The Causal Relationship between Per Capita Electricity Consumption and GDP Growth: A Study of Bangladesh

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Abstract: *This paper tries to investigate the relationship between GDP growth, and per capita electricity consumption of Bangladesh through correlation coefficient analysis and graphical explanation over the period 1981 to 2016. Using correlation coefficient analysis and graphical explanation it is found that these tow variables are integrated to each other that means if one of these two variables value is changed then its effect on the calculated correlation coefficient value. All these values is collected from world-bank, data bank, from world development indicator. Like many other developing countries in the world, the electricity demand and its uses in Bangladesh has been increasing day by day at a high rate. This demand is charged by the sustained growth in GDP in early years.*
Keywords: GDP growth, energy consumption, correlation coefficient, Bangladesh.

I. Introduction

Electrical power provides a low entropy form of energy and can be carried long distances and converted into other forms of energy such as motion, light or heat with high energy efficiency. On the demand side, energy is one of the products a consumer decides to buy to maximize his utility. On the supply side, energy is the key factor of production in addition to labor, capital and other raw materials. Energy consumption is considered to be the key element in the socio-economic development and GDP growth of a country. It also helps to improve the living standards of the society through the increase in economic growth. This implies that there is a causal link between per capita energy consumption and GDP growth. Electricity is a major source of energy in the industrial, agricultural, and household sectors in Bangladesh. These three sectors collectively contribute to 90.3% of Bangladesh's GDP. The contribution of agricultural, household, and industry sector to GDP in fiscal year 2016-17 was 25.9 percent and 30.4, and 35% percent respectively (Bangladesh Bank, 2017). The share of agriculture, house-hold and industry sectors in electricity consumption is increasing gradually. According to the Bangladesh Power Development Board (BPDB) analysis, about 89 percent (1991 to 2017) of total electricity was consumed by agrarian and manufactured sectors. These statistics indicate that industries, household and agriculture together contribute significantly to GDP and electricity consumption as well. From this we can refer, that electricity consumption plays an important role in economic growth, GDP growth and economic development of Bangladesh. It is, therefore important to identify the relationship between electricity consumption and GDP growth and also their direction of causality to get a better understanding of the issues involved and determine the policy strategies. That is why in this study, the main purpose is made to examine the causal relationships between per capita electricity consumption and GDP growth for Bangladesh using the time series data spanning from 1980 to 2017.

It is well known that energy plays a vital role in eradication of poverty, economic growth, sustainable infrastructure development and better security of any country. In our Bangladesh, electricity is the biggest extensively used form of energy. Poor access to electricity in Bangladesh has been a major impediment to Bangladesh economic growth. SMEs (Small and medium enterprise) have been decided as the engine of economic progress but its execution is grossly pungent due to inadequate power supply. **Masuduzzaman (2012)** has identified the increase in energy use as a vital component of emerging economies; economic growth of the Bangladesh which is closely related to its energy consumption which is an impediment for enhancing export values, increasing remittances receipts from manpower supply. **Ahmad and Islam (2011)** they found short-run uni-directional causality running from per capita electricity consumption to per capita GDP without feedback

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applying co-integration and VECM in Bangladesh. **Asaduzzaman and Billah (2008)** both of them found that there has a direct relationship between electricity consumption and economic progress for Bangladesh using statistical data from 1994– 2004 and indicate that a higher level of energy use led to higher level of economic growth. **Alam and Sarker (2010)** found that there exists a short run causal relationship running from electricity generation to economic growth without feedback. **Ahmad and Jamil (2010)** found annual data for the period of 1960– 2008, found the presence of unidirectional causality from economic activity to electricity consumption. **Apergis and Payne (2010),** they found that in South America while studying the relation between energy consumption and economic growth using Gross Domestic Product to measure that directly and real gross fixed capital formations indirectly. They used a yearly data from 1981-2005, for Venezuela, Argentina, Bolivia, Chile, Ecuador, Brazil, Paraguay, Uruguay, and Peru like developing countries. **Buysse, Begum, and Alam (2012)** shows that the possible existence of dynamic causality among electricity production, energy consumption, and economic growth in Bangladesh. **Belloumi (2009)** shows that in Tunisian per capita energy consumption in the short-run caused to per capita GDP and there were bidirectional long-run causal relationship between the series for the period of 1971 to 2004. **Chontanawat, Hunt and pierse (2008)** have found the existence of causal relationship between energy economic growth nexus in 30 OECD developed economies and 78 non-OECD developing countries. **Ghosh (2002)** conducted data of 1950–51 to 1996–97 in India and found that unidirectional Granger causality existed running from economic growth to electricity consumption. **Islam (2011)** found that on the overall energy consumption and GDP growth there exist negative relationship between total energy consumption and GDP growth from 2005-2010 in Bangladesh. **Jumbe (2004)** if there is no causality between energy consumption and GDP, it implies that energy conservation policies may be pursued without affecting the economy. Based on these arguments, it is necessary to analyses the link between energy consumption and economic growth because it is often argued that the increased availability of energy services act as key stimulus of the process of economic development. **Lean and Shahbaz (2012)** illustrate that electricity consumption has positive impact on economic growth and bi-directional Granger causality has been identified between electricity consumption and economic growth in Pakistan. **Shahbaz and Feridun (2011)** they shows that with the increase of per capita energy consumption in the economy the country GDP growth also increased steadily. **Saeki and Hossain (2011)** have found presence of unidirectional relationship from economic growth to electricity expenditure in India, Nepal, Pakistan, and also from electricity expense to economic growth in Bangladesh. **Mozumder and Marathe (2007)** found reverse relationship that is unidirectional causality from GDP to electricity consumption for Bangladesh over the period 1971 to 1999 by employing Co-integration and Vector Error Correction Model (VECM). **Morimoto and Hope (2004)** pointed out that current as well as past changes in electricity supply have a significant impact on a change in real GDP in Sri Lanka. **Masih and Masih (1996)** Shortage of energy may negatively affect economic growth and may cause poor economic performance leading to a reduction of income and employment. On the other hand, if causality runs from GDP to energy consumption, this implies that economy is not energy dependent, and hence energy conservation policies may be implemented without adverse effects on economic growth and employment. **Ouedraogo (2010)** found that there was a long run bi-directional causal relationship between electricity consumption and GDP for Burkina Faso for the period spanning from 1968 to 2003 and claimed electricity was a significant factor in economic development. Essentially.

From this study we come to the conclusion that although this study has made significant contributions regarding the relationship between electricity consumption and GDP growth, but not sufficiently shed lights on the dynamic insights of the energy-growth relationship. Thus, our entire study is based on the Per capita electricity consumption which plays an important role to increase the GDP growth, that's why we try to establish the link-up between electricity consumption and GDP growth, so we chose the following objective.

➢ To show the casual relationship between per capita electricity consumption and GDP growth of Bangladesh.

II. Methodology

This empirical study based on the time series data of GDP and electricity consumption for the 1980-2017 period of Bangladesh. GDP and electricity consumption data for Bangladesh is obtained from the World Bank, data bank of world development indicator. Firstly, the per capita energy consumption data is obtained by GDP growth of per unit energy consumption for 1980-2017 based on GDP growth rate of 1980-2017. Secondly, the GDP and electricity consumption data are shown in the graph by horizontal axis and vertical axis, the horizontal axis shows the years and vertical axis shows the GDP growth of per unit of energy consumption & per capita energy consumption. All the data used in this model is secondary data which refers that are those type of which collected from various sources. To explain the research objective, we generally used the graphical and table method for the general purpose. All the data is collected from World Bank development indicator from World Bank, data bank.

III. Results and Discussion

Evidences have shown that Bangladesh is primarily an energy store house accommodating resources such as coal, natural gas, crude oil, solar, hydro, biogas. In spite of the available vast resources, only four sources (coal, crude oil, natural gas and hydro) are currently used in case of production of energy. In my result discussion I have shown the relationship between GDP with these four resources separately. Also, I have shown the relationship between GDP and electricity consumption, now above all these relationship explanations are bellow,
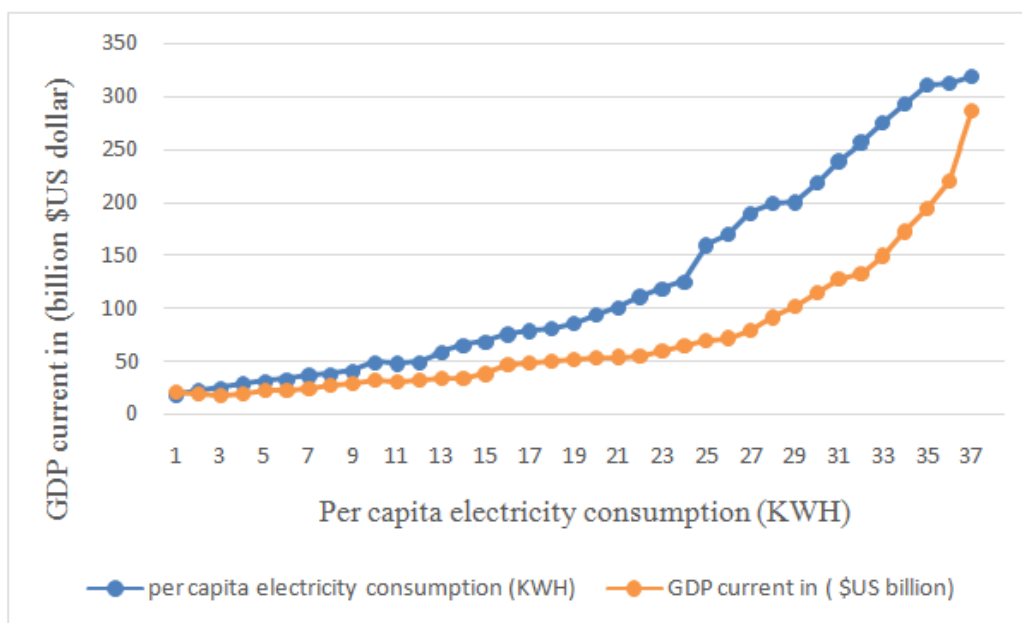

Figure 1: Correlation between GDP current in (billion $US dollar) & per capita electricity consumption (KWH)
From the above figure to explain the correlation between the per capita electricity consumption (KWH) and GDP current in (billion $US dollar) we may follow the following results from correlation.

Table 1: Correlation results table between GDP current in (billion $US dollar) & per capita electricity consumption (KWH)

Name	Correlation coefficient, r
Correlation coefficient for the 1st five unit	-0.41
Correlation coefficient for the 2nd five unit	0.87
Correlation coefficient for the 3rd five unit	0.97
Correlation coefficient for the 4th five unit	0.96
Correlation coefficient for the 5th five unit	0.90
Correlation coefficient for the 6th five unit	0.90
Correlation coefficient for the 7th eight unit	0.87

From the correlation result (r = -0.41) we can say that there exist a moderate negative relationship between per capita electricity consumption and GDP growth for the 1st five unit. Because of this GDP value decrease with the increasing of time where the per capita electricity consumption was growing in every sector i.e household, industry and agriculture sector but due to the small portion consume of per capita energy consumption it has no effect on GDP. The correlation result (r = 0.87) says that there exist a strong positive relationship between per capita electricity consumption and GDP growth The reason behind it that, although energy consumption is increased at higher rate but GDP is increased and decreased at various rate during this time. Correlation result (r = 0.97) says that there exist a strong positive relationship between per capita electricity consumption and GDP for the 3rd five unit. The reason behind it that the per capita electricity consumption is increased at very lower rate and also the GDP growth of per unit energy consumption is increased at lower rate.

From the correlation result (r = 0.96) we can say that there exists a strong positive relationship between per capita energy consumption and GDP for the 4th five unit. The reason behind it that the four unit of per capita electricity consumption is increased at very fast rate but the GDP rate is increased by 1billion to 9 billion in each period. Again the correlation result (r = 0.90) says that there exist a strong positive relationship between per capita electricity consumption and GDP growth for the 5th five unit.. The factor behind it that this five unit of

per capita electricity consumption is increased from 1 to 10 KWH but the GDP is increased by 0.66 billion to 5 billion per period. Correlation result (r = 0.90) says that there exists a strong positive relationship between per capita electricity consumption and GDP for the 6ᵗʰ five unit. In this case the increment of the value of GDP for per capita electricity consumption. The reason behind it that the 1ˢᵗ four unit of per capita electricity consumption is increased to 10-20 KWH rate but the GDP is increased by 1 billion to 9 billion in this time. At last correlation result (r = 0.87) says that there exist a strong positive relationship between per capita electricity consumption and GDP for the last eight unit. In this case the increment of the value of GDP for per capita electricity consumption. The reason behind it that the per capita electricity consumption is increased to 2-6 KWH but the GDP consumption is increased by 6 billion to 20 billion in this time
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IV. Conclusion

The main goal of this paper was the examination of causal relationship between GDP growth, and energy consumption in Bangladesh. For this purpose, the study focused on total electricity consumption, total current GDP and various energy resource spanning from 1981 to 2011. Also, a brief review of the energy consumption and GDP growth of Bangladesh is presented in this paper. Previous and current energy consumption of electricity power, electricity demand and energy power generate resources also has been highlighted. Bangladesh has attained development with a relatively low per capita energy consumption compared to many other countries. Our overall findings indicate that Bangladesh is an energy (electricity) dependent country. This implies that an increase in electricity consumption raises GDP growth. We also find that an increase in per capita electricity consumption raises total energy consumption and obviously an increase in total energy consumption raises the GDP growth.

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