Renewable and Sustainable Energy Reviews 57 (2016) 1237–1244

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

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

Clean energy-growth nexus in sub-Saharan Africa: Evidence from cross-sectionally dependent heterogeneous panel with structural breaks

Mahamat Hamit-Haggar [1]

Centre d'Études et de Recherches sur le Développement International (CERDI), Ecole d'Économie, Université d'Auvergne, 65 Boulevard François Mitterrand, 63000 Clermont-Ferrand, France

ARTICLE INFO

Article history:
Received 21 October 2014
Received in revised form
14 October 2015
Accepted 17 December 2015

Keywords:
Clean energy
Output growth
Cross-sectional dependence
Structural breaks
Bootstrapped
Causality

ABSTRACT

This paper examines the existence and nature of a causality relationship between clean energy consumption and economic growth for a panel of eleven sub-Saharan African countries over the period 1971–2007. We apply the panel unit root test that accounts for the presence of multiple structural breaks [13] and the newly-developed panel cointegration methodology which allows for cross-section dependence and multiple structural breaks [38] as well as a bootstrap-corrected Granger causality test. The estimation results show that there is cointegration between clean energy consumption and economic growth. Further, the results from the panel causality tests indicate that there is indeed a unidirectional Granger causal flow from clean energy consumption to economic growth.

Contents

1. Introduction

Determining the link between energy consumption and economic growth has become a topic studied in depth in the field of energy economics, given the scarcity of energy resources and the fact that energy serves as a major input in production processes. Previous studies have found a strong correlation between energy usage and the level of economic development and growth in both developed and developing economies [18]. However, the presence of a strong correlation does not necessarily imply a causal relationship. Identifying the existence and directions of the causalities is important in the design and effectiveness of energy policies. For instance, if there is a unidirectional causality running from energy consumption to economic growth, reducing energy consumption

E-mail address: mahamat.hamit-haggar@etu.udamail.fr
[1] Tel.: +33 7 85 13 18 41; fax: +33 4 73 17 74 28.

http://dx.doi.org/10.1016/j.rser.2015.12.161
1364-0321/

could lead to a fall in economic growth. In contrast, if there is a unidirectional causality running from economic growth to energy consumption, it could imply that policies designed at reducing energy consumption may be implemented with little or no adverse impact on economic growth.

There is a plethora of empirical work that examines the causality between energy consumption and economic growth. Some studies are those of Narayan and Smyth [28], Jinke et al. [20], Bowden and Payne [12], Wolde-Rufael [39], Chandran et al. [14], Lean and Smyth [23], Apergis and Payne [6], Payne and Taylor [29], Wolde-Rufael [40], Menegaki [27], Dedeoglu and Piskin [16], Al-Mulali [2], Jin and Kim [21], Husaini and Lean [19], Shahbaz et al. [35] to name only a few. Yet, there seems to be no consensus regarding the causal relationship between energy consumption and economic growth. In general, the empirical findings have yielded rather mixed results. The lack of consensus among the empirical works may be attributed to such factors as differences in variable selection, model specification, sample size, the reference period and the econometric approaches undertaken, among others [15,42,8].

For instance, Narayan and Smyth [28] investigate the relationship between gross capital formation, total energy consumption and real GDP in a panel of G7 countries over the period 1972–2002. The authors find evidence of a unidirectional causality running from energy consumption to real GDP. In a similar study, Bowden and Payne [12] examine the causality between total energy consumption and real GDP at the aggregate and sectoral level in the U.S. over the period 1949–2006. They fail to reach a consensus as to the direction of causation. Dedeoglu and Piskin [16] examine the relationship between energy consumption and real gross domestic product (GDP) per capita for the 15 former Soviet Union countries over the period 1992–2009. Their results evidence the presence of a unidirectional causal relationship running from energy consumption to the real GDP per capita in the long run but not in the short-run. However, they discover a bidirectional relationship for oil importer and natural gas importer within the 15 former Soviet Union countries.

On the coal consumption-growth nexus, Jinke et al. [20] investigate the relationship between coal consumption and economic growth in a group of coal consuming countries (OECD and non-OECD) over the period 1980–2005. They find a unidirectional causality running from economic growth to coal consumption in Japan and China and no causality relationship between coal consumption and economic growth in India, South Korea and South Africa. For the case of the United States, the series are not even cointegrated. Similarly, Wolde-Rufael [39] applies a modified version of the Granger causality test to the same sample of countries, by expanding the time span, 1965–2005. He finds a unidirectional causality running from coal consumption to economic growth in India and Japan while the opposite causality running from economic growth to coal consumption was found in China and South Korea. A bi-directional causality running between economic growth and coal consumption was found in the case of South Africa and the United States. In a study of this sort, Jin and Kim (2015) examine the causal relationship between coal consumption and economic growth for 58 countries (OECD and non-OECD countries) over the period 1971–2010. They find that coal consumption and economic growth have a long-run equilibrium in OECD countries. In contrast, no long-run relationship between coal consumption and economic growth is found for non-OECD countries.

Using time series data for the period 1971–2003 and applying a bivariate and multivariate framework, Chandran and colleagues (2010) study the relationship between electricity consumption and real GDP in Malaysia. The authors discover a unidirectional causality flowing from electricity consumption to economic growth. Lean and Smyth [23] investigate the same issue, by examining electricity consumption, aggregate output, exports, labor and capital in a multivariate framework. They find a unidirectional causality running in the opposite direction, i.e., Granger causality running from aggregate output to electricity consumption. More recently, Husaini and Lean [19] investigate the relationship between electricity consumption, output, and price in the manufacturing sector in Malaysia over the period 1978 to 2011. They find that there is a unidirectional causality from manufacturing output to electricity consumption in the long run.

Apergis and Payne [6] explore the causality between renewable energy consumption and economic growth for 13 countries within Eurasia over the period 1992–2007. They find a bidirectional causation between renewable energy consumption and economic growth. Menegaki [27] investigates the causal relationship between renewable energy and economic growth for 27 European countries in a multivariate framework over the period 1997–2007. She adds variables such as greenhouse gas emissions and employment and reports no causality between renewable energy consumption and economic growth. Shahbaz et al. [35] examines the relationship between renewable energy consumption and economic growth by using quarterly data over the period of 1972Q1–2011Q4 and by incorporating capital and labor as potential determinants of production function in case of Pakistan. They find evidence of a bidirectional causality between economic growth and renewable energy consumption.

Research on the causal relationship between nuclear energy consumption and economic growth was performed by Yoo and Jung [41] for the case of Korea over the period 1977–2002. Their findings show that nuclear energy consumption causes economic growth but economic growth does not cause nuclear energy consumption. Payne and Taylor [29] employ the Toda and Yamamoto [36] test to examine the causal relationship between nuclear energy consumption and GDP growth in the United States over the 1957–2006 period. Their results indicate that there is no causality associated with nuclear energy consumption and economic growth. Al-Mulali [2] investigates the causality between nuclear energy consumption, GDP growth and CO_2 emission in 30 major nuclear energy consuming countries over the period 1990–2010. He find that nuclear energy consumption has a positive short run causal relationship with GDP growth and a negative short run causal relationship with CO_2 emission.

While most of the existing published literature has focused on the relationship between electricity consumption and economic growth, the relationship between coal consumption and economic growth, the relationship between renewable energy consumption and economic growth or the relationship between nuclear energy consumption and economic growth, virtually no published research exists that looks into the relationship between clean energy consumption and economic growth in either developed or developing economies.[2] In this paper, we extend the findings of the existing literature by applying rigorous econometric techniques to a sample of sub-Saharan African countries to study the causality between clean energy consumption and economic growth. One of the major limitation of earlier studies is the use of the traditional panel unit root test and panel cointegration test (first generation of panel unit root and cointegration tests). Recent developments in panel data analysis have raised concerns about the validity of the first generation of panel unit root and cointegration tests which may lead to biased inferences and hence misleading results due to lower power of the unit root and

[2] Clean energy is noncarbohydrate energy that does not produce carbon dioxide when generated. It includes hydropower and nuclear, geothermal, and solar power, among others (http://data.worldbank.org/data-catalog/world-development-indicators/wdi-2014).