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Electricity consumption and economic growth in Nigeria: A revisit of the energy-growth debate

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ABSTRACT

This paper examines the dynamic causal linkages between electricity consumption and economic growth in Nigeria within a trivariate VECM, for the period 1971–2011. The paper obviates the variable omission bias, and the use of cross-sectional techniques that characterise most existing studies. The results show that there is a distinct causal flow from electricity consumption to economic growth: both in the short run and in the long run. This finding supports the electricity-led growth hypothesis that has been conjectured in the literature. The paper urges policy-makers in Nigeria to implement policies which enhance the generation and consumption of electricity in order to engineer economic growth. Appropriate monetary policies must also be put in place, in order to moderate inflation, thus enhancing growth.

1. Introduction

One of the most examined issues in growth literature, recently, is the causal linkages between electricity consumption and economic growth.[1] The modern day climate change, energy crises, rising prices of crude oil, and the ever-growing emission of carbon into the atmosphere have added momentum to the debate. The ability to establish the exact causal pattern between electricity consumption and economic growth is of immense relevance for policy formulation, especially for countries such as Nigeria which rely heavily on electricity as their sole source of energy.

Empirical support for electricity-led growth would imply that conservation policies could be disastrous for economic growth, which inherently enhances poverty, and reduces both job creation and societal welfare (see Ghosh, 2002). Further, if economic growth Granger-causes electricity consumption, then there might be little to worry about when implementing electricity-related conservation policies (see, Asafu-Adjaye, 2000; Narayan and Smyth, 2007).

The pioneering work of Kraft and Kraft (1978) triggered the interest in the energy consumption-growth debate. Since then, the debate has been extended to specifics, such as the electricity-growth nexus, clean energy-growth, and other related issues. Until this point in time, the energy consumption and economic growth debate had produced conflicting and interesting outcomes. Previous research on this debate was widely conducted for countries in Latin America, the Caribbeans and Asia; however, few concentrated on the countries in sub-Saharan Africa (see Odhiambo, 2009a); and Nigeria's case has been even less researched.

Our extensive search shows that Lee (2005), Wolde-Rufael (2006), and Akinlo (2008a and 2008b) are the only available literature on the electricity consumption and economic growth debate on Nigeria. Besides, majority of the literature on electricity consumption and economic growth suffers from two main limitations: a) omission-of-variable bias, when testing for causality within a bivariate VAR (see Akinlo, 2008a; Murray and Nan, 1996; Yoo, 2005) and b) and over-reliance on cross-sectional data to explain country-specific issues (see Murray and Nan, 1996; Wolde-Rufael, 2006). Last and equally crucial is the fact that most of these studies examine the relationship between electricity consumption and economic growth on the basis that such a relationship, if at all exists, is linear. In practice, such variables may

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[1] The original debate was whether energy consumption causes economic growth or economic growth causes energy consumption. The over-reliance of certain economies on electricity—a component of energy—has compelled researchers to narrow the debate to specifics. This work follows suit, since Ghana is more electricity dependent; albeit, the use of oil cannot be discounted (see Lee, 2005, for a broad debate).

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share nonlinear relationships. Thus, inferences from studies which assumed linearity could be very misleading.

Acknowledging the four important shortcomings of the previous literature, especially on Nigeria, our contributions are in three folds. First and foremost, we present fresh empirical findings for Nigeria using an extended annual time series. Secondly, we avoid the possible omission-of-variable bias involved in using bivariate VAR frameworks. Next, we introduce a very important variable, inflation, which has been found to be vital for economic growth. Recent papers have argued that the introduction of additional influential variable(s) in a bivariate causality framework could change both the magnitude and the direction of causality between variables (see Caporale and Pittis, 1997; Iyke, 2013; Odhiambo, 2009a). Finally, we employ nonlinear unit root and cointegration techniques to examine the possibility of nonlinearities in the relationship between economic growth and electricity consumption.

In terms of methodological motivation, the inclusion of additional variable(s) in a bivariate VAR/VECM setting to examine Granger causality is well-founded. The main question is why did we, among strong array of candidate variables, elicit inflation as the additional variable? In the spirit of De Gregorio (1992), Fischer (1993), Sbordone and Kuttner (1994), and Smyth (1994), we argue that inflation has negative impact on economic growth. Inflationary environments are not conducive for general business activities and the performance of the economy. It is, therefore, not surprising that many central banks have preoccupied themselves with maintaining moderate inflation. In addition, energy prices (or electricity prices) form substantial component of the common measure of inflation, the consumer price index (CPI). Intuitively, higher energy prices should drive up inflation. Other things remaining unchanged, energy consumption (in the current context, electricity consumption) should decline, consequently. Rather than the CPI, we could have used electricity prices in order to desirably interpret the resulting elasticities. However, in the Nigerian case, complete data on electricity prices for our study period was unavailable (or simply unreliable). Meanwhile, prices of goods and services generally correlate strongly with the CPI. Hence, we proxy electricity prices by the CPI.

The remaining sections of this paper are organised as follows: Section 2 provides an overview of the trends in electricity consumption and economic growth in Nigeria; Section 3 discusses the relevant literature on the electricity-growth debate; Section 4 presents the methodology; Section 5 presents the empirical results and discussion; while Section 6 provides the conclusions and implications for policy.

2. Electricity consumption and economic growth trends in Nigeria

Nigeria has struggled to provide electricity to her large population ever since independence. According to the Nigerian Electric Power Authority (NEPA), the Niger Dam has the maximum capacity to generate 5900 MW of electricity per day which falls far below the average national consumption rate of 10,000 MW per day. This has compelled the NEPA to ration electric power supply over the years. The inability to satisfy the domestic and, to a large extent, industrial needs for electricity is reported to have had debilitating impact on the growth potentials of the Nigerian economy (World Bank, 1991). Even so, the demand for electricity, according to the NEPA, is projected to increase from 5746 MW in 2005 to nearly 297,900 MW by the end of 2030. This implies that the NEPA needs to add approximately 11,686 MW of electricity to its stock each year in order to match this projection.

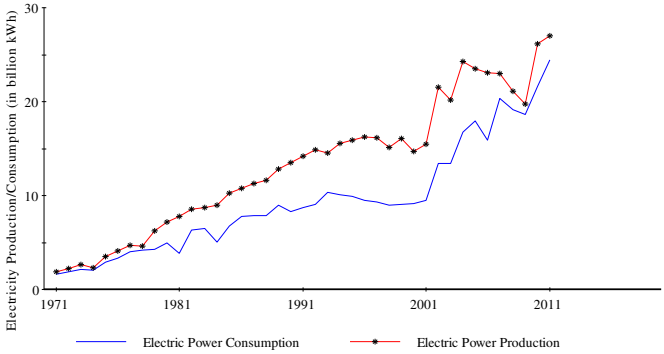
Electric power production and electric power consumption in Nigeria have generally followed the same trend over the period 1971–2011. In the exception of some rare instances, increases in electric power production have been associated with increases in electric power consumption and vice versa. For example, when electricity production increased from 1.887 billion kWh in 1971 to 2.625 billion kWh in 1973, electricity consumption also increased from 1.637 billion kWh to 1.920 billion kWh over the same period. Besides, a sudden drop in electricity production from 2.625 billion kWh in 1973 to 2.287 billion kWh in 1974 forced electricity consumption to decline from 2.122 billion kWh to 2.026 billion kWh during this period. The difference between electricity production and consumption has averaged nearly 3 billion kWh for most part of the study period. This indicates that about 3 billion kWh of the electric power generated has mostly not been consumed. The causes of the wide gap between electricity production and consumption remain a topic for future research. Fig. 1 shows the trend in electricity production and consumption in Nigeria for the period 1971–2011.

The dynamic pattern of electricity consumption and economic growth over the 1971–2011 is not immediately clear, as Fig. 2 shows. At some point, it appears as if real GDP per capita growth influences the movement of the percentage change in electricity consumption per capita. For instance, when real GDP per capita growth declined from 11.6% in 1971 to 0.95% in 1972, the impact on the percentage change in electricity consumption per capita was only shown in 1972. The percentage change in electricity consumption per capita declined from 14.55% in 1972 to −8.95% in 1974. In addition, when real GDP per capita growth increased from −7.43% in 1983 to 5.6% in 1985, the percentage change in electricity consumption per capita was only affected after 1984 — increasing from −24.07% to 29.6% in 1985. In contrast, when the real GDP per capita growth was on the decline between 1974 and 1975, the percentage change in electricity consumption per capita was increasing during this period. On this evidence, it is quite unclear whether electricity consumption causes economic growth or economic growth causes electricity consumption. Fig. 2 shows the dynamic pattern of electricity consumption and economic growth in Nigeria over the period 1971–2011.

3. Literature review

The electricity-growth causality debate has taken twists and turns in the literature without a common conclusion. The classic debate was whether energy consumption causes economic growth or economic growth causes energy consumption. The fact that electricity consumption forms a higher percentage of energy consumption in most countries has shifted the original debate to what our paper examines. Four major strands of conclusions on the energy-growth causality debate have been established in the literature.

The first strand concludes that energy (electricity) consumption causes economic growth (energy-led or electricity-led growth hypothesis); the second strand concludes that economic growth causes energy consumption (the growth-driven energy or electricity consumption hypothesis). The third strand concludes that there is bidirectional causality between energy (electricity) consumption and economic growth (the feedback hypothesis); finally, the fourth strand argues that there is no causal link between energy (electricity) consumption and economic growth (the neutrality hypothesis).



Source: *Constructed from the World Development Indicators (2014)*

Fig. 1. Electricity production and consumption in Nigeria (1971–2011).
Source: Constructed from the World Development Indicators (2014).