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Energy consumption and economic growth nexus in Tanzania: An ARDL bounds testing approach

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ABSTRACT

In this paper, we examine the intertemporal causal relationship between energy consumption and economic growth in Tanzania during the period of 1971–2006. Unlike the majority of the previous studies, we employ the newly developed autoregressive distributed lag (ARDL)-bounds testing approach by Pesaran et al. [2001. Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics 16, 289–326] to examine this linkage. We also use two proxies of energy consumption, namely total energy consumption per capita and electricity consumption per capita. The results of the bounds test show that there is a stable long-run relationship between each of the proxies of energy consumption and economic growth. The results of the causality test, on the other hand, show that there is a unidirectional causal flow from total energy consumption to economic growth and a prima-facie causal flow from electricity consumption to economic growth. Overall, the study finds that energy consumption spurs economic growth in Tanzania.

1. Introduction

Since 1970s, a number of studies have attempted to examine the causal relationship between energy consumption and economic growth in both developed and developing countries. Unfortunately, the majority of the studies in developing countries have concentrated mainly in Asia and Latin America, affording sub-Saharan African (SSA) countries very little coverage and in some instances none at all. In fact, empirical studies on countries like Tanzania are almost non-existent. Even where such studies have been undertaken, the empirical findings on the direction of causality between energy consumption and economic growth have been largely inconclusive. Over all, the empirical evidence from previous studies on this subject shows that the causal relationship between energy consumption and economic growth differs from country to country and over time. In addition, previous studies have shown that the causality between the two variables may be sensitive to the choice of the energy consumption variable. Although the majority of the previous studies have found a direct causal relationship between the various proxies of energy consumption and economic growth, the literature regarding the possible neutrality between energy consumption and economic growth is growing in quantity and substance. The majority of the previous studies on the causality between energy consumption and economic growth have mainly used the residual-based cointegration test associated with Engle and Granger (1987) and the maximum likelihood test based on Johansen (1988) and Johansen and Juselius (1990). Yet it is now well known that these cointegration techniques may not be appropriate when the sample size is too small (see Narayan and Smyth, 2005). In addition, some previous studies have over-relied on the cross-sectional data analysis, which generalises the causal relationship between energy consumption and economic growth across countries. The problem of using a cross-sectional method is that by grouping together 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 also Odhiambo, 2008; Ghirmay, 2004; Quah, 1993; Casselli et al., 1996). It is against this backdrop that the current study attempts to investigate the intertemporal causal relationship between energy consumption and economic growth in Tanzania using the autoregressive distributed lag (ARDL)-bounds testing approach. The study uses two proxies of energy consumption, namely the total energy consumption per capita and the electricity consumption per capita against the real GDP per capita—a proxy for economic growth. The rest of the paper is structured as follows: Section 2 gives an overview of the energy policies in Tanzania. Section 3 presents the literature review, while Section 4 deals with the empirical model specification, the

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estimation technique and the empirical analysis of the regression results. Section 5 concludes the study.

2. An overview of energy policies in Tanzania

The main sources of energy in Tanzania include biofuel, wood fuel, hydroelectric power, natural gas, biogas, coal reserves, wind and solar energy. However, the most exploited energy source is wood fuel, which is considered to be cheap and accessible to the majority of Tanzanians who live mainly in rural areas. In fact, the biomass energy resource, which consists of fuel-wood and charcoal from natural forests and plantations, accounts for 90% of the total energy consumption, while petroleum accounts for 8% (SARDC, 2006). Petroleum and hydroelectric power on the other hand, account for 8% and 1.2%, respectively. The remaining energy sources, such as solar energy, wind, etc. account for only 0.8%. The vast majority of Tanzanians do not have access to electricity. In particular, the rural population is hard hit. While about 39% of the urban population have access to electricity, only 2% of the rural population have access to electricity. The government of Tanzania has implemented a number of policies which are aimed at addressing the country's energy needs. Recently, the government decided to review the country's energy policy of 1992, which culminated in the National Energy Policy of 2003. The main aims of this policy are to: (i) promote affordable and reliable energy supplies throughout the whole country; (ii) reform the market for energy services and establish an adequate institutional framework to facilitate investment in the energy sector, taking into account the environmental concerns in all energy activities; (iii) enhance the development and utilisation of indigenous and renewable (RE) energy sources; (iv) promote energy efficiency and conservation; and increase energy education and build gender-balanced capacity in energy planning, implementation and monitoring (Republic of Tanzania, 2005).

The consumption of energy in Tanzania has, however, shown a mixed trend, especially since the 1990s. For example, the energy consumption, measured in kilograms of oil equivalent per capita, steadily decreased from 428.142 in 1980 to 352.062 in 1994, before increasing to 358.427 in 1995. Although the consumption later decreased to 353.185 and 347.882 in 1996 and 1997, respectively, it later increased again to 360.055 in 1998. Since 1999 the energy consumption in Tanzania has been increasing consistently, with the highest level of 498.29 since 1973 being recorded in 2004. Fig. 1 shows the trends of energy consumption per capita and GDP per capita during the period 1994–2005 as compared to 1980.

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 electricity 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). 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 no effect on economic growth (see Asafu-Adjaye, 2000; Paul and Bhattacharya, 2004).

On the empirical front, there exist four views regarding the causal relationship between energy consumption and economic growth. The first view argues that energy consumption Granger-causes economic growth. This view has been widely supported by

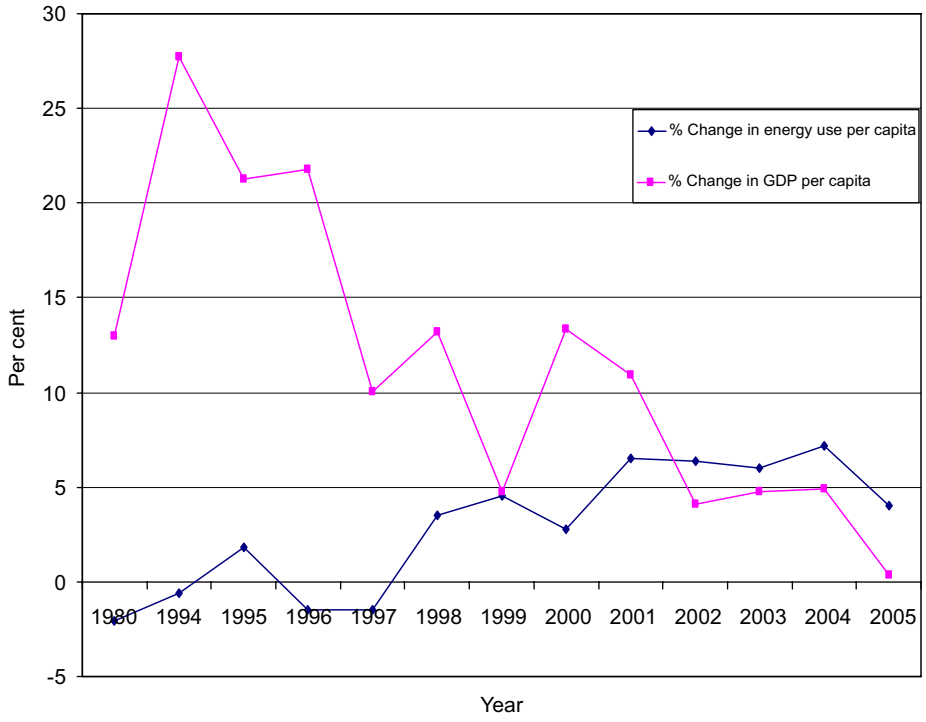

Fig. 1. Trends of energy consumption per capita and economic growth during the period 1994–2005 as compared to 1980. *Source*: Author's own computation from the World Development Indicators CD-ROM, 2007; International Financial Statistics Yearbook, 2007.