DOES ANNUAL OUTPUT OF PALM OIL, PALM KERNEL AND RUBBER CORRELATE WITH SOME MACRO-ECONOMIC POLICY VARIABLES IN NIGERIA?

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ABSTRACT

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The study modeled palm oil, palm kernel and rubber annual output equations in Nigeria. Time series data were used in the analysis, and the time frame covered the period 1962 to 2013. The data were obtained from the Food and Agriculture Organization; Central Bank of Nigeria and National Bureau of Statistics. Augmented Dickey-Fuller unit root test revealed that, specified macroeconomic variables were non-stationary at level but stationary at first difference. Following these results, cointegration and error correction models were specified. The coefficient of the ECM for each crop equation was negative and statistical significant at conventional probability levels, thus justifying the long run equilibrium relationship in the specified crop output equations. The empirical results revealed that, per capita GDP, industrial capacity utilization, lending interest rate and kilowatts per capita of electricity influenced the output of palm oil, palm kernel and rubber in the long run; whereas, per capita GDP was significant variable in the short run. The result revealed the need to stabilize some macroeconomic variables in order to attain sustainable agricultural production in Nigeria. Hence, it is recommended that, the country should expand its industrial capacity; increase the per capita income or the demand capability of Nigerians and also increase the Kilowatts per capita of electricity in the country. In addition, the study upholds that, government should intervene in the lending policy of commercial bank. Lending policy should be influence to favour lower lending rate to the agricultural sector in the country.

Keywords: Palm oil, palm kernel, rubber, macroeconomic, Nigeria

INTRODUCTION

Palm oil and palm Kernel as well as the Rubber sub-sectors are integral part of the nation’s economy. These sub-sectors were one of the major earners of foreign exchange before crude oil exploitation started in early 1970s in Nigeria (Ogen, 2007; Akpan, et al., 2012). Nigeria economy during the first decade after independence was considered as an agricultural based economy because agriculture served as the engine for all sectors of economy (Ogen, 2003). Agricultural sector was the major contributor to the country’s gross domestic product (GDP). For instance, the agricultural sector contributed over 60% of the GDP in the 1960s, and despite that the bulk of the farmers were peasants thus employing traditional tools and indigenous farming methods; these farmers produced about 70% of Nigeria’s exports and 95% of its food needs (Lawal, 1997). During this period Nigeria was the world’s second largest producer of cocoa, largest exporter of palm kernel and largest producer and exporter of palm oil. The country was also a leading exporter of other major commodities such as cotton, groundnut, rubber, hides and skins (Alkali, 1997). The agricultural sector now accounts for less than 5% of Nigeria’s GDP (Olagbaju and Falola, 1996). Historically, the roots of the crisis in the agricultural sector lie in the neglect of this critical sector and the increase dependence on a mono-cultural economy based on crude oil importation (Ogen, 2003). In several attempts to revive the agricultural sector, the federal government had formulated and implemented several macroeconomic policies ranging from the use of fiscal (tax, investment and government expenditure) and monetary (money supply, interest rate) policies instrument, set up institutional frameworks and programmes to accelerate the growth of the agricultural sector and the economy at large. The agricultural sector was one of the top priority areas of the federal government. Tax incentives, export incentives and arrays of agro-based institutional frameworks among others were instituted in favour of the agricultural sector (Akpan, 2012; Akpan, et al., 2012.). Despite the incentives to the agricultural sector, the agricultural GDP witnessed a negative growth rate of about -28.21% between 2004 and 2005. However, following the marginal increase in the agricultural output in recent years, many economic analysts have attributed the growth to the expansion in cultivated land which has implication on the green economy envisaged globally (Akinbile and Adekunle, 2000, Okiki et al., 2001, Raufus, 2010 and Udoh et al., 2011). In addition, this growth has not been able to trickle down to the poorest of the poor, and has not helped tackle the problem of unemployment and underemployment of the rural youth (Fan et al., 2008; Akpan, 2010). Analysts have pinpoint uncertainty in the macroeconomic environment as one of the problem areas of agricultural sector in Nigeria (Ogen, 2003; Akpan et al., 2012). The macroeconomic environment consists of the fiscal, monetary, exchange rate regimes and trade policies among other policies tended to regulate production activities in the real sectors and other sectors including the agricultural sector. Macroeconomic policy outcomes in any
economy vary greatly depending in part on the policy targets and instruments employed as well as operating environment (Agu, 2007). Sound macroeconomic policies are important to achieve national development targets through agricultural development (Fan et al., 2008). Macroeconomic variables have serious economic and development implication for the sustenance of green agricultural production and stimulation of export. The achievement of green economy’s objective has a lot to do with the stability of macroeconomic variables in the country. A Green Economy promotes a triple bottom line: sustaining and advancing economic, environmental and social well-being. Hence for Nigeria to key into this global concept, there is an overwhelming need to understand the working relationship between some macroeconomic variables and sub-sectoral outputs of agriculture in Nigeria.

However, several literature have relate agricultural output with some macroeconomic variables in Nigeria. For instance, Nwosa and Akinbobola (2012) examined nexus between aggregate energy consumption and sectoral output in Nigeria for the period spanning 1980 to 2010. Utilizing a bi-variate Vector Autoregressive (VAR) model, the study observed bi-directional causality between aggregate energy consumption and agricultural output. Liew et al., (2012) analyzed the interdependence relationship between energy consumption and sectoral outputs in Pakistan for the period 1980 to 2007. The study utilized the Johansen-Juselius co-integration approach and the Granger causality test. The co-integration estimate revealed that energy consumption exhibited long-run relationship with the agriculture as well as with services output. Chebbi and Boujelbene (2008) examined the co-integration and causal nexus between energy consumption and sectoral output in Tunisia for the period 1971 to 2003. The sectors covered included agricultural; manufacturing, and services sector as well as the overall gross domestic product. Utilizing the Johansen’s co-integration technique and the Vector Error Correction Model (VECM), the study observed that the various sectors (agriculture, manufacturing and service) and overall gross domestic product are co-integrated with energy consumption. Akpan, et al. (2012) established empirical relationship between agricultural productivity and some key macroeconomic variables in Nigeria. The short-run and long-run elasticity of the agricultural productivity with respect to some key macro-economic variables were determined using the techniques of co-integration and error correction models. The empirical results revealed that in the short and long run periods, the coefficients of inflation rate has a significant negative relationship with the agricultural productivity in the country; whereas industry’s capacity utilization rate has positive association with agricultural productivity in both periods. However, per capita real GDP influence on the agricultural productivity was positive and significant only in the ECM model. Olatunji, et al. (2012), empirically analyzed the relationship between agricultural production and Inflation rate from 1970 to 2006 in Nigeria. They discovered that, there is direct relationship between agricultural output change and inflation rate in Nigeria. Amassoma, et al. (2011), examined the nexus of interest rate deregulation, lending rate and agricultural productivity in Nigeria by employing co-integration and error correction techniques on annual data spanning from 1986 to 2009. The study showed that interest deregulation had a positive and significance effect on agricultural productivity. Ezeanyeji, (2014) examines the impacts of interest rate deregulation on agricultural productivity from 1986 to 2010 in Nigeria. The findings showed that interest rate deregulation has significant and positive impact on agricultural productivity in Nigeria within the period under review. The empirical works reviewed so far have only relates aggregate agricultural output to some macroeconomic variables. The literature is silent on the relationship between individual crop output and some macroeconomic variables in Nigeria. Hence, this research was designed to fill this gap in the literature. Such relationship is crucial and will be one of the reliable tools needed to accelerate productivity in the agricultural sector, sustain the environment as well as improve farmers’ well-being in the country.

The main objective of this study is to establish the empirical relationship between cash crop outputs and some macroeconomic variables in Nigeria. Specifically, the study established the short and the long run links between palm oil, palm kernel and rubber outputs and some key macroeconomic fundamentals in the country.

METHODOLOGY

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 about 923,769km² (or about 98.3 million hectares) with 853km of coastline along the northern edge of the Gulf of Guinea and a population of over 140 million people (NPC, 2006). Nigeria is bounded by the Republics of Benin in the west, Chad and Cameroon in the east and Niger to the north.

Data source: Secondary data were used for the study. These data were sourced from several publications of Central Bank of Nigeria (CBN), National Bureau of Statistics and Food and Agricultural Organization (FAO). Data covered the period from 1962 to 2013.

A time dependent regression model to capture the dynamic nature of annual output of palm oil, palm kernel and rubber equations in relation to some macroeconomic variables was specified at the level of variables. Hence, the study applied the Engle and Granger two-step technique to test for the long run relationship (co-integration) among variables specified. The lag length was kept at unity to improve the degree of freedom and the confident
interval of estimates. The decision was informed by the significant lag length indicated by the Akaike Criterion, Hannan-Quinn and Schwarz Criterion. The long run model is specified as follows:

\[
\ln PAO_t = \gamma_0 + \gamma_1 \sum_{i=1}^{n} \ln IFL_{t-i} + \gamma_2 \sum_{i=1}^{n} \ln DEM_{t-i} + \gamma_3 \sum_{i=1}^{n} \ln ENE_{t-i} + \gamma_4 \sum_{i=1}^{n} \ln ICU_{t-i} + \gamma_5 \sum_{i=1}^{n} \ln INT_{t-i} + U_t \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots 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Cointegration test for palm oil, palm kernel and rubber output in Nigeria

The study applied the Engle and Granger two-step technique to examine cointegration or long run relationship among time series. The result of the Engle and Granger two-step technique of cointegration test is presented in the lower portion of Table 2. The results show that at the 10% and 5% probability levels of significance, the Engle–Granger cointegration tests rejected the null hypothesis of no cointegration for palm oil, palm kernel and rubber equation respectively. The result implies that, there is a long run equilibrium relationship between quantity of palm oil, palm kernel and rubber produce and some major macroeconomic variables in Nigeria. The upper part of Table 2, also present the long run estimates for the respective output equation. The estimated coefficients represent the long run output elasticity with respect to each specified macroeconomic variable.

Table2: Relationship between palm oil, palm kernel and rubber output some macro-policy variables in Nigeria

<table>
<thead>
<tr>
<th>Variables</th>
<th>Palm oil</th>
<th>Palm Kernel</th>
<th>Rubber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>5.254 (12.39)**</td>
<td>4.480 (7.786)**</td>
<td>3.352 (5.376)**</td>
</tr>
<tr>
<td>LnDEMt 1</td>
<td>0.106 (7.405)**</td>
<td>0.268 (13.73)**</td>
<td>0.108 (5.131)**</td>
</tr>
<tr>
<td>LnCU1t</td>
<td>0.157 (1.836)*</td>
<td>0.251 (2.160)**</td>
<td>0.003 (0.026)</td>
</tr>
<tr>
<td>LnINTt</td>
<td>0.233 (3.067)**</td>
<td>0.057 (0.557)</td>
<td>0.443 (3.978)**</td>
</tr>
<tr>
<td>LnENEt</td>
<td>-0.148 (-2.941)**</td>
<td>-0.363 (-5.324)**</td>
<td>-0.206 (-2.790)**</td>
</tr>
<tr>
<td>LnINPt</td>
<td>-0.053 (-2.516)**</td>
<td>-0.048 (-1.686)*</td>
<td>-0.011 (-0.340)</td>
</tr>
<tr>
<td>R²</td>
<td>0.840</td>
<td>0.913</td>
<td>0.824</td>
</tr>
<tr>
<td>F-Cal</td>
<td>48.353***</td>
<td>96.956***</td>
<td>43.182***</td>
</tr>
<tr>
<td>DW</td>
<td>0.793</td>
<td>0.926</td>
<td>0.806</td>
</tr>
</tbody>
</table>

Note: the equation for the ADF test include constant and trend. Values in bracket represent t-values. The asterisk *** represents 1% significance level. Variables are as defined in equation 1.

Error correction model for agricultural productivity in Nigeria

The primary reason for estimating the ECM model is to capture the dynamics in palm oil production, palm kernel and rubber outputs in Nigeria. It also aimed at generating the short run elasticity of these agricultural outputs with respect to some macroeconomic variables in Nigeria. The ECM in addition intended to identify the speed of adjustment of palm oil, palm kernel and rubber as a response to departures from the long-run equilibrium. However, the study adopted Hendry’s (1995) approach in which an over parameterized model is initially estimated and then gradually reduced by eliminating insignificant lagged variables until a more interpretable and parsimonious model is obtained. The result of the exercise is presented in Tables 3. The slope coefficient of the error correction term is negative and statistically significant at 1% probability level for palm oil (-0.372), palm kernel (-0.511) and rubber (-0.473) output equation. The result validates the existence of a long-run equilibrium relationship in palm oil, palm kernel and rubber output equations. This also indicates that, theseus outputs are sensitive to departure from their equilibrium quantity in previous periods. Hence, the slope coefficient of the error correction term in each output equation represents the speed of adjustment and also is consistent with the hypothesis of convergence towards the long-run equilibrium once their respective equation is shocked. The coefficient of error correction term (ECMt) suggests that, the deviation from the long run equilibrium quantity is corrected at the rate of 37.20%, 51.10%, and 47.30% per annum for palm oil, palm kernel and rubber output respectively.
Table 3: Error correction model estimates for palm oil, palm kernel and rubber output and it relationship with some macro-policy variables in Nigeria

<table>
<thead>
<tr>
<th>Variables</th>
<th>Palm oil</th>
<th>Palm Kernel</th>
<th>Rubber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.004 (0.211)</td>
<td>-0.032 (-1.186)</td>
<td>-0.005 (-0.182)</td>
</tr>
<tr>
<td>Self Lag</td>
<td>0.133 (0.881)</td>
<td>0.216 (1.427)</td>
<td>0.146 (0.979)</td>
</tr>
<tr>
<td>ΔLnDEMi</td>
<td>0.049 (0.667)</td>
<td>0.269 (2.610)**</td>
<td>0.198 (1.718)*</td>
</tr>
<tr>
<td>ΔLnICUi</td>
<td>0.037 (0.303)</td>
<td>-0.011(-0.069)</td>
<td>0.044 (0.244)</td>
</tr>
<tr>
<td>ΔLnINTi</td>
<td>0.071 (0.689)</td>
<td>0.019 (0.137)</td>
<td>0.149 (0.989)</td>
</tr>
<tr>
<td>ΔLnENEi</td>
<td>-0.002(-0.821)</td>
<td>-0.091(-0.655)</td>
<td>-0.257(-1.671)</td>
</tr>
<tr>
<td>ΔLnICFi</td>
<td>-0.26 (-1.468)</td>
<td>0.024 (0.974)</td>
<td>-0.0005(-0.016)</td>
</tr>
<tr>
<td>ECMt-1</td>
<td>-0.372 (-2.910)***</td>
<td>-0.511 (-4.105)***</td>
<td>-0.473 (-3.770)***</td>
</tr>
<tr>
<td>R²</td>
<td>0.200</td>
<td>0.413</td>
<td>0.353</td>
</tr>
<tr>
<td>F-Cal</td>
<td>1.502</td>
<td>4.226***</td>
<td>3.279***</td>
</tr>
<tr>
<td>DW</td>
<td>2.047</td>
<td>1.944</td>
<td>2.165</td>
</tr>
</tbody>
</table>

Note: Values in bracket represent t-values. The asterisk *** represents 1% significance level. Variables are as defined in equation 3.

The diagnostic tests for the error correction models revealed R² values of 0.222, 0.413 and 0.353 for palm oil, palm kernel and rubber output equation respectively. This means that, the specified explanatory time series explained about 22.22%, 41.30% and 35.30% of adjusted total variations in palm oil, palm kernel and rubber output respectively. The F-statistics are significant for palm kernel and rubber outputs. The Durbin-Watson values for the three output equations did not revealed serious autocorrelation problem. The ECM model has been shown to be robust against residual autocorrelation. Therefore, the presence of autocorrelation does not significantly affect the estimates (Laurenceson and Chai, 2003).

DISCUSSION

In the long run model, the coefficient of per capita GDP is positive and significant (at 1% level) in palm oil, palm kernel and rubber output equation. This result implies that, as domestic purchasing power which often proxy aggregate demand increases, the output of these agricultural commodities increase too. In the short run, this relationship was replicated in palm kernel and rubber output equations. This result agrees with empirical finding of Akpan et al., (2012) in Nigeria. The long run elasticity of palm oil, palm kernel and rubber with respect to the industrial capacity utilization rate (ICU) is significant and positive. This means that, the domestic industrial utilization of these agricultural commodities increases with increase in outputs. Given this result, it implies that, palm oil, palm kernel and rubber are significant sources of raw material to the manufacturing firms in the country. In another way, the result portrays a good backward integration potential in these agricultural commodities in to the manufacturing sector in the country. This result corroborates the empirical results reported by Akpan et al., (2012) in Nigeria.

However, the long run slope coefficient of lending interest rate (INTt) showed positive correlation with palm oil and rubber output in Nigeria. This result is contrary to the expected result. It is suspected that, due to the insufficient credit facilities available to farmers in the country, tree crop farmers will still go for loan facilities even with high interest rate. This result is in consonance with the reports of Amassoma, Nwosu, and Ofere (2011) and Ezeaneyeji, (2014) in Nigeria. The long run coefficient of Kilowatts per capita (ENEt) of electricity consumed which proxies’ infrastructure availability exhibited a significant negative correlation with the outputs of palm oil, palm kernel and rubber in Nigeria. This result gives a clear picture of the devastating nature of electricity consumption in the country. The result suggests that, farmers do not readily have access to sufficient Kilowatts of electricity they need for their agricultural activities. The result is rather robust and may indicate the necessity of energy (electricity) in palm oil, palm kernel and rubber production and processing in the country. This result is in agreement with the research findings of Chebbi and Boujelbene (2008); Akpan et al., (2012), Nwosa and Akinbobola (2012) and Liew et al. (2012) in Nigeria.

In addition, palm oil and palm kernel production has a significant negative long run elastic relationship with respect to the annual inflation rate in Nigeria. This result reveals that, escalating inflation rate has significant probability to reduce palm oil and palm kernel production in the country. However, this relationship was not significant in the short run period in the country. Akpan et al., (2012) and Olutunji, Omotesho, Ayinde, and Adewumi, (2012) found similar result in Nigeria.

SUMMARY AND RECOMMENDATIONS

The study established the short and long run empirical relationship between palm oil, palm kernel and rubber outputs and some key macro variable indicator in Nigeria. The data properties were analyzed to determine the stationarity of time series using the Augmented Dickey-Fuller unit root test. The result indicates that the series used in the analysis were integrated of order one in ADF equation that contains trend only. Engle Granger two –
step cointegration test was conducted for the specified variables. The long and short run output equation was estimated for palm oil, palm kernel and rubber commodity. The Ordinary Least Squares technique (OLS) was used to estimate the time dependent double-logarithm function specified. The diagnostic tests generated showed minimal influence of auto correlation and other econometric problems. The empirical findings show that some key macro indicators in Nigeria’s economy have significant relationship with the palm oil, palm kernel and rubber outputs. The result reveals that these crop outputs have significant long run relationships with per capita GDP, industrial capacity utilization, lending rate, per capita energy consumption and inflation rate in the country. In the short run, outputs of palm kernel and rubber are significantly influence by per capita GDP. For a greener economy in the country, the findings call for macroeconomic policies that should focused on improvement in industrial capacity utilization rates, increase in per capita consumption of energy as these will stimulate outputs of palm oil, palm kernel and rubber. Government policy aim at reducing inflation rate will help to promote increase productivity in palm oil, palm kernel and rubber outputs. The commercial Banks lending rate should be regulated in favour of agricultural sector in the country.

REFERENCES


