

**THE NEXUS BETWEEN ECONOMIC GROWTH, URBANIZATION AND HEALTH
INDUSTRY IN BANGLADESH- AN EMPIRICAL APPROACH**

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ABSTRACT

Economic theory postulates that urbanization is a demographic process where an increasing share of the national population lives within urban settlements (Arouri et al., 2014). With the change in momentum, as industrialization accelerated, so did urbanization, as enervate farm workers flocked to factories in the hope of better living standards. Urbanization increases energy usage by aggravating the demand for housing, land use, public utilities, food, electric appliances and nonetheless transportation. The energy demand will keep on increasing in the coming years as development targets and economic growth accelerates. Bangladesh aims to become a middle-income nation by 2021. Bangladesh has become the New Asian Tiger and has the potential to be the 28th largest economy in the world by 2030. The complex dynamics between energy demand and urbanization have increasingly attracted debates over the past decades. Economic theory has long struggled in attempting to explain the impact of urbanization on energy demand (Luo, 2014). Good governance is important in this aspect as the country has set a target to gain universal health coverage by 2023 to pay 70% of the medical expenses. However, healthcare industry needs to utilize renewable energy and smart technology for the sustained economic growth. Bangladesh should adopt appropriate energy policies to curb down the constraints regarding energy supply, to spur economic growth and urbanization.

Keyword: Energy demand, Urbanization, Healthcare Industry, Economic growth

INTRODUCTION

Economic theory posits that urbanization is a demographic process where an increasing share of the national population lives within urban settlements (Arouri *et al.*, 2014). It is a shift of rural labor force from agricultural sector to industrial sector, mainly situated in urban regions of the cities, as it's the hub for eminent professions and social networks. This structural shift of rural areas into urban hubs influences energy demand in a number of ways. During the industrial revolution, only a small number of the global population lived in urban cities. Urbanization and economic development are intimately related, and the concentration of resources, particularly labor and capital in cities is a part of this process (Quigley, 2008). With the change in momentum, as industrialization accelerated, so did urbanization, as enervate farm workers flocked to factories in the hope of better living standards. Urban areas are magnets for young people and entrepreneurs, as they provide a range of opportunities, mainly benefitting the growing middle class. Urbanization is considered as the engine for economic growth, as 80% of

the economic output originates in the urban regions.

Economic theory postulates that economic growth and social modernization lead to urbanization, where energy has played a vital role (Shahbaz *et al.*, 2016). Urbanization increases energy usage by aggravating the demand for housing, land use, public utilities, food, electric appliances and nonetheless transportation. Today, 58% of the world's population resides in urban regions and is expected to increase up to 66% by 2050, with 90% of the increase in Asian countries including Bangladesh (United Nations, 2014). Urban dwellers consume higher quantities of resources and add pressure to the feeble ecosystem, implying that the continuous increase in the ecosystem in urbanization will have a notable impact on the energy demand. The industrial growth simultaneously leads to the economic development by cross-sectoral growth that enlarges the demand for further energy usage. The rise in income among urban residents boost the demand for luxury items like cars, televisions, refrigerators, laptops, washing machines, air conditioners, etc (Shahbaz and Lean, 2011). It is worth noting that millions of people are concentrating in townships every year and the number will keep on spiraling until prominent alternative jobs are created in other regions of the country. New residential buildings, shopping malls, grocery shops, educational institutions, offices (including startups) and hospitals are growing in urban regions of Bangladesh, namely in Dhaka city and Chittagong, mainly due to the immense opportunities and prospects. This is complementing to the rising demand for energy (mainly electricity) at an alarming rate. The development of Bangladesh has occurred mainly through the industrialization, and the energy demand is expected to increase to keep pace with the rapid urbanization. Buildings are responsible for approximately 40% of total energy demand in urban regions. Most of this energy is for the provision of lighting, heating, cooling, and water supply. The rise in Green House Gas (GHG) is leading to increased usage of the air conditioners in urban cities as more number of people are able to afford such a luxury due to increased income, resulting from urbanization (subsequently adding more to global warming). Urbanization is heeded as the marvel of innovation and engine for economic growth and affluence. However, a rapid and poorly planned urbanization can cause widespread energy poverty. As 40% of the world's urban expansion occurs in slums, it exacerbates socioeconomic disparity, the spread of disease and ill use of energy resources (e.g. power theft).

Bangladesh experienced urbanization in a faster pace than rest of the South Asian countries over 2000 to 2013. However, this speed of urbanization still fell behind the East Asian and Pacific regions in 2000. Irrespective of lagging behind other nations, this dynamic moderation phenomenon on social and economic capability has led to increased energy demand. The energy demand in Bangladesh is projected to reach 34,000 MW by 2030. The urbanization process has failed to keep pace with the city's rapid growth, resulting in uneven economic growth. Many residents till date lack the basic services like sanitation, water, infrastructure, etc. The government of Bangladesh aims to increase the energy supply to keep pace with the increased demand as for urbanization mainly. Urbanization has a crucial role to play in the economic development of Bangladesh. The consumption of coal has significantly increased from 740 to 2000 (thousand metric tons) over 2005 to 2015. As for electricity, the net consumption has increased from 23 to 44 (billion KW) from 2005 to 2015 (International Energy Agency, IEA, 2017).

The energy demand will keep on increasing in the coming years as development targets and

economic growth accelerates. Bangladesh aims to become an upper middle-income nation by 2021 and a developed nation by 2050. Bangladesh has the potential to be the 28th largest economy in the world by 2030 and will be 23rd by 2050 (PricewaterhouseCoopers, PwC, 2017). Experience regarding development in other countries in the past postulates that energy demand will rise faster when per capita income reaches between US\$1,000 and US\$10,000, a range that Bangladesh is currently entering. Energy is crucial for economic growth in any country and a key ingredient for improving the socioeconomic condition, where Bangladesh remains no exception. Electricity is most widely used form of energy. Unfortunately, since its independence in 1971, Bangladesh has struggled to generate sufficient electricity as well as other forms of energy to meet the existing energy demand. Meanwhile, state-owned electricity utilities suffer from large deficits. The energy sector has not been very successful in attracting private investments as much as the developed nations have been able to due to bottlenecks and poor pricing strategies. The present installed generation capacity is 13151 MW (Bangladesh Power Development Board, BPDB, 2017). There is no alternative way to reduce energy demand except implementing efficient and sustainable energy technology to stand out in the pace of urbanization. Rapid urbanization along with rapid transportation and modern sector growth influence energy demand. However, urbanization and rapid economic growth come with its own challenges, such as carbon emissions, corruption, and pollution. All these phenomena have motivated many to conduct researches in order to provide the clear condition of the present situation and guidelines to help policy-making authorities in designing feasible and practical policies for using urbanization as an economic tool for the efficient use of energy to enjoy sustainable economic development.

Few researches have been conducted on the nexus between urbanization with financial development, carbon dioxide emissions, poverty alleviation and economic growth over the past few decades in various countries. Urbanization adds to energy consumption, which is linked to economic growth, which on the other hand increases energy demand (Shahbaz *et al.*, 2016). The population has an effect on energy consumption, which contributes to economic growth in Malaysia (Mohd *et al.*, 2013). Furthermore, urbanization has cast a profound impact on the industry and residential sector in China, influencing the energy consumption accordingly (Guan and Zhou, 2015).

Through the tests conducted in this research paper, we have found bidirectional relation in both long run and the short run between urbanization and energy use. However, no causality was found between urbanization and total electricity consumption. Unidirectional causality ran from electricity consumption in industry sector to urbanization, but bidirectional causality ran for urbanization and electricity consumption in the commercial sector. The interpretations are stated in the findings section. The research paper also concludes short run disequilibrium and presence of long run cointegration, keeping urbanization as the dependent variable. Furthermore, urbanization, electricity consumption in industry and in domestic sectors were stationary at levels.

Bangladesh, having a GDP rate of 7.86% (FY 2018) has improved remarkably in terms of GDP and health indicators since its independence in 1971. Despite some drawbacks in insufficient health financing, the economy has achieved Millennium Development Goal 4 and 5 on child mortality rate and maternal mortality. Recently, Bangladesh has let its target to achieve Sustainable Development Goals (SDGs) with universal health coverage. The increasing

economic growth, improved socio-economic conditions, higher income levels, and education have led people to gain better health care system. In 2015, the total health expenditure in Bangladesh was 2.9% of GDP, which was one of the lowest allocations around the globe. On the other hand, out-of-pocket expenditure was 67% of the total health expenditure, which was of the highest proportions around the globe. Annually, on average, 4% of the households are pushed towards impoverishment due to high out-of-pocket health expenditures. According to the Health Economics Unit of Ministry of Health and Family Welfare (MOHFW), a target have been established to decrease the out-of-pocket expenditures on health by 32% and has identified some health financing reforms to the country forwards towards universal health coverage.

THEORETICAL BACKGROUND & EMPIRICAL EVIDENCE

Urbanization is a major phenomenon for economic development. It substitutes traditional energy with modern energy. It also accompanies structural transformation, as the rural-urban migration leads to shifting in labor force from the agricultural sector in rural areas to industrial and service sectors in urban areas. This causes a change in energy demand too, as the production shifts from low-energy intensive agricultural production to high-energy intensive, specialized goods and services. In the traditional agricultural sector, farmers usually consume a large proportion of what they produce, and the rest will be sold. For example, rice husking uses human and animal energy, whereas modern food processing uses machinery. Sheng *et al.* (2017) examined the impact of urbanization on energy consumption and efficiency using data from 78 countries for the period of 1995 to 2012, using Stochastic Impact by Regression on Population Affluence and Technology (STIRPAT)¹ model. They indicated that the process of urbanization leads to substantial increase in both actual and optimal energy consumption, but a decrease in efficiency of energy use. Moreover, they found energy inefficiency correlated with urbanization was greater in countries with higher Gross Domestic Product (GDP) per capita.

With people concentrating in townships for job opportunities and better social security, it creates the potential for economic development. Subsequently, the production rate increases and so does transport distances, requiring more commuting energy. On one hand, the labor force in agricultural sector decreases, leading to decreased share of agricultural commodity producers. On the other hand, many goods and services than are transported over long distances and agricultural production faces the pressure to be intensified and mechanized. Hence, both developments lead to a rise in energy demand. Although the scale of production reduces unit output costs but increasing production and labor force raises the need for transportation (i.e. increasing demand for fossil fuel). A vital component of rising energy demand for both developed and developing nations is motorized individual transport. Urbanization increases private transport within the city as well. As urbanization causes rise in income and standard of living, it leads to increased motorized individual transport, implying greater energy demand and emissions. Jamel and Derbali (2016) investigated empirically the impact of energy consumption,

¹ STIRPAT is a coordinated program of research devoted to understanding the dynamic couplings between human systems and the ecosystems upon which they depend. Its theoretical foundations lie in a union between social scientific and ecological lenses. The word STIRPAT, itself, is an acronym that refers to a statistical and conceptual model for assessing human impacts on the environment at virtually any scale to the analytic strategy testing Structural Human Ecology Theory (SHE). The goal of STIRPAT is to provide an analytic strategy for testing Structural Human Ecology Theory (SHE).

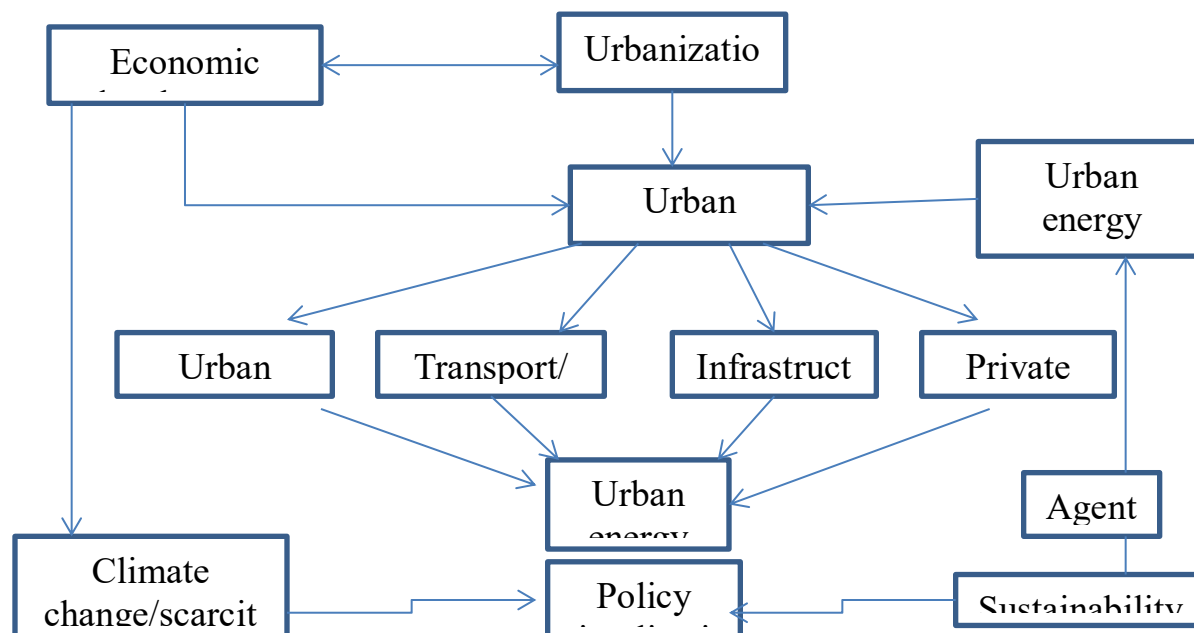
economic growth and environmental degradation as measured by CO₂ emissions for eight Asian countries during the period 1991-2013. They have used cointegration test, FMOLS², panel causality, Granger Causality, ECM, and Innovating Accounting approach (IAA). The cointegration tests confirmed the long run relationship between environmental degradation, energy consumption, and economic growth along with financial development, trade openness, capital stocks and urbanization as control variables. FMOLS confirmed positive relationships among the variables. The panel causality through VECM verifies the bidirectional causal connection between those variables, suggesting Asian governments to promote financial development along with investment on renewable energy resources. Topcu and Girgin (2016) examined the impact of urbanization on energy demand for a panel of 11 Middle Eastern countries over the period 1990-2012. Panel cointegration and causality approaches were employed. The panel cointegration results indicated a co-movement between variables in the long run and the cointegrating regression results showed that 1% increase in urbanization leads to 0.49% increase in energy demand in the long run. In terms of causality, results differed from short term through the long term. Their findings showed that causality ran from energy demand to urbanization in the short run, but the direction turns out to run from urbanization to energy demand in the long run. Energy conservation policies were recommended to decrease region's global gas emissions.

Moreover, urbanization causes expansion of urban infrastructure and building stock. In general, construction of roads, bridges, office buildings, sewage channels, power plants, etc., consumes high energy. A phenomenon of congested and dense cities is the Urban Heat Island (UHI) effect, where the sealed surfaces (roads and buildings) retain solar radiation. It increases air temperature and aids to global warming. Likewise, urbanization alters consumer needs and lifestyles of private households. Urban population relies more on commercial goods and services than the rural population. For instance, urban people are more likely to consume cooling devices or other electrical appliances for their home, which consumes high energy and policy makers need to implement proper energy conservative and energy efficiency policies. Figure 1 summarizes the main effects of urbanization. As Bangladesh concentrates on manufacturing production (e.g. RMG), it heavily depends on fossil fuels for production. Firms find electricity cheaper and more reliable in urban areas, than in rural areas. Overall, urbanization and economic development increase fuel consumption per worker and per unit of output, particularly of fossil fuels (Jones, 1991). But measurement of energy consumption due to urbanization is difficult to assess because of the informal sector. This sector is neither registered nor taxed by the government.

Fig. 1. Impact of urbanization on energy demand and urban structures

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² Fully Modified Ordinary Least Squares is used to calculate long run estimates and provides consistent estimates in small samples, eliminating distortions of large size, in the presence of heterogenous dynamic and endogeneity.



Source: Madlener and Sunak (2011)

OVERVIEW OF ECONOMY, URBANIZATION AND HEALTHCARE INDUSTRY IN BANGLADESH

Per capita income of Bangladesh is US\$ 1,602 (The World Bank, 2017). The country secured an economic growth rate of 7.24% over the last decade, which is well above the global economic growth and prediction by The World Bank of 6.4%-6.8%. Being unaffected by the global fickleness, the growth of the economy of Bangladesh maintained its stability and secured a growth of 6.5% of Gross Domestic Product (GDP) in 2015. This was possible because of higher growth of the industrial sector as well as the service sector, accompanied by increasing demand for energy. On the bright side, Bangladesh also shifted up from a low-income country to a lower middle-income country and plans to become a middle-income nation by 2021.

In 2013, the total primary energy consumption was 1.13 quadrillion Btu, with a change of 4.54% from the previous year. Subsequently, the country aims to grow at 8% by 2020 (U.S Energy Information Administration, EIA, 2016). The growth of electricity was 10% in 2010, and power generation capacity of Bangladesh was 5936 MW in January 2011, which rose to 10416 MW in 2016. However, the present capacity cannot be realized to its fullest due to forced outage. About one-fourth of the generation plants of the power system is more than 20 years old, causing higher maintenance costs and regular plant outages. It has been suggested that the pace of electricity sector development has to be accelerated, to enjoy the overall economic development of the country. Nearly 90% of the population is urban and 42% of the rural households have access to grid electricity (Bangladesh Bureau of Statistics, BBS, 2010). At the present, the government of Bangladesh is aiming to promote off-grid renewable energy technologies. Electricity is one of the major reasons for slow GDP growth in this country and priority is being given to the

electricity sector. It is suggested that a 0.23% of GDP growth can be achieved by 1% increase in per capita energy consumption. Although energy consumption by Bangladesh has experienced one of the highest percent increase within the Asian countries, by 4.5% since 1990 till 2012, yet per capita energy consumption is still very low, as compared to other countries. Table 1 represents electricity sector in Bangladesh at a glance.

Subject	2009	2010	2011	2012	2013	2014	2015	2016
Installed Generation Capacity	5719	5823	7264	8716	9151	10416	11534	12365
Derated Generation Capacity	5166	5271	6639	8100	8537	9821	7817	12921
Generation (MW)	3589	3883	3962	4805	5010	5320	7817	9036
Highest Generation	4162	4606	4890	6066	6434	7356	6389	8091
Electricity Demand (peak demand)	6066	6454	6765	7518	8349	9268	10283	11405
Access to Electricity	47	48.5	49	53	62	69	72	80
Per Capita Electricity Generation	183.26	200.32	211.86	231.65	248.89	270.83	251.68	-

Source: Power Division Bangladesh, GOB, 2016

While demand for energy, mainly oil is increasing, the supply remains sticky. The energy crisis in Bangladesh also exaggerated due to lack of experience, frequent changes in key policy makers and decision makers, lack of political commitment and trained manpower, and corruption. However, the energy sector has set objectives and targets, keeping in line with the Vision 2021 a national development plan, as follows: A) Institute administrative, financial and legal reform in Petro-Bangla and companies. B) Reduced system losses and improve energy efficiency usage. C) Encourage public-private partnerships. D) Development of energy infrastructures. E) Increase indigenous energy supply. F) Ensure sustainable operation of energy utilities. G) Ensure rational

use of total energy sources. H) Rational energy tariff and market policy reform, along with energy infrastructure development. Keeping the aims and objectives in mind, the following are some of the achievements of National Energy Policy of Bangladesh (2014) have been in discovering 3 gas fields by International Oil Companies (IOC), involvement of Independent Power Producers (IPP) in electricity generation, establishment of Bangladesh Energy Regulatory Commission (BERC), and enactment of Sustainable & Renewable Energy Development Authority Act-2012 regarding renewable and energy efficiency issues. Furthermore, the government has initiated different energy saving measures and demand side management program to save power and energy, for a sustainable economic growth.

As Bangladesh is one of the most densely populated countries, it has witnessed a rapid urbanization and the spread will continue over the next decade as well. Historically, urbanization has been closely linked to industrialization, as it initiates industrialization-led economic growth and a shift from agricultural based income and employment to modern jobs. The rapid urban growth can be explained by two factors. First, there was migration from rural to urban areas mainly for employment opportunities. As much as 38% of the total urban population of 1974 is estimated to have come from rural areas. Second, the sociopolitical changes after the Liberation War 1971 also seem to have considerable influence on urbanization. The rural ‘push’ and urban ‘pull’ factors were one of the reasons for large-scale migration. Reasons like rural impoverishment, natural calamities leading to riverbank erosion triggered those factors. The new status of Dhaka as the capital of independent Bangladesh was a major attraction indeed. Dhaka being the capital city is the most urbanized area of the country, followed by Chittagong. About 90% of the migration occurs in Dhaka city, followed by 53.3% in Chittagong (Urbanisation, 2015).

Bangladesh is the 8th most populated country in the world, with 44,500 people per km² (World Economic Forum, 2017). According to World Bank, almost every other human will live in the urban areas by 2030 (World Bank, 2015). The urban areas in Bangladesh are mainly Dhaka (capital city), Rajshahi, Chittagong, Rangpur, Khulna, and Barisal. In 1961, only 6% of the total population lived in the urban areas, but this phenomenon has now taken a dynamic shift. The rapid migration is causing Dhaka’s population to grow even faster. One significant aspect of recent urbanization has been the large scale migration of rural women to urban areas, particularly Dhaka. This is mainly due to the growth and opportunities in the garment industries, which slowly resulted in the development of the economy. Furthermore, the night time lights indicate rapid economic growth on the periphery of Dhaka, but the city’s urban core has stagnated experienced massive challenges with pressures on infrastructure and basic utilities (The World Bank, 2015). If this rapid urbanization isn’t effectively managed and harnessed, ills like pollution, jobless growth, radicalism is going to increase. Furthermore, the growing inequality among the slum dwellers and urban elites will multiply. As urban areas provide access to better education, along with other opportunities, per capita income and literacy rate are higher there, compared to rest of the country. The garments industry alone is responsible for 70-80% of the country’s export earnings. Much of the service sector (government, banking, real estate, trade, and finance) is also clustered in the urban city (Dhaka). Urbanization plays a major role in the economic development and also provides a secure basis for the rapid growth of income. Urbanization aids in blending different cultures as various people from different corners of the

rural areas come in the urban areas to seek jobs. This brings a new perspective among the migrants, aiding to form an inclusive society. During 1995 to 2005, the road surface in Dhaka city expanded by 5%, while the population increased by 50% and traffic congestion by 134%. The urbanization of Dhaka originated from the northern corridor of the central region and later expanded westward.

Healthcare industry is termed as one of the salient fields for any country, as health is wealth. Medication is considered as a basic need for living, which has a growing demand. As growth in living standards (due to urbanization and increase in income) and aging population ensures a healthy economy. But depending on the form of health service patients need, the level of health care is divided into 3 major categories.

Primary	Basic/general healthcare. Given through doctors, who are trained in: family practice, pediatrics, internal medicine, and gynecology
Secondary	Medical care given by physicians, who are consultants and work as per call of the primary physician
Tertiary	Specialized consultative care, usually on referral from primary or secondary medical care personnel, by specialists working in a center which has personnel and facilities for special investigation and treatment

Source: Light Castle Partners, 2016

Bangladesh has spent on average 37% of the total healthcare expenditure. Public spending on health is financed from non-development or revenue budget and development budget or Annual Development Programme (ADP) in the form of national tax, foreign development tax, etc. Moreover, there are 64,434 registered doctors, 6,034 registered dentists, 30,516 registered nurses and 27,000 midwives. (Light Castle Partners, 2016).

As the country is experiencing an energy transformation, this will not only provide adequate energy supply to the growing urbanization and population of the country as a whole but also provide quality healthcare for the citizens.

Urban poverty is a multidimensional issue. Poverty has historically been epidemic in this country and is defined into two categories (Zaman *et al.*, 2010). Around 81.4% of the urban population was considered to fall into the category of Poverty Line I, whereas 44.3% under Poverty Line II during 1973-74. In 1985-86 population was reduced to 56.0% and 19% respectively. The incidence of poverty was further reduced to 52.5% under Poverty Line I in the 2000 but raised to 25% under Poverty Line II in the same year. This could be due to many reasons like rising inequality between urban elites and slum dwellers, corruption, and education disparity. Unplanned and spontaneous urbanization in Bangladesh has mounted to many challenges and issues. The lack of advanced planning for utility services (e.g. access to electricity among poor people) and public transportation has led to frustration among the urban migrants. There must be political stability and good governance. Following the previous work in Bangladesh, the government aims to tap all possible sources of energy, adequate supplies of energy to its various uses, commercialization of renewable energy, and improvement in the transmission and distribution system. As the country is experiencing 'jobless growth', this will not only provide

adequate energy supply to the growing urbanization and population of the country as a whole but also provide job opportunities to the youth.

FINDINGS OF THE STUDY

The empirical results obtained by employing different econometric tools are presented below:

1. ADF Unit Root Test

ADF unit root test was conducted to determine the order of integration of the data series for each of the variables. The table 4 shows the ADF statistics and corresponding critical values of all the variables in their level and first differenced forms. It is worth noting that, unit root tests have non-standard and non-normal asymptotic distribution which is highly affected by the inclusion of deterministic terms, e.g. constant, time trend etc. A time trend is considered as an extraneous regressor whose inclusion reduces the power of the test. However, if the true data generating process were trend stationary, failing to include a time trend also results in a reduction in power of the test. In addition, this loss of power from excluding a time trend when it should be present is more severe than the reduction in power associated with including a time trend when it is extraneous (Lopez *et al*, 2005).

Table 3: Augmented Dickey Fuller Unit Root Test for the Variables			
Panel 1: Levels			
	ADF Statistics (Constant)	ADF Statistics (Constant & Trend)	Decision
Electricity Consumption in the Service Sector	2.587954	0.155831	Non Stationary
Energy Use	2.826289	-0.350563	Non Stationary
Electricity Consumption in the Industry Sector	-0.950167	-3.841821	Stationary
Total Electricity Use	2.611227	0.11930	Non Stationary
Urbanization	-6.978227	-7.540299	Stationary
Electricity Consumption in the Domestic Sector	3.691268	0.794883	Stationary
Panel 2: First Difference			
	ADF Statistics (Constant)	ADF Statistics (Constant & Trend)	Decision
Electricity Consumption in the Service Sector	-5.214089	-4.586648	Stationary
Energy Use	-5.588461	-7.678213	Stationary
Total Electricity Use	-4.895306	-5.939694	Stationary
Note: All regression is estimated with and without trend. Selection of the lag is based on Schwartz Information Criterion (SIC). Eviews 9 software automatically selects the most significant lag			

length based on this criterion.

As electricity in commercial services, energy use and total electricity were non-stationary at levels, their first differences were checked and found stationary as the final result.

Critical Value	Levels		First Differences	
	No Trend	With Trend	No Trend	With Trend
1%	-3.639407	-4.252879	-3.646342	-4.284580
5%	-2.951125	-3.548490	-2.954021	-3.562882
10%	-2.614300	-3.207094	-2.615817	-3.215267

2. ARDL Cointegration Test

Firstly, the order of lags on the first differenced variables was obtained. In this paper, lag 2 is taken as an optimal level. Lag 1 is excluded because as a rule of thumb we should include more than one lag for the annual data. The computed F-test statistics for each order of lag is presented in the following table where F-statistics is highly significant in lag 2.

Order of Lag	F - Statistic without Trend	F - Statistic with Trend
2	F (6,13) = 9.3128	F (6,12) = 8.3836

Table 6 represents the computed F statistics, keeping urbanization as the dependent variable. There is a significant change in the level of 99% level. We have considered ARDL Cointegration both with the trend and without trend. As a rule of thumb, if F statistics lie between upper and lower value, then cointegration is present. The null hypothesis states that no cointegration is present and we reject the null hypothesis and confirm the presence of ARDL cointegration.

3. Error Correction representation of the ARDL model

The ECM represents the speed of adjustment to restore equilibrium in the model. The ECM coefficient shows how slowly/quickly variable return to equilibrium and it should be negative, less than 1 and highly significant, which is the case here. Bannerjee *et al.* (1998) hold that a highly significant error correction term is further proof of the existence of the relationship. Lag 1 is excluded because as a rule of thumb we should include more than one lag for the annual data. The estimated coefficient of the ECM (-1) is equal to -0.82 and lag 2 has been taken for all the tests, to maintain robustness in of the test. As ECM value is less than one, it can be stated that there is a short run disequilibrium and auto correction is occurring at a fast rate.

Regressor	Coefficient	T - Ratio
dURB1	0.15286	1.6746

dEU	-0.060939	-2.8264
dECT	0.1456E-4	0.16528
dECT1	0.1066E-3	1.8251
dECD	-0.9028E-5	-.068722
dECD1	-0.2465E-3	-1.8414
dECS	0.0014595	2.9804
dECI	0.1672E-5	.025093
dC	8.1898	4.0623
ecm(-1)	-0.82767	-9.3597

4. Engle Granger Causality Test

The result³ shows that relationship of urbanization and disaggregates energy use is highly significant, as depicted by the T-Ratio of 3.4037 and -5.9359. However, there no causality was found between Urbanization and Total electricity use in the test.

Table 7(a): Engle Granger Causality Test Statistics (Lag 2)		
Dependent Variable: DU		
Null: Urbanization does not cause Energy Use		
Regressor	Coefficient	T-Ratio
C	5.5653	5.4713
DURB	1.3422	1.4320
DU(-1)	-0.40130	-2.0841
RES1(-1)	0.096291	3.4037
Table 7(b): Granger Causality Test Statistics		
Dependent Variable: DURB		
Null: Energy Use does not cause Urbanization		
Regressor	Coefficient	T-Ratio
C	-2.5588	-2.1659
DU	.0071864	.35044
DURB(-1)	.27646	2.3245
RES2(-1)	-.39491	-5.9359
Table 7(c): Granger Causality Test Statistics		
Dependent Variable: DECT		
Null: Urbanization does not cause Total Electricity Consumption		
Regressor	Coefficient	T-Ratio
C	1086.2	2.5102
DURB	-103.0438	-.056226
DECT(-1)	.057997	.27895

³ Microfit 4.1 was used for the test.

RES3(-1)	335.5969	.45770
Table 7(d): Granger Causality Test Statistics		
Dependent Variable: DURB		
Null: Total Electricity Consumption does not cause Urbanization		
Regressor	Coefficient	T-Ratio
C	-.051028	-1.1481
DECT	-.3404E-8	-.1510E-3
DURB(-1)	.032106	.61482
RES4(-1)	-.2272E-5	-.41974
Table 7(e): Granger Causality Test Statistics		
Dependent Variable: DECI		
Null: Urbanization does not cause Electricity Consumption in Industry Sector		
Regressor	Coefficient	T-Ratio
C	448.6887	1.07451
DURB	-38.1227	-.059013
DECI(-1)	-.25508	-1.4182
RES5(-1)	-621.2140	-.081815
Table 7(f): Granger Causality Test Statistics		
Dependent Variable: DURB		
Null: Electricity Consumption in Industry Sector does not cause Urbanization		
Regressor	Coefficient	T-Ratio
C	-.20773	-2.3606
DECI	-.5726E-4	-1.1830
DURB(-1)	.28897	2.4889
RES6(-1)	-.40444	-5.9720
Table 7(g): Granger Causality Test Statistics		
Dependent Variable: DECS		
Null: Urbanization does not cause Electricity Consumption in Commercial Sector		
Regressor	Coefficient	T-Ratio
C	132.9126	3.6571
DURB	83.1195	1.7562
DECS(-1)	-.22334	-1.1059
RES7(-1)	.099740	2.1053
Table 7(h): Granger Causality Test Statistics		
Dependent Variable: DURB		
Null: Electricity Consumption in Commercial Sector does not cause Urbanization		
Regressor	Coefficient	T-Ratio
C	-.18052	-2.2794
DECS	.3002E-3	.76103
DURB(-1)	.088038	.87729
RES8(-1)	-.59043	-7.0938
Table 7(i): Granger Causality Test Statistics		

Dependent Variable: DECD		
Null: Urbanization does not cause Electricity Consumption in Domestic Sector		
Regressor	Coefficient	T-Ratio
C	457.1390	2.2340
DURB	-207.3645	-.22002
DECD(-1)	.22020	1.0811
RES9(-1)	-234.4398	-.65984
Table 7(j): Granger Causality Test Statistics		
Dependent Variable: DURB		
Null: Electricity Consumption in Domestic Sector does not cause Urbanization		
Regressor	Coefficient	T-Ratio
C	-.061341	-1.4116
DECD	.1696E-4	.40458
DURB(-1)	.029198	.56941
RES10(-1)	-.7651E-5	-.74342

CONCLUSION, RECOMMENDATIONS, AND LIMITATIONS

This section has been divided into three parts: Conclusion, Recommendation, and Limitations.

1. Conclusion

Bangladesh is characterized by rapid urbanization, backed by huge population. Urban areas are magnets for young people and entrepreneurs, as they provide a range of opportunities, mainly benefitting the growing middle class. Urbanization is considered as the engine of economic growth, [80% of economic output](#) originates in cities. However, urbanization in Bangladesh is occurring at a fast pace and the poor management has posed challenges. This rapid increase in urbanization will add more pressure on existing urban infrastructure. The industrial growth simultaneously leads to the economic growth by the cross-sectoral growth that enlarges the demand for further energy usage. Urbanization increases energy usage by aggravating the demand for housing, land use, public utilities, food, electric appliances and nonetheless transportation. Today, 58% of the world’s population resides in urban regions and is expected to increase up to 66% by 2050, with 90% of the increase in Asian countries including Bangladesh (United Nations, 2014). This rapid increase in urbanization will add more pressure on existing urban infrastructure. Urban dwellers consume higher quantities of resources and add pressure to the feeble ecosystem, implying that the continuous increase in the ecosystem in urbanization will have a notable impact on the energy demand. The industrial growth simultaneously leads to the economic development by cross-sectoral growth that enlarges the demand for further energy usage. The rise in income among urban residents boosts the demand for luxury items like cars, televisions, refrigerators, laptops, washing machines, air conditioners, etc (Shahbaz and Lean, 2011). The urbanization raises demand for both personnel and public transportation. With the advancement of technology and improvement in the standard of living, the energy demand in Bangladesh will keep on rising. It is worth noting that millions of people are concentrating in townships every year and the number will keep on spiraling until prominent alternative jobs are created in other regions of the country. New residential buildings, shopping malls, grocery shops,

educational institutions, offices (including startups) and hospitals are growing in urban regions of Bangladesh, namely in Dhaka due to the immense opportunities and prospects. This is complementing to the rising demand for energy (mainly electricity) at an alarming rate. Buildings are responsible for approximately 40% of total energy demand in urban regions. Most of this energy is for the provision of lighting, heating, cooling, and water supply. The rise in Green House Gas (GHG) is leading to increased usage of the air conditioners in urban cities as more number of people are able to afford such a luxury due to increased income, resulting from urbanization (subsequently adding more to global warming). Urbanization is heeded as the marvel of innovation and engine for economic growth and affluence. The development of Bangladesh has occurred mainly through the industrialization, and the energy demand is expected to increase to keep pace with the rapid urbanization. However, a rapid and poorly planned urbanization can cause widespread energy poverty. As 40% of the world's urban expansion occurs in slums, it exacerbates socioeconomic disparity, the spread of disease and ill use of energy resources (e.g. power theft).

There was a bidirectional relationship between urbanization and energy use. However, the relationship of urbanization, with total electricity consumption remains insignificant in this research paper. By the Engle Granger Causality Test, we found a bidirectional relation between energy use and urbanization (both in long run and short run) but no causality between total electricity consumption and urbanization. The long run relation was highly significant between electricity consumption in the industry sector and urbanization and also between electricity consumption in the service sector and urbanization. Simultaneously, there was also long run relation between urbanization and electricity consumption in the service sector. By employing ECM Test and ARDL cointegration test we found a significant long run relation between the variables. Electricity consumption in the industry sector, urbanization, electricity consumption in the domestic sector were stationary at levels when Unit Root Test was applied in this study. Many people migrate to cities in hope of better standard of living, better jobs, improved social security, etc. In response to the migration, their energy demand increase, as they commute to cities or workplace using vehicle (mostly public transportation). They rent houses, which consumes energy, mostly in the form of electricity. Migrants living in slum get access to electricity mainly through power theft. Afterward, as income increases, people in Bangladesh start using more energy intensive services like air conditioner, private cars, heater, geaser etc. All these add more pressure on the energy demand of our country.

Bangladesh has already been attributed as the new Asian Tiger earlier this year and with a projected GDP growth rate of 7.24% in 2017, the energy demand in Bangladesh is projected to reach 34,000 MW by 2030 as more economic activities will spur over time. Increased energy demand will lead to urbanization, and simultaneously, urbanization will lead to increased energy demand in Bangladesh. As industries are the main driving force of development, there should be more industries but not at the cost of over crowding the city. More industries should be built in other divisions of the country. Likewise, as electricity consumption in service sector results in urbanization and vice versa, more attention should be given to this sector. As Bangladesh targets to become a middle-income nation by 2021 and a developed nation by 2050, the government has to invite more international organizations to boost service sector.

Good governance is important in this aspect as the country aims to achieve universal health

coverage by 2023 to pay 70% of the medical expenses. However, the healthcare industry needs to utilize more and more renewable energy and smart technology for the success.

More industries should be built in other divisions of the country. Likewise, as electricity consumption in service sector results in urbanization and vice versa, more attention should be given to this sector. As Bangladesh targets to become a middle-income nation by 2021 and a developed nation by 2050, the government has to invite more international organizations to boost service sector. However, transparency and accountability regarding funds need to be monitored and evaluated, as well as good governance need to be ensured. For example, facilities are provided based on the bed counts and past funding history, rather than on performance based category or need-based category like population size or bed turnover rates. Hence, it's salient to improve the resource allocation to reflect upon the needs of the populations and facilities. Perhaps sensitization or buy-in of major stakeholders at the national level can reduce the reform based allocations. Nonetheless, government can then advocate to increase the budget allocation for the health industry, which as a whole will benefit everyone.

The per capita energy use in Bangladesh has increased from 85.61 in 1971 to 215.52 in 2013 kg of oil equivalent. Although the figure is quite low as compared to developed nations like Saudi Arabia (6,700 kg of oil equivalent), it's similar to Myanmar and slightly higher than its neighboring country India. The growth of energy use in Asian countries from 1990 to 2012 indicates a remarkable growth of 4.5% in Bangladesh, as compared to China with 5.9%. Moreover, the average GDP per unit of energy used was 10.03 GDP (in dollars) per kg of oil equivalent, with the maximum of 14.09 GDP (in dollars) per kg of oil equivalent in 2014 (The World Bank, 2015). With the figures, it can be seen that energy supply has to increase to keep pace with the energy demand. Urbanization is still increasing in Bangladesh, and whether it has reached the turning point of Louis Curve is yet to be analyzed. With the current population of Bangladesh of 164,124,266 and urban population of 58,746,319, indicating 35% of the population resides in the urban area, the energy use will keep on spiraling. By 2020, the urban population of Bangladesh is expected to reach approximately 64,479,585.

2. Recommendations

In 2010, 21.3% of the country's population lived below national poverty line. However, in 2009, 62% of the urban population lived in slums. The existence of poverty and slums reflect messy and unplanned urbanization (The World Bank, 2015). With nearly 40% of the country's urban population living in the greater Dhaka city, it has posed many challenges on the positive impact of urbanization, although there has been some improvements in the living standards for many. In order to become an upper middle-income country by 2030, Bangladesh must manage Dhaka's urban growth. While poor people flock to the megacity, the migration will face increasing challenges to the feeble system like pollution, crime, global warming, exploitation of natural resources, etc. Bangladesh is currently the 8th most populated country in the world, with 44,500 people per km² (World Economic Forum, 2017). The urbanization process has failed to keep pace with the city's rapid growth, resulting in uneven economic growth. Many residents till date lack the basic services like sanitation, water, infrastructure, etc. Since the last 10 years, the median traffic speed dropped down from 21km/hour to 7 km/hour, which is only a slightly

higher than the average speed of walking. Moreover, congestion in Dhaka eats up 3.2 million working hours per day, which is a major challenge the authorities need to address (The World Bank, 2017). By taking full advantage of East Dhaka, the ample availability of land near the heart of the city can provide new economic opportunities and livability. Confronting these challenges will require deeper dialogue among the leaders of the nation. Finding the common ground within geographic and cultural boundaries will be one of the issues, in the long run. With proper planning and implementation, East Dhaka can become a vibrant pole for prosperous activities, while easing the density and congestion in the rest of the parts of the city. But if not managed properly, the rapid and unplanned urbanization of East Dhaka will add further to congestion, crime rate and frustration of the citizens. As this paper has identified the bidirectional relation between energy use and urbanization, the government should take proper measure in preventing any hurdle or barrier between the energy supply. Use of solar power or electric bus can be good strategies to combat the challenges. As all the developed nations and many nations have already undertaken renewable energy technologies, Bangladesh should opt for the same. Although the budget for 2017 has increased fund allocation for energy and power sector, it should emphasize more on the renewable energy. Some lesson can be taken from the success of our neighboring country, India. The government should target proper energy conservation policies, which should also give incentive to the citizen (e.g. solar powered home system, where Grameen Shakti has pioneered). As industry and service sector lead to urbanization, there should be more investment, particularly in the electricity infrastructure. Public-Private-Partnership (PPP) could be another strategy. Moreover, adequate urban planning with clean energy both in cities and villages should be applied for a sustainable development, where people from all walks of life can enjoy. Bangladesh should adopt appropriate energy policies to curb down the constraints regarding energy supply, to spur economic growth and urbanization. Lastly, it has been widely seen that many solutions to current problems are coming not from national government but from municipal, regional level and private organizations. Leadership training should be provided to all the youth of the nation so that they can have a positive impact in civil, public and private sectors of the economy. Hence, proper leadership to empower youth will play a key role here, where many individuals and private organizations will take initiatives themselves to change the current and future problems of Bangladesh and make the country become a middle-income nation by 2021, upper middle-income country by 2030, and a developed nation by 2050.

3. Limitations

The most significant limitation of this study is the limited sample size of 34 years. As Bangladesh gained its independence in 1971, no credible data was found before that period. Hence, it posed a challenge in finding a long run relationship. A simple multivariate model was considered in this research paper, using electricity consumption in different sector (domestic, service and industrial), total electricity consumption, population growth and urbanization as control variable and excluded some important variables such as income, international trade, socioeconomic aspects, and individual impact of electricity consumption on each sector (whether it leads to economic growth or savings etc). Nevertheless, it points to several research directions in the future. It is mentionable here that inclusion or exclusion of variables might have some

significant effect on the econometric results. Furthermore, it is essential to examine the hypotheses in different developing countries (cross panel) for the generalization. Whether domestic electricity consumption leads to economic growth, or whether consuming modern technology for electricity usage (e.g. inverter in air conditioners or refrigerators) leads to increased savings or investment, and subsequently resulting in economic growth can also a dimension for new research. Hence, this research paper provides a way forward for new dimensions and study, where the readers can reflect on the true potentials and merits of urbanization and improve its present scenario. This research paper concentrates mostly on ARDL approach in determining the cointegrating relationship between the variables. Similarly, it just considers the ADF test to conduct the unit root tests and Engle Granger Causality to causality between variables.

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