

Electricity Generation, Output, Trade Openness & Foreign Direct Investment nexus in Bangladesh: An Empirical Analysis

Ayesha Tasnim² and Sakib Bin Amin¹

As the world is becoming more of a global village, Bangladesh is also having its fair share of growth through technological advancement, development in energy sector, open economy and thus attracting foreign investors in the process. A close observation may reveal a causal relationship between electricity generation, trade openness, Foreign Direct Investment and output, though no attempt has been made to explore such nexus in Bangladesh. Hence, this study aims to investigate the existence and direction of causality among the variables electricity generation, trade openness, Foreign Direct Investment and output in Bangladesh over the period 1980-2013. The findings show a long run co-integrating relationship among these variables. The inferences drawn from the study imply adoption of energy growth policies as important policy implication.

Field of Research: Economics

1. Introduction

Electricity has become a vital component of economic growth with the advancement of technology all over the world. Electricity is required in every sector of the economy either directly or as a complement to other factors of production. Growing economies tend to be more open in terms of trade in order to fully utilize resources and lower production cost through international trade. Trade openness is the removal of barriers on the free exchange of goods within nations. It stimulates overall economic performance by creating employment opportunities, transferring technology, reducing poverty and so on. Open economies also provide access to Foreign Direct Investment which is a crucial indicator of economic growth. Along with capital formation, FDI requires labor intensive economic growth which increases the employment situation of the country (Constant and Yaoxing, 2010). Countries with higher economic growth likely to attract more foreign investors to invest in domestic markets. International trade and FDI allow transfer of new technologies which requires electricity supply. Again, high national income demands electricity due to increased electricity usage. Thus, there is a possible linkage among electricity, FDI, trade openness and GDP growth. So, it is important for the researchers to examine the relationship between the variables.

¹AyeshaTasnim,BS student and corresponding author, School of Business and Economics, North South University, Dhaka, Bangladesh. Email: ashtithi@gmail.com

²Dr. Sakib Bin Amin,Assistant Professor, School ofBusiness and Economics, North South University Dhaka, Bangladesh, Email: sakib.amin@northsouth.edu

Tasnim & Amin

Voluminous literatures exist on the nexus between electricity generation and GDP, FDI and GDP and, trade and GDP in bivariate frameworks. Since the seminal work of Kraft and Kraft (1978), where they find a unidirectional Granger causality from output to energy consumption for USA, energy-GDP nexus has become an interesting area for researchers to study. Lately, energy economists have been more focused on including variables such as, trade, export, FDI in their models of electricity-GDP nexus. However, the empirical findings differ from each other.

The relationship between electricity generation and economic growth from empirical studies suggests two possible direction of causality between them. Higher economic growth requires higher level of power supply. On the other hand, for efficient utilization of electricity, economic development is necessary. A number of studies assess the empirical evidence regarding the nature of causality between electricity and economic growth. Recent studies include papers by Masuduzzaman (2013), Amin et al., (2016), Alam (2010), and Coers & Sanders (2012).

Trade openness and FDI are closely linked to growth. Economies with trade liberalization tend to grow faster (Edwards & Lederman, 1998). Policymakers believe that foreign direct investment (FDI) enhances the productivity of host countries and promotes economic development as -FDI provides direct capital financing and also creates positive externalities through adaptation of new technology (Alfaro et al, 2006).

The present study is different from the previous studies in respect that most of the previous studies focus either on energy-GDP nexus, or FDI, energy and economic growth nexus for Bangladesh. This study explores the contemporary relationship between electricity generation, trade openness, FDI and economic growth in Bangladesh. The ample opportunities that Bangladesh have in these sectors have driven us to conduct this study. In the recent years, Bangladesh has experienced a robust economic growth attaining the peak at 7.24% breaking all the previous records in fiscal year 2016-2017 with its export oriented strategy. However, to reach and maintain a growth of 8%, policy makers suggest focusing more on factors including production and distribution of electricity, export-led growth, diversification in export, Foreign Direct Investment inflow. To the best of our knowledge, no studies have yet been conducted in Bangladesh focusing on the empirical relationship among Electricity Generation, Output, Trade Openness and Foreign Direct Investment. Hence, the objective of this study is to investigate the causal relationship and nature of causality among these four variables in Bangladesh over the period 1980-2013 using a multivariate framework. The study aims to produce some important policy insights from inferences for more growth possibilities. There are three sets of hypotheses concerning the long run relationship between, (i) electricity generation and GDP, (ii) trade openness and GDP and, (iii) FDI and GDP.

The rest of the paper is organized as follows: section 2 provides a review of the literature followed by an overview of the energy sector in Bangladesh in section 3. Then, section 4 describes the data set and the econometric methodology. The subsequent section discusses the results obtained, followed by conclusion in section 6.

2. A Review of Literature

A number of empirical literatures exist regarding the nexus between electricity, trade, FDI and GDP from different countries' perspective using different methodologies and framework. These studies vary substantially across countries. Thus, no clear indication of granger causality among electricity generation, trade, foreign direct investment and GDP can be obtained from the assessment of these study results. The relationship among the above mentioned variables holds great significance in the field of energy economics.

There have been many studies over past three decades to examine the nexus between electricity consumption and economic growth either for a single country or for a group of countries. Sarker and Alam (2010), in their paper "Nexus between electricity generation and economic growth in Bangladesh", try to find the causality between electricity generation and GDP. The empirical results reveal that electricity generation granger causes economic growth in the long run. The study applies the ADF and PP unit root test, Johansen co-integration approach and granger causality approach using the time series data covering the period 1972-2006 in order to assess the empirical relationship between them. The study finds unidirectional causality running from electricity generation to GDP. However, the study fails to show any long run relationship between the variables which reduces the robustness of the results found. The authors suggest diversification of energy sources and more focus on renewable energy sources.

Lean & Smith (2014) carry out a study "Electricity consumption, Output and Trade in Bhutan" with three set of hypotheses including e bidirectional causality between electricity consumption and GDP, unidirectional causality from export to GDP and unidirectional causality from export to electricity consumption. They take a dataset over the period 1980-2013 and apply the Augmented Dickey-Fuller unit root test and the Johansen and Juselius test for co-integration. From granger causality test they find a unidirectional granger causality running from electricity consumption to economic growth. The weakness of this paper is that the findings do not entirely support the hypotheses. The paper concludes that Bhutan is an energy dependent country.

Altintas and Kum (2013) conduct a similar study in Turkey titled "Multivariate granger causality between electricity generation, exports, prices and economic growth in Turkey" where they seek to find the short and long run relationship between electricity generation, exports, prices and economic growth in Turkey. They find a bidirectional granger causality between economic growth and electricity generation. They use the Autoregressive Distributed Lag (ARDL) model and employ the annual data from 1970 to 2010 in their study.

Bekhet and Othman (2011) examine the causal relationship between electricity consumption, consumer price index (CPI), foreign direct investment (FDI) and economic growth in Malaysia in their paper "Causality analysis among electricity consumption, consumer expenditure, GDP and FDI: Case study of Malaysia" over the period 1971-2009 using the Vector Error Correction Model (VECM). They found unidirectional long run causality from electricity consumption to inflation and long run causality running from

Tasnim & Amin

electricity consumption to FDI. However, they found no trace of short run causality which indicates a weakness in their finding.

Bekhet and Othman (2014) conduct another study “Long-Run elasticity of Electricity Consumption, FDI, Export and GDP in Malaysia” to examine the co-integration among electricity consumption, FDI, export and economic growth over the period 1971-2011 and find significant long run equilibrium relationship among the variables using the ADF, KPSS, PP test and F- bound test. The study finds long run correlation among the variables but there is no confirmation about the direction of causality. So the weakness of the methodology used by the authors should be reported.

Hussain (2012) uses Vector Error Correction (VEC) model for the panel of three SAARC countries; India, Pakistan and Bangladesh over the period 1976-2009 and find the dynamic causal relationship between economic growth, electricity consumption, export values and remittances. From the panel Granger F-test results they find that there is bidirectional short run causality between economic growth and export values but there is no long run relationship among the variables. They farther find that there is long run unidirectional causality running from electricity consumption and remittance from economic growth for the SAARC countries. In this study they apply four different panel unit root tests (Levin, Lin and Chu (LLC, 2002), Im, Peasaran and Shin (IPS, 2003), Maddala and Wu (1999), and Choi (2006) tests) and Augmented Dickey Fuller (ADF) unit root test, The Kao and the Johansen Fisher panel co-integration tests.

According to Siddique and Majeed (2015), a bidirectional long run relationship exists between growth and energy consumption for five South Asian countries. Their paper “Energy Consumption, Trade and GDP: A Case Study of South Asian Countries” examines the causality between energy consumption, trade, financial development and economic growth in five South Asian countries namely Bangladesh, Pakistan, India, Sri-Lanka and Nepal for the period of 1980 to 2010. The strength of this study is the methodology used by authors where they adopt a panel co-integration approach which is advantageous over a single equation technique. The conclusion of this study is consistent with that of Shakeel et.al.(2013) where the authors find a linkage among energy consumption, trade and economic growth for South Asian economies using vector error correction model (VECM) and panel co-integration approach.

Our study contributes to the literature by examining the linkage between trade openness, FDI, electricity generation and economic growth in context of Bangladesh. There are very few studies that have considered all these variables in one model. The only study, of which we are aware, is “The Electricity Consumption, Real Income, Trade Openness and Foreign Direct Investment: The Empirical Evidence from Turkey” by Acaravci et.al. (2015) which uses electricity consumption instead of generation and aim to find the effects of electricity consumption per capita, trade openness and foreign direct investment inflows per capita on economic growth in Turkey over the time period 1974-2013. The study yields the evidence of a long run relationship between electricity consumption and real income. Authors come to the conclusion that growth hypothesis is confirmed in Turkey. One weakness of the study is that no causality is found from real income per capita to electricity consumption per capita.

Tasnim & Amin

One of the major issues that we want to address in this paper is to bring the variables, electricity generation, GDP, trade openness and FDI, under a single framework to analyze their interrelationships due to the extensive importance of these specific variables on the economy of Bangladesh. However, after analyzing existing literatures and from the studies mentioned above, we come to this conclusion that, unlike our paper, these papers have not considered all of these variables (electricity generation, GDP, trade openness and FDI) in their framework. Most of the papers focus on either electricity consumption or GDP and their interrelationship. Based on this gap in the existing literature, we aim to investigate the long run relationship and causality between each of the variables through this study that the existing literature have failed to show.

3. Bangladesh Scenario

3.1 Economic Growth in Bangladesh

Bangladesh is a small and one of the most densely populated countries with a per capita income of \$ 1211.7 (WDI, 2015). The economy of Bangladesh shows an astounding growth by evolving around a continued average economic growth of over 6% for the last ten years (2005-2015). Despite innumerable challenges, Bangladesh now proudly stands as a destination for trade and investment in South Asia.

Through various policy reforms, including market-oriented trade liberalizing policy reforms, Bangladesh economy has experienced both macro-economic stability and robust economic growth. Even though the economy still suffers due to various underdeveloped sectors, Bangladesh has been successfully maintaining an average GDP growth rate of 6.5% since fiscal year 2004. Moreover, Bangladesh has been upgraded from lower income country to lower-middle income country in 2016. The GDP growth rate for the last ten years has been shown in the table below:

Table 1: Annual GDP Growth Rate in Bangladesh

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
GDP (annual growth rate)	6.5%	6.7%	7.06%	6.01%	5.04%	5.6%	6.46%	6.5%	6.01%	6.06%	6.5%

Source: WDI, 2016

Apart from some fluctuations during 2007 to 2010, the economy shows a stable rate of growth of around 6%-6.5% for the past ten years. The economy had to face some challenges such as political turbulence, which caused slight fluctuations in growth. However, some key factors such as increased capital accumulation, private investment, increasing flow of remittances etc. has contributed to the acceleration of economic growth. Shift from agro based economy to industrial economy played a great role in economic development of Bangladesh.

Tasnim & Amin

3.1.2 Trade Openness

Trade liberalization has been one of the major economic policy reforms undertaken by Bangladesh Government. Since the independence in 1971, Bangladesh had been experiencing negative trade balance as the value of import doubled compared to the value of export during 1971 to 1991. To improve the balance of payment and protect domestic markets, Bangladesh Government followed a highly restricted trade regime strategy characterized by high tariffs and non-tariff barriers and overvalued exchange rate system. With the implementation of import and export policy reforms, share of both imports and exports in GDP has increased since 1995.

Table 2: Economic Growth and Trade to GDP Ratio during Pre-Liberalization and Post-Liberalization Period

Indicator	Pre Liberalization			Post Liberalization Period				
	1972	1980	1990	1995	2000	2005	2010	2015
GDP (per capita \$US)	\$93.05	222.94	298.14	320.4	406.5	485.9	760.3	1211
GDP growth rate	-14%	0.9%	5.6%	5.1%	5.3%	6.5%	5.6%	6.5%
Trade (% of GDP)	19.4%	22%	19%	28%	29%	34%	38%	42%

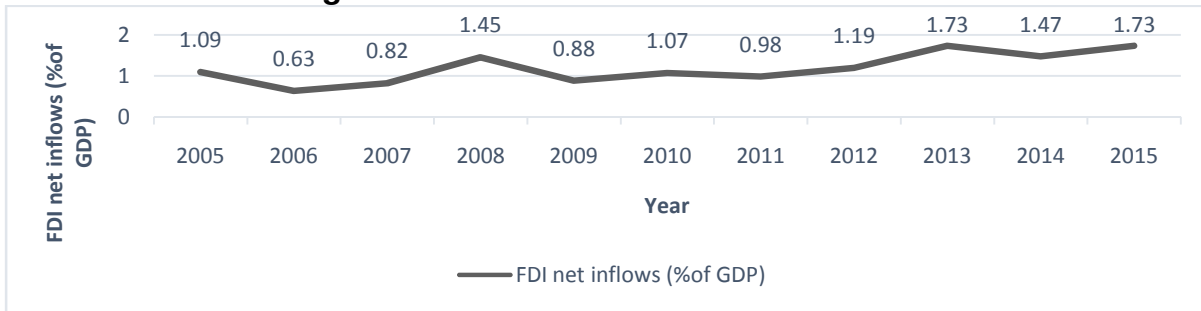
Source: Bangladesh Bureau of Statistics, 2016.

The trade-GDP ratio has been increasing consistently from the start of post liberalization period. Due to significant improvement in trade liberalization, Bangladesh has been announced as second most open economy in South Asia (BB,2015).

3.1.3 Foreign Direct Investment

Foreign direct investment (FDI) works as powerful tool for economic development in the present global context. It enables a capital-shy country like Bangladesh to build up physical capital, create employment opportunities, enhance skills of local labor through transfer of technology, and helps integrate the domestic economy with the global economy (Amin, 2007). Government of Bangladesh is trying to create a hospitable environment for foreign investors through introducing economic policies, incentives for investors promoting privatization etc.

Figure 1: FDI net inflows as share of GDP



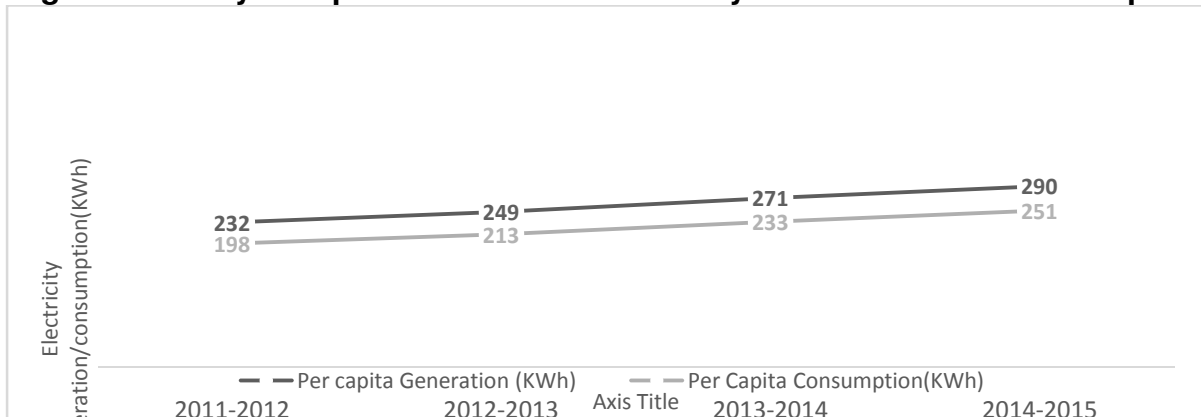
Source: WDI, 2016

The trend of FDI net inflow in the initial period shows frequent fluctuations. However, from 2013, the inflow started to maintain an average growth of 1.64. It is the consequence of the surge in FDI inward in recent periods. According to world investment report 2016, Bangladesh has witnessed a “historically high” level of growth in FDI in 2015 by crossing the figure \$2bn mark. The reasons of such achievement can be attributed to rising FDI in labor-intensive manufacturing sector. China is also counting Bangladesh as a major destination for future investment.

3.1.4 Electricity Sector

Electricity is a crucial determinant for economic growth and overall development in any country. However, Bangladesh is still suffering from insufficient electricity supply while the demand for electricity is continuously increasing. Only 69% of population has access to electricity. The remaining 31% are yet to be brought under national grid. To fulfill the increasing demand of electricity demand, Government has set the vision to provide with affordable access to electricity by 2021 and the whole area under coverage by 2030 (Ahmed.et.al. 2014).

Figure 2: Yearly Comparison between Electricity Generation and Consumption



Source: WDI, 2016

There is a growing trend in both generation and consumption per capita. However the gap between them needs to be reduced for sufficient electricity to be reached to overall population. The power sector is mainly dependent on natural gas fired generation. Due to forced outage, fuels constraint, the present generation capacity of 10939 MW cannot

be realized to its fullest (BBS, 2015). One-fourth of the power generation plants are more than 20 years old which causes high maintenance cost. Besides, gas supply shortfall forces the plants to operate at a reduced rate. Thus demand originating from grid remains unmet.

4. Data Set, Model Variables and Methodology

Our paper aims to examine the long run relationship and the direction of causality among electricity generation, output, trade openness and foreign direct invest (FDI) in Bangladesh. Our study uses time series data over a period of 1980-2013 for which 32 observations are available at most. We use Gross Domestic Product per capita (current US\$) to represent economic growth. The generation of electricity per capita is measured in kilowatt per hour.

In statistics, the existence of a unit root can cause problems in statistical inference in time series models (Amin, 2011). The Augmented Dickey Fuller (ADF) test and Phillips-Perron (PP) test are the appropriate unit root tests to check the stationarity of the variables. If the variables are found to be stationary, the co-integration test is then run to find out possible linear combinations of the variables which could be considered stationary. Once the variables are found to be co-integrated, the Granger causality test is run to check the possible direction of causality between the variables.

The Johansen co-integration test is applied to test for co-integration. This method provides a unified framework for estimation and test co-integration relations in the context of Vector Autoregressive error correction model. The form of estimation of an Unrestricted Vector of Autocorrelation is:

$$\Delta x_t = \alpha + \theta_1 \Delta x_{t-1} + \theta_2 \Delta x_{t-2} + \dots + \theta_{k-1} \Delta x_{t-k+1} + \theta_k \Delta x_{t-k} + u_t$$

Here, Δ is the difference operator. x_t is a $(n \times 1)$ vector of non-stationary variables (in levels) and u_t is a $(n \times 1)$ vector of random errors. The matrix θ_k determines the long run relationship between variables. The rank of $\theta_k = 0$ means that the variables are not co-integrated. If rank (usually denoted by r) is equal to one, there exists one co-integrating vector. Finally, when $1 < r < n$, multiple co-integrating vectors exist. There are two types of Johansen test, namely trace test and maximum Eigenvalue test. The null hypothesis for the trace test is that there are at most r co-integrating vectors whereas the maximum eigenvalue test evaluates the null hypothesis that there are exactly r co-integrating vector.

If two variables are found to be co-integrated, there is at least one direction of causality between them. The granger causality test is the best approach to determine the direction of causality between the variables. This approach was introduced by Granger (1969, 1980, and 1988) which is widely practiced in empirical macroeconomics and empirical finance. The existence of non-stationary variables can yield misleading conclusions in the granger causality test (Engle & Granger, 1978). The variables need to be co-integrated in order to deduce a long run causal relationship between the variables.

Tasnim & Amin

If y and x are two time series variables, the granger causality test determines whether the past values of y forecast the future values of x or the past values of y can explain the current values of x as provided by the information in past values of x . If the changes in prior values of y cannot explain the current changes in the values of x , then y does not granger cause x . By interchanging and repeating the process granger causality from x to y is determined. The granger causality test leads to four likely outcomes,

1. y granger causes x but not otherwise
2. x granger causes y but not otherwise
3. Both x and y granger cause each other
4. Neither variable granger cause each other

In this study, the causality test between GDP, trade openness, FDI and electricity generation is conducted. To test the null hypothesis, the following equations are estimated:

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \dots + \alpha_l x_{t-l} + \beta_1 y_{t-1} + \dots + \beta_l y_{t-l}$$

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \dots + \alpha_l y_{t-l} + \beta_1 x_{t-1} + \dots + \beta_l x_{t-l}$$

We consider the above sets of equations for all possible pairs of (x, y) series in the group.

The result of these tests help us decide the nature of causality among electricity generation, trade openness, foreign direct investment (FD) and economic growth of Bangladesh. Although numerical representations of the relationship among the variables are possible, a simple relationship (that means a simple linear function) is considered in this study based on the consideration of simplicity. The data are collected from the World Development Indicator 2013 published by World Bank and Statistical Year Book Bangladesh 2014 published by Bangladesh Bureau of Statistics. It should be mentioned here that since data of some of the variables prior to 1980 are unavailable, we consider the period of 1980-2013 for our study. A small sample size might be problematic in finding long run relationship. The focus of this study is not to develop a new model but to rather investigate the causal relationship among the variables. EViews 7.0 is used as the statistical software packages for all the tests run in this study. All the econometrics results are available on request.

5. Empirical Results

Unit root tests were conducted to determine the order of integration of the data series for each of the variables. Table 3A & 3B shows the ADF and PP statistics and corresponding critical values of all the variables respectively in their level and first differenced forms. Here, it is mentionable that, the inclusion of a time trend in unit root test often tends to affect the non-standard and non-normal asymptotic distribution of the test as it is an extraneous regressor which reduces the power of the test. However, excluding time trend may also result in a reduction in the power of test. This loss of

Tasnim & Amin

power from excluding a time trend is more severe than the reduction of power from including the time trend (Lopez et al, 2005).

Table 3A: Augmented Dickey Fuller (ADF) Unit Root Test

Panel 1: Levels - I(0)					
Variables	ADF Statistics (only constant)	Critical Value	ADF Statistics (constant and trend)	Critical Value	Decision
Electricity Generation	2.077069	-2.957110	8.522842	-3.552973	Non-stationary considering only constant and Stationary considering constant and trend.
Trade Openness	0.160422	-2.954021	-3.071565	-3.552973	Non-Stationary
FDI	1.533212	-2.986225	1.684695	-3.603202	Non-Stationary
GDP	5.132169	-2.954021	1.673125	-3.552973	Stationary considering only constant and non-stationary considering constant and trend
Panel 2: First Difference - I(1)					
Variables	ADF Statistics (only constant)	Critical Value	ADF Statistics (constant and trend)	Critical Value	Decision
Electricity Generation	2.228201	-2.957110	1.152553	-3.557759	Non-stationary
Trade Openness	-3.381454	-2.991878	-4.314654	-3.612199	Stationary
FDI	0.859327	-2.981038	-1.068373	-3.595026	Non-Stationary
GDP	-2.453794	-2.957110	-4.246474	-3.557759	Stationary considering constant and trend.
Note: All regression is estimated with and without trend. Selection of the lag is based on Schwartz Information Criterion (SIC). EViews 7.0 software automatically selects the most significant lag length based on this criterion.					

Tasnim & Amin

Table 3B: Phillips-Perron (PP) Unit Root Test

Panel 1: Levels - I(0)					
Variables	PP Statistics (only constant)	Critical Value (5%)	ADF Statistics (constant and trend)	Critical Value (5%)	Decision
FDI	4.498	-2.954	0.652	-3.553	Stationary using only constant.
Panel 2: First Difference - I(1)					
Variables	ADF Statistics (only constant)	Critical Value (5%)	ADF Statistics (constant and trend)	Critical Value (5%)	Decision
FDI	-4.774	-2.957	-5.656	-3.578	Stationary using both constant and constant and trend

The variables are made stationary in their level or first differenced form. These results allow us to proceed to check the co-integration among the variables. The relationship between dependent variable (ELECG) and the independent variables (OPEN, FDI and GDP) is observed by using the Johansen Co-integration test. Results of Johansen test for co-integration are reported in table 4.

Table 4: Model 1- Johansen Test for Co-integration (Trace Test)

Null	Alternative	Trace Statistic	95% Critical Value	Critical	Conclusion
r = 0	r = 1	62.77885	47.85613		2 co-integrating relationship at the 0.05 level.
r <=1	r = 2	35.07232	29.79707		
Model: 2 - Johansen Test for Co-integration (Maximum Eigenvalue Test)					
Null	Alternative	Max-Eigen Statistic	95% Critical Value	Critical	Conclusion
r=0	r=1	27.70652	27.58434		2 co-integrating relationship at the 0.05 level
r<=1	r=2	23.91789	21.13162		

The results from both the trace test and the Maximum Eigenvalue test indicate that two co-integrating relationships exist at 95% significance level among the variables ELECG,

Tasnim & Amin

OPEN, FDI and GDP. The existence of co-integrating vector implies that there is a significant long run relationship among these variables.

The Granger causality test has been done with specific lag period and the results are reported in table 6. Lag length has been chosen by using Schwarz Information Criterion (SIC). The results show that there are three unidirectional causal relationships running from electricity generation to trade openness, electricity generation to FDI and, GDP to FDI. There are also evidences of bidirectional causality between electricity generation and GDP and, between trade openness and GDP. However, no causality is found between FDI and trade openness.

The results of causality test for lag 2 are shown in the following table.

Table 5: Granger Causality Tests (LAG 2)

Null	F-Statistic	P-Value	Conclusion
OPEN does not Granger Cause ELECG ELECG does not Granger Cause OPEN	0.80394 9.16296	0.4580 0.0009	Unidirectional Causality ELECG → OPEN
FDI does not Granger Cause ELECG ELECG does not Granger Cause FDI	2.20090 13.4303	0.1302 0.00009	Unidirectional Causality ELECG → FDI
GDP does not Granger Cause ELECG ELECG does not Granger Cause GDP	4.98441 4.91419	0.0144 0.0151	Bidirectional Causality ELECG ↔ GDP
FDI does not Granger Cause OPEN OPEN does not Granger Cause FDI	1.33935 1.86252	0.2789 0.1747	No Causality between FDI and OPEN
GDP does not Granger Cause OPEN OPEN does not Granger Cause GDP	2.73589 2.62941	0.0828 0.0905	Bidirectional causality GDP ↔ OPEN
GDP does not Granger Cause FDI FDI does not Granger Cause GDP	2.87257 0.76254	0.0739 0.4763	Unidirectional Causality GDP → FDI

The bidirectional causality between electricity generation and GDP indicates energy oriented economy in Bangladesh. Bidirectional causality between GDP and trade

Tasnim & Amin

openness means that higher economic growth escalates the trade-GDP ratio while trade openness positively affects economic growth. The results show that GDP granger causes FDI. So higher growth is also needed for high level of FDI inflow.

The findings of this study are in contrast to the findings from studies such as Sarker and Alam (2010) where they find no long run relationship between electricity generation and GDP in Bangladesh. This contradiction may be due to the inclusion of FDI and trade openness in the model. This study proceeds holding three sets of hypotheses concerning the long run relationship between, (i) electricity generation and GDP, (ii) trade openness and GDP and, (iii) FDI and GDP. All three of the hypotheses are found accepted from the Johansen test results where we find long run co-integrating relationship between the said variables.

According to the research question mentioned in the Introduction section, this paper aims to determine the causal relationship between electricity generation, trade openness, output and FDI in Bangladesh. The causality test results answer this research question by implying that there is unidirectional causality between electricity generation and trade openness, electricity generation and FDI, and between GDP and FDI. Moreover, bidirectional causality exists between electricity generation and output, and between trade openness and output. However, no causality has been found between trade openness and foreign direct investment which contradicts with existing literature where positive relationship is depicted between the variables (Liargovas and Skandalis, 2011), (Seyoum et al., 2013), (Dritsaki et al., 2004). Very few studies have been done on the nexus between trade openness and foreign direct investment in Bangladesh and the existing literatures are mostly in the context of middle income countries. It should be taken into account that the FDI net inflow in Bangladesh is upgrading very recently and due to various factors such as, political turmoil, tragic incidents in ready-made garment industries often discouraged foreign investors to invest in Bangladesh which caused the frequent fluctuations in the trend of FDI net inflow in the past years. On the other hand, the trade-GDP ratio has been rapidly increasing since the post liberalization period. So we can conclude that, the reason our finding i.e. there is no causality between trade openness and FDI in Bangladesh contradicts with the existing literature may be attributed to the fact that, other than FDI, there are some other major economic indicators that affect trade openness more than FDI in Bangladesh.

6. Conclusion

Our paper attempts to empirically analyze the dynamic relationships between electricity generation, trade openness, Foreign Direct Investment and output in Bangladesh over the period 1980-2013. Electricity is an immutable part of energy economics which links growth with trade openness of economy and Foreign Direct Investment inflows. Hence, the objective of our study is to investigate the causal relationship among these economic indicators for advanced policy implication. However, there are some limitations that need to be addressed in this paper. There are some other economic indicators that could have been used for more accurate results such as inflation.

Tasnim & Amin

However, due to unavailability of data, we could not take such indicators into consideration.

The findings of this study provide a proper answer to the research question on the existence and direction of causality among the variables used in this study. These findings that show causal relationship among the variables make this study different from previous research. The findings show causal relationship between variables which are different in their nature and direction from the relationships found in previous studies. Previous studies show unidirectional causality between electricity generation and GDP whereas our study has found bidirectional causality between these variables. Besides, only a few studies considered generation of electricity in their study while most of the studies considered consumption of electricity. As a result, some fluctuations can be noted between the findings of this study and that of the previous studies.

Existing literature, to the best of our knowledge, has failed to show the nexus between trade openness, electricity generation, foreign direct investment and GDP in the context of Bangladesh. The findings from our study contribute to the literature by filling this gap through showing the direction of causality between each of these variables and recommending important policy implications.

As a policy implication, Government should implement energy growth policies regarding electricity generation. In the past few years, Government of Bangladesh has invested largely in various power projects including the first nuclear power plant of the country at Rooppur. Diversification of electricity generation sources with special focus on renewable energy sources may be helpful. According to our study, any form of energy restriction may harm the economy. An important policy implication based on the general result of the study is to regulate the flow of trade and expansion in economic growth. In addition, trade liberalization of growing economic sectors can be an effective policy recommendation.

The main limitations of our study is that very few empirical literatures exist in the context of Bangladesh which are related to our paper. Also, we have used only time series data in our paper and our sample size was small due to unavailability of data of electricity generation. Recommendation for further research would be to combine the renewable and non-renewable sources of energy and examine their impact on economic growth. It can also include other relevant variables such as pollution emission, employment or urbanization. Further research could also be done in the context of South Asian countries for appropriate policy implication.

References

Acaravci, A., Erdogan, S. & Akalin, G., 2015, The Electricity Consumption, Real Income, Trade Openness and Foreign Direct Investment: The Empirical Evidence from Turkey. *International Journal of Energy Economics and Policy*, Vol. 5, No. 4, Pp. 1050-1057.

Tasnim & Amin

- Ahmed, S., Islam, T., Karim, A. & Karim, N. M., 2014, Exploitation of Renewable Energy for Sustainable Development and Overcoming Power Crisis in Bangladesh, *Renewable Energy*, Vol. 72, No. 3, Pp. 223-235.
- Alfaro, L., Chanda, A., Kalem-Ozcan, S. & Sayek, S., 2010, How does Foreign Direct Investment promote growth? Exploring the effects of financial markets on linkages, *Journal of Development Economics*, Vol. 91, No. 2, Pp. 242-256.
- Altintas, H., Kum, M., 2013, Multivariate Granger Causality between Electricity Generation, Exports, Prices and Economic Growth in Turkey, *International Journal of Energy Economics and Policy*, Vol. 3, Pp. 41-51.
- Amin, S.B., 2007, The Relationship between Foreign Direct Investment (FDI) and Economic Growth in Bangladesh: An Empirical Analysis, *Bank Parikrama*, Vol. XXXII, No. 1, 2, 3 & 4, Pp. 14-31.
- Amin, SB, 2011, 'Quantity Theory of Money and its Applicability: The Case of Bangladesh', *World Review of Business Research*, Vol.1, No. 4, Pp.33-43.
- Amin, S.B., Anoor, Q.S.Z., Khandker, L.L., & Nakagawa, H., 2016, 'The Impact of Electrification on Economic Development: An Empirical Analysis of Bangladesh', *Global Review of Accounting and Finance*, Vol.7, No.2, Pp.15-31.
- Awad, A. & Yossof, I., 2016, Electricity Production, Economic Growth and Employment Nexus in Sudan: A Cointegration Approach. *International Journal of Energy Economics and Policy*, Vol. 6, No. 1, Pp. 6-13.
- BBS, 2016, *Statistical Yearbook of Bangladesh 2015*, Bangladesh Bureau of Statistics, Dhaka.
- Bekhet, H. A. & Othman, N. S. B., 2011, Causality analysis among electricity consumption, consumer expenditure, gross domestic product (GDP) and foreign direct investment (FDI): Case study of Malaysia, *Journal of Economics and International Finance*, Vol. 3, No. 4, Pp. 228-235.
- Bekhet, H. A. & Othman, N.S.B., 2014, Long-Run Elasticities of Electricity Consumption, FDI, Export and GDP in Malaysia. *International Journal of Economics and Finance*, Vol. 6, No. 8, Pp. 78-86.
- BPDB, 2016, *Annual Report 2014-2015*, Bangladesh Power Development Board Limited, Dhaka.
- Constant, N. B. Z. S. & Yaoxing, Y., 2010, The Relationship between Foreign Direct Investment, Trade Openness and Growth in Cote d'Ivoire, *International Journal of Business and Management*, Vol. 5, No. 7, Pp. 99-107.
- Engle, R.F. & Granger, C.W.J., 1987, Co-Integration and Error Correction: Representation, Estimation, and Testing, *Econometrica*, Vol. 55, No. 2, Pp. 251-276
- Hossain, S., 2012, Multivariate Granger Causality between Economic Growth, Electricity Consumption, Exports and Remittance for the Panel of Three SAARC Countries. *Global Journal of Management and Business Research*, Vol. 12, No. 4, Pp. 41-54.
- Kraft, J. & Kraft, A., 1978, On the relationship between energy and GNP, *Journal of Energy and Development*, Vol. 3, No. 2, Pp. 401-403.
- Lean, H. H. & Smyth, R., 2014, Electricity Consumption, Output, and Trade in Bhutan. *ADB South Asia Working Paper Series*, No. 34, Pp. 01-19, viewed 25 September 2018, <<https://www.adb.org/sites/default/files/publication/152765/south-asia-wp-034.pdf>>

Tasnim & Amin

- Masduzzaman, M., 2012, Electricity Consumption and Economic Growth in Bangladesh: Co-integration and Causality Analysis, *Global Journal of Management and Business Research*, Vol. 12, No. 11, pp. 47-56.
- Sarker, A. R. & Alam, K., 2010, Nexus between Electricity Generation and Economic Growth in Bangladesh, *Asian Social Science*, Vol. 6, No. 12, Pp. 16-20.
- Shakeel, M., Iqbal, M. M. & Majeed, M. T., 2014, Energy Consumption, Trade and GDP: A Case Study of South Asian Countries, *The Pakistan Development Review*, Vol. 53, No. 04, Pp. 461-476.
- Siddique, A. & Majeed, M. T., 2015, Energy Consumption, Economic Growth, Trade and Financial Development Nexus in South Asia. *Pakistan Journal of Commerce and Social Sciences*, Vol. 9, No. 2, Pp. 658-682.
- World Bank, 2016, *World Development Indicators 2016*, World Bank Group, Washington DC, USA.