

An Empirical Investigation of Globalization and Energy Consumption: Evidence from Bangladesh

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Globalization is referred to as a medium of the integration of national economies across the world whereby markets of different origins integrate and operate into a single market. Liberalization policies, particularly with respect to international trade, are believed to attribute to the globalization drives between nations. In addition, globalization has empirically been associated with the global energy market development which is a pre-requisite for development of economies across the globe. Therefore, the aim of this study is to empirically analyse the impacts of globalization on Bangladesh's energy consumption. To the best of knowledge there is no previous study addressing the effects of globalization on energy consumption in the context of Bangladesh. The study encompasses relevant data for a period of 36 years ranging from 1980 to 2015. As part of the methodology, the data set was tested using Johansen Cointegration test, Granger Causality test and vector error-correction model approach. The results reveal that there are long run unidirectional causalities running from energy consumption and globalization to economic growth. However, no long run causal association was found to be running from globalization and energy consumption in Bangladesh. This could be because of the existence of price distortions in the energy market in Bangladesh whereby the economies to engaging in the globalization processes could not boost the per capita energy consumption in the country.

Field of Research: Economics

1. Introduction

The term Globalization has been in the lime light for ages as more and more economies and societies are integrating and operating within a common platform. Thus, globalization and its aftermath generating externalities, on both developing and developed economies, have been an important area of research for policy makers and economists worldwide. Globalization is a multidimensional concept with various socioeconomic and political implications to ponder on. In international economics terminology, globalization is viewed as integration of different economies across the globe through less-restrained bilateral and multilateral trade and financial flows (Ray 2012). In addition, globalization is also referred to as a medium of exchanging technology and promoting knowledge spillovers. However, globalization is not only confined to engagement in international trade, but it also facilitates cross-border labor

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movements which have macroeconomic implications as well. Moreover, the surge in financial flows, in the form of Foreign Direct Investments (FDIs), Official Development Assurances (ODA), Portfolio Investments (PIs) and so on, can also be associated to globalization (Baylis *et al.* 2017; Gumus 2015; Vongpraseuth and Choi 2015). Thus, it can be referred to as a source of finance for developing countries in particular those are unable to finance the necessary investments required for the development of their respective economies. Following this notion, globalization is believed to be a cornerstone in designing policies to achieve the United Nations' Sustainable Development Goals (SDGs) across the globe (Lempert 2017; Otobe 2016; Parra *et al.* 2015). Globalization, at present, is viewed as one of the utmost important prerequisites of SDG attainment which provides substantial motivation for analysing the effects of rapid globalization, especially from the perspective of the Least Developing Countries (LDCs) like Bangladesh.

Economic openness is believed to foster the globalization drives of economies that were historically classified as closed economies (Capello and Perucca 2015). As an economy gradually opens up mainly through liberalization of its trade barriers, it is presumed to internalize the economies of being integrated with other economies whereby exchange of goods, services, technology and knowledge is likely to put the economies involved in a win-win situation as compared to the pre-globalization phase. The world, with time, has progressively become more open to economic integrations which can be understood from the exponential rise in the global trade volumes. According to the World Trade Organization (WTO), world trade has increased by a staggering 2.8% between the fiscal years 2005 and 2017 and it is expected to rise by 3.6% by the end of the fiscal year 2017 (World Trade Organization, 2016).

The significance of investigating the globalization impacts on any economy is of paramount importance for a LDC like Bangladesh simply because of the fact that it can be related to attainment of energy security within these countries that are characterized by energy shortages which account for low Energy Consumption (EC) per capita. For instance, Bangladesh has had the illustrious history of not being self-sufficient in electricity generation whereby the difference between the electricity demand and supply has grown steadily with time (Amin and Murshed 2017; Islam 2017; Alamet *et al.* 2012). It is believed that globalization in the form of cross-border energy trade can help the nation to boost its energy supply and overcome the deficit it has been facing for prolonged period of time (Amin and Murshed 2016). Globalization is referred to as one of the means through which the energy sector of Bangladesh can be developed which in turn would also exert other positive externalities on the overall macroeconomic indicators of the nation. The existing energy generation scenario in Bangladesh is rather gloomy particularly due to the hefty reliance of energy sector on the indigenous natural gas reserve. However, the nation is currently at stake of running out of its natural gas reserves in the next couple of decades resulting in acute shortage of natural gas, which justifiably calls for immediate development of the nation's energy sector. It is believed that Bangladesh should ideally look forward to diversify its energy resource uses for which globalization can play an effective role (Amin, Murshed and Jannat 2017). The nation is better-off importing relatively less costly energy resources which would not only raise its energy supply but would also keep a check on the fiscal burdens

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associated with fuel imports as well. Thus, globalization is inextricably linked to attainment of the energy security in Bangladesh which could ultimately play a major role in boosting the level of EC in the country.

Although, there has been a plethora of studies engulfing the globalization-energy sector development nexus across the globe, not many studies have pressed this issue in the case of Bangladesh. Bangladesh is a prime country of choice for such investigations since the country not only experiences energy constraints but its per capita EC is also relatively lower than that of its counterparts. Thus, this paper aims to bridge this gap in literature by probing into the globalization-EC nexus specifically in the context of Bangladesh. In addition, the paper also looks forward to shed light on the effects of Economic Growth (EG) on EC as well. This paper precisely targets to find answers to the questions adhering to the effectiveness of Bangladesh's decision to be a more globalized economy with time linking it to the development of its energy sector and EC. Thus, the following questions are addressed in this paper:

- a) Is there any evidence of long run associations between globalization, EC and EG in Bangladesh?
- b) What are the directions of causalities running between these three macroeconomic indicators both in the short-run and the long-run?

The remainder of the paper is as follows. The section 2 provides overviews of the globalization trends and the energy sector scenarios in Bangladesh which is followed by the review of literature in section 3. Specification of the empirical model and corresponding data used in this paper are given in section 4. Sections 5 and 6 respectively portray the different methodologies used and reports the results obtained from the empirical investigations. Finally, the conclusions in light of the estimated findings are opined in section 7.

2. An Overview of the Globalization and Energy Sector Scenario

The paper focuses on the international economics aspects of globalization with the notion that as developing country like Bangladesh gradually opens up, foreign currencies are expected to flow in to the economy while trade volumes are likely to go up simultaneously. Table 1 provides statistical data regarding key globalization indicators in the context of Bangladesh. According to the figures displayed in the table, the openness index in Bangladesh has almost doubled from 23.38 to 44.51 between 1980 and 2015. This implies that the country has gradually liberalized its trade operations and has also facilitated inflow of foreign currencies over the last three and half decades. Both exports and imports have projected upward trends growing at a rate of 31.94% and 12.60% on average between 1980 and 2015. Simultaneously, the volumes of foreign currency inflows in the form of Foreign Direct Investment (FDI) and Foreign Aid (FAID) increased from 0.85 million US\$ to 2.65 billion US\$ and from 1.29 billion US\$ to 2.42 billion US\$ between 1980 and 2015. In addition, globalization over the years has led to outward labor migration resulting in an increase in remittances by almost 44% in the last three and half decades.

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Table 1: Some Important Indicators of Globalization in Bangladesh

Year	Openness (index)	Exports (US\$)	Imports (US\$)	FDI (US\$)	FAID (US\$)	REMIT (US\$)
1980	23.38	996555891.5	3243617765	8510000	1286720000	338666748.1
1985	18.22	1199576923	2860038462	(6660000)	1126530000	502471374.5
1990	18.97	1866930005	4126170021	3238781	2092760000	778865600.6
1995	29.32	4122014847	6580596891	1896373	1281740000	1201664307.1
2000	34.40	6588073942	9060862652	280384630	1172840000	1967528809.3
2005	37.80	9994813008	13891430894	760504266	1318850000	4642385284.2
2010	42.09	18472449276	25106319011	1232258247	1403930000	10850211617.4
2015	44.51	32830360072	44128009984	2539190940	2417990000	14982837635.3

Source: World Development Indicators, 2016.

Note: FAID refers to Net Official Development Assistances Received. Openness is measured in terms of indices while all the variables are measured in terms of current US\$.

The energy market of Bangladesh, in accordance to that of almost all developing nations across the globe, is not that much developed as it would have liked. As a result, the country despite raising generation capacities over the years could not match it with actual generations due to several constraints. The country has faced energy crises mainly due to being mono-fuel dependent, particularly relying heavily on its indigenous natural gas supply. Access to energy has become essential to the functioning of modern economies and the government of Bangladesh has been putting its best efforts to develop the indigenous energy resources, which ultimately plays a vital role in the socio-economic growth of the country. However, the overall energy use in the economy is very low which is evident from a report by the US Energy Information Administration (2015), in which the total energy use in Bangladesh in 2012 was merely 0.20% of world EC. Moreover, the per capita energy use in the country is also quite low when compared to other peer developing countries. According to the figures shown in Table 2, the per capita energy use in Bangladesh was around 212.52 kg of oil equivalent in 2013 which was lower than the neighbouring South Asian nations like India, Nepal, Pakistan and Sri Lanka.

Table 2: Per Capita Energy Use in Different Countries

Countries	Energy Use Per Capita (kg of oil equivalent) as in 2013
Bangladesh	215.52
India	606.05
Nepal	369.68
Pakistan	474.86
Sri Lanka	487.52
South Asia	672.64
Sub-Saharan Africa	488.06
Lower Middle Income	744.60
Middle Income	2008.50
World	3104.38

Source: World Development Indicators (WDI), 2016.

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Electricity is the widely used form of energy used in the country. At present, the country is dependent on its natural gas and imported oils for the electricity generation purposes. However, following the acute shortage of natural gas and high fiscal burdens arising from the costly oil imports have restrained the nation from matching its electricity generation capacity. As a result, electricity supply has always lagged behind its demand hampering the EG process in Bangladesh. Table 3 shows a picture of the electricity sector scenario in Bangladesh.

Table 3: Electricity Sector Scenario in Bangladesh

Parameters (units)	Year 2013/14	Year 2014/15
Installed Capacity (MW)	10416	11534
Derated Capacity (MW)	9821	10939
Maximum Demand (MW)	9268	10283
Maximum Peak Generation (MW)	7356	7817
Per capita Generation (kWh)	271	290
Per capita Consumption (kWh)	233	251
Total No. of Consumers (Nos.)	2901235	3157030
Maximum Load Shedding (MW)	932	307

Source: MoF (2016)

3. Review of Literature

The literature review section has been divided into two subsections. First of all, theoretical frameworks are provided to support the arguments regarding the economies of engagement in globalization drives on the overall economy and the energy sector as well. This is followed by empirical findings in which some of the previous papers on similar topics have been summarized.

3.1 Theoretical Framework

According to the National Income (NI) accounting procedure, the GDP (Y) of an economy is referred as a function of the aggregates of consumption expenditure (C), investment (I), government spending (G), and net exports (NX) which is shown in equation (i).

$$Y = C + I + G + NX \text{ ----- (i)}$$

The impact of globalization on the overall economy can be understood from this national income accounting equation. For instance, a more globalized economy can be viewed as a more open economy that is ready to engage in relatively large scale international trade. As a result, following a rise in the degree of economic openness through trade liberalization policies, the NX of the economy is expect to increase as well, provided the monetary value of exports exceeds that of imports. Hence, GDP is expected to grow simultaneously attributing to development of the economy.

Moreover, the impact of globalization can be associated to the energy sector of an economy as well. According to the economics conjecture, aggregate consumption within

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an economy can be termed as a function of its GDP, which can be acquired from equation (i). Thus the aggregate consumption (C) function is given in equation (ii):

$$C = f(Y) \text{ ----- (ii)}$$

The aggregate consumption expenditure can be disaggregated into EC and non-energy consumption expenditure. Thus, a rise in economic openness leading to a rise in the GDP can also stimulate a rise on the level of EC expenditure in the economy. Thus, the globalization-EC nexus can be explained by this theoretical reasoning.

3.2 Empirical Findings

There has been a plethora of previous studies inquiring the validity of globalization with respect to contributing to the overall EC in the economy. There has been ambiguity regarding the effects of globalization on EC which calls for further studies in this particular field of research.

In a study by Shahbaz *et al.* (2017), the causality between globalization and EC developed economies was analysed in country-specific time series and panel frameworks. The paper was based on data acquired from 1970 to 2014 in context of 25 developed nations across Asia, North America, Western Europe and Oceania. The authors used common correlated effects mean group estimator and the augmented mean group estimators to ascertain the long run heterogeneous elasticities between globalization, EC and EG. In light of the estimated results, the authors remarked that in most of the countries the consumption of energy resources was driven by globalization with the USA and the UK being the exceptions revealing a negative correlation between globalization and EC in these two countries. Moreover, the Emirmahmutoglu and Kose (2011) and the Dumitrescu and Hurlin (2012) Granger causality tests revealed evidence suggesting the fact that globalization was statistically significant in influencing EC.

Dogan and Deger (2016) reviewed the potential impacts of globalization and EG on EC in context of the BRICS-member nations. The authors pooled annual data from 2000 to 2012 and resorted to using panel cointegration analyses and Granger causality test to determine the causal correlation between EC and its two possible determinants within the BRICS region. The results advocated in favor of long run cointegrating relationships amongst these three indicators while the Granger causality results provided statistical significance with respect to two unidirectional causalities EC and globalization to EG without the feedback causations. The results failed to establish any form of long run causal association between globalization and EC.

Linking urbanization and trade openness to globalization, Shahbaz *et al.* (2015) examined their impacts on the Malaysian EC between 1970 and 2011. The authors used quarterly data to perform the Autoregressive Distributed Lag (ARDL) Bounds testing and Vector Error-Correction Model (VECM) Granger causality approaches to identify the causal relationships amongst the aforementioned macroeconomic variables. The authors used these econometric tools in context of a log-log model in which per capita EC was expressed as a function of per capita urbanization, real trade openness

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per capita, real GDP per capita and real capital use per capita. The results suggested that urbanization is a key factor that attributed to EC in Malaysia. Moreover, trade openness was found to Granger cause EG which in turn results in further rise in the EC per capita in the economy. A bidirectional causal association between trade openness and EC was also concluded in light of the results found in the paper.

A measure of the overall EC within the economy can be interpreted from its volume of carbon dioxide (CO₂) emissions. In line with this notion, Mutascu (2018) performed a time-frequency analysis of trade openness and CO₂ emissions in France. The annual dataset used in this study stemmed across 1960 and 2013 in order to wavelet tool. The findings from the analyses confirmed the neutrality hypothesis engulfing trade openness and CO₂ emissions in the short term. However, in the medium term, CO₂ emissions are found to be positively influence trade openness while in the long term, the relationship between these two variables is determined by the business cycle in France.

Apart from EC being driven by globalization, many researchers have also endeavored their time in investigating the impacts of EG on the overall EC. In a study by Sylvester *et al.*(2015), the linkage between EC and EG in Nigeria was examined using a Vector Autoregressive (VAR) analysis. The authors incorporated annual time series data from 1980 to 2011 in order to regress an energy augmented production function in which EG was expressed as a function of capital, labor and energy inputs. Moreover, Granger causality tools were also tapped to understand the causal associations between EG and EC in particular. The findings from the econometric analyses of the aforementioned dataset revealed a positive correlation between EC and EG in Nigeria while the Granger causality test results provided evidence regarding a bidirectional causal association between these variables. The results corroborated the conclusions made by Oyedepo (2012), Rosen (2009), Alam (2006) and Morimoto and Hope (2001).

Chandran *et al.* (2010) investigated the relationship between EC, in the form of electricity, and real GDP growth in Malaysia. The authors resorted to using annual data from 1971 to 2003 and employed the ARDL approach and Granger causality techniques to ascertain the long run relationships between consumption of electricity and EG in the Nigerian economy. The results found in the paper suggested a positive relationship between consumption of electricity and EG while a unidirectional long run causal association is also found to be running from electricity consumption to EG. In light of these findings, the authors referred Nigeria as an economy that is reliant on electricity supply for attainment of its growth.

A particular limitation of the aforementioned studies is in the manner that most of these are biased towards long run causality analyses using the Granger causality test method with little emphasis on the short run causal linkages. However, it is crucial to understand the short run dynamic relationships as well in order to get accustomed to the possible time period-specific disparities in the context of the causal associations between the macroeconomic variables. In contrast, this paper addresses both the short run and the long run causal associations between EC, globalization and EG in Bangladesh using the VECM and the Granger causality approaches respectively.

4. Empirical Model and Data Description

Our paper has employed a multivariate linear regression model in which EC is expressed as a function of globalization and EG in Bangladesh. The model is as follows:

$$OC_t = \beta_0 + \beta_1(OPEN)_t + \beta_2(GDP)_t + \varepsilon_t \text{-----} (iii)$$

Where the subscript t denotes the specific observation of the variables at a particular time (year). OC, OPEN and GDP denote oil consumption, economic openness and gross domestic product in context of Bangladesh. The data concerning all these three variables are compiled from several sources for the time period between 1980 and 2015. Oil consumption is used as a proxy for the EC variable in context of Bangladesh. It is measured in terms of thousand barrels per day on average and is compiled from British Petroleum Statistical Review of World Energy (2016). The economic openness index is used to denote the degree of globalization in Bangladesh. The greater the value of the openness index the more globalized the economy and vice-versa. Economic openness is basically used to capture the effects of trade liberalization within the Bangladesh economy, mainly with respect to influencing EC and attaining EG. Since there is no specific data for economic openness it is proxied by the trade openness index which is measured as the sum of total imports and exports as a function of the GDP of Bangladesh. The corresponding data for the economic openness index calculation is retrieved from World Development Indicators(2016). Finally, GDP is used as an indicator of EG in Bangladesh and is measured in terms of current US dollars. Data for gross domestic product is also acquired from World Development Indicators(2016).

5. Methodology

5.1 Augmented Dickey Fuller Test for Stationarity

At first, data of all the variables were tested for unit root in order to check the stationarity of the variables that were considered in this study. The authors used the Augmented Dickey Fuller (ADF) stationarity test to detect possible existence of unit roots in the data set. Testing time series data for stationarity is a prerequisite for moving forward since presence of unit roots would lead to the regression being spurious unless there is the existence of at least one cointegrating relationship. The variables should ideally be stationary at either at their levels, $I(0)$, or at their first difference forms, $I(1)$. Once the variables are found to be stationary, cointegration test is to be followed.

5.2 Johansen Test of Cointegration

The Johansen (1991) procedure is applied to test for cointegration, which is known to provide a unified framework for estimation and testing of cointegration relations in the context of VAR error correction models. It basically tells us whether or not the variables are associated in the long run. The authors estimate an Unrestricted Vector of Autocorrelation of the following form for this purpose:

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$$\Delta x_t = \alpha + \theta_1 \Delta x_{t-1} + \theta_2 \Delta x_{t-2} + \theta_3 \Delta x_{t-3} + \dots + \theta_{k-1} \Delta x_{t-k+1} + \theta_k \Delta x_{t-k} + u_t \quad \text{----- (iv)}$$

where Δ is the difference operator; x_t is a $(n \times 1)$ vector of non-stationary variables (in levels); and U_t is the $(n \times 1)$ vector of random errors. The matrix θ_k contains the information on long run relationship between variables, for instance, if the rank of $\theta_k = 0$, the variables are not cointegrated. On the other hand if rank (usually denoted by r) is equal to 1, there exists one cointegrating vector and finally if $1 < r < n$, there are multiple cointegrating vectors. Johansen (1991) derive two tests for cointegration, namely the trace test and the maximum Eigenvalue test. The trace statistic test evaluates the null hypothesis that there are at most 'r' cointegrating vectors whereas the maximal Eigenvalue test, evaluates the null hypothesis that there are exactly r cointegrating vectors in x_t . According to cointegration analysis, when two variables are cointegrated then there exist at least one direction of causality.

5.3 Granger Causality Test

According to cointegration analysis, when two variables are cointegrated then there exist at least one direction of causality. Granger-causality, introduced by Granger (1969, 1980, 1988), is one of the important matters that has been much studied in empirical macroeconomics and empirical finance. The presence of non stationarity can lead to ambiguous or misleading conclusions in the Granger causality tests (Engel and Granger, 1987). Only when the variables are cointegrated, it is possible to deduce that a long run relationship exists between the non-stationary time series. When we take y and x as the variables of interest, then the Granger causality test (Granger, 1969) determines whether past values of y add to the explanation of current values of x as provided by information in past values of x itself. If previous changes in y do not help explain current changes in x , then y does not Granger cause x . In a similar way, we can examine if x Granger causes y just by interchanging them and carrying out this process again. There could be four probable outcomes: (i) x Granger causes y (ii) y Granger causes (iii) Both x and y granger causes the other and (iv) neither of the variables Granger causes the other. In this paper, the causality tests among all the concerned variables are conducted. For this the following set of equations are estimated:

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \dots + \alpha_l x_{t-l} + \beta_1 y_{t-1} + \dots + \beta_l y_{t-l} + u_t \quad \text{----- (v)}$$

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \dots + \alpha_l y_{t-l} + \beta_1 x_{t-1} + \dots + \beta_l x_{t-l} + v_t \quad \text{-----(vi)}$$

We consider the above set of equations for all possible pairs of (x, y) series in the group. The reported F-statistics are the Wald statistics for the joint hypothesis.

5.4 Vector Error-Correction Model (VECM) Approach

Engle and Granger (1987) showed that a vector error correction model (VECM) is an appropriate method to model the long-run as well as short-run dynamics among the cointegrated variables. Causality inferences in the multi-variate framework are made by estimating the parameters of the following VECM equations.

$$\Delta Y = \alpha + \sum_{i=1}^m \beta_i \Delta Y_{t-i} + \sum_{j=1}^n \gamma_j \Delta X_{t-j} + \sum_{k=1}^0 \delta \Delta M^s + \sum_{l=1}^p \zeta \Delta N + \theta Z_{t-1} + \varepsilon_t \text{ -----(vii)}$$

$$\Delta X = a + \sum_{i=1}^m b_i \Delta Y + \sum_{j=1}^n c_j \Delta X_{t-j} + \sum_{k=1}^0 d \Delta M^s + \sum_{l=1}^p e \Delta N + f Z_{t-1} + \xi_t \text{ ----- (viii)}$$

z_{t-1} is the error-correction term which is the lagged residual series of the cointegrating vector. The error-correction term measures the deviations of the series from the long run equilibrium relation. For example, from equation (vii), the null hypothesis that X does not Granger-cause Y is rejected if the set of estimated coefficients on the lagged values of X is jointly significant. Furthermore, in those instances where X appears in the cointegrating relationship, the hypothesis is also supported if the coefficient of the lagged error-correction term is significant. Changes in an independent variable may be interpreted as representing the short run causal impact while the error-correction term provides the adjustment of Y and X toward their respective long run equilibrium. Thus, the VECM representation allows the authors to differentiate between the short- and long-run dynamic relationships. The Chi-Square test statistic is used to determine the short run causalities between pairs of variables in the model.

The authors resorted to use of the EViews 7.1 software for carrying out all econometric tests in this paper.

6. Results and Discussions

The results from the ADF test confirms that all the variables are stationary at their first differenced levels, I(1). Thus, the possibility of the regression being spurious is nullified following the presence of stationarity of the data set. Results from the ADF test are provided in Table 4.

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Table 4: Augmented Dickey Fuller (ADF) Test Results (Lag=9)

Variable	ADF Statistic ^a	Critical Value (95% level)	ADF Statistic ^a	Critical Value (95% level)	Decision on Stationarity
Level I (0)					
OC	-0.004	-2.948	-2.384	-3.544	Non-Stationary considering both constant and constant and trend
OPEN	1.686	-2.981	-3.160	-3.595	Non-Stationary considering both constant and constant and trend
GDP	-0.712	-2.951	-2.471	-3.548	Non-Stationary considering both constant and constant and trend
First Difference I (1)					
OC	-5.561	-2.951	-5.567	-3.548	Stationary considering both constant and constant and trend
OPEN	-2.330	-2.986	-4.774	-3.595	Stationary considering constant and trend
GDP	10.369	-2.948	-5.493	-3.544	Stationary considering both constant and constant and trend

Notes: a. ADF statistic considering only constant; b. ADF statistic considering constant and trend. All regressions are estimated with and without trend. Selection of the lag is based on Schwartz Information Criterion (SIC). EViews 7.1 software automatically selects the most significant lag length based on this criterion.

The Johansen Cointegration test results show that there is presence of at least one cointegrating equation in the model. Thus, the variables are found to be associated in the long run which answers the research question addressed in this paper and also fulfills the prerequisite for proceeding to the Granger causality tests. Results from the Johansen cointegration test are given in Table 5.

Table 5: Johansen Cointegration Test Results (Lag = 2)

Johansen Test of Cointegration (Trace Test)				
Null	Alternative	Trace Statistic	95% Critical Value	Conclusion
r = 0	r = 1	30.975	29.797	1 cointegrating equation
r <= 1	r = 2	5.898	15.495	
r <= 2	r = 3	0.750	3.841	
Johansen Test of Cointegration (Maximum Eigen Value Test)				
Null	Alternative	Max-Eigen Statistic	95% Critical Value	Conclusion
r = 0	r = 1	25.077	21.132	1 cointegrating equation
r <= 1	r = 2	5.148	14.265	
r <= 2	r = 3	0.750	3.841	

Notes: Selection of the lag is based on Schwartz Information Criterion (SIC). EViews 7.1 software automatically selects the most significant lag length based on this criterion.

The estimated results from the Granger causality test suggest that EG in Bangladesh is influenced by both globalization and EC in the long run. This can be concluded from the figures presented in Table 6, where unidirectional causalities are found to be running from OC and OPEN to GDP which is pretty much in line with the conclusions made by Dogan and Deger (2016) in the context of a panel of BRICS nations. Thus, these findings imply that the growth hypothesis explaining the EC-EG nexus is proven to be valid in context of Bangladesh. Moreover, the results are also in line with the conventional economics conjecture that advocates in favour of greater globalization in order to boost EG. However, no causal association is observed between OPEN and OC

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which implies that EC in Bangladesh is not affected by the nation's degree of globalization in the long run suggesting the existence of the neutrality hypothesis.

Table 6: Granger Causality Test Results (Lag=2)

Null Hypothesis	F Statistic	P-Value	Conclusions
OPEN does not Granger cause OC OC does not Granger cause OPEN	1.577 0.526	0.224 0.597	No Causality
GDP does not Granger cause OC OC does not Granger cause GDP	1.512 2.537	0.237 0.097	Unidirectional Causality running from OC to GDP
GDP does not Granger cause OPEN OPEN does not Granger cause GDP	0.379 3.543	0.688 0.042	Unidirectional Causality running from OPEN to GDP

Notes: Selection of the lag is based on Schwartz Information Criterion (SIC). EViews 7.1 software automatically selects the most significant lag length based on this criterion.

The results from the VECM approach are given in Table 7. According to the results, globalization is found to be unrelated to EC in the short run as no causal relationship was found between OPEN and OC. This finding corroborates to the views expressed in the paper by Mutascu (2018) in the context of France. A possible reasoning behind the ineffectiveness of globalization in influencing EC in the short run could be due to the fact that the inflow of foreign funds following globalization engagements of the nation could not be incorporated into the projects aimed at developing Bangladesh's energy sector. Conversely, the foreign funds could be well have been invested in the non-energy sectors since the results confirm that globalization is effective in influencing EG in the short run as visible from the statistical evidence suggesting a unidirectional causality running from OPEN to GDP. Furthermore, these results also point out that the growth hypothesis, although proven to be valid in the long run, does not hold in the short run as no causality is found between OC and GDP. This implies that EC is subject to time lags for it to be translated into EG in Bangladesh.

Table 7: VECM Test Results (Lag = 2)

Dependent Variable	Null Hypothesis	Chi-Square Statistic	Prob. Value	Conclusions
Causality Test Statistics between OC and OPEN				
OC	OPEN does not cause OC	1.812	0.404	No Causality
OPEN	OC does not cause OPEN	1.226	0.542	
Causality Test Statistics between OC and GDP				
OC	GDP does not cause OC	0.121	0.941	No Causality
GDP	OC does not cause GDP	1.536	0.464	
Causality Test Statistics between OPEN and GDP				
OPEN	GDP does not cause OPEN	0.943	0.624	Unidirectional Causality running from OPEN to GDP
GDP	OPEN does not cause GDP	14.099	0.001	

Notes: Selection of the lag is based on Schwartz Information Criterion (SIC). EViews 7.1 software automatically selects the most significant lag length based on this criterion.

7. Conclusions

Globalization is an important tool when it comes to attainment of macroeconomic and social welfare in the LDCs in particular. Thus, it is of paramount significance to investigate, both theoretically and empirically, the impacts of globalization on key macroeconomic indicators in the LDCs like Bangladesh that have the prospects of rapid

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development. Moreover, the prolonged energy crisis in Bangladesh also provides motivation for analyzing the impacts of globalization on energy generation and EC in the country. Thus, the focal point of this paper was set to empirically examine the cointegrating and causal relationships between globalization, EC and EG in Bangladesh. The results obtained from this empirical examination are pretty much in line with the theoretical concept of globalization leading to EG in Bangladesh. In addition, the growth hypothesis was found to be valid whereby EC was referred to be a determinant of EG as well. However, in contradiction to the a priori anticipations regarding the positive impact of globalization on EC in Bangladesh, the results suggest no causal associations between these two particular macroeconomic variables. This finding is extremely crucial from the perspective of policymaking since the underdeveloped energy market of Bangladesh could act as a barrier towards the attainment of the SDGs in the country. A possible reason behind these findings could be the fact energy price distortions exists in Bangladesh whereby the economies to engaging in the globalization processes could not boost the per capita EC in the country. In addition, the non-energy sectors of the economy could well have been the direct beneficiaries of such globalization in Bangladesh providing support to the absence of causal association between EC and globalization.

Bangladesh, in pursuit of the SDG attainment, can ideally leave no stones unturned in reallocating the economies of globalization towards development of its energy sector in future. The finding of this paper can be a cornerstone with regard to developing crucial policies aimed at resolving the existing inefficiencies within the energy sector of Bangladesh. For instance, lack of competition is a concerning phenomenon within the energy sector of the country. Following the dominance of the state owned energy generation entities with minimal involvement of the private sector, enhancement in the degree of globalization through greater economic openness could induce FDI inflows into the economy of Bangladesh generating private investments in power generations projects. This would not only increase competition within the sector, correcting the existing energy price distortions, but would also increase energy supply mitigating the energy deficit in the country. Provided the energy price distortionary factors are taken care off, globalization is expected to contribute to energy production within the country and thereby enhance the level of EC as well. In addition, globalization can also play a pivotal role in tackling the lack of skill development within the energy sector that has been upholding discovery of new gas fields and extraction of indigenous coal reserve in Bangladesh. Through greater economic openness, Bangladesh can easily employ foreign technology and thereby allowing foreign firms to come and operate in the energy sector of the country.

A major limitation of this study has been the unavailability of relevant data which restrained the authors from considering more controlled variables. As part of future scope of research, the authors would like to analyse the causal association between globalization and EC in context of a panel of Asian countries which would help to enhance the robustness of the results. Moreover, the authors would also like to disaggregate the period of research and perform cross-sectional studies in order to capture the effects of intertemporal shocks.

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