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CAUSALITY RELATIONSHIP BETWEEN ENERGY DEMAND AND ECONOMIC GROWTH IN NIGERIA

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ABSTRACT

This paper attempts to examine the causal relationship *between* electricity demand and economic growth in Nigeria using data for 1970 – 2003. The study uses the Johansen cointegration VAR approach. The ADF and Phillips – Perron test statistics were used to test for stationarity of the data. It was found that the data were not stationary at level but only after first differencing i.e. the data were I (1). The Johansen co integration technique reveals that one co integrating relationship exists between real GDP and Electricity demand in Nigeria. The result of the study reveals that there is unidirectional causality between energy consumption and economic growth i.e. energy consumption Granger causes economic growth in Nigeria based on the available data estimated. The result has useful implications on account of energy conservation and energy related pollution in Nigeria.

KEY WORDS: Energy demand, Economic growth and VAR.

1. INTRODUCTION

Different studies have focused on causality effect between energy consumption for different countries at different times with different proxies for energy consumption and income. The empirical results from these studies have been conflicting (see Cheng, 1999; Fatai et al, 2002; Soytas and Sari, 2003; and Wolde – Rufael, 2004). The results differ on the causality direction. The policy implication of these relationships can be significant depending on the type of causal relationship.

Empirical literature on this subject is still not unanimous to provide policy recommendation(s) that can be applied across countries. For example, Cheng (1999), using Granger (1988) causality, *cointegration and error correction mechanism* found no causality from energy consumption to economic growth but found causality from economic growth to energy consumption in the case of India. In his study on New Zealand, Fatai et al (2002) considered total energy consumption as well as disaggregated consumption of electricity, coal, oil and gas and found no causal relationship between energy consumption, employment and economic growth. The study *did not find unidirectional causality from electricity* consumption to employment.

By using Vector Error Correction Mechanism (VECM) for similar study in India, Masil and Masil (1996) considered six Asian countries (India, Pakistan, Indonesia, Malaysia, Singapore and Philippines) *to examine the temporal causality* between energy consumption and income. While they found that energy consumption Granger causes income in India, on the contrary [illegible] that income Granger causes energy consumption in Indonesia. The study *also* found that bidirectional causality exists in Pakistan. The study does not find any causality in Malaysia, Singapore and Philippine using *the vector autoregressive*, VAR model for the three non cointegrating countries.

While country specific causality study between energy consumption and economic growth can provide input for appraising and designing future energy policy, it is imperative to arrive at *unanimous result for policy implementation*. There are several causality studies carried out for countries like Canada, U.S.A., India, Pakistan, Indonesia and the U.K. There is no similar study of causal relationship in Nigeria to the best of my knowledge. This study attempts to fill the gap by examining the causality relationship between energy consumption and economic growth in Nigeria using data for 1970 to 2003. The study uses cointegration and Granger *causality techniques*. *Energy consumption* is proxied by electricity demand and real Gross Domestic Product is used as proxy for economic growth. Section two considers previous empirical findings, section three deals with the power sector in Nigeria; section three discusses method of data analysis while section five is devoted to discussion of results and conclusion.

2. PREVIOUS EMPIRICAL FINDINGS

The existing literature on the causal relationship between energy consumption and income or economic growth can be *summarized into three main categories*: no causality, unidirectional causality and bidirectional causality. The findings from these studies vary across countries and methodologies even for the same country as shown in table 1 below.

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Table 1: Some Empirical Findings on the Causality of Energy Consumption and Income/ Economic Growth

Authors/ Year of Study	Countries /Period of Study	Variables Used	Methodology	Findings of Study
Akarca and Long (1980)	US (1950-1968, 1970)	GNP and energy consumption	Sims' technique	No causal relation between GNP and energy consumption
Yu and Hwang (1984)	US (1947-1979)	GNP and total energy consumption	Sims' technique	No causal relationship between GNP and energy consumption
Yu and Jin (1992)	US (1974-1990)	Industrial production index of manufacturing and total energy consumption	Cointegration and Granger causality	No causal relationship (long-run) between GNP and energy consumption
Cheng (1995)	US (1947-1990)	GNP and energy consumption	Cointegration and Granger causality	No causal relationship between GNP and energy consumption
Glasure and Lee (1997)	South Korea and Singapore (1961-1990)	GDP and energy consumption	Cointegration, Granger causality	No causal relation between GNP and energy consumption for South Africa; GDP causes energy consumption in Singapore
Fatai et. al. (2002)	New Zealand (1960-1999)	Employment, total energy consumption (also disaggregated in oil, electricity and gas) and GDP	Granger causality, Toda and Yamamoto's Autoregressive Distributed Lag (ARDL) technique	No causal relationship (long-run) between total energy consumption and real GDP; real GDP causes oil and electricity consumption.
Abosedra and Baghestani (1991)	US (1947-1972, 1947-1974 1947-1979, 1947-1987)	GNP and energy consumption	Cointegration, Granger causality	GNP Granger causes energy consumption
Cheng and Lai (1997)	Taiwan (1954-1993)	GDP and energy consumption	Ganger causality	GDP Granger causes energy consumption
Cheng (1999)	India (1952-1995)	GDP and energy consumption	Cointegration, Granger causality	GDP Granger causes energy consumption
Chang and Wong (2001)	Singapore (1975-1995)	GDP and energy consumption	Cointegration, Granger causality	GDP Granger causes energy consumption
Aqeel and Butt (2001)	Pakistan (1955-1996)	GDP and total energy consumption	Cointegration and Granger causality	GDP Granger causes energy consumption
Wolde-Rufael (2004)	Shanghai (1952-1999)	GDP; total and disaggregated industrial energy consumption	Granger causality	Energy consumption (total and disaggregated) to real GDP
Morimoto and Hope (2004)	Sri Lanka (1960-98)	GDP and electricity production	Granger causality	Electricity production Granger causes GDP
Erol and Yu (1988)	West Germany (1952-1982), Italy (1952-1982), Canada (1952-1980), France (1952-1982), UK (1952-1982), and	GNP and energy consumption	Granger causality	Bidirectional causality for Japan, energy consumption causes GNP (Canada), real

	Japan (1952-1982)			GNP causes energy consumption (West Germany and Italy) and no causality for France and UK
Masih and Masih (1997)	Korea (1955-1991) and Taiwan (1952-1992)	Income, energy consumption and energy prices	Cointegration, Vector error correction, variance decomposition and impulse response function	Bi-directional causality
Soytas and Sari (2003)	Argentina (1950-1990), Italy (1950-1992), Korea (1953-1991), Turkey (1950-1992), France (1950-1992), Germany (1950-1992), Japan (1950-1992)	Per capita GDP and energy consumption	Cointegration and Granger causality	Bi-directional causality (in Argentina) and unidirectional causality (GDP causes energy consumption in Italy and Korea and energy consumption causes GDP in Turkey, France, Germany and Japan)
Hwang and Gum (1991)	Taiwan (1961-1990)	GNP and energy consumption	Cointegration	Bi-directional causality
Glasure (2002)	South Korea (1961-1990)	GDP, energy consumption, government expenditure, money supply, oil price	Cointegration, Error correction, Variance decomposition	Bi-directional causality
Ghali and El-Sakka (2004)	Canada (1961-1997)	GDP and energy consumption	Cointegration, Granger causality	Bi-directional causality
Jumbe (2004)	Malawi (1970-1999)	GDP, agricultural GDP, nonagricultural GDP and electricity consumption	Cointegration, Granger causality and error correction	Bidirectional causality from Granger causality test; GDP causes electricity consumption from error correction test.
Oh and Lee (2004)	Korea (1970-1999)	GDP and electricity	consumption Granger causality error correction	Bidirectional causality (long-run); electricity consumption causes GDP (short-run)

Source: Mozumber, P. and A Marathe (Undated)

3. ELECTRICITY (POWER SECTOR) IN NIGERIA

Public electricity generations commenced in Nigeria in 1896 with the installation of 30kw generating sets by the erstwhile colonial Public Works Department (PWD) at Marina, Lagos. The PWD coordinated electricity undertakings in different towns until 1950 when the colonial government created Electricity Corporation of Nigeria (ECN) to integrate electricity supply in Nigeria and make it more effective than what was in existence. The corporation became the statutory body responsible for generation, transmission, distribution and sale of electricity to all consumers in Nigeria. As at Nigeria's independence in 1960, the country inherited a rudimentary and localized electric power generation and distribution system. There was neither a national grid nor a single large power station. In particular, the Niger Dam Authority (NDA) was established in 1962 for the development of Kainji Hydro-Electric project and the associated 330 kilovolts (Kv) transmission lines and substations which were completed in 1969. In 1972, Electricity Corporation of Nigeria (ECN) and the Nigeria Dam Authority were merged to form the National Electric Power Authority (NEPA) [Olayide (1976)]. This is currently called the Power Holding Company of Nigeria (PHCN).

Electricity system in Nigeria centers around the National Electric Power Authority (NEPA) now Power Holding Company of Nigeria (PHCN) since it accounts for about 98% of total electricity generation in the country. Power generation by other agencies such as Nigerian Electricity Supply Company (NESCO), relies on thermal power for electricity generation unlike PHCN that rely on hydro and thermal power (Central Bank of Nigeria, CBN, 2000). However, electricity is also a consumer of fuel and energy like coal, fuel oil, natural gas and diesel oil The importance of these sources of energy and fuel for generating electricity has been decreasing in recent years For example, in 1966, over 166,000 metric tons of coal was used as fuel for generating electricity. This declined to about 1,300 metric tons in 1969 and went down as low as 500 metric tons in 1972. This sharp fall in the use of coal was due to the Nigerian civil war which blocked the source of coal to the power states (Olayide, 1976). However by 1973, this rose to about 40,000 metric tones from 500 metric tons in 1972 As shown in table 2 below, none of the types of fuel has been able to reach its pre-war levels as a source of fuel for generating electricity

Table 2: Fuel Used for Generating Electricity (1960-1973)

Year	Coal '000 Metric Ton	Gas/Diesel '000 liters	Natural Gas '000 Cubic Metre	Residual Fuel Oil '000 Litres
1960	123.3	Na	Na	Na
1961	136 0	Na	Na	Na
1962	184.8	Na	Na	Na
1963	151 2	35,582	26,774	152 994
1964	172 8	60,354	44,405	161,363
1965	198 3	88,162	70,508	185,303
1966	166.0	123,435	154,684	181,753
1967	56.6	85,821	95,433	172,297
1968	17.3	105,519	126,982	141,233
1969	1.3	38,325	31,110	72,756
1970	0.5	18,325	39,553	14,825
1971	—	19,466	62946	12,361
1972	0.5	34,641	106,011	46,316
1973	39.6	48,425	130,704	94,545

Source: Federal Office of statistics, F.O.S. Digest of Statistics (Various issues)

However, in recent times, the Power Authority generates electricity through a mix of both thermal and hydro systems. All the power stations, distribution stations and sub-stations are specially interlinked by a transmission net work popularly known as the national grid. The entire electricity generated nation-wide is pooled into the National Control Centre, Osogbo from where electricity is distributed to all parts of Nigeria. With respect to the transmission of the electricity generated at different power stations, PHCN has installed a total of 11,000 kilometers of transmission lines throughout Nigeria. Also, there has been extensive distribution of transformers and other relevant facilities to ensure even distribution of electricity to all customers across the country (Anyanwu et al 1997).

Electricity in Nigeria is generated through the major sources. hydro, thermal and fossil fuels. Available electric generating units include five thermal and three hydro-power stations, with a total installed capacity of about 5,876 megawatts (MW) as shown in table 3 below.

Table 3: Nigeria's Complement of Electricity Generation Stations (Megawatts)

Station	Installed Capacity	Available Capacity	Percentage of Availability	Types of Plant/Fuel
Kainji	760	500	65.8	Hydro
Jebba	540	450	83.3	Hydro
Shiroro	600	600	100	Hydro
Egbin	1,320	880	66.7	Thermal-station HYFO & NG Thermal-station
Sapele (1)	720	240	33.3	HPFO & NG
Sapele (II)	300	0	0	Thermal Steam
Ijora	60	20	33.3	Thermal – GT
Delta	876	660	75.6	Thermal – GT
Afam	700	277	39.6	Thermal – GT
Total	5876	3,627	61.7	

Source: Anyanwu et al (1997)

The thermal power stations are:

(i) Delta Gas Turbines, installed in four phases between 1966 and 1990 with a total capacity of 876 megawatts;

(ii) Sapele steam station, installed between 1978 and 1980 with 720 megawatts capacity.

(iii) Sapele Gas Turbines installed between 1978 and 1980 with 720 megawatts capacity.

(iv) Afam Gas Turbines, installed in 1982 with 700 megawatts capacity.

(v) Egbin steam station, installed between 1986 and 1987 with 1,320 megawatts capacity

The Hydro Power Stations are:

(i) Kainji Hydro Station, installed between 1968 and 1978 with 540 megawatts capacity.

(ii) Jebba Hydro Station, installed between 1983 and 1984 with 578 megawatts capacity and

(iii) Shiroro Hydro Station, installed between 1989 and 1990 with 600 megawatts capacity.

As at 1991, balance sheet of electricity supply-demand (table 4) shows electricity supply inadequacy and an emergence of a crisis situation in which electricity supply could not catch up with the demand requirements thus creating imbalances in the 1990s (Ayodele, 2001). This is why some analysts [Iwayemi (1992)] have identified this period as a period of serious electricity crisis; a crucial or decisive movement; an undesirable turning point; a time of difficulty and distress; a state of confusion when things no longer happen in the normal or usual manner.

Table 4: Electricity supply-demand balance sheet (March 1991)

Plant Capacities (MW)			Demand Situation (MW)			
	Installed	Effective	Moving peak	Evening peak	Highest demand	Average demand
Demand	4,633	1,712	1,500	1800	1,902	1,855
Excess		–	212	–	–	–
Shortage		2,921	–	88	190	143
Remarks		Unsatisfactory	Unsatisfactory	Unsatisfactory	Unsatisfactory	Unsatisfactory

Source: Adegbuluge & Serki Ed. Energy issues in Nigeria (1991)

In terms of contribution to GDP as shown in table 5 below, as at 1981, while total gross domestic product was N205, 222.1 million contribution of electricity was about N801.9 representing less than 1% contribution to total gross domestic product. As at 1985, while total gross domestic product was N205,036.3 million representing 9.5% growth rate from 1984 figure, contribution of electricity was N1019.2 million representing also less than 1% of the total contribution to gross domestic product. However, in all the years under review, the contribution of electricity to gross domestic product was less than 1%.

Table 5: Contribution of Electricity to Total Gross Domestic Product in Nigeria (1981 – 2003)

Year	Total GDP (Nm)	Growth rate of total GDP (%)	Electricity contribution to GDP (Nm)	Contribution to GDP (%)
1981	205,222.1	–	801.9	0.39
1982	199,685.3	- 2.7	887.7	0.45
1983	185598.1	-7.1	853.6	0.46
1984	183,563.0	-1.1	902.4	0.49
1985	201,036.3	9.5	1019.2	0.51
1986	205,971.4	2.5	665.9	0.32
1987	204,806.5	-0.6	696.6	0.34
1988	219,875.6	7.4	702.1	0.32
1989	236,729.6	7.7	759.4	0.31
1990	267,550.0	13.0	828.0	0.31
1991	265,379.1	-0.8	828.0	0.31
1992	271,365.5	2.3	923.5	0.34
1993	274,833.2	1.3	937.4	0.34
1994	275,450.6	0.2	1006.8	0.37
1995	281,407.4	2.2	990.7	0.35
1996	293,745.4	4.4	1012.5	0.34
1997	302,022.5	2.8	1006.4	0.33
1998	310,890.1	2.9	940.9	0.31
1999	312,183.5	0.4	953.2	0.31
2000	329,178.7	5.4	972.2	0.30
2001	344,2858	4.6	1105.4	0.03
2002	356,3058	3.5	1421.2	0.04
2003	392,7670	10.2	1469.9	0.04

Source: Central Bank (2003) Statistical Bulletin Vol. 14

Inspite of the contribution of electricity to total gross domestic product, it is still bedeviled with several problems in Nigeria. The existing facilities of NEPA (now PHCN) notwithstanding electricity supply in the country have remained very unavailable with many urban and rural areas being without electric power supply for long period of time Besides the main evidence of inadequate supply of electricity is the substantial installed capacity of private generators estimated to be almost half of PHCN total generation capacity, comprising of numerous small units that are expensive to operate (Sule et al, 1994).

The incessant power shedding and erratic supply of electricity which has persisted over the years resulted largely from lingering problems. Some of these problems according to Central Bank of Nigeria (2000) include:

- Lack of preventive and routine maintenance of PHCN facilities which result in huge energy losses. This reflects the poor quality of the electrical system which itself is dependent on inadequate maintenance of the equipment for generation and distribution.
- Lack of coordination between town planning authorities and Power Holding Company of Nigeria. This results in poor overall power system planning and overloading of power generation equipment such as transformers by undeclared additional load as well illegal connections by consumers. Inadequate generation due to operational/technical problems, arising from machine breakdown, low gas pressure and low water levels.

4. METHODOLOGY AND DATA

Following Chang and Wong (2001), Aqueel and Butt (2001) and Ghali and EL – Sakka (2004), total electricity demand and Real Gross Domestic Product data for Nigeria were collected from the Central Bank of Nigeria Statistical Bulletin (2003) The log of both variables [(LLEDD) and (LRGDP)] were used for the estimation.

In our analysis, we first test the stationarity of each series. Several tests are used to test for unit root but the most widely acceptable and reliable ones are the Augmented Dickey-Fuller (ADF) test proposed by Dickey and Fuller (1979) and the Philips - Perron tests (Philips and Perron, 1988). However, only the ADF test was used to determine whether the series are stationary or non-stationary and also their order of integration. The order of integration assists in the determination of subsequent long-run relationship among the variables. Following Engle and Granger (1987), a non stationary series is said to be integrated of order d if it can be made stationary by differencing d times, expressed as $X_t \sim I(d)$. The standard Dickey – Fuller (DF) is implemented by confirming that our series are generated by first order autoregressive process i.e. AR (1) of the form:

$$y_t = y_{t-1} + \varepsilon_t \qquad (1)$$

Second, we specify the basic DF test by including deterministic terms (trend and constant):

$$\Delta y_t = \mu_0 + \gamma_t + \delta y_{t-1} + u_t \qquad (2)$$

Where y_t is a particular variable; γ, δ are parameters; ε_t and u are respective error terms assumed to be white noise i.e. $\varepsilon_t, u_t \sim IID(0, \delta^2)$. The above simple DF test can be extended to allow for AR (n) process, yielding the Augmented Dickey Fuller (ADF) test used in the study. It is of the form;

$$\Delta y_t = \delta y_{t-1} + \sum_{i=1}^{n} \delta_i \Delta y_{t-i} + \varepsilon_t \qquad (3)$$

The deterministic components can also be included in (3). Given the limitations of our small sample size and low power and size of the tests, we limit our ADF test to the simplest possible form.

Where y_t represents a time series e.g. LLEDD, LGDP, ε_t represents IID (0, δ^2) errors;

Δ implies the first difference of the series. This equation corrects for higher order correlation by adding lagged differences of the series y_t to the regressors.

Stationarity Test

The ADF test (table 6) shows that both LLEDD and LRGDP series are non-stationary in their levels but become stationary after first differencing.

Table 6: Results of Augmented Dickey Fuller Unit Root Test

Variables	Only Intercept	Trend and Intercept
LRGDP	-3.696174*** -(3.6576)	-3.626057** (-3.5614)
LLEDD	- 4.262209*** (- 3.6576)	-4.579371*** (-4.2826)

*** significant at 1% level of significance
** significant at 5% level of significance
Figures in Parenthesis are the critical value

Thereafter, cointegration among the series was tested for There are many possible tests for cointegration The most commonly used one is the multivariate test based on the autoregressive representation discussed in Johansen (1988) and Johansen and Juselius (1990). To determine the number of cointegrating equations, the Johansen maximum likelihood method was used as shown in table 7 below:

Table 7: Johansen cointegration Result

Sample: 1970 - 2003				
Included Observations: 32				
Test assumption No deterministic trend in the data				
Series: LRGDP LLDD				
Lags interval 1 to 1				
Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.388487	16.76953	12.53	16.31	None**
0.031714	1.031300	3.84	6.51	At most 1
*(**) denotes rejection of the hypothesis at 5%(1%) significance level				
L.R. test indicates 1 cointegrating equation(s) at 5% significance level				

Cointegration implies that causality exists between the two series but it does not indicate the direction of the causal relationship. The dynamic Granger causality can be captured from the vector error correction model (VECM) derived from the long-run cointegrating relationship (Granger 1988). Engle and Granger (1987) showed that if the two series are cointegrated, the vector-error correction model for the LRGDP and LLEDD series can be written as follows.

$$\Delta LRGDP_t = \alpha + \sum_{i=1}^{n} \beta_i \Delta LRGDP_{t-1} + \sum_{i=1}^{n} \gamma_i \Delta LLEDD_{t-1} + \delta\varepsilon_{t-1} + \mu_t \qquad (4)$$

$$\Delta LLEDD_t = \alpha + \sum_{i=1}^{n} \beta_i \Delta LLEDD_{t-1} + \sum_{i=1}^{n} \gamma_i \Delta LRGDP_{t-1} + \delta\varepsilon_{t-1} + \mu_t \qquad (5)$$

where ε_{t-1} refers to the error correction term derived from long-run cointegrating relationship

Table 8: Causality Results

Pairwise Granger Causality Tests			
Sample: 1970 - 2003			
Lags: 2			
Null Hypothesis:	Obs	F- Statistic	Probability
LLDD does not Granger Cause LRGDP	32	3.45780	0.04603
LRGDP does not Granger Cause LLDD		0.13090	0.87786

5. DISCUSSION OF RESULTS AND CONCLUSION

The result for the unit root test reveals that the two variables are non-stationary in their levels and become stationary after first differencing (Table 6). The Johansen cointegration test reveals that the series have long run relationship. It reveals that at least one cointegrating relationship exist between the variable.

Since the two series are cointegrated, a conventional extension is to estimate the vector error correction model (VECM). The VECM contains the cointegration relation built into the specification so that it restricts the long run behaviour of the endogenous variable to converge to their cointegrating relationship while allowing for short run adjustment dynamics. The dynamic Granger causality in the VECM specification was considered by running a pair wise Granger causality tests.
The result reveals that there is unidirectional causality at 2 lag length It shows that Energy consumption Granger causes economic growth in Nigeria. There was no bidirectional causality between energy consumption and economic growth. It means that the estimation does not suffer from simultaneity problem. The result is in consensus with earlier studies by Yu and Choi (1985), Masil and Masil (1996), Yang (2000) and Wolde – Rufael (2004).

Since causality runs from energy consumption to economic growth, it would imply that when energy consumption drops economic growth will suffer. It is an indication that conserving energy in any way will be problematic in Nigeria. If the contrary were the case, i.e. if GDP were to Granger cause energy conservation, conservation of energy will not hurt economic growth and development. It also implies that energy conservation would be a feasible policy tool for Nigeria, particularly now that the federal government of Nigeria is thinking along the line of privatizing the power sector Therefore, a well designed energy conservation policy can be an effective tool in managing the energy sector. This is particularly applicable to issues relating to energy related pollution and emissions.

REFERENCES

Abosedra, S. and Baghestani, H., 1991 "New Evidence on the Causal Relationship between United States Energy Consumption and Gross National Product" *Journal of. Energy Development* 14, 285-292.

Adegbulugbe and Seriki (1991): in Ayodele, S.A., 2001 Ed. *Improving and Sustaining Power (Electricity) Supply for socio-Economic Development in Nigeria.* Proceedings of the 19th annual Conference of Zonal Research Units, Organized by Research Dept. Central Bank of Nigeria, 4th-8th June.

Akarca, A. T and Long, T.V., 1980. "On the Relationship between Energy and GNP: A Re-examination" *Journal of Energy Development* 5, 326-331.

Anyanwu, J.C; et al, 1997. *The Structure of the Nigerian Economy (1960-1977)* Joanee Educational Publishers Ltd on the Nigeria.

Aqeel, A. And M.S. Butt, T.V., 2001 " The Relationship between Energy Consumption And Economic Growth in Pakistan". *Asia Pacific Development Journal* 8, 101-110.

Ayodele, A.S., 1992. *Public Enterprises Institutional Reforms, the Nigeria Electric Power Authority, NEPA, and Electricity Development in Nigeria, and Economic Analysis;* A Commissioned Paper, NEPA District Commercial Managers Workshop, Calabar, 8-10 April.

Central Bank of Nigeria, CBN, 2003. *Statistical Bulletin* Vol.14, December, 2003.

Chang, Y and Wong, J.F., 2001 *Poverty, Energy and Economic Growth in Singapore* Working Paper, Dept. of Economics, National University of Singapore, pp. 37.

Cheng, B. S., 1995. "An Investigation of Cointegration and Causality between Energy Consumption and Economic Growth" *Journal of Energy and Development*, 21, 73-84.

Cheng, B. S., 1999. "Causality between Energy Consumption and Economic Growth In India: An Application of Cointegration and Error-Correction Modeling". *Indian Economic Review* 34, 39-49.

Cheng, B.S. and Lai, T.W., 1997 "An Investigation of Co-Integration and Causality between Energy Consumption and Economic Activity in Taiwan" *Energy Economics.* 19, 435–444.

Dickey, D.A. and Fuller, W.A., 1979. "Distribution of the Estimators for Autoregressive Times Series with a Unit Root" *Journal of American Statistical Association* 74: 427 - 431

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

Erol, U. and Yu, E.S.H., 1988. "On the Causal Relationship between Energy and Income for Industrialized Countries" *Journal of. Energy Development* 13, 113-122.

Fatai, K., L. Oxley, and Scrimgeour, F., 2002. *Energy Consumption and Employment in New Zealand: Searching for Causality.* Paper presented at NZAE Conference, Wellington, 26 – 28 June 2002

Federal Office of Statistics, (Annual Series 1960-1973): *Annual Abstract of Statistics* Lagos, Nigeria.

Federal Office of Statistics (1960-1973, annual Series): *Digest of Statistics*, Lagos, Nigeria.

Ghali, K.H., M.I.T El-Sakka, 2004. "Energy Use and Output Growth in Canada: A
Multivariate Cointegration Analysis". *Energy Economics.* Forthcoming.

Glasure, Y. U. and Lee, A., 1997. "Cointegration, Error Correction and The Relationship between GDP and Energy The Case of South Korea and Singapore," *Resource Energy Economics* 20, 17-25.

Glasure, Y.U., 2002. "Energy and National Income in Korea Further Evidence on the Role of Omitted Variables" *Energy Economics*. 24, 355–365.

Granger, C. W. J., 1988. "Causality, Cointegration and Control" *Journal of Economics Dynamics and Control* 12, 551-559.

Hwang, D. And Gum, B., 1991. "The Causal Relationship between Energy and GNP: The Case of Taiwan". *Journal of Energy Development* 16, 219-226.

Iwayemi, A. P., 1991. *Deregulation of Public Utilities in Nigeria; An Econometric Analysis* Centre for Econometric and Applied Research CEAR. Published Analysis of Key Public Sector Utilities in Nigeria; University of Ibadan, Nigeria.

Johansen, S., 1988. Statistical Analysis of Cointegrating Vectors. *Journal of Economics Dynamics Control* 12, 231-254.

Johansen, S. and Juselius, K., 1990. "Maximum Likelihood Estimation and Inference on Cointegration with Applications to the Demand for Money" *Oxford. Bulletin Economics Statistics* 52, 169-210.

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

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

Masih, A M. M. and 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.

Masih, A. M. M. and Masih, R., 1997 "On Temporal Causal Relationship between Energy Consumption, Real Income and Prices, Some New Evidence from Asian Energy Dependent NICs Based on a Multivariate Cointegration/Vector Error Correction Approach", *Journal of Policy Modeling*. 19, 417-440

Morimoto, R. And Hope, C., 2004. "The Impact of Electricity Supply on Economic Growth in Sri Lanka". *Energy Economics*. 26, 77-85.

Mozumber, P and Marathe, A., (Undated): "Comparison of the Previous Studies on the Causality of Energy Consumption and Economic Growth" *Causality Relationship between Energy Consumption and GDP in Bangladesh* University of New Mexico Albuquerque, NM 87131

Oh, W. and Lee, K., 2004. "Causal Relationship Between Energy Consumption and GDP Revisited. The Case of Korea 1970–1999, *Energy Economics*. 26, 51-59.

Olayide, S. O., 1976. *Economic Survey of Nigeria (1960-1975)* Aromolaran Publishing Company Ltd, Ibadan, Nigeria.

Soytas U. and Sari, R., 2003. "Energy Consumption and GDP: Causality Relationship in G–7 Countries and Emerging Market" *Energy Economics* 25, 33 - 37

Sule, E.I.K and Anyanwu, C.M., 1994. "An Appraisal of Electricity supply in Nigeria and privatization option *Central Bank of Nigeria, CBN, Research Department Occasional Paper Series* No.9 30th August.

Wolde – Rufael Y., 2004. "Disaggregated Industrial Energy Consumption and GDP: The Case of Shanghai 1952 –1999 *Energy Economics* 26, 69 – 75

Yu, E.S.H. and Hwang, B.K., 1984. "The Relationship between Energy and GNP: Further Results". *Energy Economics* 6, 186 -190

Yu, E.S.H. and Jin, J.C., 1992. "Co integration Tests of Energy Consumption, Income and Employment. *Resource and Energy* 14, 259 – 266