Testing the Long-run Relationship between CO_2 Emission, Energy consumption and Economic Growth for Bangladesh: An ARDL bound testing Approach

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Abstract
Environmental degradation, population growth, scarcity and increasing use of electricity has been a source of serious concern for Bangladesh over the past few decades. Since Bangladesh has a target to be in the middle income countries by 2021 it is highly appropriate to know the connection between economic growth,CO_2 emission and energy consumption. Since the ARDL Bound testing approach is less restrictive and give more reliable estimated coefficients compared to other methods of cointegration we preferred ARDL approach to test for cointegartion between these variables over the period 1972-2007 for Bangladesh. All the series of the variables taken in natural logarithm become stationary after first differences using KPSS test however $LNCO_2$,LNGDP,LNPCGDP,LNEPN are stationary using ADF and PP tests. The ARDL bound test results show that there exists long run relationship between CO_2 emission, economic growth and energy consumption from non-renewable resources for Bangladesh given the period under consideration. The long-run coefficients are significant with expected signs. The error correction model implies that any external shock to CO_2 emission, the speed of reaching equilibrium is significant with expected signs. The CUSUM and CUSUMSQ graphs imply stability of the parameters. The composite effect of Environmental Kuznet's curve do hold for Bangladesh.

Keywords: Economic growth,CO_2 emissions, Energy consumption, Bangladesh ,Cointegration test
JEL classification: F43,Q43,Q56

1.Introduction:

Bangladesh is a rapidly growing and emerging economy of South Asia. With the pace of development which is measured in terms of per capita GDP , the economy has become more dependent on the production and distribution of electricity throughout the country. Bangladesh could produce electricity both from renewable and non-renewable energy sources.We all know if electricity is being produced from renewable energy resources it is innocuous for the overall environment of the country. Renewable resouces are naturally replenished such as solar energy,wind,waves,rain,tides ,biomass and geothermal heat.

Bangladesh is lacking behind using high-powered technology ,updated research and expertise and proper incentives to use our natural resouces to meet this collosal growing demand for electriticity which are being used for domestic,commercial,agricultural and industrial purposes.Bangladesh has planned to produce only 10% of total power generation by 2020 fromrenewable energy sources like air,waste and solar energy.

In practice Bangladesh produces electricity primarily from non-renewable sources of energy like fossil fuel energy.Natural gas,various types of petrolium products including diesel,petrol,kerosene,octane,coal mines are the basic sources of nonrenewable energy in Bangladesh.The per-capita consumption of non-renewable energy use is about 220.00 kwh which is lowest in the world and even lower compared to other South Asian developing countries like India, Pakistan and Srilanka. In India the figure is 443.54, in Pakistan it is 388.10 and in Srilanka it is 388.09 .All the figures are in Kwh in 2009.The data are being collected from CIA world factbook , 2009.The per capita Natural gas is the single most important source of power generation in Bangladesh which accounts for 73% of the total commercial energy of the country.Nautural gas is cheaper than other conventional sources of energy.The number of discovered gad fields is 25 in our country.Gas reserve from 25 gas fields has been estimated as 27.04 trillion cubic feet [TCF] out of which recoverable reseve is 20.70 (P1) and recoverable reserve is 6.39 TCF.

Bangladesh is one of the densly populated countries securing fifth position in the South Asia amounting to 154.5 million.To keep pace with fast growing population deleterious urbanizationand industrialization is taking place even at the cost of environmental degradation.There are many reasons of CO_2 emission where CO_2 emission is a major factor for green house gasemission (GHG) which in turn is largely responsible for global warming,climate change and sea level rise.Other reasons of CO_2 emission are Industrialization which requires burning of carbon based fuels, man-made green houses especially in cold countries ,acidification of the ocean water due to carbon explosion in world climate, burning of coal, gas, oil for energy use, burning wood and waste materials ,cement production, deforestation and overrunning of engine driven vehicles.

The amount of CO_2 emission due to urbanization,industrial and agricultural movement is alsogrowing very fast.The following figure 1 shows the amount of CO_2 emission per capita
increasing over time in Bangladesh.

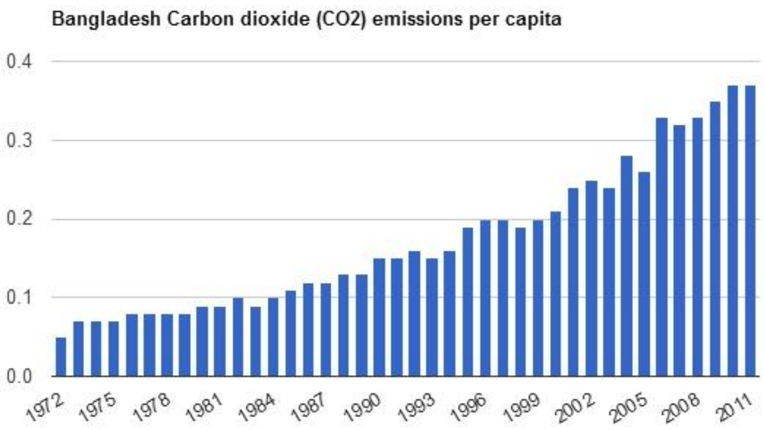
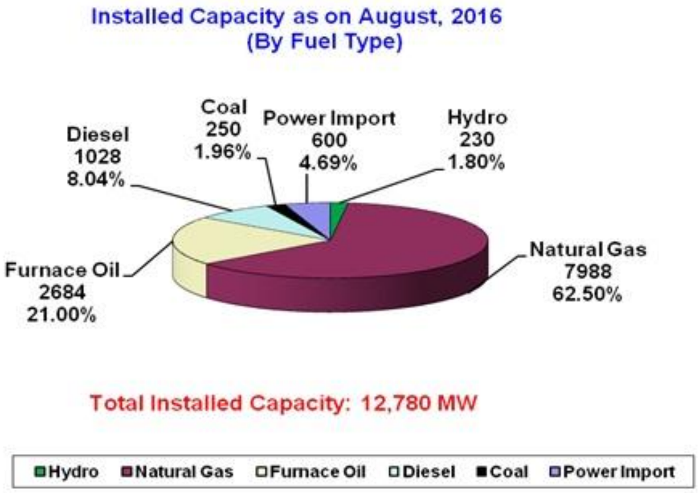


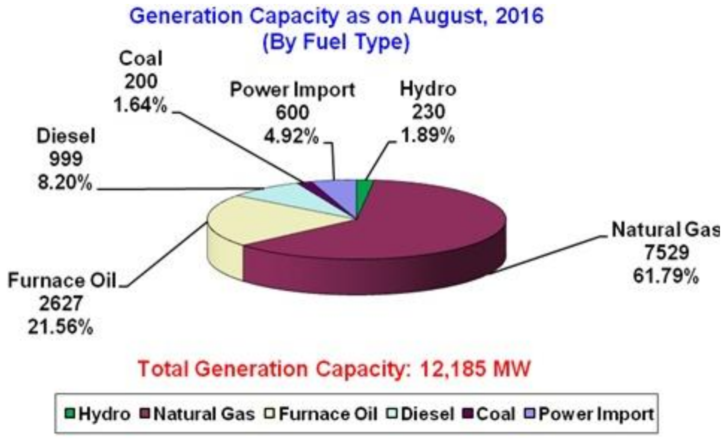
Figure 1:

The follwing figures 2 and 3 show both installed capacity and generation capacity as of august 2016. We see that the total installed capacity 12,780 MW whereas natural gas constitutes 62.5%of the total installed capacity but the natural gas's generation capacity is 61.79%.Furnace oiland diesel come respectively after natural gas in percentage for both installed capacityand generation apacity.Among other sources of electricity generation imported power,coal and hydeo electrics are worth notable sources though these sectors contribute in small percentage.

Sources: Bangladesh power development board

Figure 2&3:





he gravity of the relationship between CO2 emission,energy consumption and economic growth is quite understandable.It is need of the time to do research on the longrun relationship of the variable for Bangladesh because of very fast growing population,urbanization,industralization and massive environmetal degradation.

This paper investigates the presence of long-run relationship between economic growth, electricity production form non-renewable resourcs (fossil fuels) and carbon emission in Bangladesh from 1972-2007.We could not extend the period of reserach due to unavailiblity of the data.We take Bangladesh as the country for research because first of all only a handful of reserches have been conducted for Bangladesh context in this arena.Secondly, Bangladeshi data for this period will help to understand if there any country specific economic ,social,cultural,historical connections and shifts. We do not know of any reserach conducted on Bangladesh for this period using this model specification using ARDL approach. This paper is an attempt to fill up the gap of the existing literature on this topic for Bangladesh. The rest of the paper proceeds as follows. Section 2 represents review of literature,section 3 is mainly about data,variables and econometric model,section 4 contains empirical results and section 5 ends with conclusion.

2.Review of Literature:

If we cast a glance on the existing literature of this topic we see three basic trends in research.The first stream tries to test for the validity of the well known EKC (Environmental Kuznets Hypotheses) curve or inverted U hypothesis.The EKC hypothsis states that at the initial stage of economic growth CO_2 emission is higher and CO_2 emission becomes lower at higher stage of economic growth after reaching threshold point or tuning point or peak point.The researchers are divided in this regard.Some papers found validity of the research whereas others failed to get it. However the cross country heterogeneoty,variation in time period and cultural heterogeneity might play pivotal role in this case.In this connection the works of Seldon and Song (1994),Panayatou (1997) ,Unruh and Moomaw(1998),Galeotti and Lanza(1999), Agras and Chapman (1999),Friedl and Getzner (2003), Dinda and Coondo (2006), Managi and Jena (2008), Gurluk S anf Karaer F (2004), Akbostanci E (2009), Satci M and Dumrul Y (2011) have findings in favor of the existence of EKC curve for different countries.Islam F et al (2013) found lonr run cointegration between CO2 emission and energy consumption for Bangladesh.They also found that economic growth,energy consumption,trade and urbanization Granger causes CO_2 emissions.

On the other hand some other works namely Shafik (1994),Cole et al.(1997), Roca etal.(2001),de bryun(1998) , Acaravci and Ozturk (2010), Lise (2006) got evidence against the existence of EKC curve.They found monotonically positive relation between per capita GDP and CO_2. Basar and Temurlenk(2007) ,Omay (2013) rather found an N shaped relation between CO_2 emission,energy cosumption and per capita GDP for Turkey rather being inverted U shape.

The second stream of research focuses on the long-run relationship between CO_2 emission,energy consumption and economic growth.Halicioglu (2009) found trade variable as insignificant and found long run nexus bewtween CO_2 emission, per capita GDP and energy consumption. An enormous amount of literature have been produced to test for empirical evidence of the co-integration model and Granger causality and the results are inconclusive.Most of these papers uses bivariate model and failed to get expected results. Among the studies Kraft and Kraft (1978), Ozturk (2010), Masih and Masih (1996), Cheng and Lai(1997), Glasur and Lee (1998), Stern (2000), Soytas and sari (2003), Paul and Vattacharya (2004),Wolde-Rufael (2005), Mehrara (2007), Narayan and Smith(2008) are worth mentioning.

The third strand of research cosists of the above mentioned two methods in other words testing the existence of both nexuses.The works of Ang (2007),Soytas and Sari(2003), Zhang and Cheng (2009) fall in these category of research.

3.Data,Variables and Model

It is found in the literature that long run relationship between energy consumption proxied by electricity consumption either from renewable and non-renewable resources, economic growth and CO_2 emission has been tested using a quadratic form of equation. To facilitate the test of EKC hypothesis we thereby followed the following equation.

$CO_{2t} = \beta_0 + \beta_1 GDP_t + \beta_2 GDP2_t + \beta_3\ EPN_t + u_t$...(1)

In Eq (1),CO_2 is the carbon dioxide emission per capita measured in metric ton per capita as a proxy for environmental degradation, GDP is per capita gross domestic product measured in constant 2010 US Dollar,GDP2 is the square of GDP,EPN stands for electricity production nonrenewable resources like oil, gas and coal sources (% of total) and u is the disturbance term. The annual time series data for each variable was obtained from World Development Indicators online database of World Bank between the time period 1972 and 2007.We take natural log of each series to fit our model. However the data for each variable after 2007 are not available. While testing the EKC hypothesis ,coefficient β_1 is expected to be positive implies greater economic growth is positively related to greater emission. More interestingly, β_2 is expected to be negative because emission declines as economic growth further increases after certain point ,which is known as the turning point of EKC curve. For our paper β_3 is expected to be positive because electricity production from oil, gas, coal increases CO_2 emission for the ignition of fossil fuels. The following table 2 shows descriptive statistics of the variables including the means, median, maximum, minimum of each series for the period 1972-2007.

Table 1: Descriptive statistics for the variables of the period 1972-2007

Variables	$LNCO_2$	LNGDPPC	LNGDPPC2	LNEPN
Mean	-1.874615	4.487941	515.4209	12.37368
Median	-1.853768	4.525142	440.6932	12.17649
Maximum	-0.988815	4.593890	972.8807	13.76052
Minimum	-2.957868	4.277702	317.7899	11.52278
Std. Dev.	0.552430	0.098391	190.3659	0.670229

3.1.Cointegration Methods

In time series econometrics cointegration techniques are usually used to explore long-run relationship. The Engle-Granger method, Philips and Hansen method and Johansen-Juselius methods of multivariate cointegration analysis are examples of different types of cointegrating technique. A more recent advanced cointegration approach autoregressive-distributed lag model (ARDL) bound test allows different time series to be either tationary at levels I(0) or differenced at I(1) developed and proposed by Pesaran et al.We can write Eq (1) as an ARDL model with intercept and Eq (3) as the model with intercept and trend as follows:

$$\Delta CO_{2t} = \alpha + \sum_{i=1}^{m} \beta_{1i} \Delta CO_{2t-i} + \sum_{i=0}^{m} \beta_{2i} \Delta GDP_{t-i} + \sum_{i=0}^{m} \beta_{3i} \Delta GDP_{t-i}$$

$$+ \sum_{i=0}^{m} \beta_{4i} \Delta EPN_{t-i} + \beta_5 CO_{2t-1} + \beta_6 GDP_{t-1} + \beta_7 GDP2_{t-1} + \beta_8 EPN_{t-1} + v_t \quad \ldots\ldots..(2)$$

$$\Delta CO_{2t} = \alpha_0 + \alpha_1 t + \sum_{i=1}^{m} \beta_{1i} \Delta CO_{2t-i} + \sum_{i=0}^{m} \beta_{2i} \Delta GDP_{t-i} + \sum_{i=0}^{m} \beta_{3i} \Delta GDP2_{t-i}$$

$$+ \sum_{i=0}^{m} \beta_{4i} \Delta EPN_{t-i} + \beta_5 CO_{2t-1} + \beta_6 GDP_{t-1} + \beta_7 GDP2_{t-1} + \beta_8 EPN_{t-1} + v_t \quad \ldots\ldots..(3)$$

ARDL bound test helps us to examine the long run relationship between variables. Null hypothesis of this test implies no cointegration H_0 : $\beta_5 = \beta_6 = \beta_7 = \beta_8 = 0$ against the alternative H_1: $\beta_5 \neq \beta_6 \neq \beta_7 \neq \beta_8 \neq 0$.The null hypothesis will be rejected if the F statistic is higher than upper bound critical value I(1) for the number of explanatory variables. If the F statistic is lower than lower bound critical value I(0) ,null hypothesis will be rejected. If the F statistic lies between upper bound critical value and lower bound critical value there is indecision about cointegartion. The minimum Akaike information criteria (AIC) or minimum Schwarz Information criteria (SIC) determines optimal lag value in the above mentioned equations. The long-run equation of ARDL model of the equation would be as follows:

$$CO_{2t} = \beta_0 + \sum_{i=0}^{p} \beta_{1i} CO_{2t-i} + \sum_{i=1}^{q} \beta_{2i} GDP_{t-i} + \sum_{i=0}^{r} \beta_{3i} GDP2_{t-i}$$

$$+ \sum_{i=0}^{s} \beta_{4i} EPN_{t-i} + \varepsilon_t \dots\dots\dots\dots.(4)$$

The minimum AIC, SIC, Hannan-Quinn information criteria and maximum Adjusted R^2 are used to choose lag values p, q ,r, s in the ARDL equation. The short-run estimation or error correction model of ARDL model is estimated as equation 5.

$$CO_{2t} = \delta_0 + \sum_{i=0}^{p} \delta_{1i} \Delta CO_{2t-i} + \sum_{i=1}^{q} \delta_{2i} \Delta GDP_{t-i} + \sum_{i=0}^{r} \delta_{3i} \Delta GDP2_{t-i}$$

$$+ \sum_{i=0}^{s} \delta_{4i} \Delta EPN_{t-i} + \lambda ECM_{t-i} + \tau_t \dots\dots\dots\dots.(5)$$

The co-efficient of the error-correction term λECM_{t-1} is expected to be negative and significant which is known as speed of adjustment parameter shows the speed of the series how quickly it reaches the long -run equlibrium. We conducted several tests such as serial correlation, normality, heteroscedasticity tests. Stability tests such as (CUSUM) and cumulative sum of squares (CUSUMSQ) by Brown et al. are performed to see the stability of the coefficients.

4. Empirical Results

4.1. Integration process

To test for stochastic stationarity in the time series data we conducted the ADF test (Augmented Dickey-fuller test),PP test (Phillips-Perron test) and KPSS test (Kwiatkowski-Phillips-Schmidt-Shin) test. The models are considered as models with intercept for all these three tests .Schwarz information criteria has been used for determination of lag length for the ADF test. Barlett Kernal estimation method with Newey-Bandwidth has been used for the test of KPSS. Table 3 shows the results of these three tests.

Table 2:Unit root tests at the levels of the variables.

Variables	ADF		PP		KPSS	
	Test Statistic	Critical Value	Test Statistic	Critical Value	Test Statistic	Critical Value
LNCO2	-1.269	-3.661	-1.466	-3.661	0.755	0.739
LNGDPPC	2.135	-4.243	7.231	-3.632	0.649	0.739
LNGDPPC2	4.017	-3.632	3.665	-3.632	0.682	0.739
LNEPN	-1.895	-3.661	-0.815	-3.646	0.595	0.739

Critical values are evaluated at 1% and KPSS critical values are asymptotic critical values at 1%.

According to ADF ,PP tests the $LNCO_2$,LNGDPPC,LNGDPPC2 ,LNEPN series are stationary, that is the test statistics are bigger than critical values at 1% implying rejection of the null hypothesis of the test that each series has a unit root at 1% critical values. But the KPSS test shows critical values are smaller than test statistics implying rejection of the null hypothesis of the test that each series is stationary at 1% asymptotic critical value. But all the series including $LNCO_2$,LNGDPPC,LNGDPPC2 become stationary at first differences using KPSS test .LNEPN become stationary at first differences using KPSS test. So we can conclude all the series $LNCO_2$,LNGDPPC,LNGDPPC2 are I(1) .The result of unit root tests for the first differences is given in table 4.

Table 3. Unit root tests at the first differences of the variables.

Variables	KPSS (Kwiatkowski-Phillips-Schmidt-Shin) test statistic Null hypothesis: Each series is stationary			
	LNCO2	**LNGDPPC**	**LNGDPPC2**	**LNEPN**
Test Statistic	0.333	0.683	0.576	0.131
Critical Value (1%)	0.739	0.739	0.739	0.739

It is evident form table 4 that test statistic is smaller than critical values at 1% , accepting the null hypothesis that LNEPN is stationary. We expect our results or findings to be very accurate because we computed the tests at 1% level of significance or the highest possible level of significance.

4.2.Cointegrtaion process

The ARDL bound test is generally is used to test for long run relationship or cointegration among the series. The ARDL bound testing approach is based on joint F statistic with whom we compare the upper bound and lower bound value. If value of joint F statistic is higher than upper bound value we say there is cointegartion among the series. If value of joint F statistics is lower than lower bound value we say there is no cointegration. If value of joint F statistics lies within the range of upper bound value and lower bound value ,there is indecision about cointegration. The results of ARDL (1,1,0,0) model are given below in table 4.

Table 4: ARDL (1,1,0,0) model results

Dependent variable is LNCO2

Regressor	Coefficient	Standard Error	T-Ratio	[Prob]
LNCO2(-1)	0 .784	0.079	9.896	[0.000]*
LNGDPPC	0 .004	0 .001	3.204	[0.004]*
LNGDPPC(-1)	-0.003	0.001	-2.402	[0.024]*
LNGDPPC2	-0.373	0.180	-2.068	[0.049]*
LNEPN	0 .781	0 .397	1.967	[0.060]**
Intercept	-1.072	0.285	-3.12	[0.042] *

R^2 = 0 .98 R-Bar-Squared = 0 .88
F[4,26] = 412.8891 [Prob = 0.000]*
DW = 2.09 Durbin's h = -0.300 [Prob = 0.764]

Table 5: Diagnostic Tests

Serial Correlation :	$\chi^2_{(1)}$ = 0 .09 [Prob = 0.809]
Functional Form :	$\chi^2_{(1)}$ = 0.12 [Prob = 0.882]
Normality :	$\chi^2_{(1)}$ = 0 .80 [Prob = 0.668]
Heteroscedasticity:	$\chi^2_{(1)}$ = 0 .88 [Prob = 0.348]

*Significant at 1% level
**Significant at 5% level

Considering AIC,SIC and Hannan-Quinn information criteria the best model for equation 4 is ARDL (1,1,0,0) model which implies p = 1,q = 1,r = 0 and s = 0. The estimated ARDL (1,1,0,0) model results diagnostic test results are reported in table 5 and table 6 respectively. All coefficients are significant at 1% critical value with only one exception of LNEPN which is significant at 5% critical value. As the F statistic is higher than the upper critical values by Pesaran et al. in all cases it can be concluded there is cointegration or long-run relationship among the series. Lagrange multiplier test was conducted to test for residual serial correlation and detected no serial correlation for the residuals of the model. Functional form is being determined using the Ramsey's RESET test using the square of the fitted values. The value of normality was found based on a test of skewness and kurtosis of residuals. Heteroscedasticity test was performed based on the regression of squared residuals on squared fitted values.The long-run estimation results are reported in table 6.All coefficients are significant and they all have expected signs.

Table 6: Estimated Long Run Coefficients using the ARDL Approach

Dependent variable is LNCO2	Coefficient	Standard Error	T-Ratio	[Prob]
LNGDPPC	0.006	0 .001	4.142	[0.000]*
LNGDPPC2	-1.737	0 .534	-3.252	[0.003]*
LNEPN	3.632	1.326	2.739	[0.011]*
Intercept	1.064	0.183	2.023	[0.001]*

*Significant at 1% level

The fact that the coefficient for GDP variable is positive and coefficient for GDPPC2 variable is negative implies Environmental kuznets curve (EKC) holds for Bangladesh. This result resembles with the former studies about EKC hypothesis for Bangladesh namely Islam,F , Shahbaz, M and Butt M.S(2013).The peak point of EKC curve was calculated to be $\beta_1/2\ \beta_2$. = 0.0018 US dollars which is smaller than the maximum value of GDPPC in our sample which can be seen from table 1 where the maximum value of GDPPC is 4.5938 in the sample. This is an indication of the fact that EKC 's turning point is inside of the sample period since we tried to cover the maximum possible data for Bangladesh.The short-run estimation results are shown in table 7 where the coefficient of the error correction term is negative and significant as expected.

Table 7: Error Correction Representation for the Selected ARDL Model

Dependent variable is ΔLNCO2

Regressor	Coefficient	Standard Error	T-Ratio	[Prob]
ΔLNGDPPC	0.004	0.001	3.204	[0.003]*
Δ LNGDPPC2	-0.373	0 .180	-2.068	[0.048]*
Δ LNEPN	0.781	0 .397	1.967	[0.059]**
ecm(-1)	-0.215	0 .0793	-2.711	[0.011]*
Intercept	-1.69	0 .005	-3.19	[0.004]*

R^2 = 0 .74 R-Bar-Squared = 0 .64 F (3,27) = 4.60 [Prob = 0.01]*
DW-statistic = 2.09 *Significant at 1% level

When per capita CO_2 emission level diverges away from the equilibrium level it adjusts by 22% within the first year. In the case of any external shock to emissions the speed of reaching equilibrium is significant. We also tested the stability of the parameters by CUSUM and CUSUMSQ graphs by Brown et al. respectively. The figures are shown in the following where the straight lines represent critical bounds at 5% significance level. It can be seen from the following figures 4 and 5 that statistics are between the critical bounds which imply the stability of the coefficients.

Figure :

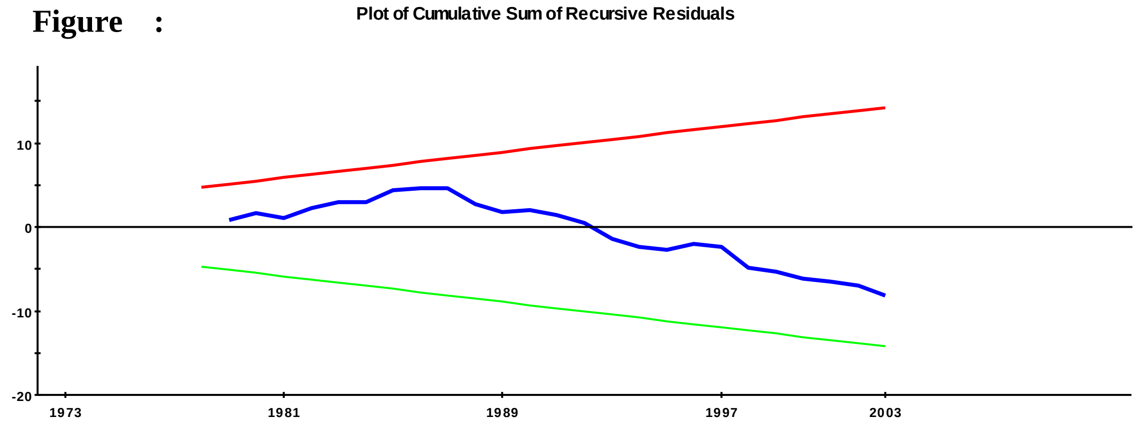
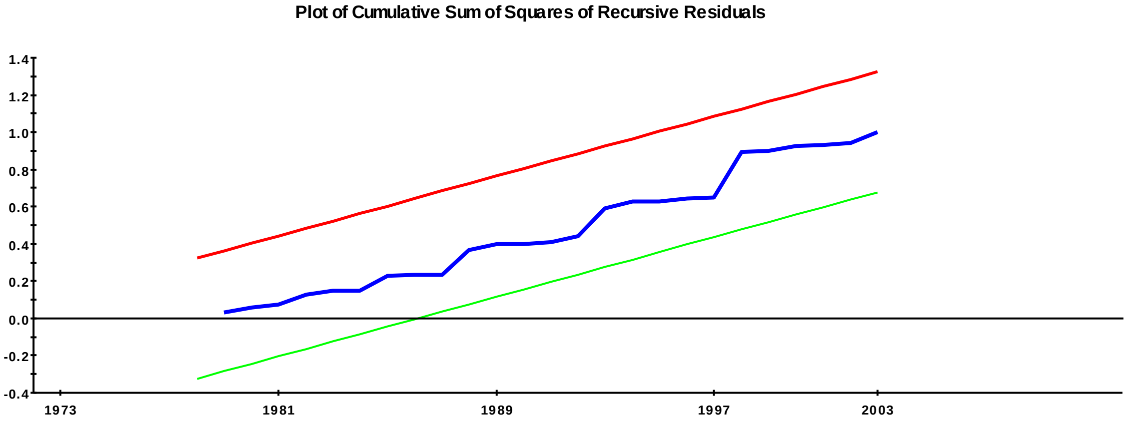


Figure :



The straight lines represent critical bounds at 5% significance level

Conclusion:

The present paper tried to address and recollect the possible connections between energy consumption ,economic growth and CO_2 emission for Bangladesh.Very few researches have been conducted in this area for Bangladesh.The rationale of undertaking this type of research in this time is clearly perceptible because of population growth,urbanization, migration, industrialization that are taking place in Bangladesh.We can say that because of the reliability of data source as well as the methodological soundness of econometric method the findings of the paper is robust.

As we all know the supply of fossil fuel will diminish and reach it's minimum level in coming years and Bangladesh is suffering from energy crisis simultaneously, the policy makers should pay more attention and take neceesary requirements to produce and distribute electricity from renewable resources which ensures environment friendly sustainable development.Due to lacking data of renewable resources from Bangladesh we could not do research on the long-run relationship between renewable energy,economic growth and CO_2 emission.A more effective research would be to test for long run relationship among these variables which requires massive reconstruction in electricity and power generation sector to be undertaken by the Government of Bangladesh.To fulfill the dream of Bangldesh to reach to middle income country by 2021 it is high time to realize this tranformation of energy sector to renewable source of energy like the middle income countries.

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References:

[1] Acaravci, A., Ozturk I.(2010). On the relationship between energy consumption,CO_2 emissions and economic growth in Europe . *Energy*; 35: 5412–20.

[2] Akbostancı, E., Turut-Asık, S.,Tunc GI (2009). The relationship between income and environment in Turkey: is there an environmental Kuznets curve? *Energy Policy*; 37 (3):861–7.

[3] Gürlük, S., Karaer, F.(2004). On the examination of the relation between economic growth and environmental pollution.*Turkish J Agr Econ*;10(2):43–54.

[4] Halicioglu, F.(2009). An econometric study of CO_2 emissions, energy consumption, income and foreign trade in Turkey. *Energy Policy*; 37: 1156–64.

[5] Omay, RE. (2013). The relationship between environment and income: regression spline approach. *Int J Energy Econ Policy* ;3:52–61(Special issue).
[6] Pesaran, HM., Shin, Y . (1999) . Autoregressive distributed lag Modelling approach to Cointegration Analysis. In :Storm S, editor. Econometrics and economic theory in the 20^{th} century: The Ragner Frisch centennial symposium. Cambridge University Press: [chapter 11]
[7] Pesaran, MH., Shin, Y., Smith, RJ. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*;16: 289-326.
[8] Boluk, G., Mert, M. (2015). The renewable energy ,growth and environmental kuznets curve in Turkey:An ARDL approach. *Renewable and Sustainable Energy Reviews* ;52:587-595.
[9] Acaravci, A.,Ozturk, I. (2010). On the relationship between energy cosumption,CO_2 emissions and economic growth in Europe.*Energy*;35:5412-5420.
[10] Ozturk, I., Ali, A. (2010*).* CO_2 emissions,energy consumption and economic growth in Turkey.*Renewable and Sustainable energy reviews* ;14:3220-3225.
[11] Grossman, G., Krueger, A. (1991). Environmental impacts of a North American free trade agreement.National Bureau of Economics Reserach working paper,No. 3194,NBER,Cambridge:
[12] Stern, DI. (2004). The rise and fall of the environmental Kuznets curve.*World Development* ;321419-39.
[13] Kraft, J., Kraft, A. (1978) .On the relationship between energy and GNP.*Journal of Energy and Development* ;3:401-3.
[14] Ozturk, I. (2010). A literature survey on energy -growth nexus.*Energy Policy*;38:340-9.
[15] Ang, J., (2007). CO_2 emissions,energy cosumption,and output in France.*Energy policy*;35:4772-8.
[16] Soytas, U., Sari, R., Ewing, BT. (2007). Energy consumption,income and carbon emissions in the United states.*Ecological Economics*;62:482-9.
[17] Lise, W. (2006). Decomposition of CO_2 emissions over 1980-2003 in Turkey.*Energy Policy*;34:1841-52.
[18] Shafik, N., Bandayopadhyay, S. (1992).Economic growth and environmenatl equality:time series and cross-country evidence.*In:World Bank Working paper no.904;*.Washington DC.
[19] Seldon, T., Song, D. (1994). Environmental equality and development:Is there a Kuznets curve for environmental pollution emissions.*J Environ Econ Manage*;27:147-62.
[20] Holtz-Eakin D,Selden, T. (1995). Stoking the fires?CO_2 emissions and economic growth.*J Public Econ*;57:85-101.
[21] de Bruyn SM, Opschoor JB.(1997). Developments in the throughput-income relationship:theoretical and empirical observations.*Ecol Econ*;20:255-68.
[22] Panayotou, T.,(1997*).* Demystifying the environmental Kuznets curve:turning a black box into a policy tool.*Environ Dev Econ*;42:265-484.
[23] Unruh, GC., Moomaw , WR. (1998). An alternative analysis of apparent EKC type transitions.Ecol Econ;25:221-9.
[24] Galeotti, M., Lanza, A. (1999*).* Richer and Cleaner?A study on carbon dioxide emissions in developing countries.*Energy Policy*;27:565-73.
[25] Agras, j., Chapman, D. (1999). A dynamic approach to the environmenatl Kuznets curve hypothesis.*Ecol Econ*;45:133-48.
[26] Friedl, B., Getzner, M. (2003*).* Determinants of CO_2 emissions in a small open economy.*Ecol Econ*;45:133-48.
[27] Dinda, S., Coondoo, D. (2006). Income and emission :a panel data based cointegration analysis.*Ecol Econ*;57:167-81.

[28] Managi, S., Jena, PR. (2008). Environmental productivity and Kuzntes curve in India*:Ecol Econ*;65:432-40.
[29] Shafik, N., (1994). Economic development and Environmetal quality: and economwtric analysis .*Oxf Econ Pap*;46:757-73.
[30] Coondoo, D., Dinda, S. (2008). The carbon dioxide emission and income :a temporal analysis of cross-country distributional patterns.*Ecol Econ*;65:735-85.
[31] Lotfalipour, M R., Falahi, M A., Ashena, M. (2010). Economic growth,CO_2 emissions and fossil fuels consumption in Iran.*Energy*;35:5115-5120.
[32] Banglapedia, National Encyclopedia of Bangladesh

[33] Oil Gas and Natural Resources

www.sdnbd.org/sdi/metadata/fifth5-yesr-plan/258.htm

[34].*Ministry of finance report.2010*
*www.mof.gov.**bd**/en/budget/10_11/p&e/english_1.pdf*
[35] Renewable Energy Policy of Bangladesh
https://en.wikipedia.org/wiki/Electricity_sector_in_Bangladesh
[36] Islam, MD S.(2011*).* Research Report: Energy Sector of Bangladesh. IDLC limited.
[37] Cole, MA., Rayner, AJ., Bates, JM. (1997). The environmental Kuznets curve:an empirical analysis.*Environ Dev Econ*;2(4):401-16.
[38] de Bruyn, SM., VAN den Bergh JCJM., Opschoor JB. (1998). Economic growth and emissions; reconsidering the empirical basis of environmenatl kuznets curves.*Ecol Econ*;25:161-75.
[39] Roca, J., Padilla, E., Farre, M., Galletto, V. (2001). Economic growth and atmospheric pollution in spain :discussing the environmental Kuznets curve hypothesis.*Ecol Econ*;39:85-99.
[40] Masih, AMM., Masih, R. (1996). Energy consumption ,real income and temporal causality:results from a multi-country study based on cointegration and error -correction modelling techniques.*Energy Econ*;18:165-83.
[41] Cheng, BS., Lai, TW. (1997). An investigation of cointegration and causality between energy consumption and energy activityin Taiwan.*Energy Econ*;19:435-44.
[42] Gasure, YU., Lee, AR. (1998). Cointegration error -correction and the relationship between energy GDP and energy:the case of South Korea and Singapore.*Resource Energy Econ*;20:17-25.
[43]Stern, D., (2000). A multivariate cointegration analysis of the role of energy in the US.*Macroeconomy*;22: 267-83.
[44] Soytas, U., Sari, R. (2003). Energy consumption and GDP :causality relationship in G-7 countries and emerging markets.*Energy Econ*;25:33-7.
[45] Paul, S., Bhattacharya, RN. (2004). Causality between energuy consumption and economic growth in India:a note on conflicting results.*Energy Econ*;24:977-83.
[46] Wolde-Rufael, Y., (2005). Energy demand and economic growth :the african experience .*J Pol Model*;27: 891-903.
[47] Mehrara, M., (2007). Energy cosumption and economic growth :the case of oil exporting countries.*Energy Policy*;35:2939-45.
[48] Narayan, PK., Smyth, R.(2008). Energy cosumption and real GDP in G-7 countries : new evidence from panel cointegration with structural breaks. *Energy Econ*;30: 2331-41.
[49]Islam, F., Shahbaz, M., Butt, M S. (2013). Is there an Environmental Kuznets curve for Bangladesh ?Evidence from ARDL bound testing approach. *Bangladesh Development Studies;* 4:1-23.