, energy prices, energy use | Granger causality test                                                     | Unidirectional relationship exists from emissions of CO₂ to price of energy and economic growth in short period. Unidirectional causal association in energy use, emissions of CO₂ emissions and GDP in long period. |
| Asjad and Aqeel (2014)  | Pakistan                                                                         | CO₂ emissions, GDP per capita, energy consumption, population growth. | Granger causality test                                                     | Unidirectional causality found in the variables                                                                                                                                                    |
| Saidi and Hammami (2015)| six oil-exporting countries (1990-2012)                                          | CO₂ emissions, GDP, energy usage.             | GMM model Bootstrap panel Granger causality test                            | Two way granger causality for UAE for economic growth and CO₂.                                                                                                                                       |
| Al-Mulali and Ozturk (2015) | Fourteen MENA states (1962-2012)                                                | Urbanization, energy use, industrial development. | fully modified OLS, Granger causality test                                 | All the variables have short and long term causalities.                                                                                                                                              |
| Sarkodie & Owusu (2017) | Rwanda (1965-2011)                                                                | CO₂ emissions, GDP per capita, population, industrialization. | ARDL, Granger causality test                                               | Unidirectional causality found for industrialization to per capita GDP, population towards GDP per capita, population towards industrialization, population towards CO₂ emissions. |
| Liu and Bae (2018)      | China (1970-2015)                                                                | CO₂ emissions, real GDP, industrialization, urbanization, energy consumption. | ARDL, VECM                                                                | All variable have positive impact on CO₂ emissions. Granger causality exists in Industrialization, energy consumption and CO₂                                                                           |

3. Data and Empirical Method
3.1 Data Source and Variables
The research study is based upon time series data for the span of 1975 to 2017 that is retrieved from World Bank Development Indicators (WDI, 2017). The main variables that are employed in the study are economic growth, which is represented by a percentage growth in real GDP, urbanization represented by urban population as a percentage of the total population, industrialization represented by industry including construction value added whereas for environmental degradation, CO₂ emissions is used as a proxy. VAR model is used for identifying causalities among the macroeconomic variables, namely economic growth, urbanization, industrialization, CO₂ emissions with granger causality test for identifying the directions of causalities in the studied variables.

3.2 Model Specification
The causal link between CO₂ emissions with macroeconomic variables has been analyzed by different econometric techniques. The present study follows the analytical techniques used by Zhao and Wang (2015). Prior to conducting econometric techniques, the data are analyzed for stationarity through Augmented Dickey-Fuller (1979) along with Phillips and Perron (1988) tests, both with intercept and with a linear deterministic trend. Stationarity of the variables allows us to use co-integration test for identifying long run association in the variables. For this purpose, Johansen co-integration (1991, 1995) test is used. The Impulse Response Function (IRF) and variance decomposition is used to examine the vibrant impact of the errors on the variable’s system. Granger causality test is used for identifying the direction of causality amongst the variables.

The paper deals with the empirical investigation of the causal relationship between economic growth, urbanization, industrialization and environmental degradation using Pakistan data. We hypothesis our model for empirical analysis pursuing Zhao and Wang (2015), Liddle, B., & Lung, S. (2014). More specifically, the general functional form the model is:

\[ CO_{2t} = \alpha_{it} + \sum_{j=1}^{k} \alpha_j U_{rt-j} + \sum_{j=l}^{k} \beta_j I_{ndt-j} + \sum_{j=1}^{k} \gamma_j CO_{2t-1} + \sum_{j=1}^{k} \delta_j E_{gt-j} + \mu_t \]  
\( i \)

\[ Ur_t = \alpha_{it} + \sum_{j=1}^{k} \alpha_j U_{rt-1} + \sum_{j=l}^{k} \beta_j I_{ndt-j} + \sum_{j=1}^{k} \gamma_j CO_{2t-j} + \sum_{j=1}^{k} \delta_j E_{gt-j} + \mu_t \]  
\( ii \)

\[ Ind_t = \alpha_{it} + \sum_{j=1}^{k} \alpha_j U_{rt-j} + \sum_{j=l}^{k} \beta_j I_{ndt-1} + \sum_{j=1}^{k} \gamma_j CO_{2t-j} + \sum_{j=1}^{k} \delta_j E_{gt-j} + \mu_t \]  
\( iii \)

\[ Eg_t = \alpha_{it} + \sum_{j=1}^{k} \alpha_j U_{rt-j} + \sum_{j=l}^{k} \beta_j I_{ndt-j} + \sum_{j=1}^{k} \gamma_j CO_{2t-j} + \sum_{j=1}^{k} \delta_j E_{gt-1} + \mu_t \]  
\( iv \)

Where CO₂ is representing Carbon Dioxide Emissions, Ur represents urbanization, Ind stands for industrialization, Eg represents economic growth, k represents lag length and ut represents error term.

3.3 Empirical Results
- **Result of ADF and Phillips- Perron (PP) unit root tests**

For stationarity analysis, we use Augmented Dickey-Fuller (ADF) 1979 and Phillips and Peron (1988) tests. The mathematical form of ADF test is

\[ \Delta z_t = \varphi z_{t-1} + \gamma \sigma + \varepsilon_t \]  
\( v \)

Where \( \varphi = \rho - 1 -1 \leq \rho \leq 1 \), with hypothesis as under:

\[ H_0: \varphi = 0 \text{ or } \rho = 1 \]

\[ H_1: \varphi < 0 \text{ or } -1 \leq \rho < 0 \]

Phillips-Perron (PP) test is used to adjust the coefficient (t-ratio) of the ADF test, when test statistic distribution got affected by any serial correlation. The PP test is presented as
Where \( \gamma_0 \) is the appraisal of error variance while \( f_0 \) is the zero occurrence of error. Table 2 represents the results of the above mentioned tests. The table shows that economic growth is stationary at level whereas urbanization, industrialization as well as \( \text{CO}_2 \) emissions were non stationary that are converted into stationary after taking the first difference in both tests.

### Table 2 Results of Unit root test

| Variables | Result of ADF test | Result of PP-test |
|-----------|-------------------|-------------------|
|           | Intercept         | Intercept and Trend | Intercept         | Intercept and Trend |
| Eg        | -11.136*          | -11.910*          | -9.283*          | -11.271*          |
| Ur        | 0.379             | -0.818            | 0.264            | -1.383            |
|           | -7.281*           | -7.306*           | -7.277*          | -7.247*           |
| Ind       | -2.511            | -2.705            | -2.322           | -2.537            |
|           | -7.210*           | -7.174*           | -8.021*          | -8.492*           |
| \( \text{CO}_2 \) | -2.235            | -2.149            | -4.043           | -1.741            |
|           | -7.627*           | -8.259*           | -7.627*          | -17.127*          |

*Significant at 1% significance level

### 3.4 Cointegration Test

For identifying the presence of long term association in the used variables, Johansen(1988) presented two likelihood ratio tests that are maximum Eigen value and trace statistics. These tests are represented in two equations:

\[
J_{\text{max}} = -T \ln \left( 1 - \lambda_{r+1} \right) 
\]

\[
J_{\text{trace}} = -T \sum_{i=r+1}^{n} \ln (1 - \lambda_i) 
\]

Where in \( T \) both equations represent the size of the sample, \( \lambda_i \) is the ith largest known associations. Table 3 shows the results of cointegration test. The results show that for all 4 variables, the null hypothesis of no cointegration is rejected at 1% significance level.

### Table 3 Results of Cointegration test

| N.Hypothesis | A. Hypothesis | Trace Statistics |
|--------------|---------------|------------------|
|              |               | Statistic        | Critical Value  |
| \( r = 0 \)  | \( r = 1 \)   | 73.92*           | 47.86           |
| \( r \leq 1 \)| \( r = 2 \)   | 31.84*           | 29.80           |
| \( r \leq 2 \)| \( r = 3 \)   | 17.74*           | 15.06           |
| \( r \leq 3 \)| \( r = 4 \)   | 6.74*            | 3.84            |

Levels of significance: *\( p < 0.01 \)

### 3.5 Impulse Response Function (IRF) Results

IRF is used to know about the response of dependent variables to any change or innovation in error term. Figure (1) presents the estimation of 4 variables that are, \( \text{CO}_2 \) emissions, urbanization, industrialization, economic growth in IRF terms to unitary innovation or shock from outside. The graphs show that if one standard deviation innovation or shock occurs from outside, the \( \text{CO}_2 \) will takes 13 years, urbanization will takes 19 years, industrialization will take 16 years and economic growth will takes 12 years to 726
absorb the shocks.

**Figure 1. Response of Variables to impulses of 1 standard deviation innovation**

![Graphs showing the response of variables to impulses of 1 standard deviation innovation](image)

**3.6 Variance Decomposition Results**

Variance decomposition analysis is used to identify that how much of the variations in dependent variable are lagged by their own variance and by other variables. Table 4 shows the variance decomposition of the employed variables. The first group referred to the values of variance decomposition of CO$_2$. The values of standard error (S.E) values which is explained by CO$_2$ itself ranging from 100% to 82%. Economic growth is also explaining much of variations in CO$_2$, ranging from 4.09% to 8.52%. Similarly, the variation in CO$_2$ explained by industrialization and urbanization are ranging from 0.62% to 7.62% and 0.02% to 1.74% respectively. The second group represents the values of variance decomposition of urbanization. The values of standard error explained by urbanization itself, ranging from 99% to 94%. The second variable that explains most of the variation in urbanization is economic growth that explains 3.57% to 3.84% variation. Similarly, CO$_2$ explains 1.04% to 0.95% variation and industrialization explained 0.06% to 0.89% variation in urbanization. In a similar way the values of the variance decomposition for industrialization and economic growth can be interpreted.

| Table 4. Values of Variance Decomposition |
|-------------------------------------------|
| Variance Decomposition of CO$_2$          |
| Period | S.E. | CO$_2$ | Ur   | Ind | Eg   |
|-------|------|--------|------|-----|------|
| 1     | 0.0687 | 100.0000 | 0.0000 | 0.0000 | 0.0000 |
| 2     | 0.0713 | 95.2936  | 0.0012 | 0.6159 | 4.0894 |
| 3     | 0.0725 | 92.4464  | 0.0224 | 0.6217 | 6.9096 |
| 4     | 0.0751 | 86.4072  | 1.1595 | 3.9799 | 8.4535 |
| 5     | 0.0757 | 85.6066  | 1.4681 | 4.1339 | 8.7914 |
| 6     | 0.0769 | 83.2002  | 1.5832 | 6.6833 | 8.5333 |
| 7     | 0.0761 | 83.0070  | 1.6455 | 6.7951 | 8.5524 |
| 8     | 0.0772 | 82.4011  | 1.7333 | 7.3760 | 8.4896 |
| 9     | 0.0774 | 82.2217  | 1.7296 | 7.5311 | 8.5168 |
| 10    | 0.0774 | 82.1319  | 1.7361 | 7.6154 | 8.5158 |
Variance Decomposition of Ur

| Period | S.E.  | CO₂    | Ur     | Ind    | Eg    |
|--------|-------|--------|--------|--------|-------|
| 1      | 0.0026| 1.0421 | 98.9578| 0.0000 | 0.0000|
| 2      | 0.0027| 0.9951 | 95.3750| 0.0642 | 3.5657|
| 3      | 0.0030| 0.7886 | 96.1344| 0.0702 | 3.0068|
| 4      | 0.0031| 0.9367 | 94.6304| 0.7297 | 3.7032|
| 5      | 0.0032| 0.8984 | 94.7619| 0.8279 | 3.5117|
| 6      | 0.0032| 0.9254 | 94.5247| 0.8244 | 3.7255|
| 7      | 0.0032| 0.9150 | 94.5576| 0.8258 | 3.8234|
| 8      | 0.0032| 0.9429 | 94.3576| 0.8760 | 3.8439|

Variance Decomposition of Ind

| Period | S.E.  | CO₂    | Ur     | Ind    | Eg    |
|--------|-------|--------|--------|--------|-------|
| 1      | 0.0561| 0.1296 | 6.7216 | 93.1488| 0.0000|
| 2      | 0.0576| 0.4288 | 6.9157 | 90.1731| 2.4824|
| 3      | 0.0635| 0.6687 | 7.8809 | 89.2175| 2.2329|
| 4      | 0.0650| 0.6779 | 8.3033 | 88.4470| 2.5718|
| 5      | 0.0657| 0.7038 | 8.2256 | 88.3215| 2.7491|
| 6      | 0.0663| 0.7111 | 8.0835 | 88.4619| 2.7435|
| 7      | 0.0663| 0.7149 | 8.1064 | 88.3589| 2.8198|
| 8      | 0.0666| 0.7221 | 8.1950 | 88.2840| 2.7988|
| 9      | 0.0666| 0.7214 | 8.1986 | 88.2390| 2.8411|
| 10     | 0.0667| 0.7256 | 8.1885 | 88.2436| 2.8422|

Variance Decomposition of Eg

| Period | S.E.  | CO₂    | Ur     | Ind    | Eg    |
|--------|-------|--------|--------|--------|-------|
| 1      | 0.5107| 1.6656 | 25.6034| 13.3006| 59.4304|
| 2      | 0.5674| 7.9035 | 23.7860| 11.2723| 57.0382|
| 3      | 0.5935| 10.5154| 24.0396| 12.6282| 52.8167|
| 4      | 0.6065| 10.6401| 23.0406| 15.4812| 50.8382|
| 5      | 0.6119| 10.5116| 24.1891| 15.2418| 50.0574|
| 6      | 0.6161| 10.4247| 24.2526| 15.6373| 49.6854|
| 7      | 0.6178| 10.4335| 24.4099| 15.5591| 49.5976|
| 8      | 0.6192| 10.4328| 24.2954| 15.8647| 49.4071|
| 9      | 0.6197| 10.4274| 24.3282| 15.9044| 49.3400|
| 10     | 0.6199| 10.4211| 24.3461| 15.9235| 49.3094|

Cholesky ordering: CO₂ Ur Ind Eg

3.7 Granger Causality Results

Granger causality test (1969) is adopted for identifying the directions of causal link in these variables. Once, long run cointegration is confirmed in variables, then the Granger unidirectional or bidirectional causality test can make clear the direction between the used variables Feng et al. (2009). The estimates of granger causality are given in table5. The results identify two unilateral causalities. One is running from CO₂ to urbanization and the other is from CO₂ to economic growth.

| Null Hypothesis | F-ratios | Prob. |
|-----------------|----------|-------|
| UR ≠ CO₂        | 1.83816  | 0.1737|
| CO₂ ≠ UR        | 5.81056  | 0.0065|
| IND ≠ CO₂       | 0.39351  | 0.6776|
| CO₂ ≠ IND       | 0.25946  | 0.7728|
EG ≠ CO₂
CO₂ ≠ EG

IND ≠ UR
UR ≠ IND

EG ≠ UR
UR ≠ EG

EG ≠ IND
IND ≠ EG

|                | VAR (2019) | VAR (2019) |
|----------------|------------|------------|
| EG ≠ CO₂       | 0.77482    | 0.4683     |
| CO₂ ≠ EG       | 3.75681    | 0.0330     |
| IND ≠ UR       | 0.33006    | 0.5230     |
| UR ≠ IND       | 2.09155    | 0.1382     |
| EG ≠ UR        | 2.30943    | 0.1139     |
| UR ≠ EG        | 1.44316    | 0.2495     |
| EG ≠ IND       | 0.16602    | 0.8477     |
| IND ≠ EG       | 0.82584    | 0.4460     |

Note: ≠ represents null hypothesis i.e., does not Grangers cause

4. Concluding Remarks
Economic growth is the desire of every country. The role of urbanization and industrialization cannot be ignored in the growth process of a country. The macroeconomic variables urbanization, industrialization, economic growth are associated with CO₂ emissions too. The purpose of this work is to analyze any causal association in urbanization, industrialization, economic growth with CO₂ emissions. The results of VAR model indicate that if innovation of 1 standard deviation is given, it takes about 13 years for CO₂, 19 years for urbanization, 16 years for industrialization and 12 years for economic growth to adjust. It follows that in Pakistan the policies regarding economic growth, industrialization, urbanization and CO₂ emissions are not effective as it takes much longer time to adjust. Furthermore, the case of urbanization is much alarming, therefore special attention is needed in policy formulation for urbanization, and further the policy must be objective oriented and also proper check on its implementation is required. In addition, for all variables, the causality result indicates that the response of every variable to their own shock/innovation was much better as compare to shock in other variables. Granger causality results identify only two unilateral causalities, that is from CO₂ emissions towards economic growth, and urbanization. There found no bidirectional causality and independent type relationships were found in economic growth and urbanizations, economic growth with industrialization, urbanization with industrialization and industrialization with CO₂ emissions. The issue of CO₂ emissions must not be ignored at the time of framing policy for industrialization.

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