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The nexus between carbon emissions, energy consumption and economic growth in Middle East countries: A panel data analysis

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HIGHLIGHTS

- The relationship between CO_2 emissions, energy consumption, and growth is examined.
- Panel data estimation methods are used for 12 Middle East countries.
- We obtain a U-shaped curve contrary to the EKC hypothesis.
- The causality runs from economic growth to energy consumption in the short-run.
- In the long-run, causality runs from energy consumption and growth to CO_2 emissions.

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ABSTRACT

The environmental Kuznets curve (EKC) hypothesis assumes that there is an inverted U-shaped relationship between environmental degradation and income per capita. In other words, as a country grows, it is assumed that its environmental quality improves. In this study, we aim to test the EKC hypothesis for 12 Middle East countries during the period 1990–2008 by employing recently developed panel data methods. Our results provide evidence contrary to the EKC hypothesis. We found evidence favorable to the U-shaped EKC for 5 Middle East countries, whereas an inverted U-shaped curve was identified for only 3 Middle East countries. Furthermore, there appear to be no causal links between income and CO_2 emissions for the other 4 countries. Regarding the direction of causality, there appears to be a unidirectional causality from economic growth to energy consumption in the short-run; in the long-run, however, the unidirectional causality chain runs from energy consumption and economic growth to CO_2 emissions. We also suggest some crucial policy implications depending on these results.

1. Introduction

Global warming and climate change are serious environmental problems of our world. Especially, as a dominant contributor to the greenhouse effect, the increasing amount of carbon dioxide (CO_2) appears to be aggravating environmental problems. These increasing environmental threats have led scholars and policy-makers to assess the impacts of global warming on the world economy and to debate over reducing greenhouse gases (GHGs) emissions to alleviate global warming since 1990s. Furthermore, the mitigation assessment of greenhouse gas emissions has been an integral part of national and international climate policy agendas (Haggar, 2012, p. 358).

After a while, industrialized countries have started to arrange important environmental agreements and agendas in order to decrease and control atmospheric concentration of GHGs emissions. For instance, the United Nations Framework Convention on Climate Change (UNFCCC), adopted in 1992 and opened for signatures at the United Nations Conference on Environment and Development in Rio de Janeiro, is one of the best known environmental conventions. The main aim of UNFCCC is the contracting and converging of CO_2 emissions across countries to combat global climate change and greenhouse effects arising from high atmospheric carbon concentration.

In addition, another international agreement, the Kyoto protocol, has been signed during the UNFCCC. It was adopted on 11 December 1997 in Kyoto and entered into force on 16 February 2005 with the aim of setting binding targets for 37 industrialized countries and the European community to reduce their GHGs emissions. According to the Kyoto protocol, the contracting parties from developed countries are committed to reducing their greenhouse gas emissions by at least 5% from 1990 levels between 2008 and 2012.

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As a result of an increasing environmental consciousness over the last 2 decades, scholars have started to analyze the environment–economy nexus in the framework of environmental economics. For instance, the relationship between environmental degradation and income is one of the most important topics being debated under the name of the environmental Kuznets curve (EKC). The EKC was derived from the original Kuznets curve, testing an income–inequality nexus, proposed by Kuznets (1955). The EKC hypothesis indicates that there is an inverted U-shaped relationship between environmental degradation and economic growth. During a country's early stage of development, economic growth leads to environmental degradation until a turning point is reached. However, this situation is reversed beyond this turning point. In other words, according to the proponents of the EKC hypothesis, emissions are considered to be a function of income whereby as income increases, emissions increase until a threshold level of income is reached after which emissions start to decline (Apergis and Payne, 2010, p. 650).

Testing the validity of the EKC hypothesis or exploring the causal links between income and CO_2 emissions is crucial when designing appropriate policy tools for protecting the environment, fighting against global warming, and ensuring sustainable economic development. In addition, as stated by Narayan and Narayan (2010), examining the relationship between economic growth and environmental quality allows policymakers to judge the response of the environment to economic growth.

Apart from the EKC hypothesis, the second most debated topic in the framework of environmental economics concerns the connection between energy consumption and economic growth. Economic development is closely related to energy consumption given that more energy consumption leads to higher economic development level via productivity enhancement (Ang, 2007). In addition, using energy in a more efficient way requires a higher level of economic development. Thus, as stated by Ang (2007), energy consumption and economic development may be jointly determined and the direction of causality cannot be determined *a priori*.

The final and third research area concerning environmental economics focuses on the relationship between energy consumption, environmental degradation, and economic growth. This is a synthesis of the first (EKC) and the second (energy consumption–economic growth nexus) research areas. In this study, we examine the relationship between energy consumption, environmental degradation, and real per capita income. Additionally, we test the validity of the EKC hypothesis for 12 Middle East countries by taking CO_2 emissions as an environmental quality indicator. Moreover, we examine the direction of causality among economic growth, energy consumption, and CO_2 emissions in the framework of panel vector error correction (PVEC) model.

Our sample of countries consists of Bahrain, United Arab Emirates (UAE), Iran, Israel, Egypt, Syria, Saudi Arabia, Turkey, Oman, Jordan, Lebanon, and Yemen. The Middle East countries attract a special interest for energy economists due to their abundant natural resource reserves, such as crude oil and natural gas. For instance, Iran has about 15% of the world's total reserves of natural gas (Farhani and Rejeb, 2012). The Middle East's share of worldwide oil reserves is about 57.5%. Among Middle East countries, Saudi Arabia, Iran, Iraq, Kuwait, and United Arab Emirates are the major oil producing countries. For instance, according to the statistics of Energy Information Administration (EIA, 2012, http://www.eia.gov), Saudi Arabia was the world's largest producer and exporter of total petroleum liquids in 2010, and the world's second largest crude oil producer behind Russia. Its economy remains heavily dependent on crude oil and oil export revenues have accounted for 80–90% of total Saudi revenues. In addition, according to the report published by the World Bank (2007), Iran and Saudi Arabia are the 13th and 16th highest CO_2 emitters, having produced 402 and 365 million metric ton in 2004, respectively. Furthermore, among the top 20 countries ranked by percentage growth in emissions between 1994 and 2004, there are six Middle East countries, namely Iran, Oman, Saudi Arabia, Turkey, Egypt, and UEA. Thus, it is of great interest to examine the nexus of energy consumption, CO_2 emissions, and economic growth in Middle East countries.

Contributions of our study to the literature are two-fold. First, our panel, consisting of 12 Middle East countries, has not been studied before. There are three panel studies analyzing the relationship between energy consumption, GHGs emissions, and real income in Middle East and North African (MENA) countries. However, we differ from them in that we exclude North African countries. In addition, to the best of our knowledge, there are few panel studies (see for instance, Arouri et al., 2012; Haggar, 2012; Jaunky, 2011) that have taken into account both cross-sectional dependence and slope heterogeneity issues while testing the EKC hypothesis. We employ recently developed panel data methods, i.e. second generation panel unit root tests and panel cointegration test instead of first generation panel tests. This is the novelty of this study.

The rest of paper is organized as follows. In Section 2, we present the literature review. In Section 3, we present methodology and empirical results, and in Section 4, we conclude the study and suggest some policy implications.

2. Literature review

There are three empirical research strands examining the aforementioned topics in the environmental economics literature.

The first strand concentrates on the environmental pollutants and output nexus, and tests the validity of the EKC hypothesis. The first empirical paper concerning the EKC is attributed to Grossman and Krueger (1991). After that, several researchers have tested the EKC hypothesis (see, inter alia, Agras and Chapman, 1999; Dinda and Coondoo, 2006; Friedl and Getzner, 2003; Galeotti et al., 2009; Holtz-Eakin and Selden, 1995; Selden and Song, 1994). Also, Dinda (2004), He and Richard (2010), and Stern (2004) provide extensive literature reviews on the EKC hypothesis.

The second strand consists of studies analyzing the growth–energy nexus. These studies date back to Kraft and Kraft's (1978) seminal study. The earlier studies, given that they mostly applied a bivariate model, were criticized due to omitted variables bias and failed to get unanimous results (see Akarca and Long, 1980; Bentzen and Engsted, 1993; Erol and Yu, 1987; Yu and Hwang, 1984). However, recent studies have started to examine the nexus of energy consumption and economic growth in a multivariate framework (see Gurgul and Lach, 2011, 2012; Altinay and Karagol, 2004; Al-Iriani, 2006; Apergis and Payne, 2009b; Narayan and Smith, 2008; Oh and Lee, 2004; Soytas and Sari, 2003, 2006; Stern, 2000; Yang, 2000). Ozturk (2010) provides an extensive literature survey on the energy–growth nexus.

As stated by Saboori and Soleymani (2011), considering the growth–environment nexus and growth–energy nexus in a bivariate framework suffers from omitted-variables bias. Ang (2007) and Soytas et al. (2007) have gathered both nexus in a single framework in their seminal studies, and thus, the third research strand has emerged. Our study is an example of this third research strand. Studies in this strand can be divided into two sub-groups. The first group includes time-series analyses and focuses on individual countries, whereas the second group consists of panel data analyses for a group of countries. The results of these studies change due to their samples, time intervals, and estimation techniques. A brief literature review of this strand is given below.