Renewable and Sustainable Energy Reviews 62 (2016) 468–477

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

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

The relationship between energy-resource depletion, climate change, health resources and the environmental Kuznets curve: Evidence from the panel of selected developed countries

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ARTICLE INFO

Article history:
Received 27 September 2015
Received in revised form
13 April 2016
Accepted 26 April 2016

Keywords:
Energy depletion
Resource depletion
Climate change
Health resources
Environmental Kuznets curve
Panel GMM technique

ABSTRACT

The objective of the study is to examine the relationship between energy-resource depletion, climate change, health resources and the Environmental Kuznets Curve (EKC) under the financial constraint environment in the panel of selected developed countries, over the period of 2000–2013. The study employed panel Generalized Method of Moments (GMM) estimate for robust inferences. The results confirmed the existence of EKC hypothesis in the energy-resource depletion model i.e., inverted U-shaped relationship between energy-resource depletion and GDP per capita in the selected developed countries. The results of climate change model confirmed the U-shaped relationship of Perfluorocarbons (PFC) gas emission and Particulate Matter-2.5 micrometers ($PM_{2.5}$) emissions with the per capita income. The health resource model confirmed the existence of inverted U-shaped relationship of infant deaths and health expenditures per capita with the per capita income, while there is a U-shaped relationship between incidence of Tuberculosis (TB) and GDP per capita. The other results indicate that carbon dioxide (CO_2) emissions increase Sulfur Hexafluoride (SF_6) emissions and health expenditures; fossil fuel energy consumption increases PFC gas emissions and $PM_{2.5}$ emissions; energy demand increases $PM_{2.5}$ emissions and health expenditures; and financial dummy (D_{2008}) affected energy-resource depletion, $PM_{2.5}$ emissions, Greenhouse Gas (GHG) emissions index, infant deaths, and health expenditures per capita.

Contents

Abbreviations: EKC, environmental Kuznets curve; GMM, Generalized Method of Moments; PFC, Perfluorocarbons; $PM_{2.5}$, Particulate Matter (2.5 micrometers); TB, Tuberculosis; GDP, Gross Domestic Product; CO_2, carbon dioxide emissions; SF_6, Sulfur Hexafluoride; D_{2008}, dummy variable; GHG, greenhouse gas; SO_2, sulfur dioxide; PCA, principal component analysis; JB test, Jarque–Bera test; LM, Lagrange Multiplier; VIF, variance inflation factor; GNI, Gross National Income; PPP, Purchasing Power Parity; MENA, Middle East and North Africa; eHDI, emissions associated Human Development Index; EEA, European Environmental Agency

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http://dx.doi.org/10.1016/j.rser.2016.04.061
1364-0321/

1. Introduction

The relationship between energy-resource depletion and the growth trajectories is one of the focal points for the policy makers to device the long-term energy policies in order to balance the free flow of energy supply across the globe. In addition, climate change and health hazards are a more pronounced agenda in the environmental literature that became obvious to finance with the sustained economic growth and long-term developmental vision of the nations. This study investigated the relationship between energy-resource depletion, climatic factors and health resources under the framework of Environmental Kuznets Curve (EKC) that provided the set of regressors to explain these environmental-growth models in the panel of selected developed countries.

The EKC debate is almost covered since last three decades, while the starting point of this theory is based upon the original work of Kuznets [1] that described the different growth phases in relationship with the income inequality. Almost half of the century has passed away, but Kuznets' work is still alive in different forms i.e., the most debatable form of Kuznets' work is EKC which has still been showing conflicting results in different regional settings and in the cross-sectional panel of settings.

There are number of parallel studies available on the work of EKC in different environmental settings, however, these studies are like the two sides of the same coin that always stand opposite to each other. Asafu-Adjaye [2] examined the cause–effect relationship between energy demand and economic growth for four Asian developing countries and found the causality running from energy demand to economic growth in India and Indonesia, while there is a feedback relationship between energy and economic growth in Thailand and the Philippines. Bhattarai and Hammig [3] investigated the long-run relationship between deforestation and GDP per capita in Latin America, Africa and Asian continent. The results confirmed the inverted U-shaped relationship between GDP per capita and deforestation in all the three regions of the World. The study concludes that the deforestation process was significantly influenced by the institutional structure and economic policies of the continents, however, the progress in political reforms and good governance significantly reduced deforestation process. Fischer-Kowalski and Amann [4] analyzed both the IPAT (population led emission) model and EKC hypothesis in the context of industrial and developing countries. The result fail to explain the IPAT model and EKC hypothesis under different socio-economic factors, however, population growth and technology both increased the carbon share more than the GDP per capita in the selected panel of countries. Ehrhardt-Martinez et al. [5] investigated the deforestation–Kuznets curve in the cross-sectional panel of less developed countries and found a strong evidence of inverted U-shaped relationship between deforestation and economic development in the region. Halkos [6] employed two sophisticated panel econometric techniques including panel GMM technique by Arellano-Bond and random coefficient method, and evaluating EKC hypothesis with sulfur dioxide (SO_2) emissions in the panel of 73 OECD and non-EOCD countries, comprised the larger data set from 1960 to 1990 and found that there is an inverted U-shaped relationship between SO_2 emissions and GDP per capita by Arellano-Bond method, while in random coefficient panel technique, there is no visible sign of EKC with SO_2 emissions. Both the results are different from each other, while using the same data set with different econometric modeling techniques. Therefore, the EKC hypothesis considered is more sensitive with different econometric techniques, which should be cautioned with care while handling EKC modeling.

Jalil and Mahmud [7] investigated the relationship between air pollutant, energy demand, economic growth, and trade openness in the context of China, over the period of 1975–2005. The results confirmed the inverted U-shaped relationship between GDP per capita and per capita CO_2 emissions nationwide. The causality results confirmed the unidirectional causality running from economic growth to CO_2 emissions but not vice versa. Akbostanci [8] examined both the time series modeling technique (for country-wide) and panel data estimation technique for Turkish Province and found that there is monotonic increasing function between GDP per capita and per capita CO_2 emissions by using time series modeling, while the results of panel estimation confirmed the N-shaped relationship between (i) GDP per capita and SO_2 emissions and (ii) GDP per capita and PM_{10} emissions, respectively. Winchester and Reilly [9] argued that carbon price is a feasible solution to enlarged low carbon technologies and bioenergy across the globe. Gul et al. [10] examined the causal relationship between CO_2 emissions and energy demand by employing maximum entropy bootstrap approach in the context of Malaysia, over the period of 1975–2013. The results confirmed that energy consumption deteriorates environmental quality which further depicts in the result of Granger causality result where the causality runs from energy demand to per capita CO_2 emissions, but not vice versa. Qureshi et al. [11] investigated the long-run relationship between electric power shortages and specific growth factors in the context of World's largest regions and found that climatic variability possesses the largest variance in terms of inadequate electric power transmission. Khan et al. [12] investigated the relationship between water resources, resource rent, energy use and CO_2 emissions in the context of Pakistan and found that both the energy use and water resources significantly increase CO_2 emissions. The results of variance decomposition analysis indicate that natural resources rent has least contribution in influencing air pollution in a country. Saidi and Hammami [13] explored the long-run panel relationship between energy demand and income of the 58 countries from 1990 to 2012. The results show that the energy consumption is significantly associated with the increasing economic growth of the cost of air pollution in the region. Ozturk and Bilgili [14] highlighted the importance of biomass consumption and trade liberalization policies in the context of Africa's growth.

Menegaki and Tsagarakis [15] examined the panel relationship between GDP per capita, fossil fuel energy and renewable energy production in 33 European countries, over the period of 1999–2010. The study employed both the random effect panel model and Arellano Bond estimator and confirmed the U-shaped EKC relationship with the coal production and renewable energy production accordingly. Ahmed et al. [16] confirmed the existence of EKC hypothesis with the deforestation in the context of Pakistan. Al-Mulali and Ozturk [17] confirmed the significant and positive impact of energy associated emission that leads towards the ecological footprint in the MENA region. Tan et al. [18] examined the relationship between seven types of industrial pollution intensity and GDP per capita of 46 Chinese pilot cities, over the period of 1993–2012. The results confirmed the 'intensity EKC' hypothesis in which industrial pollution initially decreased with the increasing economic growth, while at the later stage of development this rate of decline is persistent and is continued in the next stages. According to Capellán-Pérez et al. [19], p. 397], *"The end of the era of cheap and abundant energy flows brings the issue of economic growth into question, stimulating research for alternatives as the de-growth proposal"*. Zhou et al. [20] emphasized the importance of biophysical factors including climate change in the EKC framework that explained 78% variations in environmental quality as compared to the only 37% variations found in the original EKC framework in China. Liddle [21] investigated the relationship between per capita GDP and transport related emissions and found the existence of EKC hypothesis in relationship between per capita GDP and emissions technology. Ozturk and Al-Mulali [22] although did not find the traces of EKC hypothesis for Cambodia,