



Economic growth and electricity consumption in Cote d'Ivoire: Evidence from time series analysis

Auguste K. Kouakou*

Department of Management and Economic Sciences, University of Cocody-Abidjan, Cote d'Ivoire

ARTICLE INFO

Article history:

Received 5 October 2010
Accepted 29 March 2011

Keywords:

Electricity
Causality
Cointegration

ABSTRACT

This paper examines the causal relationship between the electric power industry and the economic growth of Cote d'Ivoire. Using the data from 1971 to 2008, a test was conducted for the cointegration and Granger causality within an error correction model. Results from these tests reveal a bidirectional causality between per capita electricity consumption and per capita GDP. A unidirectional causality running from electricity consumption to industry value added appears in the short run. Economic growth is found to have great effects on electricity consumption and a reverse causality from electricity to economic growth may also appear. In the long run, there is a unidirectional causality between electricity and both GDP and industry value added. From these findings, we conclude that the country will be energy dependent in the long run and must therefore secure the production network from shortfalls to ensure a sustainable development path. Accordingly, government should adopt policies aimed at increasing the investment in the sector by stepping up electricity production from existing and new energy sources.

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1. Introduction

Energy is a key factor in the determination of economic growth in modern economies. Individuals and organizations need different energy sources to ensure the sustainability of their businesses. It has also been proven that the energy sector, which includes electricity, plays a significant role in any economic development. This developmental effect can be felt not only on the improved labor and capital productivity due to a reliable energy sector but also by the fact that the consumption of electricity is a sign of good health of the economy in developing countries. Using the World Development Indicator (World Bank, 2008), we noticed that electricity consumption in OECD developed countries in 2007 is extensively above the overall consumption of electricity (more than 4 times) while Sub Saharan African countries account for only 20% and developing countries only 4% of global energy consumption.

The theoretical analysis of the relationship between energy and economic growth is addressed in the literature through the concept of energy neutrality in economic growth. Indeed, the neoclassical growth models result in the technological and energy neutrality on growth. Empirically, the effect of energy such as electricity has been established through the analysis of causality

between energy consumption and the GDP. The fundamental question of this research is to know whether there is a causal relationship between economic growth and electricity consumption in Cote d'Ivoire. The statement will determine whether the GDP dynamics lead to the growth of electricity use and conversely, if energy development explains national product growth or if the two latter aspects may occur. Since the late 70s, several studies have underscored the importance of the empirical evidence of energy-growth nexus since the onset of the oil crises and their negative impact on economic activities around the world (Kraft and Kraft, 1978; Akarca and Long, 1980). In recent years, we have noticed a renewed interest illustrated by conflicts in the Gulf region and in the use of different methodological frameworks (Asafu-Adjaye, 2000; Shiu and Lam, 2004; Jumbe, 2004; Paul and Bhattacharya, 2004; Oh and Lee, 2004; Lee, 2005; Narayan and Smyth, 2005; Narayan and Singh, 2007; Akinlo, 2008; Wolde-Rufael, 2009).

In Cote d'Ivoire, the demand for energy as well as its production capacity is rapidly growing since 1990. Generated initially from hydroelectric power, the input of thermal gas has augmented the capacity in electricity production. In early 2010, however, the country experienced an unprecedented electricity production shortfall (April–May) causing great embarrassment to both residents and businesses. It is therefore expedient to establish a strong link between economic activity and the electricity sector to know whether or not shortages will have impacts on economic growth and, if so, identify the causality.

* Tel.: +225 05663107/03367652

E-mail addresses: augustekk@yahoo.fr, auguste.kouakou@univ-cocody.ci

The aim of this paper is twofold: firstly, we have to investigate the long-term relationship between electricity consumption and economic growth and secondly, the causal impact of electricity and growth will be tested using Granger causality tests. This is to establish whether long-term electricity consumption per capita goes with the GDP per capita and determine the causality between them.

The empirical analysis of causality is carried out in a vector error correction model after stationary and cointegration relationship testing. In terms of causality, three types of results may occur. The first may be a no causality relationship between energy consumption and the extent of economic growth. It refers to the neutrality hypothesis, which implies that energy policy is not correlated with the GDP and vice versa (Akarca and Long, 1980). In this case, an apparent inconsistency between global and energy policies may not create excessive distortions. The second may be the unidirectional causality either from economic growth to energy sector (GE) or from the energy sector to economic growth (EG). If the result shows a unidirectional causality of type GE, this means that the economy is less dependent on energy and energy policy has no effect on growth. If the unidirectional causality of type EG appears, then shortfalls or conservation of electricity power will have impacts in terms of go-slow in economic activity and conversely, an increase in the use of energy involve positive impact on economic growth. In the latter perspective, energy plays an important direct and indirect role in economic growth by acting as a complement of labor and capital factors. Finally, the causality may be bidirectional between energy and growth yielding the feedback hypothesis. This result implies that both energy consumption and economic growth are jointly determined.

The remaining part of this document emphasizes a review of the relevant empirical literature in section 2 and describes the electricity sector and economic activities in Cote d'Ivoire in section 3. Section 4 introduces the methodological framework while section 5 displays the econometric results. Policy implications and conclusions are outlined in section 6.

2. Literature review

The link between economic dynamics and the electricity sector have received a great deal of attention from researchers. The early works of Kraft and Kraft (1978) and Akarca and Long (1980) focus on the US economy using causality techniques. Based on a survey by Ozturk (2010), we identify over sixty papers focusing on the link between energy and economic growth both in specific countries and panel data studies. In recent time, several studies address the issue of causal relationship between the GDP dynamics and energy consumption to capture the main effects of various contemporary energy crises on development (Erdal et al., 2008; Hu and Lin, 2008; Belloumi, 2009; Odhiambo, 2009a; Ouédraogo, 2010; Lorde et al., 2010; Iwayemi et al., 2010; Sharma, 2010). On the whole, the neoclassical neutrality hypothesis is rejected as the majority of these studies reveal a causal relationship between energy and growth.

In addition to the above literature, many studies still focus deeply on the specific causal link between electricity and economic growth from the early 90s. Payne (2010), identified more than 40 papers and synthesized the literature on electricity consumption-growth nexus. As in the energy-growth relationship, three types of results may also appear: unidirectional causality from electricity to GDP (EG) or from GDP to the electricity sector (GE), bidirectional causality (BD) and the absence of causality (AC). He shows that the majority of studies support the non-neutrality hypothesis (69%).

Thus in the EG unidirectional causality case, it can be seen that the studies cover different countries and use Granger causality to

highlight the fact that the electricity sector may be a limiting or accelerating factor of economic growth (Ramcharran, 1990; Altinay and Karagol, 2005; Ho and Siu, 2007; Yuan et al., 2007; Aqeel and Butt, 2008; Yuan et al., 2008; Abosedra et al., 2009; Akinlo, 2009). In the case of unidirectional causality of type GE, it appears that an energy saving and electricity consumption reduction policy does not affect the growth of economic activity, that is the GDP is not explained by electricity (Ghosh, 2002; Jumbe, 2004; Narayan and Smyth, 2005; Yoo and Kim, 2006; Mozumder and Marathe, 2007; Halicioglu, 2007; Hu and Lin, 2008; Ghosh, 2009). In the case of bidirectional causality (BD), electricity consumption explains economic growth and vice versa, the GDP growth leads to increased power consumption. In this case, there is a two-way relationship with both factors being closely related (Yang, 2000; Yoo, 2005; Zachariadis and Pashouortidou, 2007; Tang, 2008; Odhiambo, 2009b; Narayan and Smyth, 2009; Lean and Smyth, 2010). Finally, in the AC causality case, there is no causal relationship between the electricity sector and the GDP, showing a neutral hypothesis (Murray and Nan, 1996; Wolde-Rufael, 2006; Chen et al., 2007; Narayan, Prasad, 2008).

The analysis of empirical data reveals that the relationship between electricity consumption and the GDP is not clearly identified, but a number of papers support the causality link. The emergence of conflicting results for the same country can be explained by the different periods chosen, the estimation methods for cointegration and causality, the set of variables and above all the country's specific energy policy and institutional framework (Belloumi, 2009; Ozturk, 2010). Notably, Keho (2007) using Toda-Yamamoto framework and Wolde-Rufael (2009) using data on African countries illustrated that there is a causality running from economic growth to energy consumption in Cote d'Ivoire. A different methodological framework shows a bidirectional causality within a bound testing approach and a Toda-Yamamoto causality test (Esso, 2010) while Chontanawat et al. (2008) yields a lack of causation for the same country.

It is therefore necessary to consider the nature of the relationship between electricity and the GDP dynamics in Cote d'Ivoire to implement the strategies with regard to existing causality and direction.

3. Electricity, industry value added and economic growth in Cote d'Ivoire

3.1. Electricity sector profile and GDP

Electricity distributed in Cote d'Ivoire mainly comes from two sources. The first source of production is historically made of six hydroelectric dams namely Ayame I and II, Kossou, Taabo, Buyo and Faye. The second, representing 67% of national production is produced by both CIE and the private companies called AZITO and CIPREL. The inputs used for the thermal power come from the two main offshore gas fields known as Panther and Lion. With the exploitation of these sources, thermal power production continues to increase and it can also be noted that the contribution of gas in electricity production has been increasing since 1995.

After many technical and financial difficulties in 1990, the Ivorian government initiated a reform within the electricity sector with three major features aimed at deregulating the sector. Firstly, the government reduced the level of its financial commitment in the standing equity capital structure by turning over some of its shares to foreign investors. In 1990, the state-owned company Energie Electrique de Cote d'Ivoire (EECI) was privatized by a lease contract negotiated with a consortium led by the group Urban Rural Development Corporation (SAUR) and Electricite

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