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Energy Consumption, electricity, and GDP Causality; The Case of Russia, 1990-2011

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Abstract

This article examines the causal relationship between the energy consumption, electricity consumption and GDP in Russia by using time series data from 1990-2011 implying the Toda and Yamamoto approach, which is revised form of the Granger (1969) causality test (Econ. 66 (1995) 225). The maximum order of integration was determined by using PP and ADF unit root tests. The Toda and Yamamoto test is applied regardless of whether the series are $I(0)$, $I(1)$, or $I(2)$, mutually cointegrated or non-cointegrated. The variables were estimated at level in the unrestricted lag-augmented VAR. The AIC, SC and LR lag criteria were used to determine the optimal lag length. The diagnostics tests were performed at the optimum lag selected by estimating the variables at level and confirmed the stability of the unrestricted VAR model. The empirical evidence showed that there exists a the bi-directional causality from electricity consumption to GDP that implies the validity of feedback hypothesis but no causality was found for GDP and energy consumption supporting the neutrality hypothesis. The estimated results confirmed that both the economic growth and electricity consumption empirically support each other and have a mutual and complementary relationship. But on another hand the energy sector of Russia has no impact on the economic growth for a period 1990-2011. Furthermore, if the Government of Russia devises policies to promote the access of energy and higher level of consumption, economic growth will not be affected.

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1. Introduction

Energy consumption has been the burning issue around the world especially in the industrialized advanced nations. A huge literature can be found about the debate, on both energy consumption and GDP and the empirical results has been different for countries. The studies were conducted with the aim to know about the causality direction of energy consumption and GDP. Two views have inferred from the empirical studies conducted. One view is that as the economy expands that causes increase in demand for energy consumption. The second view that is an alternative view to the first argument claims that it is because of the energy consumption that the economy expands. While the third view is both the economic growth and energy consumption cause each other. i.e. bidirectional causality. Not only the causal relationship was studied, but also the long term relationship was analyzed between GDP and energy consumption. This is evident from the study conducted by Bowden and Payen, (2010), Lee (2006), Ozturk (2010); Apergis and Pyne, (2009a, 2011b;), Ewing et al.,2007, Soytas and Sari (2003), and Payne (2010) by setting four different hypothesis. The *growth hypothesis* in which the use of energy stimulates economic growth characterizes by causality direction from energy consumption to GDP. This causal relationship indicates that if the energy supplied to an economy is limited that may result in poor economic performance. In growth hypothesis the government should encourage the investment in more innovative approaches that should be aimed at improving the access to the energy at affordable rates for all productive sectors (Squalli, 2007).

The *conservation hypothesis means* that it is because of the economic growth which stimulates the increase consumption of energy supported by uni-directional causality from GDP to energy consumption. This supports the fact that economic growth stimulates the development of energy sector in an economy that is characterized by less dependence on energy. The policies which are based on energy conservation, if implemented properly, will have no adverse impact on economic growth. The *feedback hypothesis* is reinforced by the mutual relationship of economic growth and the energy consumption reinforced by bi-directional causality. The *neutrality hypothesis* means that both the energy consumption and GDP does not affect each other. The absence of causality of neutrality hypothesis implies that the policies reinforced by promotion of energy access and increase level of consumption will not have any impact on economic growth (Ouedraogo 2013). The rest of the article is organized as follows. Section 2 highlights brief literature review. Section 3 elucidates the data and model specification. Section 4 explains econometric methodology. Section 5 outlines the empirical results. Finally section 6 concludes.

2. Literature Review

Table 1. Literature Review

Authors	Estimation Sample	Country	Econometric Methodology	Causality direction	Hypothesis
Odhiambo (2009a)	1971-2006	South Africa	ARDL Bounds test	EC ⟶ GDP	Growth hypothesis
Odhiambo (2009b)	1971-2006	South Africa	ARDL Bounds test	GDP ⟶ EC	Conservation Hypothesis
Soyatas and Sari (2003)	1950-1992	Italy, Japan, South Korea	Vector error correction model, Granger Causality test	GDP — EC	Neutrality hypothesis
Akinlo (2008)	1980-2003	Ghana, Ghambia and Senegal	Fully modified OLS	GDP ⟷ EC	Feedback hypothesis
Wolde-Rufael (2006)	1971-2001	Algeria, Cango, Egypt, Ghana, Ivory coast	Toda and Yamamoto granger causality test	GDP ⟶ EC	Conservation Hypothesis
Lee (2005)	1975-2001	Ghana	VEC model, granger causality	EC ⟶ GDP	Growth hypothesis
Twerefo et al (2008)	1975-2006	Ghana	VEC model, granger causality	GDP ⟶ EC	Conservation Hypothesis
Fatai et al(2004)	1960-1999	Philippines	Toda and Yamamoto	GDP ⟷ EC	Feedback