Journal of Business and Policy Research
Vol. 13. No. 1. July 2018, Pp.104-118

The Causal Relationship between Government Spending and Environmental Quality: The Case for Bangladesh

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Government spending plays an important role in the development of a country. However, amidst such development, the environment is often overlooked, resulting in the deterioration of air quality and depletion of resources. Our study aims to investigate the possible relationship between government spending and environmental quality in Bangladesh over a period of 1976 – 2014, using a multivariate model. We use economic growth, capital stock and trade as control variables and two environmental indicators to represent the environmental quality. We employ the Augmented Dickey Fuller (ADF) unit root test followed by the Johansen cointegration technique and Granger Causality test to identify if a long run relationship exists between the variables. Next, we run the Dynamic OLS approach to find out if the increase in government expenditure impacts the environment in a positive or negative manner. We also run the Vector Error Correction Model (VECM) to find out if any short run causality exists among the variables. The study reveals that government expenditure degrades the air quality as well as depletes the resources in the long run. In the short run, the environmental problems affect the public health leading to a rise in the government expenditures. The government must undertake initiatives to prevent pollution and the depletion of resources, but at the same time promote growth through the increase in government expenditures.

Field of Research: Economics

1. Introduction

The concern for growth has most of the time been prioritized over environmental quality across the countries, particularly in developing countries. Bangladesh has achieved over 7% growth in the recent years and has been considered as one of the high – growth countries (World Bank, 2017). However, in order to pursue more growth and overcome poverty, we tend to overlook the environment around us. Bangladesh being highly populated and a poor country, is considered to be a potential haven for pollution. The flexible and less stringent environmental laws in the country often invite businesses to take their advantage and deteriorate the environment in the process. In the urban cities, the most severe form of pollution is the air pollution that mostly originates from vehicular and industrial emissions (Dewan et al., 2012). Over the years, the emission of greenhouse gases contributing to global warming and climate change has been on

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the rise. According to the experts, the natural order and processes through which the ecosystem works could be distorted; such distortions would worsen the quality of the environment leading to severe climate conditions (Charfeddine, 2016). Therefore, it is of utter importance to identify the probable factors that play a role in deteriorating the environmental quality.

Recent studies, both theoretical and empirical, have identified government spending or expenditure as a significant determinant of environmental quality (Bernauer and Koubi 2013; Halkos and Paizanos 2013; Galinato and Islam 2014; Islam and Lopez 2014). A growing number of studies also postulate a relationship between environmental quality and other factors such as economic growth, trade and capital formation could interact with government expenditure as well(Arouri et al., 2012;Bernauer and Koubi, 2010; Antweiler et al., 2001; Grossman and Krueger, 1995).According to the economists, trade and capital intensive production can promote growth (Sadorsky, 2012), however, at the cost of environmental degradation. Higher growth creates an increased demand for energy which leads to the depletion of natural resources and release of air pollutants, thus deteriorating the environment (Ahad and Khan, 2016).

Government expenditure is one of the components of Gross Domestic Product (GDP) and GDP per capita usually represents the economic growth of a country. The government of a country can influence the growth rate of the economy through the use of fiscal policy, which refers to the change in government expenditures along with the tax structure to achieve the economic goals. The fiscal policy has a significant role to play in accumulating and allocating the resources of a country (Lopez et al., 2010).

In our study, we attempt to examine the possible relationship between government expenditure and environmental quality in Bangladesh, by focusing on the concepts of GDP and Environmental Kuznet's Curve (EKC) hypothesis. The EKC hypothesis postulates that with economic development the environmental quality tends to become worse, until a threshold point is reached, after which environmental quality gets better with further economic development. In case of Bangladesh, a number of studies show that growth deteriorates the environmental quality in the long run (Amin, Morshed and Porna, 2016; Rahman and Porna, 2014). However, the relationship between the particular components of GDP, such as government expenditure and environmental quality has often been overlooked (Saidi and Hammami, 2015; Kasman and Duman, 2014) even though the relationship between government spending and environmental quality is of considerable interest to the policy makers.

This is from where our motivation arises; we want to find out if the government expenditure component of GDP has a role in deteriorating the environmental quality in Bangladesh. Studies concerning the link between these two variables have been carried out in other countries. However, to the best of our knowledge, no paper has addressed the link between government expenditure and environmental quality in Bangladesh. Our paper aims to fill this gap in the literature and consequently investigate using a multivariate model if a relationship exists between the two concerned variables, taking two indicators to represent the environmental quality. The rest of the paper is organized as follows; section 2 provides a review of the relevant literature followed by the methodology and dataset in sections 3 and 4 respectively. The results obtained and the conclusion are presented in the subsequent sections 5 and 6.

2. Literature Review

The studies carried out to examine the relationship between government expenditure or spending and environmental quality provide ambiguous findings. Huang (2018) examines the relationship between government's environmental protection spending and sulphur dioxide (SO2) emissions in China by considering a panel dataset of thirty provinces over a time period of 2008 – 2013. The paper employs the panel Spatial Durbin models to find that the SO2 emissions can be reduced with an increase in the government spending on the environmental protection. The study points out that an increase in the foreign direct investment can cause the level of emissions to decrease as well. Zhang et al. (2017) employ the Generalized Methods of Moments (GMM) technique over a time span of 2002 – 2014 to examine the effect of government expenditure on the three typical pollutants, which are sulphur dioxide (SO2) emissions, soot and chemical oxygen demand (COD). The study finds that the effects of government expenditure are decreasing, inverted U- shaped and U-shaped in case of SO2 emissions, soot and COD, respectively.

Halkos and Paizanos (2017) consider the panel data for 94 countries over a period of 1970-2008 to investigate the relationship between government spending and environmental quality. The findings show that an increase in government expenditure causes the oxides of sulphur and nitrogen to decrease in the long run. However, no significant relationship is found between government expenditure and carbon dioxide as well as nitrous oxide. The paper by Lyu et al. (2016) considers a time period of 1997 – 2012 to investigate about the key factors that contributes to air pollution in China. According to the research, economic growth is identified as the primary factor in increasing PM2.5, SO2 and NOX emissions in China. The study also points out that development of the transportation sector might have also contributed in increasing the pollutants, mostly NOX emissions in the air.

The study by Abdullah et al. (2016) focuses on the national health expenditure particularly and examines its relationship with environmental quality over the period of 1970 – 2014 in Malaysia. The paper uses the ARDL approach to find that both CO2 and SO2 emissions have a positive relationship with health expenditure in the short run as well as in the long run. A similar study carried out by Yazdi and Tahmasebi (2014) in Iran over the period 1967 – 2010, finds that the impact of pollutants such as SO2 and CO (carbon monoxide) on health expenditures is positive and statistically significant in the short run as well as in the long run.Boachie et al. (2014) carry out the study in Ghana over a period of 1970 – 2008 to find a positive but insignificant relationship between CO2 emissions and health care spending. The paper by Assadzadeh(2014) focuses on a panel study based on 8 oil exporting countries over a time span of 2000 – 2010 to find that CO2 significantly and positively affects health expenditures in the short run.

Another study by Halkos and Paizanos (2016), utilizes the Vector Auto regression (VAR) model and quarterly data from 1973 – 2013 to study the impact of the fiscal policy on CO2 emissions in the US. The authors differentiate between the production generated and consumption generated CO2 emissions to include the effects of the fiscal policy according to the sources of the pollutants. The paper depicts that an increase in the fiscal spending reduces the emissions from both sources of the pollutants; however, deficit financing tax cuts causes an increase in the consumption-generated CO2 emissions. Islam and Lopez (2014) consider an assembled data set of government expenditures in US to study its effect on SO2, particulate matter and ozone concentrations over the three time periods, which are 1985 – 2008, 2000 – 2008 and 1983 – 2008. According to their results, a shift in the spending by state and local governments, from private to social and public goods attenuate the concentrations of air pollutants in the air.

The theoretical and empirical models developed by Lopez et al. (2011) show SO2 emissions are reduced when a reallocation of government spending is made towards social and public goods. However, an ambiguous effect on SO2 emission is found due to an increase in total government expenditure. In case of Europe, the study by Lopez and Palacios (2010) considers the disaggregated data for 21 European countries over the time span of 1995-2006 to find the impact of government expenditure and environmental taxes on environmental quality. The study depicts that government expenditure is negatively related to air pollution.

The abovementioned studies depict that the link between government expenditure and environmental qualityis equivocal in nature. Many studies find a positive relationship between the variables, with rise in air pollutants leading to higher expenditure. Whereas, other studies find a negative relationship, where rise in government expenditure decreases the pollutants in the air. Some studies also reveal a nonlinear relationship between the variables, while interestingly; few studies find no significant relationship at all. Furthermore, literature also shows that there are no studies concerning government expenditure and environmental quality in context of Bangladesh. Thus, our aim is to fill this gap in the literature and test the hypothesis that an empirical relationship exists between the government expenditure and environmental quality in Bangladesh. We consider a time period of 1976- 2014 to test our hypothesis.

3. Methodology

In order to carry out our study, we first employ the Augmented Dickey Fuller (ADF) unit root test to check for stationarity of the concerned variables (Dickey and Fuller, 1981). The variables considered are known for their non-stationary properties which could lead to spurious regressions unless a cointegrating relationship is present. Next, in order to determine the presence of possible linear combinations which could be considered stationary, we carry out the Johansen Cointegration test. This procedure provides a unified framework to test the cointegrating relationship with respect to the Vector Autoregressive (VAR) error correction models. To fulfill our purpose, we estimate an Unrestricted Vector of Autocorrelation ofthe following form:

$$\Delta x_t = \alpha + \theta_1 \Delta x_{t-1} + \theta_2 \Delta x_{t-2} + \theta_3 \Delta x_{t-3} + \cdots\cdots + \theta_{k-1} \Delta x_{t-k+1} + \theta_k \Delta x_{t-k} + u_t$$

Where, the difference operator is represented by Δ; a *(n x 1)* vector of non-stationary variables (in levels) is shown by x_t; the *(n x 1)* vector of random errors is shown u_t The matrix θ_t in the estimated equation holds the information regarding the long run relationship between variables. For instance, if the rank of $\theta_k = 0$, it means that there exists no cointegrating relationship among the variables. However, if the rank (usually denoted by *r*) is equal to 1, it depicts that there exists one cointegrating vector and finally if *1< r < n*, it denotes that multiple cointegrating vectors exits.

The Maximum Eigen value test and the Trace test are the two tests for cointegration, derived by Johansen and Juselius (1990). For both of the tests, a null hypothesis is evaluated. The null hypothesis for the trace statistic is that there are at most 'r' cointegrating vectors. However, null hypothesis for the Eigen value test is that there are exactly *r* cointegrating vectors in x_t. If the variables are found to be cointegrated, we run the Granger Causality tests to determine if a long run relationship exists between the variables and which variable granger causes the other variable(Granger, 1969). The estimated regressions are:

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \cdots\cdots + \alpha_l x_{t-l} + \beta_1 y_{t-1} + \cdots\cdots + \beta_l y_{t-l} + u_t$$
$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \cdots\cdots + \alpha_l y_{t-l} + \beta_1 x_{t-1} + \cdots\cdots + \beta_l x_{t-l} + v_t$$

The above sets of equationsare considered for all possible pairs of (x, y) series in the group. The reported F-statistics are the Wald statistics for the joint hypothesis $\beta_1 = \beta_2 = \beta_3 = \cdots\cdots = \beta_l = 0$

In order to make our results more robust and as well as to find if any short run causal relationship exists, we employ the Vector Error Correction Model (VECM) approach. VECM is able to model the short run as well as the long run dynamics among the cointegrated variables (Engle and Granger, 1987). The VECM equations we estimate are:

$$\Delta Y = \alpha + \sum_{i=1}^{m} \beta_i \Delta Y_{t-i} + \sum_{j=1}^{n} \gamma_j \Delta X_{t-j} + \sum_{k=1}^{0} \delta \Delta M^s + \sum_{l=1}^{p} \zeta \Delta N + \theta Z_{t-1} + \varepsilon$$

$$z_{t-1} = Y_{t-1} - \beta_0 - \beta_1 x_{t-1}$$

Where, z_{t-1} is the error-correction term which contains the lagged residual series of the cointegrating vector. This error term measures the deviation of the series from the long run equilibriumand depicts how quickly the variables return to equilibrium. This coefficient of the error correction term must be negative and statistically significant at 5% significance level to have econometric interpretations (Pahlavanietal., 2005). The short run causality is denoted by the changes in the independent variables, which can be concluded by using the Wald tests.

Once the direction of causality is determined, in order to find how one variable affects the other, we run the Dynamic Ordinary Least Square (DOLS) estimation (Stock and Watson, 1993). In the process, we adopt an approach used by Camacho – Guttierrez (2010).The Stock and Watson model of the following form is estimated:

$$Y_t = \beta_0 + \beta X + \sum_{j=-q}^{p} d_j \Delta X_{t-j} + u_t$$

Where β is cointegrating vector that depicts the effect of the change in the X variable on the Y variable; p and q represent the lag and lead length respectively. To make the stochastic error term independent, we consider the lag and lead terms in the DOLS regression.

4. Data Set and Variables

Our study spans over a time period of 1976 – 2014 and uses a multivariate model to examine the relationship between government expenditure and environmental quality in Bangladesh. Due to the lack of data, we use the government final consumption expenditure (current US$) as a proxy for government expenditure (GE). The two indicators used to represent the environmental quality are carbon dioxide emissions (CO2) emissions (in metric tons per capita) and net forest depletion (NFD) in current US $). Based on previous literature, the control variables used in the model are (i) GDP per capita (current US$) to represent economic growth, (ii) gross capital formation to represent capital (CAP) and (iii) trade represented by the total amount of trade as a percentage of GDP (TRADE). We have log transformed all our data for econometric analysis. All the required data are obtained from World Development Indicators (WDI) 2017, published by the World Bank. The software package EViews 8.1 is used to carry out the required tests.

5. Results

In order to find out if our data is stationary or not, we employ the ADF unit root test. Our null hypothesis is that the data series is non stationary and integrated. We find our data to be non stationary at levels that is supporting our hypothesis (See Table 1a). However, we reject the null hypothesis at differenced form where we find our variables to be stationary (See Table 1b).

Table 1a : Augmented Dickey Fuller (ADF) Unit Root Test for the Selected Variables

Panel 1: Levels					
Variables	ADF Statistics (only constant)	Probability Value	ADF Statistics (constant and trend)	Probability Value	Decision
GE	-0.342	0.909	-2.221	0.465	Non stationary considering constant and constant and trend
CO2 emissions	0.769	0.992	-3.848	0.025	Non stationary considering constant and stationary considering constant and trend
NFD	-2.267	0.187	-2.746	0.225	Non stationary considering constant and constant and trend
GDP	-2.267	0.187	-2.746	0.225	Non stationary considering constant and constant and trend
Capital	-2.387	0.152	-2.452	0.348	Non stationary considering constant and constant and trend
Trade	-0.240	0.924	-2.690	0.246	Non stationary considering constant and constant and trend
Note: All regressions are estimated with and without trend. Selection of the lag is based on Schwartz Information Criterion (SIC). EViews 8.1 software automatically selects the most significant lag length based on this criterion.					

Table 1b: Augmented Dickey Fuller (ADF) Unit Root Test for the Selected Variables

Panel 2: First Difference					
Variables	ADF Statistics (only constant)	Probability Value	ADF Statistics (constant and trend)	Probability Value	Decision
GE	-3.679	0.009	-3.615	0.042	Stationary
CO2 emissions	-6.483	0.000	-6.515	0.000	Stationary
NFD	-8.337	0.000	-8.448	0.000	Stationary
GDP	-8.337	0.000	-8.448	0.000	Stationary
Capital	-5.002	0.001	-4.971	0.001	Stationary
Trade	-3.748	0.009	-3.401	0.041	Stationary
Note: All regressions are estimated with and without trend. Selection of the lag is based on Schwartz Information Criterion (SIC). EViews 8.1 software automatically selects the most significant lag length based on this criterion.					

Once we find our variables to be integrated of order one, I(1) we then proceed onto carrying out the Johansen Cointegration test to determine if any possible long run cointegration exists among the concerned variables. A null hypothesis is evaluated for both the tests. As explained earlier, the null hypothesis for the Trace Test is that there are at most 'r' cointegrating factors, whereas, in case of Eigen Value Test, the null hypothesis is assumed as having exactly *r*cointegrating vectors inx_t. The results for Johansen Cointegration test consisting of both Eigen Value test and Trace Test are shown in Tables 2a and 2b (See Appendix). From the results, it is evident that at least 1 cointegrating relationship exists at 95% critical level or 5% significance level. The next step is to carry out the Granger Causality test to find the possible direction of long run causality. The null hypothesis is that one concerned variable does not granger cause the other. The results from the test are shown in Table 3.

Table 3: Granger Causality Tests (Lags 2)

Hypothesis	F-Statistics	P-Value	Granger Causality
NFD does not Granger Cause GE	2.47275	0.1003	Unidirectional Causality : GE→NFD
GE does not Granger Cause NFD	3.99738	0.0282	
NFD does not Granger Cause GDP	5.13339	0.0117	Bidirectional Causality GDP⇄ NFD
GDP does not Granger Cause NFD	6.18341	0.0054	
CO2 does not Granger Cause GE	10.0351	0.0004	Unidirectional Causality : CO_2 →GE
GE does not Granger Causes CO2	0.80443	0.4562	
GDP does not Granger Cause GE	0.25163	0.7791	Unidirectional Causality : GE→GDP
GE does not Granger Cause GDP	6.70667	0.0037	
GDP does not Granger Cause CO2	1.54373	0.2291	Unidirectional Causality : CO_2 →GDP
CO2 does not Granger Cause GDP	3.93776	0.0296	
GE does not Granger Cause Trade	3.24643	0.0520	Unidirectional Causality : GE →Trade
Trade does not Granger Cause GE	1.33511	0.2774	
GE does not Granger Cause CAP	10.2243	0.0004	Bidirectional Causality GE ⇄ CAP
CAP does not Granger Cause GE	2.70492	0.0822	

Based on the reported F- statistics and P-values, we reject our null hypothesis for the regressions shown in Table 3. We find that a unidirectional causality runs from government expenditure to net forest depletion and from CO2 emissions to government expenditure in the long run. Both government expenditure and CO2 emissions cause economic growth in the long run as well. There is also bidirectional causality between economic growth and net forest depletion and between government expenditure and capital. The government expenditure also Granger causes trade.

Now, in order to make our results more robust, we employ the VECM to examine the short run as well as the long run dynamics of our model. The estimated VECM results with the concerned variables are shown below in Table 4. Table 4a summarizes the results for the long run model:

Table 4a: Cointegration Equation

Target Variable	ECM Coefficient	Probability
GE	-0.432281	0.0172
CO2	-0.010060	0.9569
NFD	0.421926	0.0628

The ECM coefficient for the long run model has to be negative and significant at 5 % significance level in order to be considered econometrically meaningful. The results support the granger causality findings that there is a unidirectional causality running from at least one of the environmental indicators towards government expenditures in the long run.

Table 4b: Causality Test Statistics

Hypothesis	F-Statistic	Probability	Causality
NFD does not Granger Cause GE	4.184949	0.0288	Bidirectional causality between NFD and GE in the short run
GE does not Granger Cause NFD	8.783155	0.0016	
CO2 does not Granger Cause GE	0.377543	0.6899	No Short run causality between CO2 and GE
GE does not Granger Cause CO2	1.781690	0.1918	

Table 4b shows us that the null hypothesis that net forest depletion does not granger cause government expenditure in the short run is rejected and a bidirectional causality exists in the short run. However, we cannot reject the null hypothesis that CO2 emissions does not granger cause government expenditure in the short run. Hence, no short run causality is found between government expenditure and CO2 emissions in the short run unlike the causality found in the long run. Now, in order to understand if the impact of the environmental indicator on government expenditure or vice versa is positive or negative, we employ the Dynamic Ordinary Least Square (DOLS) Approach, proposed by Stock and Watson (1993). The results are shown in Table 5.

Table 5: DOLS Estimation

Dependent Variable	Variable	Coefficient	T-statistic	Probability	R-squared	Adjusted R-squared
GE	CO2	1.399833	20.84052	0.0000	0.971246	0.967536
NFD	GE	0.379117	2.83.547	0.0081	0.451001	0.380162

The positive and statistically significant coefficients indicate a positive relationship between the concerned variables. Thus our findings confirm that a positive relationship exists between government expenditure and environmental quality in Bangladesh. We find that an increase in the CO2 emissions will lead to an increase in the government expenditures. Similarly an increase in the government expenditure will lead to an increase in the net forest depletion in the long run.

6. Conclusion

To the best of our knowledge, no studies have been carried out in Bangladesh concerning the relationship between government expenditure and environmental quality. Our paper aims to fill this gap in the literature and examines the possible relationship between government expenditure and environmental quality in Bangladesh over a time span of 1976-2014. The study employs a multivariate model, using growth, trade and capital formation as control variables. However, there are certain limitations of this study. Due to the unavailability of the data, other environmental indicators such as the oxides of sulphur and nitrogen could not be added to represent the air quality. Moreover, the exact data on government expenditure was also unavailable for which a proxy variable is needed.

We find that a causal relationship exists between GE and NFD both in the short-run and in the long-run. Bangladesh is a developing country and thus a major portion of the government expenditure is allocated in promoting urbanization which results in deforestation in the long run. In the short run, however, a bidirectional causality is found. The reason could be that in the short run, the impact of deforestation makes the country more vulnerable to natural calamities. This increases government expenditure and also raises concern for human welfare and national economy.

No causal relationship is found between CO2 and GE in the short-run, however, in the long-run a unidirectional causality runs from CO2 to GE. This indicates that carbon emissions lead to health problems and other socio-economic problems, requiring the government to increase its expenditure in the health sector. However, this effect is not visible in the short-run as carbon emission takes time to have pronounced effects. There are important policy implications of our study since our findings confirm that government expenditure leads to environmental degradation both in the short run and long run. We also find that government expenditure is essential for economic growth and thus government expenditure cannot be reduced. It is evident that growth is fueled by an increase in the government expenditure, however, at the cost of the environment. Deforestation and the emission of pollutants in the air are social costs to the economy and can leave long term effects which can harm the future generations.

The growth of an economy cannot be compromised, but measures and policies can be taken to minimize the environmental damage. Bangladesh Bank has already enacted policies associated with green banking, the positive effects of which would be realized in the long run. However, in the meantime, other policies need to be enacted to alleviate the environmental damage. There are certain policies, such as the use of carbon tax and pollution permits that could be undertaken. More subsidies could be allocated to the renewable energy industry to promote the use of renewable sources of energy. Advertisements to create social awareness and simple measures such as planting more plants could also be undertaken. Another direction of research could be carried out in this field by including more indicators and other control variables such as different sources of energy, energy consumption, etc. Moreover, a panel study concerning government expenditure and environmental quality could also be carried out by taking the South Asian countries into consideration.

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Appendix

Table 2a: Johansen Test for Cointegration (Trace Test)
Lag Intervals 1

Trend Assumption: Linear Deterministic Trend				
Null	Alternative	Statistics	95% Critical Value	Conclusion
r=0	r=1	180.7836	95.75366	2 cointegrating equations at the 0.05 level
r<=1	r=2	105.4459	69.81889	
r<=2	r=3	43.73375	47.85613	
Trend Assumption: No Deterministic Trend				
Null	Alternative	Statistics	95% Critical Value	Conclusion
r=0	r=1	142.3028	83.93712	3 cointegrating equations at the 0.05 level
r<=1	r=2	72.40007	60.06141	
r<=2	r=3	43.96244	40.17493	
Trend Assumptions: No Deterministic Trend (Restricted Constant)				
Null	Alternative	Statistics	95% Critical Value	Conclusion
r=0	r=1	201.9249	103.8473	3 cointegrating equations at the 0.05 level
r<=1	r=2	125.1028	76.97277	
r<=2	r=3	62.20519	54.07904	
Trend Assumption: Linear Deterministic Trend (Restricted)				
Null	Alternative	Statistics	95% Critical Value	Conclusion
r=0	r=1	245.9107	117.7082	3 cointegrating equation at the 0.05 level
r<=1	r=2	164.3500	88.80380	
r<=2	r=3	90.57049	63.87610	

Table 2b: Johansen Test for Cointegration (Maximum Eigenvalue Test)
Lag Intervals 1

Null	Alternative	Statistics	95% Critical Value	Conclusion
Trend Assumption: Linear Deterministic Trend				
Null	Alternative	Statistics	95% Critical Value	Conclusion
r=0	r=1	75.33774	40.07757	2 cointegrating equations at the 0.05 level
r<=1	r=2	61.71213	33.87687	
r<=2	r=3	22.51205	27.58434	
Trend Assumption: No Deterministic Trend				
Null	Alternative	Statistics	95% Critical Value	Conclusion
r=0	r=1	69.90277	36.63019	1 cointegrating equation at the 0.05 level
r<=1	r=2	28.43763	30.43961	
r<=2	r=3	25.30709	24.15921	
Trend Assumptions: No Deterministic Trend (Restricted Constant)				
Null	Alternative	Statistics	95% Critical Value	Conclusion
r=0	r=1	76.82213	40.95680	2 cointegrating equations at the 0.05 level
r<=1	r=2	62.89759	34.80587	
r<=2	r=3	25.32361	28.58808	
Trend Assumption: Linear Deterministic Trend (Restricted)				
Null	Alternative	Statistics	95% Critical Value	Conclusion
r=0	r=1	81.56070	44.49720	3 cointegrating equations at the 0.05 level
r<=1	r=2	73.77955	38.33101	
r<=2	r=3	48.48773	32.11832	