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The nexus between electricity consumption and economic growth in Bahrain

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ABSTRACT

This paper explores the relationship between electricity consumption, foreign direct investment, capital and economic growth in the case of the Kingdom of Bahrain. The Cobb–Douglas production is used over the period of 1980Q1–2010Q4. We have applied 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 exposed the feedback effect between electricity consumption and economic growth and the same is true for foreign direct investment and electricity consumption. This study suggests government authorities to explore new sources of energy to achieve sustainable economic development for the long run.

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 (for example 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 the case of the United States. Since this study was 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 (Abosedra et al., 2009; Shiu and Lam, 2004; Solarin, 2011; Zeshan and Ahmad, 2013 etc.). But Ghosh (2002), Narayan and Smyth (2005), Mazumder and Marathe (2007), Sami (2011), and Akpan and Akpan (2012) contradicted Kraft and Kraft's findings and reported that energy (electricity) consumption Granger causes economic growth.

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 (Ghali and El-Sakka, 2004; Jumbe, 2004; Shahbaz and Lean, 2012; Shahbaz et al., 2011; Shahbaz et al., 2012 and Wolde-Rufael, 2005). The second range finds unidirectional causality from economic growth to energy (electricity) consumption (Cheng and Lai, 1997; Jamil and Ahmad, 2010; Kraft and Kraft, 1978; Narayan and Smyth, 2008; Shahbaz and Feridun, 2012; Soytas and Sari, 2003). 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 running from energy (electricity) consumption to economic growth (Chandran et al., 2009; Odhiambo, 2009b; Shiu and Lam, 2004; Yoo, 2005; Yuan et al., 2007). Finally the fourth range finds no causal relationship between energy (electricity) consumption and economic growth (Akarca and Long, 1980; Stern, 2000, 2003; Yu and Choi, 1985). This suggests that energy does not play its role to enhance economic growth and implementation of the energy conservation policies would not be 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

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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 Phillips and Perron (1988) and later on, we applied the Zivot and Andrews (1992) structural break unit root test. Further, to check the existence of structural breaks in time series we shall be using the Zivot and Andrews (1992) 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, then final step is to apply the VECM Granger causality test to detect the nature of the causal relationship between the variables.

The remainder 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 towards an industrial based economy to diversify its economy and to shrink its dependency on oil, thus electricity is becoming an 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 investigating whether electricity consumption contributes to economic growth in order to make appropriate energy policies. The Kingdom of Bahrain makes use of five electric generation plants namely: the 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), and the Hidd power and water station (Gas Turbine and Steam Turbine). The total electricity generating capacity is around 2.9 GW. 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 the privatization process of some state-owned power sector assets. The Al Ezzel plant is the first output of this initiative. It has started commercial operation in 2006. The 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 relies much more on gas for 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 the natural gas issue and is pursuing various options to 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 mid-2012. This project aims to secure the 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 Fig. 1 shows that it has doubled in less than twenty years (from 4637.43 KW per capita in 1980 to 8875.75 KW per capita in 1999). Regarding, GDP per capita, the mean is 11398.04 dollars, with a maximum of 14788.89 dollars and a minimum of 8710 dollars. Fig. 1 below illustrates the trajectory of the four indicators (before logarithmic transformation) during the period of our study.

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, the growth hypothesis has been confirmed. This means that electricity consumption Granger causes economic growth. For example, Shiu and Lam (2004) for China; Ho and Sui (2006) for Hong Kong; Gupta and Chandra (2009) for India; Abosedra et al. (2009) for Lebanon; Chandran et al. (2009) for Malaysia; Odhiambo (2009a) for Tanzania; Solarin (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; Mazumder and Marathe (2007) for Bangladesh; Jamil and Ahmad (2010); Shahbaz and Feridun (2012) for Pakistan; Ciarreta and Zarraga (2010) for Spain; Sami (2011) for Japan; and Adom (2011) for Ghana showed

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