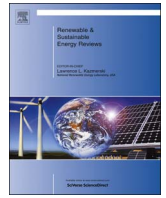




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CO₂ emissions, energy consumption, economic growth, and financial development in GCC countries: Dynamic simultaneous equation models

1. Introduction

The relationship between energy consumption and economic growth, as well as economic growth and environmental pollution, has been the subject of intense research in the last three decades. However, the empirical evidence remains controversial due to many influencing factors. The existing literature reveals that empirical studies differ substantially; for example, some investigate single countries and others examine multiple countries, see [1–10]. The results of these studies carry various policy implications in an economic context. An assessment of the existing literature suggests that most studies have focused either on the nexus of economic growth and energy consumption or of economic growth and environmental pollutants, but only a limited number of studies has tested these two relationships in the same framework.

Rapid global economic growth resulted in a 1.4% increase in overall emissions over 2011, reaching a total of 34.5 billion tonnes in 2012. The CO₂ emissions trend reflects energy-related human activities which were determined by economic growth, particularly in emerging countries. In 2012, a decoupling of the increase in CO₂ emissions from global economic growth (in gross domestic product) took place, which points to a shift toward less fossil fuel-intensive activities. Furthermore, it reflects enhanced use of renewable energy and increased energy saving. Actually, 90% of the CO₂ emissions originate from fossil-fuel combustion and therefore are determined by the energy demand or the level of energy-intensive activity. High energy demand predicts high levels of use in power generation, industries, and road transport. However, changes in energy efficiency and shifts in the fuel mix, especially from carbon-intensive coal to low-carbon gas or from fossil fuels to nuclear or renewable energy, can cut the overall global emissions level [11].

The relationship between energy consumption and economic growth, as well as economic growth and environmental pollution, has been the subject of intense research in oil-rich countries (Oman, United Arab Emirates (UAE), Kingdom of Saudi Arabia (KSA), Bahrain, Qatar, and Kuwait). These countries are blessed with abundant renewable energy resources; however, their economies are still highly dependent on the export of fossil fuel products. These countries hold around 23.5% of the world's natural gas and 40% of proven oil reserves. However, only 0.61% of the world's population resides in Gulf Cooperation Council (GCC) countries, but they contribute about 2.4% of the total global greenhouse gas (GHG) emissions [12]. In the present scenario, the economic growth of GCC states is better represented by their gross domestic product (GDP) and per capita energy consumption, which are much higher than in other developing countries [13]. Most of these countries' domestic energy needs are served by fossil fuels, which eventually are responsible for their high per capita GHG emissions. Furthermore, it is significant that GCC states stand in the top 25 countries for CO₂ emissions per capita in global rankings [14].

Growing energy consumption in conjunction with environmental threats poses a practical challenge for GCC countries. There is urgent need to plan renewable energy (RE) technologies which can combat the future challenges. In this context, GCC has a unique opportunity to channel more investment projects in placement of RE technologies to enhance future energy security and cutting off CO₂ emissions. So, the aim of this study is to offer a discussion to policymakers to develop comprehensive and conversation energy policies to achieve long term sustainability in GCC energy systems. Thus, it is appropriate to investigate the relationship and causality among economic growth, financial development, CO₂ emissions, and energy consumption in one framework.

The structure of this paper is as follows. Section 2 contains an overview of GCC countries. Section 3 summarizes the previous studies and Section 4 discusses the estimation methodology. Section 5 provides the empirical analysis, which includes data and the estimation results. Lastly, conclusions and policy implications are presented in Section 6.

2. GCC context

A combination of brisk economic expansion and population growth is fueling a rapid increase in energy demand in the GCC countries [16]. Their energy consumption has grown 74% since 2000 and is projected to nearly double its current level by 2020 [17]. The GCC countries are facing a dual challenge; one aspect involves having to maintain the domestic energy demand and the other involves controlling emissions.

All the GCC nations are projected to experience a substantial rise in energy demand, with Qatar leading the others in its energy-demand growth rate (its share of GCC energy demand is projected to increase from around 10% to 15% between 2010 and 2020). Qatar is estimated to have earned \$55 billion from net oil exports and this sector accounted for 57.8% of the country's GDP in 2012 [18]. The GCC countries present an increasingly attractive opportunity for industrial and energy companies looking to take advantage of low-cost hydrocarbon inputs and favorable tax regimes for the production of higher value products such as steel, aluminum, refined fuels, petrochemicals, and plastics. The recent growth in GCC energy demand and electricity demand, in particular, has resulted in rising global concern over CO₂ emissions and climate change. In the absence of carbon-reduction technologies, alternative sources of energy, and significant energy efficiency measures, CO₂ emissions will continue to increase.

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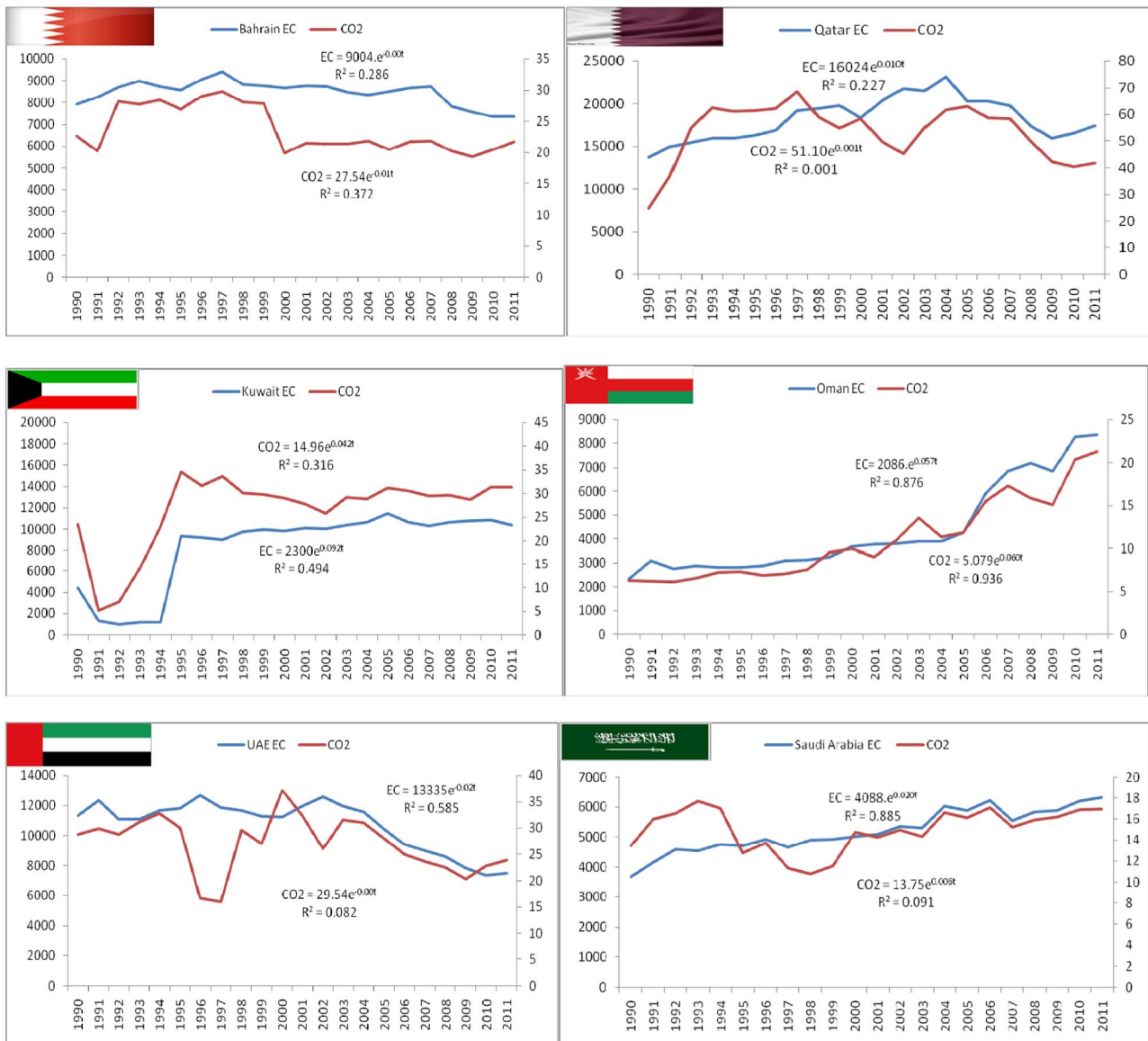


Fig. 1. Energy use and CO₂ emissions by GCC Countries (1990–2011).

Source: World Bank Indicators (2014); Retrieved from: <http://data.worldbank.org/country>.

Overall, only 0.6% of the global population is living in GCC countries, but the region contributes 2.4% of the global greenhouse gas emissions. CO₂ emissions per capita, energy intensities, and CO₂ emissions per GDP in the GCC countries are higher than the average of 25 European Union (EU) countries and Organization for Economic Cooperation and Development (OECD) countries. Considering all the above, it is clear that energy efficiency can be improved in the region [19].

This resource-rich group (the GCC countries) is characterized by extremely high levels of energy use and carbon emissions per capita. The reason behind such high levels is the scarcity of water. These countries lack sufficient renewable water resources within their borders and must depend on other non-renewable water sources to satisfy the needs of their growing populations. In most cases, especially in Saudi Arabia and UAE, they have adopted desalination of sea water as a solution to the water challenges. However, given the energy-intensive nature of the desalination process, they have to rely on fossil fuels to operate the desalination plants, which add to their energy demand and subsequently high emissions. Abu Dhabi is estimated to devote more than half its domestic energy use to desalination [20]. The trends in energy consumption and emissions in all the GCC countries are close to each other (see Fig. 1).

The GCC economies have benefitted from historically high oil prices and expanded oil production, with expansionary fiscal policies and low interest rates providing additional stimulus. However, nominal GDP increases resulting from higher oil prices – assuming that they are not short-lived – represent “real” income and are not just an expression of inflationary price increases. In 2009, for example, the GCC countries’ total real GDP increased marginally, while their combined nominal GDP measured in U.S. dollars fell by almost 19%, primarily as a result of lower oil prices. The GCC countries are leading the regional recovery as oil prices have rebounded and the GCC financial sector is stabilizing. Also, they posted strong economic growth at 7.2% and 6.0% for 2011 and 2012, respectively, but in 2013 the pace slowed a bit to 4%. While the 2009 collapse in oil prices led to a sharp decline in both nominal oil GDP and fiscal revenues in that year, continued increases in government spending kept real non-oil GDP growth positive in all the GCC countries except Kuwait and Oman. Clearly, in these countries, positive growth in real non-oil GDP does not preclude a major decline in real income, or vice versa. Fig. 2 depicts the increase in GDP per capita from 1995 through 2013.

In addition, GCC countries make up the most financially developed region among the group of oil exporters, with the largest energy reserves and

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