# ENERGY ECONOMICS LETTERS

http://aessweb.com/journal-detail.php?id=5049


## THE ANALYSIS OF RELATIONSHIP BETWEEN ECONOMIC GROWH AND ELECTRICITY CONSUMPTION IN AFRICA BY ARDL METHOD


***Melike E BILDIRICI***

*Yildiz Technical University, Turkey*


### ABSTRACT


*This paper investigates the relationship between electricity consumption and economic growth by using Autoregressive Distributed Lag (ARDL) bounds testing approach and vector error-correction models (VECM) in* Cameroon, Cote D'Ivoire, Congo, Ethiopia, Gabon, Ghana, *Guatemala*, Kenya, Senegal, Togo and Zambia for period 1970-2010. *The ARDL results show that there is cointegration relation between electricity consumption and economic growth in ten of the eleven countries. The results reveal that income elasticities of electricity consumption, electricity consumption is luxury good for Gabon and Guetemela, necessity good or Engel's good for Senegal and inferior good for Zambia. The causality analysis reports that growth hypothesis exists in Cameron, Congo Rep., Ethiopia, Kenya and Mozambique and the conservation hypothesis in Senegal and Zambia. For Gabon, Ghana and Guatemala, there exists the bidirectional causality between economic growtth and electricity consumption.*



**Keywords:** Growth, Development, Electricity consumption, ARDL

**Jel Codes:** C13, C22, O40, Q41, Q43



**Crossponging Author:** melikebildirici@gmail.com



**Citation:** Melike E Bildirici (2013) "The Analysis of Relationship Between Economic Growh and Electricity Consumption in Africa by Ardl Method" Energy Economics Letters, 2013, Vol. 1, No.1, pp.1-14.

## 1. INTRODUCTION

Despite being endowed with natural energy resources and/or fosil fuel resources in African countries especially for those in the Sub-Saharan Africa, these countries experience the lowest per capita energy consumption levels in the world (United Nations Economic Commission of Africa, 2004, Nondo et al. 2010). The rate of energy consumption increases with economic development and the consumption of energy sources improve living standards (Darmstadter et al. 1979; Schurr, 1982; and Rosenberg, 1983), a higher level of socio-economic development is associated with a well developed energy (Kebede et al. 2011). Energy and/or electricity consumption plays a vital role in economic development of countries and have become a focus of many papers involved in the energy economics literature. The relationship between electricity consumption and economic growth has been analyzed through a plethora of perspectives within the field of energy economics (Bildirici, 2012, Shahbaz et al. 2011, 2012).

The literature on the relationship between energy consumption and economic growth dates back to the late 1970s. Rasche and Tatom's (1977) study was specified that the increase of energy prices stimulated the decreasing trends on GNP by using energy, land, labor and capital. Kraft and Kraft, (1978) found the relation between energy consumption and GNP as one way from GNP to energy consumption by using Sims causality analysis. Akarca and Long, (1980) continued to analyse by eliminating the data of 1973 and 1974. They found neutrality effect between GNP and energy consumption as being different from the results of the Kraft and Kraft, (1978). Yu and Choi, (1985) found no causality relationship between GNP and energy consumption for the USA, UK and Poland. Erol and Yu, (1987) found the bidirectional causality between energy consumption and GNP for Japan, from energy consumption to GNP for Canada, from GNP to energy consumption for Germany and Italy, no causality for England and France.

If the results obtained by the papers that have examined energy (electricity) consumption and economic growth in causality framework in the literature are investigated, we observe that different results about the direction of causality are obtained. Following the literature, one may construct four different hypotheses: (1) N*eutrality hypothesis*" that is, there is no causality between economic growth and energy (electricity) consumption. Under the stated neutrality hypotesis, the policies aimed at conserving energy resources fail to retard economic growth (Asafu-Adaye, 2000; Jumbe, 2004). (2) *Feedback hypothesis* states that, there exists a bi-directional causality running between economic growth and energy (electricity) consumption and this relationship assumed a bidirectional relationship between energy consumption and economic growth (Shahbaz and Lean, 2012). Energy consumption and economic growth are complementary, and that an increase in energy consumption stimulates economic growth, and vice-versa (3) *conservation hypothesis that* determines the unidirectional causality running from economic growth to energy (electricity) consumption. When causality runs from economic growth to energy consumption, an economy is less energy dependent, and thus energy conservation policies, such as phasing out energy subsidies, may not adversely affect economic growth (Mehrera, 2007). (4) G*rowth hypothesis* evaluates the existance of the unidirectional causality running from energy (electricity) consumption to economic growth (Narayan and Smyth, 2005b; Ghosh, 2002). According to the growth hypothesis, country's economy is energy dependent; in this case, the reduction of energy (electricity) consumption will lead to a fall in economic growth. Energy is a direct input in the production process and /or an indirect input that complements labor and capital inputs (Ebohon, 1996; Toman and Jemelkova, 2003). This implies that a negative shock to electricity consumption, leads to higher electricity prices or electricity conservation policies and will be negative impact on GDP (see Narayan and Singh, 2007; Shahbaz et al. 2012; Bildirici and Kayıkcı, 2012; Shahbaz and Feridun, 2012).

## 2. LITERATURE REVIEW

The literature focusing on African countries are relatively rare vis-a-vis papers on European and Asian countries, although in recent times, some papers about energy economics have focused on African countries (see Jumbe, 2004; Lee, 2005; Wolde-Rufael, 2005, 2006; De Vita et al 2006; Squalli, 2007; Jefferis, 2008; Akinlo, 2009; Kouakou, 2011; Odhiambo, 2009a, b; Odhiambo, 2010; Esso, 2010; Kebede et al. 2011; Nondo et al. 2011; Adebola, 2011; Bildirici, 2012). Lee, (2005) analysed the relationship between energy consumption and GDP by panel estimation techniques for 18 developing countries including sub-Saharan African countries, Kenya and Ghana, and determined that the causality running from energy consumption to GDP. Rufael, (2005) tested the long run relationship between energy consumption and GDP for 19 African countries over period 1971–2001 by ARDL method. The results repoted that there was a long run relationship between the two series for only eight countries and causality for only 10 countries. De Vita et al. (2006) examined the determinants of electricity demand in Namibia. Wolde-Rufael, (2009) analysed the relationship between energy consumption and economic growth for 17 African countries by incorporating labor and capital as additional variables. Odhiambo, (2010) assessed the causal relationship between energy consumption and economic growth in three sub-Saharan African countries. Esso, (2010) used threshold cointegration for 7 African countries. Bildirici, (2012) used MS-Granger causality approach to examine the causal relationship between electricity consumption and the real GDP in nine African countries. The results reported the bidirectional Granger causality between electricity consumption and economic growth for the nine countries analyzed.

The results of the studies on African countries in the literature are presented in Table 1.

**Table-1.** Causality Literature on Energy Economics in African Countries

| Author(s) | Country | Period | Methodology | Main Variables | causality |
|---|---|---|---|---|---|
| *Conservation hypothesis* | | | | | |
| Wolde-Rufael, (2006) | Cameroon, Gabon, Ghana, Nigeria, Senegal, Zambia, Zimbabwe | 1971-2001 | ARDL (Toda Yamamamoto) | GDP, Electricity consumption | Y → EC |
| Wolde-Rufael, (2005) | Algeria, Democratic Republic of Congo, Egypt, Ghana and Ivory Coast | 1971-2001 | ARDL (Toda Yamamamoto) | GDP, Electricity consumption | Y → EC |
| Esso, (2010) | Congo Ghana | 1970-2007 | Threshold cointegration Approach | GDP, Electricity consumption | Y → EC |
| *Growth Hypothesis* | | | | | |
| Lee, (2005) | Sub-Saharan African Kenya and Ghana | 1971-2001 | | GDP, Electricity consumption | EC → Y |
| Wolde-Rufael, (2006) | Benin, Congo, Tunusia | 1971-2001 | ARDL (Toda Yamamamoto) | GDP, Electricity consumption | EC → Y |
| Odhiambo, (2009) | Tanzania | 1971-2006 | ARDL)-bounds testing approach | GDP, Electricity consumption | EC → Y |
| Belloumi, (2009) | Tunusia | 1971–2004 | Granger causality, VECM | GDP, Electricity consumption | EC → Y (in SR) |
| Quedraogo, (2010) | Burkina Faso | 1968-2003 | ARDL | GDP, Electricity consumption | EC→Y |
| Kebede et al. (2010) | 20 Sub-Saharan Africa | 1980-2004 | Atomic Energy Agency Energy Demand Projection (MAED) model | GDP, Electricity consumption | EC→Y |
| *Feedback hypothesis* | | | | | |
| Ebohon, (1996) | Nigeria, Tanzania | 1960-1984 1960-1981 | Granger Causality | GDP, Electricity consumption | EC←→ Y |
| Belloumi, (2009) | Tunusia | 1971–2004 | Granger causality, VECM | GDP, Electricity consumption | EC←→ Y (in LR) |
| Ouedraogo, (2010) | Burkina-Faso | 1968-2003 | Bound test | GDP, Electricity consumption | EC←→ Y |
| Esso, (2010) | Ivory Coast | 1970-2007 | Threshold cointegration | GDP, Electricity consumption | EC←→ Y |

| | | | | | |
|---|---|---|---|---|---|
| | | | Approach | | |
| Nondo et al. (2010) | 19 African countries (COMESA) | 1980-2005 | Panel VEC, Granger Causality Tests | GDP, Electricity consumption | EC←→Y (in LR) |
| Bildirici, (2012) | Algeria, Egypt, Morocco, Nigeria, South Africa, Sudan, Togo, Tunisia and Zimbabwe | 1970-2010 | MS-VAR, MS-VAR Causality | GDP, Electricity consumption | EC←→Y |
| *Neutrality hypothesis* | | | | | |
| Wolde-Rufael. (2006) | Kenya | 1971 - 2001 | Bound test (Toda Yamamamoto) | GDP, Electricity consumption | none |
| Wolde-Rufael, (2006) | Sudan | 1971 - 2001 | Bound test (Toda Yamamamoto) | GDP, Electricity consumption | none |
| Huang et al. (2008) | in the low income group | 1972 - 2002 | Panel VAR, GMM-SYS | GDP, Electricity consumption | none |
| Esso, (2010) | Cameroon, Nigeria, Kenya, South Africa | 1970 - 2007 | Threshold cointegration Approach | GDP, Electricity consumption | none |

Note: EC←→Y, Y→EC and EC→Y represent bidirection causality between energy consumption and economic growth, causality is running from economic growth to energy consumption and energy consumption to economic growth respectively.

# 3. DATA AND METHODOLOGY

## 3.1. Data

This study invstgiates the relationship between electricity consumption (EC = log (electricity consumption) and real GDP (Y= log (real GDP) by applying the ARDL bounds testing approach to cointegration. This study involved eleven (11) countries in Africa over the period of 1970-2010. The eleven (11) countries covered in the study are Cameroon, Cote D'Ivoire, Congo, Ethiopia, Gabon, Ghana, Kenya, Nigeria, Senegal, Togo and Zambia. The choice of countries included in the work was based on the availability of data on the variables incorporated. The sample covers the period of 1970-2010. The data is taken from World Bank World Development Indicators, IEA, OECD and U.S. Energy Information Administration.

## 3.2. Methodology

In the ARDL bounds analysis, the variables of the model are allowed to possess mixed order of integration. The ARDL model for the standard log-linear functional specification of long-run relationship between variables with OLS estimation technique is presented as:

$$\Delta Y = \alpha_0 + \sum_{i=1}^{m} \beta_i \Delta Y_{t-i} + \sum_{i=0}^{n} \phi_i \Delta EC_{t-i} + \delta_1 Y_{t-1} + \delta_2 EC_{t-1} + \varepsilon_t \qquad (1)$$

where $\Delta$ *and* $\varepsilon_t$ are the first difference operator and the white noise term. The ARDL bounds testing follows estimation of regressions in order to obtain the optimal lag length for each variable. An appropriate lag selection is chosen based on Akaike information criterion (AIC). The bounds testing procedure is based on the joint F-statistic or Wald statistic that tests the null hypothesis of no cointegration. The null hypothesis of no cointegration among the variables in Eq. (1) are $H_0: \ \delta_1 = \delta_2 = 0$ against the alternative hypothesis $H_1: \ \delta_1 \neq \delta_2 \neq 0$ . One set of critical values assumes that all variables in the ARDL model are I(0), while the other is calculated on the assumption that the variables are I(1). In the second step, if cointegration is established, the conditional ARDL long-run model can be estimated as:

$$\mathrm{Y} = \lambda_0 + \sum_{\mathrm{i=1}}^{\mathrm{m}} \alpha_{\mathrm{i}} Y_{\mathrm{t-i}} + \sum_{\mathrm{i=0}}^{\mathrm{n}} \vartheta_{\mathrm{i}} EC + \mathrm{u_t} \qquad (2)$$

In the third stage, the short-run dynamic parameters are obtained by estimating an error correction model (ECM) associated with the long-run estimates:

$$\Delta \mathrm{Y} = \chi_0 + \sum_{\mathrm{i=1}}^{\mathrm{m}} \beta_{\mathrm{i}} \Delta \mathrm{Y}_{\mathrm{t-i}} + \sum_{\mathrm{i=0}}^{\mathrm{n}} \theta_{\mathrm{i}} \Delta \mathrm{EC}_{\mathrm{t-i}} + \zeta \ ECM_{t-1} + \mathrm{e_t} \qquad (3)$$

where residuals $e_t$ is independently and normally distributed with zero mean and constant variance and $ECM_{t-1}$ is the error correction term. $\zeta$ is a parameter that indicates the speed of adjustment to the equilibrium level after a shock. It shows how quickly variables converge to equilibrium and it must have a statistically significant coefficient with a negative sign.

### 3.3. VECM Granger Causality

The ARDL bounds testing approach tests if the existence or absences of long-run relationship between electricity consumption and real GDP but it doesn't determine the direction of causality. It was used the two-step procedure from the Engle and Granger, (1987) model to examine the causal relationship between electricity consumption and real GDP. After it is estimated the long-run model in order to obtain the estimated residuals, the next step is to employ the following error-correction based on Granger causality model (see Shahbaz et al. 2013; Bildirici and Kayıkcı, 2012; Odhiambo, 2009a)

The advantage of using an error correction term to test for causality is that it allows testing for short-run causality through the lagged difference explanatory variables and for long-run causality through the lagged $ECM_{t-1}$ term. The vector error correction model that was used to analyze the short run relationships between the variables is constructed as follows:

$$\Delta Y = \alpha_0 + \sum_{i=1}^{m} b_{1i}\Delta Y_{t-i} + \sum_{i=0}^{n} b_{2i}\Delta EC_{t-i} + b_3 ECM_{t-1} + e_t \qquad (4)$$

$$\Delta EC = \alpha_0 + \sum_{i=1}^{p} d_{1i}\Delta EC_{t-i} + \sum_{i=0}^{q} d_{2i}\Delta Y_{t-i} + d_3 ECM_{t-1} + e_t \qquad (5)$$

where residuals, $e_t$ is independently and normally distributed with zero mean and constant variance and $ECM_{t-1}$ is the error correction term resulting from the long-un equilibrium relationship and *d*'s are parameters to be estimated. Granger causality can be examined in two ways in the paper. First, short run or weak Granger causalities are tested by $H_0 : b_{2i} = 0$ and $H_0 : d_{2i} = 0$ in Eq. (4) and (5). Second, long run Granger causalities are tested from the ECTs in those equations. Long-run causalities are tested by $H_0 : b_3 = 0$ and $H_0 : d_3 = 0$.

## 4. EMPIRICAL RESULTS

Bildirici, (2012) used MS-Granger causality approach to examine the causal relationship between electricity consumption and real GDP in nine African Countries. Kebede et al. (2011) estimated date of structural breaks for African countries. But for analysed countries in this paper, we didn't find any estimated date for business cycle and structral break. Lag length supplying the smallest critical value is determined as the lag length of the model and is based on the AIC. Model structures are determined after applying LM tests to all of the possible models.

The results of the ARDL bounds tests shown in Table-2, suggest the rejection of the null hypothesis of no long run relationship at the 1% level of significance when *GDP* is treated as dependent variable and EC is independent variable. That means, there is a long run equilibrium relationship between electricity consumption and economic growth for African countries. The majority of studies in the literature do not examine the coefficients with respect to both the sign (positive or negative) and the magnitude of the relationship between electricity consumption and economic growth. The long run elasticities results (t-ratios in parenthesis) are also displayed in Table-2.

**Table-2.** Bounds Testing for Cointegration

| | $F_y$ (Y\|EC) | $F_{EC}$ (EC\|Y) | Long-run Coefficient | ECM term |
|---|---|---|---|---|
| Cameron | 5.7628* | .3005 | -.4858(7.35) | -.173357(2.37) |
| Congo, Rep. | 7.2110* | 1.2557 | -.19693(2.017) | -.15542(2.189) |
| Ethiopia | 7.6550* | 1.5113 | .7521(2.1574) | -.12360(2.0735) |
| Gabon | 8.5273* | 1.05875 | -.21345(2.1668) | -.24772(2.827) |
| Ghana | 0.32876 | 6.4651* | 1.8143(2.0143) | -.30831(2.7941) |
| Guatemala | 0.65423 | 9.0273* | 1.20688(2.7177) | -.16692(2.35) |
| Kenya | 6.7815* | 0.1758 | .01763(2.5869) | -.32558(2.896) |
| Mozambique | 5.4145* | 1.1145 | .83089(11.31) | -.33036(2.0784) |
| Senegal | 1.3848 | 7.1004* | 0.3905(2.918) | -.64139(2.116) |
| Togo | 1.635 | 1.449 | - | - |
| Zambia | 2.1434 | 5.9814* | -0.07587(3.487) | -.18635(5.896) |

When analyzing the relation with electricity consumption to income, it is seen that the income elasticity of electricity demand has a positive sign and statistically significant in the long run for Gabon, Guatemala and Senegal but negative sign for Zambia. A positive income elasticity of electricity demand is associated with normal good. This result indicates that electricity consumption is a normal good for Gabon, Guatemala and Senegal as it increases with income. The estimated income elasticities of electricity demand are greater than 1 for Gabon and Guetemela and it is a luxury good or a superior good that is a type of normal goods. In Senegal situation, electricity consumption is a necessity good or Engel's good that is a type of normal good. For Zambia that income elasticity of electricity demand has a negative sign, electricity consumption is inferior good. The error-correction term was negatively and statistically significant showing speed of adjustment ranging from 12 to 65% within one year of any disequilibrium toward a long run equilibrium state.

**Granger Causality Result**

According to results of ARDL methods, because there is a long-run relationship between electricity consumption and economic growth, a causality relationship must exist in at least one direction. It was used the augmented Granger causality test by incorporating the error correction term. In short run causality analysis, there is evidence to support the growth hypothesis for Cameron, Congo, Ethiopia, Kenya and Mozambique. In these countries, there is a unidirectional relationship from electricity consumption and economic growth, which means that electricity consumption acts as a stimulus to economic growth. With these findings, energy policies aimed at improving the energy infrastructure and increasing the energy supply are the appropriate options for these countries since electricity consumption increase the economic growth level. For Senegal and Zambia, there is evidence to support the unidirectional causality running from economic growth to electricity consumption. Energy conservation measures can be taken without jeopardising economic development. In Gabon, Ghana and Guatemala, it was found the evidence to support the feedback hypothesis.

**Table-3.** Results of Granger Causality

| *Countries* | $\Delta EC \rightarrow \Delta Y$<br>$\Delta Y \rightarrow \Delta EC$<br>*F statistic for SR- GC* | $ECM \rightarrow \Delta Y$<br>$ECM \rightarrow \Delta EC$<br>*F statistic for LR – GC* |
|---|---|---|
| Cameron | 192.9291<br>.09925 | .48792<br>2.5801 |
| Congo, Rep. | 790.605<br>1.79012 | 5.4141<br>71.8448 |
| Ethiopia | 233.63<br>.04235 | 3.619<br>7.3546 |
| Gabon | 121.5253<br>26.8130 | 108.7935<br>120.6216 |
| Ghana | 12.2593<br>177.8403 | 178.6614<br>172.7276 |
| Guatemela | 33.119<br>52.987 | 14.732<br>42.702 |
| Kenya | 276.6179<br>1.3055 | 274.5761<br>276.4182 |
| Morocco | 0.27365<br>249.426 | 240.4896<br>17.8728 |
| Mozambique | 39.4715<br>3.2874 | 41.047<br>37.8278 |
| Senegal | 1.5917<br>83.84 | 66.7365<br>86.4215 |
| Zambia | 0.27891<br>234.51 | 7.9356<br>230.5457 |

Note: In this table, the symbol → shows the direction of causality. F statistic for SR-GC: F statistic for Short-Run Granger Causality; F statistic for LR- GC: F statistic for Long-Run Granger Causality.

According to long-run causality result, there is evidence to support a bidirectional causality running between economic growth and electricity consumption for all countries except for Cameron. Electricity consumption and economic growth are complementary, and that an increase in energy consumption stimulates economic growth, and vice-versa. For Cameron, there is evidence to support neutrality hypothesis as a unexpectional result.

## 5. CONCLUSION

When analyzing the relation with electricity consumption to income, it is seen that the income elasticity of demand has a positive sign and statistically significant in long run for Gabon, Guatemala and Senegal but negative sign for Zambia. A positive income elasticity of electricity demand is associated with normal good and this result indicates that electricity consumption is a normal good as it increases with income. For Gabon and Guetemela, electricity consumption is a luxury good. In Senegal, electricity consumption is a necessity good or Engel's good that is a type of normal good. For Zambia, electricity consumption is inferior good. The ECM coefficients were negative and statistically significant. The short run causality results indicate the growth hypothesis in Cameron, Congo Rep., Ethiopia, Kenya and Mozambique. In these economies, energy policies aimed at improving the energy infrastructure and increasing the energy supply are the appropriate options for Cameron, Congo Rep., Ethiopia, Kenya and Mozambique. Energy conservation policies could hamper social and economic progress when there is a unidirectional relationship between electricity consumption and economic growth.

There is evidence to support the conservation hypothesis for Senegal and Zambia. The unidirectional causality goes from economic growth to energy consumption and suggests that the policy of conserving energy consumption may be implemented with little or no adverse effects on economic growth, such as in a less energy-dependent economy. This is not theoretically expected outcome for those countries since they are developing countries.

For Gabon, Ghana and Guatemala, there exists the bidirectional causality running between economic growth and electricity consumption in short run causality. There is evidence to support a bidirectional causality running between economic growth and electricity consumption for all countries except for Cameron. Energy consumption and economic growth are complementary, and that an increase in energy consumption stimulates economic growth, and vice-versa. For Cameron, under the stated neutrality hypotesis, the policies aimed at conserving energy resources fail to retard economic growth.

One factor explaining African countries' poverty is the lack of investments in energy infrastructure and services. Wolde-Rufael, (2005) stated the current energy infrastructure of these countries is still inadequate to support their quest for rapid economic growth that is required to eradicate poverty and to raise the living standards of their people. The results highlight the importance of electricity policy on economic growth, economic development and welfare in African countries.

## 6. REFERENCES


Adebola, S.S. 2011. Electricity Consumption and Economic Growth: Trivariate investigation in Botswana with Capital Formation. *International Journal of Energy Economics and Policy*, 1: 32-46.

Akarca, A.T., Long, T.V. 1980. On the Relationship between Energy and GNP: A Re-examination. *Journal of Energy and Development*, 5: 26-331.

Akinlo, A. E. 2009. Electricity Consumption and Economic Growth in Negeria: Evidence from Cointegration and Co-feature Analysis. *Journal of Policy Modeling*, 31: 681-693.

Amaewhule, K. 2003. What are the Constraints Facing the Development and Implementation of an Energy Efficiency Policy in Nigeria and How can These be Overcomed?http://www.dundee.ac.uk/cepmlp/car/html/car7_article7.pdf .

Amusa, H., Amusa, K., Mabugu, R. 2009. Aggregate Demand for Electricity in South Africa: An Analysis Using the Bounds Testing Approach to Cointegration. *Energy Policy*, 37: 4167-4175.

Asafu-Adjaye, J. 2000. The Relationship between Energy Consumption, Energy Prices and Economic Growth: Time Series Evidence from Asian Developing Countries. *Energy Economics* 22: 615-625.

Babatunde, M. A., Shuaibu, M. İ. 2009. The Demand for Residential Electricity in Nigeria: A Bound Testing Approach. http://www.africametrics.org/conference09/papers/Babatunde_Shuaibi.pdf

Belloumi, M. 2009. Energy Consumption and GDP in Tunisia: Cointegration and Causality Analysis. *Energy Policy* 37: 2745-2753.

Bildirici M. 2012. The Relationship between Economic Growth and Electricity Consumption in Africa: MS-VAR and MS-Granger Causality Analysis. *The Journal of Energy and Development*, 37:????

Bildirici, M., Kayıkcı, F. 2012. Energy Consumption and Growth in Eastern Europa: ARDL Approach. *Economic Research*, 25: 538-559.

Darmstadter, J., Dunkerley, J., Alterman, J. 1979. *How Industrial Societies Use Energy: A Comparative Analysis*. John Hopkins University Press, Washington, D.C.

De Vita, G., Endresen, K., Hunt, L. C. 2006. An Empirical Analysis of Energy Demand in Namibia. *Energy Policy*, 34: 3447-3463.

Ebohon, O. J. 1996. Energy, Economic Growth and Causality in Developing Countries: A Case Study of Tanzania and Nigeria. *Energy Policy*, 24: 447-453.

Engle, R. F., Granger, C. W. J. 1987. Co-integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*, 55: 251-276.

Erol, U., Yu, E. S. H. 1987. On the Relationship between Electricity and Income for Industrialized Countries. *Journal of Electricity and Employment*, 13:113-122.

Esso, L. J. 2010. Threshold Cointegration and Causality Relationship between Energy Use and Growth in Seven African Countries. *Energy Economics,* 32: 1383-1391.

Fatai, K., Oxley, L., Scrimgeour, F. G. 2004. Modeling the Causal Relationship between Energy Consumption and GDP in New Zealand, Australia, India, Indonesia, The Philippines and Thailand. *Mathmetical Computation and Simulation*, 64: 431-445.

Ghosh, S. 2002. Electricity Consumption and Economic Growth in India. *Energy Policy,* 30: 125-129.

Huang, B. N., Hwang, M. J., Yang, C.W. 2008. Causal Relationship between Energy Consumption and GDP Growth Revisited: A Dynamic Panel Data Approach. *Ecological Economics,* 6: 41-54.

Jaunky, C. V. 2006. Income Elasticities of Electric Power Consumption: Evidence from African Countries. *Regional and Sectoral Economic Studies,* 7: 25-50.

Jefferis. K. 2008. *Summary of Economic Developments.* BIFM Economic Review 1st Quarter.

Jumbe, C. B. L. 2004. Cointegration and Causality between Electricity Consumption and GDP: Empirical Evidence from Malawi. *Energy Economics,* 26: 61-68.

Kebede, E., Kagochi, J., Jolly, C. M. 2010. Energy consumption and economic development in Sub-Sahara Africa. *Energy Economics,* 32: 532-537.

Kebede, E., Kagochi, J., Jolly, C. M. 2011. Energy Consumption and Economic Growth Revisited in African Countries. *Energy Policy,* 39: 7408-7421.

Kouakou, A. K. 2011. Economic Growth and Electricity Consumption in Cote d'Ivoire: Evidence from Time Series Analysis. *Energy Policy,* 39: 3638-3644.

Kraft, J., Kraft, A. 1978. On the Relationship Between Energy and GNP. *Journal of Energy and Development*, 3: 401-403.

Lee, C. C. 2005. Energy Consumption and GDP in Developing Countries: A Cointegrated Panel Analysis. *Energy Economics,* 27: 415-427.

Mehrara, M. 2007. Energy Consumption and Economic Growth: The Case of Oil Exporting Countries. *Energy Policy,* 35: 2939-2945.

Narayan, P. K. 2005. The Saving and Investment Nexus for China: Evidence for Cointegration Tests. *Applied Economics,* 37: 1979-1990.

Narayan, P. K., Singh, B. 2007. The Electricity Consumption and GDP Nexus for the Fiji Islands. *Energy Economics,* 29: 1141-1150.

Narayan, P. K., Smyth, R. 2005. Electricity Consumption, Employment, and Real Income in Australia: Evidence from Multivariate Granger Causality Tests. *Energy Policy,* 33: 1109-1116.

Nondo, C., Kahsai Mulugeta, S., Schaeffer Peter, V. 2010. Energy Consumption and Economic Growth: Evidence from COMESA Countries. RESEARCH PAPER 2010-1.

Odhiambo, N. M. 2007. Supply-leading versus Demand-following Hypothesis: Empirical Evidence from Three SSA Countries. *African Development Review*, 19: 257-279.

Odhiambo, N. M. 2009a. Energy Consumption and Economic Growth Nexus in Tanzania: An ARDL Bounds Testing Approach. *Energy Policy*, 37: 617-622.

Odhiambo, N. M. 2009b. Electricity Consumption and Economic Growth in South Africa: A Trivariate Causality Test. *Energy Economics*, 31: 635-640.

Ouédraogo, I. M. 2010. Electricity Consumption and Economic Growth in Burkina Faso: A Cointegration Analysis. *Energy Economics*, 32: 524-531.

Ozturk, İ., Acaravci, A. 2011. Electricity Consumption and Real GDP Causality Nexus: Evidence from ARDL Bounds Testing Approach for 11 MENA Countries. *Applied Energy*, 88: 2885-2892

Pesaran, M. H., Pesaran, B. 1997. Working with Microfit 4.0: interactive econometric analysis. Oxford University Press, Oxford.

Pesaran, M. H., Shin, Y., Smith, R. J. 2001. Bounds Testing Approaches to the Analysis of Level Relationships. *Journal of Applied Econometrics*, 16: 289-326.

Rasche, R. H., Tatom, J. A. 1977. The Effects of the New Energy Regime on Economic Capacity, Production, and Prices. Review, Federal Reserve Bank of St. Louis, May: 2-12.

Rosenberg, N. 1998. The Role of Electricity in Industrial Development. *The Energy Journal*, 19: 7-24.

Shahbaz, M., Feridun, M. 2012. Electricity Consumption and Economic Growth Empirical Evidence from Pakistan. *Quality & Quantity: International Journal of Methodology*, 46: 1583-1599.

Shahbaz, M., Lean, H. H. 2012. The Dynamics of Electricity Consumption and Economic Growth: A Revisit Study of Their Causality in Pakistan. *Energy*, 39: 146-153.

Shahbaz, M., Lean, H. H., Farooq, A. 2013. Natural Gas Consumption and Economic Growth in Pakistan. *Renewable and Sustainable Energy Reviews*, 18: 87-94.

Shahbaz, M., Mihai, M., Tiwari, A. V. 2012. Revisiting the Relationship between Electricty Consumption and Economic Growth: Coinetgation and Cusality Analysis in Romania. Romanian *Journal of Economic Forcatsing*, 3: 97-120.

Shahbaz, M., Tang, C. F., Shabbir, M. 2011. Electricity Consumption and Economic Growth Nexus in Portugal Using Cointegration and Causality Approaches. *Energy Policy*, 39: 3529-3536.

Squalli, J. 2007. Electricity Consumption and Economic Growth: Bounds and Causality Analyses of OPEC Countries. *Energy Economics*, 29: 1192-1205.

Toman, M. 2003. The Roles of the Environment and Natural Resources in Economic Growth Analysis. Discussion Papers dp-02-71.

Toman, M., Jemelkova, B. 2003. Energy and Economic Development: An Assessment of the State of Knowledge. *Energy Journal*, 24: 93-112.

Wolde-Rufael, Y. 2006. Electricity Consumption and Economic Growth: A Time Series Experience for 17 African Countries. *Energy Policy,* 34: 1106-1114.

Wolde-Rufael, Y. W. 2005. Energy Demand and Economic Growth: The African Experience. *Journal of Policy Modeling*, 27: 891-903.

Yu, E. S. H., Choi, J. Y. 1985. The Causal Relationship between Energy and GNP : An International Comparison. *Journal of Energy and Development*, 10: 249-272.

Ziramba, E. 2008. The Demand for Residential Electricity in South Africa. *Energ Policy*, 36: 3460-3466.