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Abstract: This paper explores the relationship between electricity consumption, foreign direct investment, capital and economic growth in case of the Kingdom of Bahrain. The Cobb-Douglas production is used over the period of 1980Q1–2010Q4. We have the ARDL bounds testing approach and found that cointegration exists among the series. Electricity consumption, foreign direct investment and capital add in economic growth. The VECM Granger causality analysis has reported the feedback effect between electricity consumption and economic growth and same is true for foreign direct investment and electricity consumption. This suggests us to explore sources of energy to achieve sustainable economic development for long run.

Keywords: Electricity Consumption, Economic Growth, Foreign Direct Investment, Bahrain
JEL Classifications: O13; Q43; C33

1. Introduction

Since the mid-eighties and especially following the second oil shock, there has been a great deal of attention devoted towards the importance of energy (electricity) in the economy. Hence, several researches have been conducted to study the relationship between electricity consumption and economic growth. Some studies have been focused on carbon dioxide emissions and its consequences on economic growth while some others have investigated whether electricity consumption increases output or not. Studies have analyzed the electricity-growth nexus for different countries and regions around the world by the use of different econometric techniques (ECM, ARDL, VAR, OLS-EG, DOLS, FMOLS, etc). The earliest study was conducted by Kraft and Kraft, (1978) and provided evidence to support unidirectional causality running from GNP to energy consumption in case of United States. Since this study established, many authors have joined the debate, some who have opposed and empirically challenged Kraft and Kraft's initial findings; and others who have supported their views (Shahbaz and Lean, 2012, Bildirici, 2013).

In general, divergence in findings could be summarized into four different stands. The first range of study finds bidirectional causality between energy (electricity) consumption and economic growth (Jumbe, 2004; Ghali and El-Sakka, 2004; Wolde-Rufael, 2005; Shahbaz et al. 2011; Shahbaz and Lean, 2012 and Shahbaz et al. 2012). The second range finds unidirectional causality from economic growth to energy (electricity) consumption (Kraft and Kraft, 1978; Cheng and Lai, 1997; Chang and Wong, 2001; Soytas and Sari, 2003; Narayan and Smyth, 2008; Jamil and Ahmad, (2010) and Shahbaz and Feridun, 2012). This implies that adoption of energy conservation policies will impede economic growth and for sustainable economic growth, energy exploration policies should be encouraged. The third range finds unidirectional causality from energy (electricity) consumption to economic growth [Shiu and Lam (2004); Yoo (2005); Yuan et al. (2007); Odhiambo (2009b); Chandran et al. (2010)]. Finally the fourth range finds no causal relationship between energy (electricity) consumption and economic growth (Akarca and Long, 1980; Yu and Choi, 1985; Erol and Yu, 1988; Stern, 1993). This suggests that energy does not play its role to enhance economic growth and implementing the energy conservation policies would not harmful for economic growth.

The aim of this paper is to test the relationship between electricity consumption, economic growth, foreign direct investment and capital for a small open economy named the Kingdom of Bahrain. In fact, during the past decade the government of Bahrain has intensified the structural reforms in order to improve the infrastructure as well as the well-being of Bahraini citizens. Bahrain has become an open-ended economy with liberalized trade and capital account. It has also become the hub of international affairs and the preferred destination for investors. Consequently, the economy has known an unprecedented dynamism, population has been grown drastically and projects have been multiplied. Following this performance, energy consumption has increased drastically and electricity is becoming a driver of the local economy. Electricity has been a principal source of the increase in the standard of living of Bahraini citizens and it has played a crucial role in the technological and scientific advancement of the Kingdom.

The data on electricity consumption (kWh per capita), per capita real GDP (constant 2000 US $), foreign direct investment (constant 2000 US $) per capita and capital (constant 2000 US $) per capita are used as the proxies for electricity consumption and economic growth, foreign direct investment and capital respectively. The testing procedure involves the following steps. At the first step, whether each variable contains a unit root will be examined using the usual the Augmented Dickey–Fuller (F-ADF) and Philips–Perron (PP, 1998) and later on, we applied

Zivot-Andrews, (1996) structural break unit root test. Further, to check the existence of structural breaks in time series we shall be using Zivot-Andrews, (1996) structural break unit root test with structural break. If the variables contain a unit root, the second step is to test whether there is a long-run cointegration relationship between the variables. If a long-run relationship between the variables is found, the final step is to apply the VECM Granger causality test to detect the nature of causal relationship between the variables.

The reminder of the paper is as follows: section-2 presents an overview on energy supply in Bahrain, section-3 reviews the relevant literature, section-4 show model construction and data collection, section-5 presents the econometric methodology, section-6 presents results interpretations and section-7 concludes and points out some policy implications.

2. Electricity in Bahrain

Nowadays, electricity infrastructure is becoming a central component of an economy for many reasons. Firstly, as Bahrain is the center of finance in the Gulf Cooperation Council (GCC) region, electricity is an essential factor for the effectiveness of the banking and financial sector. Secondly, Bahrain is moving toward an industrial based economy to diversify its economy and to shrink its dependency to oil, thus electricity is becoming and important factor for achieving this goal (Helmi and Sbia 2012). Thirdly, Bahraini households are among the highest users of information and communication technology (ICT henceforth) in Arab countries (WTI 2011). Bahraini households become dependent on ICT such as Internet and broadband and other technologies such as cell phones, personal computers, digital video recorders, digital music players, etc. Hence; electricity is the first element of the knowledge based society in Bahrain. The role of electricity in the economy of Bahrain seems to be crucial; thus it is worth to investigate whether electricity consumption contribute to economic growth in order to make appropriate energy policies. The Kingdom of Bahrain disposes of five electric generation plants namely: Manama power station (Gas Turbine), Muharraq power station (Gas Turbine), Sitra power and water station (Gas Turbine and Steam Turbine), Riffa power station (Gas Turbine), Hidd power and water station (Gas Turbine and Steam Turbine). The total electricity generating capacity is around 2.9 Giga watts. To face the growing demand and to avoid recurrent power failure during the peak summer months[1], the kingdom supported independent projects (IPPs) and engaged in privatization process of some state-owned power sector assets. Al Ezzel plant is the first output of this initiative. It has started commercial operation in 2006. Al Dur plant is another example. It is planned to operate in two phases. The first one was finalized in 2011 and the second phase has been launched in the current year. According to the Electricity & Water authority, installed capacity is composed by four types:

-Dual Fuel Gas Turbine with 37.9% of the total capacity;

-Diesel Fuel Gas Turbine with 1.6%;

-Steam Turbine with 20%;

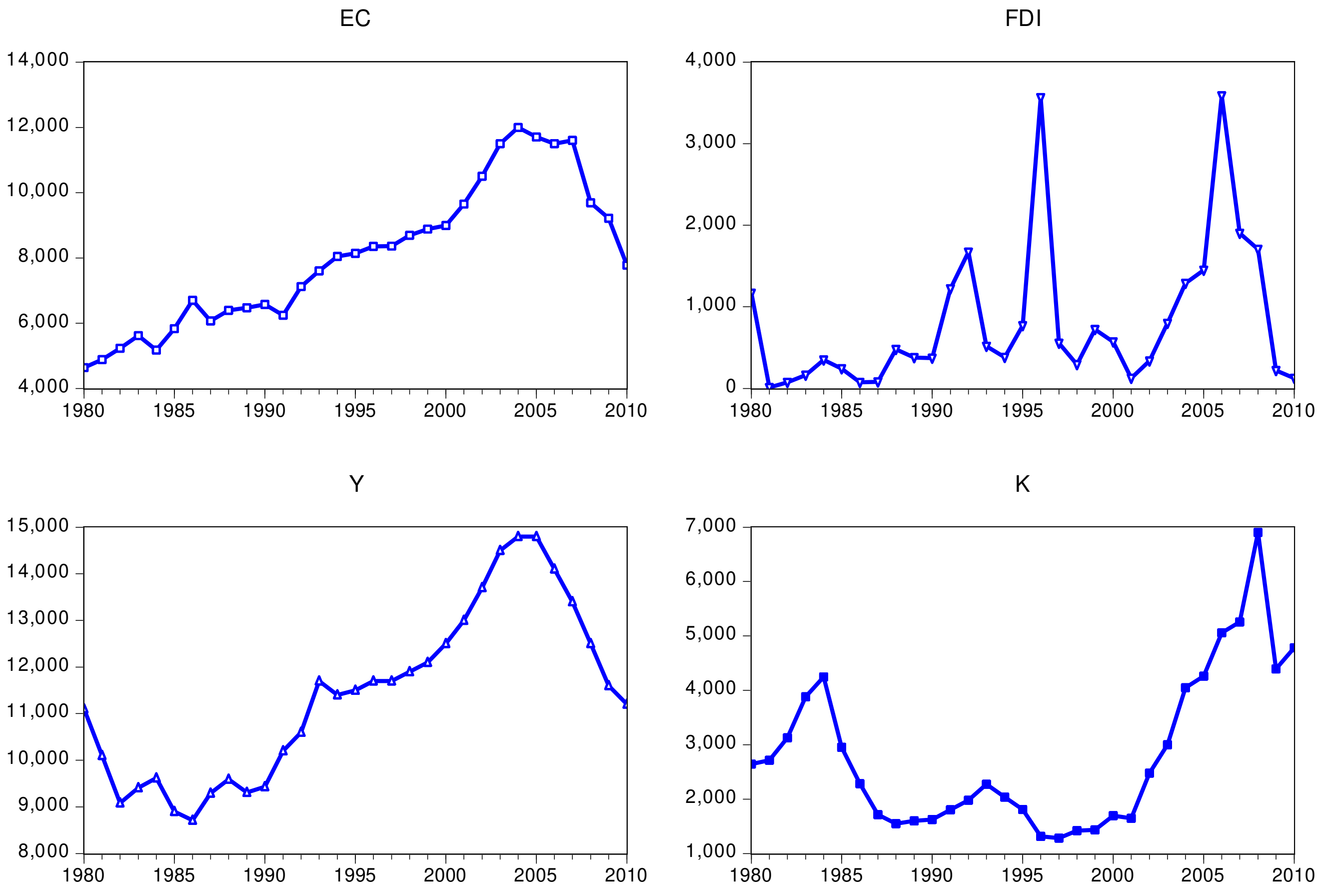
-Gas Fuel Turbine with 40.5%.

It is clear that Bahrain rely much more on gas in its power generation. However, gas reserves are systematically declining. Therefore, the issue of gas exhaustion is inevitable. With the present demand and supply patterns of gas consumption, there will be a shortage of gas in the near future. The government is fully aware of naturel gas issue and is pursuing various options to

[1] In summer of 2004 a one-day countrywide power failure occurred due to mismanagement of power flow.

secure different sources of gas imports. Currently, none of the import options seems to offer clear scenarios. The major part of electricity generation will continue to be based on natural gas. It is important to mention that The Gulf Cooperation Council (GCC) drew plans for a unified power grid in 2004. The first phase of the project was completed in 2009, linking the grids of Saudi Arabia, Qatar, Bahrain, and Kuwait. The remaining GCC members, United Arab Emirates and Oman are expected to be fully integrated into the grid by the mid of 2012. This project aims to secure power supply in GCC countries even in cases of emergencies, while reducing the cost of power generation in member countries. Electricity is becoming a main concern for the kingdom of Bahrain and the GCC region as whole. In Bahrain, electricity consumption per capita grows at an astonishing rate and Figure-1 shows that it has doubled in less than twenty years (from 4637.43 Kwt per capita in 1980 to 8875.75 Kwt per capita in 1999). Regarding, GDP per capita, the mean is 11398.04 dollar, with a maximum of 14788.89 dollar and a minimum of 8710 dollar. The Figure-1 below illustrates the trajectory of the four indicators (before logarithmic transformation) during the period of our study.

Figure-1: Variables Trends in Bahrain



3. Literature Review

3.1 Economic Growth and Electricity Consumption

It is evident that electricity has played a key role in the evolution of human-being life. It has contributed in the progress and development of major needs: transportation, communication and manufacturing. Economists are usually attracted by finding a new determinant (variables) of economic growth. Electricity consumption has been one of those variables. The literature investigating the relationship between electricity consumption and economic growth is enormous. It was produced an extended range of studies since the pioneering work of Kraft and Kraft, (1978). Rosenberg, (1998) examined the role played by electricity in the course of industrial development over the past century. However, one can distinguish four different streams according to the type of the relationship between both the variables: (i) electricity consumption-led growth hypothesis (or growth hypothesis), (ii) feedback hypothesis, (iii) growth-led electricity consumption hypothesis (or conservation hypothesis) and, (iv) neutrality hypothesis.

For many countries, growth hypothesis has been confirmed. This means that electricity consumption Granger causes economic growth. For example, Shiu and Lam, (2004) for China; Ho and Siu, (2007) for Honk Kong; Gupta and Chandra, (2009) for India; Abosedra et al. (2009) for Lebanon; Chandran et al. (2009) for Malaysia; Odhiambo (2009a) for Tanzania; Adebola (2011) for Botswana and Kouakou (2011) for Cote d'Ivoire. For other countries, studies such as Ghosh, (2002) for India; Narayan and Smyth, (2005) for Australia; Hu and Lin, (2008) for Taiwan; Yoo and Kim, (2006) for Indonesia; Mozumder and Marathe, (2007) for Bangladesh; Jamil and Ahmad, (2010) and; Shahbaz and Feridun, (2012) for Pakistan; Ciarreta and Zarraga, (2010) for Spain; Sami, (2011) for Japan; Adom, (2011) for Ghana showed the validity of conservation hypothesis i.e. economic growth Granger causes electricity consumption. Yusof and Latif, (2007) in case of Malaysia and Akpan and Akpan, (2012) in case of Nigeria supported the neutrality hypothesis. This reveals that implementation of energy (electricity) conservation polices would not adversely affect economic growth.

Similarly, some studies suggested the existence of feedback hypothesis such as Yang, (2000); Jumbe, (2004); Yoo, (2005); Zachariadis and Pashouortidou, (2007); Tang, (2008); Aktas and Yilmaz, (2008); Acaravci, (2010); Odhiambo, (2009b); Ouédraogo, (2010); Lorde et al. (2010); Shahbaz et al. (2011); Shahbaz and Lean, (2012) and Shahbaz et al. (2012) confirmed the existence of bidirectional Granger causality between electricity consumption and economic growth in Taiwan, Malawi, Korea, Cyprus, Malaysia, Turkey, South Africa, Burkina Faso, Barbados, Portugal, Pakistan and Romania. This implies that energy exploration policies should be encouraged to sustain economic growth in long run.

3.2 Foreign Direct Investment and Electricity Consumption

As Alfaro et al. (2010) suggested, there is a widespread belief among policy maker that FDI generates productivity externalities for host countries. However, the empirical literatures do not confirm such belief. Moreover, using different approach and techniques led to conflicting results. Alfaro et al. (2010) established that FDI could improve the energy utilization efficiency of the host country by restructuring of production, technology transfer, and other ways. Nevertheless, this will be conditioned by the host country's absorptive capacity. Sun et al. (2011) investigated whether the effects of foreign direct investment on the reduction in energy consumption and the increase in energy use efficiency are different through countries according to their per income capita. They used data of 74 high-income and low-and middle-income countries for the period 1985-2008. The empirical results confirmed that FDI might improve energy efficiency and reduce energy consumption intensity.

Using the VAR model, He et al. (2012) examined the temporal linkages among GDP, energy consumption, and FDI in Shanghai during the period 1985-2010. From the impulse response analysis, they concluded that in the short term, the increase in foreign direct investment will result in reduction of energy consumption. They justify that FDI leads to the improvement of energy efficiency through (i) technology effects and (ii) by upgrading the industrial structure.

Hubler and Keller (2009) investigated the impact of foreign direct investment (FDI) inflows on energy intensities with a special focus on 60 developing countries for the period 1975–2004. In the first step they used a simple ordinary least squares (OLS) estimation to confirm energy-intensity reductions from FDI inflows. With more advance models and using macro-level panel data including additional potential determinants of energy intensities. Further, the authors carried out robustness checks. However, the empirical results did not confirm the hypothesis that aggregate FDI inflows decrease energy intensity of developing countries. Moreover, foreign development aid seems to be associated to energy efficiency gains.

4. Model Construction and Data Collection

The main objective of present paper is to investigate the relationship between electricity consumption and economic growth using data of Bahrain over the period of 1980Q1-2010Q4. We use Cobb-Douglas production function. The general form of production is given below:

$$Y = AK^{\alpha} L^{\beta} e^{u} \qquad (1)$$

Where, Y is real gross domestic product (GDP), K and L indicate real capital and labor respectively. A, represents technology and e is the error term assumed to be having normal distribution. The output elasticity with respect to capital and labor is α and β respectively. When Cobb-Douglas technology is constrained to ($\alpha + \beta = 1$) we get constant returns to scale. We augment the Cobb-Douglas production function by assuming that technology can be determined by the level of foreign direct investment and electricity consumption. Foreign direct investment utilizes advanced technology and managerial skills for production. Entrepreneurs play the pivotal role on the stage of free market. They take risk and act as the force behind innovation and technological progress. Foreign direct investment also helps technological advancements and its diffusion. Thus, the model is constructed as following:

$$A(t) = \phi.FDI\ (t)^{\sigma} \tag{2}$$

where ϕ is time-invariant constant, FDI is indicator of foreign direct investment. Substituting equation-2 into equation-1:

$$Y(t) = \phi.EC\,(t)^{\delta_1}\, FDI\ (t)^{\delta_2}\, K(t)^{\alpha}\, L(t)^{\beta} \tag{3}$$

Following Shahbaz, (2012) we divide the both sides by population and get each series in per capita terms; but leave the impact of labor constant. By taking log, the linearized Cobb-Douglas function is modeled as following:

$$\ln Y_t = \beta_1 + \beta_{EC} \ln EC_t + \beta_{FDI} \ln FDI_t + \beta_K \ln K_t + \mu_t \tag{4}$$

where, $\ln Y_t$, $\ln EC_t$, $\ln FDI_t$ and $\ln K_t$ is the log-transform of real GDP per capita, electricity consumption per capita, real foreign direct investment per capita and real capital use in per capita, respectively. The term μ_t refers to the random error term.

The data on real GDP, real capital use, electricity consumption (kWh) and real foreign direct investment (domestic currency) is obtained from world development indicators (CD-ROM, 2012). The data on real GDP, real foreign direct investment and real capital use in US dollar. We divide series of real GDP, electricity consumption, real FDI and real capital on population to transform them into per capita. We have applied quadratic sum match method of extrapolation to convert annual frequency data into quarter frequency following Romero, (2005). We have used real GDP per capita, electricity consumption (kWh) per capita, real foreign direct investment per capita and real capital use per capita for our empirical analysis.

5. Estimation Strategy

5. 1 Unit Root Testing

The usual first step in empirical analysis is to test the stationarity properties of the variables. Traditional unit root tests are ADF by Dickey and Fuller (1979), P-P by Philips and Perron (1988), KPSS by Kwiatkowski et al. (1992), DF-GLS by Elliott et al. (1996) and Ng-Perron by Ng-Perron (2001). However, as pointed by Baum, (2004), empirical evidence on order of integration of the variable by ADF, P-P and DF-GLS unit root tests are not reliable in the presence of structural break in the series. In fact, unit root tests may be biased and inappropriate in absence of information about structural break occurred in series.

To overcome this problem, Zivot-Andrews (1992) suggested three models to test the stationarity properties of the variables in the presence of structural break point in the series. (i) First model permits a one-time change in variables at level form, (ii) Second model allows a one-time change in the slope of the trend component i.e. function and (iii) Last model has one-time change both in intercept and trend function of the variables to be used in the analysis. Zivot-Andrews (1992) adopted three models to check the hypothesis of one-time structural break in the series as follows:

$$\Delta x_t = a + ax_{t-1} + bt + cDU_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \quad (5)$$

$$\Delta x_t = b + bx_{t-1} + ct + bDT_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \quad (6)$$

$$\Delta x_t = c + cx_{t-1} + ct + dDU_t + dDT_t + \sum_{j=1}^{k} d_j \Delta x_{t-j} + \mu_t \quad (7)$$

Where DU_t represents the dummy variables displaying mean shift occurred at each point with time break while trend shift variables is presented by DT_t[2]. So,

$$DU_t = \begin{cases} 1 ... if \;\; t > TB \\ 0 ... if \;\; t < TB \end{cases} \text{ and } DU_t = \begin{cases} t - TB ... if \;\; t > TB \\ 0 ... if \;\; t < TB \end{cases}$$

The null hypothesis of unit root break date is $c = 0$ which indicates that series is not stationary with a drift not having information about structural break point while $c < 0$ hypothesis implies that the variable is found to be trend-stationary with one unknown time break. Zivot-Andrews unit root test fixes all points as potential for possible time break and does estimation through regression for all possible break points successively. After that, this unit root test selects that time break which decreases one-sided t-statistic to test $\hat{c}(= c - 1) = 1$. Zivot-Andrews indicate that in the presence of end-points, asymptotic distribution of the statistics is diverged to infinity

[2] We used model-4 for empirical estimations following Sen, (2003)

point. It is compulsory to choose a region where end-points of sample period are excluded. To do so, we followed Zivot-Andrews suggestions by choosing the trimming regions i.e. (0.15T, 0.85T).

5.2 The ARDL Bounds Testing

We employ the autoregressive distributed lag (ARDL) bounds testing approach to cointegration developed by Pesaran et al. (2001) to explore the existence of long run relationship between economic growth, electricity consumption, foreign direct investment and capital in the presence of structural break. This approach has multiple econometric advantages. The bounds testing approach is applicable irrespective of whether variables are I(0) or I(1). Moreover, a dynamic unrestricted error correction model (UECM) can be derived from the ARDL bounds testing through a simple linear transformation. The UECM integrates the short run dynamics with the long run equilibrium without losing any long run information. The UECM is expressed as follows:

$$\begin{aligned}\Delta \ln Y_t = {} & \alpha_1 + \alpha_T T + \alpha_Y \ln Y_{t-1} + \alpha_{EC} \ln EC_{t-1} + \alpha_{FDI} \ln FDI_{t-1} + \alpha_K \ln K_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta \ln Y_{t-i} \\ & + \sum_{j=0}^{q} \alpha_j \Delta \ln EC_{t-j} + \sum_{k=0}^{r} \alpha_k \Delta \ln FDI_{t-k} + \sum_{l=0}^{s} \alpha_l \Delta \ln K_{t-l} + \alpha_D D_1 + \mu_t\end{aligned} \tag{8}$$

$$\begin{aligned}\Delta \ln EC_t = {} & \alpha_1 + \alpha_T T + \alpha_Y \ln Y_{t-1} + \alpha_{EC} \ln EC_{t-1} + \alpha_{FDI} \ln FDI_{t-1} + \alpha_K \ln K_{t-1} + \sum_{i=1}^{p} \beta_i \Delta \ln EC_{t-i} \\ & + \sum_{j=0}^{q} \beta_j \Delta \ln Y_{t-j} + \sum_{k=0}^{r} \beta_k \Delta \ln FDI_{t-k} + \sum_{l=0}^{s} \beta_l \Delta \ln K_{t-l} + \beta_D D_2 + \mu_t\end{aligned} \tag{9}$$

$$\Delta \ln FDI_t = \alpha_1 + \alpha_T T + \alpha_Y \ln Y_{t-1} + \alpha_{EC} \ln EC_{t-1} + \alpha_{FDI} \ln FDI_{t-1} + \alpha_K \ln K_{t-1} + \sum_{i=1}^{p} \vartheta_i \Delta \ln FDI_{t-i} + \sum_{j=0}^{q} \vartheta_j \Delta \ln Y_{t-j} + \sum_{k=0}^{r} \vartheta_k \Delta \ln EC_{t-k} + \sum_{l=0}^{s} \vartheta_l \Delta \ln K_{t-l} + \vartheta_D D_3 + \mu_t \quad (10)$$

$$\Delta \ln K_t = \alpha_1 + \alpha_T T + \alpha_Y \ln Y_{t-1} + \alpha_{EC} \ln EC_{t-1} + \alpha_{FDI} \ln FDI_{t-1} + \alpha_K \ln K_{t-1} + \sum_{i=1}^{p} \rho_i \Delta \ln K_{t-i} + \sum_{j=0}^{q} \rho_j \Delta \ln Y_{t-j} + \sum_{k=0}^{r} \rho_k \Delta \ln EC_{t-k} + \sum_{l=0}^{s} \rho_l \Delta \ln FDI_{t-l} + \vartheta_D D_4 + \mu_t \quad (11)$$

Where Δ is the first difference operator, D is dummy for structural break point based on Z-A test and μ_t is error term assumed to be independently and identically distributed. The optimal lag structure of the first differenced regression is selected by the Akaike information criteria (AIC). Pesaran et al. (2001) suggests F-test for joint significance of the coefficients of the lagged level of variables. For example, the null hypothesis of no long run relationship between the variables is $H_0 : \alpha_Y = \alpha_{EC} = \alpha_{FDI} = \alpha_K = 0$ against the alternative hypothesis of cointegration $H_a : \alpha_Y \neq \alpha_{EC} \neq \alpha_{FDI} \neq \alpha_K \neq 0$. Accordingly Pesaran et al. (2001) computes two set of critical value (lower and upper critical bounds) for a given significance level. Lower critical bound is applied if the regressors are I(0) and the upper critical bound is used for I(1). If the F-statistic exceeds the upper critical value, we conclude in favor of a long run relationship. If the F-statistic falls below the lower critical bound, we cannot reject the null hypothesis of no cointegration. However, if the F-statistic lies between the lower and upper critical bounds, inference would be inconclusive. When the order of integration of all the series is known to be I(1) then decision is made based on the upper critical bound. Similarly, if all the series are I(0), then the decision is made based on the lower critical bound. To check the robustness of the ARDL model, we apply diagnostic tests. The diagnostics tests are checking for normality of error term, serial correlation, autoregressive conditional heteroskedasticity, white heteroskedasticity and the functional form of empirical model.

5.3 The VECM Granger Causality

After examining the long run relationship between the variables, we use the Granger causality test to determine the causality between the variables. If there is cointegration between the series then the vector error correction method (VECM) can be developed as follows:

$$\begin{bmatrix}\Delta \ln Y_t \\ \Delta \ln EC_t \\ \Delta \ln FDI_t \\ \Delta \ln K_t\end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \\ b_4 \end{bmatrix} + \begin{bmatrix} B_{11,1}\ B_{12,1}\ B_{13,1}\ B_{14,1} \\ B_{21,1}\ B_{22,1}\ B_{23,1}\ B_{24,1} \\ B_{31,1}\ B_{32,1}\ B_{33,1}\ B_{34,1} \\ B_{41,1}\ B_{42,1}\ B_{43,1}\ B_{44,1} \end{bmatrix} \times \begin{bmatrix}\Delta \ln Y_{t-1} \\ \Delta \ln EC_{t-1} \\ \Delta \ln FDI_{t-1} \\ \Delta \ln K_{t-1}\end{bmatrix} + \ldots + \begin{bmatrix} B_{11,m}\ B_{12,m}\ B_{13,m}\ B_{14,m} \\ B_{21,m}\ B_{22,m}\ B_{23,m}\ B_{24,m} \\ B_{31,m}\ B_{32,m}\ B_{33,m}\ B_{34,m} \\ B_{41,m}\ B_{42,m}\ B_{43,m}\ B_{44,m} \end{bmatrix}$$

$$\times \begin{bmatrix}\Delta \ln Y_{t-1} \\ \Delta \ln EC_{t-1} \\ \Delta \ln FDI_{t-1} \\ \Delta \ln K_{t-1}\end{bmatrix} + \begin{bmatrix}\zeta_1 \\ \zeta_3 \\ \zeta_3 \\ \zeta_4\end{bmatrix} \times (ECM_{t-1}) + \begin{bmatrix}\mu_{1t} \\ \mu_{2t} \\ \mu_{3t} \\ \mu_{4t}\end{bmatrix} \tag{12}$$

where difference operator is $(1-L)$ and ECM_{t-1} is the lagged error correction term, generated from the long run association. The long run causality is found by significance of coefficient of lagged error correction term using t-test statistic. The existence of a significant relationship in first differences of the variables provides evidence on the direction of short run causality. The joint χ^2 statistic for the first differenced lagged independent variables is used to test the direction of short-run causality between the variables. For example, $B_{12,i} \neq 0 \forall_i$ shows that electricity consumption Granger causes economic growth and electricity consumption is Granger cause of economic growth if $B_{11,i} \neq 0 \forall_i$.

6. Empirical Results

The descriptive statistics and correlation matrix is detailed in Table-1. We find that electricity consumption, economic growth, foreign direct investment and capital are normally distributed. It is confirmed by findings of Jarque-Bera normality test. This leads us for further analysis to investigate the relationship between electricity consumption and economic growth in Bahrain. The pairwise correlation analysis reveals that economic growth and electricity consumption are positively correlated. There is also a positive association between foreign direct investment and electricity consumption and same inference is valid for capital and electricity consumption. The correlation of foreign direct investment and capital with economic growth is positive. Foreign direct investment and capital are positively associated.

Table-1: Descriptive Statistics and Correlation Matrix

Variable	$\ln EC_t$	$\ln Y_t$	$\ln FDI_t$	$\ln K_t$
Mean	8.9544	9.3290	6.0830	7.8277
Median	8.9921	9.3501	6.1748	7.7332
Maximum	9.3926	9.6023	8.1853	8.8399
Minimum	8.4424	9.0722	2.4119	7.1558
Std. Dev.	0.2790	0.1601	1.2687	0.4769
Skewness	-0.0802	0.0939	-0.6487	0.3850
Kurtosis	1.9758	1.9203	3.6156	1.9470
Jarque-Bera	1.3882	1.5513	2.6640	2.1980
Probability	0.4995	0.4603	0.2639	0.3331

$\ln EC_t$	1.0000			
$\ln Y_t$	0.8834	1.0000		
$\ln FDI_t$	0.5225	0.5427	1.0000	
$\ln K_t$	0.2194	0.2683	0.0909	1.0000

We use the ADF (Dickey and Fuller, 1981) and PP (Philips and Perron, 1998) unit root tests. The results are reported in Table-2. The test statistics of electricity consumption, economic growth, foreign direct investment and capital are non-stationary at level (variables are converted into logarithm before analysis) with intercept and trend confirmed by ADF test. We find that all the series are stationary at level with intercept and trend. We find that all the series are integrated at I(1) but PP test shows that variables have missed order of integration such as $\ln FDI_t$ is I(0) and $\ln EC_t$, $\ln Y_t$ and $\ln K_t$ are I(1). Thus, from all of the tests, the unit roots tests indicate that each variable is integrated of order one if we follow the ADF unit root test otherwise not. The traditional unit root tests may provide ambiguous empirical evidence. These tests do not accommodate information about structural break arising in the series. The presence of structural breaks in the series leads to accept null hypothesis when it is false and vice versa. We have applied Zivot-Andrews structural break unit root test to over the ambiguity of empirical results, which accommodates single unknown structural break stemming in the series.

Table-2: Unit Root Analysis for Bahrain

Variables	**ADF Test**		**PP Test**		**Decision**
	Level	1st difference	Level	1st difference	

$\ln EC_t$	0.7553	-6.3156*	1.9144	-5.3536*	I(1)
$\ln Y_t$	-1.3404	-4.5449*	-1.9848	-4.2021*	I(1)
$\ln FDI_t$	-3.0323	-4.7930*	-5.0720*	-8.6837*	I(1)
$\ln K_t$	-0.8015	-6.4603*	-1.1638	-4.8930*	I(1)

Note: * denotes the rejection of the null hypothesis at 1 per cent level of significance.

The results of Zivot-Andrews unit root test are reported in Table-3. We find that all the variables show unit root problem at level in the presence of structural breaks. The results show that electricity consumption, economic growth, foreign direct investment and capital are found to be stationary at 1st difference. The 2006Q4, 2001Q1, 1998Q4 and 2002Q2 are structural break dates indicated by Zivot-Andrews unit root test in series of electricity consumption, economic growth, foreign direct investment and capital respectively. Overall our results report that all the series have same level of integration i.e. I(1).

Table-3: Zivot-Andrews Structural Break Unit Root Test

Variable	**At Level**		**At 1st Difference**	
	T-statistic	Time Break	T-statistic	Time Break
$\ln EC_t$	-4.221 (1)	2006Q4	-9.320 (3)*	2001Q1
$\ln Y_t$	-4.344 (2)	2001Q1	-5.814 (3)*	1994Q4
$\ln FDI_t$	-4.320 (3)	1998Q4	-5.772 (3)*	1984Q2
$\ln K_t$	-3.844 (1)	2002Q2	-7.578 (3)*	2002Q2
Note: * represent significant at 1% level of significance. The critical				

value at1% is -5.57 and at 5% is -5.08. Lag order is shown in parenthesis.

The unique integrating order of the variables lends a support to test the existence of cointegration between the variables. In doing so, we apply the ARDL bounds testing approach in the presence of structural break to examine cointegration between the variables. The results are reported in second column of Table-4. The lag order of the variable is chosen following Akaike information criterion (AIC) due to its superiority over Schwartz Bayesian criterion (SBC). AIC performs relatively well in small samples but is inconsistent and does not improve performance in large samples whilst SBC in contrast appears to perform relatively poorly in small samples but is consistent and improves in performance with sample size (Acquah, 2010).

Table-4: The Results of ARDL Cointegration Test

Bounds Testing to Cointegration				**Diagnostic tests**		
Models	Optimal lag length	F-statistics	Break Year	R^2	$Adj-R^2$	D. W test
$EC_t = f(Y_t, FDI_t, K_t)$	6, 5, 4, 3	3.720***	2006Q4	0.7115	0.5901	2.1576
$Y_t = f(EC_t, FDI_t, K_t)$	6, 6, 6, 6	4.046**	2001Q1	0.7757	0.6552	2.-480
$FDI_t = f(EC_t, Y_t, K_t)$	6, 6, 6, 6	4.156**	1998Q4	0.5066	0.2600	2.0102
$K_t = f(EC_t, FDI_t, Y_t)$	6, 6, 6, 6	2.505	2002Q2	0.9021	0.8539	2.0520
Significant level	Critical values					
	Lower bounds $I(0)$	Upper bounds $I(1)$				
1 per cent level	3.60	4.90				

5 per cent level	2.87	4.00				
10 per cent level	2.53	3.59				
Note: *(**) and *** represents significant at 1(5) per cent and 10 per cent levels respectively.						

The appropriate lag section is required because F-statistic variables with lag order of the variables. The results reported in Table-4 reveal that our computed F-statistics are greater than upper critical bounds generated by Pesaran et al. (2001) at 10% and 5% levels respectively. We find three cointegrating vectors once electricity consumption, economic growth and foreign direct investment are used as dependent actors. This validates that there is long run relationship between electricity consumption, foreign direct investment, capital and economic growth in case of Bahrain.

Table-5: Long Run Results

Dependent Variable = $\ln Y_t$			
Variables	Coefficient	T-Statistic	Prob. Values
Constant	4.1678*	21.3540	0.0000
$\ln EC_t$	0.4643*	17.5171	0.0000
$\ln FDI_t$	0.0221*	3.8259	0.0002
$\ln K_t$	0.0241***	1.7200	0.0881
R^2	0.8095		
$Ajd - R^2$	0.8046		
Akaike info criterion	-2.4224		
Schwarz criterion	-2.3295		

F-statistic	164.492*		
Note: *, *** represent significance at 1% and 10% levels respectively.			

The evidence on marginal impact of electricity consumption, feign direct investment and capital on economic growth is noted in Table-5. We find that electricity consumption adds in economic growth and it is statistically significant at 1% level of significance. All else is same, a 1 per cent increase in electricity consumption is linked with 0.4643% economic growth in long span of time. Foreign direct investment is positively and significantly (at 1% level of significance) linked with economic growth. Keeping other things constant, a 1% increase in foreign direct investment adds in economic growth by 0.0221%. The impact of capital use on economic growth in positive and it is statistically significant at 10% significance level. A 1% increase in capital use will be linked positively with electricity consumption by 0.0241% by keeping other things constant.

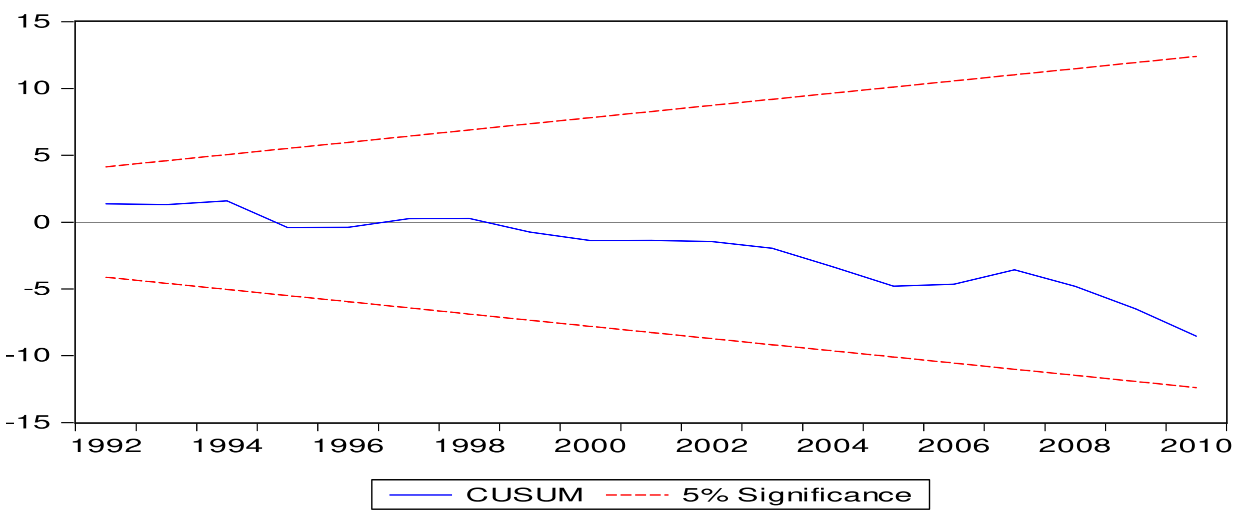
Table-6: Short Run Results

Dependent Variable = $\Delta \ln Y_t$			
Variables	Coefficient	T-Statistic	Prob. Values
Constant	0.0002	0.2007	0.8413
$\Delta \ln Y_{t-1}$	0.6599*	10.6792	0.0000
$\Delta \ln EC_t$	0.0039	0.1045	0.9169
$\Delta \ln FDI_t$	-0.0074	-0.0487	0.9612
$\Delta \ln K_t$	0.0445*	2.8683	0.0049
ECM_{t-1}	-0.0425*	-2.8813	0.0048
R^2	0.5719		

$Ajd-R^2$	0.5524		
F-statistic	23.3904*		
Diagnostic Tests			
Test	F-statistic	Probability	
$\chi^2 SERIAL$	1.9582	0.1461	
$\chi^2 ARCH$	2.1231	0.1481	
$\chi^2 REMSAY$	0.0013	0.9705	
Note: * represents significance at 1% level. $\chi^2 SERIAL$ is for LM Serial correlation test, $\chi^2 ARCH$ for autoregressive conditional heteroskedasticity and $\chi^2 REMSAY$ for Resay Reset test.			

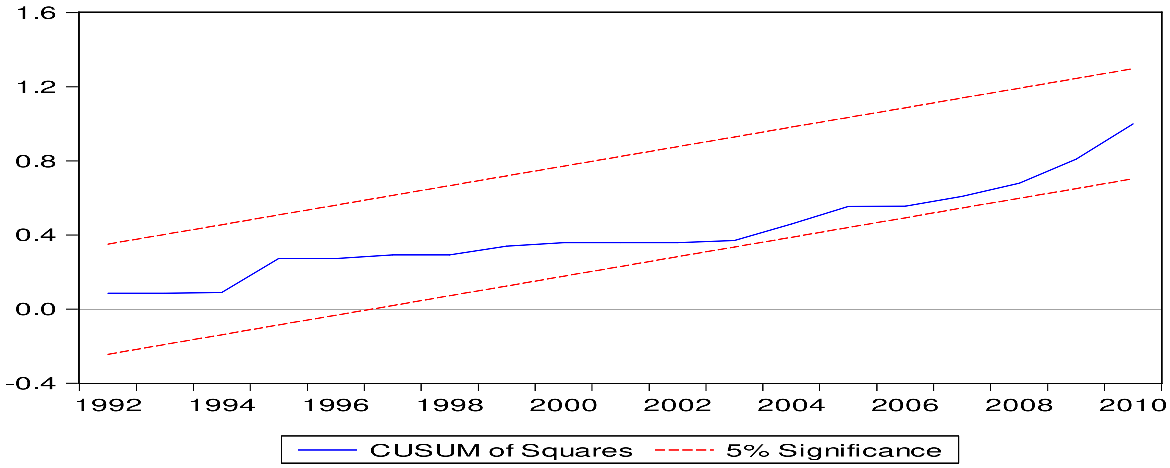
The short run results are illustrated in Table-6 reveal that current economic growth is influenced by economic growth in previous period and it is statistically significant at 1% level of significant. The impact of electricity consumption and foreign direct invetsmnet on economic growth is positive and negative but statistically, it is insignificant. The capital use has positive and significant impact on economic growth in short run. The statistically significant estimate of lagged error term i.e. ECM_{t-1} with negative sign corroborates our established long run relationship between electricity consumption, foreign direct investment and economic growth. The empirical evidence reported in Table-6 pointed out that the coefficient of ECM_{t-1} is -0.0425 which is statistically significant at 1% level of significance. This concludes that changes in economic growth are corrected by 4.25% in each quarter in long run. It suggests that full convergence process will take three years and three quarters (five years and three quarters) reach the stable path of equilibrium. This implies that the adjustment process is very fast and significant for Bahrain economy in any shock to economic growth equation. The empirical evidence for diagnostic tests is detailed in Table-7 in lower segment. The results suggest that short run model seems to pass serial correlation, autoregressive conditional heteroskedasticity and white heteroskedasticity. This indicates that there is no problem of serial correlation and autoregressive conditional heteroskedasticity. There in existence of white heteroskedasticity in short run model. The results of stability tests such as CUSUM and CUSUMsq are shown in Figure-2 and 3.

Figure-2: Plot of Cumulative Sum of Recursive Residuals



The straight lines represent critical bounds at 5% significance level

Figure-3: Plot of Cumulative Sum of Squares of Recursive Residuals



The straight lines represent critical bounds at 5% significance level

The results of CUSUM and CUSUMsq tests indicate the stability of the ARDL parameters because graphs of both tests are lying within critical bounds at 5% level of significance.

Table-7 illustrates the results of the VECM Granger test. We have performed three Granger causality tests: short-run causality, long-run causality and joint short and long run. The first test indicates the significance of the sum of lagged terms of each explanatory variable by the mean of joint Fisher test; the second test indicates the significance of the error correction term by the mean of the t-test and finally the third test is the short-run adjustment to restore the long-run equilibrium. Our results reveal that electricity consumption and economic growth are complements. The bidirectional causality between electricity consumption an economic growth shows the importance of exploration of new sources of electricity supply. The relationship between foreign direct investment and economic growth is bidirectional. The feedback effect exists also between foreign direct investment and electricity consumption. The establishment of Bahrain as financial hub and modern open economy in the Middle East has attracted considerable amounts of FDI and significant immigrant mass. This has add to the low cost of electricity has definitely increased the consumption of electricity for business use and housing use. The unidirectional causality is running from capital to foreign direct investment, economic growth and electricity consumption. A good business environment in the Kingdom of Bahrain, which is considered as one of the best in the Arab countries has supported the investment of local and foreign capitals and boosted the growth. Investment in infrastructure, namely roads, ports, airport and telecommunication has increased the level of FDI, improved economic activities and by the way increased the electricity consumption.

Table-7: The VECM Granger Causality Analysis

Dependent Variable	Direction of Causality				
	Short Run				Long Run
	$\Delta\ln Y_{t-1}$	$\Delta\ln EC_{t-1}$	$\Delta\ln FDI_{t-1}$	$\Delta\ln K_{t-1}$	ECT_{t-1}
$\Delta\ln Y_t$	....	4.1823** [0.0179]	0.1183 [0.8885]	1.9382 [0.1429]	-0.0337** [-2.2824]
$\Delta\ln EC_t$	2.4009*** [0.0956]	....	2.0325 [0.1361]	9.9083* [0.0003]	-0.0438* [-2.8101]
$\Delta\ln FDI_t$	1.4812 [0.2321]	1.3864 [0.2545]	....	1.8641 [0.1601]	-0.1271** [-2.4946]
$\Delta\ln K_t$	8.4009* [0.0004]	1.0440 [0.3556]	2.6391*** [0.0761]	....	....
Note: *, ** and *** show significance at 1, 5 and 10 per cent levels respectively.					

In short run, economic growth and capital Granger-cause electricity consumption. Capital use is

Granger cause of economic growth and foreign direct investment. The summary of causality results is reported in Table-8.

Table-8: Summary of Causality Analysis

Directional of Causality	Short Run	Long Run
$\ln EC_t$ Granger causes $\ln Y_t$	Significant at 5%	Significant at 5%
$\ln EC_t$ Granger causes $\ln FDI_t$	No Causality	Significant at 1%
$\ln EC_t$ Granger causes $\ln K_t$	No Causality	No Causality
$\ln Y_t$ Granger causes $\ln EC_t$	Significant at 5%	Significant at 1%
$\ln Y_t$ Granger causes $\ln FDI_t$	No Causality	Significant at 5%
$\ln Y_t$ Granger causes $\ln K_t$	Significant at 1%	No Causality
$\ln FDI_t$ Granger causes $\ln EC_t$	No Causality	Significant at 1%
$\ln FDI_t$ Granger causes $\ln Y_t$	No Causality	Significant at 5%
$\ln FDI_t$ Granger causes $\ln K_t$	Significant at 10%	No Causality
$\ln K_t$ Granger causes $\ln EC_t$	Significant at 1%	Significant at 5%
$\ln K_t$ Granger causes $\ln Y_t$	No Causality	Significant at 5%
$\ln K_t$ Granger causes $\ln FDI_t$	No Causality	Significant at 5%

It is argued in the economic literature that the Granger causality approaches such as the VECM Granger causality test has some limitations. The causality test cannot capture the relative strength of causal relation between the variables beyond the selected time period. This weakens the reliability of causality results by the VECM Granger approach. To solve this issue, we applied innovative accounting approach (IAA) i.e. variance decomposition method and impulse response function. We have implemented the generalized forecast error variance decomposition method using vector autoregressive (VAR) system to test the strength of causal relationship between economic growth, electricity consumption, foreign direct investment and capital case of Indonesia. The variance decomposition approach indicates the magnitude of the predicted error variance for a series accounted for by innovations from each of the independent variable over different time-horizons beyond the selected time period. It is pointed by Pesaran and Shin, (1997) that the generalized forecast error variance decomposition method shows the proportional contribution in one variable due to innovative shocks stemming in other variables. The main advantage of this approach is that like orthogonalized forecast error variance decomposition approach; it is insensitive with ordering of the variables because ordering of the variables is uniquely determined by VAR system. Further, the generalized forecast error variance decomposition approach estimates the simultaneous shock effects. Engle and Granger, (1987) and Ibrahim, (2005) argued that with VAR framework, variance decomposition approach produces better results as compared to other traditional approaches.

Table-10: Variance Decomposition Approach

Variance Decomposition of $\ln Y_t$					
Period	S.E.	$\ln Y_t$	$\ln EC_t$	$\ln FDI_t$	$\ln K_t$
1	0.0079	100.0000	0.0000	0.0000	0.0000
2	0.0142	99.3618	0.5377	0.0459	0.0545
3	0.0205	97.7460	1.8829	0.3081	0.0627

4	0.0268	95.5664	3.7545	0.6341	0.0448
5	0.0318	89.0881	10.3106	0.4684	0.1327
6	0.0369	81.6745	17.7427	0.3569	0.2258
7	0.0418	74.2287	24.9785	0.4444	0.3482
8	0.0467	67.1732	31.4541	0.8586	0.5139
9	0.0507	62.9338	35.2215	1.3415	0.5030
10	0.0542	59.7970	37.9251	1.8371	0.4406
11	0.0573	57.5671	39.6967	2.2513	0.4847
12	0.0600	55.9359	40.6433	2.4861	0.9345
13	0.0627	54.6655	41.0914	2.5019	1.7410
14	0.0653	53.6660	40.9683	2.4340	2.9315
15	0.0678	52.8586	40.4474	2.3094	4.3845
Variance Decomposition of $\ln EC_t$					
Period	S.E.	$\ln Y_t$	$\ln EC_t$	$\ln FDI_t$	$\ln K_t$
1	0.0147	6.9273	93.0726	0.0000	0.0000
2	0.0270	3.3680	96.4460	0.1357	0.0500
3	0.0389	1.6505	97.8285	0.4408	0.0800
4	0.0505	1.3264	97.7965	0.7706	0.1063
5	0.0559	1.9014	96.9404	0.8897	0.2684
6	0.0592	3.1293	95.2387	1.0984	0.5335
7	0.0615	5.1048	92.5249	1.3278	1.0423
8	0.0633	7.6348	88.9318	1.5364	1.8969

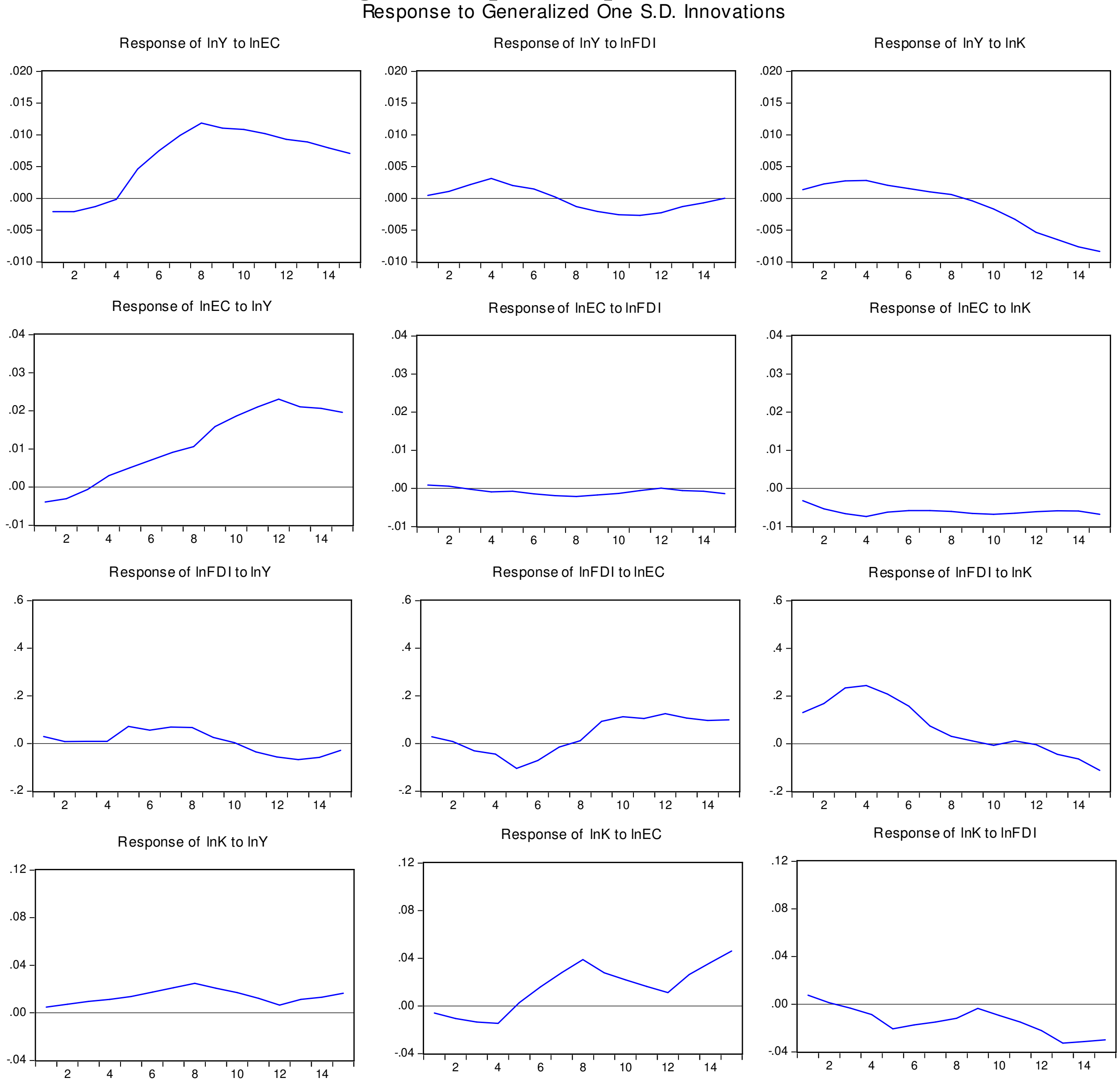
9	0.0665	12.5671	82.9636	1.6706	2.7985
10	0.0706	18.0958	76.5829	1.7181	3.6031
11	0.0755	23.5881	70.6593	1.6574	4.0951
12	0.0811	28.5030	65.7084	1.5452	4.2433
13	0.0857	31.5082	62.6802	1.5175	4.2939
14	0.0902	33.7239	60.4590	1.5113	4.3055
15	0.0943	35.2066	58.8309	1.5600	4.4022
Variance Decomposition of $\ln FDI_t$					
Period	S.E.	$\ln Y_t$	$\ln EC_t$	$\ln FDI_t$	$\ln K_t$
1	0.4803	0.3617	0.6068	99.0314	0.0000
2	0.6585	0.2059	0.3489	98.9114	0.5336
3	0.8174	0.1465	0.3584	97.5573	1.9376
4	0.9459	0.1189	0.4779	96.4562	2.9468
5	1.0121	0.6016	1.1813	94.7492	3.4677
6	1.0415	0.8623	1.4299	93.7916	3.9160
7	1.0516	1.2779	1.4035	93.3891	3.9292
8	1.0552	1.6726	1.4774	92.9328	3.9170
9	1.0616	1.7086	2.3992	91.8977	3.9944
10	1.0716	1.6783	3.5480	90.7266	4.0470
11	1.0844	1.7470	4.2968	89.5812	4.3748
12	1.1039	1.9517	5.2192	88.1818	4.6470
13	1.1195	2.2623	5.7605	87.4055	4.5715

14	1.1302	2.4829	6.2120	86.8167	4.4883
15	1.1404	2.5033	6.7990	85.9172	4.7803
Variance Decomposition of $\ln K_t$					
Period	S.E.	$\ln Y_t$	$\ln EC_t$	$\ln FDI_t$	$\ln K_t$
1	0.0276	3.0422	3.2109	7.7119	86.0348
2	0.0577	2.2349	3.1153	1.8372	92.8125
3	0.0928	1.9409	2.6878	0.8256	94.5455
4	0.1313	1.7030	2.2023	0.8253	95.2692
5	0.1598	1.8814	1.6521	2.4778	93.9885
6	0.1829	2.3473	2.6140	3.1004	91.9381
7	0.2031	2.9809	5.0438	3.3979	88.5771
8	0.2214	3.7556	8.7432	3.4521	84.0489
9	0.2386	3.9845	9.6234	3.0750	83.3168
10	0.2561	3.9033	9.4939	2.9116	83.6910
11	0.2742	3.6059	8.8347	2.9428	84.6164
12	0.2930	3.2073	7.9442	3.2325	85.6159
13	0.3095	3.0076	8.0879	4.2450	84.6593
14	0.3238	2.9103	9.0144	5.0896	82.9855
15	0.3365	2.9323	10.7560	5.8022	80.5093

The results of variance decomposition approach are described in Table-10. The empirical evidence indicates that a 52.85 percent portion of economic growth is contributed by its own innovative shocks and one standard deviation shock in electricity consumption explains economic growth by 40.44 per cent. Foreign direct investment and capital use contributes to economic by 2.30 per cent and 4.38 per cent respectively. The share of economic growth in electricity consumption is 35.20 per cent. Foreign direct investment and capital explain electricity consumption minimally i.e. 1.56 per cent and 4.40 per cent respectively. A 58.83 per cent share of electricity consumption is contributed by its own innovative shocks. The standard shocks stemming in economic growth, electricity consumption and capital use explain foreign direct investment by 2.50 per cent, 6.79 per cent and 4.78 per cent respectively. A 85.91 per cent share is explained by its own innovative shocks of foreign direct investment. The contribution of economic growth, electricity consumption and foreign direct investment in capital is ignorable and 80.50 per cent is explained by innovative shocks in capital use.

The impulse response function is alternate of variance decomposition approach and shows the reaction in one variable due to shocks stemming in other variables. The Figure-4 indicated the positive response in economic growth due to standard shocks stemming in electricity consumption after 4th time horizon. The response of economic growth is inverted U-shaped till 6th time horizon and it becomes U-shaped after 8th time horizon due to shocks in foreign direct investment. The contribution of capital in economic growth is positive but becomes negative after 9th time horizon. Electricity consumption responds positively due to standard shock in economic growth. The response of electricity consumption is negative due to standard shock stemming in foreign direct investment and capital. The response of foreign direct investment is deviating due to shocks in economic growth, electricity consumption and capital.
Economic growth contributes to capital positively (electricity consumption after 5th time horizon boosts capital use). The contribution of foreign direct investment to capital is not appealing.

Figure-4: Impulse Response Function



7. Concluding Remarks and Policy Implications

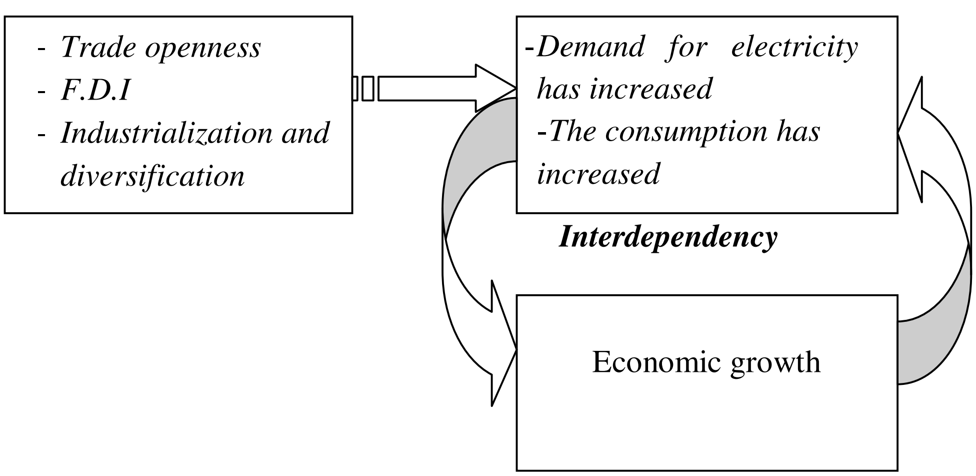
The paper studies the dynamic relationship between economic growth and electricity consumption in Kingdom of Bahrain over the period of 1980Q1-2010Q4. We applied augmented neoclassical production by incorporating foreign direct investment and capital as important determinants of economic growth as well as electricity consumption. The structural break unit root test is applied to test the stationary properties of the variables. The ARDL bounds testing is used to examine whether cointegration between the variables exists in the presence of structural break arising in the series.

Our results corroborate the existence of a cointegration relationship between the variables. Furthermore, electricity consumption contributes to economic growth. Foreign direct investment adds in economic growth. Capital use boosts economic growth. The causality analysis reveals the feedback effect between electricity consumption and economic growth. The relationship between foreign direct investment and electricity consumption is bidirectional. The bidirectional causality exists between foreign direct investment and economic growth. Electricity consumption, economic growth and foreign direct investment are Granger cause of capital.

The bidirectional causal relationship between electricity consumption and economic growth suggests implementing energy exploration policies to sustain economic development for long span of time. The adoption of energy conservation policy will have detrimental impacts on economic growth as well as on quality of life. In such situation, Bahrain must focus on solar (green) energy to meet rising demand of energy. Solar energy is environment friendly and it can be utilized to maximize domestic output as well as to enhance quality of life.

In fact, as we discussed earlier in the introduction, the changing in life-styles and the improving living standards of Bahraini citizens during the past decade has driven energy demand. The Figure-5 below illustrates, the increase in foreign direct investment (FDI) and projects as well as the dynamism of the economy has firstly created employment and secondly has increased the use of electricity for industry as well as for private consumption. Thus, per capita income has increased. The most demanded energy service in Bahrain is the air-conditioning due to the hard weather conditions during the spring and the summer, where humidity surpasses 90 per cent and heat reaches to 50 Celsius. In this case, one conclusion to be drawn is that a shortfall in the power supply will certainly results in slumps in economic activity in the long run. In this case, avoiding shortfall is a most important energy policy to guarantee continuous growth of economic activities. This could be done by building larger generating capacity to satisfy the different sectors of the economy and to develop new sources of energy such as wind energy and green energy. Bahrain plans to implement a large set of sustainable technology project across the country in the future. Bahrain's National Oil and Gas Authority (NOGA) is implementing five megawatt solar capacity into a wireless smart grid network in cooperation with Petra Solar, Bahrain Petroleum Company (BAPCO) and Caspian Energy Holdings. The grid avoids common interconnection issues and costs of traditional solar systems. Further, it has the ability to install into the current transmission and distribution infrastructure (Trade Arabia, 2012).

Figure-5: Explaining the relationship between electricity consumption and growth



The interesting insights drawn from this study leads us to reinvestigate the relationship between ICT, electricity consumption and economic growth. Furthermore, the present study does not reveal which of sectors is major driver of electricity consumption: housing, commercial or industrial. Bahrain is considered as financial hub in the Middle East. This has attracted many foreign capitals. An interesting research could be the investigation of foreign direct investment and financial development impact on carbon emissions in the case of the Kingdom of Bahrain.

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