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## **Determinants of Selected Agricultural Export Crops in Nigeria: An Ecm Approach**

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### **Abstract**

This study examines the factors that determine the export performance of three major agricultural exportable commodities of cocoa, rubber and palm-kernel in the context of liberalization. Using time series data covering thirty three years and to avoid spurious result, error correction model was applied in the analysis. The unit root test is in line with the *a priori* expectation that macroeconomic variables are not stationary at their level. Virtually all the variables tested were differenced once before attaining stationarity. Each of the three equations indicated that the dependent variables cointegrated with their arguments at 1 percent level. There is the existence of short term and long term equilibrium relationships between the dependent variables and their determinants. The results of the parsimonious error correction specifications showed that the previous year's output and the net value of world trade negatively affect cocoa exports at 1 percent level while the previous year's GDP positively contributes to cocoa exports at 5 percent. The lagged price ratio reduces rubber exports significantly at 5 percent but the real exchange rate significantly increases the export performance of rubber at 10 percent level. The previous year's exports of palm kernel and the real GDP contributed positively to palm-kernel exports at 5 percent level while the lagged premium and palm kernel output negatively contributed to its export at 5 percent and 10 percent respectively. Promotion of agricultural exports is essential to reduce the burden of dependence on oil exports

**Key words:** Agricultural exports, Cointegration, ECM, Nigeria

### **Introduction**

In the 1960's, Nigeria economy was largely sustained, at least from the point of view of off shore commitments, by the export earnings from basic agricultural and mineral commodities. The export list of the country within this period comprised groundnut, cocoa beans, palm oil and kernel, cotton, rubber, ginger, copra, hides and skins, timber, zinc, columbite, tin and lead. However, the commencement of large scale exploitation and exportation of crude petroleum in the early 1970s and the huge inflow of foreign exchange revenues therefrom diverted the attention of the government and a large percentage of the agricultural producers into other activities aimed at exploiting the economic boom. This development heralded the decline in agricultural production and the resultant drop in volume and value of the traditional export commodities (Ihimodu, 1993). The introduction of SAP in 1986 and a policy shift towards support for growth of traditional non-oil exports, led to an appreciable increase in exports. However, this growth of non-oil exports has not been consistent. Infact, the contribution of the non-oil sector to foreign earnings remain abysmally low representing less than 1% between 2000 and 2004 (CBN, 2004). Even then, primary agricultural produce remains a formidable

non-oil sector contributing about 33% of total non-oil foreign earnings and second only to semi-manufactured products with 48.9% (CBN, 2004). The devaluation of the currency with the attendant increase in domestic prices of exports is nonetheless identified as one of the major factors responsible for the increase. This study examines the relationship between the key factors on the export of some selected agricultural crops.

### **Materials and Methods**

#### ***Scope and Source of Data for the Study***

This study covered export of three major agricultural exportable commodities in Nigeria, cocoa, rubber and palm kernel. The analysis covered the period between 1970 and 2002 and the study focuses on the determinants of agricultural exports in Nigeria. Secondary sources of data are used in this study. Such sources are:

- (i) The federal Office of statistics.
- (ii) The C.B.N. Statistical bulletin

#### **Methodological Framework**

The data for this study were analyzed using error correction mechanism (ECM). The stationarity levels

of the variables were determined using Phillips Peron (PP) test. The Phillips-Peron (PP) test, is non-parametric and usually produces a superior result that corrects for serial correlation and heteroscedasticity. The PP test is also known to be better in the presence of regime shift which is a problem usually encountered with African macroeconomic data. Thereafter, cointegration test was carried out using PP test also. The cointegration test is carried out to generate an error correction model. It employs the Engle-Granger two step method (Engle and Granger 1987). Cointegration is accepted when the residuals from the linear combination of non-stationary I(1) series are themselves stationary. In essence, if we are dealing with time series data, we must make sure that the individual time series are either stationary or that they are cointegrated. Otherwise, the result may be spurious (Gujarati 1999). The critical values for accepting or rejecting the hypothesis have been given in a number of studies from Monte Carlo simulations (Fuller, 1978; Phillips, 1987; Perron, 1988; Dickey and Fuller, 1981; Blangiewicz and Charemza, 1990).

### The Model

Having established the level of stationarity of the variables and the existence of cointegration among them, an ECM equation was specified for them. In explicit terms, this can be re-written as:

$$\ln QE_{it} = \alpha_0 + \alpha_1 \ln(P^{e_{it}} / P^{d_{it}}) + \alpha_2 \ln PR_{it} + \alpha_3 \ln VWT_t + \alpha_4 \ln GDP_t + \alpha_5 \ln ER_t + PREMIUM_{it} + U_{it}$$

This is a modified form of the equation adopted in the work of Tambi, 1999. The modification involves the inclusion of the Premium in the model. Where:

$\ln QE_{it}$  = the quantity of the  $i$ th commodity exported in thousand metric tonnes.

$\ln (P^{e_{it}} / P^{d_{it}})$  = the price ratio of the  $i$ th commodity, where  $P^{e_{it}}$  is the export unit value index and  $P^{d_{it}}$  is the domestic unit value index and  $P^{d_{it}}$ .

$\ln VWT_t$  = the net exports value which invariably is the balance of trade

$\ln GDP_t$  = the real gross domestic product measured at 1984 factor cost in billion naira.

$\ln PR_t$  = the quantity of domestic production of the  $i$ th commodity in thousand metric tonnes.

$\ln ER_t$  = the exchange rate in terms of units of foreign currencies (N/US\$).

$PREMIUM_t$  = the extra amount added to the official real exchange rate by the parallel market operators. In addition, the premium is defined as the parallel rate minus the official rate over the official rate multiply by 100, and  $U_t$  is a stochastic error term and it is assumed to be independently and normally distributed with zero mean and constant variance (Nkurunziza 2002).

A priori, the price ratio  $P^{e_{it}} / P^{d_{it}}$ ,  $PR_{it}$ ,  $GDP_t$ ,  $ER_t$  are expected to have a positive effect on  $QE_{it}$  and is intended to capture the profitability of exports. On the other hand, A negative relationship is expected between premium  $PREMIUM_t$  and exports. The net value of world trade can take either sign depending on whether or not exports exceed imports.

### Results and Discussion

#### *Determinants of the export performance of three agricultural exportable crops using ECM*

#### *Unit root tests of variables used*

The examination of the time series properties of the variables used is presented in table 1.

**Table 1:** Unit root tests of variables using Phillips-Perron (PP)

| VARIABLES       | PP AT LEVEL | PP AT FIRST DIFFERENCE |
|-----------------|-------------|------------------------|
| Ln (QCE)        | -2.82       | -12.69                 |
| Ln (QCE)        | -2.83       | -7.06                  |
| Ln (QCE)        | -1.29       | -7.93                  |
| PREMIUM         | -2.53       | -4.72                  |
| Ln (VWT)        | -0.99       | -7.70                  |
| Ln (WPC/PPC)    | -0.41       | -5.05                  |
| Ln (WPR/PPR)    | -2.94       | -5.16                  |
| Ln (WPPK/PPPK)  | -2.54       | -8.55                  |
| Ln (COP)        | -2.65       | -7.65                  |
| Ln (RBP)        | -0.83       | -7.03                  |
| Ln (PKP)        | -2.00       | -6.11                  |
| Ln (GDP)        | 2.11        | -6.87                  |
| Ln RER          | 2.28        | -4.63                  |
| CRITICAL VALUES |             |                        |
| 1 PERCENT       |             |                        |
| 5 PERCENT       | -3.65       | -3.66                  |
| 10 PERCENT      | -2.96       | -2.96                  |
|                 | -2.62       | -2.62                  |

The table reveals that virtually all the variables tested are not stationary at their level. This indicates that the variables are  $I(1)$  and any attempt to specify the dynamic function in the level of these series will be inappropriate and may lead to problem of spurious regression. Also, the econometrics result of the model in the level of the series may not be ideal for policy making (Adams, 1992).

#### *Cointegration regression results of dependent variables*

Cointegration test was carried out using PP to confirm that the residuals of the non-stationary series  $y$  and  $x$  that are  $I(1)$  are actually  $I(0)$ .

**Table 2:** Cointegration regression result of dependent variables on their residuals

| VARIABLE        | P.P   | DECISION RULE                   |
|-----------------|-------|---------------------------------|
| Ln (QCE)        | -5.50 | Cointegrated at 1 percent level |
| Ln (QRE)        | -5.60 | Cointegrated at 1 percent level |
| Ln (QPKE)       | -5.11 | Cointegrated at 1 percent level |
| Critical Values |       |                                 |
| 1 Percent       | 3.65  |                                 |
| 5 Percent       | 2.96  |                                 |
| 10 Percent      | 2.62  |                                 |

All the dependent variables were found to cointegrate with their determinants at the conventional 1 percent levels. The existence of cointegration among the dependent variables and their arguments confidently led to the specification of ECM for all the three equations estimated. The results presented are the restricted/ parsimonious models. The unrestricted model can be obtained from the authors.

#### *ECM Results for the Determinants of Selected Agricultural Exports in Nigeria*

Table 3 presents the results of the parsimonious ECM for the three export commodities (cocoa, rubber and palm kernel). In all, the adjusted  $R^2$  ranges from 0.33 for Rubber to 0.67 for Cocoa. The F- values and the Log-likelihood ratio show that the models were well-fitted. The degree of adjustment of short run equilibrium to long run values was spontaneous for cocoa and a bit slower for the other two commodities. By and large, there is high level of adjustment of disturbances in the short run to long run values for all the commodities.

Hence, there seems to be a high feedback mechanism for all the crops. The combined short run dynamic effect of the lagged quantities of cocoa and GDP, and the net value of world trade jointly explains changes in exports of cocoa. The coefficients of VWT and the lagged value of GDP are rightly signed. However, the coefficient of the lagged value of COP is not rightly signed.

On the other hand, the combined short run dynamic effects of the real exchange rate and the lagged price ratio of rubber explains changes in rubber exports. The price ratio does not conform to apriori expectation due to the negative sign of the coefficient. This in essence, may indicate that the previous year relative price does not favour the quantity exported or perhaps the previous year price fell short of expectation and then discouraged current year exports of rubber. The real exchange rate is rightly signed.

The result for palm kernel shows that the combined short-run dynamic effect of the GDP and the lagged values of quantity of palm-kernel exported, premium and the palm-kernel annual output jointly account for the changes in palm-kernel exports. Of the four determinants, it is only the lagged output of palm kernel that is not rightly signed.

#### **Conclusion**

The performance of agriculture has not been two impressive even with liberalization measures. This is especially true in the area of commodity exports and foreign exchange earning. Though the exchange rate policy is probably the most likely instrument to induce increase competitiveness of agricultural export commodities in a developing country like Nigeria, parallel exchange rate premium only significantly affect the export performance of palm-kernel but not cocoa and rubber. Thus, critical attention should be paid to such incentives as export promotion because it is believed that export promotion have potential to stimulate productivity, thrift and entrepreneurship.

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**Table 3:** ECM results for the three agricultural export commodities

| Variable                        | Cocoa            | Rubber           | Palm Kernel      |
|---------------------------------|------------------|------------------|------------------|
| Constant                        | -2.92 (-0.57)    | 0.21 (0.05)      | -9.39 (-0.99)    |
| dLn $PR_t(-1)$                  | -0.33 (-3.48)**  | -                | -0.09 (-1.95)*   |
| dLn GDP                         | -                | -                | -                |
| dLn GDP(-1)                     | 122.66 (2.00)*   | -                | 327.39 (2.55)**  |
| dLn ( $P^e_{it}/P^d_{it}(-1)$ ) | -                | -0.09 (-2.01)*   | -                |
| dLn $QE_{it}(-1)$               | -                | -                | 0.40 (2.42)**    |
| dLn $VWT_t$                     | -0.03 (-3.86)*** | -                | -                |
| dLn $ER_t$                      | -                | 0.62 (1.82)*     | -                |
| dPREMIUM $_t(-1)$               | -                | -                | -0.24 (-2.10)**  |
| RESIDUAL (-1)                   | -0.99 (-6.30)*** | -0.68 (-3.44)*** | -0.87 (-4.67)*** |
| R-Squared                       | 0.72             | 0.40             | 0.59             |
| Adjusted R-squared              | 0.67             | 0.33             | 0.51             |
| Mean dependent variable         | -1.99            | 2.62             | -1.39            |
| S.D. Dependent variable         | 46.87            | 26.73            | 71.37            |
| S.E. of Regression              | 26.87            | 21.85            | 50.16            |
| Sum square residual             | 18768.86         | 12886.68         | 62895.63         |
| Log likelihood                  | -123.28          | -137.45          | -162.02          |
| Durbin-Watson stat              | 2.31             | 1.81             | 2.08             |
| Akaike information criterion    | 9.57             | 9.13             | 10.84            |
| Schwarz criterion               | 9.80             | 9.31             | 11.12            |
| F-statistic                     | 16.33            | 5.97             | 7.15             |
| Prob(F-statistics)              | 0.00             | 0.003            | 0.00             |