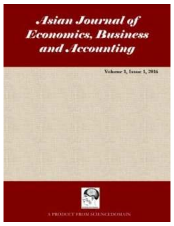

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Does Energy Consumption Boost Economic Growth in Bangladesh: Evidence from ARDL Bounds Testing Approach

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Authors' contributions

This work was carried out in collaboration between all authors. Author MKIC designed the study, wrote the protocol and managed the literature searches. Author MAH performed the statistical analysis and wrote the first draft of the manuscript. Author MAW managed the analyses of the study and wrote the final draft of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

The paper assesses whether energy consumption leads to economic growth in Bangladesh applying the ARDL (autoregressive distributed lag) bounds testing approach of cointegration. We use time series data for the period from 1979 to 2014. Results report that energy use and economic growth cause each other to boost both in the short- and long-run. Policy implication is that the government needs to continue generating and ensuring supplying of energy to boost both economic growth and energy generation to achieve the 'Vision 2041' of developed country.

Keywords: Energy consumption economic growth; bounds test; error correction mechanism.

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1. INTRODUCTION

Bangladesh is a densely populated developing country with a per capita income of US $ 1466 in 2016 [1]. The economy of Bangladesh has been boasting at a real GDP growth rate of 6.15 percent during the past few years [2], and this growth is accompanied by increasing demand for energy. Total primary energy, electricity, petroleum, natural gas and coal consumption consists of total energy demand in Bangladesh. The growth of electricity generation in 2016 was 15.6 percent, with an average growth of 8.12 percent since 1996-97. The maximum power generation of Bangladesh on 30 June 2016 was 9036 megawatt (MW) [2]. Up to June 2016, almost 76 percent of the population in Bangladesh has had access to electricity including renewable energy [2]. On the other hand, power outages in Bangladesh due to inadequate power generation, has been held responsible for an estimated loss of US $ 1 billion worth of annual industrial output [3]. However, system loss has been decreased at 13.55 percent in 2015-16 which was 27.97 percent in 2001-02 [2].

Wadud et al. [4] states that main contributors to the total primary energy consumption in Bangladesh are natural gas, biomass and petroleum. In 2015, total primary energy consumption of Bangladesh is estimated to be 62 percent natural gas, 12 percent traditional biomass and waste, 21 percent oil, 2.5 percent coal, and 2.5 percent hydropower and solar [5]. Biomass energy is utilized for cooking in rural areas. Biomass provides more than 50 percent of the entire energy requirement of the country in 1990s and it is still one the major source of energy for the rural population in Bangladesh. The sources of biomass fuel include agricultural residues, animal wastes, scrub wood and fire wood [6]. It is estimated that biomass contributes to almost 54% of total primary energy consumption, which reduced to 35% just over a decade in 2005 [4]. Currently, natural gas is certainly the apex source of commercial energy in Bangladesh. The use of natural gas from 26 gas fields is more diverse, which is brought into play in the processes of heating the boilers in industries às power generation, raw materials in fertilizer companies, fuel in brick fields and fuel in cooking in households. Petroleum is mostly imported from abroad and makes up one–fifth energy consumption. Petroleum is predominantly used in the transportation sector, although the demand for petroleum is decreasing since the government of Bangladesh is encouraging compressed natural gas (CNG) as a substitute fuel. Diesel is used in the agricultural sector for running irrigation pumps and kerosene is used in rural areas for lighting. In 1996, around 65% of households in Bangladesh use kerosene for lighting [7]. Several coal reserves have been discovered in the north western part of Bangladesh, but the coal sector of the country still remains underdeveloped. Coal is primarily used in brick making factories; however, 1.62% of total electricity as on June, 2016 is generated by coal [2].

The renewable energy sector in Bangladesh requires quick and major developments in order for Bangladesh to pursue sustained economic growth. Currently, hydropower represents a little less than 1.84% of the total primary electricity generation capacity [2]. Due to the geographical setting of the country, Bangladesh is termed as a flat country; hence possibility of installing more hydropower plants is negligible [8,9]. In addition, solar photovoltaic (PV) has gained popularity in the rural communities and is made affordable due to opportunities of microcredit. At present, there are wind turbines installed in Muhuri Dam in the Feni district and Kutubdia Island in the Cox's Bazar district with the total capacity of 2 MW.

In 2015-16, the share of gas, hydro, coal, import-based and oil-based energy generation were 68.63 percent, 1.84 percent, 1.62 percent, 7.32 percent and 20.58 percent respectively. Therefore, it is evident that Bangladesh is highly dependent on gas for generation of power, basically due to the relative abundance of the gas resource in the country. Total grid-based installed capacity is 12,365 MW in FY2015-16 including 6,512 MW in public sector, 5,253 MW in private sector and 600 MW from cross border power trade from India, while maximum power generation as on 30 June 2016 is 9036 MW. Installed generation capacity including captive power (as on 01 January, 2017) has increased to 15,351 MW [10]; however, only 7000-9000 MW of power is actually generated. Gas shortage is believed to be responsible for the loss of 500-700 MW of power. The peak demand has been observed to go as high as 9000 MW and up to 2000 MW of load shedding has occurred during the summer.

The government of Bangladesh, like any other government, sets certain goals in their agenda. One of them is the 'Vision 2021', the objective of this vision is to promote Bangladesh into a middle income country by 2021. The government recognizes the interrelationship between economic growth and energy use. Hence the government has decided to carry out infrastructure development in power and energy sectors. In order to fulfill this vision, the government has planned to generate 24,000 MW electricity within 2021. Furthermore, the government has also had plans to generate 40,000 MW and 60,000 MW electricity within 2031 and 2041 to achieve the millennium development goals and obtain the 'Vision 2041'of reaching the level of developed country [2].

This research is designed to evaluate the short- and long-run relationship between economic growth and growth of various components of energy consumption applying the ARDL based cointegration and error correction mechanism in Bangladesh and prescribe some policies. The rest of the paper is organized as follows. Section 2 explains a brief literature review, Section 3 presents data and methodology, Section 4 discusses results and Section 5 concludes the paper.

2. BRIEF LITERATURE REVIEW

The relationship between energy use and output nexus suggests that economic growth is closely linked to energy use; higher economic development demands higher use of energy. On the other hand, for energy to be used efficiently, it is necessary to have higher economic growth. Hence, the causality might be either way or bidirectional. There has been a growing literature on the causal relationship between energy consumption and economic growth. Following the seminal study of Kraft and Kraft [11], where they found a unidirectional Granger causality running from output to energy consumption for USA between 1947-1974 employing Sims causality test, number of studies have assessed the empirical evidence by employing Granger causality and cointegration model. Mallick [12] studies whether energy use drives economic growth or vice versa in the Indian context during 1970– 71 to 2004–05. Utilizing the Granger causality test, the study suggests that it is the economic growth that fuels more demand for both crude oil and electricity consumption and it is the only growth of coal consumption that drives economic growth. Ahamad and Islam [13] reveal a short-run unidirectional causality running from per capita electricity consumption to per capita GDP in Bangladesh applying co-integration and VECM based Granger causality test for the period from 1971 to 2008. Like [11], Ameyaw et al. [14] reveal that there exists a unidirectional causality running from GDP to electricity consumption using the Cobb-Douglas growth model covering time series data of Ghana from 1970 to 2014. Ahmad et al. [15] investigate the relationship between energy consumption and economic growth of Pakistan for the period of 1973-2006. GDP is taken as dependent variable and energy consumption as independent variable. The results of Granger causality test show unidirectional causality running from GDP to energy consumption. Pata and Terzi [16] study the causality link between net electricity consumption and economic growth in the Turkish covering the period from 1960 to 2014. Results of UVAR and ARDL analysis finds that there is a positive unidirectional and statistically significant causality moving from net electricity consumption to economic growth in the short/long run. Thus, they comment that there is growing net electricity consumption positively stimulates the economic growth in the short/long run in Turkey. Alam and Sarkar [17] claims that there exists short run causal relationship running from electricity generation to economic growth, while Buysse et al. [18] explore that unidirectional causality exists from energy consumption to economic growth both in short and long run in Bangladesh.

Thus, employing a variety of time series econometric techniques, the empirical results of previous studies on the energy consumption-growth nexus have yielded mixed and inconsistent results in terms of their causal relationships.

3. METHODOLOGY

3.1 Data

This study uses annual time series data of real GDP (proxy for economic growth) and annual time series data of total primary energy, electricity, natural gas, coal and petroleum consumption over the period from 1979 to 2014. The data on real GDP (at constant US dollar 2005 price) are collected from World Development Indicators, 2016 published by World Bank [19], while the data of total primary energy use in BTU, electricity (billion Kwh), natural gas (billions of cubic feet), coal (1000 short tons) and petroleum (1000 bbl/d) are collected from International Energy Statistics, 2016 [20]. All the data series are transformed in growth forms.

3.2 Methodology

This study applies the ARDL based bounds testing cointegration procedure introduced by Pesaran, Shin and Smith [21] and ARDL based error correction model (ECM) to examine the short run and long-run relationship between growth of energy consumption and economic growth. We also apply unit root test – augmented Dickey-Fuller and Philips-Perron test to check the non-stationary properties of the variables – energy consumption growth and economic growth.

3.2.1 Unit root test

Unlike cointegration technique of Johansen and Juselius [22], the ARDL bounds testing approach of cointegration does not need the same order of integration for each variable. The ARDL model is applicable irrespective of whether the regressors in the model are purely *I(0)* or purely *I(1)* or mutually cointegrated. However, in order to run the ARDL framework, some preconditions need to be checked, such as, none of the variables should be *I(2).*Two extensively used unit root test, namely Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) test are employed to examine the stationarity of the time series. The ADF test is performed using the following equation:

$$\Delta Y_t = \alpha + \beta T + \gamma Y_{t-1} + \delta_i \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t \quad (1)$$

where, α is a constant, β is the coefficient of time trend T, γ and δ are the parameters, ∆ is the first difference operator, m is the number of lagged first differenced term, and ε is the error term. The Phillips-Perron unit root test is performed using the following equation:

$$\Delta Y_t = \alpha + \beta T + \gamma Y_{t-1} + \varepsilon_t \quad (2)$$

where α is a constant, β is the coefficient of time trend T, γ is the parameter and ε is the error term.

3.2.2 ARDL bounds test

Ordinary least squares approach of Autoregressive Distributed Lag modeling (ARDL) to cointegration procedure [21] is employed in this study as it has several advantages in comparison to the conventional cointegration procedures, such as, residual-based approach proposed by Engle and Granger [23] and the maximum likelihood approach proposed by Johansen and Juselius [22]. First, ARDL model can be applied on a time series data irrespective of whether the variables are I(0) or I(1) [24], while Johansen cointegration techniques require that all the variables in the system be of equal order of integration. Second, the ARDL procedure permits that the variables may have different optimal lags, while it is impossible with conventional cointegration procedures. Third, the ARDL procedure is statistically more significant approach to determine the cointegration relation in small samples, while the Johansen cointegration procedures need large data samples for validity [21,25]. Fourth, the ECM can be derived from ARDL integrates the short-run dynamics with the long run equilibrium without losing long-run information. Finally, the ARDL procedure makes use of only a single reduced form equation, while the conventional cointegration procedures estimate the long-run relationships within a context of system of equations.

The ARDL long-run models can be expressed mathematically as:

$$GDP_t = \alpha_1 + \beta_1 TEC_t + \beta_2 EC_t + \beta_3 GC_t + \beta_4 PC_t + \beta_5 CC_t + \varepsilon_{1t} \quad (3)$$

$$TEC_t = \alpha_1 + \beta_1 GDP_t + \beta_2 EC_t + \beta_3 GC_t + \beta_4 PC_t + \beta_5 CC_t + \varepsilon_{1t} \quad (4)$$

where GDP denotes economic growth, TEC, EC, GC, PC and CC indicate total primary energy, electricity, natural gas, petroleum and coal consumption. α, β and ε represent constants, coefficients and error terms respectively. Equation (3) and (4) can be re-expressed in the following conditional error correction model (ECM) version of the ARDL to implement the bounds testing procedure:

$$\begin{aligned} \Delta GDP_t = {} & c_1 + \pi_1 GDP_{t-1} + \pi_2 TEC_{t-1} + \pi_3 EC_{t-1} + \pi_4 GC_{t-1} \\ & + \pi_5 PC_{t-1} + \pi_6 CC_{t-1} + \sum_{i=1}^{\rho} \theta_i \Delta GDP_{t-i} + \sum_{i=1}^{\rho} \phi_i \Delta TEC_{t-i} \\ & + \sum_{i=1}^{\rho} \delta_i \Delta EC_{t-i} + \sum_{i=1}^{\rho} \gamma_i \Delta GC_{t-i} + \sum_{i=1}^{\rho} \eta_i \Delta PC_{t-i} \\ & + \sum_{i=1}^{\rho} \psi_i \Delta CC_{t-i} + u_{1t} \end{aligned} \quad (5)$$

$$\Delta TEC_t = c_2 + \pi_1 TEC_{t-1} + \pi_2 GDP_{t-1} + \pi_3 EC_{t-1} + \pi_4 GC_{t-1} + \pi_5 PC_{t-1} + \pi_6 CC_{t-1} + \sum_{i=1}^{\rho} \theta_i \Delta GDP_{t-i} + \sum_{i=1}^{\rho} \emptyset_i \Delta TEC_{t-i} + \sum_{i=1}^{\rho} \delta_i \Delta EC_{t-i} + \sum_{i=1}^{\rho} \gamma_i \Delta GC_{t-i} + \sum_{i=1}^{\rho} \eta_i \Delta PC_{t-i} + \sum_{i=1}^{\rho} \psi_i \Delta CC_{t-i} + u_{1t} \quad (6)$$

where (5) and (6) are termed as model 1 and 2 respectively. The first parts of the equations represent the long-run dynamics of the models and the second parts show the short-run relationship in which Δ signifies the first difference operator. c_i (i = 1, 2) show constants, π_i (i = 1..6) denote coefficients on the lagged levels, θ_i, ϕ_i, δ_i, γ_i, η_i and Ψ_i (i = 1…ρ) denote coefficients on the lagged variables, and finally u_i(i = 1…6) stand for error terms. ρ signifies the maximum lag length, which is decided by the Akaike Information Criterion (AIC) [1].

The ARDL bounds testing method consists of two steps [21]. The first step inspects the presence of long-run relationship, while the second step estimates the long run and short-run coefficients of the models. Thus, we estimate the equations (5) and (6) in order to test the long-run relationship by conducting F-test for the joint significance of the coefficients of the lagged levels of the variables. The null and alternative hypotheses are as follows:

$$H_0: \pi_1 = \pi_2 = \pi_3 = \pi_4 = \pi_5 = \pi_6 = 0 \quad \text{(No long run relationship)}$$

$$H_1: \pi_1 \neq \pi_2 \neq \pi_3 \neq \pi_4 \neq \pi_5 \neq \pi_6 \neq 0 \quad \text{Long run relationship exists)}$$

Pesaran, Shin and Smith [21] argues that two sets of critical values for a given significance level can be determined. The first level is calculated on the assumption that all variables incorporated in the ARDL model are integrated of order zero, while the second one is calculated on the assumption that the variables are integrated of order one. The null hypothesis of 'no cointegration' is rejected when the value of the test statistic exceeds the upper critical bounds value, while it is accepted if the F-statistic is lower than the lower bounds value. Otherwise, the cointegration test is inconclusive.

Finally, we perform diagnostic and stability tests to establish the goodness of fit for the ARDL models. The diagnostic tests include the serial correlation, normality and heteroscedasticity associated with the models. The stability tests are conducted by operating the cumulative sum of recursive residuals and the cumulative sum of squares of recursive residuals.

4. EMPIRICAL RESULTS

4.1 Unit Root Test Results

Results of ADF and Phillips-Perron tests given in Table 1 show that growth of GDP, TEC, EC and PC series are nonstationary, while GC and CC series are stationary in levels. Results from the ADF and PP tests also show that all series are stationary in first differences with 1% significance level (except TEC for ADF test). So, the individual series are found to be integrated of order one, i.e., I (0) and I(1), while none of the variable are intregrated of order two, i.e., I (2). Since the ARDL model was introduced by Pesaran et al. [21] in order to incorporate I(0) and I(1) variables in same estimation, we proceed to apply the ARDL bound testing method.

4.2 Results of ARDL Bounds Testing Approach

The ARDL procedure estimates the models and tests for the presence of cointegration among the variables. The AIC selects the ARDL (4, 1, 4, 2, 4, 2) for the variables included in the model 1, while the AIC chooses the ARDL (4, 4, 2, 2, 4, 3) for the model 2. After specifying the optimum lag lengths for the models, we proceed to the ARDL cointegration bounds testing. The result of the F-Statistic is presented in Table 2 which shows that the computed F- statistics are 11.59 and 12.11 respectively for model 1 and model 2 that are both higher than the upper bound critical value of 4.15 at 1% level of significance. Therefore, the long-run relationship among the energy consumption and economic growth exists when GDP is dependent on energy consumption (TEC, EC, GC, PC, CC), and total primary energy consumption is dependent on GDP, EC, GC, PC and CC.

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[1] *The Schwartz Bayesian Information Criterion (SBC) and Akaike Information Criterion (AIC) are two lag length criteria popularly used to select the maximum lag length in autoregressive models. The Akaike Information Criterion (AIC) is utilized in this* study *to determine the order of the ARDL model* as *it has a lower prediction error than that of the SBC*[26] .

Table 1. Results of ADF and Phillips-Perron unit root tests

Variables	ADF		PP	
	Intercept	Trend & Intercept	Intercept	Trend & Intercept
GDP	4.32 (1.00)	0.26 (0.99)	4.32 (1.00)	0.26 (0.99)
∆GDP	-3.97* (0.00)	-4.33* (0.00)	-4.35* (0.00)	-9.60* (0.00)
TEC	-1.25 (0.64)	-2.21 (0.47)	-2.41 (0.14)	-2.21 (0.47)
∆TEC	-7.14 (0.00)	-7.32 (0.00)	-4.56* (0.00)	-9.27* (0.00)
EC	-1.08 (0.71)	-3.09 (0.12)	-1.12 (0.69)	-3.19 (0.10)
∆EC	-6.10* (0.00)	-6.02* (0.00)	-6.20* (0.00)	-6.10* (0.00)
GC	-3.05** (0.04)	-2.52 (0.32)	-4.11* (0.00)	-2.72(0.23)
∆GC	-5.95* (0.00)	-6.94* (0.00)	-5.96* (0.00)	-7.16* (0.00)
PC	0.00 (0.95)	-2.47 (0.34)	-0.07 (0.94)	-2.42 (0.36)
∆PC	-7.61* (0.00)	-7.52* (0.00)	-7.59* (0.00)	-7.52* (0.00)
CC	-1.82 (0.36)	-3.46*** (0.06)	-1.68 (0.43)	-3.25*** (0.09)
∆CC	-6.58* (0.00)	-6.54* (0.00)	-8.79* (0.00)	-10.65* (0.00)

*Note: First bracket shows p values.** , ** *and* *** indicate stationary at 1%, 5% and 10% levels respectively using *MacKinnon (*1996) critical and *p* values.*The number of optimal lags for the ADF test is specified by* AIC*,* that *is minimized from the maximum* 4 *lags length. Automatic bandwidth for PP test is selected according to Newey-West using Bartlett kernel.*

Table 2. Results of ARDL bounds cointegration test

Dependent Variable	Forcing Variables	F-Statistics	1% Critical Bounds I(0)	I(1)	Remarks
1: GDP	TEC, EC, GC, PC, CC	11.59*	3.06	4.15	Cointegration Presents
2: TEC	GDP, EC, GC, PC, CC	12.11*	3.06	4.15	Cointegration Presents

Note: denotes rejection of the null hypothesis at the 1% level*

Results of the short-run dynamics along with the estimated values of error correction terms are reported in Table 3. The results of the estimated ARDL error correction model indicate that the coefficients of error correction terms of the model 1 and 2 are negative and statistically significant at the 1% level of significance. It suggests that the long-run causality is directing from TEC, EC, GC, PC, CC to economic growth, and GDP, EC, GC, PC, CC to total primary energy consumption. The error correction term of model 1 is -0.19, which implies that GDP requires about five years to converge to equilibrium after being shocked. In contrast, the error correction term of model 2 is -0.81 which implies that 81% of the last year's disequilibrium is corrected this year by changes in total primary energy consumption.

The short run results are almost consistent with those of the long-run coefficients. The short-run impact of electricity, gas, and petroleum and coal consumption on GDP is positive and significant at the 1% level of significance. The short-run impact of D(GDP(-3)) on total primary energy consumptionis also positive and significant. From the model (1), we find that there is short run causality running from TEC, EC, GC, PC, CC to economic growth at the 1% level of significance. Model (2) reveals that there is short run causality running from GDP, EC, GC, PC, CC to total primary energy consumptionat the 1% level of significance. Thus, is a bidirectional causality exists between GDP and primary energy consumption in the short-run.

We can therefore comment that total primary energy, electricity, gas, petroleum and coal consumption have had positive short- and long run impact on economic growth and, in turn, economic growth has got positive short-and long-run influence on total energy, electricity, gas, petroleum and coal consumption in Bangladesh.

In order to verify the robustness of results, diagnostic checking of the estimated models have been carried out in terms of conventional multivariate residual-based tests for serial correlation, normality and heteroscedasticity and results are given in Table 4. At 1% level of significance, the Lagrange Multiplier (LM) test for autocorrelation indicates the absence of autocorrelation and ARCH Chi-square test for heteroskedasticity indicates the absence of heteroskedasticity. The model also passes the Jarque-Bera normality test at 1 percent suggesting that the error is normally distributed in the models.

Table 3. Results of ARDL based error correction model

Variable	Coefficient	P-Value	Variable	Coefficient	P-Value
Model 1 (Equation 5)			Model 2 (Equation 6)		
D(GDP(-1))	-0.880116	0.0001	D(TPE(-1))	-0.390256	0.0027
D(GDP(-2))	-0.244451	0.0056	D(TPE(-2))	-0.072397	0.0114
D(GDP(-3))	0.217082	0.0021	D(TPE(-3))	-0.072797	0.0135
D(TPE)	-0.446116*	0.0000	D(GDP)	-1.293767*	0.0001
D(EC)	0.088942*	0.0000	D(GDP(-1))	-0.883428	0.0012
D(EC(-1))	-0.157470	0.0001	D(GDP(-2))	0.271521	0.0574
D(EC(-2))	-0.091112	0.0001	D(GDP(-3))	0.735672	0.0004
D(EC(-3))	-0.062711	0.0007	D(EC)	0.139329*	0.0001
D(GC)	0.192209*	0.0001	D(EC(-1))	-0.045590	0.1058
D(GC(-1))	0.076542	0.0005	D(GC)	0.472143	0.0000
D(PC)	0.145476*	0.0000	D(GC(-1))	0.272005	0.0016
D(PC(-1))	0.028094	0.0043	D(PC)	0.273703*	0.0000
D(PC(-2))	-0.013749	0.0699	D(PC(-1))	0.088139	0.0092
D(PC(-3))	-0.027120	0.0021	D(PC(-2))	-0.064220	0.0038
D(CC)	0.005018*	0.0002	D(PC(-3))	-0.056495	0.0066
D(CC(-1))	0.006140	0.0003	D(CC)	0.011092*	0.0001
ECT (-1)	-0.190946*	0.0000	D(CC(-1))	0.006070	0.0105
			D(CC(-2))	-0.004988	0.0118
			ECT (-1)	-0.812069*	0.0000

*Note: * and ** denote significance at 1% and 5% levels respectively*

Table 4. Results of diagnostic tests

Diagnostic tests	Model 1		Model 2	
	Statistics	P-Value	Statistics	P-Value
Serial Correlation LM	F=3.41	0.10	F = 14.47	0.07
ARCH Heteroskedasticity	χ^2 = 0.28	0.99	χ^2 = 10.58	0.03
Jarque-Bera Normality	1.50	0.47	0.67	0.71

Finally, following Pesaran and Pesaran [24], the cumulative sum (CUSUM) of recursive residuals and the cumulative sum of squares (CUSUMSQ) of the recursive residuals tests are employed to assess parameter stability. Figs. 1 and 2 plot the statistics of CUSUM and CUSUMSQ of recursive residuals for model 1 and 2 respectively. The plotted points for the CUSUM and CUSUMSQ statistics for both models stay within the critical bounds of 5% level of significance. Thus, these statistics confirm the stability for all coefficients of the estimated models.

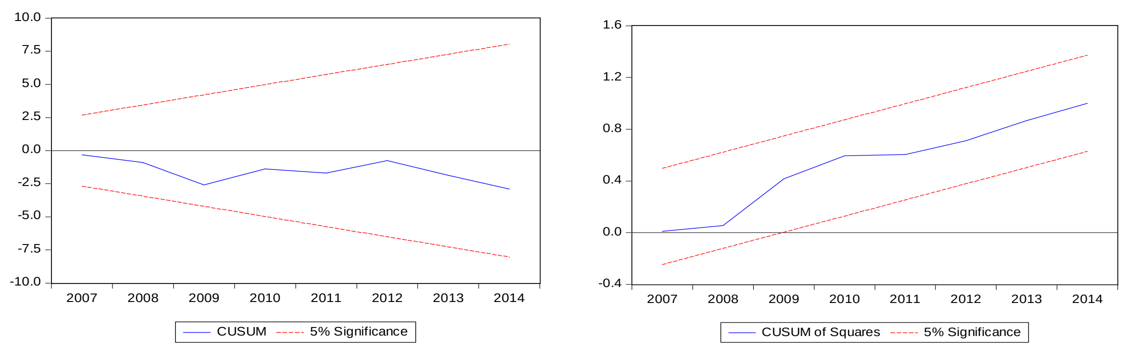

Fig. 1. Plots of CUSUM and CUSUMSQ stability test for model 1

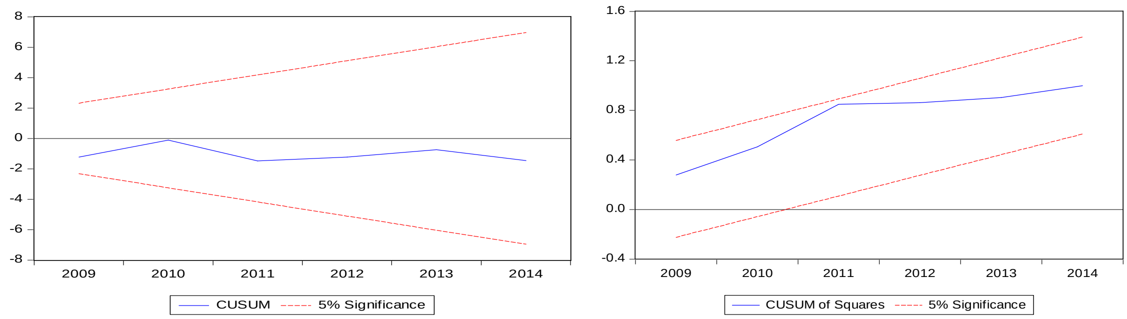

Fig. 2. Plots of CUSUM and CUSUMSQ stability test for model 2

5. CONCLUSION

Energy is one of the factors which causes improve economic growth. This paper empirically investigates whether energy consumption has had a positive impact on economic growth in Bangladesh applying the ARDL bound testing approach for the period from 1979 to 2014. Results show that economic growth and energy consumption growth in Bangladesh has had positive short- and long-run bidirectional causal relationship. These short- and long-run bidirectional relationships mean that economic growth enhances energy use and energy use boosts economic growth. Contrary to Buysse et al. [18] which explores that uni-directional causality exists from energy consumption to economic growth both in short**-** and long-run in Bangladesh, we find support for the feedback hypothesis and empirical study as in Ahamad and Islam [13], which gives emphasis to the interdependent relationship between energy consumption and economic growth**.** Future researches can be conducted using other methods like, cointegration and error correction based Granger causality. Comparative study can also be done using data from Asian and other countries. We could therefore draw policy implication that the government should continue taking effective arrangements to produce energy and ensure efficient and sufficient supply of energy to various agent of economy to obtain the goals of millennium development and reach the level of developed country by 2041 following the 'Vision 2041'.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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