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IMPACT OF MACRO-ECONOMIC VARIABLE FLUCTUATIONS ON TECHNOLOGY BASED CAPACITY UTILIZATION IN SUGAR INDUSTRY IN NIGERIA

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ABSTRACT

The study analyzed technology based capacity utilization in the sugar industry in Nigeria in the period 1970 to 2010. Data used in the analysis were obtained from the sugar firms in Nigeria, Central Bank of Nigeria (CBN) and National Bureau of Statistics (NBS) as well as Food and Agriculture Organization (FAO) database. Unit root test was conducted on the specified data to ascertain their stationarity and order of integration. The short-run and long-run coefficients of technology based capacity utilization with respect to the macro-economic variables were determined using the techniques of co-integration and error correction estimation. Trend in the technology based capacity utilization rate exhibited undulating pattern throughout the study period with an average value of 24.24% and excess value of about 75.76% per annum. The empirical results obtained substantiate the presence of a long-run equilibrium relationship between the technology based capacity utilization in the sugar industry and some key macro economic variables in Nigeria. Real sugar import, real 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 sugar industry in Nigeria. Our results suggest that policy measure that should focus on periodic upward review of sugar tariff is strongly advocated as a means of enhancing domestic capacity utilization in the industry. Also policy measure that would promote full commercialization of the sugar industry manufactures in the country was strongly recommended.

Keywords: *Sugar, Capacity, Utilization, Industry, Technology, Macroeconomic*

1.0INTRODUCTION

In Nigeria, sugar sub sector is one of the key providers of industrial employment. The sub sector also plays an important role in an effort to achieve the objective of the food self sufficiency policy of the federal government (ADB, 2000; ADF, 2000 and NSDC, 2008). Sugar is a critical raw material in food and beverage, bakery and confectionery, soft drinks and pharmaceutical industries. The demand for direct household and industrial consumption remain firm and the soft drink production accounts for about half of total industrial usage in the country (Michael, 2010). The current domestic consumption of sugar in Nigeria is in excess of one million tons per annum (CBN, 2008). Domestic sugar production however, has varied between 7,000 to 55,000 tons per annum from 1969 to 2010 (Wada *et al.*, 2001 and SSC, 2010). Currently, domestic production of sugar is slightly less than 5% of the country's annual requirement (CBN, 2010 and NSDC 2010). As revealed in Table 1; from 2001 to 2003 domestic sugar production in the country declines considerably reaching all time low value of less than 1% of sugar consumed in the country (SSC, 2010; CBN, 2010).

Table 1. Sugar Supply and Import Price of Sugar in Nigeria (1970-2008)

Year	*Average domestic output (tons)*	*Average Import (tons)*	*Average Total supply (tons)*	*Average Import Price ₦/ton*	*Share of domestic output in Total (%)*	*Share of Import in Total (%)*
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); Savannah Sugar Company limited (SSC) (2000), and FAO database (2011).

Nigeria is the largest consumer of sugar in the West Africa and has a large area of cultivable land suitable for growing commercial industrial sugarcane (Busari *et al.*, 1996; ADB, 2000 and ADF, 2000). Also, over the years the federal government has carried out policies that were aimed at boosting sugar production in the country. Some of the policies include; 50% tariff on the importation of white sugar, 5% levy on imported raw sugar, five year tax holiday to sugar refineries and privatization of major sugar firms in the country, as well as sugar expansion programme in collaboration with the African Development Bank and African Development Fund in 1989 and 1991 respectively. These packages were meant to stimulate local sugar production and increase the commodity's productivity as well capacity utilization in the sub sector. In spite of these provisions, Nigeria still imports above 90% of its sugar consume locally (Nigerian Financial Business News, 2010). This implies that huge amount of foreign exchange is needed for sugar importation and this has a tendency to impact negatively on the country's external reserves, development of other sectors of the economy and the welfare of sugarcane farmers in the country. For instance, about ₦26billion or about $173.33million (at ₦150 for 1 dollar) was spent on sugar importation in 2008 (Nigerian Business Financial News, 2010).

Capacity utilization rate is an industry performance indicator that is widely used in business cycle to characterize the situation of individual industry and to assess the appropriateness of the economy policy (Danish, 2003). The technology based capacity utilization is common in Nigeria and has been used by 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 technology based capacity utilization rate could be the means through which the backward integration policy of the industrial sector to agricultural sector could be assessed. Farmer's income and welfare will be enhance 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 2010 (CBN, 2010 and NBS, 2010). In a similar way, some key macro-economic variables in the Nigeria's economy have also shown wide fluctuations over the years (Table 2). These have manifested through the falling and rising inflation rates, unsteady external reserves, deteriorating value of naira as well as undulating demand imposed by the volatile real GDP per capita in the country. Continuous downward fluctuation in capacity utilization rates of the Nigeria's sugar industry might lead to increase in prices of sugar based products in the country; this has a 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 sugar industry was attainable. In view of the problems raised in the preceding paragraphs, this study provided answers to the following questions: what is the trend in the technology based capacity utilization rate in the sugar industry in Nigeria? And does the trend in the technology based capacity utilization in the sugar industry correlates with fluctuations in some key macro economic variables in Nigeria? In an attempt to answer these questions, the study specifically estimates the technology based capacity utilization rates and analyzed it trend as well as examine macro economic factors that influenced it.

Table 2: Macroeconomic variable fluctuations in various policy regimes in Nigeria

INDICATOR	***Policy periods***						
	1970-1975	***1976-1980***	***1981-1985***	***1986-1990***	***1991-1995***	***1996-2000***	***2001-2005***
Mean macroeconomic variable indicator							
Inflation rate (%)	*14.3*	*13.0*	*19.4*	*20.5*	*48.9*	*12.3*	*15.7*
Official Exchange rate (₦/$)	*0.66*	*0.69*	*0.77*	*5.90*	*19.16*	*54.78*	*127.84*
External Reserve (₦b)	*1.19*	*3.06*	*1.40*	*11.98*	*39.2*	*361.6*	*1869.7*
Index of Energy Consumption (1985=100)	*26.3*	*64.6*	*122.8*	*95.6*	*95.7*	*83.3*	*167.4*
Real GDP per capita (₦/person) (1985=100)	*177.2*	*735*	*3.25*	*962*	*674*	*547*	*819*
Real FPI in Manu. and Processing (₦b)	*2.79*	*3.17*	*2.74*	*2.20*	*1.53*	*1.09*	*1.26*
Index of Agricultural Production (1990=100)	*65.62*	*56.44*	*58.74*	*79.20*	*121.6*	*141.5*	*158.2*
Index of Manufacturing Production (1985=100)	*32.85*	*75.42*	*105.7*	*135.4*	*154.7*	*137.2*	*145.6*
Non oil export (₦m)	*358.4*	*574.9*	*328.4*	*2335.1*	*8468.3*	*26175.4*	*87356.4*

Source: Computed by authors, data from Central Bank of Nigeria Statistical Bulletin. FPI means foreign private investment and GDP means gross domestic product.

In Nigeria, little information is available on the estimation of capacity utilization in the manufacturing sector. Fabayo (1981) employed Cobb-Douglas production function to estimate capacity output for four industries in the period 1974 and 1975 in the Nigeria's manufacturing sector. He used firm related survey data and data from the National Bureau of Statistics. The results reveal that textile, soft drinks and cement industries had capacity utilization of 36.6%, 41.1% and 34.7% respectively in 1974; the indices stood at 36.8%, 43.3% and 39.3% respectively in 1975. Soderbom and Teal (2002), from the report on the Nigerian manufacturing enterprise survey 2001, reported an average capacity utilization rate 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 the firm size and was higher in food sub sector and lower in chemical sub sector. Adeel *et al.,* (2006) 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 food sub sector, while textile and wood/furniture had 44.53% and 41.88% respectively. Raimi *et al.,* (2009) study the impact of change in government policies on capacity utilization rate in the real sector of Nigeria's economy. They used descriptive statistics and ordinary least squares (OLS) methods on secondary data obtained from official sources (i.e. CBN & NBS) from 1991 to 2003 to estimate and analyzed 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), study determinants of manufacturing capacity utilization rate in Nigeria in the period 1970 to 1988. He employs OLS method on secondary data derived from the Central Bank of Nigeria publications. The results reveal that the real exchange rate; federal government capital expenditure on manufacturing and per capita real income has positive effect on manufacturing capacity utilization. Inflation and real loans and advances to manufacturing sector have a negative effect on the industry's capacity utilization rate. McElthattan (1985) investigated relationship between capacity utilization in industrial sector and inflation rate in U.S.A. she obtained a significant positive relationship between the two variables. Earlier, Franz and Gordon (1993) discovered that capacity utilization depends more on inflation than unemployment in both U.S.A and Germany economies. Similar results were obtained by Garner (1994) and Yoo (1995).

1.1 Concept of Capacity and Capacity Utilization

Capacity is a short-run concept, for which firms and industry face short-run constraints, such as the stock of capital or other fixed inputs, existing regulations, the state of technology and other technological constraints (Morrison, 1985). Capacity utilization is the ratio of the actual or observed output to capacity or potential output (Prior & Nelda, 2001). Various forms of capacity utilization exist depending on how the capacity output is measured. It could be technology based or physical capacity utilization, when actual output is compared to technical maximum or installed plant output (Gold, 1955; 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). Mathematically, capacity utilization rate is defined as the ratio of the actual output Y_0 to potential or capacity output Y* i.e.

$CUR = Y_0/Y^*$ ……..…… (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 (Johanson, 1968). Alternatively, full capacity output is that level of output, which the existing stock of equipment is intended to produce under normal conditions with respect to the use of variable inputs (Smithies, 1957). On the other hand, Klein (1960) and Friedman (1963) defined economic capacity as the output level at which the long-run and short-run average total cost curves are tangent; while Hickman (1964) defines 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 utilization has been found to be more operational than the economists' concept especially in the developing countries (Budhin & Paul, 1961). Most managers and technical experts prefer to operate with the engineering definition of capacity utilization and incidentally the same definition is the basis of the capacity utilization definition of the Central Bank of Nigeria, National Bureau of Statistic 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 represents the optimum decision concerning the resource use by the firms (Kumar & Nitin, 2009).

2.0 MATERIALS AND METHODS

2.1 The study area and 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 4^0 and 14^0 north of the equator and between longitude 3^0 and 15^0 east of the Greenwich. Nigeria has a total land area of 923,768km^2 (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 Central Bank of Nigeria (CBN) and National Bureau of Statistics. The data covered the period 1970 to 2010.

2.2 Empirical model:

To examine the influenced of macro-economic variables on technology based capacity utilization rate, a capacity utilization rate equation model for the sugar industry in Nigeria was specify (Thoumi, 1972; Gokcekus, 1997; Ukoha 2000; Biccardo 2004).

$$LnCUR_t=\beta_0+\beta_1 LnINFL_t+\beta_2 LnRSI_t+\beta_3 LnTRS_t+\beta_4 LnREX_t+a\beta_5 LnPCR_t+\beta_6 LnPMP_t+\beta_7 LnIMPR_t+U_t \quad \text{……(2)}$$

Where

CUR_t = technology based capacity utilization in sugar industry in Nigeria

$INFL_t$ = inflation rate (%)

RSI_t = real sugar import (₦/ton)

TRS_t = tariff rate on sugar import (%)

REX_t = real exchange rate (₦/$)

PCR_t = per capita real GDP (2003=100) (₦)/person

PMP_t = parallel market exchange rate premium (measured as the ratio of the official exchange rate to parallel market rate)

$IMPR_t$ = import price of sugar (₦)

U_t = stochastic error term.

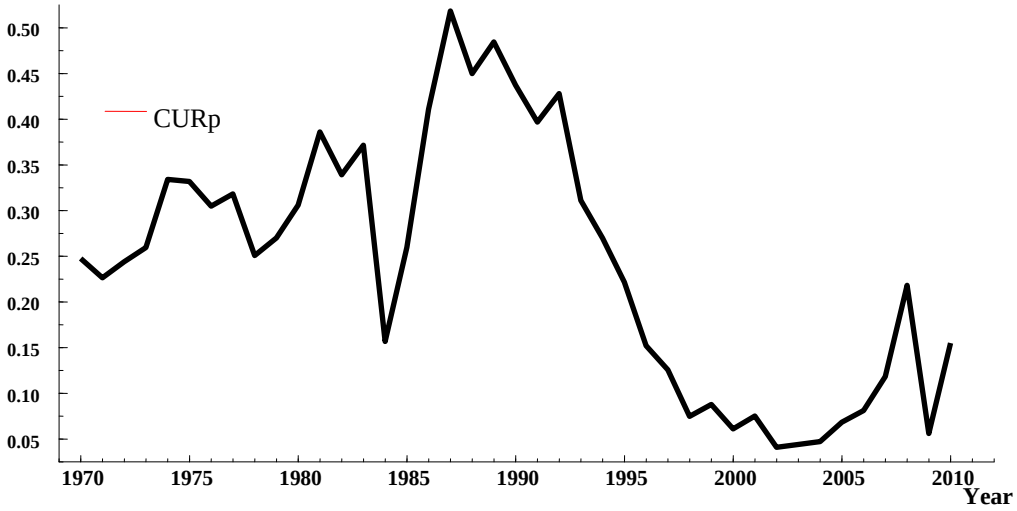
3.0 RESULS

3.1Trend Analysis of Technology Based Capacity Utilization rate in Sugar Industry in Nigeria

Figue1 reports the trend in the technology based capacity utilization rates for sugar industry in Nigeria. The result reveals that the fluctuations in the capacity utilization rate exhibit undulating trend between 1970 and 1983. The fluctuations showed a sharp increase from 15.7o% in 1984 to a peak value of 51.80% in 1987; it later

displayed a downward trend to a trough value of 4.09% in 2002. With the value of about 4.71% in 2004, the fluctuation assumes a rising trend reaching the value of 21.80% in 2008.

Figure 1: Trend in Technologically based capacity utilization rate in sugar industry in Nigeria



In all the observations, the technology capacity utilization rate in the industry was less than unity with an average value of 24.24%. This implies that the industry had an excess capacity utilization rate of about 75.76% due to under-utilization of factors of production. Given the available resources and technology, the industry needed an average of 75.76% increase in capacity utilization rate to attain a technically maximum or an optimum capacity utilization rate. This means that the industry needed to acquire more factors of production in order to increase the operating capacity to an optimum level. Hence the distribution of the estimated values of capacity utilization rates in the industry denotes that the industry output was low in relation to the installed capacity of the industry.

3.2 Unit root test results for variables used in the analysis

Table 3 shows the result of ADF statistics tests and order of integration of the time series variables defined in equations (2) as well as the order of integration of the residual generated from the same equation. PC-Give 10 and gretl econometric softwares were used to generate the test statistics. The result reveals that LnCURt, $LnRSI_t$, $LnTRS_t$, $LnREX_t$, $LnPCR_t$, LnIMPRt and LnPMP were not stationary at level but stationary at first difference. This implies that equation (2) cannot be specified at levels of the variables without the risk of obtaining spurious regressions (Granger and Newbold, 1974). However, inflation was stationary at level and was thus excluded from the analysis.

Table 3: Result of Augmented Dicker Fuller Test for Variables Used in the Analysis

	With Trend			***Without Trend***		
Variable	*Level*	*1st diff.*	*OT*	*Level*	*1st diff.*	*OT*
$LnCUR_t$	*-2.397*	*-8.227****	*1(1)*	*-1.654*	*-8.366****	*1(1)*
$LnRSI_t$	*--2.338*	*-6.213****	*1(1)*	*-0.069*	*-6.222****	*1(1)*
$LnTRS_t$	*--1.617*	*-4.955****	*1(1)*	*-2.100*	*-4.590****	*1(1)*
$LnREX_t$	*-1.670*	*-4.359****	*1(1)*	*-0.053*	*-4.444****	*1(1)*
$LnPCR_t$	*-2.232*	*-6.050****	*1(1)*	*-2.109*	*-5.642****	*1(1)*
$LnPMR_t$	*-1.936*	*-6.222****	*1(1)*	*-2.037*	*-6.228****	*1(1)*
$LnIMPR_t$	*-2.014*	*-6.701****	*1(1)*	*-0.186*	*-6.784****	*1(1)*
Residual	*-3.956****	-	*1(0)*	*-4.077****	-	*1(0)*
1%	*-4.21*	*-4.22*		*-3.61*	*-3.61*	
5%	*-3.53*	*-3.53*		*-2.94*	*-2.94*	

Note: OT means order of integration. Critical values (CV) were defined at 1% and 5% significant levels and asterisks *** and ** represent 1% and 5% significance levels respectively. This test was performed by including drift and a deterministic trend in the regressions. Variables are as defined in equation 2.

Following the results of ADF statistics, the existence of cointegration between the endogenous and exogenous variables was determined. The Engle–Granger two-step procedure was adopted to test for co-integration (Gujarati, 2004). The order of integration of the residual generated from the long run model in equation (2) was evaluated and found to be significant at level. The result of this exercise is presented in Table 3. Consequently, the existence of co-integration in technology based capacity utilization rate with respect to the independent variables in equation (2) could not be rejected. Thus Table 4 presents the result of the estimated long-run (static) regression equation.

Table 4: Long-run (static) technology based capacity utilization rate equations in sugar industry in Nigeria

Variables	*coefficients*	*Standard error*	*t-values*
Constant	-2.8219	3.9235	-0.719
$LnRSI_t$	-0.1504	0.1680	-0.895
$LnTRS_t$	0.3216	0.1512	2.127**
$LnREX_t$	-0.3595	0.1137	-3.161***
$LnPCR_t$	-0.0089	0.1533	-0.057
LnPMPt	-0.3744	0.2158	-1.735*
LnIMPt	0.4346	0.2235	1.945*

Diagnostic Statistics

R^2	0.694	*Akaike Criterion*	57.164
F- Statistic	12.456***	*Hannan Quinn*	61.439
DW-Statistic	1.295	*Schwarz Criterion*	68.986
Normality test	0.229 (0.8916)	*Loglikelihood*	-21.582
Hetero-test	1.293 (0.5486)	*rho*	0.326
RESET test	12.165 (0.001)***		

Note: Asterisks *, **, and ** *represent 10%, 5% and 1% significance levels respectively.

3.3 Selecting the Optimal lag- length for the Co- integrating Series

To estimate the error correction model for variables in equation 2, optimal lag lengths were determined for the specify variables. The Akaike criterion (AIC), Schwarz Bayesian criterion (SBC) and Hannan - Quinn criterion (HQC) were used to select appropriate lag lengths for the cointegrating series. The test results as showed in Table 5 reveal that the optimum lag lengths appropriate for generating a more interpretable parsimonious ECM model for the specified variables were at the second lag.

Table 5: Optimal lag length of variables used in each cash crop equation in the analysis

Equations	*lags*	*loglike*	*p(LR)*	*AIC*	*SBC*	*HQC*
	1	-13.876	0.000	1.183	1.531	1.305
Equation 2	2	-11.074	0.018	1.085*	1.477*	1.223*
	3	-11.031	0.771	1.137	1.572	1.290

Note: Asterisk means optimum lag length of series in each food crop volatility equation.

3.4 Error Correction Model for technology based capacity utilization rate equation in sugar industry in Nigeria

Following the Granger Representation Theorem, we specify the ECM model for the cointegrating series in the study. The primary reason for estimating the ECM model was to capture the dynamics in the technology capacity utilization rate equation in Nigeria in the short-run and identify the speed of adjustment as a response to departures from the long-run equilibrium. The general specification of the ECM estimated for the technology capacity utilization rate equation in the sugar industry in Nigeria is described as follows:

$$\Delta LnCUR_t = \delta_0 + \delta_1 \Delta LnCUR_{t-2} + \delta_2 \Delta LnRSI_{t-2} + \delta_3 \Delta LnTRS_{t-2} + \delta_4 \Delta LnREX_{t-2} + \delta_5 \Delta LnPCR_{t-2} + \delta_6 \Delta LnPMR_{t-2} + \delta_7 \Delta LnREX_{t-2} + \delta_8 ECM_{t-2} + U_t \ldots \quad (4)$$

The variables are as defined previously in equation (2). To obtain a parsimonious dynamic ECM for the equation specify, the study adopts Hendry's (1995) approach in which an over parameterized ECM model was initially estimated and then gradually reduce by eliminating insignificant lag variables until a more interpretable and parsimonious ECM model was obtained. The result of the exercise is presented in Tables 6.

Table 6: Parsimonious Error Correction Model estimates for equations (2)

Variables	***coefficients***	***Standard error***	***t-values***
Constant	*-0.1553*	*0.0789*	*-1.968**
$\Delta LnCUR_{t-1}$	*-0.1999*	*0.1484*	*-1.347*
$\Delta LnRSI_t$	*0.3526*	*0.1262*	*2.794****
$\Delta LnTRS_{t-2}$	*0.2644*	*0.1368*	*1.932**
$\Delta LnREX_t$	*0.1677*	*0.1828*	*0.918*
$\Delta LnPCR_{t-2}$	*0.0633*	*0.1491*	*0.424*
$\Delta LnPMP$	*-0.2881*	*0.1510*	*-1.908**
$\Delta LnIMPR_{t-1}$	*0.2949*	*0.1644*	*1.794**
ECM_{t-1}	*-0.5773*	*0.1540*	*-3.748****

Diagnostic Statistics

R^2	*0.588*	*Akaike Criterion*	*24.730*
F- Statistic	*4.99****	*Hannan-Quinn*	*29.842*
DW-Statistic	*1.92*	*Schwarz Criterion*	*39.229*
Normality test	*2.266 (0.3220)*	*rho*	*0.0757*
Hetero-test	*0.6109 (0.8234)*		
RESET test	*0.553 (0.46313)*		

Note: Asterisk ** and *** represent 5% and 1% significance level respectively.

4.0 DISCUSSION

The ECM model as presented in Table 6 shows the short-run effect of changes in the independent variables on capacity utilization rate in the sugar industry. The error correction term *(ECMt-$_1$)* is negative in sign and statistically significant at 1% probability level and thus indicates the quick convergence to equilibrium in each period, with intermediate adjustments captured by the differenced terms.

The ECM coefficient indicates that about 57.73% of the discrepancy between actual and the equilibrium value of technology based capacity utilization rate in the sugar industry in Nigeria is corrected in each period. The R^2 of the ECM model indicates that, about 58.80 percent of variability in the technology based capacity utilization rate in the short run is attributed to the explanatory variables in the ECM model. The F-statistic value of 4.99 is significant at 1 percent probability level, suggesting the goodness of fit of the error correction model. The Durbin-Watson value of 1.92 indicates a minor problem of autocorrelation in the model. The information criteria in both models confirm the reliability and predictability of the estimates. Also, the result of the long run equation shows that, the explanatory variables explain about 69.40% of adjusted total variations in capacity utilization rate in the sugar industry in Nigeria.

The empirical result reveals that in the short run, the technology based capacity utilization rate in the sugar industry has a significant positive and inelastic relationship with the real sugar import (RSI_t) in Nigeria. This means that in the short run, a unit increase in the real sugar import increases the technology based capacity utilization rate by about 0.3526 units. However the impact of the real sugar import was not significant in the long run; this means that the influence of the real sugar import on the technology based capacity utilization in the industry was not sustainable in the long run. The reason for this result could be attributed to the fact that in the short run; increase in sugar import triggers slight competition in the domestic production. This induces a marginal increase in capacity utilization rate in the industry. But this short benefit could not be sustain till the long run due to many factors including poor technology and increase domestic demand on sugar industry manufactures as well as insufficient raw materials.

On the other hand, the long run real exchange rate (REX_t) exerted a significant negative impact on the technology based capacity utilization in the sugar industry in Nigeria. The finding suggests that the exchange rate liberalization policy adopted by the Nigeria's government impacted negatively on the technology based capacity utilization in the sugar industry in the country. It could be that the current exchange rate deregulation policy of the federal government constraint the operators of the industry from accessing sufficient foreign exchange to finance the sub-sector inputs importation. However, this effect was not significant in the short run period.

The result also reveals an adverse relationship between the technology based capacity utilization and parallel market exchange rate premium (PMP_t) in both short and long run periods in the sugar industry in Nigeria. The

result points to the fact that there was inefficiency in the foreign exchange market transaction in the country. Since most of the industry capital equipment/machineries were imported, there exists that tendency that inefficiency in the currency exchange market would lead to high cost of imports. This constricted production and reduces capacity utilization rate in the industry in both short run and long run periods.

Similarly, the coefficient of tariff rate on sugar imports (TRS_t) in both short run and long run had a positive influence on the capacity utilization in sugar industry in Nigeria. This implies that 10% increase in the tariff rate in the short and long run periods would result to 0.2644 and 0.3216 units increase respectively in technology based capacity utilization of the industry. The result is as expected because tariff regimes in Nigeria were formulated to protect domestic *industry*; as such sugar tariff assumes a protectionist stance in both short and long run irrespective of increase in domestic demand and shortfall in domestic supply of sugar in the country.

5.0 CONCLUSION

The study analyzed the trend in the technology based capacity utilization in the sugar industry in Nigeria for the period 1970 to 2010. Sugar firm data and macro-economic data were used in the analysis. Following the definition of technology based capacity utilization; the indices of capacity utilization were derived from sugar firm production data based. Unit root test was conducted on the specified data and their stationary as well as the order of integration determined. The result of Augmented Dicker Fuller test confirmed the presence of co-integration among specified variables indicating the existence of a long-run equilibrium relationship. The long run and ECM models for technology based capacity utilization rate in the sugar industry in Nigeria were estimated. The error correction term had the appropriate sign and was statistically significant indicating a quick convergence to equilibrium in each period, with intermediate adjustments captured by the differenced terms. This implies that market forces and interaction of some key macro economic factors are in operation to restore long-run equilibrium in the technology based capacity utilization rate following a short-run random disturbance. However the results reveal that the trend in the technology based capacity utilization rate in the sugar industry in Nigeria exhibited undulating pattern throughout the study period. The estimated capacity utilization rate for all observations was less than unity with an average value of 24.24% and excess capacity of about 75.76% per annum.

Whereas the empirical result for the long run technology based capacity utilization equation reveals that the real exchange rate and parallel market exchange rate premium have significant negative relationship with the technology based capacity utilization in the sugar industry. On the other hand, import price of sugar and tariff rate on sugar import have significant positive relationship with the technology based capacity utilization in the sugar industry in Nigeria. The ECM model indicates that the technology based capacity utilization rate in the industry was statistically and significantly promoted by increase in the real sugar import, tariff rate on sugar import and price of sugar import; while increase in parallel market exchange rate premium has an adverse effect on technology based capacity utilization rate.

Following the result of the analysis, some policy measures were recommended to achieve increase sugar production and capacity utilization rate in Nigeria. The study reveals that periodic increase in the tariff rate of sugar import in the short and long run is an incentive to increase technology based capacity utilization in sugar industry in Nigeria. Hence a policy measure that should ensures periodic upward review of sugar tariff is strongly advocated. Also policy measure that would promote full commercialization of the sugar industry manufactures in the country is strongly recommended. Furthermore, the study suggests that a special policy instrument under the deregulation of exchange rate context should be set up to address the issue on foreign exchange constraints to genuine industrialists especially in the sugar industry.

The analysis has focused exclusively on the technology based capacity utilization in sugar industry on the assumption of constant effect of technology throughout the study period. This implies that firm resources might not be optimized and it could violate the economic theory of firm production. As such, capacity utilization of firms derived following the economic optimization of resources might be more revealing, thus it should be encourage.

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