Ecological Indicators 45 (2014) 622–631

Contents lists available at ScienceDirect

Ecological Indicators

journal homepage: www.elsevier.com/locate/ecolind

Economic growth, electricity consumption, urbanization and environmental degradation relationship in United Arab Emirates

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ARTICLE INFO

Article history:
Received 12 February 2014
Received in revised form 17 May 2014
Accepted 21 May 2014

Keywords:
Electricity consumption
Growth
CO_2 emissions
Urbanization

ABSTRACT

The present study explores the relationship between economic growth, electricity consumption, urbanization and environmental degradation in case of United Arab Emirates (UAE). The study covers the quarter frequency data over the period of 1975–2011. We have applied the ARDL bounds testing approach to examine the long run relationship between the variables in the presence of structural breaks. The VECM Granger causality is applied to investigate the direction of causal relationship between the variables. Our empirical exercise reported the existence of cointegration among the series. Further, we found an inverted U-shaped relationship between economic growth and CO_2 emissions i.e. economic growth raises energy emissions initially and declines it after a threshold point of income per capita (EKC exists). Electricity consumption declines CO_2 emissions. The relationship between urbanization and CO_2 emissions is positive. Exports seem to improve the environmental quality by lowering CO_2 emissions. The causality analysis validates the feedback effect between CO_2 emissions and electricity consumption. Economic growth and urbanization Granger cause CO_2 emissions.

1. Introduction

The negotiations to extend the Kyoto Protocol which expired in 2012 and to prepare the ground for future global agreement to replace it are still blocked. This is due mainly to two issues. (i) Developing countries are criticizing the non-commitment of industrialized countries to reduce their industrial emissions of carbon dioxide and other greenhouse gases. (ii) Further, they are asking more financial aid from the rich nations to poorer countries to move forward for a cleaner energy source and to reduce greenhouse gases and thus fulfill their pledges under Kyoto Protocol. Yet, are oil-exporting countries concerned by the latest issue? Mining-resources rich countries enjoy sizeable revenues coming from oil and gas export. This is case of United Arab Emirates (UAE). The UAE is a federation of seven emirates namely: Abu Dhabi (the capital emirate), Ajman, Dubai, Fujairah, Ras-al-Khaimah, Sharjah and Umm al-Quwain. Since early 1960s, when oil was first extracted, the UAE moved from fishing and agricultural-based economy to an oil-based economy. The UAE is one of the biggest oil producers in the world.

The UAE has observed resilient economic growth in the last decades sustained by high oil prices. The country has taken advantage to improve its local infrastructure i.e. roads, ports, airports etc. Developed infrastructure had a direct impact on urbanization. World Urbanization Prospects (the 2011 Revision) reports that the UAE's urban population jumped from 54.4% in 1950 to 84.4% in 2010. The urbanization rate reached 2.9% over the period of 2005–2010, which is one of the highest rates in the world. The country's landscape has changed completely and the UAE has become one of the most attractive destinations of regional and global tourism. The UAE government's ambition went beyond the borders with unique projects including the world's tallest building, artificial island (The Palm and World map), and first shopping mall with indoor ski-resort (Dubai mall).

However, such development is costly to the environment, as well as to the public health. Construction industry pollutants are contributing heavily to the air deterioration and water quality. That is why environmental degradation–economic growth nexus has become one of the most attractive empirical topics in

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http://dx.doi.org/10.1016/j.ecolind.2014.05.022
1470-160X/

environmental economics. It has been producing a large amount literature since the beginning of the 1990s. The major concern of this literature is to investigate the relationship between income and environmental degradation is also known as environmental Kuznets curve (EKC). The EKC hypothesis reveals that environmental deterioration increases when country witnesses economic growth, but starts to decrease when income reaches the so-called "turning point". This hypothesis was first introduced and tested by Grossman and Krueger (1991). However, the origins of the EKC are older. In fact, Simon Kuznets, in his presidential address entitled "Economic Growth and Income Inequality", in 1955 suggested that as per capita income increases, income inequality increases initially and after a threshold level of income per capita, income inequality decreases (Kuznets, 1955). This implies that the relationship between income per capita and income inequality is an inverted U-shaped.

To our knowledge, this is the first study for UAE which examines the relationship between economic growth, electricity consumption, urbanization and carbon emissions. Thus, the main goal of this paper is to fill this gap in the energy economics literature. We have applied the ARDL bounds testing approach to examine the relationship between these variables for the period of 1975–2011.

The rest of the paper is organized as follows. The next section gives literature review. Section 3 presents the methodology and data description. Section 4 reports the empirical findings of the study. The last section concludes the paper.

2. Literature review

In pioneering effort, Grossman and Krueger (1991) used the Kuznets curve as a tool to analyze the relationship between the environmental degradation and income per capita. It is important to mention that there is no convention on the best indicator to be used for environmental degradation. Some researchers use carbon dioxide emissions (Holtz-Eakin and Selden, 1995; Roberts and Grimes, 1997; Moomaw and Unruh, 1997, among others) and other use sulfur dioxide emissions (Grossman and Krueger, 1991; Panayotou, 1997; Davidsdottir et al., 1998, among others). A bulky amount of studies tested the economic growth and environmental pollution nexus. However, this literature could be divided to two distinguished components. The first component investigates the pollution–economic growth nexus for a cross-section and/or panel of countries. The second component investigates for individual countries. As it is impossible to review all studies due its large amount, we would review some of recent selected examples from both single studies and cross-sectional/panel data-based analysis of the EKC hypothesis.

In panel framework, Holtz-Eakin and Selden (1995) estimated a quadratic polynomial model on the panel of 130 countries over the period of 1951–1986 and supported the EKC hypothesis. Similarly; Tucker (1995) examined the EKC hypothesis using CO_2 emissions as an indicator of environmental degradation using cross-section data of 131 countries and results supported for EKC hypothesis. Cole et al. (1997) used wide range of indictors (nitrogen dioxide, sulphur dioxide, suspended particulate matter, carbon monoxide, nitrogen dioxide from transport, sulphur dioxide from transport, SPM from transport, nitrate concentrations, carbon dioxide, total energy use, CFCs and halons, methane, municipal waste, energy use from transport, traffic volumes) to investigate the relationship between economic growth and environmental degradation. They employed a quadratic polynomial model using both linear and log-linear versions. Their empirical analysis advocated that the EKC hypothesis exists only for local air pollutants. Hill and Magnani (2002) argued that the EKC for carbon emissions is found to be highly sensitive to the dataset used. They used data for 156 countries and examined the KEC hypothesis for 1970, 1980 and 1990. Their empirical exercised showed the EKC hypothesis for three cross-sections.

Recently, Apergis and Payne (2009) examined the relationship between energy consumption, CO_2 emissions and economic growth for six Central American economies using the panel VECM. They reported that energy consumption raises CO_2 emissions and relationship between CO_2 emissions and economic growth in an inverted U-shaped i.e. KEC is confirmed. Narayan and Narayan (2010) collected the data of 43 developing economies to examine whether EKC exist or not. Based on individual country analysis, they reported that in approximately 35 percent of the sample carbon dioxide emissions have fallen over the long run. Moreover, their results indicated that only for the Middle Eastern and South Asian panels, the income elasticity in the long run is smaller than the short run, implying that carbon dioxide emission has fallen with rise in income. For panel of BRIC countries; Pao and Tsai (2010) investigated the dynamic causal relationships between pollutant emissions, energy consumption and economic growth. They found the long run relationship between the series. Energy consumption has positive impact on energy emissions and the EKC hypothesis also exists in BRIC region. The panel causality analysis revealed the feedback effect between energy consumption and CO_2 emissions and same is true for economic growth and energy consumption. They suggested that in order to reduce CO_2 emissions and not to adversely affect economic growth, increasing both energy supply investment and energy efficiency, and speeding up energy conservation policies to reduce wastage of energy can be initiated for energy-dependent BRIC countries.

Jaunky (2011) attempted to test the environment Kuznets curve (EKC) hypothesis for 36 high-income countries following Narayan and Narayan (2010). Based on single country analysis, results found inverted U-shaped relationship between economic growth and CO_2 emissions i.e. EKC only in Greece, Malta, Oman, Portugal and the United Kingdom. Piaggio and Padilla (2012) explored the relationship between CO_2 emissions and economic growth for 31 countries (28 OECD, Brazil, China, and India). They confirmed the necessity relevance of considering the differences among countries in the relationship between air pollution and economic activity to avoid wrong estimations and conclusions. Arouri et al. (2012) investigated whether the relationship between economic growth and CO_2 emissions shows EKC phenomenon or not by applying bootstrap panel unit root tests and cointegration techniques. Their results showed that energy consumption is a major contributor to CO_2 emissions. However, the EKC hypothesis is confirmed in the long run in most sample countries, the turning points are very low in some cases and very high in other cases. This could reduce the evidence supporting of the EKC hypothesis. They suggested that future reductions in CO_2 emissions per capita might be achieved at the same time as GDP per capita in the MENA region continues to grow.

Table 1 presents the summary of time series studies of single countries. We found that there is no even single country study while investigating the relationship between economic growth and CO_2 emissions using the framework of environmental Kuznets curve in case of UAE. This is a humble effort to fill the gap in exiting literature in the case of United Arab Emirates. The present study opens up new insights for policy making authorities to design comprehensive economic, energy and environmental policy to sustain long run economic growth while improving environmental quality.

3. Data and methodology

3.1. The data and empirical modeling

The data on CO_2 emissions (metric tons), real GDP, electricity consumption (kt of oil equivalent) and urban population has