

Investigating the Trend and Sources of Economic Efficiency in the Sugar Industry in Nigeria

Sunday Brownson Akpan

Department of Agricultural Economics and Resources Management, Akwa Ibom state University, Ikot Akpaden, Mkpato Enin, Akwa Ibom state, Nigeria

E-mail: sundayakpan10@yahoo.com

ABSTRACT

This study estimated and analyzes economic efficiency indices in the sugar industry in the period 1970 to 2010 in Nigeria. Secondary data were obtained from sugar firms, Food and Agricultural Organization (FAO), Central Bank of Nigeria (CBN) and National Bureau of Statistics (NBS) as well as the federal Ministry of Finance. Stochastic Cobb-Douglas cost function for the sugar industry was estimated from which indices of economic efficiency were obtained. Trend in the estimated economic efficiency indices showed time invariant fluctuations across the study period with an average index of 50.80% and excess efficiency of 49.20%. Multiple-regression of various forms based on the ordinary least squares technique was used to determine factors that influence economic efficiency in the industry. Empirical result revealed that economic efficiency in the sugar industry was influenced positively by the industry's sales growth and capital-labour ratio. On the other hand, the industry's expenditures on research and training, physical capacity utilization rates and the real exchange rate of naira for US dollar impacted negatively on economic efficiency of the industry. We recommend that capital intensive method of production should be adopted as a means of promoting economic efficiency of resource use in the industry. Also, effective marketing policy on the industry manufactures is strongly recommended as this will stimulates sale growth and economic efficiency in the industry. Government should increase budgetary allocation to the Sugarcane Research Development and Training Center to intensify its activities in areas of manpower development, information dissemination on improved varieties of sugarcane to farmers and sugar firms in the country. Finally, the industrial policy package for the industry during liberalization period should used as a basis for promoting economic efficiency in the industry in Nigeria.

Keywords: Economic efficiency, macroeconomic variables, policy, sugar, production

1. INTRODUCTION

In Nigeria, sugar sub-sector is one of the contributors to economic development [28]. The importance of the sub-sector is derived from its contribution to the employment and food self sufficiency as well as creating a significant impact in the rural economy in the country [31, 4, 5]. The demand for direct household sugar consumption remains firm in the country and the soft drink production alone accounts for about half of total industrial sugar usage [25]. According to reports by the [16] and [28], the current domestic consumption of sugar in Nigeria is in excess of 1.5 million tonnes per annum. Currently, domestic production of sugar is slightly less than 5% of the country's annual requirement [16, 28]. 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 [28].

Over the years the government has employed several policy measures to increase the manufacturing capacity in the economy and at the same time curb excessive fluctuation of some key macroeconomic variables. The government policy measures varied from the pre-structural Adjustment Programme (Pre-SAP) period (1970-1985) to the SAP (1986-1993) and post-SAP (1994 to date) periods. Direct monetary control techniques were employed in the pre-SAP period (Anyanwu *et al*, 1997). In the SAP period (1986-1993), indirect measures were adopted such as deregulation policy among others. In the post-SAP period (1994 to date), administratively controlled measures were first adopted in 1994 and were abandoned in 1995 for policy of guided deregulation. Apart from monetary policies, the government also employed some fiscal policy measures to ensure full employment and efficient use of resources in the manufacturing sector. The 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 had been employed over the years to boost sugar production in the country. These policies include; 50% tariff on the importation of white sugar, 5% levy on imported raw sugar, free excise duties on sugar production, reduce import duties on sugar industry machineries, 5-year tax holidays 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) in 1989 and 1991 respectively. These measures were meant to stimulate local production and hence increase the productivity in the sub-sector. Also the National Sugar Development Council (NSDC) was established by decree 88 of 1993. The NSDC was mandated to develop strategies that would promote local production of sugar such that 70% of the country's sugar requirement would be met by domestic production [15, 28]. Based on the government policy of direct participation and investment in the sugar industry, NSDC strategies were the expansion and rehabilitation of the four government owned sugar industries, establishment of 5 medium scale and many mini sugar plants in the country as well as the establishment of 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 [39]. In spite of these measures, Nigeria still imports over 90% of its sugar mostly in semi-processed form [28]. The country has the largest demand for sugar in the West Africa sub-region and second in Africa in addition to large area of cultivable land suitable for the growing of industrial sugarcane [15, 4, 5]. Despite the favorable agro-climatic and soil conditions for the production of sugar-cane in addition to the long period of existence of sugar mills; sugar requirements of the country remains largely unmet from domestic sources [34]. The cost implication of sugar imports in the country is devastating: 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); while ₦217 billion or (\$1.45b) was spent in 2010 (CBN, 2011).

Therefore based on issues raised and the need to assess the level of resource utilization as well as efficiency in the industry, this study has provided answers to the following questions:

how economically efficient is sugar production in Nigeria? What factors influenced economic efficiency in the sugar industry from 1970 to 2010 in Nigeria? Which industrial policy regime(s) promoted high performance of sugar industry in Nigeria? Given the importance of the sugar industry in the Nigeria's economy, there is an overwhelming need to identify the fundamental variables that are responsible for the surging performance of the industry over the years. The study specifically establishes the empirical relationship among economic efficiency in the industry, some key macroeconomic factors and industrial policy regimes in the country.

2.0 Literature review

[14], provided evidence of low economic efficiency among public manufacturing firms in Greece in the period 1979 to 1988. [35] analyzes the role of economic efficiency in small and medium industries performances in Malaysia. He identified effective policy and incentives as major ways of improving economic efficiency in the sub sectors. In Nigeria, [32] and [38] conducted empirical researches on the performance of manufacturing sector in various policy regimes in Nigeria. The result reveals positive relationships between technical efficiency in the manufacturing sector and import substitution period in Nigeria. Also [2] study the impact of trade policy reform on technical efficiency in Nigeria's manufacturing sector. The result revealed that the nominal protection rate and import penetration ratio had positive significant effects on the technical efficiency of the manufacturing sector. Negative effects were obtained for the interest rate and exchange rate respectively. The study concluded by asserting that the trade policy reform produced positive impact on the technical efficiency in the Nigeria's manufacturing sector. [6] employed regression analysis on firm's related data from Peru manufacturing sector between 1988 and 1992 to obtain a similar result. They also discovered that firm's size had a negative significant effect on the technical efficiency of firms. [30] in Cameroon, found a positive significant relationship between manufacturing firm's technical efficiency and effective protection, official tariff rates, import penetration ratio, and share of manufacturing in exports. [18] also confirmed positive significant relationship between firm's technical efficiency and share of manufacturing in exports, capital-labour ratio and worker skill in Malawi. The result also showed that tariff rate, share of manufacturing in imports and firm size had negative significant relationship with firm's technical efficiency. [7] analyzed factors explaining technical efficiency in Spanish industrial sector in the period 1991 to 1994. The result revealed that technical efficiency had a significant positive relationship with the firm size and investment level and a negative relationship with the expense on research and development. [20] in their empirical investigation concluded that privatization improves firm performance and efficiency and in addition that concentrated ownership enhances firm performance. [3] explores technical efficiency level of the small and medium scale enterprises (SMEs) in Tanzania, and found that the mean technical efficiency level for all firms is about 50 percent, meaning that by operating at the full technical efficiency levels, these firms could increase their productive level by about 50 percent. The study also indicates that the technical inefficiencies of the Tanzanian SMEs are significantly related to firm age, firm size, and human capital development.

[8] conducted a study on the determinants of technical efficiency in small firms in Chilean manufacturing industry. Using plant survey data and Non - Parametric Deterministic Frontier Methodology; they estimated efficiency that was positively related to the experience of workers, modern capitals, and innovation in products. In contrast, outward orientation, owner's education and participation in public programs have significant negative impact on firm's efficiency. [36] investigated the impact of economic reforms on the manufacturing efficiency in India in the period 1991 to 2001. The finding supported positive relationship between firm's efficiency and import liberalization in India.

[10] used cross sectional data from 241 industries in Germany between 1995 and 2001 to estimate technical efficiency and its determinants. The results revealed that technical efficiency was positively and significantly influenced by the index of new firm formation and human capital, and negatively correlated to the concentration indices. The results also showed that technical efficiency was not related to sales growth, research and training expenditures, capital intensity and firm size. A similar study was conducted by [11] using panel data from 35,000 German firms in the period 1992 to 2004. The report indicated that the firm size increases the technical efficiency while outsourcing, research and development decrease technical efficiency. [21] used the Data Envelopment Analysis (DEA) technique to estimate the technical efficiency of firms in Ghana across six manufacturing industries during 1991 to 2002. They observed that the manufacturing firms in Ghana were significantly less efficient than their counterparts in other countries. In addition, their results reveal that firm characteristics such as size, age, foreign ownership, and the mix of labor and capital used during the production process have positive effects on firm's efficiency. [29] also investigated the relationship between technical efficiency and firm size in Uganda and Tanzania manufacturing sector. The result showed a negative association between firm's size and technical efficiency in both countries. [19] examined the impact of trade liberalization and other variables on Vietnamese manufacturing firm's efficiency. The results revealed that trade liberalization and share of skilled workers have significant positive effect on the sector's efficiency, while capital-labour ratio had a negative influence.

3.0 Research methodology

3.1 Study area: The study was conducted in Nigeria; the country is situated on the Gulf of Guinea in the sub Saharan Africa. Nigeria lies between 4° and 14° north of the equator and between longitude 3° and 15° east of the Greenwich. The country has a total land area of 923,768.622km² or about 98.3 million hectares and population of over 140 million [27]. Industrial sugarcane is cultivated in commercial quantity in the northern part of the country, and is mostly planted 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 four 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 40,000tons/annum; Savannah Sugar Company Limited at Numan, Adamawa State established in 1980 with initial installed capacity of 65,000tons/annum; Lafiagi Sugar Company in Kwara State and Sunti Sugar Company in Niger State are mini sugar plants. The refineries are BUA and Dangote sugar refineries located in Lagos state. The refineries are not involved in direct production of sugar, but refined semi processed sugar imported from Brazil and other sugar producing countries [28].

3.2 Data source: Data used in the study were collected from the sugar producing firms in Nigeria and macro economic data published by the Central Bank of Nigeria (CBN), Food and Agricultural Organization, National Bureau of Statistics, Federal Ministry of Finance and Federal Ministry of labour and Productivity as well as the Federal Ministry of Agriculture and Rural Development. Two major sugar producing firms were purposely selected for the data collection. This was because the firms depend fully on the domestic sugarcane for the production of sugar and produced more than 95 percent of domestic produced sugar in the country [28]. 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.

3.3 Analytical techniques

The empirical model was specified based on the objective of the study. Following [12] specification of stochastic production function, sugar firm's stochastic cost efficiency function (EE) was defined as follows:

$$EE = \frac{TVC_i}{TVC_i^*} = \frac{(P_i, Q_i, Z_i, R_i) \exp(V_i)}{(P_i, Q_i, Z_i, R_i) \exp(U_i)} = \frac{1}{\exp(-U_i)} \quad \dots \dots \dots (1)$$

Where, TVC_i is the actual or firm total variable cost of production, TVC_i^* is the frontier or optimum total variable cost, P_i represent prices of all inputs of i th firm, Q_i is the output level, and Z_i represent other variables.

The economic efficiency (EE) of the sugar industry presented in equation (1) was estimated using equation (2) specify in log-linear form as follows:

$$\begin{aligned} \ln TVC_t = & \delta_0 + \delta_1 \ln WNP_t + \delta_2 \ln PLP_t + \delta_3 \ln RPK_t + \delta_4 \ln WPW_t + \delta_5 \ln PS_t + \delta_6 \ln EC_t + \\ & \delta_7 \ln POI_t + \delta_8 \ln SOI_t + \delta_9 \ln TEP_t + V_j - \\ & U_j \quad \dots \dots \dots (2) \end{aligned}$$

Where;

TVC_t = annual total variable cost of 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 (₦) ($\delta TVC_t / \delta POI_t > 0$)

SOI_t = sugar output (tonnes) ($\delta TVC_t / \delta SOI_t > 0$)

TEP_t = technological progress capture by time trend ($\delta TVC_t / \delta TEP_t > 0$)

3.4 Determinants of Economic Efficiency (EE) in Sugar industry in Nigeria.

To determine factors that influence economic efficiency in sugar industry in Nigeria, efficiency equation model was specified as in equation 3 [33]. A dummy variable (D) was introduced into equation (3) to capture policy impact on the economic efficiency in sugar industry in Nigeria [2].

$$\begin{aligned} EE = & \eta_0 + \eta_1 SIMP_t + \eta_2 INFL_t + \eta_3 SG_t + \eta_4 ERT_t + \eta_5 RER_t + \eta_6 FS_t + \eta_7 K_t/LA_t + \\ & \eta_8 GGDP_t + \eta_9 OTR_t + \eta_{10} PXR_t + \eta_{11} HC_t + \eta_{12} PCUR_t + \eta_{13} RWS_t + \eta_{14} D + \\ & U_t \quad \dots \dots \dots (3) \end{aligned}$$

Where,

EE = economic efficiency of sugar industry in Nigeria

$SIMP_t$ = real sugar import (₦m)

$INFL_t$ = inflation rate (%)

SG_t = sales growth (proxy by output growth, %)

225 ERT_t = real expenditure on research and training in the sugar industry (N/m)
 226 RER_t = real exchange rate (N/\$)
 227 RWS_t = average real wage of skilled workers (N/skilled worker)
 228 FS_t = firm size proxies by the sugar industry's employment growth rate (%)
 229 K_t/LA_t = capital-labour ratio (real capital to labour) (N/worker)
 230 $GGDP_t$ = growth rate of real GDP per capita (%)
 231 OTR_t = official tariff rate on sugar imports (%)
 232 PXR_t = parallel market exchange rate premium (measured as the ratio of the official
 233 exchange rate to parallel market rate)
 234 HC_t = human capital (number of skilled and unskilled workers)
 235 $PCUR$ = physical capacity utilization rate in sugar industry (%)
 236 D = dummy variable which takes the value 1 in the liberalization period (1986-2010) and 0
 237 otherwise (1970-1985)
 238 U_t = Stochastic error term.
 239 η 's are coefficients.

240
 241 **Note:** Physical capacity utilization rate for the industry (PCUR) was estimated independently
 242 using production function approach and injected into this analysis as a variable in equation
 243 3.

244 As shown in [13], for the distribution assumptions made about random term (μ_i), the
 245 elasticity of economic or cost efficiency with respect to a given explanatory variable describe
 246 in equation 3 is given by:

$$\left\{ \frac{1}{\sigma_u} \left[\frac{\varphi\left(\frac{\mu_i}{\sigma_u} - \sigma_u\right)}{\phi\left(\frac{\mu_i}{\sigma_u} - \sigma_u\right)} - \frac{\varphi\left(\frac{\mu_i}{\sigma_u}\right)}{\phi\left(\frac{\mu_i}{\sigma_u}\right)} - 1 \right] \right\} \frac{\delta \mu_i}{\delta \ln X_i} \dots \dots \dots (4)$$

248
 249
 250 Where $\phi(\cdot)$ and $\varphi(\cdot)$ are density and distribution function of a standard normal variable
 251 respectively. X 's are independent variables describe in equation 3. The elasticity was
 252 estimated for each explanatory variable describe in equation 3.

253
 254 **3.5 Estimation techniques:** Equation (2) was estimated by using the Maximum Likelihood
 255 method, while various forms of equation (3) were estimated using Ordinary Least Squares
 256 method.

257 258 **4.0 Results and Discussion**

259 The Augmented Dicker Fuller test (ADF) was carried out to determine the time series
 260 properties of the variables used in the analysis. It was discovered that some series (including
 261 the dependent variable) were stationary at level while some were not. Since economic
 262 efficiency (EE) was stationary at level, it implies that equations (3) can be specify at level of
 263 the variables without the risk of obtaining spurious regressions. Also, since production
 264 variables do not carry negative sign, it therefore means that level specification is the best for
 265 firm production variables.

266 Maximum likelihood estimates of the Cobb-Douglas stochastic cost function for the sugar
 267 industry as defined in equation (2) is presented in Table 1. The result revealed a significant
 268 sigma squared coefficient of 0.5351 at 5% level of probability. This indicates a good fit and
 269 correctness of the specified distribution assumption of the composite error term for the
 270 model. The variance ratio or gamma (λ) indicates the proportion of variation in the total
 271 variable cost in the sugar industry in Nigeria that is due to deviation from cost or economic
 272 efficiencies. The gamma ratio of 0.4171 suggests that the presence of economic or cost
 273 inefficiency in the sugar industry in Nigeria explained about 41.71% variations in the total

variable cost of the industry. The generalized likelihood ratio test for the equations is highly significant and this confirms the presence of one - sided error component in the composite error term. Therefore, the result of the diagnostic test confirms the relevance of the stochastic parametric cost function and maximum likelihood estimation technique.

Table 1: Maximum Likelihood estimates of Cobb-Douglas stochastic cost function of sugar industry in Nigeria as defined in equation (2)

Variable	Coefficient	t-value
Constant	-0.1882	-0.09315
Wage rate of non prod. workers (WNP _t)	-0.2685	-0.3839
Land price (PLP _t)	-0.1278	-1.8235*
Depreciation cost (RPK _t)	-0.5039	-3.665***
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
Sigma square Gamma (δ^2)	0.5351 (2.425)**	
Gamma (λ)	0.4171 (2.415)**	
Log-Likelihood	-0.4425	
LR Test	15.4047	

Note: Asterisk *, ** and *** represent 10%, 5% and 1% significance levels respectively. Variables are as defined in equations (2).

The empirical result revealed 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 industry.

4.1 For estimated indices of economic efficiency: In all the observations, the economic efficiency was less than unity with an average value of 41.80%. This implies that the industry had low level of economic efficiency. The finding indicates that the industry had economic efficiency gap or excess economic efficiency of 58.20% which could have been achieved by improving the financial and resource base of the industry given the technology endowment of the sub-sector *ceteris paribus*. The result suggests that, there was insufficient financial and production resource in the industry in the study period.

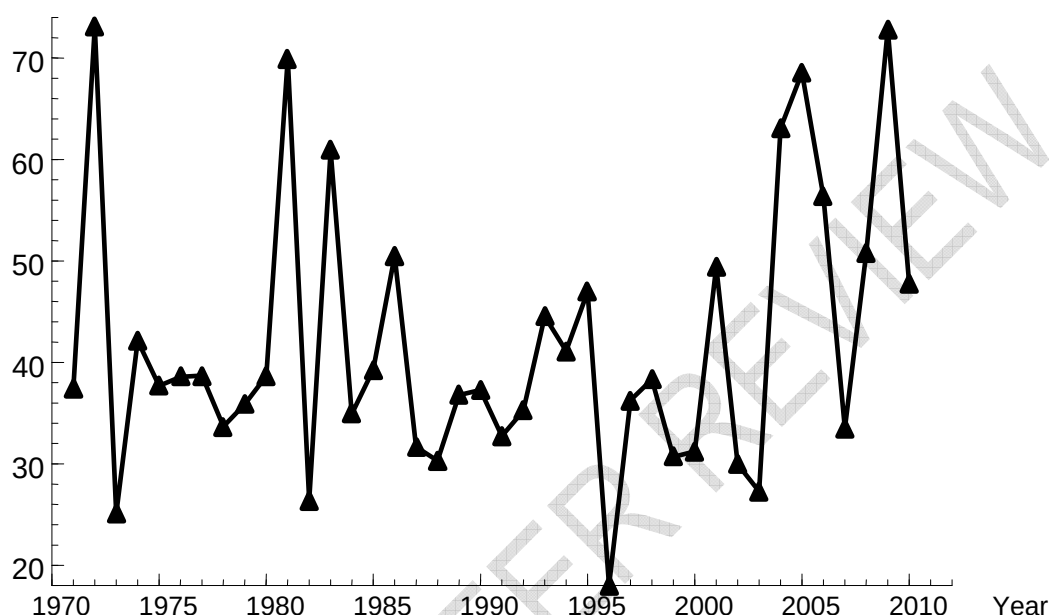
4.2 Trend in Economic Efficiency of Sugar Industry in Nigeria

Figure 1 shows the graphical representation of the trend in the estimated economic efficiency indices of sugar industry in Nigeria for the period 1971 to 2010. The economic efficiency index increases from 37% in 1971 to around 73% in 1972 probably due to increase in the federal government subvention to the industry arising from the oil boom of early 1970s [23]. In the period 1973 to 1980, the industrial policy of import substitution was overwhelmingly protective. However, the deliberate policy of maintaining an overvalued exchange rate and protective tariff created weak and drowsy manufacturing sector that was unwilling to compete and innovate. However, the sugar industry during this period was able to integrate most it operations backward through local sourcing of raw materials. The trend in economic efficiency exhibited an average downward trend and could be attributed to increase in volatility in some key macroeconomic variables during the period. The policy of import substitution pursued in Nigeria in the period 1981 to 1985 was characterized by high

311 levels of protection, fluctuating tariff structures, and ban of import of selected finished goods.
 312 Budgetary allocation to the real sector was quite low and direct government policy to support
 313 productive activities were unavailable.

314
 315
 316
 317

Figure 1: Trend in Economic Efficiency in the Sugar Industry in Nigeria



318
 319

320 In this period, trade policy with respect to the real sector focused on promoting domestic
 321 produced raw materials [22]. By the end of 1985s, the Nigerian economy was highly
 322 protected with an average unweighted nominal rate on imports of above 30 percent and
 323 individual tariffs were adjusted frequently, often on an ad-hoc basis. The oil shocks and the
 324 debt crisis during this period affected subventions to the sugar industry by the federal
 325 government. As a consequent, the indices of economic efficiency during this period assumed
 326 average downward trends. The adoption of the Structural Adjustment Programme (SAP) in
 327 1986 lead to the implementation of diverse liberalization measures including a sizeable
 328 devaluation and partial liberalization of the trade policies. During SAP era, the sugar industry
 329 focused on sourcing of raw material in the domestic market. However this attempt was
 330 constrained by increase volatility in macroeconomic variables and insufficient funds. The
 331 economic efficiency rose from 37% in 1990 to 44% in 1993 following the recapitalization of
 332 the industry by ADB and ADF in 1989 and 1991 respectively.

333

334 In the post-adjustment period (1994 to 2010), trade policy had deemphasized protection and
 335 import substitution and focused on export promotion [1]. Nigeria's adoption of trade
 336 liberalization led to a significant fall in import tariff. Incidences of tariff escalation and tariff
 337 peaks also declined. All of these work together to stifle much needed funds required by the
 338 real sector for working capital and investment financing. The economic efficiencies during
 339 this period (1994 to 2010) assumed undulating trend following the uncertainties that crowded
 340 the industry. Between 2002 and 2008, all the four sugar firms in Nigeria were partly
 341 privatized and the process of recapitalization by the co-investors was rather sluggish. Most
 342 of the sugarcane plantations were destroyed prior to privatization, government subventions
 343 to the sub sector was terminated and most capital equipment depreciated [37]. In addition,

the pressure on domestic sugar firms generated by increasing domestic demand causes an upsurge in raw and refined sugar imports. Domestic production was less than 4% of the total sugar consumption in the period 2004 to 2008 [17]. Increased in the sugar import in the country during the period (1994 to 2010) reduces competition in the sugar industry, hence the indices of economic efficiency decline during 1995 to 2004. In the period 2005 to 2010, there were traces of improvement in the efficiencies in the industry following attempts by the co-investors to recapitalize the sub sector. The index of economic efficiency rose from 63% in 2004 to 68% in 2005, and 72% in 2009.

4.3 Determinants of Economic Efficiency in Sugar Industry in Nigeria

Table 2 presents the result of estimation of various functional forms of economic efficiency equation in the sugar industry in Nigeria. The result of the diagnostic tests and the number of significant explanation variables present in each functional form favoured semi-log form as the lead equation. The R^2 for the lead equation explains 68.70% of the adjusted total variations in the sugar industry's economic efficiency. The F-statistic of 3.917 is significant at 1% probability level, indicating that the R^2 is significant and this implies that the equation had goodness of fit. The Durbin-Watson value of 2.08 indicates that autocorrelation was not a problem in the selected equation.

Table 2: Economic Efficiency Equations in Sugar Industry in Nigeria

Variable	Linear	Exponential	Semi-log (L)	Double- log
Constant	1.067 (3.70)***	0.539 (0.79)	-0.163 (-0.16)	-2.82 (-1.12)
SIMP _t	-1.49e-006 (-0.948)	-2.07e-006 (-0.56)	-0.023 (-1.14)	-0.041 (-0.18)
INFL _t	1.93e-005 (0.013)	0.0003 (0.09)	0.021 (0.76)	0.033 (0.48)
SG _t	0.002 (3.33)***	0.005 (3.04)***	0.019 (3.42)***	0.039 (2.72)**
ERT _t	-0.0002 (-0.89)	-0.0006 (-1.06)	-0.035 (-1.86)*	-0.087 (-1.87)*
RER _t	-0.002 (-1.08)	-0.004 (-1.11)	-0.081 (-3.04)***	-0.167 (-2.52)**
RWS _t	0.0003 (0.97)	0.0008 (1.00)	-0.009 (-0.13)	-0.002 (-0.01)
FS _t	3.32e-005 (0.16)	0.0002(0.33)	-0.0008 (-0.36)	-0.003 (-1.49)
K/L _t	4.58e-008 (2.23)**	1.12e-007 (2.29)**	0.116 (4.46)***	0.252 (3.89)***
GGDP _t	0.0003 (1.19)	0.0006 (0.94)	-0.0006 (-0.19)	-0.002 (-0.23)
OTR _t	0.004 (2.03)*	0.009 (1.96)*	0.051 (1.34)	0.137 (1.44)
PXR _t	-0.080 (-0.48)	-0.168 (-0.42)	-0.0002 (-0.004)	-0.009 (-0.005)
HC _t	-3.26e-005 (-0.41)	-5.04e-005 (-0.27)	-0.133 (-1.23)	-0.217 (-0.808)
PCUR _t	-0.756 (-2.41)**	-0.766 (-2.37)**	-0.448 (-2.26)**	-1.00 (2.03)**
D ₁	-0.0260 (-0.36)	-0.076 (-0.45)	0.157 (1.35)	0.289 (1.00)
R^2	0.578	0.545	0.687	0.629
F-Statistic	2.442**	2.137**	3.917***	3.039***
DW-test	2.38	2.47	2.08	2.22
Normality test	16.801 (0.0002)***	10.615 (0.0050)***	3.962 (0.0079)***	2.526 (0.2828)
Hetero-test	21.870 (0.7439)	28.553 (0.3829)	31.176 (0.2640)	24.188 (0.6199)
RESET –test	1.468 (0.2374)	3.7673 (0.0641)*	0.729 (0.4018)	0.009 (0.9216)

Note: Asterisk *, ** and *** represent 10%, 5% and 1% significance levels respectively. Variables are as defined in equation (2). L means the lead equation

As revealed in Table 2, the coefficient of sales growth (SG_t) is statistically significant at 1% probability level and is positively related to the economic efficiency in the sugar industry in Nigeria. This relationship indicates that increase in the sales growth increases the economic efficiency in the industry. This implies that 1% increase in the sales growth will increase economic efficiency by 0.019%.

Also the coefficient of real expenditure on research and training in the sugar industry (ERT_t) had a significant negative relationship (at 10% probability level) with economic efficiency. The result implies that as the expenditure on research and training in the industry increases, the industry's economic efficiency decreases. This means that one million naira increase in the research and training expenditure in the industry would result in 0.035 units decrease in

economic efficiency of the industry. The finding agrees with the results reported by [7] in Spain and [11] in Germany.

The coefficient of real exchange rate (RER_t) exhibited a significant negative effect (at one percent level) on the economic efficiency of sugar industry in Nigeria. The finding implies that a unit increase in the real exchange rate of naira for US dollar will lead to 0.002 units decrease in economic efficiency of sugar industry. The result suggests that the exchange rate policy adopted by the federal government of Nigeria impacted negatively on the economic efficiency of sugar industry in Nigeria. Similar result had been reported by [2] in Nigeria.

In addition, the slope coefficient of capital-labour ratio (K_t/L_t) was statistically significant at one percent level and positively related to the sugar industry's economic efficiency. The result implies that 10% increase in capital-labour ratio will increase economic efficiency by 1.16%. The result suggests that economic efficiency in the sugar industry could be enhanced if the change in the capital base of the sub-sector is greater than the same proportional increase in workforce. The result is in line with the findings reported by [18] in Malawi and [8] in Chile.

Furthermore, the coefficient of physical capacity utilization rate ($PCUR_t$) was statistically significant at 5% level and negatively correlated to the economic efficiency in the sugar industry in Nigeria. This relationship shows that increase in the physical capacity utilization rate decreases the economic efficiency in the sugar industry in Nigeria. The result indicated that a unit increase in the physical capacity utilization rate in the industry will decrease the economic efficiency by 0.448 units. The result is as expected, as increase in production would increase the total variable cost of the industry.

Table 3: Elasticity values of Significant Variables that affect Economic Efficiency in the Sugar Industry in Nigeria.

Variable	a	b	Elasticity value (b/a)
Sales growth (SG_t)	10.195	0.463	0.045
Expenditure on training and research (ERT_t)	0.157	-0.013	-0.084
Real exchange rate (RER_t)	0.741	-0.144	-0.194
Capital-Labour ratio (K_t/L_t)	0.034	0.009	0.278
Physical capacity utilization rate ($PCUR_t$)	3.603	-3.862	-1.072

Note: Parameters are estimated at the mean value of variables. **Functional form is semi-log.**

The result in Table 3 reveals that, economic efficiency in the sugar industry in Nigeria had inelastic association with respect to the industry's sales growth (SG_t), expenditure on research and training (ERT_t), real exchange rate (RER_t) and capital-labour ratio (K_t/L_t). This implies that 10% change in these variables would produce less than equivalent 10% change in the economic efficiency of the industry. On the other hand, economic efficiency in the industry had elastic correlation with respect to the physical capacity utilization rate. This means that a unit change in the physical capacity utilization rate in the industry will lead to more than equivalent unit change in the economic efficiency of the industry in the same period.

4.4 Assessment of the performance of Sugar Industry in import Substitution period (1970-1985) and liberalization period (1986-2010) in Nigeria

In assessing the performance of the sugar industry in the industrial policy periods in Nigeria, economic efficiency was descriptively analyzed and compared during the period of import substitution and period of liberalization. The level of economic efficiency achieved in the sugar industry was higher during years of import-substitution than liberalization (Table 4). This is suggested by higher maximum and average value of 73.07% and 42.16% respectively for economic efficiency during the period of import substitution compared to lower maximum and average value of 72.84% and 41.65% respectively during the

liberalization period. The values of coefficient of variability in the sub-periods suggest that fluctuation in the economic efficiency in the sugar industry was more during import-substitution period than liberalization period.

Table 4: Comparing Economic Efficiency in Sugar industry during periods of Import-Substitution and Liberalization in Nigeria.

Indicators	Import substitution Period (1971-1985)	Liberalization Period (1986-2010)
Minimum value (%)	25.07	18.02
Maximum value (%)	73.07	72.84
Mean value (%)	42.16	41.65
Coefficient of variability (%)	33.96	32.13
Excess efficiency (%)	57.84	27.16
Average growth rate (%)	14.01	8.67

Source: Computed by the author from the analysis data.

Comparing the values of excess efficiency in the sub-periods, the industry had more excess efficiency in the period of import substitution than liberalization. This implies that, the industry was more economically efficient in resource use during the period of liberalization than the import-substitution period. The growth rate in economic efficiency in the industry was higher during the import-substitution period than the liberalization period. Based on the descriptive analysis, we conclude that the industrial policy of liberalization period had a more stimulating influence on the sugar industry's economic efficiency than the import-substitution period. [2] in Nigeria confirmed a positive relationship between efficiency indices in the manufacturing sector and trade policy reform period.

5.0 Summary of findings and Recommendations

We used sugar industry data and macro-economic data from 1970 to 2010 to analyze economic efficiency in the sugar industry in Nigeria. The descriptive analysis of the economic efficiency indices in the industry reveals that the indices displayed minimal fluctuation that was invariant with time. The indices had an average value of 41.80% and excess economic efficiency of about 58.20%. The empirical results revealed that economic efficiency in the sugar industry had significant positive relationship with the industry's sales growth and capital-labour ratio. On the other hand, the industry's expenditures on research and training, physical capacity utilization rates and the real exchange rate of naira for US dollar impacted negatively on economic efficiency of the industry. we recommend that special policy instrument under the deregulation of exchange rate context should be set up to specifically address the issue of foreign exchange constraint to genuine industrialists in the sugar industry. Also, capital intensive method of production should be adopted as a means of promoting economic efficiency of resource use in the industry. Furthermore, effective marketing policy on the industry manufactures is strongly recommended as this will stimulates sale growth and economic efficiency in the industry. Government should increase budgetary allocation to the Sugarcane Research Development and Training Center to intensify its activities in areas of manpower development, information dissemination on improved varieties of sugarcane to farmers and sugar firms in the country. Finally, the industrial policy package for the industry during liberalization period should used as a basis for promoting economic efficiency in the industry in Nigeria.

References

1. Adenikinju, A. (2003). "African Imperatives in the New World Trade Order Country Case Study of the Manufacturing Sector: Nigeria". Final Report Submitted to the AERC, Nairobi, Kenya.
2. Adewuyi, A. O. (2006). Trade Policy Reform and Technical Efficiency in Nigerian's Manufacturing Sector. A paper Prepared for the African Econometrics Society (AES) Conference at Nairobi, Kenya.
3. Admassie, A. (2002). "Technical Efficiency of Small- and Medium- Scale Enterprises: Evidence from a Survey of Enterprises in Tanzania," *Eastern Africa Social Science Research Review*, Vol. 18, No. 2, 2002, 1-29.
4. African Development Bank Document (ADB) (2000).
5. African Development Fund (ADF), 2000. Operations Evaluation documents.
6. Alam, M. S and A. R. Morrison (2000). A Trade Reform Dynamics and Technical efficiency: The Peruvian Experience@. *The World Bank Economics Review*, Vol. 14, No 2: 309 -330.
7. Albert, m. g and j. m. (2000). The determinant of efficiency: the cas of the Spanish industry. *Applied economics*, vol.34, Issue 15, pages 1941-1948.
8. Alvarez, R. and Gustavo C.. (2003). Determinants of technical efficiency in small firms. *Small Business Economics*, 20; 233-244.
9. Anyanwu, J. C., Oyefusi A. Oaikhenan H., and Dimowo, F. A. (1997). The Structure of the Nigerian Economy (1960-1997). Onitsha Joanee Educational Publisher.
10. Badunenko, O., and A. Stephan, (2004). The Potential determinants of German Firms Technical Efficiency Using Industry Level Data. A Publication of European University, Viadrina, Faculty of Economics, Germany.
11. Badunenko, O., Michael F., and Adreas S. (2006). What determines the technical efficiency of a firm? The importance of industry, location and size. A research project sponsored by German Institute for economic research and German statistic office in Wiesbaden.
12. Battese, G. E. and Coelli, T. J. (1995). A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data. *Empirical Econ.*, 20:325-332.
13. Battese, G. E. and S.S. Broca, (1997). "Functional forms of stochastic frontier production functions and models for technical inefficiency effects. A comparative study for wheat farmers in Pakistan" *journal of productivity Analysis*, 8(4), 395-414.
14. Bitros, G. C. (2002). Firm ownership and economic efficiency. A publication of Athens University of Economic and Business.
15. Busari, L. D., and S. M. Misari, (1996). Sugar and sugarcane in Nigeria. A Publication of NCRI in Nigeria.

16. Central Bank of Nigeria (CBN), Statistical Bulletins 2008.
17. Central Bank of Nigeria (CBN), Statistical Bulletins 2010.
18. Chirwa, E. W. (2000). A Structural Adjustment Programme and Technical efficiency in Malawian Manufacturing Sector. A project sponsored by the African Development Bank.
19. Chu, S. and Kaliappa K. (2010). Impact of trade liberalization on technical efficiency of Vietnamese manufacturing firms. Paper for presentation at the Conference on "Frontier Issues in Technology, Development and Environment" organised by the Madras School of Economics and the Forum for Global.
20. Djankov, S., and Murrell, P. (2002). Enterprise restructuring in transition; a quantitative survey, *Journal of Economics literature*. 40: Pp. 739-792.
21. Faruq, H, A., and David T. Y. (2010). The Determinants of Technical Efficiency of Manufacturing Firms in Ghana. *Global Economy Journal*, Volume 10, Issue 3. Article 7. <http://www.bepress.com/gej/vol10/iss3/7>.
22. Fine, Jeffrey, (2001) "Implementing Trade Policy in Nigeria: Findings and Recommendations", Chemonics.
23. Gunning, J. W. (1994). "Trade reform in Africa: The role of donors". In J. W. Gunning, H. Kox, W. Tims and Y. de Wit., eds., *Trade, Aid and Development*, pp. 86–98. Basingstoke and London: Macmillan.
24. Lafiagi, M. S., 1984. Towards Self-Sufficiency in Sugar Production in Nigeria. Memo Submitted to Federal Ministry of Commerce and Industry pp 1 – 46.
25. Michael David, USDA foreign Agricultural service on sugar imports in Nigeria, 2010.
26. National Bureau of Statistics Publication, 2006 publication. www.nigeriastat.gov.ng/. Retrieved 11-12-2010.
27. National Population Commission (NPC), 2006 National Census Data. www.population.gov.ng/. Retrieved 10-12-2010.
28. National Sugar Development Council of Nigeria (NSDC). A Publication of the federal ministry of Industry Abuja (FMI), Nigeria (2003); (2010) and (2011). Nigerian Financial Business News, Dec., 2010. www.thenigeriabusiness.com/. Retrieved 13-12-2010.
29. Niringiye, A., Luvanda E., and Shitundu J. (2010). Firm Size and Technical Efficiency in East African Manufacturing Firms. *Current Research Journal of Economic Theory* 2 (2): 69-75.
30. Njikam, O. (2000). A Trade Reform Efficiency in Cameroonian Manufacturing Industries A Final report presented at November - December 2000 AERC Workshop. Nwaobi, G. C., 2005. The Nigerian Sugar Industry (1960- 1987). 0501001, *EconsWPA*.

- 574 31. Nwaobi, G. C. (2005). The Nigerian sugar industry (1960- 1987). 0501001,
575 *EconsWPA*.
576
577 32. Ogun, O. (1987). Nigeria's Trade Policy During and After the Oil Boom: An
578 Appraisal, University of Ibadan, 1987.
579
580 33. Ogundari, K., Ojo S.O., Ajibefun I. A., 2006. Economics of scale and cost efficiency
581 in small scale maize production. Empirical evidence from Nigeria. *Journal of Social*
582 *Sciences*, 13 (2): 131–136.
583
584 34. Olomola, A. S. (2007). Competitive commercial Agriculture in Africa study (CCAA),
585 Nigeria case study. A final report submitted to the Canadian International
586 Development agency (CIDA) and the World Bank.
587
588 35. Onn, F. C. (1990). Small and medium industries in Malaysia: Economic efficiency
589 and entrepreneurship. *The developing economies*, XXVIII Pp 152-179.
590
591 36. Ray, S. (2003). Economic reforms and efficiency of firms: the Indian manufacturing
592 sector in the nineties. A paper presented at the institute of economic growth,
593 University of Delhi, India.
594
595 37. Savannah Sugar Company limited (SSC) (2010). Production Data for Savannah
596 Sugar Company Ltd., Numan, 1983-1999.
597
598 38. Soludo, C. C. and A. F. Adenikinju, (1996). "Economic Policy and Total Factor
599 Productivity in Nigeria's Manufacturing Sector", Final Report Submitted to the
600 Development Centre, OECD, Paris.
601
602 39. Federal Ministry of Industry Abuja (FMI), Nigeria (2003). "National Sugar Policy". A
603 Publication of National Sugar Development Council of Nigeria.
604
605