Energy Policy 61 (2013) 1295–1304

Contents lists available at ScienceDirect

Energy Policy

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

Energy consumption and economic growth: Evidence from Cameroon

Yris D. Fondja Wandji *

Centre de Géopolitique de l'Energie et des Matières Premières (CGEMP), Paris Dauphine University, Place du Maréchal de Lattre de Tassigny, 75775 Paris, Cedex 16, France

HIGHLIGHTS

- The series of GDP, ELECTRICITY, OIL and BIOFUELS are integrated of order 1.
- The Granger causality test yields a unidirectional causality running from OIL to GDP.
- No causal link between GDP and ELECTRICITY, and no more between GDP and BIOFUELS.
- Cointegration tests also show that only OIL and GDP are co-integrated.
- Every percentage increase in OIL increases GDP by around 1.1%.

ARTICLE INFO

Article history:
Received 22 October 2012
Accepted 30 May 2013
Available online 11 July 2013

Keywords:
Energy consumption
Economic growth
Cameroon

ABSTRACT

The aim of this paper is to study the nature of the relationship between energy consumption and economic growth in Cameroon through a three-step approach: (i) Study the stationarity of the chronic, (ii) test of causality between variables and (iii) estimate the appropriate model. The study concludes in a non-stationarity of the series. Using the data in first difference, the Granger causality test yields a strong evidence for unidirectional causality running from OIL to GDP. Cointegration tests also show that these two series are co-integrated and the Error Correction Model (ECM) reveals that every percentage increase in Oil products consumption increases economic growth by around 1.1%. This result confirms the intuition that an economic policy aimed at improving energy supply will necessarily have a positive impact on economic growth. On the other side, a lack of energy is a major bottleneck for further economic development in Cameroon.

1. Introduction

Works dealing with developmental issues from the field of energy can mainly be divided into three categories (Kanagawa and Nakata, 2008):

- Descriptive studies (Aggarwal and Chandel, 2004; Bastakoti, 2003; Dung et al., 2003; Gangopadhyay et al., 2005; Rehman et al., 2005) describe current situations of energy demand or consumption as well as policies and programs in developing countries. They also investigate critical components of the policy and programs, and evaluate the outcomes. Although they include various aspects of the policy and programs such as legal, social, and fiscal, most of these studies are quantitative evaluation, which are highly case-oriented, and it is difficult to obtain ideas applicable to other areas.
- Experimental studies (Bhattacharyya, 2002; Chakrabarti and Chakrabarti, 2002; Wijayatunga and Attalage, 2002) test technological or economic efficiency of devices or appliances in order to compare technologies adopted by rural households. They measure not only the data of energy demand, consumption, and expenditure but also emissions of hazardous pollutants, which cause indoor pollution. Although they contain highly disaggregated or highly precise data, policies implication to promote these technologies are not sufficiently discussed based on the results.
- Analytical studies (Bailis et al., 2005; Biswas et al., 2001; Mathur et al., 2003; Pachauri et al., 2004; Parikh and Ramanathan, 1999) analyze energy demand or consumption structure of a developing country, and apply an analytical tool to energy demand and supply structure at village, regional, and national level taking into account economic and technological parameters. They contain model analysis, which is divided into top-down and bottom-up modelling approaches. Moreover, they can incorporate emissions associated with energy consumption such as greenhouse gas emissions and government policies, for example, environmental tax.

* Tel.: +33 650048438.
E-mail address: yris.fondja@gmail.com

0301-4215/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.enpol.2013.05.115

There are a large number of literatures for the descriptive and experimental studies. In contrast, there are a limited number of researches categorized as the analytical study (Kanagawa and Nakata, 2008). The work undertaken here could fit into this category. Our purpose is to examine the causal relationship between per capita energy consumption and per capita gross domestic product (GDP) for Cameroon. Estimating the relation between energy demand and GDP is an issue of high relevance for development and energy policies. Consider, for instance, that a government would like to introduce measures to control energy demand (say, an energy tax) to improve its environmental performance and reduce its dependence on foreign imports. If energy consumption precedes or causes economic growth, such policies would hamper further economic development (Keppler, 2006). Thus, the knowledge of causation between energy consumption and economic has significant policy implications. For example, if there is a causality running from energy consumption to income, then this denotes an energy-dependent economy such that energy is an impetus for income, implying that a shortage of energy may negatively affect income (Masih and Masih, 1998). In contrast, if unidirectional causality runs from income into energy consumption, it could imply that energy conservation policies might be implemented with little adverse or no effects on economic growth. However, the finding of no causality in either direction otherwise called "neutrality hypothesis" could imply that energy conservation policies do not affect economic growth (Akinlo, 2008).

In this study, the methodology adopted is a three-step approach: The first step is to check the time series properties (stationarity and order of integration) using unit roots tests of Dickey and Fuller (1979) and Phillips and Perron (1988). In the second step, the Granger causality test is used on the stationary data, where stationarity is achieved by differencing the data since the series are integrated. Finally, in the presence of cointegration among the variables, an error correction model (ECM) is used instead of a vector autoregressive (VAR) model. This three-step approach was used by Ambapour and Massamba (2005), Keppler (2006) and Tamba et al. (2012). Before beginning the study of the series, let's make an overview on the preliminary work on the relationship between economic growth and energy consumption.

2. Review of literature

It is widely recognized that there is a clear relationship between economic growth and energy consumption. However, it is necessary to keep in mind the traditional problem of causality between two correlated variables. Can it be said that access to energy causes mechanical economic development? Or conversely, does the growth of economic activity drive energy consumption? Or, is there a third variable inducing these effects? It is difficult to provide definitive answers to these questions, as the works that have dealt with have resulted in different conclusions and sometimes contradictory.

2.1. The work of the pioneers

Kraft and Kraft (1978) seems to be the first study of the causal relationship between energy consumption and income. Using testing procedure developed by Sims (1972), these two authors show the existence of a strong statistical relationship between energy and growth, and a unidirectional causality running from income to energy consumption for the USA over the period 1947–1974. They conclude that energy conservation policies may be initiated without deteriorating the economic side effects. The paper by Kraft and Kraft has been criticized by Akarca and Long (1980) who noted that the period chosen was unstable because it included the first oil shock. Returning to the analysis and adopting the same technique, but this time over a more uniform 1950–1968 period, Akarca and Long call into question any causal relationship between income and energy. Later, this result was confirmed by Yu and Hwang (1984) for the United States over the period 1947–1979.

Since then, empirical studies have been extended to cover other countries using other methods of econometric analysis. By applying these new techniques, several econometric studies have demonstrated the existence of unidirectional or bidirectional causal relationship but they failed to provide a general trend for countries at different development levels or structure of economy.

2.2. A synthesis of empirical works on the relationship between energy and income

Different studies on the relationship between energy consumption and economic growth, measured mainly by the GDP, lead to very mixed results and thus to prudent recommendations in economic and energy policies. These results are influenced by the analytical techniques used, the level of development of selected countries and finally the study period chosen. Regarding the techniques used, it should be noted that very often the authors did not care about the statistical properties of the series, including their stationarity. However, most of macroeconomic data are not stationary, and apply the usual techniques of econometrics without previously getting stationarity can lead to divergent trends and fallacious estimations, so an incorrect assessment of the link of causality.

Besides the Sims techniques used by Kraft and Kraft (1978), Akarca and Long (1980), and Yu and Hwang (1984), the approach testing the cointegration between two variables was increasingly used. An early work adopting the cointegration methodology of Engle and Granger is that of Nachane et al. (1988). Under this approach, the authors found a long-term relationship between energy consumption and economic growth for eleven developing countries and five developed countries (Ambapour and Massamba, 2005). This technique of Engle and Granger (1987) was then applied by many authors in different countries without always clear result. For example, the study of Yang (2000) on the Chinese province of Taiwan has led to bidirectional causality between energy and GDP, and unidirectional causality from GDP to oil consumption and from consumption of natural gas to GDP over the period 1954–1997. This study contradicts Cheng and Lai (1997), who found that there was a unidirectional causal relationship from GDP to energy use for the same province of Taiwan, but over the period 1954–1993.

Afterwards, Masih and Masih (1996) are among the first who use the Johansen methodology in research of the relationship between energy and growth. Thus, in a series of articles based on India, Indonesia, Malaysia, Pakistan, the Philippines and Singapore, they showed that there is a long-term relationship between energy and growth in the case of India, Indonesia and Pakistan. The conclusions of these authors also report the existence of bidirectional causality between energy consumption and GDP in Pakistan, unidirectional causality from energy to GDP in India and from GDP to energy in Indonesia. According to Masih and Masih, the use of an ordinary VAR reveals the absence of causal relationship between income and energy in Malaysia, the Philippines and Singapore. The result for India is not confirmed by Keppler (2006) who establishes rather a causal relationship from GDP to energy consumption, at a significance level of 5%. And for this author, this result is consistent with the India's policy of massive subsidisation of oil consumption, notably in rural areas.

Table 1 below summarizes a number of empirical studies, using the technique of Sims, the methodology of Engler and Granger, or