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Energy consumption, prices and economic growth in three SSA countries: A comparative study

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ABSTRACT

In this paper we examine the causal relationship between energy consumption and economic growth in three sub-Saharan African countries, namely South Africa, Kenya and Congo (DRC). We incorporate prices as an intermittent variable in a bivariate setting between energy consumption and economic growth—thereby creating a simple trivariate framework. Using the ARDL-bounds testing procedure, we find that the causality between energy consumption and economic growth varies significantly across the countries under study. The results show that for South Africa and Kenya there is a unidirectional causal flow from energy consumption to economic growth. However, for Congo (DRC) it is economic growth that drives energy consumption. These findings have important policy implications insofar as energy conservation policies are concerned. In the case of Congo (DRC), for example, the implementation of energy conservation policies may not significantly affect economic growth because the country's economy is not entirely energy dependent. However, for South Africa and Kenya there is a need for more energy supply augmentations in order to cope with the long-run energy demand. In the short-run, however, the two countries should explore more efficient and cost-effective sources of energy in order to address the energy dependency problem.

1. Introduction

The debate regarding the relationship between energy consumption and economic growth has attracted vast literature from both theoretical and empirical fronts in recent years. The thrust of this debate largely revolves around the inter-temporal causal relationship between energy consumption and economic growth. Four views currently exist regarding the causal relationship between energy consumption and economic growth. The first view argues that economic growth causes energy consumption, and that as the economy grows the demand for energy from different sections of the economy increases. The second view, however, argues that it is the consumption of energy that causes economic growth. The third view argues that both electricity consumption and economic growth cause each other, i.e. that there is a bi-directional causality between electricity consumption and economic growth. While these three views support the causal relationship between energy consumption and economic growth, the fourth view contends that there is no causal relationship between energy consumption and economic growth. In other words, both energy consumption and economic growth are neutral with respect to each other.

Although a number of studies have been conducted on the causal relationship between energy consumption and economic growth in sub-Saharan African countries, some of these studies have typically relied on the cross-sectional data, which may not satisfactorily address the country-specific issues. The problem of using a cross-sectional method is that by grouping countries that are at different stages of economic development, it fails to address the country-specific effects of energy consumption on economic growth and vice versa. In particular, the method fails to explicitly address the potential biases induced by the existence of cross-country heterogeneity, which may lead to inconsistent and misleading estimates (see Ghirmay, 2004; Quah, 1993; Casselli et al., 1996; Odhiambo, 2008, 2009a). Even where time-series data have been used, the empirical findings on the direction of causality between energy consumption and economic growth have been largely inconclusive (see Odhiambo, 2009a). The current study, therefore, attempts to examine the inter-temporal causal relationship between energy consumption and economic growth in three SSA countries, namely South Africa, Kenya and Congo (DRC). The three countries include two low-income economies, i.e. Kenya and Congo (DRC), and one highly developed economy, i.e. South Africa. The study uses the recently developed ARDL-bounds testing approach in a trivariate setting to examine this linkage. Specifically, the study incorporates prices in the bivariate setting between energy consumption and economic growth—thereby creating a simple trivariate model. The price level has been chosen as an intermittent variable because of its

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effects on both energy consumption and economic growth. On the one hand, an increase in prices (for example) is expected to lead to a decrease in energy demand, thereby leading to a decrease in energy consumption. On the other hand, an increase in prices leads to a decrease in demand, thereby leading to a contraction in aggregate output. The rest of the paper is structured as follows: Section 2 gives an overview of the energy policies in the three study countries. Section 3 presents the literature review, while Section 4 deals with the empirical model specification, the estimation technique and the empirical analysis of the regression results. Section 5 concludes the study.

2. An overview of the energy sector in the three study countries

The energy sector in the three study countries differs significantly from country to country and over time. South Africa, for example, is considered to have the highest energy production and consumption in Africa. Eskom, a parastatal responsible for the supply of electricity in South Africa, is estimated to generate about two-thirds of the total sub-Saharan African electricity output and 80% of the total southern African output (see Estache et al., 2008). With a generating capacity of about 40 000 MW, Eskom is ranked as one of the top five energy utilities in the world. Overall, the energy sector contributes about 15% of the South African GDP, and employs about 250 000 people. The main energy resource in South Africa is coal, which contributes about 88% of the country's total electricity. However, the country recently experienced a decrease in its reserve margin, which forced it to embark on a number of interventions in early 2008. In some instances, load shedding had to be used as the last resort in order to prevent a system-wide blackout. These interventions enabled Eskom to bring the demand for electricity slightly closer to its supply, while at the same time maintaining a reasonable reserve margin. The South African government attributes the unprecedented decline in the electricity reserve margin during the recent years to the robust economic growth and the associated demand for electricity. Currently, the government is working on both medium- and long-term programmes intended to enable the country to cope with the future demand for electricity. At the same time alternative sources of energy are being explored in order to supplement the supply of electricity (see Odhiambo, 2009b). The South African energy policy is based on a number of key objectives. These include: (i) attaining universal access to energy by 2012; (ii) providing accessible, affordable and reliable energy, especially to the poor; (iii) diversifying primary energy sources and reducing dependency on coal; and (iv) proving energy that is environmentally friendly, amongst others. The energy in South Africa is regulated by the National Energy Regulator of South Africa (NERSA), which was launched in 2005. Although South Africa's electricity tariff has been one of the lowest in the world, the recent electricity demand from both the household and business sectors forced Eskom to significantly increase the electricity tariff in order to expand its generating capacity.

Unlike in South Africa, Kenya relies largely on wood fuel. In fact, wood fuel provides about 68% of the total energy requirements in Kenya, while petroleum and electricity provide 20% and 10% of total energy consumption, respectively. Other sources of alternative energy account for the remaining 2%. Just as in other developing countries, a number of policies have been implemented in Kenya since independence in order to address the country's energy needs. One of Kenya's most significant energy policies was the Electric Power Act of 1997, which was legislated to replace the previous electric power Act (CAP 314). The aim of this legislation was to facilitate private sector participation in the provision of electricity. This led to the establishment of an independent electric power producer known as Kenya Electricity Generating Company (KenGen) in 1998. The Electric Power Act of 1997 also provided for rural electrification on a limited scale, using renewable energy technologies. Following the unprecedented power shortages in Kenya in 1999 and 2000, the country decided to formulate a comprehensive energy policy for the entire energy sector. The ultimate goal of this policy is to ensure an adequate, reliable, cost-effective and affordable energy supply for developmental needs, while at the same time paying attention to environmental protection and conservation. The energy sector in Kenya is regulated by the Energy Regulatory Commission (ERC), which replaced the Energy Regulatory Board (ERB) in July 2007. The main functions of the ERC are to: (i) regulate the electrical energy, petroleum and related products, renewable energy and other forms of energy; (ii) protect the interests of consumers, investors and other stakeholders; and (iii) ensure the implementation of the principle of fair competition in the energy sector, amongst others. As in other sub-Saharan African countries, energy prices have risen significantly in Kenya in recent years.

In the Democratic Republic of Congo (DRC), the dynamics are somewhat different. Despite the fact that the country has extensive potential hydro-electric capacity of approximately 100 000 MW, only a fraction of its hydro-electric power has been developed. This has been largely due to the political uncertainties that have ravaged the country and scared potential investors over the years. For example, in 2003 the DRC had a total generating capacity of about 2568 MW, but only produced between 600 and 700 MW because two-thirds of the turbines were dysfunctional. The DRC has massive hydro-electric potential because of its Congo River, which is currently the world's second largest in terms of its flow. Overall, the energy sector in the DRC is largely dominated by the high consumption of wood and bio-mass energy. In fact, it is estimated that only about 6% of the country's population has access to electricity. The current energy focus in the DRC, however, centres mainly on the Grand Inga Scheme, which is expected to produce about 39 000 MW, thereby making it the biggest hydro-electric plant in the world, as well as being the biggest single source of hydro-electric generation. The DRC exports hydro-electricity to the Republic of Congo along a 220 kV connection. It is estimated that this connection supplies nearly one-third of the electricity consumed in Congo-Brazzaville. The country also exports electricity to other African countries such as Zambia, the Central African Republic and Angola, among others. The electricity in the DRC is generated by Societe Nationale d'Electricite (SNEL).

3. Literature review

The causal relationship between energy consumption and economic growth has important implications from the theoretical, empirical and policy standpoints. A unidirectional causality running from energy consumption to economic growth, for example, implies that economic growth is dependent on energy consumption, and a decrease in energy consumption may restrain economic growth (see also Narayan and Singh, 2007, p. 1142; Odhiambo, 2009a). A unidirectional causality running from GDP to energy consumption, on the other hand, implies that a country is not entirely dependent on energy for its economic growth, and that energy conservation policies can be implemented with little or no adverse effects on economic growth. Likewise, the finding of no causality in either direction, i.e. the so-called 'neutrality hypothesis', implies that energy conservation policies have little or no effect on economic growth (see Odhiambo, 2009a; Asafu-Adjaye, 2000; Paul and Bhattacharya, 2004). Table 1 shows the empirical findings of the causality between energy