Renewable and Sustainable Energy Reviews 76 (2017) 138–154

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

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

The impact of economic development and social-political factors on ecological footprint: A panel data analysis for 15 MENA countries

Lanouar Charfeddine*, Zouhair Mrabet

Department of Finance and Economics, College of Business and Economics, Qatar University, P.O. Box: 2713, Qatar

ARTICLE INFO

Keywords:
EKC hypothesis
Ecological footprint
Energy consumption
Political index
Life expectancy
Fertility rate
Oil and non-oilexporting MENA countries

ABSTRACT

This paper extends the work of Al-Mulali and Ozturk (2015) [1] by re-investigating the Environment Kuznets Curve (EKC) hypothesis for 15 MENA (Middle East and North African) countries using the Ecological Footprint (EF) as a proxy of environmental degradation over the period 1975–2007. Unlike the existing studies, we augment the basic EKC relationship by considering life expectancy at birth, fertility rate and political institutional index variables as new possible determinants of environmental degradation. The estimation of this relationship has been conducted for all MENA 15 countries, for oil-exporting and non-oil-exporting countries sub-samples. The results show that energy use worsens ecological footprint, whereas real GDP per capita exhibits an inverted U-shaped relationship with EF in oil-exporting countries and in the sample as a whole, i.e., the EKC hypothesis is validated. For the non-oil-exporting countries, the relationship between EF and economic growth is U-shaped. Moreover, our findings show that socio-demographic variables such as urbanization, life expectancy at birth and fertility rate improve the environment in the long term. We also found that the improvement of political institutions in those countries has not been accompanied by a reduction of environmental stress.

The Granger causality results support evidence of the existence of an error correction mechanism between the EF, real GDP, energy use and the fertility rate. Specifically, in the short term, we found strong evidence for bidirectional causality among the ecological, real GDP and energy-use variables.

1. Introduction

In the last few decades, the MENA region has undergone rapid economic growth thanks to its abundance of natural resources (crude oil, gas, non-oil fuels, mineral and non-mineral resources) and the transition of their economies from agriculture-based economies to industrial and services-based economies [2]. However, the improvement in several economic and socio-economic indicators has not been attained without costs. In particular, the ecosystem of the region, including air, water and land, has been seriously affected by the intensive use of energy, the rapid growth of population and urbanization. As an example, energy production and consumption contribute approximately 85% of all greenhouse gas (GHG) emissions in this region. Consequently, there is an extensive consensus among policy-makers concerning an urgent and optimal economic policy that can help in preserving and protecting the environment of the region. Moreover, with the increasing awareness among the MENA governments and community, this region has begun facing several challenges, the most important of which concerns how to reach higher economic growth without compromising the quality of the environment. This question has been the topic of intense research in recent years. However, until now, no consensus has been reached on this question [3–12].

In the energy economic literature, the main framework used to investigate the economic growth-environmental degradation nexus was the EKC [13–15]. Since the seminal works of Grossman and Krueger [13,14], a plethora of empirical studies have examined the relationship between economic growth and environmental quality in different countries around the globe. Overall, these studies provide a varied mixture of results. Some studies support the EKC hypothesis and find an inverted-U relationship [16–20], whereas other studies fail to validate the EKC hypothesis by finding a linear and/or N-shaped relationship [21,22].

In this research, we focus on the MENA countries because few studies focussed on this region [1,23,24]. Overall, the empirical findings of these studies provide evidence of the existence of the EKC hypothesis for this region. However, in their empirical studies, the authors consider that this region is homogeneous in terms of energy

* Corresponding author.
E-mail addresses: lcharfeddine@qu.edu.qa (L. Charfeddine), zouhair.mrabet@qu.edu.qa (Z. Mrabet).

http://dx.doi.org/10.1016/j.rser.2017.03.031
Received 20 August 2015; Received in revised form 23 February 2017; Accepted 8 March 2017

consumption, energy production and income per capita. Moreover, previous studies employ a basic EKC equation augmented by control variables such as energy consumption, urbanization and trade openness.

This paper contributes to the empirical literature of the EKC hypothesis in many ways. First, it tries to fill the previously cited gap by focussing in the MENA region using three subsamples. The first sample is formed by 15 countries that are closely related to the samples employed in the three above-mentioned studies. The second sample contains all oil exporting countries, and the third sample corresponds to the non-oil-exporting countries. Our choice of the MENA region as a sample of study has been motivated by several reasons. First, this region produces approximately 38% of crude oil and gas, a variety non-oil fuels and many mineral and non-mineral resources. This region possesses approximately 57% of oil reserves. Second, this region faces several environmental problems and challenges largely in terms of CO2 emissions. The level of CO2 emissions for the majority of the MENA countries exceeds the world average. Third, in contrast to many emerging and developed countries, the MENA countries remain in the initial stage of industrialization, and an additional increase in manufacturing production is anticipated. Moreover, the high dependence of the MENA countries on fossil fuel resources and their fast population and economic growth threaten to increase the cost of environmental degradation. According to the World Bank [25], this cost varies from 2.7% of GDP in Tunisia to as high as 7.1% of GDP in Iran. This alarming environmental pressure in the region raises questions about the main factors contributing to environmental damage in the MENA region in addition to GDP per capita.

The second contribution of this paper is to examine the impact of some socio-demographic and political institutional factors in determining environmental degradation. As many previous studies have argued, omitting important explanatory variables can result in a biased estimate of the EKC in a non-random sample of countries [26]. Thus, this paper extends previous studies in this area by investigating the role played by fertility rate, life expectancy at birth and political institutional index variables on environmental degradation.

The third contribution of this study is the use of a more general environmental degradation proxy. For that reason, policymakers need a robust accounting measure tool of environmental degradation to control the pressure on the environment and to take actions towards less degradation of the ecological resource base. The indicator of environmental degradation used in this paper is the ecological footprint. The EF measures the biologically productive land and sea required to produce all of the resources a population consumes and to absorb its waste using prevailing technology [27]. Thus, we believe that EF is a more suitable indicator of environmental degradation because it can reveal the consequence of human activity in a country on the environment in terms of air, soil and water.

The remainder of this paper is organized as follows. Section 2 reviews the empirical literature addressing the EKC hypothesis. Section 3 presents the environmental challenges in the MENA countries. Section 4 describes the data, the model specification and the empirical methodology. Section 5 presents and discusses the empirical results of panel unit root tests, Pedroni tests of panel cointegration, the DOLS and FMOLS estimation and the causality direction results. Finally, Section 6 concludes the paper and proposes policy recommendations.

2. Literature review

2.1. EKC hypothesis

In a pioneering paper, Grossman and Krueger [13] established that the long-term relationship between economic development and environmental degradation was an inverted U-shaped curve. In other words, countries in the initial stage of economic development are generally associated with a high level of environmental quality deterioration. However, after a certain threshold level of economic development, the awareness of a best environmental quality becomes important, and individuals are motivated to pay for a cleaner environment. After this point, environmental degradation decreases. Panayotou [28] labelled this phenomenon the EKC. This idea is important because, if correct, it would allow people to anticipate the levels of environmental degradation for future years based on countries' predicted GDP [22]. Moreover, an important implication of the EKC hypothesis is that most developing countries with low income levels, such as MENA countries, certainty will undergo an increase of environmental degradation largely during the take-off process of industrialization. Moreover, as Van Alstine and Neumayer have mentioned, "Some developing countries will not reach the turning point for decades to come" [29], p.57. Thus, it is important to bear in mind that economic growth by itself will most likely not be the solution to environmental degradation in the near future. Therefore, determining the existence of the EKC in MENA countries is important. If they have an inverted U-shaped curve, it is likely that the EF can be reduced through economic development.

In recent decades, the relationship between environmental quality and economic development has long been a crucial debate and received substantial concern. Several empirical studies have examined this relationship in different countries around the globe. Overall, these studies provide mixed results. Some studies support the EKC hypothesis and find an inverted-U relationship [23,30–34]. Other studies fail to validate the EKC hypothesis by finding a linear and/or N-shaped relationship [35–38]. As select examples, Selden and Song [30] employed a panel data analysis to test the relationship between CO2 emissions and the Gross Domestic Product (GDP) for 130 countries over the period 1951–1986. Their result shows that the EKC hypothesis exists with a turning point equal to $35,428. The same result was obtained by [39] when they investigated the EKC hypothesis for 156 countries. Jalil and Mahmud [31] used the Auto Regressive Distributed Lag (ARDL) methodology to investigate the long-term relationship between CO2 and income in the case of China over the period 1975–2005. Their results validate the EKC hypothesis and show the existence of one-direction causality running from economic growth to CO2 emissions. In the same vein, Tiwari et al. [40] confirm the existence of an inverted U-shaped curve between income and CO2 emissions in the case of India. Tamazian and Rao [32] used the Generalized Method of Moments (GMM) approach to investigate the relationship between CO2 emissions and GDP for a panel of 24 transition economies in the period 1993–2004. They introduced institutional, economic and financial development as independent variables in the equation. Their results validate the EKC hypothesis and reveal the importance of economic, financial and institutional developments in reducing CO2 emissions. Al-Mulali [33], by using the panel cointegration test, shows that over the period 1980–2009, CO2 emissions and GDP per capita have a long-term relationship with economic growth in 12 Middle East and North African Countries (MENA). For the same region, Arouri et al. [23] checked the existence of the EKC hypothesis over the period 1981–2005 by using the bootstrap panel unit root tests and cointegration technique. Their results show that the EKC hypothesis is confirmed in the long term in most countries. Ibrahim and Law [41] examined the EKC hypothesis for a panel of 69 countries over the period 2000–2008. Their result finds evidence of the EKC hypothesis. In a more recent study, Oshin and Ogundipe [34] adopt a static panel data method for 15 West Africa countries over the period 1980–2012. Their empirical evidence supports the EKC theory in the region.

Others studies fail to validate the EKC hypothesis. For instance, Soytas et al. [36] employed the Toda-Yamamoto procedure to test whether the long-term Granger causality is running from real GDP and energy consumption to carbon emissions for the United States over the period 1960–2004. The authors do not find a causal relationship between GDP and CO2 emission and suggest that economic growth by itself might not be a solution to reduce environmental degradation as described by the EKC hypothesis. Chebbi [37] found that there is no