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Exploring the Impacts of Electricity Consumption and Financial Development on Urbanization

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Abstract:
This paper proposes to make a contribution to the existing literature through examining the impacts of electricity consumption and financial development on urbanization in Bangladesh during 1974-2014 by employing modern econometric techniques. We conduct dynamic nexus among financial development, electricity consumption, and urbanization by utilizing ARDL technique. The ARDL technique is employed to find dynamics among variables and to check the long run connection. This analysis performed the unit root problem through the ADF test where variables are I(0). Long-term associations are found by checking the bound test. Both electricity consumption and financial development are significant to affect urbanization. The long-run elasticities are higher impacts on urbanization than the short-run elasticities. Also, various diagnostic tests are made such as serial correlation, heteroscedasticity, normality. To evaluate the parameter stability, we execute the CUSUM test and CUSUM square. The results confirmed that there is no structural break in the economy. The paper provides some policy recommendations based on the results.

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Introduction

A well-developed, effective financing sector helps to conduct capital investment decisions by businesses and individuals (Shahbaz et al., 2018); to motivate nationals by managing their limited funds more efficiently; and by making capital cheaper leads further investment activities which allocate capital to productive means. (Xu et al., 2018) To accelerate the stock exchange and banking along with receiving inflows for foreign direct investment financial growth is important that boost the economy further. Several studies have been carried out to find the association between financial development and urbanization, but those studies cannot draw definite conclusions about the potential result of urbanization and the financial sector.

Recent surveys have shown that the use of energy can affect financial development. Economic development leads to economic growth, generates demand for more infrastructure development, and thus creates a positive effect on the usage of energy. (Magazzino, 2018) A versatile and essential type of resource for daily life is electricity and a crucial infrastructural input for the development of economic growth. Households and businesses in all economies have extensive demand for electricity. The amount of energy used by individuals, companies, nations, etc. is referred to as electricity consumption. Financial development measured as Private sector Domestic Credit (percent of GDP) refers to financial services that financial companies offer to the private sector, including loans, non-company securities purchases, commercial loans, and other receivable accounts that create repayment claims. The banking and leases firms, pension funds, money lenders, insurance firms, and foreign exchange firms are admirable examples for the other financial companies.

Urbanization measured by urban population refers to urban residents, which permanently concentrates large numbers of people on comparatively small regions, which form towns. Different scholars have been inspected the link between pollution, economic activities, and energy consumption. But, in the last few decades, financial development and electricity consumption get rapid momentum which rises the urbanization. Moreover, electricity consumption and financial development might affect urbanization in different channels. Hence, this study observes the effect of electricity consumption (EC) and financial development(FD) on urbanization(UR) in Bangladesh. On basis of our study, we recommend some policy measures.

Literature Review

From 1990–2013, Al-Mulali et al. (2015) explore the disaggregated output on renewable energy by the source in 23 selected European nations on CO2 emissions. The co-integration results from Pedroni show that CO2 emissions, GDP growth, urbanization, financing, and the development of renewable energy sources are co-integrated. Also, completely modified lowest-fourth results have demonstrated that while opening up trade, growth of GDP and FD would, in the long-term enhance the CO2 emission. Also, renewable electricity produced from fuel and waste, hydro and nuclear energy has a negative long-term impact on CO2, whereas solar and wind energy renewable energy generated is negligible. Moreover, the causality of the VECM Granger identified GDP growth in all the existing models investigated is the variable that has causal impacts on CO2 emissions. Asumadu-Sarkodie & Owusu (2017) tries to identify the standardized regression coefficient which shows a 1% increment in electrical consumption, industrialization, and financial growth cause to increase CO2 emissions respectively by 0.4 percent, 0.1 percent, and 0.7 percent.

The study found by Shahbaz et al., (2018) verified Tunisia's long-term relationships among energy consumption, industrialization, economic growth, urbanization, and financial development. Two-way causalities between financial growth and energy production, Financial development and industrialization, as well as energy use are found. Therefore, it is important to promote a sound and established a financial system that capable of attracting investors, boosting stock markets, and improved economic performance in the country. Nonetheless, the planning process can never be removed from encouraging industrialization and urbanization. The study of Farhani and Ozturk (2015) gives a positive indicator for the financial growth coefficient, which indicates that FD has taken place in Tunisia at the cost of pollution. Tunisia's case also displays that real GDP and CO2 emissions are positive. It investigates the cause of the variables by using Granger's causality and suggests that FD in the tunisian economy is crucial for further growth. Xu et al., (2018) costs of environmental quality and CO2 have been degraded by financial growth. The findings also show that globalization plays an insignificant role in environmental damage and that power use is the key fault of Saudi Arabia's rising CO2 emissions. The empirical outcomes of the investigation indicate that financial developments lead in the long-term but not cause in the short-term to CO2 emissions in Saudi Arabia. Magazzino (2018) is investing to raise a country's financial system's economic efficiency which may influence economic activity and the energy demand. The financial developments in Italy and GDP growth have increased, and this is a product of high pollution. The findings of Sbia et al. (2017) have shown a long-term co-integration in the UAE among energy usage, urbanization, economic growth, and financial development. There are interdependencies between economic development and urbanization. There are two-way triggers between energy consumption and urbanization, and the same applies between urbanization and financial growth.

The Habibullah & Eng results (2006) indicate that the positive effect of financial growth in Asian developing countries is causal to financial progress. Financial development must be linked to economic growth, since the economic policy, especially in developing countries, has different policy implications to boost growth. Salahuddin et al. (2018) ARDL estimates indicate that both the SR and LR associations of CO2 emissions and found negligible for FD, economic growth, FDI, electricity uses as well as an important link between CO2 discharge and FDI. Further study revealed that R&D investment in low carbon technology and renewable link of energy might be useful to minimize CO2 emissions without deteriorating Kuwait's economic growth. According to Mahalik et al. (2017) the ARDL energy demand forecast, financial growth in energy demand is rising on a long-term basis in Saudi Arabia. Capital and urbanization are both the key factors contributing to more energy demand in the long run, while economic growth is negatively related to energy use. From financial development to energy demand, there is evidence of unidirectional causality. These findings call on Saudi Arabia's policymakers to add financial growth and urban growth to their policies.

Data and Methodology

To examine the dynamics of electricity consumption and financial development on urbanization, we employ time series annual data for Bangladesh. Domestic credit to the private sector use as the proxy of financial development which is collected from the World Bank. Urban to population is used as the proxy of urbanization and electricity consumption which are collected through the World Bank. Data are not available for last few years so we utilize the period from 1972-2014 for Bangladesh. For the analysis, we use the statistical packages of EViews 9.0. The nature of the variables is given below.

Table 1: Variables Description

Variables	Nature
LUP	Natural log of urbanization
LFD	Natural log of financial development
LEC	Natural log of electricity consumption

Source: Data Collected From WDI

Normally time series shows the unit root problem. So, checking the unit root problem is necessary to analyze the model. Regression of non-stationary data may guide to a spurious outcome. Numerous tests are used to find the unit root problem among them Philips Perron and Augmented Dickey-Fuller test etc. The equation of the ADF test is given below:

$$z_t = \alpha_0 + \alpha_1 t + \beta z_{t-1} + \sigma \sum_{i=1}^{n} \Delta z_{t-1} + u_t$$

Here u_t = a white noise error.

The long and short models are utilized to run the dynamics of the variables. We used the ARDL technique which was pioneered by Pesaran et al., (2001). Recently it is becoming popular among econometrics analysis. For small simple, it is very useful. Irrespective of I(0) or I(1) we used the ARDL technique. The ARDL equation takes the following form:

$$\Delta LUP_t = \alpha_1 + \alpha_2 t + \alpha_3 LFD_{t-1} + \alpha_4 LEC_{t-1} + \sum_{i=1}^{n} \beta_i \Delta LUP_{t-i} + \sum_{i=1}^{n} \gamma_i \Delta LFD_{t-i} + \sum_{i=1}^{n} \mu_i \Delta LEC_{t-i} + U_t$$

For the long-term link, we need to test the bound approach. If the F value is larger than the upper bound then cointegration among the variables is found which means a long-term link exists. For the short-term connection, we need to run the error correction model. The ECM equation depicts the following.

$$\Delta LUP = \alpha_1 + \alpha_2 t + \sum_{i=1}^{n} \beta_i \Delta LUP_{t-i} + \sum_{i=1}^{n} \gamma_i \Delta LFD_{t-i} + \sum_{i=1}^{n} \mu_i \Delta LEC_{t-i} + \omega ECM_{t-1} + U_t$$

A various diagnostic test is performed for checking the model of stability, serial correlation, normality test, etc.

Result and Discussion

Table 2 represents the descriptive statistics of LUP, LFD, and LEC. The Jarque-Bera statistic for LUP is 2.920862 with a p-value of 0. 232136, for LFD is 4.684876 with a p-value of 0. 096093, and for LEC is 2.697621 with a p-value of 0. 259549. All the respective p-values are more than 0.05 here, which specifies the receiving of the null hypothesis so that it can be concluded that the respective residuals of the variables LUP, LFD, and LEC are distributed normally.

Table 3 includes the outcomes of the unit root test (ADF). If we take the assumption of "with constant and trend" then the t-statistic of the LEC, LUP, and LFD becomes -4.8849, -4.1350, and -4.7953 respectively while the respective p-value becomes 0.0017, 0.0119, and 0.0022. As all the p-values are less than 0.05 now, rejection of the null hypothesis becomes possible and all the variables are now stationary. Therefore, LEC, LUP, and LFD are I(0) series.

Table 2: Descriptive Statistics of LUP, LFD, and LEC

	LUP	LFD	LEC
Mean	3.016347	2.732299	4.241754
Median	3.060021	2.789396	4.263757
Maximum	3.512590	3.778174	5.768959
Minimum	2.200995	0.650824	2.841210
Std. Dev.	0.334150	0.810784	0.935030
Skewness	-0.648479	-0.827910	0.041578
Kurtosis	2.833649	2.974911	1.746134
Jarque-Bera	2.920862	4.684876	2.697621
Probability	0.232136	0.096093	0.259549
Sum	123.6702	112.0243	173.9119
Sum Sq. Dev.	4.466239	26.29485	34.97127
Observations	41	41	41

Source: Software Result

Table 3: ADF Test

H_0 = Variable is nonstationary				
	At Level			
		LFD	LEC	LUP
With Constant	t-Statistic	-2.1301	0.2984	-0.9498
	Prob.	0.2345	0.9753	0.7610
		n0	n0	n0
With Constant & Trend	t-Statistic	-4.8849	-4.1350	-4.7953
	Prob.	0.0017	0.0119	0.0022
		***	**	***
Without Constant & Trend	t-Statistic	2.3685	7.0131	1.5532
	Prob.	0.9949	1.0000	0.9682
		n0	n0	n0

Source: Software Result

Before applying the ARDL technique we must have set the lag criteria. For these we apply the unrestricted VAR model, then we identify the optimal lag for these periods. The VAR lag selection criteria are given in Table 4. The desired lag length is three (3). Then based on the Akaike Information Criteria (AIC), the desired model of ARDL(2,2,3).

Table 4: Lag Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	52.21991	NA	1.40e-05	-2.660536	-2.529921	-2.614488
1	225.0081	308.2168	2.01e-09	-11.51395	-10.99149	-11.32976
2	262.9119	61.46570	4.26e-10	-13.07632	-12.16202	-12.75399
3	280.0072	24.94988*	2.83e-10*	-13.51390	-12.20775*	-13.05343*
4	289.6861	12.55636	2.87e-10	-13.55060*	-11.85260	-12.95198

Source: Software Result

We apply the ARDL bounds test technique to find out the cointegration among LUP, LFD, and LEC in the context of Bangladesh. The F-statistic is compared to the upper and lower bound. The F-statistic of the bounds test is 11.31447 which is much larger than the 1% critical value of the upper bound of Pesaran et al. (2001) 5.0 so that it can be concluded that LUP, LFD, and LEC are cointegrated. It can be concluded that the variables under this study are cointegrated, and they have long-term convergence.

Table 5: Bound Test

H0 = No long-term association exist		
F-statistic	11.31447	2
Critical Value Bounds		
Significance	I(0) Bound	I(1) Bound
10%	2.63	3.35
5%	3.1	3.87
2.5%	3.55	4.38
1%	4.13	5

Source: Software Result

As urbanization, electricity consumption, and financial development are cointegrated, then the long-term association ship is constructed. Here, LUP is the dependent variable and the explanatory variables are financial development and electricity consumption. The LR outcomes are as follows in Table 6.

Table 6: Long-term Outcomes

ARDL(2,2,3) constructed on AIC
Dependent Variable: LUC

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LFD	0.166671	0.060880	2.737716	0.0106
LEC	0.180088	0.037703	4.776479	0.0001
C	1.843324	0.054490	33.828360	0.0000

Source: Software Result

Here all the explanatory variables are significant at the given level of significance. If a 1% rise in financial development will cause to increase the urbanization by 0.17%. And a 1% rise in electricity consumption followed by a 0.18% surge in urbanization. The short-term outcomes are shown in Table 7.

Table 7: Short-run outcome

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LUP(-1))	0.776954	0.028679	27.091698	0.0000
D(LFD)	0.009768	0.005387	1.813356	0.0805
D(LFD(-1))	-0.013090	0.005780	-2.264603	0.0315
D(LEC)	-0.000813	0.007817	-0.104030	0.9179
D(LEC(-1))	-0.014654	0.007733	-1.894909	0.0685
D(LEC(-2))	0.030053	0.007389	4.067043	0.0004
ECM(-1)	-0.129176	0.018249	-7.078625	0.0000

ECM = LUP - (0.1667*LFD + 0.1801*LEC + 1.8433)

Source: Software Result

In the short run, financial development is significant at a 10% level of significance to influence urbanization. Financial development is caused to increase urbanization. Electricity consumption will cause to decrease the urbanization but not significant in the short run. The negative value of ECM(-1) with statistically significant are indicated to the short-term deviation to long-run deviation. About 12.92% is corrected each year form short divergence to long -term equilibrium. The ECM shows the speed of adjustment from a long run to a short run.

Diagnostic Test

Model diagnoses include serial correlation, heteroscedasticity, normality test, functional form. For the normality test, the residuals of the null hypothesis are normally distributed. That means, the probability value is greater than 5%, thus the residuals are normally distributed. Figure-1 shows the normality plot which is shown below.

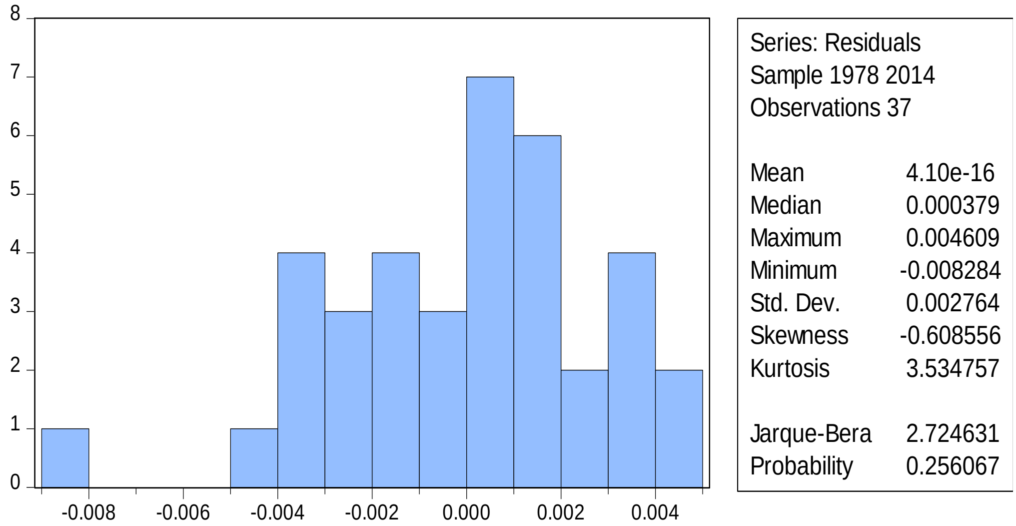

Figure 1: Normality Plot

The Ramsey RESET test designates that the null hypothesis of the model is not rejected as the probability value is larger than the 5% significance level. The model is therefore perfect. The test of heteroskedasticity is carried out if the null hypothesis cannot be rejected, which represents the homoscedasticity of the model. The model is also free of serial correlation, where neither the F-version nor the LM version is rejected. Via all diagnostic tests, the model is fine. The description of the diagnostic test is shown in Table 8.

Table 8: Diagnostic Test

Ramsey RESET Test			
	Value	df	Probability
t-statistic	0.700737	27	0.4895
F-statistic	0.491032	(1, 27)	0.4895
Breusch-Pagan-Godfrey			
F-statistic	1.935906	Prob. F(9,28)	0.0876
Obs*R-squared	14.57582	Prob. Chi-Square(9)	0.1033
Scaled explained SS	15.1804	Prob. Chi-Square(9)	0.0861
Breusch-Godfrey Serial Correlation LM Test			
F-statistic	2.271196	Prob. F(2,26)	0.1233
Obs*R-squared	5.651519	Prob. Chi-Square(2)	0.0593

Source: Software Result

By employing the CUSUM test we will check the stability of the model. Figure-2 shows the graph of CUSUM and Figure-3 shows the graph of CUSUM square. Here both the CUSUM and

CUSUM square shows the stable relationship over periods. The following figures show the CUSUM and CUSUM square test.

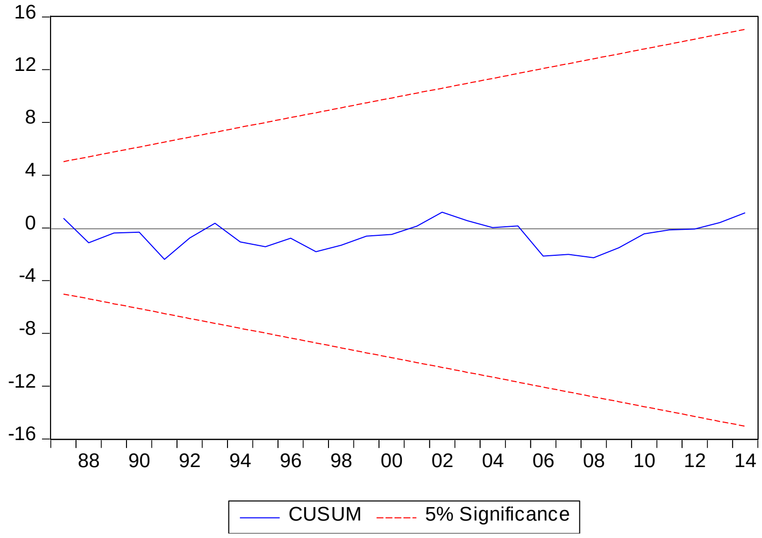

Figure 2: CUSUM test

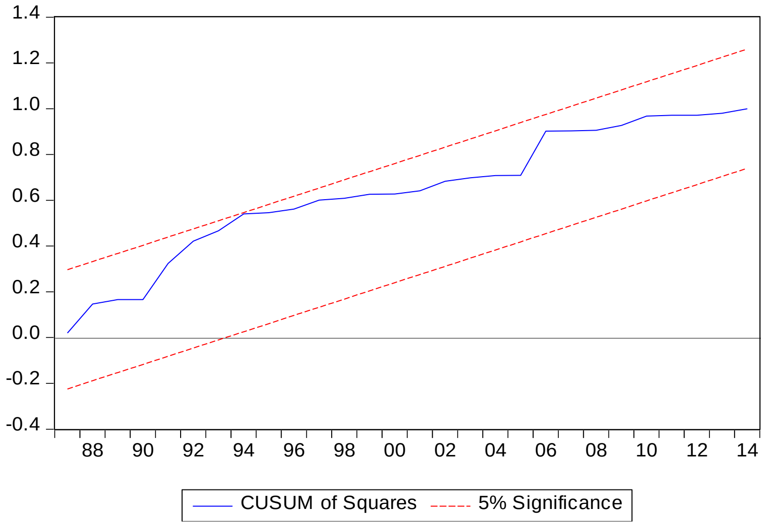

Figure 3: Test of CUSUM Square

Conclusion and Recommendation

In the recent world, urban growth and economic development have taken place at the same rate and our research shows that the use of electricity and financial development plays an important role in urbanization. So, we try to investigate the dynamic nexus among urbanization, financial development, and electricity consumption. ARDL technique is utilized to perform these analyses. Augmented Dickey-Fuller (ADF) is performed in which the variables are I(0) with constant and trends. Diagnostic tests are performed where the model is satisfied with all the diagnostic tests. The CUSUM test confirms that there is no structural breakup in the economy. Financial development and electricity consumption are effective to change urbanization in the long-term. Electricity consumption has a greater impact on urbanization in the long-term. So, elasticity consumption is more effective to influence urbanization in the long-term rather than the short-run. The government should give importance to the financial development sector. Investment through the financial sector is effective to create a positive impact on economic growth. Since financial development has a positive impact both in the long and in the short term on urbanization, the government should concentrate more on financial stability in Bangladesh, which in turn generates stable economic growth. In the case of electricity consumption even if in the short-term it impacts negatively on urbanization but it follows the positive trend in the long-term. The government should then devise long-term energy policies.

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