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Influence of firm related factors and industrial policy regime on technology based capacity utilization in sugar industry in Nigeria

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Abstract

The study analyzed the technology based capacity utilization rate in sugar industry in Nigeria in the period 1970 to 2010. Data used in the study were obtained from the sugar firms, publications of the Central Bank of Nigeria and National Bureau of Statistics. Augmented Dicker Fuller unit root test was conducted on the specified data to ascertain their stationarity and order of integration. The result reveals that some variables were stationary at level while some were stationary at first difference. The diagnostic statistics from the multiple log linear regression on the specified variables confirmed the reliability of the model. The empirical result reveals that sugar cane price and sugar industry's real 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, industry's, real research expenditure, human capital and period of import substitution have significant positive influenced on the technology based capacity utilization rate in the industry. Our findings suggest that policy measures aim at expanding the hectares of industrial sugarcane and increase production of refined petroleum fuel in the country will promote capacity utilization in the industry. Also policies targeted on the intensification of research and improved worker's remuneration in the sub-sector is strongly advocated.

Key words

Sugar, firm, capacity, utilization, industry, technology.

Introduction

Sugar sub-sector is one of the major sources of industrial employment in Nigeria's economy (ADB and ADF, 2000 and NSDC, 2010). Sugar is a vital raw material for food and beverage, bakery and confectionery, soft drinks and pharmaceutical industries. The demand for industrial consumption remains firm and accounted for about 70% of total consumption in Nigeria (NSDC, 2010 and Michael 2010). The current domestic consumption of sugar in Nigeria is in excess of 1.5million tons per annum (CBN, 2008 and 2010). Domestic sugar production however has varied between 7,000 to 55,000 tons per annum from 1969 to 2010 (Wada et al., 20017 and PDSSC, 2010). Currently, domestic production of sugar is slightly less than 5% of the country's annual requirement (CBN, 2008 and 2010). From 2001 to 2006, domestic production has declined considerably reaching all time low value of less than 1% of sugar consumption in the country (Table I).

The dismal performance of the sub-sector has been attributed to multifarious factors including inadequate supply of sugar cane to factories, few operating sugar factories, deteriorating capacity utilization in the sub-sector, myriad of factory and field production problems, lack of improved indigenous sugar production technology as well as insufficient domestic private investment (Lafiagi, 1984 and Wada et al., 2001).

Nigeria is the largest consumer of sugar in West Africa and has a large area of cultivable land suitable for the growing of industrial sugarcane (Busari et al., 1996 and ADB and ADF, 2000). Also, over the years the government has carried out policies aimed at boosting sugar production in the country. Some of the policies are; 50% tariff on importation of white sugar, 5% levy on imported raw sugar, 5–year tax waving to sugar refineries and privatization of the major sugar firms in the country, as well as the Nigeria's sugar expansion programme in collaboration with the African

Year	Average domestic output (tons)	Average import (tons)	Average total supply (tons)	Share of domestic output in total (%)	Share of import in total (%)
1970-1972	38141	129629	167770	22.73	77.27
1973-1975	42594	322 222	364816	11.68	88.32
1976-1978	34074	514 814	548888	6.21	93.79
1979-1981	36296	644 444	680740	5.33	94.67
1982-1984	37778	851852	889630	4.25	95.75
1985-1987	51872	803763	855575	6.06	93.94
1988-1990	51080	774073	825 153	6.19	93.81
1991-1993	40735	859259	899994	4.53	95.47
1994-1996	45577	666666	712243	6.40	93.60
1997-2000	13654	801333	814987	1.68	98.32
2001-2006	6238.67	1153301.73	1159540.4	0.538	99.46

Source; NSC, 2000 and SSC, 2000.

Table 1: Sugar supply in Nigeria (1970-2000).

Development Bank and African Development Fund in 1989 and 1991 respectively. These packages were meant to stimulate local production and increase productivity as well as capacity utilization in the sub sector. In spite of these provisions, Nigeria sugar imports (i.e. the white and semi-refined sugar) have continued to rise reaching above 95% of domestic consumption (NFB, 2010). This implies that huge amount of foreign exchange is needed for sugar importation and this could have adverse effect on the country's external reserves, development of other sectors of the economy and the welfare of the industrial sugarcane farmers in the country. For instance, about N26billion or around $250million was spent on sugar importation in 2008 (NFB, 2010).

Capacity utilization index is one of the most important measures of resource use in industrial production (Zoltan, 1999). It is an industry's performance indicator that is widely used in empirical studies to help explained investment and inventory behaviors, productivity measurement, and as indicator of the strength of aggregate demand (Kim, 1999 and Danish, 2003). In the presence of good policy environment and stable economy, calculated capacity utilization rates of sugar industry could be a reliable indicator of the extent of agriculture – industry linkage in the economy. The technology based capacity utilization is common in Nigeria and has been used by the Manufacturing Association of Nigeria (MAN) and Central Bank of Nigeria (CBN) to assess the production performance of industries in the country. In the sugar industry, estimates of capacity utilization could be the means through which the backward integration policy of the industry to agricultural sector could be assessed. Farmer's income and welfare will be enhanced if the linkage is healthy and would also promote optimal resource flow among sectors.

The average industry capacity utilization rates in Nigeria have shown wide fluctuations between 1970 and 2008 (CBN, 2008 and 2010 and NBS, 2009). Continuous downward fluctuations in the sugar sub sector's capacity utilization might lead to increase in prices of sugar based products in the country; this has the tendency of reducing the welfare of low income earners. Sugar based firms entrepreneurs could be exposed to production uncertainties and demand shock, a situation that will be unnecessary if full capacity utilization in the sugar industry was attainable. Therefore, in an attempt to discover reasons for the trend in technology based capacity utilization in sugar industry in Nigeria, the study will provide answers to the following research questions: what is the relationship between technology-based capacity utilization rate and sugar firm related factors in the sugar industry in Nigeria? Does the trend in technology based capacity utilization in sugar industry correlates with import substitution policy period in Nigeria? To answer these questions, the study specifically analyzed the effect of firm related factors on technology based capacity utilization rates and determined the impact of import substitution policy period on technology based capacity utilization rates in the sugar industry in Nigeria.

Concept of Capacity and Capacity Utilization

Capacity utilization is the ratio of the actual or observed output to capacity or potential output

(Prior and Nelda, 2001). Various forms of capacity utilization exist depending on how the capacity output is measured. It could be physical capacity utilization, when actual output is compared to technical maximum or installed plant output (Gold, 1955 and Johansen, 1968) or it could be economic capacity utilization, when actual output is compared to optimum output (from economic point of view) of a firm (Hashim, 2003). However, measuring the rate of capacity utilization requires identifying the appropriate capacity output. Mathematically, capacity utilization rate is defined as the ratio of the actual output Y0 to potential or capacity output Y* i.e.

$$CUR=Y0/Y^* \quad (1)$$

In the physical or engineering concept, the potential output may be technologically derived and hence defined relative to the maximum possible physical output that the fixed inputs are capable of supporting when the variable inputs are fully utilized (Johansen, 1968). Hickman (1964) defined economic capacity of a firm as an output level at which the short run average total cost curve reaches it minimum. Thus, the engineering or technology based measure of capacity output has found to be more operational than the economists' concept especially in the developing countries (Budhin and Paul 1961). Most managers and technical experts prefer to operate with the engineering definition of capacity and incidentally the same definition is the basis of the capacity definition of Central Bank of Nigeria, National Bureau of Statistics and Manufacturing Association of Nigeria. This notion of capacity utilization has an advantage over other methods because it is capable of producing stable indices over the years and makes comparison easier between and among firms. However this method of capacity utilization does not represent the optimum decision concerning the resource use by the firms.

Literature review

In Nigeria, few literature exist on the estimation of capacity utilization in the manufacturing sector. Soderbom et al., (2002) reported an average capacity utilization of 44% for the industrial sector. The study employed combined rapid appraisal technique in assessing capacity utilization of firms. Their report asserted that capacity utilization exhibits positive correlation with firm size and was higher in food sub sector and lower in chemical sub sector. Adeel et al., (2004) applied survey and expert opinion technique to the manufacturing sector in Nigeria and discovered an average capacity utilization rate of 44.2% for the sector. Also, 44.74% capacity utilization rate was recorded for the food sub sector, while textile and wood/furniture had 44.53% and 41.88% respectively. Raimi (2009) studied the impact of changes in government policies on capacity utilization in the real sector of Nigeria's economy. They used descriptive statistics and ordinary least squares methods on secondary data obtained from official sources (i.e. CBN and NBS) from 1991 to 2003 to estimate and analyze capacity utilization situation in Nigeria. The findings reveal that capacity utilization trends in the real sector during the period ranges from 30% to 60%. Ukoha (2000) studied determinants of manufacturing capacity utilization rate in Nigeria in the period 1970 to 1988. He employed ordinary least squares method on secondary data derived from the Central Bank of Nigeria publications. The results reveal that real exchange rate; federal government capital expenditure on manufacturing and per capita real income have positive effects on manufacturing capacity utilization. Inflation and real loans and advances to manufacturing sector have negative effect on capacity utilization rates. Kim (1999) analyzed the determinants of economic capacity utilization rates in US manufacturing sector. Evidence shows that capital stock, price of materials, capital price have significant negative relationship with economic capacity utilization rates; while energy price, labor price and output have significant positive influenced on economic capacity. On the other hand, Phillippe and Robin, (2003) provided evidence on the impact of liberalization policies on industrial performance in India and UK. They used panel data from selected firms in the two countries and adopted Schumpeterian growth model to analyze the relationship. They discovered that firm's level productivity and capacity utilization increase during the policy period. Kim (2003) analyzed investment behavior in South Korea manufacturing sector using the investment and capacity utilization indices. The estimation of investment equation relative to capacity utilization reveals that capacity utilization is a better predictor of investment. He also discovered that price of energy, labor price and rental price of capital exhibit significant negative relationship with the capacity utilization rates; whereas material price and output have significant positive influenced on the capacity utilization rate in the sector. Kuman and Nitin (2009) used time series data from the period 1974 to 2005 to analyze the trends in capacity utilization in sugar industry in India. The results reveal that, the industry is operating with an excess capacity of 13 percent in each studied year. The results also show capacity

utilization decline during post reform years, and that the availability of raw material is the most significant variable explaining capacity utilization in India's sugar industry.

Materials and Methods

The study area and method of data collection. The study was conducted in Nigeria; the country is situated on the Gulf of Guinea in the sub Saharan Africa. Nigeria lies between 40 and 140 north of the equator and between longitude 30 and 150 east of the Greenwich. Nigeria has a total land area of 923,768km2 (i.e. about 98.3 million hectares) and a population of over 140 million (NPC, 2006). Sugar firm's data were used in the analysis and secondary data derived from publications of the Central Bank of Nigeria (CBN) and the National Bureau of Statistics; the data covered the period 1971 to 2010.

Empirical Model

To examine the influenced of firm related variables on the technology based capacity utilization rate, a capacity utilization equation model for the sugar industry in Nigeria is specified as follows: (Thoumi, 1972; Gokcekus, 1997; Ukoha, 2000 and Boccardo, 2004).

$$LnCUR_t = a_0 + a_1 Ln\text{PIS}_t + a_2 Ln\text{IRE}_t + a_3 Ln\text{WRS}_t + a_4 Ln\text{IRS}_t + a_5 Ln\text{CLR}_t + a_6 Ln\text{HCR}_t + a_7 Ln\text{FGS}_t + a_8 Ln\text{SGRt} + a_9 D_1 + U_t \quad (2)$$

Where

LnCUR*t* = Technology based capacity utilization in sugar industry in Nigeria

LnPIS = Price of industrial sugarcane (₦)

$LnIRE_t$ = Sugar industry's real energy consumption (₦)

$LnWRS_t$ = Wage rate of skilled workers (₦)

$LnREX_t$ = Industry's real research expenditure (₦)

$LnCLR_t$ = Capital-labor ratio (₦)

$LnHCP_t$ = Human capital (number)

$LnFGS_t$ = Federal Government subvention to the industry (₦)

$LnSGR_t$ = Sales growth (%)

D_1 = Dummy variable which takes the value 1 during import substitution era and zero otherwise (1970 — 1985)

Ln = Natural logarithm

U_t = Stochastic error term.

Results and Discussion

Unit root test results for variables in equation (2)

Table (2) reports the ADF test results and order of integration of time series variables defined in equation (2). The results reveal that LnCLRt, LnFGSt, and LnSGRt are stationary at level; while LnPISt, LnIREt, LnWRSt, LnREXt, LnHCPt and LnCURt are stationary at first difference. This implies that the nature of relationship among specified variables could be determined by multiple regression at the level of the variables provided the diagnostic statistics are satisfactory and show no evidence of spurious regression (i.e. R2 > D.W) or any econometric problem (Granger and Newbold 1974 and Resende, 2000).

Table (3) reports the result of the estimation of the technology based capacity utilization equation for the sugar industry in Nigeria. The R2 of 0.481 denotes that about 48% of variations in the

Variables	Level	First difference	Order of integration
LnCUR	-2.626	-7.206***	1(1)
LnPIS	-1.904	-5.184***	1(1)
LnIRE	-1.615	-6.212***	1(1)
LnWRS	-2.189	-8.782***	1(1)
LnREX	-1.761	-6.771***	1(1)
LnCLS	-5.139***	–	1(0)
LnHCP	-1.669	-6.503***	1(1)
LnFGS	-5.222***	–	1(0)
LnSGR	-6.642***	–	1(0)

Note: At level, critical value at 5% = -3.52, and at 1% = - 4.20; at first difference critical value at 5% = -3.53 and at 1% = -4.21. Asterisk *** represents 1% significance level. Variables are as defined in equation (2). These tests were performed by including drift and a deterministic trend in the regressions.

Table 2: Augmented Dicker Fuller unit root test results for variables in equation (2).

Variables	coefficients	Standard error	t-values
Constant	-9.436	3.322	-2.84***
$LnPIS_t$	-0.231	0.114	-2.03**
$LnIRE_t$	-0.100	0.059	-1.71*
$LnWRS_t$	0.446	0.184	2.43**
$LnREX_t$	0.152	0.055	2.77***
$LnCLS_t$	0.112	0.095	1.18
$LnHCP_t$	0.628	0.292	2.15**
$LnFGS_t$	0.024	0.023	1.06
$LnSGR_t$	0.001	0.002	0.326
Dummy	0.450	0.150	3.00***
Log likelihood = -11.95		F-cal = 3.587***	
$R^2 = 0.481$		Adjusted $R^2 = 0.347$	
Normality test = 32.29***		DW-test = 1.83	
Schwarz criterion = 57.09		Akaike criterion = 41.89 RESET test = 3.408***	

Note: Asterisk*, **and ***represent 10%, 5% and 1% significance level respectively. Variables are as defined in equation 2

Table 3: Technology based capacity utilization rate equations in the sugar industry in Nigeria.

technology based capacity utilization rates are caused by the specified independent variables. The F-statistic of 3.587 is significant at 1% probability level, suggesting the goodness of fit of the specified model. Durbin-Watson statistic of 1.83 indicates that auto-correlation is not a serious problem in the estimated model. Furthermore, the RESET test result is significant at 1% probability level and this indicates that the equation is not mis-specified and that the assumption of log linearity among variables is correct.

The empirical result shows that the coefficient of sugarcane price (PISt) has a significant negative effect (at 5% probability level) on the technology based capacity utilization in the sugar industry in Nigeria. This implies that, as the price of the out growers (farmers) increase, the industry's ability to acquire more industrial sugarcane for crushing decreases. The finding has been substantiated by the results of similar work done by Kim (2003).

Increase in wage rate of skill workers (WRSt) has an accelerating effect on the capacity utilization rate in the sugar industry in Nigeria. The finding implies that the capacity utilization rate is inelastic with respect to the wage rate of skill workers in the industry. This means that 10% change in the wage rate of the skill workers is greater than the same 10% change in the capacity utilization rate in the industry.

Capacity utilization rate in the sugar industry has a significant positive inelastic relationship with the real research expenditure (REXt). The finding implies that the industry's incentive to increase capacity utilization rate increases with increasing expenditure on research.

The coefficient of the sugar industry's real energy consumption (IREt) exhibited the a priori expectation. It has a significant negative influenced on the technology capacity utilization in the sugar industry in Nigeria. The result suggests that increase in the real energy consumption of the industry reduces the technology based capacity utilization rates in the industry. The reason for the result could be attributed to the high cost of imported fuel to the Nigerian economy; as more than 70% of refined fuel consumed is imported.

The slope coefficient of human capital (HCPt) has a significant (at 5% probability level) positive relationship with the industry's capacity utilization. This implies that increasing the workforce will result in the increase in the capacity utilization rate of the industry. The result suggests that labor intensive technique of production is predominant in the industry in Nigeria. Using the magnitude of the estimated coefficient of elasticities, the result reveals that human capital (0.628) is the most important factor in the specified variable that affects capacity utilization in the industry.

The slope coefficient of import substitution policy period (D1) exerted a significant (at 1percent level) positive effect on the technology based capacity utilization rate in the sugar industry in Nigeria. The finding suggests that the industrial policy of regular government intervention and participation in production activities which were the major components of the import substitution policy favor

increased in technology based capacity utilization in the sugar industry in Nigeria. It could be that the policy promotes financial investment in the sub-sector, thereby accelerating resource utilization. The finding is similar to the results reported by (Kuman and Nitin, 2009).

Summary, Recommendations and Conclusion

The study analyzed the impact of firm related factors and import substitution policy period on the capacity utilization in the sugar industry in Nigeria for the period 1970 to 2010. Sugar industry based data and some macro-economic data derived from the publications of Central Bank of Nigeria as well as National Bureau of Statistic were used in the analysis. The unit root test was conducted on the specified variables using the Augmented Dicker Fuller statistics. The result reveals that some variables were stationary at level while some were stationary at first difference. The diagnostic statistics from the multiple double log linear regression estimates on the specified variables confirmed the relevance and reliability of the selected model. The empirical result reveals that the coefficient of sugar cane price and sugar industry's real energy consumption has a significant negative relationship with the technology based capacity utilization in sugar industry in Nigeria. On the other hand, the wage rate of skill workers, industry's real research expenditure and human capital have significant positive influenced on the technology based capacity utilization rate in the sugar industry in Nigeria. In addition, the results revealed that the policy period of import substitution has a stimulating effect on the growth of capacity utilization in the sub sector. Furthermore, the values of elasticity for the specified variables reveal inelastic relationship of technology based capacity utilization sugar with respect to the sugarcane price, wage rate of skill workers, human labor, and industry's real research expenditure in Nigeria.

Hence, to increase capacity utilization in the sugar industry in Nigeria, the study calls for policies aims at expanding the hectares of industrial sugarcane and increase production of refined petroleum fuel in the country. Also policies targeted on the intensification of research and improved worker's remuneration in the sector is strongly advocated in Nigeria. In addition, the study recommended that the industrial policy package of import substitution should be re-defined to involve more private investor and less government participation.

Finally, our analysis has focused on influenced of firm related factors and import substitution period on the technology based capacity utilization in sugar industry in Nigeria on the assumption of constant effect of technology throughout the study period. This means that sugar firm resource utilization might not be optimized and it could violate the modern economic theory of firm production. As such, capacity utilization of firms derived following the economic optimization of resources might be more revealing, thus it is highly recommended for further research in the industry. Also factors that influenced capacity utilization should be broaden to include environmental factors and post reformed period. However the policy recommendations could form the initial framework to the policy makers and stake holders in the sub sector to build on, in their attempts to revitalize the industry in Nigeria.

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