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Energy Consumption, Economic Growth Relationship and Causal Independence: Evidence from Panel Data Forselected Low Income Countries

Odeyemi Gbenga .A
(Post graduate student)
Department of Economics,University of Lagos, Nigeria
Email Address: oddyaby@yahoo.com

Abstract
This paper uses the panel data of energy consumption (EC) and economic growth (GDP) for 8 countries from 1975 to 2010. These countries are divided into two groups: selected low income country in Asiaand selected low income country in Africa. A long run relationship was found to exist betweenenergy consumptionandeconomicgrowthisinvestigatedby employing Wadalla and Wu (1999) panel cointegration method. Panelcausalitytestisappliedtoinvestigatethewayofcausalitybetweentheenergyconsumptionandeconomic growth which shows that causality runs from GDP to economic growth for Africa and a reverse of that was observed for the selected countries in asia.The findings of this study have important policy implication sand it shows that this issue still deserves further attention infuture research.
Keyword: Energy consumption, economic growth, panel analysis, cointegration

1.0 Introduction
Energy is the essential material resources for human survival and economy development and growth. Though the issue of causal relationship between energy consumption and economic growth has been well-studied in the energy economics literature for both developing and developed countries, the empirical outcomes of these studies have been varied and sometimes found to be conflicting due to the different time periods, different variables used, countries studied and different econometric methodologies used.
The causality relationship between energy consumption and economic growth has important policy implications. Hence, several studies have attempted to establish the relationship between energy consumption and economic growth. A general observation from these studies is that the results have been overly imprecise despite the various types of causality results that have been reported in the literature Ozturk, 2010.
The main question of which one of the two variables causes the other one, i.e. which one should be varied in order to generate a change in the other one.it is paramount to note that countries of the world are classified based on the level of economic growth evident in the country and it is on that note the this paper has selected the countries used in this study i.e. low income countries.
The reliability of various countries on energy cannot be overemphasize because one can say that economic activities are not achievable without energy supply however form this may take, Either renewable or non-renewable. This however does not mean that the causality between the variable energy consumption and economic growth runs from the formal to the later as there are other things involved in terms of what energy form and structure is operational in a country or among a group of countries.
It is worthy of note that this causality is of major importance for effective energy policy design and implementation. A country that is energy dependent (a country in which causality runs from energy consumption to growth) will have a cautious energy policy because any negative shock on energy supply will have negative effects on economic growth. On the other hand, in an economy where energy consumption is determined by economic growth (a country in which the direction of causality runs from economic growth to energy consumption) an energy conservation policy will have very little effect on economic growth (Ouedraogo and Diarra, 2010).
The need to determine the relationship between energy especially with concerns to energy production and consumption and economic growth derives from the increasing realization of the importance of energy to the economic development of nations. This has led many to question the conventional neoclassical production function analysis where land, labour and capital are recognized as the main factors of production. This analysis has been extended to include an energy variable. However, the magnitude of energy's influence on the economy has been hotly debated by macroeconomists.Consequently, efforts have been made to discover the exact relationship between energy consumption and other factors of production as to whether energy complements or substitutes other factors of production to bring about economic growth.
It is also worthy to note the relationship between energy consumption and economic growth with issues with time variation. The issue of long and short run relationship between energy consumption and economic growth also calls for concerns to be able to determine the responses overtime in the latter to innovations in the formal.

Against this backdrop is the objective of this paper as it studies the relationship and causality between energy consumption and economic growth in 8 countries from a period of 1975–2010. The rest of the paper is does organized, section 2 reviews literature empirically, section 3 discuss data and methodology used in this research work and presents and interprets results while section 4 summarises and states policy implication of the result with conclusion.

2.0 Literature Review

As earlier stated, it is important to note that a lot of study has been carried out to find the relationship between energy consumption and economic growth on different platforms ranging from cross-sectional data to panel data. However a conclusive statement cannot be made because of the imprecision that accompanied their results. These studies are here below reviewed.

Toda and Yamamoto1995) examined the relationship between energy consumption and economic growth.Forinstance,ina19 country study ofAfrica, Wolde-Rufael(2005) applied this approach to analyse the causal relationship between energy consumption and economic growth. The results shows that there is evidence for a long-run relationship for only 8 of the 19 countries and a short-run causality for 12 countries

Masih and masih (1996) considered 6 Asian countries over a period of 1955-1990 using co-integration and error correction model discovered that the direction of causality was from GDP to energy consumption for all 6 countries investigated excerpt for India where the reverse was obtained as causality was from energy consumption to GDP. The other nations involved are Indonesia, Pakistan, Malaysia, Philippines and Singapore.

By 2000, Asafu-Adjaye considered other Asian countries with Philippines also in his country selection where he used cointegration and granger causality based on ECM where he found a different result entirely as causality was from energy consumption to GDP though he had used time series data from 1973-1995, this further buttress the imprecision that has accompanied previous results and this also calls for the time variations in this variables either of long or short time relationship.

Lee(2006) having investigated 11 developed countries over a period of 1960-2001 using granger causality test obtained mixed results as the causality ran from various direction on different notes.

Al-iriani (2006) considered 6 countries of GCC (Gulf corporation council) from 1970-2002 employing panel cointegration and GMM obtained that causality runs from GDP to energy consumption in all the countries investigated. His works were not without the usual hitches of data availability and reliability.

Mehrara(2007) investigated 11 oil exporting countries using panel cointegration and found that causality runs from GDP to energy consumption.

Employing a dynamic panel for 82 countries of varying income levels for the period 1972–2002, Huang et al. (2008) provided support for the neutrality hypothesis for the low income group while in the middle income group economic growth leads energy consumption positively. In the high income group countries, the author found that the overall effect of economic on energy consumption is negative. In other words, increasing economic growth decreases energy consumption in these countries

Apergis and Payne (2009) examined the relationship between energy consumption and economic growth for 11 countries of the Commonwealth of Independent States (CIS) over the period 1991–2005 employing heterogeneous panel cointegration test and error correction model .They found the presence of unidirectional causality from energy consumption to economic growth in the short-run while bidirectional causality between energy consumption and economic growth in the long-run. Similarly, Apergis and Payne (2009) discovered for six Central American countries over 1980–2004 the presence of both short-run and long-run causality from energy consumption to economic growth.

Apergis and Payne(2010) used panel causality and cointegration tests of nine South American countries over1980–2005.They found both a short-run and long-run causality from energy consumption to economic growth. Ozturk etal.(2010) analysed the causal relationship between energy consumption and economic growth for 51 countries from 1971 to 2005.These countries aredividedintothreegroups:lowincome,lowermiddle income and upper middle income countries. They found long-run causality running from GDP to energy consumption for low income countries and bidirectional causality for middle income countries

Wolde-Rufael (2009) reassessed the relationship between energy consumption and economic growth using 17 countries in Africa. He has taken into account labour and capital as additional variables. The results of his multivariate modified Granger causality analysis tend to reject the neutrality hypothesis for energy– income relationship in African countries. In contrast, results of variance decomposition analyses show that in 11 out of the 17 countries, energy was not even the second most important factor to output growth; capital and labour are the most important factors in output growth in 15 out of the 17 countries.

Kebede et al. (2010) used a panel cointegration technique for 20 sub-Saharan African countries from 1980 to 2004 to estimate energy demand, which is composed of traditional (wood fuel) and commercial energy (electricity and petroleum). They showed that wood fuel accounts for 70% of energy consumption, followed by petroleum, with most industrial activities utilizing some form of wood fuel. Furthermore, the results indicated that there are regional differences in energy consumption and GDP growth rate.

Odhiambo (2010) re-examined the causal relationship between energy consumption and economic growth in three sub-Saharan African countries .He added the prices as an additional variable because of its effects on both energy consumption and economic growth. Indeed, an increase in prices 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 energy demand, thereby leading to a contraction in aggregate output. He discovered that the causality between energy consumption and economic growth varies significantly acrossthethreecountries.Theresultsindicatedthat for South AfricaandKenyathereisaunidirectionalcausal relationship fromenergyconsumptiontoeconomicgrowthwhile for Congo (DRC)itiseconomicgrowththatdrivesenergy consumption. Similarly, Ouedraogo (2010) found thatthereisevidenceof a positive feedbackcausalrelationshipbetweenelectricityuse and real GDPfor Burkina Faso.

3.0 Methodology and Data Description

We use annual energy consumption, EC hereafter and GDP per capita data in this study. EC is kg of oil equivalent and GDP data with (LCU) constant. The data are sourced from World Development Indicators (2012). These countries are first on the platform of low income countries and from among them, four African countries are chosen which include Nigeria, Benin, Kenya and Ghana and four non-African (Asian) countries which include Bangladesh, Pakistan, India and Nepal. A Period of 1975- 2010 was considered for the purpose of this study. All variables are employed with their natural logarithms form to reduce or forestall heteroscedasticity. To investigate the relationship and causality issue, panel unit root analysis, panel cointegration analysis, panel causality analysis, panel fully modified ordinary least square (FMOLS) and panel dynamic ordinary least square (DOL) estimates are employed in this study.

3.1 Empirical results

3.1.1 Unit Root test

Before proceeding to cointegration techniques, we need to determine the order of integration of each variable. One way to do so is to implement the panel unit root test of Imetal.(2003) herein after IPS. This test is less restrictive and more powerful compared to the tests developed by Levin and Lin(1993), Levin et al.(2002) and Breitung (2000),which do not allow for heterogeneity in the autoregressive coefficient. The test proposed by IPSsolvesLevinandLin'sserialcorrelationproblemby assuming heterogeneitybetweenunitsinadynamicpanelframe-work. Thebasicequationforthepanelunitroottestfor IPSisas follows:

$$\Delta y_{it} = \propto_i + p_i y_{i,t=1} + \sum_{j=1}^{p} \emptyset_{ij} \Delta y_{i,t=j} + \varepsilon_{i.t} \qquad (1)$$

Where y_{it} stands for each variable under consideration in our model, $\propto_i$ is the individual fixed effect and p is selected to make the residuals uncorrelated over time. The null hypothesis is that p_i forall i while thealternativehypothesis that p_i>0 for some i=1,…,N1 and p_i =0 for i=N1+1,….,N.

An integrated series needs to be differenced in order to achieve stationarity. A panel series Yit, that requires no such differencing to obtain stationarity is denoted as Yit ¡«I(0). Therefore, an integrated series such as Yit ¡«I(1) is said to grow at a constant rate while Yit ¡«I(0) series appear to be trendless. Thus, if two series Yit and Xit are integrated of different order, say Yit ¡«I(0) and Xit ¡«I(1) respectively, then they must be drifting apart over time. Therefore, a regression of Yit on Xit would encounter a spurious regression problem, as the residual would also be I(1) which violates the underlying assumptions of ordinary least squares (OLS). Thus, it is important to determine that the series of interest have the same order of integration before proceeding into further estimation.

After establishing the order of integration of the data, the paper would use panel cointegration approaches to test for a long run equilibrium relationship among variables. If two series Yit and Xit are both I(1) then it is normally the case that a linear combination between the two will also be I(1) so that a regression of Yit on Xit would produce spurious results. This is because the residual is also I(1), which violates the assumptions of OLS. However, in a special case, a linear combination of two I(1) variables will result in a variable (residual) which is I(0). (Granger, 1981) has called such variables cointegrated. As shown by (Engle and Granger, 1987), there must be a vector error correction representation governing the comovements of these series over time. This leads to the intuitive interpretation of a cointegrated system as one that represents long-run steady state equilibrium.

Generally, if two or more variables are cointegrated, there is a long-term equilibrium relationship between them. To investigate the long-run relationship between the variables under study, the paper will adopt panel estimation method instead of standard OLS regression. With non-stationary variables, an OLS regression suffers from serial correlation. Moreover, since the cointegration literature does not assume exogenous regressors, estimation must account for potential endogenous feedback between X and Y (Funk, 2001). The advantage of panel estimators over standard time-series regressions is that each estimator is super-consistent. Asymptotically, the OLS estimator is normal with a nonzero mean, while panel estimators such as the PMG estimator proposed by Pesaran et al., (1999) are normal with zero means irrespective of whether the underlying regressors are I(1) or I(0).

The methods applied to the estimation of the real exchange rate model are based on the combination of panel techniques and cointegration tests. The first step to take, as in the time series context, is to analyze the order of integration of the variables, as a pre-requisite. The paper employs several panel data unit root tests in order to exploit the extra power in the cross-sectional dimension of the data. Specifically, the paper utilizes the panel unit root tests proposed by (Levin et al., 2002), (Breitung, 2000), (Im et al., 2003), (G. S. Maddala, 1999) (1999) and (Hadri, 2000). Levin et al., (2002), Breitung (2000), and Hadri (2000) tests all assume that there is a common unit root process so that ρi is identical across cross-sections. The first two tests employ a null hypothesis of a unit root while the Hadri (2000) test uses a null of no unit root. Levin et al. (2002) and Breitung (2000) consider panel versions of the Augmented Dickey–Fuller (ADF) unit root test (with and without a trend). These tests restrict α to be identical across cross-sectional units, but allow the lag order for the first difference terms to vary across cross-sectional units, which in this study are countries.

$$\Delta y_{it} = k_i + \propto y_{it-1} + \sum_{j=1}^{x} \varphi \; ij\Delta y_{it-j} + \in_{it} \qquad (2)$$

$$\Delta y_{it} = k_i + \propto y_{it-1} + \beta t \sum_{j=1}^{x} \varphi \; ij\Delta y_{it-j} + \in_{it} \qquad (3)$$

The subscript i=1, c,N indexes the countries. Equations (2) and (3) are estimated using pooled ordinary least squares (OLS). Levin et al. (2002) tabulate critical values for ta by performing Monte Carlo simulations for various combinations of N and T commonly employed in applied work. The null and the alternate hypotheses are: H0: $f_{¿}$=0 and H1: $f_{¿}$<0. Under the null hypothesis there is a unit root, while under the alternative hypothesis, there is no unit root. The difference between the Levin et al. (2002) test and the Breitung (2000) test is that while the former requires bias correction factors to correct for cross-sectionally heterogeneous variances to ensure efficient pooled OLS estimation, the Breitung (2000) test achieves the same result by appropriate variable transformations (Narayan et al., 2008).

One of the drawbacks of the Levin et al. (2002) and Breitung (2000) tests is that in Equations (3) and (4) ∝ is restricted to be identical across countries under both the null and alternative hypotheses. The t-bar test proposed by Im et al. (2003) has the advantage over the Levin et al. (2002) and Breitung (2000) tests that it does not assume that all countries converge towards the equilibrium value at the same speed under the alternative hypothesis and thus is less restrictive. (Karlsson and Löthgren, 2000) perform Monte Carlo simulations that show that in most cases the Im et al. (2003) test is superior to the Levin et al. (2002) test. There are two stages in constructing the t-bar test statistic. The first is to calculate the average of the individual ADF t-statistics for each of the countries in the sample. The second is to calculate the standardized t-bar statistic according to the following formula:

t– bar = root of **N** (tá – êt)/root of v_t (4)

where N is the size of the panel, tα is the average of the individual ADF t-statistics for each of the countries with and without a trend and κt and νt are, respectively, estimates of the mean and variance of each tαi. Im et al. (2003) provide Monte Carlo simulations of κt and νt and tabulate exact critical values for various combinations of N and T. A potential problem with the t-bar test is that when there is cross-sectional dependence in the disturbances, the test is no longer applicable. However Im et al. (2003) suggest that in the presence of cross-sectional dependence, the data can be adjusted by demeaning and that the standardized demeaned t-bar statistic converges to the standard normal in the limit.

Maddala and Wu (1999) criticize the Im et al. (2003) test such that cross correlations are unlikely to take the simple form proposed by Im et al. (2003) in many real world applications that can be effectively eliminated by demeaning the data. Maddala and Wu (1999) propose an alternative approach to panel unit root tests using Fisher's (1932) results to derive tests that combine the p-values from individual unit root tests. The test is non-parametric and has a chi-square distribution with 2N degrees of freedom, where N is the number of cross-sectional units or countries. Using the additive property of the chi-squared variable, the following test statistic can be derived:

$$\lambda = -2\sum_{i=1}^{n} log_e \pi_i \qquad (5)$$

Here, πi is the p-value of the test statistic for unit i. An important advantage of this test is that it can be used regardless of whether the null is one of integration or stationarity. The paper also implemented the panel stationarity test suggested by Hadri (2000). The Hadri (2000) panel unit root test is similar to the (Kwiatkowski et al., 1992) unit root test, and has a null hypothesis of no unit root in any of the series in the panel. Like the Kwiatkowski et al. (1992) test, The Hadri (2000) test is based on the residuals from the individual OLS regressions from the following regression model:

yit=πi+θit+μit (6)

Given the residuals û from the individual regressions, the LM statistic is:

$$LM = \frac{1}{N}\left(\sum_{i=1}^{N}\sum_{t} \quad S_i(t)^2/T^2/\, f_o\right) \qquad (7)$$

Where *Sit* are the cumulative sum of the residuals,

$$s_i(t) = \sum_{i=1}^{t} \quad U_{it} \qquad (8)$$

f is the average of the individual estimators of the residual spectrum at frequency zero

$$f = \frac{\sum_{t=1}^{N} f_{io}}{N} \quad (9)$$

Hadri (2000) shows that under mild assumptions,

$$\delta = \frac{\sqrt{N}(LM - \xi)}{\varphi} \quad (10)$$

Where ξ = 1/6 and ξ = 1/45 and φ=1/45, if the model only includes constants is set to 0 for all and ξ = 1/15 and φ = 11/6300 , otherwise. It is worth noting that simulation evidence suggests that in various settings (for example, small T), Hadri's panel unit root test experiences significant size distortion in the presence of autocorrelation when there is no unit root. In particular, the Hadri (2000) test appears to over-reject the null of stationarity, and may yield results that directly contradict those obtained using alternative test statistics (see (Hlouskova and Wagner, 2006) for discussion and details).

3.1.2 Data description

The data descriptive statistics are as follows for the country grouping.

Table 1 (Asia)

Variable	Mean	Median	Max	Min	S.D	Prob	Sum sq.Dev	kurtosis
GDP	12.3291	12.3021	13.7239	11.1619	0.67395	0.1	64.76	2.18344
EC	4.53	4.38	5.84	3.60	0.67	0.001	65.57	1.91

Table 2 (Africa)

Variable	Mean	Median	Max	Min	S.D	Prob	Sum sq.Dev	kurtosis
GDP	11.618	11.855	13.103	9.795	1.01	0.001	145.97	2.13
EU	3.986	3.912	5.053	3.081	0.59	0.01	50.802	1.99

3.1.3Panel Unit Root Results

The table below shows the panel unit root test results, there are three different null hypotheses for the panel unit root tests. The first two are the Breitung (2000) and Levin et al. (2002) tests where the null hypothesis is the unit root (with the assumption that the cross-sectional units share a common unit root process). The second group includes two tests (Im et al. (2003), and Maddala and Wu (1999) Fisher type test with null of unit root assuming that the cross-sectional units have individual unit root process. The last test is the Hadri (2000) test, where the Z-stat has a null hypothesis of no unit root (but assumes a common unit root process for all cross-sectional units).

Table 3

Unit root for African low income at 1st difference

	Null Hypothesis	Energy Consumption	GDP
Levin, Lin and Chu	Unit Root	-9.04786**	-4.72363**
Breitung t-stat	Unit Root	-6.25961**	-4.81549**
Im, Pesaran & Shin	Unit Root	-8.15338**	-5.22747**
ADF-Fisher Chi-square	Unit Root	63.3953**	39.9633**
Hadri Z-stat	stationary	2.28105**	0.68927

** Rejection of null hypothesis at 1%

Result presented with individual intercept and trend.

Automatic lag selection: SIC

Table 4

Unit root for Asia low income at first difference

	Null Hypothesis	Energy Consumption	GDP
Levin, Lin and Chu	Unit Root	-11.1476**	-7.29637**
Breitung t-stat	Unit Root	-4.70915**	-5.79362**
Im, Pesaran & Shin	Unit Root	-10.2266**	-9.54121**
ADF-Fisher Chi-square	Unit Root	87.4897**	77.2408**
Hadri Z-stat	stationary	2.10438**	0.0207**

** Rejection of null hypothesis at 1%

Result presented with individual intercept and trend.

Automatic lag selection: SIC

From the above tables, it is seen that the variables are stationary at first difference while rejecting null hypothesis at 1% both for the low income countries in Asia and Africa. Having established this fact, one can proceed to checking the cointegration that exists between the variables selected in the above country selection.

3.1.4 Panel Cointegration Tests

This test is carried out to check for the presence of cointegration which is a check for long run relationship between exchange rate, real oil price and real interest rate differential variables. The paper utilise panel cointegration tests due to Pedroni (1998), Kao (1999) and Maddala and Wu (1999). The tests proposed in (Pedroni, 1998) are residual-based tests which allow for heterogeneity among individual members of the panel, including heterogeneity in both the long-run cointegrating vectors and in the dynamics. Two classes of statistics are considered in the context of the Pedroni (1998) test. The panel tests are based on the within dimension approach (i.e. panel cointegration statistics) which includes four statistics: panel v-statistic, panel ñ-statistic, panel PP-statistic, and panel ADF-statistic. These statistics essentially pool the autoregressive coefficients across different countries for the unit root tests on the estimated residuals. These statistics take into account common time factors and heterogeneity across countries. The group tests are based on the between dimension approach (i.e. group mean panel cointegration statistics) which includes three statistics: group ñ-statistic, group PP-statistic, and group ADF-statistic. These statistics are based on averages of the individual autoregressive coefficients associated with the unit root tests of the residuals for each country in the panel. All seven tests are distributed asymptotically as standard normal. Of the seven tests, the panel v-statistic is a one-sided test where large positive values reject the null hypothesis of no cointegration whereas large negative values for the remaining test statistics reject the null hypothesis of no cointegration.

The (Kao, 1999) test follows the same basic approach as the Pedroni (1998) tests, but specifies cross-section specific intercepts and homogeneous coefficients on the first-stage regressors. In the null hypothesis, the residuals are nonstationary (i.e., there is no cointegration). In the alternative hypothesis, the residuals are stationary (i.e., there is a cointegrating relationship among the variables). The third test is the Johansen-type panel cointegration test developed by Maddala and Wu (1999). The test uses Fisher's result to propose an alternative approach to testing for cointegration in panel data by combining tests from individual cross-sections to obtain at test statistic for the full panel. The Maddala and Wu (1999) test results are based on p-values for Johansen's cointegration trace test and maximum eigenvalue test. Evidence of cointegration between real exchange rate and real oil price using the Maddala and Wu (1999) test is obtained if the null hypothesis of none ($r = 0$) cointegration variables is rejected and the null of at most 1 ($r \leq 1$) cointegrating variables is accepted, suggesting the direction of causality is running from real oil price to real exchange rate. In other word, the paper would confirm the existence of a unique cointegration vector for the estimated model.

Table 5 Panel cointegration result (Asia)
Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)

Hypothesized No. of CE(s)	Fisher Stat.* (from trace test)	Prob.	Fisher Stat.* (from max-eigen test)	Prob.
None	19.54	0.0122	17.32	0.0269
At most 1	11.96	0.1529	11.96	0.1529

from the above table, it is evident that cointegration exist between GDP and EC from johansen Fisher (Waddala and Wu) panel cointegration test in the selected low income country in Asia indicating a long run relationship between the two variables under consideration.

Table 6 Panel cointegration result (Africa)
Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)

Hypothesized No. of CE(s)	Fisher Stat.* (from trace test)	Prob.	Fisher Stat.* (from max-eigen test)	Prob.
None	14.06	0.0802	16.20	0.0396
At most 1	1.882	0.9844	1.882	0.9844

from the above table, it is evident that cointegration exist between GDP and EC from johansen Fisher panel cointegration test in the selected low income country in Africa indicating a long run relationship between the two variables under consideration.

3.1.5 Panel causality analysis

Having established cointegration in the long run by Maddala & Wu (1999) from above, weexaminethedirectionofcausality between GDP andECinapanelcontextwhichisbasedonthe following regressions:

$$\Delta lnGDP_{it} = \varphi_{1i} + \sum_{p} \varphi_{11ip} \Delta lnGDP_{it-p} + \sum_{p} \varphi_{12ip}\, \Delta lnEC_{it-p} + \psi_{1i} (1)$$

$$\Delta lnEC_{it} = \varphi_{2i} + \sum_{p} \varphi_{21ip} \Delta lnEC_{it-p} + \sum_{p} \varphi_{22ip}\, \Delta lnGDP_{it-p} + \psi_{2i} (2)$$

Eqs.(1) and (2) are estimated using the pooled mean group estimator (PMGE) proposed by Pesaran etal.(1999). Causality is tested based on H0=φ_{12ip}= 0 and H0=$\varphi_{22ip} = 0$ for all I and k. The optimal lag lengths are selected by using the Schwarz Bayesian InformationCriterion(SBIC).Optimallaglengthis1for low incomegroupand2forlowerandupper middleincome groups.

The results are shown below:

Table 7: Panel causality test for Asia

Null Hypothesis:	Obs	F-Statistic	Prob.
LNEC does not Granger Cause LNGDP	136	2.04755	0.1332
LNGDP does not Granger Cause LNEC		7.64434	0.0007

Table 8: Panel causality test for Africa

Null Hypothesis:	Obs	F-Statistic	Prob.
LNEC does not Granger Cause LNGDP	136	2.74803	0.0677
LNGDP does not Granger Cause LNEC		1.42177	0.2450

The panel Granger causality test results reports a long run Granger causality running from GDP to EC for selected low income countries in Asia. It shows that energy consumptions determined by economic growth in the selected countries. In other words, conservation hypothesis (unidirectional causality from economic growth to energy) is confirmed in these countries. Thus, energy conservation policy will have very little effect on economic growth of these countries. There exists likely reason for this outcome one of which is economic growth resulting into an expansion in the commercial and industrial sectors where electricity is a fundamental input for the production of materials that are helpful to further develop the economy. Another is higher real income which allows for the purchase of extra electronic gadgets which in turn depends on electricity. Another is government providing infrastructures that are also energy dependent. An example is the provision of street light. This result is however a replica of what is obtainable in the Middle Eastern countries. However, in the case of Africa: Causality runs from EC to GDP for the selected low income countries showing a reversal to what is obtainable in selected Asian countries but also a unidirectional causality from energy consumption to economic growth. Here energy policies will have a clear effect on economic growth so we can say that has industrial activities increase, energy consumption also increases which in turn brings about increase in capital stock and later-on engender economic growth. An increasing scale of return will also aid foreign direct investment in this region which will continue to engender growth from every side.

4.0 Conclusion and policy implications

Despite growing literature that examines the relationship between energy consumption and real GDP. The bulk of this literature focuses on developing, developed and emerging countries. A clearer understanding of the relationship between energy consumption and economic growth is important to policy marker in order to design effective energy and environmental policies. A general conclusion from these studies is that there is no consensus either on the existence of the relationship or the direction of causality between energy consumption and economic growth in the literature. In this study, we use the panel data of energy consumption and GDP for 8 countries using annual data from 1975 to 2010. The countries studied are divided into two groups: selected low income country in African and selected low income country in Asia. The aim of this study is to investigate if there is relationship between energy consumption and real GDP, examine the causality between these variables. A relationship between energy consumption and economic growth is investigated by employing Maddala & Wu (1999)panel cointegration method. After which the direction ofcausality of the relationship between energy

consumption and economic growth holds by using panel granger causality test.
The empirical results of the panel unit root shows that both variables and for both groupings are stationary at first difference. Panel cointegration test shows that energy consumption and GDP are cointegrated for both country grouping. In addition, panel causality test results reveal that there is a long-run Granger causality running from GDP to EC for the selected Low income countries in Asiabut a reversal of this in Africa.
The empirical results of this study provide policy makers a better understanding of energy consumption economic growth nexus to formulate energy policies in these countries. The examination of the causal relationship between energy consumption and economic growth has important policy implications.
When energy consumption leads growth positively,it suggests that the benefit of energy use is greater than the externality cost of energyuse.I.e. the cost of damage caused while deploying energy. Conversely,ifanincreaseineconomic growth brings about an increase in energy consumption,the externality of energy use will setback economic growth.Under this circumstance, aconservation policy is necessary.
As a policy implication,since there is evidence indicating that energy consumption leads to economic growth and vice-versa inthe selected low income country considered in this study,the policy makers should take into consideration the degree of economic growth in each country when energy consumption policy is formulated as the effect can be clearly seen above.

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