Co2 Emission, Power Consumption and Economic Growth in Bangladesh: An ARDL Bound Testing Approach

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Abstract: This paper focuses on the empirical relationship between economic growth, co2 emission, power consumption, fossil fuel energy consumption and financial development of Bangladesh using data of 1985-2013. Findings indicate that a significant relationship exists between economic growth and power consumption, economic growth and fossil fuel energy consumption in the long run. The long run relationship between co2 emission and economic growth as well as financial development is insignificant. Whereas, Granger causality shows that bidirectional association exists among economic growth and power consumption, financial development and economic growth, fossil fuel energy consumption and economic growth in the short run. However, unidirectional casualty has been found among power consumption to financial development, co2 emission to power consumption, fossil fuel energy consumption to financial development, co2 emission to financial development and co2 emission to fossil fuel energy consumption. Error correction mechanism confirms that except power consumption all the explanatory variables quick return to equilibrium in the short run.

Key words: economic growth, co2 emission, power consumption, financial development, co-integration, Bangladesh

JEL Classification: Q26, Q43, Q54, G20, E6

1. Introduction

The co2 emissions, economic growth, energy consumption and financial development are some of the burning issues in the current economics literature. However, this endeavor is a fine tune to show how the climate change dynamics are generating hurdles to the proper functioning of the economy activities of Bangladesh. The geographical location of Bangladesh has been considered to be one of the most vulnerable countries for global warming and climate change issues for the last three decades. The impact of climate changes is being felt by this country in the form of flood, cyclone, river erosion and draught. These are known to be natural disasters producing significant detrimental effects on the economic growth and financial development to one of the fastest growing economies in the south Asian region. This country is frequently called as next generation “Asian tiger” due to its tremendous potential of economic growth and emergence of a well-skilled human capital. However, climate change is becoming increasingly a challenge to economic growth and developments of the country.

At present, Co2 emissions are indeed the concerning hub of climate change issues everywhere. The climate change issue is the key focus on the world as it has terrific effects on the natural disasters. This is truly fair that the natural disasters emerge due to climate changes are taking place. The magnitude of the damage through natural disaster has been growing rapidly all over the world. For example, Zeshan and Ahmed (2013) have shown that 1% increase in energy consumption increases real GDP by 0.81% in the long run, whereas for the same increase in co2 emissions GDP falls by 0.17% in the long run. Now, if we investigate the root causes behind this natural calamity, it is human being across the globe that is responsible for this condition.

In this research, the focus on energy consumption that is symbolized by power consumption has significant influence on economic development and vice versa. So, this relationship exists between economic growth and energy consumption has been found both long run and short run dynamics through investigating on single country as well as regions. Alom k. (2014) shows energy consumption and co2 emission, co2 emission and economic growth have casual relation in short run but no long run co-integrating relationship has been found in his panel data study of five south Asian countries. Nevertheless, Stern and Cleaveland (2004) have indicated the magnitude of energy as very essential factor of production in addition to labor, capital and materials and hence energy is a key factor for growth. This statement seems to be very true in Bangladesh.

The objective of this study is to investigate the relationship among Co2 Emission, Electricity Power Consumption, fossil fuel consumption, Financial Development and Economic Growth in Bangladesh for the period of 1985 to 2013. This study will explore the co-integrating relationship among the variables highlighted in the methodology using ARDL frame work Pesaran et. al. (2001). This study will further explore on short run impact on economic growth of all explanatory variables that considered relevant for this study. This study is a unique contribution to the existing literature of co2 emission through adding fossil fuel consumption and financial development. Fossil fuel consumption and financial development is the value addition and innovation of this study on the context of Bangladesh.

The outline of this paper is as follows. The next section reviews the theoretical and empirical literature. Section 3 describes methodology and the data sources and definitions. Section 4 separately reports the estimation results for various measures. Section 5 concludes the paper and affirms the policy implications of the results.

2. Literature Review

An extensive amount of literature has been reviewed on the issues of co2 emissions, economic growth, power consumption and fossil fuel consumption. Much of them have put shed light on the co2 emission, energy consumption and economic growth issues. In the very earlier literature, Berndt and wood (1975), Griffin and Gregory (1976) have found that energy is a very important input of the industrial sector production process and its components have extensive usage on that. Stern and Cleaveland (2004) have expressed concern over considering energy as an important factor in addition to capital, labor and material and hence suggested energy as a prerequisite for economic growth.

So, in this study, we are inquisitive to investigate, whether co2 emission and economic growth has any significant relationship in the short run and long run perspective on Bangladesh. Power consumption, fossil fuel consumption and, financial developments have any significant relationship with economic growth is the key focus of the study. Energy consumption and co2 emission, co2 emission and economic growth have causal relation in the short run but in the long run no co-integrating relationship has been found of a panel data study of five south Asian countries by Alom k. (2014). The U-shaped relationship has been shown between environmental pollutants and economic growth by experimenting the validity of the environmental Kuznets Curve (EKC) hypothesis. Selden and Song (1994), Galeotti et. al (2009) confirmed empirical supports on the proposition of the environmental Kuznets Curve (EKC) hypothesis. Nevertheless, friedl and Getzner (2003) provided an N-shaped curve rather than a U-shaped curve in the relationship between environmental pollutants and economic growth relationship dynamics. However, Agras and chapman (1999) conclude with the findings of no significant relationship between economic growth and environmental pollutants.

In addition, to the EKC hypothesis, a significant numbers of the research is progressing to put shed light on the relationship dynamics in these controversial issues. For example, Ghos S. (2010) confirmed that the long run co-integrating relationship exists among urbanization, energy consumption and economic activity and unidirectional casualty running from energy consumption to economic activity and economic activity to urbanization. Ang JB (2007) studied on co2 emission, energy consumption and output growth in France. Findings' are in favors of the economic growth has casual influence on energy use as well as pollutions in the long run and in the short run unidirectional causality running from energy use to output growth. Loganathan and Subramaniam (2010) examined the same relationship in Malaysia and found the evidence of the bidirectional causality between energy consumption and economic development. On the contrary, Soytas et al. (2007), Soytas and Sari (2009) found no casual link between income level and co2 emissions and energy use to income level in the United States and Turkey respectively following the process of ARDL bound testing cointegration model. Chang CC. (2010) investigates a multivariate causality test of co2 emission, energy consumption and economic growth in China and concluded that economic growth stimulates a higher level of energy consumption and co2 emission with response consequences. Al-mulali et al. (2012) investigates cointegration between urbanization, energy consumption and co2 emission in seven regions of the world. The findings have shown 84% of the countries have a positive relationship between urbanization, energy consumption and co2 emission in the long run.

The findings of the past studies, we have explored in this study from different countries and regions of the universe have diverse outcomes. If we look at past studies in this country on this issue, we can't draw any example like "smoking gun". Alam MJ et al. (2012), Ghosh BC et al. (2014) got the evidence of one way causality running from energy consumption to economic growth and energy consumption to co2 emissions both in the shorter and longer time period. However, bi-directional causality running from electricity consumption to economic growth in long run but not in short run. Moreover, Uddin MMM. and Wadud MA. (2014) have investigated on seven SAARC countries and found that co-integration relationship prevails among the variables of co2 emissions and economic growth. Co2 emissions have positive and significant impact on economic growth in the long run.

3. Methodology

3.1. The Model and Data

The variables in this study are listed below

Y = GDP per capita (GDPC); (constant 2005 US$)

C = CO2 emissions; (metric tons per capita)

E = Power consumption; (kWh per capita)

F = Financial Development; Domestic credit provided by financial sector (% of GDP)

L = Fossil fuel energy consumption; (% of total)

We have collected data from World Bank Development Indicators (WDI). The data are annual and cover the period of 1985 to 2013 for Bangladesh. To empirically investigate the different models of time series all variables were transformed to natural logarithms.

3.2. Estimation Procedures

3.3. Tests for Unit Roots

We employ the DF-GLS (Eliott et al. 1996) unit root test to determine the order of integration of variables as this test is more powerful than other conventional tests such as PP (Phillips and Peron, 1988) and KPSS (Kwiatkowski et al., 1992).

3.4. Co-integration Tests

3.4.1. ARDL Bounds Testing Approach to Cointegration: This procedure was developed in order to examine the long-run relationships and dynamic interactions among the variables. The ARDLversion of the vector error correction model (VECM) can be specified as follows:

$$\Delta \ln Y_t = \beta_0 + \beta_1 \ln Y_{t-1} + \beta_2 \ln C_{t-1} + \beta_3 \ln E_{t-1} + \beta_4 \ln F_{t-1} + \beta_5 \ln L_{t-1} + \Sigma \gamma_i \Delta \ln Y_{t-i} + pi=1\Sigma$$

$$\Delta \ln C_{t-jqj=1} + \Sigma \delta_j \Delta_{qj=1} \ln E_{t-j} + \Sigma \varphi_l \Delta \ln F_{t-l} + \Sigma \eta_m \ln L_{t-m} + \varepsilon_{tqm=1ql=1} \quad (1)$$

Where, Y = GDP per capita (GDPC), C = CO2 emissions, E = Power consumption, F = Financial Development, L = Fossil fuel energy consumption, t = time (i = 1, 2 3,...n), ε = Error term for equation one

3.4.2. Johansen Co-integration Test

One of the research objectives is to investigate the long run dynamics relationship among the five variables; those are gdpc, co2 emission, power consumption, fossil fuel energy consumption and financial development. The system can be represented as follows:

$$Y_{it} = \alpha_i + b_i C_{it} + c_i E_{it} + d_i F_{it} + e_{iLit} + \varepsilon_{it};$$

4. Empirical Results and Discussions

Table 1: Unit Root Tests Results for Bangladesh: 1985-2012

DF-GLS	KPSS	PP
Trend &intercept	Trend &intercept	Trend &intercept
GDPC	**GDPC**	**GDPC**
Level -1.299	Level 0.1852**,***	Level -1.638
1st Diff: -5.345*,**,***	1st Diff: 0.1287**,***	1st Diff: -5.4311*,**,***
FD	**FD**	**FD**
Level -1.906	Level 0.106	Level -2.246
1st Diff: -4.120*,**,***	1st Diff: 0.155**,***	1st Diff: -3.879**,***
CO2	**CO2**	**CO2**
Level -1.774	Level 0.167**,***	Level -1.332
1st Diff: -5.743*,**,***	1st Diff: 0.215*,**,***	1st Diff: -5.540*,**,***
PC	**PC**	**PC**
Level -1.839	Level 0.125***	Level -1.578
1st Diff: -1.813***	1st Diff: 0.132**,***	1st Diff: -5.758*,**,***
FFEC	**FFEC**	**FFEC**
Level -1.769	Level 0.141**,***	Level -1.114
1st Diff: -3.758**,***	1st Diff: 0.133**,***	1st Diff: -4.758**,***