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Electricity consumption and economic growth in the GCC countries: Panel data analysis

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HIGHLIGHTS

- The relationship between electricity consumption and GDP is explored.
- Panel data econometric analysis is used to obtain the results.
- Bidirectional causality between these variables is observed.
- The results support the feedback hypothesis in the GCC countries.

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ABSTRACT

Applying recent advances in panel data analysis, we investigate the relationship between electricity consumption and economic growth in the GCC countries using annual data from 1975 to 2012. Within a framework which takes into consideration dynamics, heterogeneity and cross-sectional dependence in the panel, we show that the results obtained from using the PMGE, demeaned PMG, AMG, MGE and DFE models indicate a long-run equilibrium relationship between electricity consumption and economic growth. In order to determine the appropriate model and decide the preferred estimator, the Hausman test was performed. The PMGE model emerged as the most efficient of the three estimators. Also, the results obtained revealed a bi-directional causality between economic growth and electricity consumption in these countries, which supports the feedback hypothesis. As a result, this implies that if these countries adopt or implement any energy or electricity conservation policies, this may have a negative impact on its economic growth.

1. Introduction

Recently, there has developed a voluminous body of literature focusing on the relationship between electricity consumption and economic growth. The most recent studies in this area include Kim (2015), Al-Mulali et al. (2014), Cowan et al. (2014), Hu and Lin (2013), Abbas and Choudhury (2013), Shahbaz and Lean (2012), Bildirici et al. (2012), and Gurgul and Lach (2011), among others.[1]

This upsurge in interest can be attributed partly to the following main factors. Firstly, in the last two decades or so there has been an increase in global demand for energy consumption, particularly for oil and gas, fueled abstemiously by the fast-growing economies of China, India and the United States, among others. This has led to increased demand for electricity worldwide as a result of rising living standards, industrialization and widespread urbanization, among other factors. Also, this increase in the demand for energy and particularly for oil has dramatically increased the global price of oil, which has led to a colossal windfall for the oil-exporting countries, such as the Gulf Corporation Council (GCC) countries, namely Bahrain, Kuwait, Qatar, Oman, Saudi Arabia and the United Arab Emirates (UAE). Due to this boost in oil revenues, the GCC countries began transforming their economies by investing in various sectors of the economy such as infrastructure, education and tourism. This, likewise, has led to an increase in the demand for electricity in these countries, which will be the focus of the

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[1] Payne (2010) gave a survey of literature review on the causal relationship between electricity consumption and economic growth, particularly focusing on the different hypotheses tested, methodological issues, variables selected and model specifications. The author reported that the empirical results produced mixed results and this can be attributed to variable selection, model specification, the time periods of studies and the econometric approaches used by the different authors.

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present study. In particular, we will be focusing on examining the relationship between electricity consumption and economic growth in these countries using extensive panel data analysis.

It is widely accepted in the literature that there is a strong correlation between these two variables, as profoundly articulated recently in the following assertion by the U.S. Energy Information Administration (EIA, 2013):

> A country's economy and its energy use, particularly electricity use, are linked. Short-term changes in electricity use are often positively correlated with changes in economic output (measured by gross domestic product (GDP). However, the underlying long-term trends in the two indicators may differ. All else equal, a growing economy leads to greater energy and electricity use.

Secondly, the increase in studies focusing on the relationship between energy consumption and economic growth, and its success in producing informative results, has triggered interest in study of the relationship between electricity consumption and economic growth using characteristically similar methodologies, since the variables of interest in these studies are relatively analogous. Thirdly, the availability of both macro- and micro-level data and improvements in the quality of data have enabled researchers to investigate this relationship. Economists have been interested in studying this relationship for a long time: since the pioneering work of Kraft and Kraft (1978) on energy consumption and economic growth. Fourthly, electricity is considered one of the main inputs of the production process and will have a significant impact on the economic activities of these countries.[2] Finally, similar to other emerging economies electricity is generated in the GCC countries from conventional sources such as oil, coal and gas since these countries are well endowed with hydrocarbons and almost all of the energy used in the region comes from non-renewable sources. However, it is truism that these countries' economies have grown dramatically in the last three decades and this has led to an increase in the demand for energy and more particularly electricity consumption. This increase in the demand for energy has put a tremendous pressure on these countries' hydrocarbon resources by using an increasing amounts of these resources domestically and this had a damaging impact on environment. According to the World Bank data (2015), the GCC countries lead the way in terms of carbon dioxide emissions per capita and are major contributors to climate change with regard to total global emissions. Additionally, this growing demand for energy consumption coupled with declining reserves of fossil fuels has made the region one of the most energy intensive economies in the world and this entails that this over-reliance on fossil fuels is not sustainable. These trends have necessitated that these countries to embark on devising strategies to diversify their energy mix towards alternative sources such as renewable, improving energy efficiency and reducing carbon-dioxide (CO2) emissions. Due to these dynamics and linkages between energy consumption, environment and economic growth, it is one of the main objectives of the present study to examine the empirical relationship between electricity consumption and economic growth in these countries. Hence, understanding and developing a firm knowledge of this relationship is of fundamental importance to both policymakers and politicians in designing and formulating an effective energy and environmental policies.[3]

This paper contributes to this debate in more ways than one since it is evident from the literature that this debate on the causal relationship between these variables is far from conclusive. Firstly, it presents new empirical analysis that focuses exclusively on the GCC countries and, as deservedly noted by Wolde-Rufael (2014), because of the diversity of the empirical findings, together with the important role the electricity sector can play in economic development, not only necessitates further research but also the use of new alternative methodologies for testing the causal relationship between electricity consumption and economic growth. In this regard, the principal purpose of the paper is to complement and extend the previous literature by overcoming several limitations of previous and frequently used econometric methods in order to intervene cogently in this debate about the relationship between these variables using recently developed panel data analysis.[4] Secondly, and more specifically, the empirical analysis presented in this paper differs significantly from that of previous studies by adopting extensive panel data analysis concerning dynamics, heterogeneity and cross-sectional dependence that has never been applied in this model or, more particularly, in the context of this region. More distinctively, in order to explore the dynamic relationship between these variables, we use the recently developed panel data technique of the pooled mean group estimator (PMGE) procedure. Thirdly, besides being one of the first to use this methodology for these variables, and more particularly for the GCC countries, there are other advantages in choosing these techniques, particularly the PMGE methodology. The PMGE procedure not only permits one to control for individual (country-specific) effects that might invalidate the results of the cross-sectional analysis, but also enables the identification of the long-run equilibrium (cointegration) relationship between these variables, whether they are stationary or not. In sum, it allows for short-run parameters to differ between countries but imposes a long-run homogeneous relationship for the countries in the sample, which yields efficient and consistent estimates when homogeneity restriction is true, and which will be tested by using the Hausman homogeneity test as well as the *endo*geneity bias in the panel data.

The remainder of the paper is organized as follows: Section two presents a brief overview of the literature followed by a short discussion on the pattern of economic growth and electricity consumption in the GCC countries in section three. Section four presents the research methodology while section five is devoted to data analysis and the empirical results of the paper. Section six concludes the paper.

2. Brief overview of the literature

As indicated at the outset, a high volume of literature has extensively examined the relationship between electricity consumption and economic growth, including the nature of their interaction and the direction of causality. Based on the interaction between these two variables, most of these studies have reported and documented that there is a strong correlation between them, but in term of causality most of the studies have produced mixed and conflicting results. Several studies have indicated a unidirectional causality between these two variables, with some indicating that electricity consumption causes economic growth while others

[2] From this perspective, Lee and Chang (2008) point out that economic activities consider energy as a required input in the production process and, as the economy is driven by increasing energy demands, we firmly believe that excluding energy use from the production function would clearly be a sign of a lack of judgment.

[3] For detailed discussions of the policy implications of the relationship between electricity consumption and economic growth, see Narayan and Smyth (2005). The authors argue that the direction of causality between these two variables will generally determine the policy implications recommended. For instance, if the causality runs from economic growth to electric consumption then the authors recommend that policies on electricity conservation will not have an impact on economic growth.

[4] See footnote 1.

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