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Production Index of Electricity Generation and Consumption In Nigeria

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----------ABSTRACT----------
Electricity as a source of energy is vital to the growth and development of any economy. Its significance arises from the impact it has on infrastructure, a range of socio-economic activities and consequently on the country's standard of living. This means that transportation, communication, construction, and other facilities depend on electricity to function effectively. Electricity has continued to play a significant role in the development process. In the Nigerian situation the reverse appears to be the case because power outages have continued to affect the country's development. Some have argued that privatizing electricity supply through the unbundling of power generation arm of National Electric Power Authority (NEPA) now Power Holding Company of Nigeria (PHCN) will ensure its efficiency.
Index number is used here to study the rate of growth in electricity consumption and hence the inflation rate over time.

KEYWORDS: *Index, Electricity, Production, Consumption*

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I. INTRODUCTION

Electricity in Nigeria has come a long way, when it started more than a century ago; the Nigerian Government was in full control. Now the talk is on involving the private sector in power generation.The Nigerian power sector operates well below its estimated capacity, with power outages being a frequent occurrence. In 2003, total installed electricity capacity was 5.9 gigawatts (GW). Total electricity generation during 2003 was 15.6 billion kilowatt hours (Bkwh), while total consumption was 14.5 Bkwh. According to Power Company Holding of Nigeria (PHCN), the country's peak electric demand in February 2006 was 7,600 megawatts (MW), but actual generation capability was 3,600 MW. The discrepancy between electricity demand and actual generation is mostly due to low water levels and inadequate plant maintenance. During 2005, electricity generation capacity fluctuated between 2,600 MW and 3,600 MW. The hydropower stations Kainji, Jebba, and Shiroro have seen generation affected by insufficient water, and the Lagos Egbin, Delta, and Port Harcourt Afam plants are also operating at below capacity due to poor maintenance. Only 40 percent of Nigerians have access to electricity, the majority of who are concentrated in urban areas. Despite endemic blackouts, customers are billed for services rendered, partially explaining Nigeria's widespread vandalism, power theft and PHCN's problems with payment collection.

2.1 OBJECTIVES OF THE STUDY

- To determine whether there is an increase in federal government expenditure on power system in Nigeria.
- To study the rate of in quantity electricity consumed from 1970 to 2009.
- To notice the inflation rate in power generation and consumption in Nigeria.

HYPOTHESIS

H_o= there is no increase in Federal Government Recurrent Expenditure on power sector.
H_1= there is increase in Federal Government Recurrent Expenditure on power sector.

Our Ho is written against the aim of the study to enable the researchers have a better forum for their research.

2.2.BACKGROUND OF THE STUDY

According to **Odumosu (2005)** states that for a long time now most role-players in the power industry have agreed that the best way to rapid development is through adequate provision of electricity. However, across the African continent, there are differences in levels of power provided such that classification on the basis of sufficiency is complex. Hence the continent can be categorized into four on the basis of population and land mass.

There are small countries with sufficient power such as Lesotho, big countries with sufficient power such as Ethiopia and South Africa, small countries with insufficient power such as Benin Republic and big countries with insufficient power such as Nigeria. It is therefore imperative for Africa to generate adequate power for development to take place.

Mwangi (2005) observed that illegal electricity connections are the bane of the Kenyan power utility's life. But it is a symptom of a greater scourge, in which the poor and the small businesses are badly affected. This may not be limited to Kenya alone, but to almost all the countries on the Continent.

Ayodele (1998) pointed out that the electricity crisis in Nigeria makes many inhabitants especially the poor miserable. There have been great stress, tension, suspicion, and conflicts between electricity users and provider officials, and this encourages illegitimate activities such as illegal electricity connections either to the national grid or the existing residential/industrial electricity outfit, over/ under billing, and payment via unscrupulous business collusion, and vandalization of equipment resold in most cases to private electricity institutions. Despite the recent unbundling of the power sub-sector in Nigeria, the situations mentioned above remain the same. With the persistence of all these problems, the way forward according to**Odumosu (2005)** is to strengthen the capacity to recover debts through honest marketing strategies. To him, the need to have an incorruptible marketing sector in the power industry is to ensure efficient power self-sufficiency so that erratic power supply can be eliminated through diligent monitoring of breakdowns, replacement of obsolete pieces of equipment, and decentralization of power source.

Ezenwe (1988) however observed that privatization entails costs in terms of widening income gap, loss of jobs, price hike of the service, and upward implication for general price level. He called for selective privatization of social services to be pursued only when conditions are favorable to the economy, and at the same time ensuring that public interest is not jeopardized. It is further noted that efficiency to a great extent is determined not only by ownership structure but by competition of an industry.

Onimode (1988) favored public enterprises provided they are operationally autonomous and at least break even to enhance efficiency. However, the Nigerian government will have to outline control measures to regulate the activities of the emerging private power providers so as to avoid unfair distribution of electricity services, inflation and associated problems. Despite his criticism of privatization of public enterprises,**Adejumobi (1997)** argued that privatization eliminates demand for subsidized services, enhances efficiency to meet up customer's satisfaction as this is crucial in determining the firm's market share, production level, sales, and profit margin. Other arguments pointed out are that privatization stimulates choice making and creating new businesses by encouraging entrepreneurial development in the country. Therefore, the privatization processes are desirable for Nigeria given the numerous problems in her power sub-sector. Since the effects of these problems will generally lead to increase in cost of living,

Holtedahl and Joutz (2004) showed electricity consumption in general as a function of the stock of electrical energy using equipment (Kt), and economic factor (X_t). Both variables can have independent and interdependent impacts on electricity demand or consumption. The capital stock of energy using equipment can be divided into two types. The first relates to the demand for daily energy services: lighting, refrigeration, cleaning, and entertainment. The second relates to seasonal weather patterns which can affect the demand for heating and cooling services. The dependence of capital stock on economic factors holds in the medium to long run. This is because in the long-run, the stock of appliance is flexible and can respond to changes in relevant prices. In the short-run, the demand for electricity will be constrained to changes in the utilization rates given the fixed stock of electricity using appliances.

II. METHODS OF CONSTRUCTING INDEX NUMBERS.

There are various methods or techniques used in constructing index numbers, since price indices are the most important of all the indices, therefore their detailed construction methods shall be discussed. The consumer indices can be obtained from price indices by interchanging the price (p) and the consumer (q) in the final formula.

3.1SIMPLE AGGREGATE METHOD (UNWEIGHTED): This is the simplest of all the methods of constructing index number and this consist in expressing the total prices of all selected generation in the given data, expressed in different forms which is listed below.

a)CARLI METHOD: This is an Italian; economist who formulated this formulae, this deals specifically in comparing the changes in the price for the current year with the price in the base year, in order to study the effect on the inflation of prices on power sector.

$$pc = \frac{1}{n}.\sum\left(\frac{q_t}{q_o}\right) \times 100$$

b)DUTOT METHOD: Dutot a French economist proposed using the formulae speculated below which is used in calculating the average. The same procedure is done in this method the difference here is that here it is not divided by the total number (n).

$$pd = \frac{\frac{1}{n}.\sum(q_t)}{\frac{1}{n}.\sum(q_o)} = \frac{\sum(q_t)}{\sum(q_o)} \times 100$$

c)JEVON METHOD: This is an English Economist, whom in 1863, proposed by taking the geometric average of the price relative of period t and base period 0.This Jevon when used as a primary aggregate, the Jevons index is considered as a constant elasticity of substitution index since it allows for product substitution between time periods. The formulae are given below.

$$pj = \prod\left(\frac{q_t}{q_o}\right)^{1/n} \times 100$$

d)HARMONIC MEAN OF SIMPLE AVERAGE METHOD: This comprises of the inverse of the Carli's method but its counterpart to the Carli index. It was proposed by Jevons, and by Coggeshall in 1865 and in 1887. The formulae are given below.

$$phr = \frac{1}{\frac{1}{n}.\sum\left(\frac{q_o}{q_t}\right)} \times 100$$

III. DATA PRESENTATION AND ANALYSIS

4.1 INTRODUCTION

The data used for this research work is secondary method which was extracted from central bank of Nigeria statistics bulletin (vol. 18 2007) of Power Holding Company of Nigeria (PHCN) statistical record, and the internet.

The data collected covers the amount of power generated (MW) in Nigeria for the period of thirty nine years (1970-2009).

4.2 DATA PRESENTATION

year	installed cap.(mw)	total general(mw) (per hour)	capacity utilized (%)	industrial	% of total	com.&street lighting	% of total	residential	% of total	total	prop.of.total gen. consm.
1970	804.7	176.6	21.9	91.4	62.9	.	.	53.9	37.1	145.3	82.3
1971	804.7	215.4	26.8	114.9	63.5	.	.	66.2	36.5	181.1	84
1972	786.7	255.4	32.5	138.2	65.5	.	.	72.9	34.5	211.1	82.6
1973	670.6	299.7	44.7	146.1	62.8	.	.	86.6	37.2	232.7	77.6
1974	721	261.1	36.2	163.2	61.3	.	.	103	38.7	266.2	100
1975	926.2	395.4	42.7	200.4	62.9	.	.	118.3	37.1	318.7	80.6
1976	1125.2	468.7	41.7	214.6	58	.	.	155.2	42	369.8	78.9
1977	1114.2	538	48.3	253	58.1	.	.	182.7	41.9	435.7	81
1978	1738.3	522.7	29.1	157.7	31.3	93.5	18.5	253.2	77.9	504.4	96.5
1979	2230.6	710.7	31.9	160.3	34.8	77.9	16.9	221.9	48.2	460.1	64.7
1980	2230.5	815.1	36.5	199.7	37.2	94.1	17.5	243.1	45.3	536.9	65.9

1981	2430	887.7	36.5	121	30.2	21.3	21.3	193.6	48.4	335.9	45.1
1982	2902.1	973.9	33.6	262	38.4	79.1	11.6	344.5	50.6	685.6	70
1983	2856.8	994.6	34.8	254.4	36.5	84.3	12.1	358	51.4	696.7	70
1984	3178	1025.5	32.3	217.2	34.7	81.7	13.1	326.6	52.2	625.5	61
1985	3695.5	1166.8	31.6	259.8	36.2	85.6	11.9	372	51.9	717.4	61.5
1986	4016	1228.9	30.6	280.5	33.3	84.7	10.1	476.6	56.6	841.8	68.5
1987	4548	1286	28.3	294.1	34.5	90.2	10.6	468.6	54.9	852.9	66.3
1988	4548	1330.4	29.3	291.1	34.1	118.6	13.9	443.8	52	853.5	64.2
1989	4548	1462.7	32.2	257.9	26.4	195.3	20	523.6	53.6	976.8	66.8
1990	4548	1536.9	33.8	230.1	25.6	217.6	24.2	450.8	50.2	898.5	58.5
1991	4548	1617.2	35.6	253.7	26.8	254.1	26.8	459.3	48.5	946.6	58.5
1992	4580	1693.4	37	245.3	24.7	266.1	26.8	481.6	48.5	993	58.6
1993	4548.6	1655.8	36.4	237.4	20.8	311.6	27.3	592.4	51.9	1141.4	68.9
1994	4548.6	1772.9	39	233.3	21.3	306.7	28	575	52.5	1115	61.8
1995	4548.6	1810.1	39.8	218.7	20.3	279.6	26	552.6	51.3	1050.9	59.5
1996	4548.6	1854.2	40.8	235.3	22.8	280	27.1	518	50.1	1033.3	55.7
1997	4548.6	1839.8	40.4	236.8	23.5	264.5	26.2	508.3	50.3	1009.6	54.9
1998	4548.6	1724.9	37.9	218.9	22.5	253.9	26.1	500	51.4	972.8	56.4
1999	5580	1859.8	33.3	191.8	21.7	236.8	26.8	455.1	51.5	883.7	47.5
2000	5580	1738.3	31.2	223.8	22	274.7	27	518.8	51	1017.3	58.5
2001	6180	1689.9	27.5	241.9	21.9	298.3	27	564.5	51.1	1104.7	65.4
2002	6180	2237.3	36.2	146.2	11.5	372.6	29.3	752.8	59.2	1271.6	56.8
2003	6530	6180	38.8	196	12.9	417.9	27.5	905.6	59.6	1519.5	63.4
2004	6530	2763.6	45.1	398	21.8	489.3	26.8	938.5	51.4	1825.8	66.1
2005	6861.6	2779.3	40.5	182.3	9.7	496.6	26.5	1194.3	63.8	1873.1	67.4
2006	6907.69	2895.64	37.34	263.36		431.40	30.63	833.33		1528.09	
2007	7085.46	2977.43	37.44	265.93		446.06	31.25	855.81		1567.80	
2008	7263.22	3059.23	37.54	268.50		460.72	31.87	878.28		1607.51	
2009	7440.99	3141.02	37.65	271.08		475.38	32.48	900.76		1647.22	

The analysis carried out is an unweighted quantity index, because the quantity of electricity consumptions is not uniform in Nigerian. It's also of the fixed base type of quantity index.Taking the base year to be 1970.Unweighted quantity indexes only compare quantity between two periods.A number of different formulas have been proposed as means of calculating quantity indexes. While quantity index formulas all use

quantity generated and quantity consumption data, they amalgamate this data in different ways. A quantity index generally aggregates using various combinations of base period quantities (q0), and later period quantities (qt).By making use of this extracted data. Calculating inflation rate which is given by the formulae.

$$\frac{f-i}{i} \times 100$$

Where F is the final value and I is the initial value of the index.

year	installed cap.(mw)	total general(mw) (per hour)	Industrial	com.&street lighting	residential
1970	804.7	176.6	91.4	93.5	53.9
1971	804.7	215.4	114.9	93.5	66.2
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1996	4548.6	1854.2	235.3	280	518
1997	4548.6	1839.8	236.8	264.5	508.3
1998	4548.6	1724.9	218.9	253.9	500
1999	5580	1859.8	191.8	236.8	455.1
2000	5580	1738.3	223.8	274.7	518.8
2001	6180	1689.9	241.9	298.3	564.5
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2008	7263.22	3059.23	268.50	460.72	878.28
2009	7440.99	3141.02	271.08	475.38	900.76

Summary of analysis taking 1970as base year.

1991	5.65	9.17	2.78	2.72	8.52	28.84	1.13	5.77	576.79	584.57	33325209	441.80
1992	5.69	9.61	2.68	2.85	8.94	29.76	1.12	5.95	595.23	595.56	37309639	448.08
1993	5.65	9.39	2.60	3.33	10.99	31.97	1.06	6.39	639.30	602.07	50506346	471.87
1994	5.65	10.06	2.55	3.28	10.67	32.21	1.07	6.44	644.19	609.50	50772139	468.65
1995	5.65	10.27	2.39	2.99	10.25	31.56	1.12	6.31	631.10	607.29	42573981	444.70
1996	5.65	10.52	2.57	2.99	9.61	31.35	1.10	6.27	626.99	609.47	44046475	455.13
1997	5.65	10.44	2.59	2.83	9.43	30.94	1.12	6.19	618.77	606.34	40770211	447.06
1998	5.65	9.78	2.39	2.72	9.28	29.82	1.17	5.96	596.47	593.91	33364702	426.30
1999	6.93	10.55	2.10	2.53	8.44	30.56	1.23	6.11	611.16	682.20	32824997	406.84
2000	6.93	9.86	2.45	2.94	9.63	31.81	1.10	6.36	636.12	683.19	47341799	455.18
2001	7.68	9.59	2.65	3.19	10.47	33.58	1.02	6.72	671.51	735.56	65098302	489.49
2002	7.68	12.69	1.60	3.99	13.97	39.92	1.16	7.98	798.43	794.11	86766014	432.21
2003	8.11	35.05	2.14	4.47	16.80	66.58	0.90	13.32	1331.68	1166.26	45807188	554.70
2004	8.11	15.68	4.35	5.23	17.41	50.79	0.67	10.16	1015.80	911.35	50471713	751.54
2005	8.53	15.76	1.99	5.31	22.16	53.75	0.92	10.75	1075.10	943.70	31552571	546.09
2006	8.58	16.42	2.88	4.61	15.46	47.96	0.81	9.59	959.29	928.73	28979113	620.38
2007	8.81	16.89	2.91	4.77	15.88	49.25	0.79	9.85	985.03	953.26	32772739	633.57
2008	9.03	17.35	2.94	4.93	16.29	50.54	0.77	10.11	1010.76	977.78	36942759	646.63
2009	9.25	17.82	2.97	5.08	16.71	51.82	0.76	10.36	1036.50	1002.31	41515541	659.57

V. SUMMARY OF FINDINGS

From the indexes calculated and their respective inflation, my findings are thus;

The electricity power generation and consumption index percent rose about 50% (percent) in 1984- 2009 and it is lower than 30% (percent) decrease recorded in the previous year for CARLI, DUTOT AND JEVONS while HARMONIC MEAN index percent rose about 40% in 1970-1989 and decrease in the previous years and their respective inflation changes for index.

5.1 CONCLUSION

The paper examined the index of aggregate electricity consumption in line with privatization program in Nigeria. The validity of the explanatory variables as short-run variables was examined by conducting a co-integration test and our results confirmed that such variables as electricity generation, income and electricity tariff are short-run analysis variables. In order to avoid loss of information and to explain long-run index of electricity consumption,

Nigeria has to improve her database in order to provide accurate data on capital stock of electrical appliances. Electricity demand studies have important practical implications. The results indicate that the estimated residential demand for electricity can be used for policy purposes since it is stable. The finding that a stable aggregate residential electricity demand function seems to exist would make inflation of electricity need at the national level possible. There was an extremely stable inflation figure in the years all through (which changes), that rose to about 57% forthe years and decrease to about -1.59%.It is also essential to further ensure consumer protection apart from regulating the quantity by the government. Hence, issuance of licenses to private providers of electricity should include among other requirements the fulfillment of providing alternative source of power generation such as solar system. This will ensure uninterruptible electricity supply and the purpose of privatization in the first instance will not be defeated. As a follow up to meeting this requirement, there must be adequate security in place to protect the providers‟ equipment from being vandalized and pilfered by the undesirable elements in the country. In all, the inclusion of electricity generation in short-run analysis of electricity consumption is not problematic as the index is overall significant and well fit.

5.2 Recommendation

Government should therefore hasten the privatization process so that more electricity can be generated given the available numerous natural resources in the country.

Government will need to regulate the price of electricity when the private providers finally take over since the amenityis essential to socio-economic development.

REFERENCES

[1] **Allen, R.G.D. 1949**. "The Economic Theory of Index Numbers," Economical N.S. 16, 197-203.

[2] **Adejumobi, S. (1997)** "Marketing Public Welfare: A Theoretical Critique of the Logic of Privatization in the Social Sector" in Journal of Economics and Allied Studies, 1(1), pp. 2-4 3.

[3] **Al-Faris, A.R., 2002.**The demand for electricity in the GCC countries. Energy Policy30, 117–124.

[4] **Al-Zayer, J., Al-Ibrahim, A., 1996.**Modeling the impact of temperature on Electricity consumption in the eastern provinces of SaudiArabia.Journal of Forecasting 15 (2), 97–106.

[5] **Ayodele A.S. (1998)** "Energy Crises in Nigeria: The Case of Electric Energy" Market in Bullion, 22 (4), pp. 19-23

[6] **Beenstock, M., Goldin, E., Nabot, D., 1999.**The demand for electricity in Israel. Energy Economics 21, 168–183.

[7] Central bank of Nigeria statistical bulletin (vol.18 2007) and National Bureau of statistics.

[8] **Chinedu Arizona-OgwuL**.is the Founder of Nigeria4betterrule, and he writes FromOyigbo, Rivers State

[9] **De Vita, G., Endresen, K., Hunt, L.C., 2006.** An empirical analysis of energy demand in Namibia. Energy Policy 34, 3447–3463.

[10] **Diewert, W.E. 1976.** "Exact and Superlative Index Numbers," Journal of Econometrics 4, 114-145. Measurement, W.E. Diewert and C. Montmarquette (eds.), Ottawa: Statistics Canada.

[11] **Edgeworth, F.Y. 1888.** "Some New Methods of Measuring Variation in General Prices," Journal of the Royal Statistical Society 51, 346-368.

[12] **Eichhorn, W. 1973.**"ZurAxiomatischenTheorie des Preisindex," Denionstration Mathematical 6, 561-573. • 1976. "Fisher's Tests Revisited," Econometrical 44, 247-256.

[13] **Ezenwe, U. (1988)** "The Limits of Privatization in a Developing Economy" Privatization of Public Enterprises in Nigeria. Ibadan: Nigerian Economic Society Seminar Series

[14] **Ferger, W.F. 1946.** "Historical Note on the Purchasing Power Concept and Index Numbers," Journal of the American Statistical Association 41, 53-57.