International Journal of Energy Economics and Policy
Vol. 4, No. 2, 2014, pp.154-162
ISSN: 2146-4553
www.econjournals.com

Energy Consumption and Economic Growth: Evidence from Low-Income Countries in Sub-Saharan Africa

Eyup DOGAN
The J. E. Walker Department of Economics,
Clemson University, USA.
E-mail: edogan@clemson.edu

ABSTRACT: The main purpose of this paper is to investigate the causality relationship between energy consumption and economic growth in four low-income countries in Sub-Saharan Africa using the econometrics in time-series methods. Along the estimation process, I use the annual data on energy consumption and real GDP per capita over the years of 1971 and 2011. The results of the ADF unit root test show that the time series are not stationary for all countries at levels, but log of economic growth in Benin and Congo become stationary after taking the differences of the data, and log of energy consumption become stationary for all countries and LGR in Kenya and Zimbabwe are found to be stationary after taking the second differences of the time-series. The findings of the Johansen co-integration test demonstrate that the variables LEC and LGR are not co-integrated for the cases of Kenya and Zimbabwe, so no long-run relationship between the variables arises in any country. The Granger causality test indicates that there is a unidirectional causality running from energy use to economic growth in Kenya and no causality linkage between EC and GR in Benin, Congo and Zimbabwe.

Keywords: economic growth; energy consumption; causality test
JEL Classifications: C22; O43

1. Introduction

Should governments care about the relationship between energy consumption (EC) and economic growth (GR) in their home countries? It is important for policy makers to find out the causality relationship between EC and GR because the final result will help them to impose a proper energy policy. For instance, a government will pay more attention on a policy of stimulated energy use in the case where the reduction in EC will cause GR to go down as EC is found to have a positive impact on GR. Hence, the government will encourage people and firms to consume more energy in order to foster its growth since EC is also related to many factors such as unemployment, investment, savings and economic development. On the contrary, the government can carry out an energy conservation policy when there is no causality linkage between the variables or causality running from growth to energy use in that country. In such a case, if the government follows the appropriate policy it will unlikely face the severe economic turndown during the dramatic increase in energy prices.

Although a number of papers have focused on the causality relationship between energy consumption and economic growth over many countries from different continents, no clear consensus about this concern has been obtained. The differences in the estimation results mostly emerge due to the differences in countries' conditions (i.e. economic developments, natural resources, consumption patterns, technology, and human capitals), applied econometrics techniques, and used time periods. Referring to the existing literature, there are typically four different outcomes related to the connection between EC and GR. These hypotheses are: "Conservation hypothesis" occurs when there is a one-way causality running from economic growth to energy consumption. "Growth hypothesis" exists if energy consumption causes economic growth, but GR does not cause EC. "Neutrality hypothesis" arises when there is no linkage between energy consumption and economic growth. "Feedback hypothesis" happens if there is a two-way causality between EC and GR (Ozturk, 2010).

In this paper, we plan to investigate the relationship between EC and GR in four low-income countries[1] in Sub-Saharan Africa because of following reasons: 1) The published single and multi-country studies on the case of Sub-Saharan African countries have usually neglected the mentioned countries 2) The papers include Benin, Congo, Kenya and Zimbabwe have indicated different hypothesis in these countries 3) There has not been a recent multi-country study focuses on the low-income countries in Sub-Saharan Africa[2]. Thus, the purpose of this paper is to fulfill this gap and make an empirical contribution into the economic growth-energy literature. Because the linkage between the variables likely changes as the used time-period changes and the power of causality test increases as the number of observations in a time-series increases, the findings of this study will be more fresh and robust. In the frame of this paper, I apply econometrics in time-series methods: the Augmented Dickey-Fuller (ADF) unit root test, the Johansen co-integration test, vector autoregressive analysis (VAR), and the Granger causality test. I employ them to investigate whether or not the linkage between EC and GR exists over the period of 1971-2011.

The rest of paper is as follows: the second section brings literature review up, the third section gives more detail information about the data and methodology, the fourth section shows the empirical results, and the last section concludes the study.

2. Literature Review

There is a fair amount of empirical works that support each of the above-mentioned hypotheses. We hereby classify the existing literature as single country studies, multi-country studies, and panel studies. Empirical estimations on the causality interrelation between EC and GR on each group studies have mixed results that change from sample to sample and from time to time for the same sample.

2.1 Single Country Studies

2.1.1 Non-Sub Saharan African Countries

The pioneering work of the energy-economic growth literature by Kraft and Kraft (1978) exhibit a strong statistical relationship between EC and GR, and a unidirectional linkage from growth to energy use in the USA applying Sim's Granger method over the period of 1947 through 1974. In addition to this early study, Yu and Hwang (1984) find no causality connection between EC and GR for the case of the USA from 1947-79. Cheng and Lai (1997) exhibit that there is a conservation hypothesis in Taiwan during the years 1954-93 using the Granger causality approach. Lee and Chang (2007) show that growth hypothesis exists if the amount of used energy is low and neutrality hypothesis arises if the level of energy consumption is high in a case study of Taiwan employing the threshold autoregressive (TAR) technique for the period of 1955 through 2003. Warr and Ayres (2010) perform the Engle-Granger method for the years 1946-2000, and find energy consumption to have a positive impact on economic growth in the USA. Lotfalipour et al. (2010) show the presence of conservation hypothesis in Iran during 1967-2007 applying Toda-Yamamoto method. Pao et al. (2011), and Pao and Tasai (2011) reveal that the causality runs from GR to EC in Russia and Brazil, respectively.

2.1.2 Sub Saharan African Countries

Ambapour and Massamba (2005) demonstrate the existence of conservation hypothesis in Congo applying a co-integration approach and error correction mechanism over the period 1960 through 1999. Akinlo (2009) empirically tests the causality relationship between EC and GR and reveals that growth hypothesis takes place in Nigeria using the Johansen-Jeselius and the Engle-Granger approaches from 1980-2006. Ziramba (2009) exposes neutrality hypothesis in a case study of South Africa over the period 1980 through 2005. Adom (2011) finds the linkage running from GR to EC in Ghana applying the Granger causality test. Akinwale et al. (2013) shows that conservation hypothesis exists in Nigeria employing ADF unit root test, VAR analysis, error correction mechanism, and Granger causality test during 1970-2005. Wandji (2013) reveals a unidirectional linkage from oil consumption to GR in Cameroon using Dickey-Fuller unit root test, VECM and Granger Causality test for the period 1971-2009.

[1] These countries are Benin, Congo (Congo Dem. Rep), Kenya and Zimbabwe.

[2] To the best of my knowledge, the recent study on the case of Sub-Saharan countries is published in 2010, and use the data from 1970-2007. Please see the literature review section for further knowledge on the published papers.

2.2 Multi-Country Studies

2.2.1 Non-Sub Saharan African Countries

The seminal work of Yu and Choi (1985) known as one of the earliest multiple-country studies expose energy-growth nexus in Philippines, neutrality hypothesis for the USA, UK and Poland, and growth-energy nexus in Korea running the Granger causality test. Masih and Masih (1996) support growth hypothesis in India and Indonesia, feedback hypothesis for Pakistan, and neutrality hypothesis for Malaysia, Singapore and Philippines applying the Johansen co-integration techniques, vector decomposition and Granger causality methods. Asafu-Adjaye (2000) applies co-integration and error correction methods and Granger causality test, and shows that energy-growth nexus arises in India and Indonesia, and feedback hypothesis happens in Philippines and Thailand. Soytas and Sari (2003) demonstrate the presence of growth hypothesis in Germany, France, Japan, Italy, Turkey and Korea, and the existence of feedback hypothesis in Argentina employing co-integration techniques and the Granger causality test. Keppler (2006) reveals conservation hypothesis in India and energy-growth nexus in China applying error correction model and the Granger causality test. Kalyoncu et al. (2013) examine the relationship between EC and GR in Georgia, Azerbaijan and Armenia using co-integration methods and causality test. They find that EC and GR are not co-integrated for Georgia and Azerbaijan but are co-integrated in the case of Armenia, and there is a one-way causality from GDP per capita to energy consumption per capita in Armenia.

2.2.2 Sub-Saharan African Countries

An old study of Ebohon (1996) focuses on Sub-Saharan African countries finds a bi-directional causality relationship between energy use and growth in Tanzania and Nigeria using Granger causality test. In addition, Wolde-Rufael (2005) performs ARDL bounds test and Toda-Yamamoto approach during 1971-2001, and supports conservation hypothesis for Algeria, Congo Dem. Rep., Egypt, Ghana, Ivory Coast, Morocco and Nigeria, growth hypothesis for Cameroon, and neutrality hypothesis for Congo Republic, Kenya, Senegal, South Africa, Sudan, Togo, Tunisia and Zimbabwe. Akinlo (2008) shows that there is a two-way causality between EC and GR in Gambia, Ghana, Sudan, Senegal and Zimbabwe, growth-energy nexus arises in Cameroon, growth hypothesis happens in Congo, and no causality effect in Cote d'Ivoire, Kenya, Nigeria and Togo. Odhiambo (2010) finds a one-way causality running from energy use to growth in cases of Kenya and South Africa during 1972-2006 employing ARDL bounds test approach and the Granger causality test. Esso (2010) examines the long-run interrelation and causality linkage between EC and GR for 7 Sub-Saharan African countries from 1970-2007, indicates that feedback hypothesis exists in Cote d'Ivoire and conservation hypothesis takes place in Congo, and also shows that there is a long-run relationship between EC and GR in Cameroon, Congo, Cote d'Ivoire and South Africa.

2.3 Panel Data Studies

2.3.1 Non-Sub Saharan African Countries

Lee and Chang (2005) exert that there exists energy-growth nexus for 18 developing countries employing panel unit root, panel co-integration and panel-based error correction models over the years of 1975 through 2001. Al-Iriani (2006) demonstrate the existence of conservation hypothesis for the sample of six Gulf Cooperation Countries from 1970-2002. Mehrara (2007) exposes growth-energy nexus in eleven oil exporting countries during 1971-2002. Pao and Tsai (2011), Al-mulali (2011), and Behmiri and Manso (2012) apply panel co-integration techniques and panel VECM, and find the presence of feedback hypothesis in BRIC (Brazil, Russia, India and China), MENA and OECD countries, respectively. Farhani and Rejeb (2013) investigate the relationship between EC and GR in over 90 countries during 1971-2008, and indicate that there exist conservation hypothesis for low and high income countries, and feedback hypothesis for lower-middle and upper-middle income countries.

2.3.2 Sub-Saharan African Countries

Ozturk et al. (2010) examine the causality linkage between EC and GR in low income and high income regions from 1971-2005, and find the presences of conservation and feedback hypothesis for low income countries and high income countries, respectively. Eggoh et al. (2011) perform panel co-integration techniques and expose a bi-directional causality between EC and GR for 21 African countries over the years 1970-2006. Al-Mulali and Sub (2012) also support feedback hypothesis for 30 Sub-Saharan African countries applying panel co-integration method and panel VECM from 1980-2008. A recent study by Behmiri and Manso (2013) apply multivariate panel Granger causality method on oil exporting and oil importing Sub-Saharan African countries for the periods of 1985 through 2011, and show that energy-growth nexus occurs for oil exporting countries and feedback hypothesis arises in oil importing countries.

3. Data and Methodology

The data used in this study covers the period of 1971-2011 in 41 pairs of observations, and re follows:

a) As proxy for economic growth, the aggregate annual time series at constant prices for real GDP per capita. Aggregates are based on 2005 U.S. dollars, and converted from domestic currencies by using the annual exchange rates by the World Bank.

b) Energy consumption is defined as kg of oil equivalent per capita.

The data on EC and GR are drawn from "World Development Indicators" by the World Bank[3].

The relationship between economic growth and energy consumption in a country is stated as:

$GR_t = \pi_0 + \pi_1.EC_t + \zeta_t$

and, $EC_t = Ŧ_0 + Ŧ_1.GR_t + \eta_t$

where the parameter ζ and η are normally distributed error terms.

4. Empirical Results

4.1 Unit Root

The primary purpose of employing a unit root test is to pose whether or not the variables energy consumption and economic growth are stationary series. A time-series variable will be stationary if and only if it does not include a unit root at all. Granger and Newbold (1974) note that when both variables are non-stationary, an estimated regression will likely be spurious one which has high R^2 (goodness of fit) and statistically significant coefficients on the independent variables, and the results are without any economic meaning.

I employ one of the most applied approaches, the ADF unit root test, to pose whether or not both series are stationary. Dickey and Fuller (1979) present the ADF unit root test as:

$$\Delta X_t = \alpha + \beta X_{t-1} + \sum_{i=1}^{k} \lambda i \Delta X t - i + \gamma T + \varepsilon_t \qquad (1)$$

where ε_t is a normally distributed white noise error term, T is a deterministic time trend, X_{t-1} is the lagged value of the variable X_t, ΔX_{t-i} are the lagged values of the first differences of the variable X_t, and $\gamma,\lambda,\beta,\alpha$ are the estimated coefficients. In the frame of this study, the number of augmenting lag is determined by the method of Said and Dickey (1984), $k= N^{1/3}$, where N is the number of observations in a time-series and k is the optimal lag length. A necessary step before moving on to the test process is to determine 'k' because of two reasons; (1) if 'k' is too small, some serial correlation can be left in the errors and the test result will be biased, (2) if 'k' is too large, power of the test will decrease. The appropriate lag length in the ADF test is approximately 4 for EC and GR as both of them have 41 pairs of observations.

The further step is to posit the right hypotheses and options for the estimation process of the ADF test. As commonly observed in the literature the logarithmic values of the variables are used in this paper, where LEC and LGR represent for log of EC and log of GR, in order. The null hypotheses with an option of trend in table 1 are that LEC and LGR in each single country have a unit root, and the alternative hypotheses are that neither has a unit root. Both the z-scores and p-values yield that LEC and LGR in every single country have a unit root because I fail to reject the null hypotheses at 5% level of significance.

If a time series is found to be non-stationary, one of the most followed methods will be taking the first difference of the variable in order to make it a stationary series. In addition, the second difference of the variable will be used if it does not become stationary after taking the first difference of the data. Thus, I first take the first differences of LEC and LGR in Benin, Congo, Kenya and Zimbabwe. The null hypotheses and the alternative hypotheses without an option of trend in table 2 are that each of the variables in every separated country has a unit root, and neither has a unit root, respectively.

[3] The data are publicly available at http://data.worldbank.org/

Table 1. ADF Unit Root Test at Levels

Country	Variables	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	P-Value	Decision
Benin	EC	-0.28	-4.27	-3.55	-3.21	0.98	Fail to Reject
	GR	-2.11	-4.27	-3.55	-3.21	0.53	Fail to Reject
Congo	EC	-1.7	-4.27	-3.55	-3.21	0.74	Fail to Reject
	GR	-1.62	-4.27	-3.55	-3.21	0.78	Fail to Reject
Kenya	EC	-1.37	-4.27	-3.55	-3.21	0.86	Fail to Reject
	GR	-2.28	-4.27	-3.55	-3.21	0.44	Fail to Reject
Zimbabwe	EC	-1.93	-4.27	-3.55	-3.21	0.63	Fail to Reject
	GR	-1.41	-4.27	-3.55	-3.21	0.85	Fail to Reject

Table 2. ADF Unit Root Tests in Differences

a) The First Differences

Country	Variables	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	P-Value	Decision
Benin	DLEC	-2.14	-3.68	-2.97	-2.61	0.22	Fail to Reject
	DLGR	-3.06	-3.68	-2.97	-2.61	0.02	Reject
Congo	DLEC	-2.10	-3.68	-2.97	-2.61	0.24	Fail to Reject
	DLGR	-2.89	-3.68	-2.97	-2.61	0.04	Reject
Kenya	DLEC	-2.69	-3.68	-2.97	-2.61	0.07	Fail to Reject
	DLGR	-2.19	-3.68	-2.97	-2.61	0.20	Fail to Reject
Zimbabwe	DLEC	-2.76	-3.68	-2.97	-2.61	0.06	Fail to Reject
	DLGR	-2.22	-3.68	-2.97	-2.61	0.19	Fail to Reject

b) The Second-Differences

Country	Variables	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	P-Value	Decision
Benin	DLEC	-3.54	-3.68	-2.97	-2.61	0.006	Reject
Congo	DLEC	-3.68	-3.68	-2.97	-2.61	0.004	Reject
Kenya	DLEC	-3.97	-3.68	-2.97	-2.61	0.001	Reject
	DLGR	-4.32	-3.68	-2.97	-2.61	0.004	Reject
Zimbabwe	DLEC	-4.58	-3.68	-2.97	-2.61	0.0001	Reject
	DLGR	-3.25	-3.68	-2.97	-2.61	0.01	Reject

Because the ADF test statistic is smaller than 5% critical value, the null hypotheses of having a unit root can be rejected for the variable DLGR in Benin and Congo. Since the ADF test statistic is bigger than 5% critical value, I cannot reject that DLGR in Kenya and Zimbabwe, and DLEC in Benin, Congo, Kenya and Zimbabwe have a unit root.

The results in table 2 indicate that the variable LEC become stationary in all countries and the variable LGR are concluded to be stationary for Benin, Congo, Kenya, and Zimbabwe after taking the second differences of them. The outcomes of the ADF test also show that LEC and LGR have different order of integration for the countries Benin and Congo. For the case of Kenya and Zimbabwe LEC and LGR have the same order of integration and are integrated in order two, I(2). Two or more time-series can be co-integrated if they are integrated in the same order, and so the variables at levels did not cause a spurious regression. Thus, co-integration techniques are performed for the countries which have the same order of integration for LEC and LGR.

4.2 Co-integration Test

Co-integration implies that one or more linear combinations of the time-series variables are stationary even though they are individually non-stationary (Dickey et al., 1991). Before applying a co-integration test, I first should determine the optimal lag length using selection-order criteria such as LR and AIC. For the case of Kenya the appropriate lag length is two, and for the case of Zimbabwe the provided lag length is one. After determining the optimal lag length, the Johansen ML co-integration test presented by Johansen (1988, 1991) is applied to finalize whether or not LEC and LGR are co-integrated. This test takes the following vector auto-regression (VAR) model (2):

$$\Delta \ln Y_t = \beta + \sum_{i=1}^{k} \Gamma i \, \Delta \ln Yt - i + \Pi \ln Y_{t-1} + \varepsilon_t \quad (2)$$

where Y_t represents an n*1 vector of variables energy consumption and economic growth which are integrated in order two. The parameters Γ and Π represent for n*n matrices of coefficients on the lagged variables, and ε_t is an n*1 vector of innovations. All I need to know is that if the rank is zero, there will be no co-integrating relationship. If the rank (r) is one there will be one co-integrating relation, if it is two there will be two and so on. When there is a co-integration between two time-series, these series will have a long-run relation and roughly follow the same patterns.

The Johansen ML co-integration test is based on the maximum likelihood estimation and two statistics: the maximum eigenvalue (K_{max}) and the trace-statistics (λ_{trace}), where the λ_{trace} tests the null hypothesis that r is equal to zero (no co-integration) against a general alternative hypothesis of $r>0$. The K_{max} tests the null hypothesis that the number of co-integrating vectors is r versus the alternative of r+1 co-integrating vectors. The results in table 3 indicate that the null hypotheses of no co-integrations versus one co-integrating equations for both countries cannot be rejected at 5% level of significance since trace statistics are smaller than 5% critical value and the stars also prove the conclusion. I finally deduce that the variables LEC and LGR in Kenya and Zimbabwe are not co-integrated, nor do they have long-run relationships.

Table 3: The results of the Johansen ML Co-integration test

a) Kenya

Maximum Rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	6	214.70	-	7.47*	15.41
1	9	217.45	0.13	1.98	3.76
2	10	218.44	0.04	-	-

b) Zimbabwe

Maximum Rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	2	134.49	-	4.93*	15.41
1	5	136.91	0.11	0.10	3.76
2	6	136.96	0.01	-	-

4.3. Granger Causality

Granger (1988) notes that the Granger causality test is a statistical hypothesis test to determine whether or not one time series is useful in forecasting another. In addition, Park and Phillips (1989), and Sims et al. (1990) show that causality results can be spurious if non-stationary time series data are used in the process of test. Hence, I should carefully establish the properties of time series involved before applying the Granger causality test. When one of the series is found to be integrated in order one and the other series is I(2), VAR is specified in term of first difference for I(1) and in term of second difference for I(2) . If both series are concluded to be I(2) but not co-integrated, then the appropriate model will be VAR in the second differences of the data.

The null hypothesis of the Granger causality test is formally designed as that a variable X does not Granger cause another variable Y. In this study, there are two null hypotheses: Energy consumption does not Granger cause economic growth, and economic growth does not Granger cause energy consumption.

Table 4. The Results of the Granger Causality Test

Country	Null Hypothesis	Chi2	Lag	Prob.	Decision
Benin	EC does not Granger cause GR	0.21	1	0.64	Fail to Reject
	GR does not Granger cause EC	0.11	1	0.73	Fail to Reject
Congo	EC does not Granger cause GR	0.04	1	0.82	Fail to Reject
	GR does not Granger cause EC	0.001	1	0.99	Fail to Reject
Kenya	EC does not Granger cause GR	4.91	1	0.02	Reject
	GR does not Granger cause EC	0.95	1	0.32	Fail to Reject
Zimbabwe	EC does not Granger cause GR	3.68	4	0.45	Fail to Reject
	GR does not Granger cause EC	5.97	4	0.2	Fail to Reject

In table 4, the results of the Granger causality test between EC and GR for each country are reported. The maximum lag lengths are selected using the AIC information criteria. The probability values for chi2 statistics are given in table 4. If these probability values are higher than 0.05, the hypothesis of EC does not Granger cause GR (or GR does not Granger cause EC) cannot be rejected at 5% confidence level. Referring to that inference, I find that energy consumption Granger causes economic growth in Kenya, whereas EC does affect the pattern of GR in Benin, Congo and Zimbabwe. In addition, I also find that economic growth does not Granger cause energy consumption in any country. In other words, this paper shows the presence of growth hypothesis in Kenya, and neutrality hypothesis for the cases of Benin, Congo and Zimbabwe.

5. Conclusion

It is quite crucial for governments to know the existence and direction (if any) of the causality relationship between EC and GR in their own lands because having the knowledge of the direction of the linkage will assist policy makers to implement an appropriate energy policy. As an example, a policy maker will impose a strategy that increases energy consumption to promote economic growth if there is energy-growth nexus arises in that country, and will follow a plan which helps the government conserve energy stock if neutrality hypothesis occurs in that country. In the case of growth and feedback hypotheses, the government can contribute to economic growth and in the case of neutrality and conservation hypotheses, the government can protect its economy against a huge increase in energy prices and safeguard the environment through imposing a proper policy.

This study aims to analyze the causality relationship between energy consumption and economic growth in four Sub-Saharan African countries using annual data on EC and GR from 1091-2011 because the old studies have usually dismissed the low- income Sub-Saharan African countries Benin, Congo, Kenya and Zimbabwe and there has not been a recent study investigating the linkage between the variables for these countries. To do so, I apply econometrics in time-series methods: the Augmented Dickey-Fuller (ADF) unit root test, the Johansen co-integration test, vector autoregressive analysis (VAR), and the Granger causality test.

The results of the ADF unit root test show that the time series are not stationary for all countries at levels, but log of economic growth in Benin and Congo become stationary after taking the differences of the data, and log of energy consumption become stationary for all countries and LGR in Kenya and Zimbabwe are found to be stationary after taking the second differences of the time-series. The findings of the Johansen co-integration test demonstrate that the variables LEC and LGR are not co-integrated for the cases of Kenya and Zimbabwe, so no long-run relationship between the variables arises in any country. The Granger causality test indicates that there is a unidirectional causality running from energy use to economic growth in Kenya and no causality linkage between EC and GR in Benin, Congo and Zimbabwe. As I find the existence of growth hypothesis in Kenya, policy makers in there should consume more energy to have increased economic growth; however, the governments in Benin, Congo and Zimbabwe should implement a conservation policy to avoid unnecessary energy consumption.

References

Adom, P.K. (2011). Electricity Consumption-Economic Growth Nexus: The Ghanaian Case. International Journal of Energy Economics and Policy, 1(1), 18-31.

Akinlo, A.E. (2008). Energy consumption and economic growth: evidence from 11 Sub-Sahara African countries. Energy Economics, 30, 2391–2400.

Akinlo, A.E. (2009). Electricity consumption and economic growth in Nigeria: evidence from co-integration and co-feature analysis. Journal of Policy Modeling, 31, 681–693.

Akinwale, Y., Jesuleye, O., Siyanbola, W. (2013). Empirical Analysis of the Causal Relationship Between Electricity Consumption and Economic Growth in Nigeria. British Journal of Economics, Management & Trade, 3(3), 277-295.

Al-Iriani, M. A. (2006). Energy–GDP Relationship Revisited: An Example from GCC Countries Using Panel Causality. Energy Policy, 34, 3342-3350.

Al-mulali, O. (2011). Oil consumption, CO_2 emission and economic growth in MENA countries. Energy, 36, 6165–6171.

Al-mulali, O., Sab, C.N.B.C. (2012). The impact of energy consumption and CO_2 emission on the economic growth and financial development in the Sub Saharan African countries. Energy, 39, 180–186.

Ambapour S., Massamba C. (2005). Croissance économique et consommation d'énergie au Congo: Une analyse en termes de causalité. Document de Travail DT 12/2005, Bureau d'application des méthodes statistiques et informatiques, Brazzaville.

Asafu-Adjaye, J. (2000). The Relationship between energy consumption, energy prices and economic growth: time series evidence from Asian Developing Countries. Energy Economic, 22, 615–25.

Bashiri Behmiri, N., Manso, J.R.P. (2012). Does Portuguese economy support crude oil conservation hypothesis? Energy Policy, 45, 628–634.

Bashiri Behmiri, N., Manso, J.R.P. (2013). How crude oil consumption impacts on economic growth of Sub-Saharan Africa? Energy, 54(1), 74–83.

Cheng, S.B. , Lai, T.W. (1997). An investigation of co-integration and causality between energy consumption and economic activity in Taiwan Province of China. Energy Economics, 19, 435–444.

Dickey, D. A. and Fuller, W. A. (1979). Distributions of the Estimators for Autoregressive Time Series with a Unit Root. Journal of the American Statistical Association, 74, 427-431.

Dickey, D.A., Jansen D.W., Thornton D.L. (1991). A Primer On Co-integration With an Application to Money and Income. Journal of Federal Reserve Bank of St. Louis: Mar, 58-78.

Ebohon, O.J. (1996). Energy, economic growth and causality in developing countries: a case study of Tanzania and Nigeria. Energy Policy, 24, 447–453.

Eggoh, C., Chrysost, B., Christophe, R. (2011). Energy consumption and economic growth revisited in African countries. Energy Policy, 39, 7408–7421.

Esso, J. L. (2010). The Energy Consumption-Growth Nexus in Seven Sub-Saharan African Countries'. Economics Bulletin, 30(2), 1191-1209.

Farhani, S., Rejeb, J.B. (2013). Link between Economic Growth and Energy Consumption in Over 90 Countries. Interdisciplinary Journal of Contemporary Research in Business, 3(11), 282-97.

Granger, C.W.J. (1988). Some Recent developments in a Concepts of Causality. Journal of Econometrics, 39(1-2), 199-211.

Granger, C.W.J., Newbold, P. (1974). Spurious regressions in econometrics. Journal of Econometrics, 2, 111-120.

Johansen, S. (1988). Statistical Analysis of Co-integration Vectors. Journal of Economic Dynamics and Control, 12(2-3), 231-254.

Johansen, S. (1991). Estimation and Hypothesis testing of Co-integrationVectors in Gaussian Vector Autoregressive Models. Econometrica, 59(6), 1551-1580.

Kalyoncu, H., Gürsoy, F., Göcen, H. (2013). Causality Relationship between GDP and Energy Consumption in Georgia, Azerbaijan and Armenia. International Journal of Energy Economics and Policy, 3(1), 111-117.

Kraft, J., Kraft, A. (1978). On the relationship between energy and GNP. Journal of Energy and Development, 3, 401–403.

Keppler, J.H. (2006). Causality and cointegration between energy and economic growth in developing countries, J.H. Keppler, R. Bourbonnais, J. Girod (Eds.). The Econometrics of Energy Systems, December 2006.

Lee, C.C, Chang, C.P. (2005). Structural breaks, energy consumption, and economic growth revisited: evidence from Taiwan. Energy Economics, 27(6), 857–872.

Lee, C.,Chang, C., (2007). The impact of energy consumption on economic growth: evidence from linear and nonlinear models in Taiwan. Energy, 32, 2282–2294.

Lotfalipour, M., Falahi, M., Ashena, M. (2010). Economic growth, CO_2 emissions, and fossil fuels consumption in Iran. Energy, 35, 5115–5120.

Masih, A.M.M. , Masih, R. (1996). Energy consumption, real income and temporal causality: results from a multi-country study based on cointegration and error correction modeling techniques. Energy Economics, 18, 165–183.

Pao, H.T., Yu, H.C. , Yang, Y.H. (2011). Modeling the CO_2 emissions, energy use, and economic growth in Russia. Energy, 36, 5094–5100.

Pao, H., Tsai, C.(2011). Modeling and forecasting the CO_2 emissions, energy consumption, and economic growth in Brazil. Energy, 36, 2450–2458.

Pao, H.T., Tsai, C.M. (2011). Multivariate Granger causality between CO_2emissions, energy consumption, FDI and GDP: evidence from a panel of BRIC (Brazil, Russian Federation, India, and China) countries. Energy, 36, 685–693.

Odhiambo, N.M. (2010). Energy consumption, prices and economic growth in three SSA countries: a comparative study. Energy Policy, 38, 2463–2469.

Ozturk, I. (2010). A literature survey on energy-growth nexus. Energy Policy, 38, 340-349.

Ozturk I., Aslan A., Kalyoncu H. (2010). Energy consumption and economic growth relationship: evidence from panel data for low and middle income countries. Energy Policy, 38, 4422–4428.

Said, E., Dickey, D.A. (1984). Testing for Unit Roots in Autoregressive Moving Average Models of Unknown Order. Biometrika, 71, 599–607.

Soytas, U., Sari, R. (2003), Energy consumption and GDP: causality relationship in G7 countries and emerging markets, Energy Economics, 25, 33–37.

Wandji, Y.D.F. (2013). Energy consumption and economic growth: Evidence from Cameroon. Energy Policy, 61, 1295–1304.

Warr, B.S., Ayres, R.U. (2010). Evidence of causality between the quantity and quality of energy consumption and economic growth. Energy, 35, 1688–1693.

Wolde-Rufael, Y. (2005). Energy demand and economic growth: the African experience. Journal of Policy Modeling, 27, 891–903.

Yu, E., Hwang, B. (1984). The relationship between energy and GNP: Further results. Energy Economics, 6, 186–190.

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. (2009). Disaggregate energy consumption and industrial production in South Africa. Energy Policy, 37 (6), 2214-20.