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Natural gas consumption and economic growth nexus: Panel data analysis for GCC countries

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ABSTRACT

This study investigates the relationship between natural gas energy consumption and economic growth by including trade openness, total labor force and gross fixed capital formation as a major determinants of GDP growth within the multivariate framework model in Gulf Cooperation Council (GCC) countries. A panel GDP model is constructed taking the period of 1980–2012. The result revealed that natural gas energy consumption is cointegrated with GDP growth in the investigated countries. In addition, based on the panel dynamic ordinary least square (DOLS) and the fully modified ordinary least square (FMOLS), this study concluded that the natural gas energy consumption affects the GCC's countries GDP growth positively in the long run. Furthermore, the results from the Granger causality test revealed bidirectional causality between natural gas energy consumption and GDP growth which confirms the feedback hypothesis. From the outcome of this research, a number of policy implications were provided for the GCC countries.

Contents

1. Introduction

The Gulf Cooperation Council (GCC) countries have witnessed a substantial increase in the economic growth which represented an average increase of 50% [80] in the last three decades. The economies of the GCC countries are fossil fuel (oil and natural gas) based economies. These natural resources represent more than 75% of total exports and government revenues. Moreover, the GCC countries produce more than 21% of the world oil production and have a share of 36% of the world oil reserves. Furthermore, the GCC countries are also one of the major natural gas producers in the world. The natural gas production of these countries represents more than 11% of the world natural gas production. In addition, these countries hold more than 10% of the world natural gas reserves [31]. This abundance of fossil fuels made these resources a major source of energy in the GCC countries.

Natural gas consumption plays a vital role in electricity generation in the GCC countries because more than 80% of its electricity comes from natural gas [80]. This source of energy is considered to be the cleanest fossil fuel energy because of its low production of CO_2 emissions. Thus, it can be a good solution for reducing the levels of environmental pollution. In spite of the substantial literature that explored the energy–GDP relationship, none of the previous studies had investigated the natural gas energy consumption–GDP relationship in the GCC countries, even though they have witnessed a considerable increase in natural gas consumption in the last three decades. Therefore, the aim of this study is to fill this gap and

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contribute literature by investigating the natural gas consumption and GDP growth relationship in the 7 GCC countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates (UAE)) for the 1980–2012 period.

2. Literature review

Many studies explored the relationship between energy consumption (from renewable and non-renewable sources) and GDP growth. The conclusions of these studies varied. Some studies found that a bi-directional causality exists between energy consumption and GDP growth. This relationship is called the *feedback hypothesis* which denotes that energy consumption and GDP growth are mutually determined. Another group of studies indicated that there is a unidirectional causality from energy consumption to GDP growth. This relationship is termed the *growth hypothesis* which implies that conducting energy conservation might adversely affect GDP growth. A unidirectional causality from GDP growth to energy consumption was found in a number of studies. This relationship is called the *conservation hypothesis*. This hypothesis implies that energy conservation policies might adversely affect economic growth. Lastly, a number of studies found no causal relationship between the two variables. This phenomenon is called the *neutrality hypothesis*. This indicates that energy consumption and GDP growth are not correlated. Thus, the utilization conservation polices on energy consumption will have no affect economic growth [60].

The feedback hypothesis was found in a number of countries and regions such as Southeast Asian countries: Malawi [40], Malaysia [79], China [88,42,77,90] Taiwan [85], Bangladesh [3], Pakistan [72], in ten South east Asian countries [26], and South Korea [54,35]; in African countries such as Algeria [25], Burkina Faso [58], Tunisia [23], West African states [59], South Africa [56] and Nigeria [30]; in European countries such as Poland [36], Portugal, Italy, Greece, Spain and Turkey [33], Portugal [71], Eurasian countries [7,9] and Russia [89]; in Middle Eastern countries such as Lebanon [29] and the entire Middle East [53]. In addition, this relationship was also found in the Americas [15,69], Barbados [47], Pacific Island countries [48], in different developed and developing countries [11–13,17], emerging countries [16], and the OECD countries [10,27].

The growth hypothesis confirmed in a number of European countries [27], Turkey [5], Soviet Republics [24], and Greece [28]; in a number of Middle Eastern countries such as Israel [19], and Lebanon [1]; in South East Asian countries and ASEAN [44], Hong Kong [37], China [82,76,81], and Shanghai [83]; in a number of Pacific countries: Australia [75], and Fiji Islands [50]; in South American countries ([8], 2010); in African countries such as Tanzania [57]. Lastly, the growth hypothesis was found in the G-7 [51] and OECD countries [52].

The conservation hypothesis was discovered by a number of studies in different countries such as Switzerland [21], Pakistan [39], in the GCC countries [6], New Zealand [22], in oil exporting countries, Bangladesh [49], India [34], South Korea [55] and Turkey [46]. Furthermore, the neutrality hypothesis was detected in Turkey [4,61], transition countries [2], in the US. [64,65,86,63], in 11 MENA countries [62], and Taiwan [84].

However, a limited number of researchers studied the link between natural gas energy consumption and GDP growth. For instance, Kum et al. [41] found a unidirectional causality from natural gas consumption to economic growth in the G-7 countries. Similar results were discovered in Pakistan by Shahbaz et al. [73]. However, Aqeel and Butt [18] and Siddiqui [78] did not find such relationship in Pakistan. In addition, Hossein et al. [38] also did not find any Granger causality relationship for all the OPEC countries in the long run. On the other hand, Sari et al. [70] found a unidirectional causality from economic growth to natural gas consumption for USA. Morever, Apergis and Payne [14] found a bi-directional relationship between natural gas consumption and GDP growth in a panel of 67 countries. The same results were discovered by Lim and Yoo [45] in South Korea, Pakistan [74], Iran [87], and Taiwan [43].

The examined review of literature indicates the diverse conclusions that previous studies reached. The results obtained from the 83 studies are as follows: 52% of them indicated that feedback relationship between energy consumption and GDP growth exists, 28% of the studies showed the presence of the growth hypothesis, 10% of the studies indicated the existence of the conservation hypothesis, and 10% of the studies showed the presence of the neutrality hypothesis.

It is crucial to note that the studies which investigated the energy–GDP growth relationship in the GCC countries are relatively limited. Moreover, there have been no studies that investigated the natural gas-GDP growth relationship in the GCC countries despite its prominent significance in electricity production. Thus, this study will explore the relationship between natural gas energy consumption and GDP growth in GCC countries and fill the gap in the energy economics literature.

3. Data, methodology and empirical results

The sample period is 1980–2012 and annual data is utilized for 7 GCC countries which are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates. Four variables are used in this study to build a GDP growth model for the GCC countries. Following Sadorsky's [69] GDP growth model, this study used trade openness, total labor force and gross fixed capital formation as major determinants of GDP growth. Furthermore, natural gas energy consumption is used to examine the effect of natural gas energy consumption on the GCC countries' GDP growth.

The gross domestic product (GDP) is utilized as the dependent variable measured in millions of constant 2000 US dollars. In addition, four independent variables are utilized, namely, gross fixed capital formation (GFC) measured in millions of constant 2000 US dollars, total trade of goods and services (TD) as an indicator of openness measured in constant 2000 US dollars, total labor force (L) measured in thousands of workers and natural gas energy consumption (NG) measured in billion cubic feet.

The data source for the GDP, TD, GFC and L are retrieved from the [32]. In addition, the data for NG is sourced from the [31].

Panel model is utilized because of a number of advantages such as, its capability to control the serial correlation and the individual heterogeneity which increases the degree of freedom and it is more reliable and efficient compared to the individual time series analysis [20]. The panel GDP growth model:

$$GDP_{it} = f(GFC_{it} + L_{it} + TD_{it} + NG_{it}) \quad (1)$$

Each variable is presented in its natural log. Moreover, the error term is added to the GDP growth model. The model can be written as follows:

$$GDP_{it} = \beta_{1i} GFC_{it} + \beta_{2i} L + \beta_{3i} TD_{it} + \beta_{4i} NG_{it} + \varepsilon_{it} \quad (2)$$

The β_{1i}, β_{2i}, β_{3i} and β_{4i} represent the slop coefficients, i represent cross section (1…6 GCC countries), t is the time period (1980–2012), and ε is the error term.

The initial step in the econometric analysis is to analyze the stationarity of the variables by using the two unit root tests, namely, the Fisher-ADF and Fisher-PP. These tests are considered by a combination of individual unit root tests to attain panel results. The PP and the ADF unit root tests work under the null and the alternative hypothesis. The former indicates that the variables have a panel unit root which indicates that they are not stationary. The latter explains that the variables are stationary, i.e. do not have