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Analysis of economic capacity utilization in the Nigerian sugar industry (1970 - 2010)

Sunday B. Akpan[1]*, Inimfon V. Patrick[1], Daniel E. John[2] and Samuel J. Udoka[1]

[1]Department of Agricultural Economics and Resources Management, Akwa Ibom State University, Ikot Akpaden, Mkpat Enin, Akwa Ibom State, Nigeria.

[2]Department of Agricultural Economics and Extension, University of Uyo, Akwa Ibom State, Nigeria.

The study analyzed economic capacity utilization rates in the sugar industry for the period 1970 to 2010 in Nigeria. Secondary data obtained from sugar firms; Central Bank of Nigeria; National Bureau of Statistics and the Federal Ministry of Finance were used in the study. Stochastic Cobb-Douglas cost functions for the sugar industry were estimated from which indices of economic capacity utilization rates were obtained. Trend in the economic capacity utilization rate showed undulated pattern with an average index of 60.30% and excess economic capacity of 39.70%. Multiple-regression of various forms based on the ordinary least squares technique was used to determine factors that influence the performance indicators in the industry. Empirical results revealed that economic capacity utilization rates in the sugar industry was influenced by the inflation rate, per capita real GDP, energy consumption of the industry, federal government expenditure on the sugar industry and the period of liberalization. The result of the regression and descriptive analyses revealed that the sugar industry in Nigeria was constrained by insufficient production inputs. Policy measures aimed at reduction or maintaining a steady or less fluctuated inflation rate in the country, expansionary aggregate demand, increase funding to agencies that have direct dealings with the sugar production and adequate provision of electricity to the industry as well as the adoption of the liberalization industrial policy on sugar industry were recommended.

Key word: Sugar, industry, capacity, utilization, economic, Nigeria.

INTRODUCTION

The sugar sub-sector has contributed to the development of the Nigeria‟s economy (NSDC,domestic output2010) of the sub-sector is derived from its contribution to the employment, development of other subsidiary industries and food self sufficiency as well as its significant impact on the rural economy (Nwaobi, 2005; ADB, 2000; ADF, 2000). In Nigeria, the demand for household sugar consumption remains firm, the soft drink production alone accounts for about half of the total industrial sugar usage in Nigeria (Michael, 2010). The domestic consumption of sugar in Nigeria is in excess of one million tons per annum. Domestic production of sugar in the country had

suffered considerably in the past years. For instance, the declined. Thefrom 51,080importancetonnesinthe period 1988 to 1990 to 5,597 tonnes in the period 2001 to 2003 (Wada et al., 2001; Olomola, 2007 and SSC, 2010 (Table 1). Currently, domestic production of sugar is slightly less than 5% of the country‟s annual re (CBN, 2008; NSDC, 2012).

Data in Table 1 reveals that from 2000 to 2003, the domestic sugar production declined significantly reaching all time low value of less than 1.00% of domestic sugar consumption in the country. The dismal performance of the sub-sector had been attributed to diverse factors

*Corresponding author. E-mail: sundayakpan10@yahoo.com.

Table 1. Sugar supply and import price of sugar in Nigeria (1970 to 2008).

Year	Average domestic output (tons)	Average import (tons)	Average total supply (tons)	Average Import Price ₦ /ton	Share of domestic to total output (%)	Share of import to total output (%)
1970-1972	38141	114158	152299	144.4	33.41	66.59
1973-1975	42594	99335	141929	424.6	30.01	69.99
1976-1978	34074	327382	361458	332.6	9.43	90.57
1979-1981	36296	632379	668675	349.8	5.43	94.57
1982-1984	37778	571562	609340	293.7	6.20	93.80
1985-1987	51872	450130	502002	465.2	10.33	89.67
1988-1990	51080	292766	343846	1878.5	14.86	85.14
1991-1993	40735	485540	526275	6681.5	7.74	92.26
1994-1996	45577	390718	436295	7696.6	10.45	89.55
1997-2000	13654	729870	743524	10980	1.84	98.16
2001-2003	5597	903066	908663	25229	0.62	99.38
2004-2008	11194	350113	361307	42625	3.20	96.80

Sources: National Sugar Company Document (NISUCO) (1999, 2000); Savannah Sugar Company limited (SSC) (2000), and FAO database (2011).

including economic, environmental, social, technology and factory based hindrances (Lafiagi, 1984; Wada et al., 2001; Akpan et al., 2011, 2012a, 2012b).

The two major integrated sugar plants at Bacita in Kwara state (Nigerian Sugar Company) and Numan in Adamawa state (Savannah Sugar Company) were established in 1961 and 1977, respectively, following the adoption of import substitution industrialization policy in the country (ISYB, 1978). The aims were to encourage technological development, reduce the volume of imports and encourage foreign exchange savings by producing locally some of the imported consumer goods (Ayeni, 1981; Ekeocha, 2009). The two sugar plants had a combined installed capacity of 105,000 tonnes per annum or less than 10% of the

(FMI, 2003). Due to some rather complex factors, the major existing sugar companies at Bacita and Numan whose combined installed capacity was expected to climb to 165,000 tons per annum after their expansion programme initiated by the federal government in collaboration with the African Development Bank and African Development Fund in 1989 and 1991, respectively could not fulfill the sub-sector expectations. Besides, the two major sugar producing companies, the other 2 mini sugar firms at Sunti (Niger State) and Lafiagi (Kwara State) were producing relatively small quantities of Sugar (i.e. less than 1,000 tons per annum each) (Wada et al., 2001; Nwaobi 2005; NSDC, 2006).

The general performance of the sugar sub-sector was fair in the early 1970s as indicated in Table 2. During this period, the sugar industry had fully integrated its operations backward through its direct involvement in sugarcane farming and sourcing of other raw materials locally (Ayayi, 1988; Akpan et al., 2012a). Towards the middle of 1980s and the late 1990s, the performance of the sub sector started to decline. The index of sugar

production declined from 117.8% in the period 1986 to 1990 to 47.7% in 2001 to 2005 periods. By the middle of 1980"s, the country"s foreign significantly arising from the oil glut. The high import dependence manufacturing sector in the country became a serious liability on the economy (Isola, 2006).

The prevailing economic environment and the industrial policies during 1970s to early 1980s favored an average capacity utilization rate of above 50% in the sugar cocoa confectionery sub-sector (CBN, 2006; MAN, 2006). As revealed in Table 3, the agro based industries generally witnessed decline in productivity during the structural adjustment programme (SAP) period. The average technology based capacity utilization rate of the sugar country"scocoaconfectioneryannualindustrystoodrequirementat40%in1986and declined to 36% during the early structural adjustment programme (SAP) period. The instability in some macro-economic variables in the Nigerian economy and agro-based firm related constraints during the SAP period probably contributed to the decline in the productivity of the sugar industry. The decline in the sub sector productivity might have manifested through the influence of rising inflation rate, low external reserves which

constrained importation of s deteriorating value of naira as well as demand and other production constraints imposed by low real GDP per capita during the period ((Isola, 2006; Akpan et al., 2012b).

In the early 1990s, the Nigerian sugar sub-sector was still largely underdeveloped with untapped resources and potentialities. The 4 existing companies were completely government owned and were characterized by low productivity occasioned by managerial, financial and infrastructural and technological constraints. The awfully low production by the existing sugar companies could only satisfy about 5% of the

Table 2. Average index of agro-based manufacturing sub-sectors in Nigeria (1985 = 100)

Agro-based Industry	1970 - 1975	1976 - 1980	1981 - 1985	1986 - 1990	1991 - 1995	1996 - 2000
Sugar	420.3	534.3	149.6	117.8	101.2	56.4
Textiles	110.6	171.4	100.9	100.8	117.2	97.4
Foot work	253.6	255.9	111.1	62.1	73.7	47.7
Total GR	24.8	80.5	-169.7	-65.5	20.9	-58.9
Ave.GR. (%)	8.3	26.8	-56.6	-21.8	7.0	-19.6

Source: Computed by using data from CBN statistical bulletin (2006).

Table 3. Economic and Industrial Sector Performance in Industrial Policy Regimes in Nigeria.

Indicator	Import Substitution Era					Liberaliz
	1970-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996
Mean macroeconomic variable indicator						
Inflation rate (%)	14.3	13.0	19.4	20.5	48.9	12
Official exchange rate (N/ $)	0.66	0.69	0.77	5.90	19.16	54
External reserve (Nb)	1.19	3.06	1.40	11.98	39.2	36
Index of energy consumption (1985=100)	26.3	64.6	122.8	95.6	95.7	83
Real GDP per capita (N / person) (1985=100)	177.2	735	3.25	962	674	5
Real foreign private investment in Manu and processing (Nb)	2.79	3.17	2.74	2.20	1.53	1.
Index of agricultural production (1990=100)	65.62	56.44	58.74	79.20	121.6	14
Index of manufacturing production (1985=100)	32.85	75.42	105.7	135.4	154.7	13
Mean agro based industry capacity utilization rate (%)						
Meat and dairy product	NA	NA	55.85	30.07	30.34	36
Vegetable and grains mill	NA	92.37	48.97	33.40	35.54	18
Bakery product	66.4	71.48	58.64	37.90	37.90	21
Sugar cocoa confectionery	NA	59.59	53.12	42.20	33.12	31
Textile	79.7	80.72	59.84	51.20	48.34	34
Leather products	77.2	75.08	54.50	45.00	42.38	37
Tyres and tube	NA	NA	42.58	53.04	41.70	30
Leather foot wear	NA	47.5	76.69	55.56	41.18	24
Average agro industry capacity utilization rate (%)	75.10	73.72	56.12	43.10	38.46	28
Average industry capacity utilization rate (%)	76.6	71.12	53.58	41.14	35.40	33

Source: Computed by using data from Central Bank Nigeria Statistical Bulletin (2006) and World Bank Reports (20021). NA means data not available.

wide gap between sugar demand and supply was filled through importation with huge amount of foreign exchange requirement. With the dwindling fortune of the federal government resources, the existing sugar companies were wallowed in low productivity due to inadequate finance for both recurrent and capital expenditure (FMI, 2003). This situation further deepened the fortune of the local sugar production since all sugar companies were government owned. In an attempt to accelerate the domestic sugar production, the National Sugar Development Council (NSDC) was established by decree 88 of 1993. The NSDC was mandated to develop strategies that would promote the local production of sugar such that 70% of the would be met by domestic production (Busari et al., 1996 and FMI, 2003). Based on the government policy of direct participation and investment in the sugar industry, NSDC strategies were the expansion and rehabilitation of the 4 government owned sugar industries, establishment of 5 medium scale and many mini sugar plants in the country as well as the establishment of the sugarcane Research Development and Training Center. The Council however recorded some successes in implementing some of its strategies but could not still upsurge local production of sugar in the country (FMI, 2003).

Following the government reform programme on privatization and commercialization between 2001 and till date; the 2 integrated sugar companies and 2 mini sugar plants in Nigeria were partially privatized. The aims were to promote efficiency in resource utilization, increase productive capacity and increase the role of the private sector in the sugar industry (Zayyad, 2007). Despite this lofty attempt by the government to strengthen the productive capacity of the sugar sub-sector, the productivity of the sub-sector continued to decline. The average index of production in the sugar industry was -17.9% in the period 1970 to 2005 (CBN, 2006). During the post Structural Adjustment Programme era, growth in the sugar industry in Nigeria was hindered due to increase in manufacturing cost (Ogunbayo, 2009). The average capacity utilization for the sugar cocoa confectionery sub sector during post SAP period as published by official sources in Nigeria was below 30% (MAN, 2009; CBN, 2009).

Problem statement, objectives and justification of the study

Capacity utilization has an important bearing on the financial performance of any firm and the entire industry. It is widely used in business cycle analysis to characterize the situation of individual industry or the whole economy and to assess the appropriateness of the economic policy (Danish, 2003). The Nigerian monetary policy, among other things, aims at achieving full employment of resources without inflation (Anyanwu et

al., 1997). Consequently, over the years the government has employed a number of monetary policy measures to increase capacity utilization in the economy and at the same time curb inflation. Government policy measures have varied from the pre-structural Adjustment Programme (Pre-SAP) period (1970 to 1985) to the SAP (1986 to 1993) and post-SAP (1994 to date) periods. Direct monetary control techniques were employed during the pre-SAP period. The major tools of monetary policy were administered interest and exchange rates, special deposits by banks, prescription of cash reserve requirements, selective credit controls and credit ceilings (Anyanwu et al., 1997).

country"sIntheSAPperiod (1986sugarto1993),requirementindirectmeasures were used to control the ability of banks to extend new credits alongside credit ceilings. The measures included the deregulation of interest rates, increase in commercial banks cash reserve requirements and its extension beyond demand deposits to include time and savings

deposits. Other measures wer excess liquidity through the issuance of stabilization securities and the transfer of public sector accounts from

banks to the Central Bank of Nigeria (CBN). On June 30, 1993, the CBN formally introduced its open market operations (OMO). In the post-SAP period (1994 to date), administratively controlled measures were first adopted in1994 and were abandoned in 1995 for policy of guided deregulation. Banks became directly involved in equity funding and management of small-scale enterprises. Apart from monetary policies, the government also employed some fiscal policy measures to ensure full employment of resources. These measures include tax holidays, tariff protection, import duty relief, bans on imports and the provision of credit facilities.

In the sugar industry, some specific policies employed over the years to boost sugar production in the country included 50% tariff on the importation of white sugar, 5% levy on imported raw sugar, free excise duties on sugar production, reduction of import duties on sugar industry machineries, 5–year tax holiday to sugar refineries and privatization of the major sugar firms in the country, as well as, the sugar expansion programme in collaboration with the African Development Bank (ADB) and African Development Fund (ADF), 1989 and 1991 respectively. These measures were meant to stimulate the local production and hence increase the productivity and capacity utilization in the sub-sector. In spite of these measures, Nigeria still imports more than 90% of its sugar. Nigeria is the largest consumer of sugar in the West African sub-region and second in Africa (ADB and ADF, 2000). The country also has a large area of cultivable land, suitable for the growing of industrial sugarcane (Busari et al., 1996). Despite the favorable agro-climatic and edaphic conditions for the production of sugar-cane in addition to the long period of existence of sugar mills; sugar requirements of the country remain largely unmet from domestic sources (Olomola, 2007).

The domestic sugar production has oscillated between 7,000 tonnes and 55,000 tonnes per annum from1969 to 2010 (Wada et al., 2001; SSC, 2010).

In Nigeria, the issue on utilization rate is relatively new compared to other methods of capacity utilization especially in the agro-based industries. Several authors in Nigeria have worked on technology based capacity utilization in many industries (Fabayo, 1981; Ukoha, 2000; Soderbom et al., 2002; Salimonu et al., 2006; Adeel et al., 2006; Raimi et al., 2009; Akpan et al., 2011, 2012b). Most studies on the concept were based on survey opinions of firms on capacity utilization rate rather than empirical estimation in the individual industry through resource endowment (Soderbom et al., 2002; Adeel et al., 2006). Other studies based their analyses on the data published by the official sources such as Central Bank of Nigeria (CBN) and Manufacturing Association of Nigeria (MAN) with no consideration on capacity utilization estimation procedures (Fabayo, 1981; Ukoha, 2000; Salimonu *et al.,* 2006 and Raimi et al., 2009). Data on capacity utilization rates in the sugar-cocoa confectionary sub-sector, as reported by independent official sources showed that capacity utilization rates declined from an all time high value of 85% in 1975 to 50% in 1983, and remained consistently below 50% from 1983. This study investigated whether the sugar industry is really operating at half capacity in the sense that firms could double output without experiencing a rise in average costs.

Therefore, this study differs from the previous ones conducted in Nigeria as it estimated the economic capacity utilization rates for the sugar industry using the sugar industry production and cost data. In addition, it analyzed the factors which influence economic capacity utilization in the industry. Hence, the result of the study is a reliable quantitative fact and source of reference to policy makers to efficiently make relevant policies that can promote the sugar industry"sandproductionperformanceworkersaswellas2 quasiin-fixedNigeriafactors, In addition, the results would serve as a useful screen board for future analysis of capacity utilization in any sector of the economy. Furthermore, this study provided a frame of reference for agricultural economists, economists, manufacturers, planners and students who might be carrying out studies on capacity utilization.

The concept of economic capacity

The earliest work on the economic concept of firm"s capacity is that of Cassels (1937). The economic capacity takes explicit account of economic factors like cost, price, revenue and profit. It is defined as the optimum output of a firm from economic point of view. This approach considers capital as a quasi-fixed input, and allows for distinction between short and long-run cost curves. In the long-run, capacity can be adjusted in order to achieve optimal output (cost-minimizing, profit-maximizing) level. In the short-run, capital is fixed and only the variable

inputs can be varied. Hickman (1964) defined economic capacity of a firm as that output level at which the short run average total cost curve is at its minimum; while Klein industry"s(1960)andFriedman (1963)economicdefinedeconomiccapacity as the output level at which the long-run and short-run average total cost curves are tangent.

The relationship between the 2 notions of economic capacity measures depends upon the degree of scale of economies of a firm. Berndt and Hesse (1986) advocated that, under the assumption of prevailing constant returns to scale in the long-run, the tangency point between the long run and short–run average total cost curves will coincide at a point where the long -run and the short run optimization of the industry" average totalcostcurves reach their minimum .Hence, the two economic measures of capacity would be equivalent. The first two measures of economic capacity are termed primal economic capacity because they are directly measured in physical output and expressed in physical unit. The third measure of economic capacity proposed by Berndt and Morrison (1981), and Morrison (1985) is considered a dual-based concept and thus defines economic capacity in define economic capacity as corresponding to the shadow total cost of a firm. The shadow total cost is defined as the cost of the variable inputs plus the shadow cost of quasi-fixed inputs.

LITERATURE REVIEW

Optimizing economic variables of firms to derive economic capacity and utilization is relatively new in the literature especially in the sub-Saharan African countries. Berndt and Morrison (1981) used quadratic cost function to estimate capacity utilization rates for the U.S. manufacturing sector over the period 1958 to 1977. The model consisted of 3 variable factors, energy, materials and non production workers. He discovered capacity utilization rates greater than unity for the entire period. He also applied the same methodology to the U.S.A. automobile industry and obtained capacity utilization rates that exceeded unity for the years considered. While studying the performance of the Irish manufacturing sector, Kenny (1996) applied the translog Cost Function Approach on data from the manufacturing sector and under the assumption of long-run constant return to scale to estimate economic capacity utilization rates for the sector. In recognition of the dichotomy that characterized Irish industry, the model was fitted to 2 individual sub-sector classification; the hi-technology and traditional manufacturing sub sectors. The results revealed that substantial degree of excess capacity existed in the sector during the period 1970 to 1990. The traditional industrial sub-sector had a significant excess capacity compared to the hi-technology sub-sector. World Barik (2000) estimated the economic rate of capacity for the Indian paper industry for the period 1973 to 1974 and

1997 to 1998 using the translog Variable Cost Function. He found that under utilization of economic capacity prevailed in the industry, and also a decline in the rates of capacity utilization over time. Prior and Nelda (2001) in their study, estimated capacity utilization rate and cost efficiency in the chemical industry in Romania between period 1996 and 1997. They employed Cost Efficiency Data Envelopment Analysis (DEA) methodology. The result obtained showed high inefficiency and low capacity utilization rates among the industries. Hashim (2003) studied the trend in economic capacity utilization rates in Indian airlines for the period 1964 to 1990. He used the translog cost function to estimate the economic capacity utilization rates across the periods. The estimation of economic capacity utilization rates was based on 2 alternative measures of economic output. The first was where the short-run average cost was minimum, and the second was where the short-run and long-run average cost curves were equal. The results reveal an average estimated economic capacity utilization rate of 0.32 and 0.37 for the two methods respectively.

The results further showed that economic capacity utilization rates for the Indian airlines was generally poor, showing downward trend pattern in the study period. Lecraw (1978) analyzed factors that influence economic capacity utilization of 200 manufacturing firms in Thailand during the period 1962 to1974. He estimated profit-maximizing capacity utilization rate for each firm by using the projected balance sheets and income statements that the firms had prepared at the time of their initial investment. Their „optimal‟ variable rate explaining was the variation roughly in the capacity twice utilization the rates chosen by the firms. The extent of non-optimal capacity underutilization of a firm was determined by the nationality of the firm's owner, entry date, number of firms in the industry, projected profits, and the manager's perceived risk of multi-shift operations. Dunlevy (1980) and Hayes and stone (1983) in their independent investigations in U.S.A found a significant positive relationship between capacity utilization rates in the industrial sector and the

McElthattan (1985) investigated the relationship between capacity utilization rate in the industrial sector and inflation rate in U.S.A. She obtained a significant and positive relationship between the two variables. She however inferred from her regression results that for each percentage point, all industries capacity utilization rate exceeded 82%, inflation rate would accelerate by about 0.15% points. Earlier, Franz and Gordon (1993) discovered that capacity utilization rate depends more on inflation than on unemployment in both U.S.A and Germany economies. They also confirmed the non-accelerating inflation rate at capacity utilization rate for the U.S.A of about 82%, using Federal Reserve Bank Measures. Similar results were obtained by Garner (1994) and Yoo (1995). Gokcekus (1997) tested the hypothesis that trade liberalization increases economic capacity utilization in Turkish rubber industry. Using Generalized Leontief cost function, he established a

positive relationship between the 2 variables. Seth (1998) established a positive link between industrial capacity utilization rates in India and public investment in infrastructures, capital, intermediary import and adoption of liberal policy. Kim (1999) analyzed the determinants of economic capacity utilization in U.S.A manufacturing sector. Evidence showed that capital stock, price of materials, capital price have significant negative relationship with the economic capacity utilization rates; while energy price, labour price and output have significant positive influence on the economic capacity utilization rate in the manufacturing sector. In India, Azeez (2002) investigated the impact of Indian industrial reform policies on the economic capacity utilization rate of the industrial sector. He discovered three distinct phases relating to economic capacity utilization rate movement during the policy era. Phase 1 (1974 to 1984) was characterized by relatively wide fluctuations; phase 2 (1985 to 1990) witnessed relatively stable fluctuation, while phase 3 (1991-1998) exhibited the characteristics of the phase 1. According to him the impact of the industrial reform on the industries economic capacity utilization rate was not remarkable. Kumar et al., (2009) used time series data from the period 1974 to 2005 to analyze the trends in the capacity utilization rates in the sugar industry in India. The result revealed that, the industry was operating with an excess capacity of 13% in each of the study year. The result also showed that, capacity utilization declined during the post reform years, and that the availability of raw materials was the most significant variable explaining the variation in the capacity utilization rate in India‟s sugar industry.

In Nigeria, Adeel et al. (2006) employed the survey and expert opinion approach to estimate capacity utilization rate among Nigerian firms. They capacity utilization rates were affected by erratic power supply, variations in demand, insufficient capital and insufficient imports and domestic raw materials. Ukoha (2000) studied the determinants of the manufacturing country‟s capacity utilization exports rate in Nigeria. in the period 1970 to 1988. He employed OLS method on secondary data published by the Central Bank of Nigeria. The result revealed that, the real exchange rate, federal government capital expenditure on the manufacturing sector and the per capita real income had positive effects on the manufacturing capacity utilization rate. On the other hand, the inflation rate and the real loans and advances to the manufacturing sector had negative effects on the capacity utilization rate of the sector. Akpan et al. (2011) investigated the influence of firm related factors and industrial policy regime on technology based capacity utilization in sugar industry in Nigeria. The empirical result reveals that sugar cane price and sugar indus energy consumption have significant negative relationship with the technology based capacity utilization in the sugar industry in Nigeria. On the other hand, the wage rate of skill workers, expenditure, human capital and period of import

substitution have significant positive influenced on the technology based capacity utilization rate in the industry Akpan et al. (2012a) established the empirical relationship among technical efficiency, macroeconomic variables and industrial sugar industry. Their result revealed that technical efficiency was influenced by the industrial sales growth, capital-labour ratio, official tariff rate on sugar import, real exchange rate and the content of the liberalization policy period. Akpan et al. (2012b) also analyzed the impact of macro-economic variable fluctuation on technology based capacity utilization in the sugar industry in Nigeria. The empirical results showed that the real sugar import, exchange rate, import price of sugar, parallel market exchange rate premium and tariff rate on sugar import were significant variables that influenced technology based capacity utilization rate in the industry.

THEORETICAL FRAMEWORK

Measuring economic capacity and capacity utilization rates using stochastic cost efficiency frontier (ECUR)

Following the fundamental assumption that capacity utilization rate is a short-run concept, and that variable inputs are efficiently utilized given the constraints imposed by quasi-fixed factors; the original efficiency stochastic cost frontier (SCF) was modified to represent economic efficiency capacity utilization rate (EECUR) by incorporating only the quasi-fixed factors into the firm"s cost function (FAO, 2006). This implies that frontier cost is determined by efficient use of quasi-fixed input prices.

$$EECUR_t = \frac{C_j^*}{C_j} = \frac{f(X^*;\beta)\,\exp(V_j)}{f(X^*;\beta)\,\exp(V_j - U_j)} = \frac{1}{\exp(-U_j)} \quad (1)$$

Where C_j^* is the minimum or the frontier cost and C_j is the actual cost of production. X_j^* is the price of quasi-fixed inputs of j"s firm. Economic efficiency capacity utilization rate (EECUR) is a biased index because it incorporates both capacity utilization and economic efficiency of fixed inputs. Unbiased economic capacity utilization rate (ECUR) was derived by dividing the index of economic efficiency capacity utilization rate (EECUR) by the cost efficiency score estimated in the traditional manner, such that;

$$ECUR_t = \frac{EECUR_t}{EE_t} \quad (2)$$

Where EE is the cost efficiency score computed for all factors of production.ity isFirm"sFollowing theeconomicflexibleinvestment capacfunction; estimated as thus;

$$Economic\ Capacity = \frac{Actual\ TVC_t}{ECUR_t} \quad (3)$$

Hence, a firm that has full economic capacity utilization rate operates on the cost efficiency frontier (ECUR = 1), while those with economic capacity utilization rate less than unity (that is, ECUR < 1) operate below the cost efficiency frontier. This [imp] policy regimes in the Niger a" are under-utilized and investment disincentive exists on the fixed factors of such firm. When economic capacity utilization rate is greater than unity (that is, ECUR >1), it implies that fixed inputs are over utilized and there is high tendency of investment incentive on the fixed factors of production (Morrison, 1985).

Klein capital utilization model

The relationship between capacity utilization rate of a firm and exogenous factors is found in Klein and Preston (1967) capital utilization model. In the model, they assume that;

$$\left\{\frac{K_t^f}{K_t}\right\} = \left\{\frac{L_t^f}{L_t}\right\} \quad (4)$$

Where, K_t^f and L_t^f andare desired capital and manpower levels, while K_t and L_t are actual level of capital and manpower respectively.utputTheygap a to manpower change as thus;

$$\left\{\frac{Y_t}{Y_t^f}\right\} = \left\{\frac{L_t^f}{L_t}\right\} \quad (5)$$

Where Y_t is the actual output and Y_t^f is the full employment level of output.
Combining Equation (4) and (5)

$$\left\{\frac{Y_t}{Y_t^f}\right\} = f\left[\left(\frac{K_t^f}{K_t}\right),\left(\frac{L_t^f}{L_t}\right)\right] \quad (6)$$

Where the firm output gap, $\left\{\frac{Y_t}{Y_t^f}\right\}$ represents the capacity utilization rateKlein andatPreston,period1967; " Johansen, 1968). Attaching log to both side of the equations and assuming Cobb- Douglas production function;

$$LnY_t - LnY_t^f = LnA_0 + Ln\left(\frac{K_t^f}{K_t}\right)^\alpha + Ln\left(\frac{L_t^f}{L_t}\right)^\beta + LnZ_t \quad (7)$$

$$I_t = \delta(K^* - K_{t-1})$$

Where K* is the desired capital stock. Then

$$K^* = K_t^f = \delta^{-1}(I_t - K_{t-1})$$ (8)

Substituting Equation (8) into (7) will produce;

$$LnY_t - LnY_t^f = LnA_0 + Ln[\delta^{-1}(I_t - k_{t-1})K_t^{-1}]^\alpha + Ln\left(L_t^f/L_t\right)^\beta + LnZ_t$$ (9)

Also, firm"s demand for labour depends on the real wage rate in the economy. Hence at full employment level, wage rate corresponds to (W/P_0), while (W/P_1) corresponds to wage rates below equilibrium level. Thus;

$$\left\{\frac{L_t^f}{L_t}\right\} = \frac{(W/P_0)}{(w/P_1)}$$ (10)

Where "W" is the labour wage and "P" is the general price level in the economy. Substituting Equation (10) into (9) produces;

$$LnY_t - LnY_t^f = LnA_0 + Ln[\delta^{-1}(I_t - K_{t-1})K_t^{-1}]^\alpha + Ln[(W/P_0)/W/P_1]^\beta + LnZ_t$$ (11)

$$LnY_t - LnY_t^f = LnA_0 + \alpha[Ln(\delta^{-1}(I_t - K_{t-1})K_t^{-1}] + \beta Ln[(W/P_0)/(W/P_1)] + LnZ_t$$ (12)

In this framework, output gap defined as capacity utilization rate occurs as a result of the current investment level of a firm, the previous accumulated capital stock and the real wage rate influenced by the general price level in the economy. Their impact on firm output gap or capacity utilization rate is transmitted through factors specific elasticities. This framework assumes that, the output observed in any time period is the equilibrium level for observed rate of utilization of the inputs (Klein and Preston, 1967). Hence, other exogenous variables that affect capacity utilization can also be conceptualized in the same manner.

MATERIALS AND METHODS

Study area

The study was conducted in Nigeria; the country is situated on the Gulf of Guinea in sub Saharan Africa. It lies between 4° and 14° north of the equator and between longitude 3° and 15° east of the Greenwich meridian. Nigeria has a total land area of 923,768.622 km^2 or about 98.3 million hectares and a population of over 140 million (NPC, 2006). Industrial sugarcane is cultivated in commercial quantities in the northern part of Nigeria, and is mostly cultivated in irrigated lands or swampy areas. Niger state, Kwara state, and Adamawa state are the major industrial sugarcane producers in the country (Lafiagi, 1984). There are 4 major sugar producing firms and two sugar refineries in Nigeria.

These are: Nigeria Sugar Company at Bacita, Kwara State established in 1964 with initial installed capacity of 40,000 tons/annum; Savannah Sugar Company Limited at Numan, Adamawa State established in 1980 with initial installed capacity of 65,000 tons/annum; Lafiaji Sugar Company in Kwara State and Sunti Sugar Company in Niger State. The last 2 are mini sugar plants.

The refineries are BUA and Dangote located in Lagos state. The refineries are not involved in direct production, but refine imported semi processed sugar from Brazil and other sugar producing countries (NSDC, 2010).

Data source

Data used in the study were purposely collected from the two sugar producing firms in Nigeria. These firms depend fully on the domestic industrial sugarcane for the production of sugar and produced more than 95% of domestic produced sugar in the country (NSDC, 2010). Also, macro economic data published by the Central Bank of Nigeria (CBN), National Bureau of Statistics (NBS), Federal Ministries of Finance, Agriculture and Rural Development as well as labour and Productivity were used in the analysis. The sugar firms selected were: Bacita Sugar Company in Kwara state and Savanna Sugar Company in Adamawa state. The data collected covered the period of 1970 to 2010.

Analytical techniques

Estimation of economic efficiency (EE), economic efficiency capacity utilization rate (EECUR) and economic capacity utilization rate (ECUR)

Economic efficiency (EE) was estimated from Equation 13

$$EE = \frac{TVC_j^*}{TVC_j} = \frac{(P_j, Q_j, Z_j, \beta)exp(V_j)}{(P_j, Q_j, Z_j, \beta)exp(V_j - U_j)} = \frac{1}{exp(-U_j)^*}$$ (13)

Where, TVC_j is the actual total variable cost of production, TVC_j^* is the frontier total variable cost, P_j represents the prices of all inputs of ith firm, Q_i is the output level, and Z_j represents other variables. The economic efficiency (EE) of the sugar industry presented in Equation (13) was estimated using Equation (14) specify in log-linear as follows:

$$LnTVC_t = \delta_0 + \delta_1 LnWNP_t + \delta_2 LnPLP_t + \delta_3 LnRPK_t + \delta_4 LnWPW_t + \delta_5 LnPS_t + \delta_6 LnEC_t + \delta_7 LnPOI + \delta_8 LnSOI_t + \delta_9 LnTEP_t + V_j - U_j$$ (14)

Where; TVC_t = annual total variable cost of the sugar industry (₦)
WNP_t = average wage rate of non-production workers (₦) $(\delta TVC_t/\delta WNP_t < 0)$; PLP_t = price of land used for sugarcane production (₦) $(\delta TVC_t/\delta PLP_t > 0)$; RPK_t = real depreciation cost of capital as a proxy of the rental price of capital stock (₦) $(\delta TVC_t/\delta RPK_t > 0)$; WPW_t = average annual wage rate of production worker (₦) $(\delta TVC_t/\delta WPW_t > 0)$; PS_t = average annual price of sugarcane (₦/tonne) $(\delta TVC_t/\delta PS_t > 0)$; EC_t = real energy consumption, proxies by annual expenditure on energy (₦) $(\delta TVC_t/\delta EC_t > 0)$; POI_t = average price of other inputs (₦) $(\delta TVC_t/\delta POI_t > 0)$; SO_t = sugaroutput(tonnes) ; TEP_t = technological progress captured by time trend

The economic efficiency capacity utilization (EECU) was measured by using only quasi-fixed inputs in the cost functions of Equation (15) as shown in Equation (16).

Table 4. Maximum estimates of Cobb-Douglas stochastic cost function for the sugar industry in Nigeria as defined in equation (14) and (16).

Variable	Equation for EE indices (Equation 14)	Equation for EECUR indices (Equation 16)
Constant	-0.1882(-0.0932)	0.5235 (-1.7623)*
Wage rate of non prod. workers (WNP$_t$)	-0.2685(-0.3839)	0.2612 (0.4174)
Land price (PLP$_t$)	-0.1278 (-1.8235)*	-0.2586 (-2.1612)**
Depreciation cost (RPK$_t$)	0.5039 (3.6650)***	0.4902 (3.2466)***
Sugar output (SO$_t$)	0.9259(0.7854)	-
Wage rate of prod. worker (WPW$_t$)	0.7709 (2.0479)**	-
Price of sugarcane (PS$_t$)	0.9154(0.2374)	-
Expenditure on electricity (EC$_t$)	-0.3379(-0.5446)	-
Price of other inputs (POI$_t$)	0.1614 (2.1173)**	-
Technology progress (TEP$_t$)	0.4417(0.5260)	0.5123 (0.4565)
Sigma square gamma (δ^2)	0.5351 (2.4249)**	0.8435 (4.5056)***
Gamma (λ)	0.4171(1.4150)	0.6529 (3.7246)***
Log-Likelihood	-0.4425	-0.4826
LR Test	15.4047	25.4047

*, ** and ***, 5, 10 and 1% significant levels respectively. Figures in brackets are t-values, and variables are as defined in Equations (14) and (16).

$$EECUR = \frac{TVC_j^*}{TVC_j} = \frac{f(X_j^*;\beta)exp(V_j)}{f(X_j^*;\beta)exp(V_j - U_j)} = \frac{1}{exp(-U)^{**}} \quad (15)$$

To estimate economic efficiency capacity utilization (EECUR) presented in Equation (15), we specify Equation (16) in log-linear form as follows:

$$LnTVC_t = a_0 + \alpha_1 LnWNP_t + \alpha_2 LnPLP_t + \alpha_3 LnTEP_t + V_j + U_j \quad (16)$$

The variables have the same meaning as in Equations (13). An unbiased estimate of economic capacity rate (ECUR) was estimated using the results of Equations (14) and (16), as follows:

$$ECUR = \frac{EECUR}{EE} \quad (17)$$

Where;

$$CUR_t = \gamma_0 + \gamma_1 INFL_t + \gamma_2 PDSC_t + \gamma_3 LAP_t + \gamma_4 RER_t + \gamma_5 PGDP_t + \gamma_6 EC_t + \gamma_7 LOA_t + \gamma_8 SIM_t + \gamma_9 FCA_t + \gamma_{10} DSC_t + \gamma_{11} D + U_t \quad (18)$$

CUR_E = Economic capacity utilization rate (ECUR) for the sugar industry in Nigeria; INFL$_t$= inflation rate at period t (%); PDSC$_t$ = average annual price of domestic sugar cane (₦/tonne); LAP$_t$ = labour productivity in the sugar industry [defined as total domestic output divided by total number of workers in the sugar industry (tonnes/person)]; RER$_t$ = real exchange rate (₦/$); PGDP$_t$ = per capita real GDP (2003 =100) (₦); EC$_t$ = energy consumption proxy by annual expenditure on energy (₦); LOA$_t$ = real loans and advances to sugar industry (₦); SIMP$_t$/GDP$_t$ = ratio of sugar import to the GDP (%); FCA$_t$ = share of Federal Government Capital expenditure on the sugar industry in the GDP; DSC$_t$ = domestic produced sugarcane used as input in the industry (tons); D = dummy variable which takes the value of 1 for the liberalization period (1986-2010), and 0 for otherwise (1970- 1985); U$_t$ stochastic error term.

RESULTS AND DISCUSSION

Estimation of economic capacity utilization (ECUR) equations for the sugar industry in Nigeria

Maximum likelihood estimates of the Cobb-Douglas stochastic cost function for the sugar industry are presented in Table 4. The Cobb-Douglas stochastic cost function in Equation (14) was defined for all the factors of production and was used to generate indices of cost or economic efficiency. Equation (16) was defined for only input considered quasi-fixed inputs and was used to generate economic efficiency capacity utilization indices for the sugar industry. The result revealed a signific sigma squared coefficients of 0.5351 at 5% level of probability for Equation (14) and 0.8435 at 1% level of probability for Equation (16). These indicate good fit and correctness of the specified distribution assumption of the composite error term for the models. The variance ratios (λ) in Equation (14) *and* (16) indicate the proportion of variations in the total variable cost in the sugar industry in Nigeria that is due to deviation from full economic efficiencies and economic capacity utilization respectively. In Equation (16), a gamma ratio of 0.4171 suggests that the presence of economic or cost inefficiency in the sugar industry in Nigeria explained about 41.71% variations in the total variable cost of the industry. In the same way, the gamma ratio of 0.6529 for Equation (16) implies that about 65.29% of variations in the total variable cost are
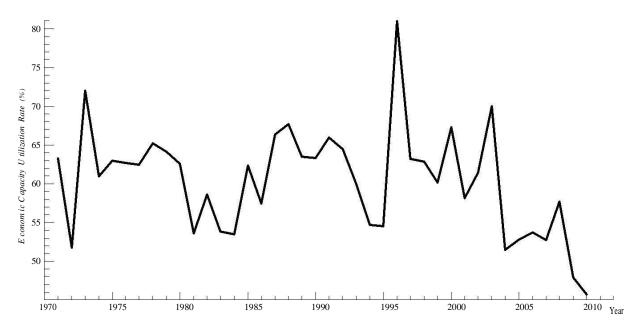
Figure 1. Trend in economic capacity utilization rates in the sugar industry in Nigeria.

attributed to cost inefficiency and unutilized cost capacity. The generalized likelihood ratio tests for the equations are highly significant and this confirms the presence of one - sided error component in the composite error terms. Therefore, the result of the diagnostic test confirmed the relevance of the stochastic parametric cost function and maximum likelihood estimation technique.

The empirical results reveal that land price (PLP$_t$), depreciation cost (RPK$_t$), wage rate of production workers (WPW$_t$), and price of other inputs (POI$_t$) were significant production variables that affect the value of total variable cost in the sugar industry in Nigeria.

Trend in the estimated economic capacity utilization rates in the Nigerian sugar industry

The trend in the estimated economic capacity utilization in the sugar industry is shown in Figure 1. The trend displayed highly undulated pattern throughout the considered years. In all observations, economic capacity utilization rate (ECUR) was less than unity with an average value of 60.30%; implying that the industry had an excess economic capacity utilization of about 39.70%. This means that the industry needed about 39.70% economic capacity gain to reach the economic or optimum capacity frontier. The present of the excess economic capacity utilization in the industry implies that the industry suffered from insufficient fund needed to cover the cost of production. This means that the industry was constrained by insufficient financial resources which prevented the attainment of the optimum economic capacity utilization level.

Determinants of economic capacity utilization rates of the Nigerian sugar industry

Table 5 reports the result of estimation of the economic capacity utilization equations in sugar industry in Nigeria. The linear form of the specified equations was picked as the lead equation following the result of the diagnostic tests and the number of significant independent variables. For the lead equation, R^2 is 0.848 denoting that about 84.80% of variations in economic capacity utilization rate were explained by the specified independent variables. The F-statistic of 3.088 is significant at 1% probability level, implying that the R^2 is significant and the model has goodness of fit. Durbin- Watson statistic of 2.74 indicates that auto-correlation might pose a minor problem. The empirical result revealed that the coefficient of inflation rate (INFL$_t$) is statistically significant (at 10% level) and negatively related to the economic capacity utilization rates in the sugar industry. This relationship indicates that an increase in the inflation rate will lead to a decrease in economic capacity utilization rates in the sugar industry. For instance, 10% increase in inflation rate will result in 0.01% decrease in economic capacity utilization rate. A similar result has been reported for the manufacturing sector in Nigeria by Ukoha (2000). However, the result is contrary to the findings of McElthattan (1985), Franz and Gordon (1993), Garner (1994) and Yoo (1995) in the United State of America.

The result also revealed a significant positive (at 5% level) relationship between the per capita real GDP (PGDP$_t$) and economic capacity utilization rate in sugar industry in Nigeria. The result is in line with the economic theory, because an increase in per capita real GDP

Table 5. Economic capacity utilization rate equations in sugar industry in Nigeria

Variable	Linear (L)	Exponential	Semi-log	Double- log
Constant	0.703 (5.60)***	-0.321 (-1.61)	0.515(1.37)	-0.639 (-1.05)
$INFL_t$	-0.001 (-1.98)*	-0.002 (-2.16)**	-0.003(-0.23)	-0.009 (-0.35)
$PDSC_t$	-9.20e-008 (-0.03)	-3.69e-007 (-0.09)	-0.032(-0.79)	-0.063 (-0.95)
LAP_t	-0.005(-0.69)	-0.009 (-0.83)	-0.032 (-0.18)	-0.068 (-0.24)
RER_t	-1.73e-005 (-0.02)	-5.92e-005 (-0.05)	0.0006 (0.02)	0.003 (0.07)
$PGDP_t$	6.85e-005(2.64)**	0.0001 (2.79)**	0.009(0.32)	0.008 (0.15)
EC_t		-0.0002 (-1.67)*	-0.020(-1.56)	-0.040 (-1.75)*
LOA_t	-0.0001 (-1.89)*	5.19e-006 (1.56)	0.003(0.88)	0.005 (0.91)
$SIMP_t/GDP_t$	3.07e-006 (1.46)	-0.161 (-0.89)	-0.010(-0.67)	-0.016 (-0.66)
FCA_t	-0.086 (-0.76)	8.77e-005 (2.21)**	-0.011 (2.33)**	0.017 (2.27)**
DSC_t	5.38e-005 (2.14)**		0.031(0.75)	0.056 (0.83)
Policy dummy	1.81e-007 (1.03)	3.21e-007 (1.15)	0.179 (2.71)**	0.302 (2.80)**
	0.213 (2.93)***	0.353 (3.07)***		
R^2	0.848	0.819	0.417	0.442
F-Statistic	3.088***	3.647***	1.822*	2.0215*
DW-test	2.74	2.73	2.25	2.17
Normality test	7.957 (0.0187)**	4.297(0.1166)	7.872(0.0195)*	5.321(0.0699)*
Hetero-test	0.336 (0.9709)	0.369 (0.9586)	0.102 (1.0000)	0.112 (0.9999)
RESET –test	7.836 (0.001)***	6.383 (0.004)****	2.462(0.1280)	5.027 (0.0334)**
Schwarz Criterion	-89.04		-78.56	-40.14
Akaike Criterion	-109.98	-52.38	-99.13	-60.41
Hannan- Quinn C.	-101.98	-72.64	-91.80	-53.08
loglikelihood	66.65	-65.32	61.57	42.21
		48.32		

*,** and ***, 10, 5 and 1% significance levels respectively. Figures in bracket are t-values and variables are as defined in equation *(18)*. L means lead equation.

raises the demand level of consumers in the economy. Increased in the per capita real GDP would exert positive influence on the industry"sThishasainstance,netone returnsmillionnaira.increase tendency to boost the economic capacity of the industry through increase ability to procure more production inputs. The result implies that the sugar industry in Nigeria was not demand constrained. Ukoha (2000) obtained a similar result for the Nigeria"s manufacturingthefederalgovernment

sector. The expenditures on energy in the sugar industry in Nigeria had a significant negative effect (at 10% level) on the economic capacity utilization rate of the industry. The result implies that increase in energy consumption decreases economic capacity utilization rate of the industry. The finding agrees to the *a priori* expectation as increase in energy consumption will tend to increase the total variable cost of the industry. This has an adverse effect on the net returns of the industry and the economic capacity utilization rates.

The coefficient of the federal government capital expenditure on sugar industry (FCA_t) was significant (at 5% level) and was a positive determinant of economic capacity utilization rate in the sugar industry. The result implies that, as the federal government subventions to

the sugar industry increase the economic capacity utilization rates of the industry also increase. For in the federal government subvention to the sub-sector will result in 0.000054% gains in economic capacity utilization rate in the industry. The reason for the result might be attributed to the fact that the sub-sector was completely owned by before it was privatized.

The liberalization policy period (D) had a significant positive influence on the economic capacity utilization in the sugar industry. This implies that the industrial policies embedded in the liberalization period had significant positive influence on the economic capacity utilization rate in sugar industry. The result agrees with the findings of Gokcekus, (1997) in Turkey, Earl and Amos (2002) in Romania, Phillipe and Robin (2003) in UK and Akpan et al., (2012a) in Nigeria.

CONCLUSION AND RECOMMENDATIONS

The study used sugar industry based data and macro-economic data from 1970 to 2010 to analyze economic

capacity utilization rates in the sugar industry in Nigeria. Sugar industry based data collected were production and cost data. The macro-economic data used were inflation rate, exchange rate, GDP, tariff rates on sugar import, consumer price index, parallel and official exchange rates among others. Unit root tests were conducted on the specified variables in economic capacity utilization equation and their stationary determined. Similarly, the specified cost function variables for the industry were used at their levels to estimate the economic capacity utilization indices and economic efficiency indices from which the unbiased economic capacity utilization rates in the sugar industry were calculated. Multiple-regression equation of various forms was estimated based on the ordinary least squares method and used to determine factors that influence the economic capacity utilization rate.

Also, the patterns of fluctuations in the estimated economic capacity utilization rate in the industry showed undulated trend throughout the study period with an average value of 60.30% and excess capacity of about 39.70%. The finding also revealed that the economic capacity utilization rate in the industry had significant positive association with per capita real GDP, share of federal government expenditure on sugar industry in the GDP and liberalization policy period. The inflation rate and energy consumption had significant negative relationship with the industry economic capacity utilization rates.

To improve economic capacity utilization rate in the sugar industry in Nigeria, the study advocated for a policy package that either reduces or maintains a steady inflation rate in the country as this will enhance increase capacity utilization in the sugar industry in Nigeria. It is also recommended that an appropriate policy measure that aim at expansionary aggregate demand as a means of promoting capacity utilization in the sugar industry should be introduced. Such policy measure should be designed to avoid inflationary tendencies. Government should strengthen the power sector to provide constant electricity to sugar industry in Nigeria. This will help to lower the total variable cost of the industry and increase the net returns as well as the capacity utilization of the industry. Furthermore, the industrial policy package during liberalization era will promote economic capacity in the industry.

REFERENCES

Adeel M, Teal F, Simon B (2004). The Performance of Nigerian Manufacturing Firms. Report on the Nigeria Manufacturing Enterprise Survey.

African Development Bank (ADB) (2000). Operations Evaluation documents.

African Development Fund (ADF) (2000) Operations Evaluation documents.

Akpan SB, Udo UJ, Essien UA, (2011). Influence of Firm related factors and Industrial Policy Regimes on Technology Based Capacity Utilization Rate in Sugar Industry in Nigeria. Agric on-line Papers in Economics and Informatics. III, 3:15-22.

Akpan SB, Obasi O, Ukoha CE. Onyenweaku-Daniel EJ (2012a). Empirical Relationship among Technical Efficiency, Macroeconomic Variables and Industrial policy Regimes: A case study of Sugar Industry in Nigeria. Int. J. Econ. Manag. Sci. 1(10):01-11.

Akpan SB, Ini-mfon VP, Daniel EJ (2012b). Impact of macro-economic variable fluctuations on technology based capacity utilization in sugar industry in Nigeria. Int. J. Econ. Manag. Sci. 1(11):26-34.

Anyanwu JC, Oyefusi A, Oaikhenan H, Dimowo FA (1997). The Structure of the Nigerian Economy (1960-1997). Onitsha Joanee Educational Publisher.

Ayayi DD (1988). Spatial Patterns of Production Sub-contracting in Nigeria. Nig. J. Econ. Soc. Stud. (NSESS), 42(1):95-111.

Ayeni B (1981). The Spatial Distribution of Manufacturing Industries in Nigeria. Technical Report No. 2 Department of Geography, University of Ibadan.

Azeez EA (2002). Economic Reforms an Analysis of Capacity Utilization in Indian manufacturing Sector. A Technical Working paper at the Institute of Economic Growth, Delhi India.

Barik K (2000). Capacity utilization in Indian paper industry, Publication of the School of Social Science, India Gandhi National Open University, New Delhi.

Berndt E, Hesse D (1986). Measuring and Assessing Capacity Utilization in the Manufacturing Sectors of Nine OECD Countries. Europ. Econ. Rev. 30:961-989.

Berndt ER, Morrison CJ (1981). Capacity Utilization: Underlying Economic Theory and Alternative Approach. Am Econ. Rev. 71:48-52.

Busari LD, Misari SM (1996). Sugar and sugarcane in Nigeria. A Publication of NCRI in Nigeria.

Cassels JM (1937). Excess Capacity and Monopolistic Competition. Q. J. Econ. 51:424-443.

Central Bank of Nigeria (CBN), Statistical Bulletin, (2006, 2008, 2009).

Danish AH (2003). Capacity Utilization in Indian Airlines. A Postdoctoral Fellowship Study at the Institute of Economic Growth, Delhi, India. Dunlevy J (1980). Aggregate Stocks and the Relationship between United State"sleFluctuationBusinessandExport CycPerformance. J. Econ. Integr. 13(1):163-198.

Ekeocha PC (2009). Evaluation of the effectiveness of industrial policy reforms in Nigeria 1999-2003: A computable general equilibrium simulation. Analysis presented at the 50th annual conference of the Nigerian Economic Society (NES) in Abuja September, 22-24th, 2009.

Fabayo A (1981). Production Function Measure of Capacity Output and Rate of Capacity Utilization in Selected Nigerian Industries: 1974-1975. Ife Social Sci. Rev. 2 (2):0-27.

FAO Corporate Document on Capacity Utilization in Fishery Sub-sector (2006).

Federal Ministry of Industry Abuja Sugar Policy". A Publication of Nat of Nigeria.

Franz W, Gordon RJ (1993). German and American Wage and Price Dynamics: Europ. Econ. Rev. May, pp. 719-762.

Friedman M (1963). More on Archibald versus Chicago Review of Economic Studies, 30:65-67.

Garner C, Alan (1994). Capacity Utilization and USA Inflation. Federal Reserve Bank of Kanakas City, Econ. Rev. 79(4):1-21.

Gokcekus O (1997). Trade liberalization and capacity utilization; New evidence from Turkish Rubber industry. Empir. Econ. 23;561-571.

Hashim DA. (2003). Capacity utilization in Indian airlines: A paper presented to Institute of Economic Growth., Delhi, India.

Hayes S, Stone J (1983). Specification of Supply Behaviors. Rev. Econ. Stat. 64:271-281.

Hickman BG (1964). On a new Method for Capacity Estimation. J. Am. Stat. Assoc. 59:529-549.

Isola WA (2006). Market reform and de-industrialization in Nigeria: 1986 -2003. Essays on Economic Development. MPRA paper no. 1025, 2006. http:// mpra.ub.uni-muenchen.de/ 1025/

ISYB (1978). International Sugar Year Book (1978), Publication of the Federal Ministry of Industry.

Kenny G (1996). Capacity Utilization in Irish Manufacturing Sector.

Technical Paper Presented to Central Bank of Ireland.

Kim HY (1999). Economic capacity utilization and its determinants: theory and evidence. Rev. Indust. Organ. 15;321-339.

Kim YC, Kwon JK (1977). The Utilization of Capital and the Growth of Output in a Developing Economy: the Case of South Korean Manufacturing. J. Dev. Econ. 4:265-78.

Klein LR, Preston RS (1967). Some new results in the measurement of capacity utilization. Am. Econ. Rev. 57:34-58.

Klein LR (1960). Some Theoretical Issue in the Measurement of Capacity. Econometrica 28:272-286.

Kumar S, Nitin A. (2009). Analyzing regional variations in capacity utilization of Indian sugar industry using non- parametric frontier technique. Eurasian J. Bus. Econ. 2(4):1-26.

Lafiagi MS (1984). Towards Self-Sufficiency in Sugar Production in Nigeria. Memo Submitted to Federal Ministry of Commerce and Industry pp. 1-46.

Lecraw DJ (1978). Determinants of capacity utilization by firms in less developed countries. J. Dev. Econ. 2(2):139-153.

Manufacturing Association of Nigeria Publication (2006, 2009).

McElthattan R (1985). Inflation, Supply Stock and the Stable Inflation Rate of capacity Utilization. Federal Reserve Bank of San Francisco, Econ. Rev. Winter 1:45-63.

Michael D (2010). USDA foreign Agricultural service on sugar imports in Nigeria. A comprehensive report on sugar imports in Nigeria. http://www.nigerianseminarsandtrainings.com. Retrieved 10-12-2010.

Morrison CJ (1985). Primal and Dual Capacity Utilization, An application to Productivity Measurement in the USA Automobile Industry. J. Bus. Econ. Statis. 3:312-324.

National Population Commission (NPC) (2006). National Census Data. www.population.gov.ng/. Retrieved 10-12-2010.

National Sugar Company Document (NISUCO) (1999). A Publication of National Sugar Development Council, Federal Ministry of Industry, Abuja, Nigeria.

National Sugar Development Council Document (NSDC) (2006, 2010 and 2012). A Publication of National Sugar Development Council, Federal Ministry of Industry, Abuja, Nigeria. http://www.nsdc.gov.ng/

Nigerian Sugar Company Ltd., Bacita Estate (NISUCO) (2000). Production Statistic for each Agricultural Year from 1965 to 2000.

Nwaobi GC (2005). The Nigerian sugar industry (1960-1987). 0501001, EconsWPA.

Ogunbayo M (2009). The fall of the Giant Unpublished Paper. Extracted from internet, (http://www.newswatch.ngr.com, 10-01-2011)

Olomola AS (2007). Competitive commercial Agriculture in Africa study (CCAA), Nigeria case study. A final report submitted to the Canadian International Development agency (CIDA) and the World Bank.

Prior D, Nela F (2001). On the Measurement of Capacity Utilization and Cost Efficiency: A Non- Parametric Approach at Firm Level. Pesquisa Operacional 22(2):247-263.

Raimi L, Adeleke I (2009). A Review and Measurement of Capacity Utilization in the Nigerian Economy. Humanomics 25(4):274-284.

Salimonu KK, Gafar OA, Akintola JO (2006). Trend Analysis of Capacity Utilization of Agro-based Industries in Nigeria. Agric. J. 1(4):311-314.

Savannah Sugar Company limited (SSC) (2006) 2010. Production Data for Savannah Sugar Company Ltd., Numan, 1983-1999. The Punch Newspaper, Thursday Sept. 14, 2000, P. 23.

Seth K (1998). Economic Reforms and Capacity Utilization in Indian Industry", Productivity-98. 39(3):391

Soderbom M, Teal F (2002). The Performance of Nigerian Manufacturing Firms. Report on the Nigerian Manufacturing Enterprise Survey 2001.

World Bank (2001), Nigeria: poverty in the Midst of Plenty, The Challenge of Growth with Inclusion.

Ukoha OO (2000). Determinants of Manufacturing Capacity Utilization in Nigeria, 1970-1988. Nig. J. Econ. Soc. Stud. 42(2):121-129.

Wada AC, Agidi G, Ishaq MN, Busari LD (2001). Current Status of Sugar Research and Development in Nigeria. Sugar Technol. *3(1):4-12.*

Yoo PS (1995). Capacity Utilization and Price within Industries, Federal Reserve Bank of St. Louis Review 77(5). Sept. - Oct. 15-25.

Zayyad HR (2007). Privatization and Commercialization in Nigeria. Unpublished Work in the Internet (http://unpanl.un.org/intradoc/groups/public/docume. 15-10-2010).