# THE IMPACT OF ENERGY CONSUMPTION, URBANIZATION, FINANCIAL DEVELOPMENT, AND TRADE OPENNESS ON THE ENVIRONMENT IN BANGLADESH: AN ARDL BOUND TEST APPROACH

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## Abstract

This paper examines the long run cointegrating relation and short run dynamics among carbon emissions, energy consumption, economic growth, urbanization, financial development and openness to trade in Bangladesh by using autoregressive distributed lag (ARDL) bounds testing approach of cointegration. Empirical results for Bangladesh over the period 1975-2010 suggest an evidence of a long-run relationship between the variables at 1% significance level in Bangladesh. The estimated coefficient of energy consumption and urbanization are positive and highly significant indicating that increasing level of urbanization and energy consumption are responsible for CO2 emission in Bangladesh. However, it is also found that an increase in the real GDP per capita tend to reduce carbon emissions per capita. On the other hand, there is no evidence of a causal relationship between carbon emission and financial development and trade openness.

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## INTRODUCTION:

While growth stays at the center of interest for almost all countries, rich or poor, growing concern about global warming and climate change is also making them more alert about the dangers incorporated in their ventures and thus the idea of sustainable development in gaining popularity. A good number of studies, apart from a few ambiguity, have found support for an inverted U-shaped relationship between environmental degradation and economic growth, a hypothesis well known as 'environmental Kuznets curve' (Grossman and Krueger, 1991; Shafik, 1994; Dinda and Coondoo, 2006; Managi and Jena, 2008; Coondoo and Dinda, 2008; RomeroAvila, 2008; Akbostanci et al., 2009; etc.).

Again starting with the seminal work of Kraft and Kraft (1978), a series of studies examines the causal linkages between energy consumption and economic growth. Primarily these investigations followed bi-variate framework (Akarca and Long, 1980; Yu and Choi, 1985; Erol and Yu, 1987; Abosedra and Baghestani, 1989; Hwang and Gum, 1992; Bentzen and Engsted, 1993; Glasure and Lee, 1997; etc.) and thus they were subject to specification bias (Strean, 1993). Stern (2000); Soytas and Sari (2003, 2006); Altinay and Karagol (2004); Oh and Lee (2004); Wolde-Rufael (2005); Ghali and El-Sakka (2004); Lee (2005, 2006); Akino (2008); Narayan and Smyth (2008); Apergis and Payne (2009); Wolde-Rufael (2009) among others recently have examined energy–GDP causality in a multivariate framework. Unfortunately no precise words could have yet been asserted to the role of energy consumption in economic growth.

Another important stream of research has emerged examining dynamic relationship between environmental pollution, energy consumption and economic growth. Soytas et al. (2007) investigate energy consumption, output and carbon emission nexus for USA finding unidirectional Granger causality running from energy consumption to carbon emission. According to Kaygusuz, (2009), one of the dominant contributors to the greenhouse effect is the ever increasing amount of carbon dioxide (CO2) emissions which seems to be aggravating this problem. Soytas and Sari (2009) have supported the link between income and carbon emission in Turkey but also have found unidirectional Granger causality from carbon emission to energy consumption in the long run. Zhang and Cheng (2009) have investigated the energy consumption, output and carbon emission nexus for China, controlling for capital and urban population. They found unidirectional long-run causality running from GDP to energy consumption and from energy consumption to carbon emission. The study has showed that neither carbon emission nor energy consumption leads to economic growth. Sari and Soytas (2009) have investigated the relationship between carbon emissions, income, energy and total employment in five OPEC countries using the autoregressive distributed lag (ARDL) model of cointegration establishing such a relationship only for Saudi Arabia. Halicioglu (2009) has applied similar technique in a log-linear quadratic equation between per capita $CO_2$ emission, per capita energy use, per capita real income, square of per capita real income and openness ratio and has found both short- and long run bi-directional causality between carbon emission and income in Turkey. In a similar kind of study, Jalil and Mahmud (2009) have found unidirectional causality from economic growth to $CO_2$ emission in China. Also Ang (2008) has found that the output growth Granger causes energy consumption in Malaysia.

Evidence of unidirectional Granger causality running from carbon emissions to income has also been observed in the long-run. Recent studies have attempted to combine the trade–growth–energy–$CO_2$ emissions nexus into a single, simultaneous multivariate model using the same framework. Ang (2007) and Soytas et al. (2007) have initiated such an approach, which was then widely adopted by various other authors (Auffhammer and Carson, 2008; Halicioglu, 2009; Jalil and Mahmud, 2009). For China, the association between $CO_2$ emissions and economic growth has been modeled by several authors using an EKC framework (Auffhammer and Carson, 2008; Jalil and Mahmud, 2009). Jalil and Mahmud (2009) have concluded for China that over the long-run $CO_2$ emissions are determined by income and energy consumption. Auffhammer and Carson (2008) have concluded that the anticipated path of China's $CO_2$ emissions has increased, and a downturn is highly unlikely unless substantial changes in energy policies are introduced that use a fixed-effect model.

An important channel through which a country's investment climate can be nurtured is the modern financial system that provides an efficient allocation and accumulation of resources with rapid technological progress (Levine, 1997; Creane et al., 2004). Hence many economists have argued for financial development with less governmental intervention for a better management of economic growth (Mikinnon, 1973; Shaw, 1973; Obstfeld, 1994; Bencivenga et al., 1995; Greenwood & Smith, 1997). A positive influence of financial development on total factor productivity and investment is depicted in many studies (Neusser and Kugler, 1998; Benhabib and Spiegel, 2000; Beck et al., 2000). But when we are concerned with finance-growth nexus, though studies based on cross-section and panel data provide support for a positive relation (Gelb, 1989; Khan and Senhadji, 2000; King and Levine, 1993a, 1993b; Levine et al., 2000), studies based on time series data remain inconclusive (Dmetriades and Hussein, 1996; Luintel and Khan, 1999). In spite of the ambiguity in the role of financial development in economic growth, its influence in smoothing and encouraging investment is clear. Frankel and Romer (1999), for example, have pointed out that the financial development in a country may attract foreign direct investment (FDI) and higher degrees of research and development (R&D). This, in turn can, increase the level of economic growth, and hence, affect the dynamics of environmental performance. Similarly, Birdsall and Wheeler (1993) and Frankel and Rose (2002) have argued that the developing countries may have access, through financial development, to new, environmental-friendly technology.

The recent literatures also have documented evidences of the linkages between financial development and FDI inflows. For example Ang (2008a) has pointed out that financial deepening in Malaysia leads to higher FDI inflows while it is found to have a positive role in innovative (R&D) activity in the case of Korea (Ang, 2010) and India (Madsen et al., 2010). Furthermore, Tamazian and Rao (2010) have documented evidence that the increase in FDI inflows and R&D activities reduce environmental pollution. On the other hand, Jensen (1996) has noted that financial development may lead to increased industrial activities, which, in turn, may lead to industrial pollution.

Although urbanization is often discussed in the context of economic modernization, it is a demographic indicator that increases urban density and transforms the organization of human behavior; thereby influencing household energy use patterns (Barnes et al., 2005). However, the extent to which urbanization affects national energy use and CO2 emissions has not been fully and clearly explained in a single theory. The relationship between urbanization and various environmental issues, including energy use and emissions, has been studied extensively in recent years. Some researchers show that urbanization increases energy demand, generating more emissions (Cole and Neumayer, 2004; Jones, 1991; Parikh and Shukla, 1995; York, 2007). Conversely, other scholars argue that urbanization and urban density improve the efficient use of public infrastructure (e.g., public transport and other utilities), lowering energy use and emissions (Chen et al., 2008; Liddle, 2004; Newman and Kenworthy, 1989). Previous research has shown conflicting results, suggesting that the relationship between urbanization, energy use and emissions is complex.

On the other hand, The Hecksher-Ohlin trade theory suggests that, under free trade, developing countries would specialize in the production of goods that are intensive in the factors that they are endowed within relative abundance: labor and natural resources. The developed countries would specialize in human capital and manufactured capital intensive activities. Trade entails the movement of goods produced in one country for either consumption or further processing. This implies that pollution is generated in the production of these goods and is related to consumption in another country. Wyckoff and Roop (1994) estimates that 13% of the total carbon emissions of the six largest OECD countries are embodied in their imports of manufactured goods. A similar line of argument also exists in Mongelli et al. (2006). Therefore, this research argues that there are strong dynamic inter-relationships between output, energy consumption, environmental pollutants and foreign trade, which should be investigated in the same multivariate framework.

The growing availability of large cross-country time series databases has fostered a rapid growth in quantitative studies of the link between trade and the environment (Antweiler et al., 2001; Cole and Elliott, 2003; Grossman and Krueger, 1991). Some conclude that increasing the openness to trade has resulted in more $CO_2$ emissions (Weber et al., 2008; Yan and Yang, 2010); while others found no significant relationship between trade and $CO_2$ (Jalil and Mahmud, 2009).

Bangladesh has witnessed a remarkable rate of economic growth and as well as financial development, trade openness, and urbanization over the last few years. However, this rapid growth in economic activity has been accompanied by environmental degradation measured as $CO_2$ emissions (see figure1 below). For instance, the annual growth rate of $CO_2$ emissions in Bangladesh has gone up by 36% between 2000 and 2010 (authors' calculation form WB data). There seems to be a pool of literature on the relationship between economic growth, energy consumption and environmental pollutants using both panel data and time series data. However, the role of financial development, urbanization, and trade openness in the context of economic growth and its effect on the environment is quite important for several reasons.

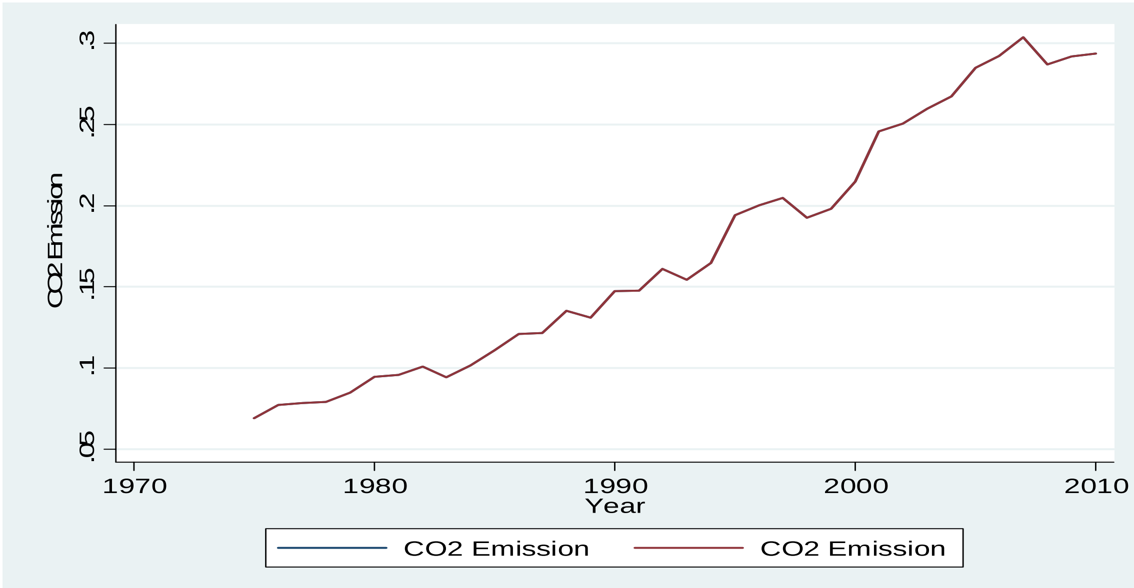



**Figure1: CO2 emission in Bangladesh: 1975-2010**

Despite its growing importance, the relationship between CO2 emission, financial development, energy consumption and economic growth has not received much attention in the case of Bangladesh. Being one of the fastest growing developing economies in the Asian region, Bangladesh can be an interesting case study as it not only needs to develop the growth enhancing factors to maintain steady growth, but also keep the environmental pollution under control. So, it is also important to investigate the direction of causal relationship among these variable for policy purpose as well. Considering this gap, the present paper tries to assess the relationship among energy consumption, financial development, economic growth, trade openness and urbanization in Bangladesh.

**DATA & METHODOLOGY:**

Based on the literature described above, our study employs CO2 emission per capita, Per capita energy consumption, real GDP per capita, financial development, Urbanization rate, trade openness. Energy consumption is measured by total energy consumption per capita (kg of oil equivalent). M2 as share of GDP is the proxy for financial development. Real GDP per capita measures the economic growth, trade as share of GDP is the proxy for trade openness and urban population as share of total population is the proxy for urbanization. We employ annual time series data for Bangladesh from 1975 to 2010 which mainly come from the World Development Indicators. Log–linear specification produces a better result compared to the linear functional form of model. Thus, all data are transformed to natural logarithmic.

**ARDL model specification:**

To empirically analyze the long-run relationships and dynamic interactions among the variables of interest, this paper adopts the autoregressive distributed lag (ARDL) approach by Pesaran, Shin and Smith (2001) also known as the bounds testing cointegration procedure. One advantage of this approach is that it is a more statistically significant approach for determining co-integrating relationships in small samples, while the Johansen co-integration techniques require larger samples for the results to be valid (Ghatak and Siddiki, 2001; Pahlavani, 2005). In addition, while other co-integration techniques require all of the regressors to be integrated of whether the variables are purely I(0) or purely I(1) or mixture of both, the ARDL can be applied irrespective of their order of integration, thus eliminates the pretesting problems associated with standard co-integration tests (Pesaran *et al.*, 2001). Moreover, estimates obtained from the ARDL approach to cointegration are unbiased and efficient since they avoid the problems that may arise due to serial correlation and endogeneity (Pesaran *et al.*, 2001).

Following Jalil & Feridun (2011), and the empirical literature in energy economics, it is plausible to form the long-run relationship between CO2 emissions, energy consumption, economic growth and foreign trade in linear logarithmic quadratic form:

$$CO2 = f(EN, Y, FIN, URBAN, OPEN) \quad [1]$$

where CO2 is the logarithm of CO2 emission, EN is logarithmic total energy consumption per capita, FIN is logarithmic M2 as a percentage of GDP, Y is logarithmic real GDP per capita, OPEN is the ratio of trade to GDP, and URB is logarithmic urban population as share of total population.

The long-run and causal relationships among these variables in Bangladesh will be performed in two steps. Firstly, we will test the long-run relationships among the variables by using the ARDL bounds testing approach of cointegration. If the computed F-statistics exceeds the respective upper critical bounds value, we are able to conclude that the variables are cointegrated. If the F-statistics fall below the respective lower critical bounds, we fail to reject the null hypothesis of no cointegration. If the F-statistics fall between its upper and lower critical bounds values, the inference is inconclusive and it is necessary to know the order of integration of the variable to reach a conclusion. Secondly, we will test the causal relationships by using the error-correction based causality models in the following form:

$$DCO2_t = \sum_{i=1}^{n} DCO2_{t-i} + \sum_{i=0}^{n} DEN_{t-i} + \sum_{i=0}^{n} DY_{t-i} + \sum_{i=0}^{n} DFIN_{t-i} + \sum_{i=0}^{n} DURBAN_{t-i} + \sum_{i=0}^{n} DOPEN_{t-i} + ECT_{t-1} \quad [2]$$

To ascertain the goodness of fit of the ARDL model, the diagnostic test and the stability test are conducted. The diagnostic test examines the serial correlation, functional form, normality and heteroscedisticity associated with the model. The stability test is conducted by employing the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ).

## RESULT & DISCUSSION:

Before we proceed with the ARDL bounds test, we test for the stationarity of all variables to determine their order of integration since ARDL requires that the dependent variable is of I(1) in levels and none of the explanatory variables is I(2) or higher. Hence standard procedure of unit root testing by employing the Augmented Dickey Fuller (ADF) test is followed. However, since the ADF test is often criticized for low power, we complement this test with the Phillips- Perron (PP) test. For the ADF tests, the lag length is based on the Schwarz Information Criterion, while for the PP test bandwidth selection is based on Newey-West. Our data shows that not all series are non-stationary at their level form rather there is a mixture of I(0) and I(1) of underlying regressors and therefore the ARDL procedure can be used. We do not reproduce the results to conserve space but the results are available from the authors.

**Table 1: Result of Unit Root test**

| **Variable** | **Augmented Dickey Fuller (ADF) test** | **Phillips- Perron (PP) test** | **Decision** |
|---|---|---|---|
| CO2 emission per capita, CO2 | I(1) | I(1) | I(1) |
| Energy consumption per capita, EN | I(1) | I(1) | I(1) |
| Financial development, FIN | I(1) | I(1) | I(1) |
| Real GDP per capita, Y | I(1) | I(1) | I(1) |
| Urbanization, URBAN | I(0) | I(0) | I(0) |
| Trade Openness, OPEN | I(1) | I(1) | I(1) |

According to Pesaran and Shin (2001), the SBC is generally used in preference to other criteria because it tends to define more parsimonious specifications. With the limited observations, this study used the SBC to select an appropriate lag for the ARDL model. Table 1 presents the estimated ARDL model that has passed several diagnostic tests that indicate no evidence of serial correlation and heteroscedasticity. Since, the critical values provided by Pesaran et al. are not suitable for small sample sizes such as 35 observations, which is what we have in the current study, we use the small sample critical values provided by Narayan. The F statistic tests the joint null hypothesis that the coefficients of the lagged level variables are zero (i.e. no long-run relationship exists between them). It can be seen from Table 2 that the calculated F-statistic for model 2 is equal to 7.04 which lies above the upper bound critical value at the 1% level reported in Narayan et al. (2005). Thus, the null hypotheses of no cointegration are rejected, implying long-run cointegration relationships amongst the variables. Once we established that a long-run cointegration relationship existed, equations were estimated using the ARDL specification.

An interesting finding is that the estimates of energy consumption in the long run pollution equation are highly significant with a coefficient of 1.97. This implies that a 1% increase in per capita consumption of energy will lead to about 2% increase in per capita CO2 emissions in the long run. The finding of a positive effect of energy use is consistent with Liu (2005) and Ang (2007, 2008, 2009), among others. Similarly, the coefficient of URBAN is 0.454 and is statistically significant. This implies that a 1% increase in urbanization will lead to a about 0.45% increase in the per capita CO2 emissions. The finding of a positive effect of energy use is consistent with Liu (2005) and Ang (2007, 2008, 2009), among others.

The statistical significance of the negative coefficient of per capita real income rules out the suggestion the level of CO2 emissions with the level of income. On the other hand, the positive sign of FIN implies that the increase in financial openness leads to a lower level of environmental pollution though the result is not significant at conventional level. Openness, on the other hand, has no significant effect on CO2 emission in Bangladesh. The elasticity of CO2 emissions with respect to openness ratio the long run is -0.007, suggesting the contribution of foreign trade CO2 emissions is not only minimal but also insignificant during the estimation period.

The coefficient of estimated ECT is negative and statistically significant at 5% confidence level. These values indicate that any deviation from the long-run equilibrium between variables is corrected by about 65% for each year to return the long-run equilibrium level. Bannerjee *et al.* (1998), states that a highly significant error correction term is further proof of the existence of a stable long-term relationship. About 65% of disequilibria from the previous year's shock converge back to the long-run equilibrium in the current year.

**Table 2: Result of Long Run & Short Run Estimation**

| | **Long Run** (Dependent variable: CO2 Emission) | | **Short run**[3] (Dependent variable: DCO2 Emission) | |
|---|---|---|---|---|
| | Model 1 | Model 2 | Model 1 | Model 2 |
| Constant | -8.92***(-10.00) | -8.974*** (-8.21) | .002 (0.06) | .0146 (0.31) |
| **CO2 Emission, CO2** | | | | |
| DCO2 (-1) | | | .027(0.09) | .0267(0.09) |
| DCO2 (-2) | | | .158 (0.52) | .091(-0.30) |
| **Energy Consumption, EN** | 1.960***(5.90) | 1.970*** (5.37) | .800 (1.65) | .527(0.81) |
| DEN (-1) | | | -.383 (-0.71) | -1.107(-1.47) |
| DEN (-2) | | | .722 (1.16) | .479(0.69) |
| **GDP Per Capita, Y** | -.77*** (-3.50) | -.770*** (-3.38) | - -1.018 (-1.08) | -1.44 (-1.22) |
| DY (-1) | | | .465 (0.45) | .641 (0.60) |
| DY (-2) | | | -.242(-0.27) | -.338 (-0.36) |
| **Financial Development, FIN** | .208*(1.69) | .206 (1.59) | .475* (1.84) | .528*(1.80) |
| DFIN (-1) | | | -.046 (-0.19) | .148(0.37) |
| DFIN (-2) | | | .022(0.10) | .132(0.46) |
| **Urbanization, URBAN** | .453*** (3.18) | .454*** (3.12) | -1.799 (-0.68) | -3.390 (-1.17) |
| DURBAN (-1) | | | 3.224 (0.95) | 2.511 (0.72) |
| DURBAN (-2) | | | -1.312 (-0.67) | .168 (0.08) |
| **Openness, OPEN** | | -.005(-0.07) | | .408 (1.60) |
| DOPEN (-1) | | | | .344 (1.39) |
| DOPEN (-2) | | | | .071 (0.43) |
| **Error correction Term (-1)** | | | -.407 (-1.31) | -.652*(-1.87) |
| F- value[4] | | | 4.45 | 7.04*** |
| F-ARCH | | | | 0.627 |
| Breusch-Godfrey Serial Correlation LM Test | | | | 0.109 |
| White Heteroskedasticity Test | | | | 0.690 |
| Jerque Bera normality test | | | | 8.25 |

*Note:*For both the short run and long run model, the values inside the parentheses are the *t*-ratios; * Significant at 10% level;** significant at 5 % level; ***significant at 1% level

## Stability Test

To ascertain the goodness of fit of the ARDL model, diagnostic tests for serial correlation, autoregressive conditional heteroscedisticity, and heteroscedisticity are conducted and the results

[3] In the short run, all variables are regressed at difference

4 Calculated F- value of bound test

are shown in bottom of table 3. The results also indicated that there is no evidence of serial correlation among variables because functional form of model is well specified. Autoregressive conditional heteroscedisticity is also not present in short-run model.

The second issue addressed is the stability of the long run coefficients that are used to form the error-correction term in conjunction with the short run dynamics. As pointed by Bahmani-Oskooee (2001), some of the problems of instability could stem from inadequate modeling of the short run dynamics characterizing departures from the long run relationship. Hence, it is useful to incorporate the short run dynamics in testing for constancy of long run parameters. In view of this we applied the CUSUM and CUSUMSQ tests proposed by Brown, Dublin, and Evans (1975) to the residuals of each model. The test finds parameter instability if the cumulative sum goes outside the area between the two critical lines. Similar procedure is adopted to carry out the CUSUMSQ, which is based on the squared recursive residuals. The same procedure has been utilized by Pesaran and Pesaran (1997), and Bahmani-Oskooee (2001) to test the stability of the long-run coefficients. The results indicate the absence of any instability of the coefficients during the investigated period because the plots of the two statistic are confined within the 5% critical bounds pertaining to the parameter stability.

**Figure 1: Plot of CUSUM**

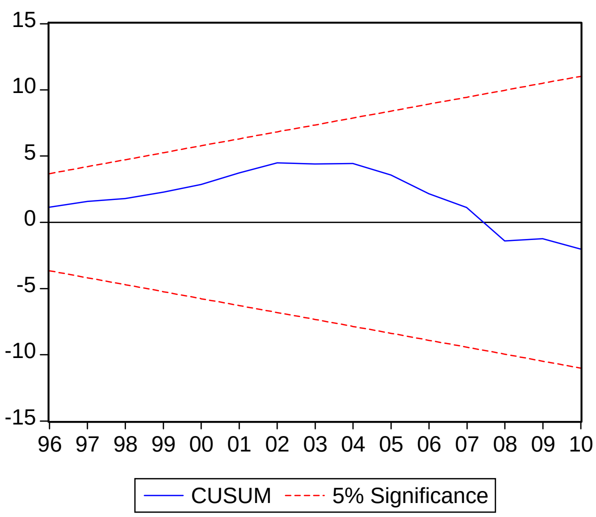
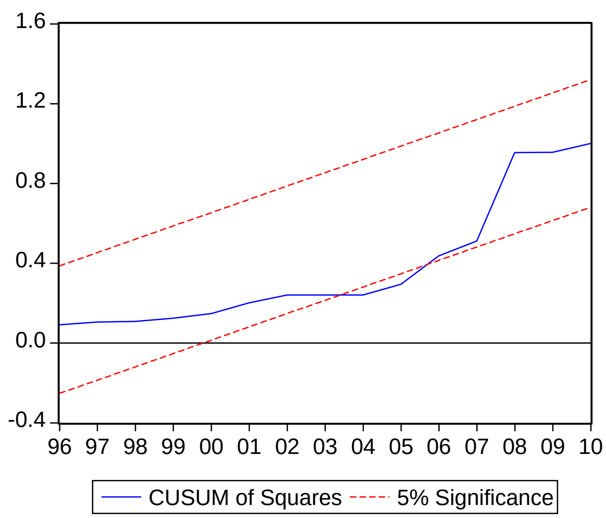



**Figure 2: Plot of CUSUM SQ**




**CONCLUDING REMARKS:**

This paper has attempted to analyze empirically the dynamic relationships between CO2 emissions, commercial energy consumption, income and foreign trade for Bangladesh. Autoregressive distributed lag

(ARDL) bounds testing approach of cointegration and error-correction based Granger causality models is used to test the short-run and long-run elasticities of CO2 emissions with respect to explanatory variables, namely: energy consumption, GDP per capita, urbanization, financial development, and trade openness in Bangladesh. Empirical results suggest an evidence of a long-run relationship among these variables at conventional level of significance. The main results are as follows: (i) energy consumption per capita causes significant carbon emissions; (ii) An increase in the real GDP per capita tends to reduce carbon emissions per capita; (iii) Another source of carbon dioxide emissions is the urbanization; (iv) the other most interesting result is that there is no evidence of a causal relationship between carbon emission and financial development and trade openness.

## REFERENCES


Abosedra, S., Baghestani, H. 1991. New evidence on the causal relationship between United States energy consumption and gross national product. Journal of Energy and Development 14, 2, 285-292.

Akarca, A.T., Long II, T.V. 1980. On the relationship between energy and GNP: a reexamination. Journal of Energy and Development, Spring, 326-331.

Ang, J., 2007. CO2 emissions, energy consumption, and output in France. Energy Policy 35, 4772–4778.

Ang, J., 2008. Determinants of foreign direct investment in Malaysia. Journal of PolicyModeling 30, 185–189.

Ang, J., 2009. CO2 emissions, research and technology transfer in China. Ecological Economics 68 (10), 2658–2665.

Apergis, N., Payne, J.E., 2009. Energy consumption and economic growth in Central America: evidence from a panel

Bahmani-Oskooee, M., Chomsisengphet, S., 2002. Stability of M2 demand functions in industrial countries. Applied Economics 34, 2075–2083.

Bahmani-Oskooee, M., Nasir, A.B.M., 2004. ARDL approach to test the productivity bias hypothesis. Review of Development Economics 8 (3), 483–488.

Banerjee, A., Dolado, J.J., Mestre, R., 1998. Error-correction mechanism tests for cointegration in a single-equation framework. Journal of Time Series Analysis 19 (3), 267–283.

Creane, S., Goyal, R., Mushfiq Mobarak, A., Randa, S., 2007. Measuring Financial Development in the Middle East and North Africa: A New Database, IMF Staff Paper, vol. 53 (3), pp. 479–511.

Dickey, D.A., Fuller, W.A., 1981. Likelihood ratio statistics for autoregressive time series with a unit root. Econometrica 49, 1057–1072.

Dinda, Soumyananda & Coondoo, Dipankor, 2006. Income and emission: A panel data-based cointegration analysis, Ecological Economics, Elsevier, vol. 57(2), pages 167-181, May

Erol, U., Yu, E.S.H. 1988. On the causal relationship between energy and income for industrialized countries. Journal of Energy and Development 13, 1, 113-122.

Ghali, K.H., El-Sakka, M.I.T., 2004. Energy use and output growth in Canada: a multivariate cointegration analysis. Energy Economics 26 (2), 225–238.

Glasure, Y.U., Lee, A.R., 1997. Cointegration, error-correction, and the relationship between GDP and energy: the case of South Korea and Singapore. Resource and Energy Economics 20, 17–25.

Halicioglu, F., 2009. An econometric study of CO2 emissions, energy consumption, income and foreign trade in Turkey. Energy Policy 37 (3), 1156–1164.

Hwang, D.B.K., Gum, B. 1992. The causal relationship between energy and GNP: the case of Taiwan. Journal of Energy and Development 16, 2, 219-226.

Katircioglu, S.T., 2009. Revisiting the tourism-led-growth hypothesis for Turkey using the bounds test and Johansen approach for cointegration. Tourism Management 30 (1), 17–20.

Kaygusuz K.2009. Energy and environmental issues relating to greenhouse gas emissions for sustainable development in Turkey. Renewable and Sustainable Energy Reviews 2009;13:253–70.

Kraft, J., Kraft, A. 1978. On the relationship between energy and GNP. Journal of Energy and Development, Spring, 401-403.

Kuznets, S., 1955. Economic growth and income inequality. American Economic Review 45, 1–28.

Jalil, A., Mahmud, S.F., emissions: 2009. Environment Kuznets curve for CO2 emissions: a cointegration analysis for China. Energy Policy 2009).

Jalil, Abdul, Mete Feridun 2011. “The impact of growth, energy and financial development on the environment in China: A cointegration analysis” Energy Economics,2011

Levine, R., Loayza, N., Beck, T., 2000. Financial intermediation and growth: causality and causes. Journal of Monetary Economics 46, 31–77.

Lee, C.-C. 2005. Energy consumption and GDP in developing countries: A cointegrated panel analysis. Energy Economics 27, 415-427.

Lee, C.-C., Chang, C.-P. 2007. The impact of energy consumption on economic growth: Evidence from linear and nonlinear models in Taiwan. Energy 32, 2282-2294.

Liu, X., 2005. Explaining the relationship between CO2 emissions and national income the role of energy consumption. Economics Letters 87, 325–328.

Managi, S., Jena, P.R., 2008. Environmental productivity and Kuznets curve in India. Ecological Economics 65, 432–440.

Mongelli, I., Tassielli, G., Notarnicola, B., 2006. Global warming agreements, international trade and energy/carbon embodiments: an input-output approach to the Italian case. Energy Policy 34, 88–100.

Narayan PK. The saving and investment nexus for China: evidence from cointegration tests. Applied Economics 2005;37:1979–90.

Oh, W., Lee, K., 2004. Energy consumption and economic growth in Korea: testing the causality relation, Journal of Policy Modeling, 2004, 26, 973-981.

Perron, P., 1997. Further evidence on breaking trend functions in macroeconomic variables. Journal of Econometrics 80 (2), 355–385.

Pesaran MH, Shin Y, Smith RJ. 2110 Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics 2001;16:289–326.

Shafik, N., Bandyopadhyay, S., 1992. Economic growth and environmental quality: time-series and cross-section evidence. Background Paper for the 1992 World Development Report. The World Bank, Washington DC.

Soytas, U., Sari, R. 2003. Energy consumption and GDP: causality relationship in G-7 countries and emerging markets. Energy Economics 25, 33-37.

Stern, D.I., 2004. The rise and fall of the Environmental Kuznets Curve. World Development 32 (8), 1419–1439.
The World Bank, 2011. World Development Indicators, Washington, DC.
Wolde-Rufael, Y., 2006. Electricity consumption and economic growth: a time series experience for 17 African countries. Energy Economics 34 (10), 1106–1114.
Yu, E.S.H., Choi, J.-Y. 1985. The causal relationship between energy and GNP: an international comparison. Journal of Energy and Development 10, 2, 249-272.
Zhang, X.P., Cheng, X.M., 2009. Energy consumption, carbon emissions, and economic growth in China. Ecological Economics 68 (10), 2706–2712.