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FDI, Economic Growth, Energy Consumption & Environmental Nexus in Bangladesh

Sandip SARKER*, Arifuzzaman KHAN, Rezwan MAHMOOD*****

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ABSTRACT

This paper attempts to investigate the relationship among economic growth, energy consumption, CO_2 emission, FDI and natural gas usage in Bangladesh through co-integration and Vector Error Correction model (VECM) over the period 1978 to 2010. Using ADP unit root tests it is found that all the four variables are integrated in first difference. The Johansen co-integration tests indicate that there is existence of long-run relationship among the variables. The VECM long run causality model indicates that there is a long run causality running from energy consumption and natural gas usage by industrial sector to GDP as well as from CO_2 emission to FDI. Likewise in the short run a causal relationships have also been found among the variables. Moreover our model is found be error free based on several statistical test. Our results provide important policy suggestions regarding our foreign direct investment, environmental issues and economic growth nexus in Bangladesh.

1. Introduction

Bangladesh is among the most rapidly growing emerging economies in South Asia; averaging around 6% annual GDP growth from 2009 to 2015. However, due to increased energy consumption created by this growth, there may be unpredictable effects on energy resources and the environment. During 2010, Bangladesh's energy consumption was triple its consumption in 1980, rising from 8402.371 kilotons (kt) oil equivalence (1980) to 30755.83 kt (2010). CO_2 emissions grew much faster than the growth of energy consumption, from 7638.361 kt carbon dioxide emissions to 56152.771 kt; an increase of almost 13 times for the same period. In recent years however, the growth of FDI has been fluctuating. A significant phenomenon in recent years has been climate change as a result of global warming. It has become a prominent issue both economically and politically. The 1997 Kyoto protocol had the aim of reducing greenhouse gases (GHG) that cause climate change by fixing the reduction of GHG emissions to 5.2% lower than the 1990 level during the period 2008-2012, and this came into force since 2005. Furthermore, it has been predicted that a meagre 2°C increase in temperature would greatly hamper many ecosystems and would cause an increase in the sea-level that would adversely impact the lives of people living in coastal zones (Lau et al., 2009). Among the main environmental pollutants which cause climate change, Carbone dioxide (CO_2) is considered to be the major contributor to global warming. CO_2 concentration in air creates more than 60% of the greenhouse gas content (IEA, 2011). The relationship between economic growth and pollutant emissions has widely acknowledged. The relationship between environmental quality and economic growth however, is unclear. According to the Environmental Kuznets Curve (EKC) hypothesis, emissions increase alongside increase in income, until a threshold level of income is reached, after which emissions start to decline. Grossman and Krueger (1993) were the chief advocators of this theory, subsequently popularizing their hypothesis and their analysis showed that ambient levels of pollutants first increased along with the country's per capita GDP, but later fell as the GDP per capita rose further. The challenge in recent studies has been to investigate the relationship between energy consumption, economic growth and CO_2 emissions, since energy use is being considered as the best tool to obtain sustainable development. In order for energy to be used efficiently, it is necessary to have a developed economy. Hence, the causality might be either way. Kraft and Kraft (1978) found a unidirectional Granger causality running from output to energy consumption of USA during the period 1947-1974, by employing Granger causality and co-integration model. Simultaneously, foreign direct investment (FDI) has become an important issue on a global scale.

The key functions of the FDI includes transfer of new technology, improving managerial skills and knowledge, increase productivity, international production network, create connections to foreign markets and decrease unemployment. Although FDI and economic growth is referred to in a general way, the relationship between FDI and economic growth is equally important for developing countries. Most of the

* Independent researcher, Bagladesh, ** Central Banker, Bagladesh, *** Banking Professional, Bagladesh. E-mail addresses: sandip0735@gmail.com (Sarker S.), arif.ku.business@gmail.com (Khan A), rez.mahmood@gmail.com (Mahmood R.)

studies on Bangladesh over FDI and economic growth have found a positive relationship between them, Shimul et al. (2009); Faruk (2013); Shah (2013). The more FDI means there is a probability that CO_2 emission as well as energy consumption will increase. Although FDI plays a vital role in triggering growth in developing countries and raising awareness about preserving the environment, it is also said to be one of the major contributing factors responsible for environmental degradation and resource depletion, and thus, welfare losses. Meanwhile, raising environmental concerns affects FDI. Therefore the relationship among the variables can demonstrate some interesting results. The connection between environmental pollution, economic growth and FDI inflows has been intensively scrutinized by several studies, but the factual evidence generally remains questionable and ambiguous. The past studies may be categorized into three research strands. The first strand focuses on the validity of the environmental Kuznets curve (EKC) hypothesis, which suggests that the relationship between economic output and CO_2 emissions conforms to an inverted-U curve. Thus, the environmental degradation levels increase as a country develops but decrease when a certain level of average income is reached. This theory predicts that economic growth is a solution to environmental problems in the future without policy intervention. Over the past few decades, a number of comprehensive studies have been conducted on the nexus between economic growth and environmental degradation, economic growth and FDI and economic growth and energy consumption. Higher levels of emissions act as an indicator of the ambient quality of the environment and have been found to be a result of increased energy consumption. Consequently, this is thought to be the result of increased economic growth. To date however, the empirical evidence remains controversial and unclear. Thus in today's world of fast economic development, it is vital for researchers to find out the link concerning carbon dioxide emissions with economic growth and energy consumption. Evaluation of the literatures suggests that most of the studies focus on either the nexus between economic growth and environmental degradation, FDI and economic growth or on economic growth and energy consumption. But very few studies have actually attempted to align and validate both these nexuses under the same framework. Bangladesh has been maintaining a GDP growth rate of 6% over the last five years. More foreign direct investment is coming in the recent years. According to the World Bank report Bangladesh has now become the lower middle income country with a per capita income of $1314. So, Bangladesh can now be considered to be a veritable haven where pollution intensive firms can settle down due to relaxed environmental regulations. To the best of our knowledge, other than the paper by Alam and Huylenbroeck (2011), no studies have been conducted focusing on the empirical relationship among economic growth, energy consumption and carbon dioxide emissions in Bangladesh. Therefore the objective of this study is to investigate the casual relationships among these three variables in Bangladesh over the period 1978-2010 by using a multivariate framework. Our findings will provide valuable policy implications for Bangladesh and other developing countries.

2. Literature review

The relationship among economic growth, FDI, energy use and CO_2 emissions has been well documented in empirical studies. Several different studies involving different countries, variables and methodologies have been taken into account, though the results of these studies appear to be contradictory at times. Some studies state that a bidirectional relationship exists between energy consumption and economic growth; whereas other studies state that a unidirectional relationship exists. According to Kim and Baek (2011), energy consumption has a damaging long run effect on environment for both developed and developing countries that is, an increase in per capita energy consumption leads to environmental degradation. Chang (2010) investigates the causality among the three variables (energy consumption, carbon dioxide emissions and GDP) in China over the period of 1981-2006 and concludes that there is bidirectional causality running from GDP to carbon dioxide emissions and consumption of resources (crude oil and coal) and also from GDP to electricity consumption. Lee (2005; 2006) displayed that there have been long-run and short-run causalities from energy consumption to GDP, but did not show evidence of vice versa. This finding suggested that economic growth might have adverse effects on energy conservation, which may be a transitory or permanent trend in developing countries. Sari and Soyta (2007) found that energy consumption has a significant relationship with economic development. Other authors such as Keppler and Mansanet-Bataller (2010), Narayan and Narayan (2010) and Pao and Tsai (2010) stated that economic growth and energy consumption are accompanied with environmental degradation in both developed and developing countries. Lean and Smyth (2009) use a panel vector error correction model for five ASEAN countries (Indonesia, Malaysia, Philippines, Singapore and Thailand) over the period 1980-2006 and find a statistically significant positive relationship existing between energy consumption and emissions with a statistically significant non-linear relationship between CO_2 emission and real output. Furthermore, it was identified that in the long run there is a unidirectional causality running from electricity consumption and CO_2 emissions to economic growth and that in the short run, there is a unidirectional causality from emissions to electricity consumption. Soytas et al. (2007) investigate the effect of energy consumption and output on carbon emissions in the United States and saw that in the long run, income does not Granger cause carbon emissions, yet energy consumption does. Ang (2007) also examines the relationship among these three variables for

France over a period of 1960-2006. It was found that a positive relationship exists between energy use and CO_2 emissions with output having a quadratic relationship with CO_2 emissions in the long run. It was also found that a unidirectional Granger causality runs from economic growth to energy consumption and pollution emissions in the long run. A unidirectional causality running from energy use to economic growth is also observed in the short run. Apergis and James (2010) explore the relationship between carbon dioxide emissions, energy consumption and real output for 11 countries of the Commonwealth of independent states over the period 1992-2004. Their findings saw that in the long-run, energy consumption has a positive and statistically significant impact on carbon dioxide emissions while real output follows an inverted U- shape pattern associated with the Environmental Kuznets Curve (EKC) hypothesis. They found bidirectional causality between energy consumption and CO_2 emissions in the long run. The short run dynamics however, show a unidirectional direction from energy consumption and real output, respectively. Yang (2000) considers the causal relationship between different types of energy consumption and GDP in Taiwan for the period 1954–1997. Using different types of energy consumption he found a bi-directional causality between energy and GDP. Using trivariate approach based on demand functions, Asafu-Adjaye (2000) tested the causal relationship between energy use and income in four Asian countries using cointegration and error-correction analysis. He found that causality runs from energy to income in India and Indonesia, and bidirectional causality in Thailand and the Philippines. Masih and Masih (1996) used cointegration analysis to study this relationship in a group of six Asian countries and found cointegration between energy use and GDP in India, Pakistan, and Indonesia. No cointegration is found in the case of Malaysia, Singapore and the Philippines. The flow of causality is found to be running from energy to GDP in India and from GDP to energy in Pakistan and Indonesia. Additionally, a number of empirical studies were carried out to study FDI-environment relationship. There is a continuing debate on the nature and direction of the relationship between FDI and environment, with inconclusive results. Letchumanan and Kodama (2000) showed that there is "no existing correlation between FDI flows and pollution content of an industry for developing countries. Kim and Seo (2003) applied a vector autoregression model to present the dynamic correlations between FDI, domestic investment, and output. They found that economic growth has a statistically significant and highly persistent influence on FDI inflows.

Li and Liu (2005) discovered a strong link between FDI and economic growth, not only in developed but also in developing countries. Chakraborty and Nunnenkamp (2008) discovered the spillover effects between FDI and India's economic output both in the short-run and long-run. Sadorsky (2010) showed evidence that net FDI has a statistically significant impact on energy demand from a sample of 22 emerging countries. Not many studies focused on combined relationship among the variables CO_2 Emissions, Energy Consumption, Economic Growth and FDI. Linh & Lin (2014) examines the dynamic relationships between CO_2 emissions, energy consumption, FDI and economic growth for Vietnam in the period from 1980 to 2010 based on Environmental Kuznets Curve (EKC) approach, cointegration, and Granger causality tests. The cointegration and Granger causality test results indicate a dynamic relationship among CO_2 emissions, energy consumption, FDI and economic growth. The short run bidirectional relationship between Vietnam's income and FDI inflows implies that the increase in Vietnam's income will attract more capital from overseas. Pao & Tsai (2011) addresses the impact of both economic growth and financial development on environmental degradation using a panel cointegration technique for the period between 1980 and 2007. The causality results show that there is strong bidirectional causality between emissions and FDI and unidirectional strong causality running from output to FDI. Additionally, they found strong output-emissions and output-energy consumption bidirectional causality, while there is unidirectional strong causality running from energy consumption to emissions. We add value to the existing literature by employing two separate models to identify environmental effects on our economic growth. We have also added another variable which is natural gas usage by industrial sector, in order to determine the relationship among the variables.

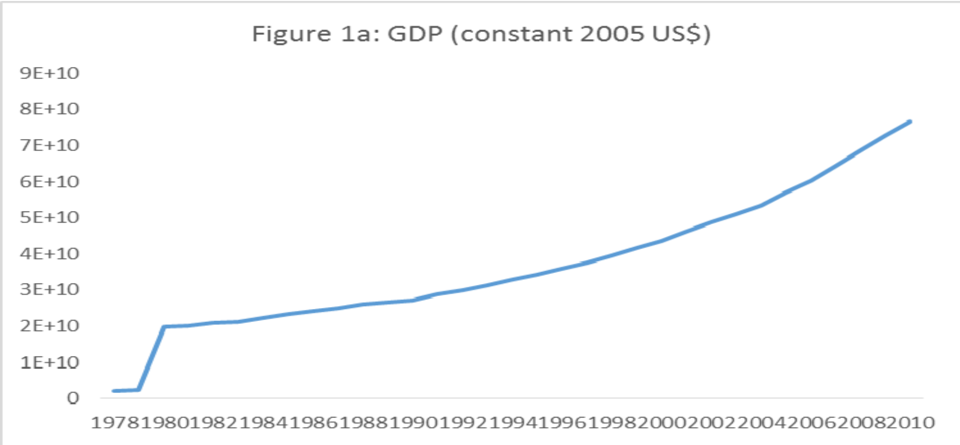
3. Data, Model & Strategy

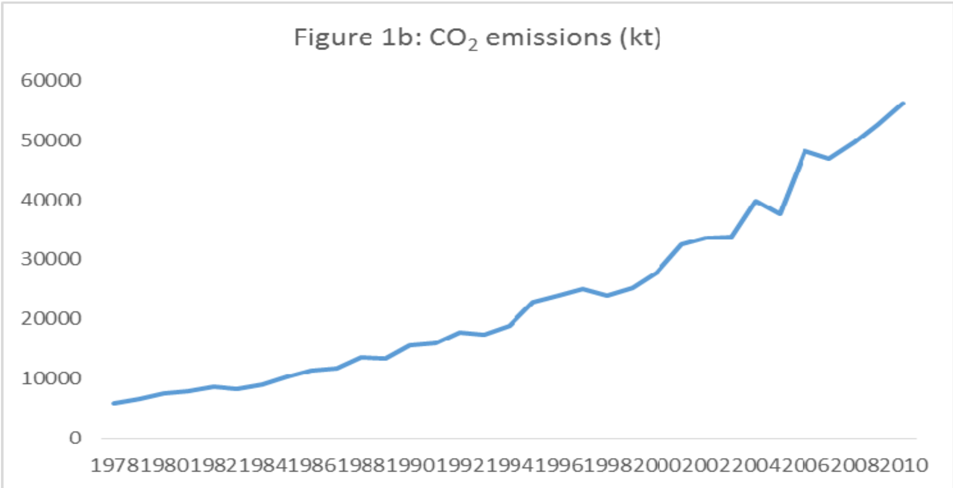
3.1 Data

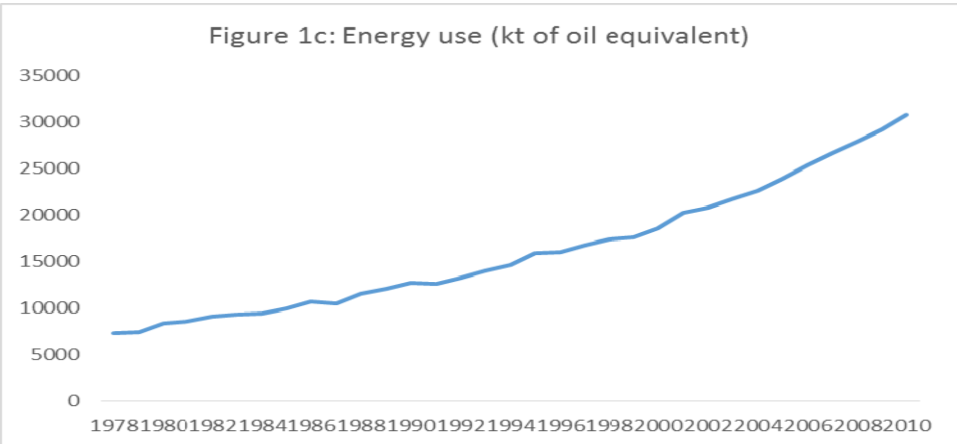
Table 1 presents descriptive statistics for the variables employed in the study. Figure 1 presents the time series of each of the variables in graphical form. Output is measured by real GDP (constant $US 2005), CO_2 emission is measured by kilotons, FDI is measured by net inflows of investment to acquire a lasting management interest, energy consumption is measured by kilotons of oil equivalent and natural gas used by industrial sector has been measured by billion cubic feet. Data has been collected from world development indicators of World Bank data sheet from 1978 to 2010.

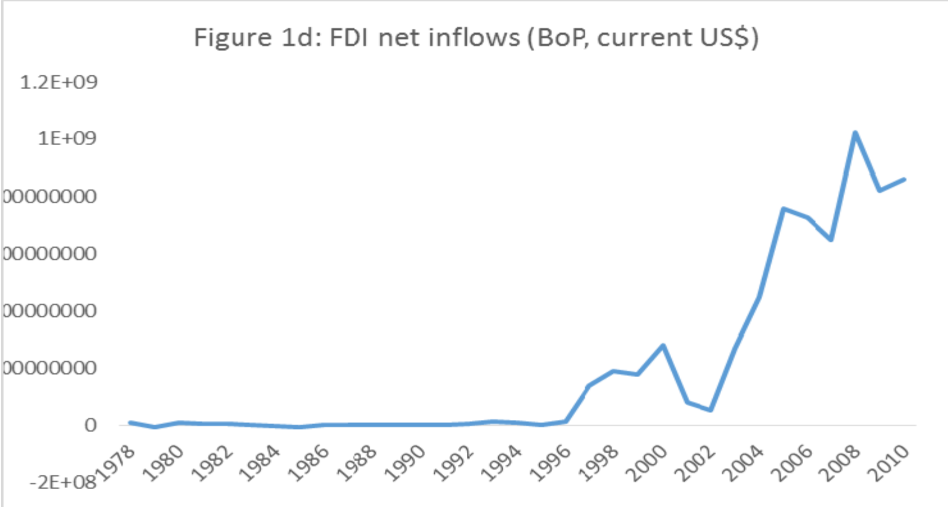
Table 1. Descriptive Statistics

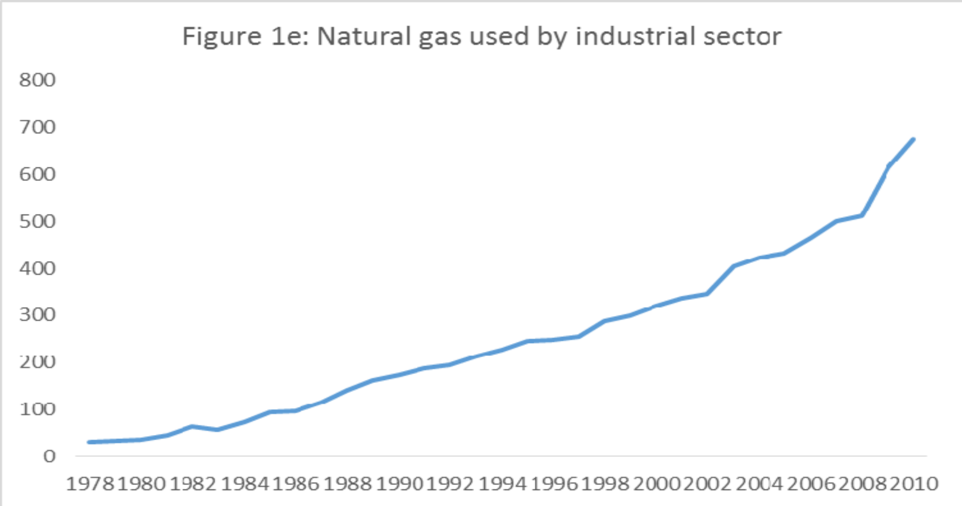
Variables	Mean	Median	Skewness	Kurtosis
CO_2	23645.93	18969.39	0.752305	-0.55504
Energy	16132.24	14611.2	0.617502	-0.69004
FDI	3.69E+10	3.29E+10	0.41447	-0.20584
Output	2.63E+08	78527040	1.311384	0.561818
Natural Gas usage	252.2373	228.2100	0.642647	2.591281











3.2 Econometric Modelling strategy

The econometric modeling strategy proceeds in several steps, consistent with previous studies. The unit root test is carried out to check the stationarity of the variables as financial and macro variables are well known for their non stationarity. The Augmented Dickey Fuller (ADF) test is then carried out to detect the existence of unit root and as a result of which, some of the variables are found to be non-stationary and thus could not be regressed unless made stationary. The null hypothesis for the ADF unit root test is that the variable has a unit root against the alternative of stationarity. We performed the ADF tests based on the following model:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \ldots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t$$

Therefore, the cointegration test is run to find out possible linear combinations of the variables which could be considered stationary. To test for cointegration we use the maximum likelihood test developed by Johansen and Juselius (1990). We use the AIC to determine lag length. Johansen and Juselius multivariate cointegration equation is given below:

$$\Delta \mathbf{X_t} = \sum \Gamma \mathbf{i}\, \Delta \mathbf{X_{t-i}} + \prod \mathbf{X_{t-1}} + \boldsymbol{\varepsilon_t}$$

Once the variables are found to be cointegrated, then Vector Error Correction model (VECM) can be employed to identify the long run and short run causality running from our variables. The long-run multivariate models are as follows:

$$\mathbf{Y_t = \alpha + \beta_1 N_t + \beta_2 E_t + u_t} \text{ --------------- } \mathbf{(Model\text{-}1)}$$

Where Y_t= Output, N_t = Natural Gas consumption, E_t = Energy use, u_t = error terms

$$\mathbf{Y_t = \alpha + \beta_1 C_t + u_t} \text{ --------------- } \mathbf{(Model\text{-}2)}$$

Where Y_t= FDI, C_t = CO_2 emission, u_t = error terms

If there is a long run relationship between the series, shocks will result in disequilibrium in the short-run before the series return to their long-run equilibrium. The short run model corresponding is as follows:

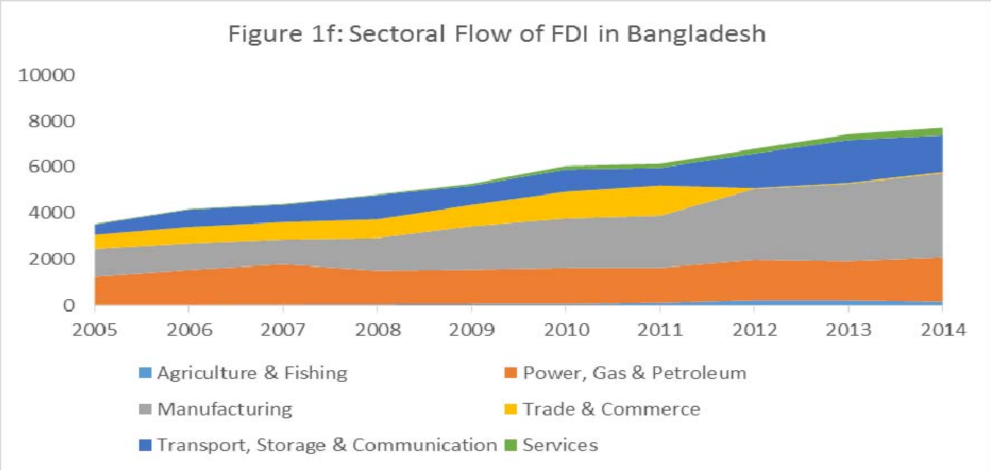
$$\Delta O_t = \sum \beta_i \Delta O_{t-i} + \sum \alpha_i \Delta EN_{t-i} + \sum \alpha_i \Delta NG_{t-I} + \varepsilon_{it} \text{ ----------- (Model-1)}$$

Where, O = GDP, EN = Energy Consumption & NG = Natural Gas usage

$$\Delta FDI_t = \sum \beta_i \Delta FDI_{t-i} + \sum \alpha_i \Delta C_{t-i} + \varepsilon_{it} \text{ ----------- (Model-2)}$$

Where, FDI = Foreign Direct Investment, C = CO_2 emission

Here in the first model we want to estimate the effect of GDP on energy and natural gas consumed by the industrial sector in Bangladesh. In the second model we want to estimate the effect of FDI on CO_2 emission in our environment. We want to test the relationship between FDI and CO_2 emission since statistics shows that major sectors of our FDI are emitting CO_2 in our environment.



E-Views 9.0 is used as the statistical software packages for all the tests run in this study.

4. Results & Discussion:

Initially, we opted for ADF test to check the datasets and we observed that the datasets were non-stationary at level. However, in first difference, we found both the series become stationary (Table 2). So it became possible for us to investigate the existence of a long-run relationship within a Johansen cointegration testing framework.

Table 2. Augmented Dickey–Fuller Unit Root Test

Variables	Level	First Difference
	t-statistic	t-statistic
GDP	-1.320603	-5.808213***
CO_2 Emission	-2.700130	-10.89087***
Energy Consumption	-0.863138	-6.898810***
FDI	-1.554045	-5.669878***
Natural Gas usage	-2.855253	-5.312199***

*Note: *** denotes significance at 1% level.*

In the next stage of our study we have divided our results into two part. First one is impact from domestic perspective and second one is from foreign perspective.

4.1 From Domestic Perspective:

In Johansen's method, both the Eigen value statistics and Trace statistics can be used to determine whether variables are cointegrated or not. To trace out the presence of cointegration, we could rely on both Trace statistics and Eigen value. From the Trace statistics (table 3), it was found that all variables have been cointegrated at 5% level where the null hypothesis is rejected indicating long-term association between the variables. Further Maximum Eigenvalue statistics indicates that there is at least two cointegrating equation. As all variables are cointegrated, we can run VECM model. It is noted that three lags were used in the analysis as suggested by both final prediction error and Akaike information criterion.

Table 3. Johansen Cointegration Test model 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.942461	102.5143	29.79707	0.0000
At most 1 *	0.422459	16.85557	15.49471	0.0310
At most 2	0.012795	0.386319	3.841466	0.5342

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.942461	85.65877	21.13162	0.0000
At most 1 *	0.422459	16.46925	14.26460	0.0220
At most 2	0.012795	0.386319	3.841466	0.5342

Table 4 shows the VECM long run causality of our model 1. Here C (1) represents the speed of the adjustments towards long run equilibrium. We see that our C (1) is negative and is also significant which indicates that there is long run causality running from energy consumption and natural gas usage by industrial sector to GDP. Further we can say that energy consumption and natural gas usage by industrial sector have influence on our dependent variable GDP in the long run.

Table 4. VECM long Run Causality Model-1

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-1.027244	0.065587	-15.66236	0.0000
C(2)	0.001904	0.045896	0.041493	0.9672
C(3)	-1200316.	254379.2	-4.718608	0.0001
C(4)	-12752176	5737616.	-2.222557	0.0355
C(5)	-3.77E+08	1.34E+08	-2.800340	0.0097

R-squared	0.956511	Mean dependent var	-4.66E+08
Adjusted R-squared	0.949553	S.D. dependent var	3.24E+09
S.E. of regression	7.28E+08	Akaike info criterion	43.80159
Sum squared resid	1.33E+19	Schwarz criterion	44.03513
Log likelihood	-652.0239	Hannan-Quinn criter.	43.87630
F-statistic	137.4643	Durbin-Watson stat	1.438067
Prob(F-statistic)	0.000000		

Now we want to estimate whether there is any short run causality or not among our variables. To do this we use wald statistics test result. Table 5 shows short run causality result between energy usage and gross domestic product. Result says that there is short run causality running from energy usage to gross domestic product since chi-square value is more less 5%.

Table 5. VECM short run causality between Energy consumption and GDP

Wald Test:

Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-4.718608	25	0.0001
F-statistic	22.26526	(1, 25)	0.0001
Chi-square	22.26526	1	0.0000

Table 6 shows short run causality result between natural gas usage by industrial sector and gross domestic product. Result says that there is short run causality running from natural gas usage by industrial sector to gross domestic product since chi-square value is less than 5%.

Table 6. VECM short run causality between Natural gas usage by industrial sector and GDP

Wald Test:

Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-2.222557	25	0.0355
F-statistic	4.939758	(1, 25)	0.0355
Chi-square	4.939758	1	0.0262

Now we want to examine whether our model 1 where GDP is the dependent variable has any statistical error or not. Here our value of R^2 is 95% which is high. Our F statistics is also significant which a good sign of our model. Breusch-Godfrey's LM Test (table 7) indicates that there is no serial-correlation in our model. Further Breusch-Pagan-Godfrey's Heteroskedasticity Test (table 8) indicates that this model does not have Heteroskedasticity.

Table 7. Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.337639	Prob. F(1,24)	0.1394
Obs*R-squared	2.662698	Prob. Chi-Square(1)	0.1027

Table 8: Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.407656	Prob. F(6,23)	0.8663
Obs*R-squared	2.883685	Prob. Chi-Square(6)	0.8233
Scaled explained SS	1.381035	Prob. Chi-Square(6)	0.9670

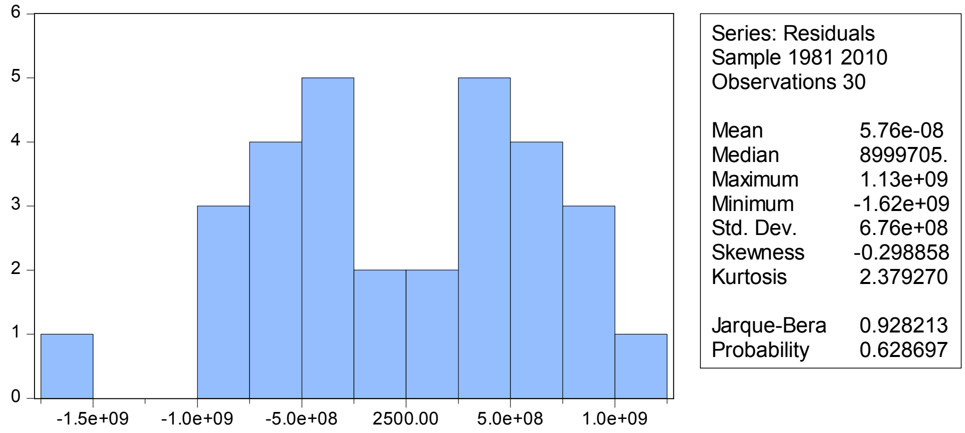


Figure 2. Normality Test

Further residuals of our model is found to be normally distributed (figure 2).

4.2 From Foreign Perspective

From the Trace statistics (table 9), it was found that FDI and CO_2 have been cointegrated at 5% level where the null hypothesis is rejected indicating long-term association between the variables. Further Maximum Eigenvalue statistics indicates that there is at least two cointegrating equation.

Table 9. Johansen Cointegration Test model 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.484964	23.95590	15.49471	0.0021
At most 1 *	0.126294	4.050331	3.841466	0.0442

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.484964	19.90557	14.26460	0.0058
At most 1 *	0.126294	4.050331	3.841466	0.0442

Table 10 shows the VECM long run causality of our model 2. We see that our C (1) is negative and is also significant which indicates that there is long run causality running from CO_2 emission to FDI. Further we can say that CO_2 emission has influence on our dependent variable FDI in the long run.

Table 10. VECM Long Run Causality result

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-3.642233	1.004282	-3.626704	0.0027
C(2)	2.345738	0.860035	2.727491	0.0164
C(3)	1.743322	0.783028	2.226385	0.0429
C(4)	1.824841	0.660918	2.761069	0.0153
C(5)	1.017671	0.471490	2.158415	0.0487
C(6)	0.885462	0.360278	2.457718	0.0276
C(7)	-101529.2	32960.14	-3.080363	0.0081
C(8)	-48928.73	32411.20	-1.509624	0.1534

C(9)	12462.51	30744.43	0.405358	0.6913
C(10)	35194.76	34071.85	1.032957	0.3191
C(11)	2980.202	26631.13	0.111907	0.9125
C(12)	5813797.	27014859	0.215207	0.8327

R-squared	0.843924	Mean dependent var	12189734
Adjusted R-squared	0.721293	S.D. dependent var	2.31E+08
S.E. of regression	1.22E+08	Akaike info criterion	40.37751
Sum squared resid	2.08E+17	Schwarz criterion	40.95817
Log likelihood	-512.9076	Hannan-Quinn criter.	40.54472
F-statistic	6.881800	Durbin-Watson stat	1.845285
Prob(F-statistic)	0.000606		

Table 11 shows short run causality result between CO_2 emission and FDI. Result says that there is a short run causality from CO_2 emission to FDI since chi-square value is less than 5%.

Table 11. Short Run causality between CO_2 emissions to FDI

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	2.876935	(5, 14)	0.0544
Chi-square	14.38468	5	0.0133

Now we want to examine whether our model 2 where FDI is the dependent variable has any statistical error or not. Here our value of R^2 is 84% which is high. Our F statistics is also significant which a good sign of our model. Breusch-Godfrey's LM Test (table 12) indicates that there is no serial-correlation in our model. Further Breusch-Pagan-Godfrey's Heteroskedasticity Test (table 13) indicates that this model does not have Heteroskedasticity.

Table 12. Serial Correlation LM Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.132078	Prob. F(12,13)	0.9994
Obs*R-squared	2.825406	Prob. Chi-Square(12)	0.9967
Scaled explained SS	1.398368	Prob. Chi-Square(12)	0.9999

Table 13: Heteroskedasticity Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.402437	Prob. F(5,9)	0.8356
Obs*R-squared	4.750809	Prob. Chi-Square(5)	0.4470

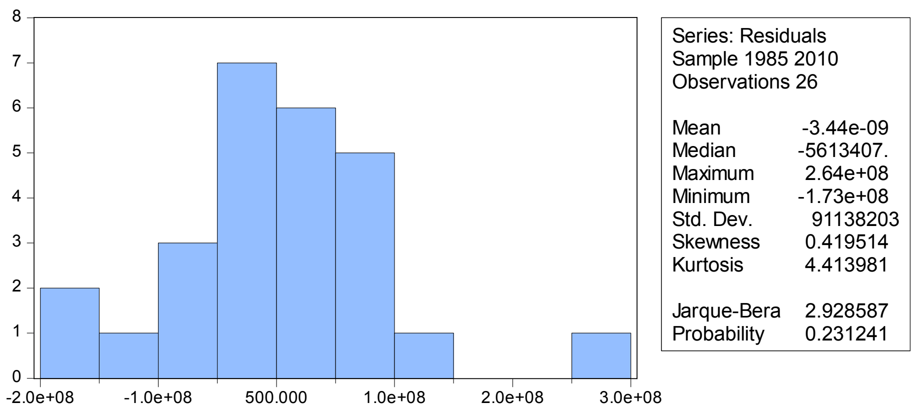


Figure 3. Normality test

Further residuals of our model 2 is found to be normally distributed (figure). Therefore we can say that the model we used for this study is fit.

3. Concluding Remarks:

This study undertakes to investigate the long run co-integrating relationships among GDP, CO_2 emissions, FDI, natural gas usage and energy consumption for Bangladesh during the period 1978-2010 by using multivariate vector error correction model. Our results are divided into two parts to get an estimate from both domestic and foreign perspectives. From domestic perspective we found that there exists a long run co-integrating relationship among GDP, energy use and natural gas used by industrial sector in Bangladesh. VECM long model says there is long run causality among the variables. Thus we can say that our growth is energy dependent. At the same time our growth also consumes a lot of natural gas as well. Therefore in our policy implication, it suggests that energy restrictions seem to harm economic growth in Bangladesh. Furthermore, since our natural gas is limited, we need to find alternative sources in order to reduce the pressure on our reserve. From the foreign perspective, we can see that FDI and CO_2 have both long run and short run causal relationship. It indicates that FDI in Bangladesh is likely to pollute our environment. It is therefore suggested that government should be cautious with regards to the environmental effect of FDI, although Bangladesh shares less than 0.1% of the global emissions as compared to the 24% emitted by the USA. Finally, a new direction for future research could be to examine the causal relationship among GDP, FDI, energy consumption, CO_2 and natural gas usage in South Asian countries to formulate appropriate policies and procedures.

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