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Energy consumption and economic growth: Evidence from the economic community of West African States (ECOWAS)

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ABSTRACT

Access to modern energy is believed to be a prerequisite for sustainable development, poverty alleviation and the achievement of the Millennium Development Goals.
However, theoretical models and empirical results offer conflicting evidence on the relationship between energy consumption and economic growth that we remain largely unsure of the cause-and-effect nature of this relationship, if indeed a relationship exists at all.
This paper tests, in a panel context, the long-run relationship between energy access, and economic growth for fifteen African countries from 1980 to 2008 by using recently developed panel cointegration techniques. We adopt a three-stage approach, consisting of panel unit root, panel cointegration and Granger causality tests to study the dynamic causal relationships between energy consumption, energy prices and growth as well as relationship between electricity consumption, prices and growth.
Results show that GDP and energy consumption as well as GDP and electricity move together in the long-run. By estimating these long-run relationships and testing for causality using panel-based error correction models, we found unidirectional long-run and short-run causality. The causality is running from GDP to energy consumption in the short-run, and from energy consumption to GDP in the long-run. There is also evidence of unidirectional causality running from electricity consumption to GDP in the long-run.
This study thus provides empirical evidence of long-run and causal relationships between energy consumption and economic growth for our sample of fifteen countries; suggesting that lack or limited access to modern energy services could hamper economic growth and compromise the development prospects of these countries.

1. Introduction

While the availability of modern energy is not by itself a panacea for the economic and social problems facing developing countries, it is now widely recognised that the lack of access to affordable and reliable energy services is a fundamental obstacle to human, social, and economic development. Moreover, the energy poverty is a major impediment to achieving the Millennium Development Goals (MDGs),[1] since energy services have an important impact on productivity, health, education, potable water and communication services (UNIDO, 2011).

The lack of access to modern energy services that are clean, efficient and environmentally sustainable is thus an obstacle to economic growth and sustainable development, poverty reduction and achievement of the MDGs.

However, if from both theoretical and qualitative points of view, the role of energy in economic development and growth is obvious, the empirical evidence and the quantitative relationship between energy use and economic growth are a matter of debate.

A number of empirical studies using various approaches, time periods, and proxy variables have been conducted on the causal relationship between energy consumption and economic growth in different countries but evidences from empirical researches are still mixed and controversial in terms of the direction of the causality and the strength of impact of energy use on economic growth.

Even when a relationship is supported by an econometric methodology it is usually weak and has very low explanatory and predictive power.

Nevertheless the nature of causality between energy and growth has important policy implications. Thus, it is important to provide empirical evidence on the possible existence of a long-run relationship between energy consumption and economic growth for a given location (country or region) or a given sector.

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[1] In September 2000, at the United Nations Conference, world leaders adopted the United Nations Millennium Declaration, committing their nations to a global partnership to eradicate extreme poverty and setting out eight goals – with a deadline of 2015 – that have become known as the Millennium Development Goals. The MDGs do not include specific targets in relation to access to electricity or to clean cooking facilities, but universal access to both is necessary for the realisation of the goals.

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Indeed, the empirical findings of relationships between energy consumption and economic growth have significant implications. They not only provide insights into the importance of energy consumption for economic growth but also provide a basis for examination and discussion of energy and environmental policies.

For instance, the existence of a unidirectional causality running from energy consumption to economic growth tends to support the hypothesis that energy plays a crucial role in economic growth. The presence of such a causal relationship implies that economic growth is dependent on energy consumption and no access, or limited access, to energy can restrain economic growth and threaten the well-being of current and future generations. Under these conditions, it is essential to integrate into national and regional development programmes, innovative approaches to improve access to affordable, modern and clean energy, including household access to electricity from renewable energy technologies, for all populations and productive sectors.

In contrast, when causality runs from economic growth to energy consumption or if there is no causality in either direction this denotes a less energy-dependent economy and, energy conservation policies may be implemented with little or no adverse effects on economic growth.

Therefore, it is of prime importance to identify the direction of causality between energy consumption and economic growth in order to implement the appropriate energy policies, including conservation policies in developing countries.

The purpose of this paper is to study the causal relationships between energy consumption, electricity consumption and economic development, for a sample of Sub-Saharan African Countries, *the Economic Community Of West African States (ECOWAS)*,[2] and then, to see how access to modern energy may trigger their economic development and accelerate poverty reduction.

More specifically, the inter-temporal causal relationship between growth in energy consumption and growth in GDP is investigated for the fifteen countries of the ECOWAS by using panel unit root tests, panel cointegration and Granger causality tests. Energy prices are included as an additional variable. Furthermore, to analyse the specific effects of modern energy on economic growth, we disaggregate energy consumption and investigate the relationship between electricity, energy prices and growth.

The remainder of this paper is laid out as follows. The second section presents the literature review on the relationship between energy consumption and growth for African countries. The third section deals with the empirical model specification and estimation technique. The fourth section discusses the empirical results. The last section suggests some policy implications and offers some concluding remarks.

2. A brief overview of the energy consumption-growth literature for Africa[3]

The causality relationship between energy consumption and economic growth has spawned considerable interest among economists since the seminal study of Kraft and Kraft (1978), which supported the unidirectional causality from GNP growth to energy consumption in the United States for the period 1947–1974. This interest stems primarily from the inherent policy implications; however, empirical studies on the relationship between energy and growth do not provide any clear-cut answer and currently there is no consensus among economists about the nature of this relationship.

Four possible relationships have been emphasised in the empirical literature on the causal link between energy consumption and economic growth: neutrality, conservation, growth, and feedback hypotheses.

A unidirectional Granger causality running from energy consumption to GDP denotes an energy-dependent economy such that energy is a prerequisite for economic growth. In such a case, inadequate provision of energy may limit economic growth or may result in poor economic performance.

When causality runs from economic growth to energy consumption, this indicates an economy which is less energy dependent and thus energy *conservation policies*, such as phasing out fossil-fuel subsidies, the reduction in greenhouse gas emissions, measures for improving energy efficiency as well as demand management policies, designed to reduce energy consumption and waste may be implemented with no adverse effect on growth.

If there is no causality between energy consumption and economic growth (also known as the *neutrality hypothesis*), this implies that policies to promote energy consumption will not have effects on economic growth.

Finally, the *feedback hypothesis* suggests that energy consumption and growth are interrelated and complement each other.

2.1. Literature survey on energy-growth nexus

The contrasting hypotheses mentioned above have motivated many scholars to investigate the causal relationship between energy consumption and economic growth.

However, a few studies have attempted to explore the causal relationship between energy consumption and economic growth in Sub-Saharan African countries. Moreover, the previous researches are mainly based on time-series data of individual countries and, employ the Engle and Granger residual-based cointegration test (1987) and the maximum likelihood test based on Johansen (1988) and Johansen and Juselius (1992).

For example, by employing Granger causality test, Ebohon (1996) shows a causal relationship between energy and economic growth for two countries in Sub-Saharan Africa: Nigeria and Tanzania.

Following advances in time series analysis in the last decade, analysis techniques have evolved and the energy consumption and economic growth relationships are carried out by using the Toda and Yamamoto tests of Granger causality (1995).

For instance, Wolde-Rufael (2005) applies this approach to investigate the long-run relationship between per capita energy use and per capita GDP for 19 African countries and finds mixed results, ranging from negative causality to bidirectional causality. The empirical evidence shows that there is a long run relationship between the two series for only 8 of the 19 countries and a short-run relationship for 10 countries.

Akinlo (2008), by using the Autoregressive Distributed Lag (ARDL) bounds and Granger causality tests based on Vector Error Correction Model (VECM), explores the causal relationship between energy consumption and economic growth for 11 Sub-Saharan African countries and finds mixed results. He reveals that economic growth and energy consumption are cointegrated and, there is a bidirectional relationship between energy consumption and economic growth for 3 countries and a unidirectional causality running from economic growth to energy consumption for 2 countries. The "neutrality hypothesis" for the energy–income relationship is confirmed in respect of 5 countries.

With the same method, Odhiambo (2009b) finds a unidirectional causality running from energy consumption to economic growth in Tanzania.

Wolde-Rufael (2009), in a multivariate framework including labour and capital as additional variables and, by using Granger causality test of Toda and Yamamoto, re-examines the causal relationship between

[2] The ECOWAS is a regional body of 15 member states. Its population represents more than 30% of the total population of SSA. 11 of the 15 are classified as Low Income Countries and Least Developed Countries. Its per capita energy consumption is 454 kgoe (5418 for the USA and 3224 for the OECD). Only 20% of the population have access to electricity and its per capita electricity consumption is 88 kWh (13,228 for the US and 8046 for the OECD). Traditional biomass (wood, agricultural residues and other primitive energy sources) accounts for more than 75% of total energy.

[3] For a recent and more detailed literature review on energy consumption and growth, see for example Ozturk (2010) and Apergis and Payne (2009a,b).