



**Full Length Article**

# Incidence Analysis of the Effects of Liberalized Trade and Exchange Rate Policies on Agriculture in Nigeria

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## ABSTRACT

This study examined the effects of liberalized trade and exchange rate policies on agriculture in Nigeria using incidence analysis. The agricultural products considered are cocoa, rubber and palm-kernel. The data for this study covering 1970 to 2005 were obtained from secondary sources and were tested for their time series characteristics using Augmented Dickey-Fuller tests. The results showed that all variables were not stationary at their levels. The Error Correction Model analysis revealed that incidence parameter significantly influenced the relative price level and that exportable and home goods were close substitutes in the liberalization years. The feedback mechanism was higher for equation with food as proxy for home goods compared with the situation, where housing was used. The incidence of parameter was significant in the two equations (food index & housing index) for all the agricultural products cocoa export, which was only significant in the food index equation. Hence, indicating the allocation of resources between home goods and tradable to be significantly influenced by the existing trade and exchange rate regimes. The significance of product of dummy and relative import-export price variable in the analysis for total agricultural, cocoa and rubber exports shows that incidence of trade during liberalization differed significantly from that obtained in the pre-liberalization era. © 2011 Friends Science Publishers

**Key Words:** Liberalized trade and exchange rate policies; Incidence analysis; Agriculture; Nigeria

## INTRODUCTION

Agriculture has remained an engine of growth in the Nigerian economy since the attainment of independence in 1960. Since 1970s, however, following the discovery and sales of crude oil, the fortunes of the agricultural sector declined significantly. Though there has been increase in petroleum export, the problems of agricultural export still agitate the minds of policy makers in Nigeria (World Bank, 1985). This led to formulations and implementations of several trade and exchange rate policies. Nigeria had no well spelt-out trade policy before 1986. It is possible to identify two well-defined periods. The first period is from 1970 to 1986, the pre-liberalization era. The second period is the deregulation era from July 1986 to 2006 (National Planning Commission, 2004; Briggs, 2007).

Several researchers in the country have analysed the impact of these trade and exchange rate policies on agriculture during pre-liberalization and liberalization era, among, which include Oyejide (1986) examined the effect of trade and exchange rate policies on agriculture in Nigeria using incidence analysis. He showed that the impact of a tariff on imports falls almost entirely on producers of agricultural products with incidence parameter range from 55 to 90%. Olomola *et al.* (1996) assess market liberalization and its effects on Nigeria agriculture using

incidence analysis. They showed that export crops received greater degree of protection during liberalization. It was also found that non-traded food crops were the most protected in the pre-liberalization era at the expense of import substituting crops and export crops, respectively and concluded that positive protection existed for food crop production but to a lesser extent during economic liberalization. Okunmadewa *et al.* (1999) also examine the effect of trade liberalization on food security in Nigeria. They showed that the food security status of Nigerians actually improved during liberalization but could not have been better without adequate attention through supportive policies and programmes is accorded the marketing system. Yusuf (2000) analysed the effect of liberalized trade and exchange rate policies on agriculture in Nigeria using incidence analysis and computable general equilibrium (CGE). According to him gross domestic product (GDP) was highest (41%) in the first period of liberalization. The incidence parameter was on the average 0.36 when food price index was used as proxy for home goods compared with 0.24 in cases, where housing index was used. The welfare impact of the policy measures showed that import liberalization elicited the highest gain of 8.2% compared with 1% recorded with the devaluation of the naira. Finally, Badmus (2002) analysed trends in Nigeria Agricultural export and the impact of naira devaluation on it. He opined

that during devaluation period cocoa and rubber increased in their export volume but there was a decrease in the export volumes of cotton during the period.

However, the afore-mentioned studies have examined the impact of these policies within the period of 1970-2000, with based year to be 1985 although few of them considered both pre-liberalization and liberalization era but did not capture the trade policy under the National Economic Empowerment Development Strategy era and the Dutch Auction System (DAS) introduced on 22<sup>nd</sup> July 2002 under exchange rate policies. Therefore, based on the discussion above this paper examines the effects of liberalized trade and exchange rate policies on agriculture; cocoa, rubber and Palm kernel within the context of incidence analysis (1970-2005) using 2003 as a base year.

## MATERIALS AND METHODS

**Nature and sources of data:** The data for this study were obtained from secondary sources including local and international agencies. The local agencies include Central Bank Nigeria (CBN) and Federal office of Statistic (FOS). The international agencies are international financial statistics (IFS) and Food and Agricultural Organization (FAO).

**Analytical procedure:** The incidence analysis of trade and exchange rate policies was used in this study. Two proxies of home goods used in this study were food and housing sub-sectors (Garcia, 1981; Oyejide, 1986; Bautisa, 1987; Olomola *et al.*, 1996; Yusuf, 2000). The equation is given below:

$$\ln\Delta\left(\frac{DPH}{DPX}\right) = b_0 + w\ln\Delta\left(\frac{DPM}{DPX}\right) + b_1 \ln GDP + b_2 \ln BOT + c_1 D + c_2 \Delta \ln\left(\frac{DPM}{DPX}\right) + d_{ecm_t} + U_t$$

Where:

DPH=composite price indices for housing (2003=100).

DPF=composite price indices for food (2003=100).

DPX=domestic price indices for total export (2003=100).

DPM=domestic price indices for total import (2003=100).

GDP=Gross Domestic Product (N million) at current basic prices.

BOT=Balance of trade proxied by difference between the natural logarithm of exports and natural logarithm of imports (Compare with Bogunjoko, 1997; Ogun, 1998).

D=Dummy variable to capture the effect of liberalization. It equals zero for pre-liberalization year and 1 otherwise;

Ln=Logarithmic operator;  $Ecm_{t-1}$ =the error correction factor;  $\Delta$  = this represents change.

The estimated parameter  $b_0$ ,  $b_1$ ,  $b_2$ ,  $c_1$  and  $c_2$  are expected to be positive and  $w$  (incidence parameter) ranges between zero and 1.

This study employed the Error Correction Mechanism

(ECM) to analyze the data. The purpose was to examine the time series characteristics of the data with a view to overcome the problems of spurious correlation often associated with a view non-stationary series and simultaneously generate long run valuable relationship (Hendry, 1986; Engle & Granger, 1987; Yusuf & Falusi, 1999). In arriving at the ECM, two steps are usually involved. The first is to test for the stationarity or order of integration of the data series while the second involves testing for cointegration of the data series. In this study, the two tests were carried out using Augmented Dickey-Fuller (ADF) tests. The ADF is a test for null hypothesis that the variable of interest is non-stationary i.e. it is integrated of order 1 (1). The test procedure is given by equation:

$$\Delta X_t = aX_{t-1} + \sum bi\Delta X_{t-1} + e_t$$

The decision rule is that the t-statistic on the coefficient of the lagged variable ( $a$ ) that is expected to be negative, must be significantly different from the critical values at a given level of significance for a given sample size, if the null hypothesis is to be rejected. In the second stage, a test for cointegration was carried out. Cointegration or ECM is accepted when the residuals from the linear combination of the non-stationary series 1 (1) are themselves stationary. The acceptance of the ECM indicates that the model is best specified in the first difference of the variables. The ECM framework in essence guarantees the non-loss of information from long term relationship in the first differences. For the purpose of analysis four items were used. These include the total Agriculture, Cocoa export, Palm kernel and rubber export.

## RESULTS AND DISCUSSION

**Stationarity test of the variables:** The analysis of incidence of trade and exchange rate policies commenced with the consideration of the time series characteristics of the data employed. This was achieved by ascertaining the order of integration of each of the series using Augmented Dickey fuller classes of unit root tests (Engle & Granger, 1987; Yusuf, 2000). Four different scenarios were experimented with. These are variables at their levels without trend, variables at their level with trend, variables at their first difference without trend and variables at their first difference with trend (Table I). This revealed that almost all the variables were not stationary at their level but became stationary at their level of first difference. These results confirmed earlier work by Bogunjoko (1997); Ogun (1998); and Yusuf (2000). Hence it suggests the need to differentiate the variables once to obtain I (0) series.

**Analysis of incidence of trade and exchange rate policies using (ECM) result for total agricultural export:** The incidence parameter conforms to a priori expectation in the two equations and was significant at 10% level when housing is used as proxy for home good compared with its being significant at 1% in case, where food served as proxy

for home goods (Table II). In addition the incidence parameter lagged by one year under food index was significant at 1% level. In the equation food index, the GDP and GDP lagged values by one year are positively and negatively related to the price ratio of food and total Agricultural export, respectively. Both were significant at 10 and 5%, respectively. This implied that 10% change in the value of GDP will lead to 2% increase and 10% change in lagged value of GDP will lead to 2.1% decrease in the relative price ratio of food and total agricultural export, respectively. In the two equations, balance of trade (BOT) is positively related to the price ratio of housing and total agricultural export at 10% significant and it is positively related to the price ratio of food and total agricultural export at 5%. The emergence of the product of dummy and the relative import and total agricultural export price indicate that incidence parameter increased during SAP or deregulation era under housing index equation. The adjusted level as depicted by the ECM showed that this is faster for food-agriculture export price relative (76%) compared with the housing-agriculture export price ratio (57%).

**ECM results of cocoa export:** The incidence parameter and GDP lagged by one year are significant at 10% level when housing is used as proxy for home good but non-significant ( $P>0.05$ ) with food index (Table III). In the equation with food index, BOT, the balance of trade (BOT) lagged by one and BOT lagged by two years were significant at 10 and 5%, respectively. The emergence of the product of dummy and the relative import and cocoa export price indicate that incidence parameter declined during SAP or deregulation era (compared with Oyejide, 1986; Yusuf, 2000). The adjustment level as depicted by the ECM shows that this is faster for food-cocoa export price relative compared with the housing-cocoa export price ratio.

**ECM results for rubber exports:** The results showed that the incidence parameter conforms to a priori expectation in the two equations and were significant at 5% level for housing index compared with its being significant at 10% in case, where food served as proxy for home goods (Table IV). In addition the lagged incidence parameter values under housing index were both significant at 1% level, but only the lagged incidence parameter by one year was significant at 10% under food index. In the equation food index, the GDP and GDP lagged by two year are negatively related ( $P<0.01$ ) to the price ratio of food and positively related ( $P<0.05$ ) to rubber export. This implied that 10% change in the value of GDP will lead to 9.3% decrease and 10% change in lagged value of GDP will lead to 1.2% decrease in the relative price ratio of food and rubber export, respectively (Yusuf, 2000).

In the equation with housing index, BOT lagged with two years is negatively related to the price ratio of housing and rubber export at 5% significant. The emergence of dummy variable and its product in the equation with housing index show the important of liberalization on the incidence parameter. The dummy alone indicated actual

**Table I: Test for Order of Integration Using ADF Test**

Variables	Level without trend	Level with trend	First difference without trend	First difference with trend
ln(DPM/DPXA)	-0.003	-1.860	-3.379	-3.309
ln(DPH/DPXA)	0.112	-2.352	-3.209	-3.310
ln(DPF/DPXA)	-0.234	-2.378	-2.726	-2.767
ln(BOT)	-0.721	-1.507	-3.215	-3.303
lnGDP	-0.008	-1.586	-2.531	-2.648
ln(DPM/DPXC)	-2.160	-2.313	-4.014	-3.922
ln(DPF/DPXC)	-2.877	-2.463	-3.199	-3.589
LN(DPH/DPXC)	-3.241	-3.253	-3.603	-3.536
Ln(DPM/DPXR)	-3.987	-3.898	-4.588	-4.611
Ln(DPH/DPXR)	-2.809	-2.447	-3.270	-3.656
Ln(DPF/DPXR)	-1.764	-1.798	-3.654	-4.175
ln(DPM/DPXp)	-2.340	-2.280	-3.407	-3.347
ln(DPM/DPXp)	-2.776	-2.440	-3.210	-3.573
ln(DPF/DPXp)	-1.692	-2.189	-2.617	-3.437
Critical value				
1%	-3.646	-4.263	-3.654	-4.273
5%	-2.954	-3.553	-2.957	-3.558
10%	-2.616	-3.210	-2.617	-3.212

Source: Extracted from Regression results

**Table II: ECM results for total agricultural export**

Independent variables	Dependent Ln (DPH/DPXA)		Variables Ln (DPF/DPXA)	
	Coefficient	t-Statistic	Coefficient	t-statistic
Constant	-0.036968	-0.532060	-0.025771	-0.417046
Ln(DPM/DPXA)	0.355288	1.74156***	0.461284	3.160142*
Ln(DPM/DPXA)-1	-0.076155	-0.791378	0.227383	3.191895*
Ln(DPM/DPXA)-2	-0.051377	-0.639630	0.072410	1.070210
Ln(GDP)	0.173579	1.244330	0.203352	1.584750***
Ln(GDP)-1	0.215603	1.572837	-0.210852	-1.733820**
Ln(GDP)-2	0.223494	1.667889	0.307877	2.640458**
Ln(BOT)	0.319792	1.98742***	0.174856	2.304550**
Ln(BOT)-1	-0.150496	-0.967959	-0.177970	-2.406246
Ln(BOT)-2	-0.083281	-0.948900	0.095595	1.305799*
D	-0.316344	-0.172424	0.203352	1.584750
D Ln(DPM/DPXA)	0.092886	0.409658*	-0.210852	-1.733820
ECM-t-1	-0.568696	-2.947296*	-0.757280	-3.742107*
R <sup>2</sup>	0.689900		2.019636	
Adjusted R <sup>2</sup>	0.503840		-0.182870	
Durbin Watson	2.048821		0.757280	

\* Significant at 1%

\*\* Significant at 5%

\*\*\* Significant at 10%

Source: Extracted from ECM analysis

improvement in the housing prices relative to rubber export under liberalization. The emergence of the product of dummy and the relative import and rubber export price indicated that incidence parameter declined during SAP or deregulation era. ECM is significant under housing index but not significant with food, although the signs are negative (Yusuf, 2000).

**ECM results for palmkernel exports:** The incidence parameter lagged by one year was significant at 10% for both equations (Table V). The incidence parameter lagged by one year was negatively related ( $P<0.1$ ) to the price ratio of housing and Palmkernel export and positively related ( $P<0.1$ ) to the price ratio of food and Palmkernel export. In the equation under housing index, the gross domestic price lagged by one year was significant and positively

**Table III: ECM results for cocoa export**

Independent variables	Dependent Ln (DPH/DPXc)		Variables Ln (DPF/DPXc)	
	Coefficient	t-Statistic	Coefficient	t-statistic
	Constant	-0.391183	-1.602347	0.000821
Ln(DPM/DPXc)	-0.388627	-0.547879	-0.021874	-0.144956
Ln(DPM/DPXc)-1	-0.707178	-1.718366***	0.095153	1.129093
Ln(DPM/DPXc)-2	-0.567626	-1.379295	-0.089120	-0.966926
Ln(GDP)	0.015852	0.497983	-0.194726	-1.986189
Ln(GDP)-1	0.885146	0.452091***	0.163358	2.086236
Ln(GDP)-2	-0.145555	0.379283	-0.852040	-2.782860
Ln(BOT)	-0.186672	-0.600183	0.103014	1.518525***
Ln(BOT)-1	0.124848	0.451700	-0.120254	-1.233737**
Ln(BOT)-2	-0.487355	-1.121660	0.037498	0.352806**
D	-1.880204	-1.320544	-	-
D Ln(DPM/DPXc)	0.827948	1.049157	0.369929	2.159407**
ECMt-1	-0.477850	-4.267857*	-0.537986	-2.58**
R <sup>2</sup>	0.600202		0.663717	
Adjusted R <sup>2</sup>	0.382131		0.502886	
Durbin Watson	2.045581		1.77	

\* Significant at 1%

\*\* Significant at 5%

\*\*\* Significant at 10%

Source: Extracted from ECM analysis for cocoa

**Table IV: ECM Results for Rubber Export**

Independent variables	Dependent Ln (DPH/DPR)		Variables Ln (DPF/DPXR)	
	Coefficient	t-Statistic	Coefficient	t-statistic
	Constant	-0.027028	-0.130757	0.090739
Ln(DPM/DPXR)	-1.033457	-2.336173**	0.189785	1.923128***
Ln(DPM/DPXR)-1	-0.945363	-4.183212*	0.095272	1.874602***
Ln(DPM/DPXR)-2	-0.632480	-2.995932*	-0.015009	-0.313874
Ln(GDP)	-0.932249	-	-0.731366	-6.625222*
Ln(GDP)-1	0.459470	1.878257***	0.092689	1.327564
Ln(GDP)-2	-0.295074	1.487627	0.120919	2.219384**
Ln(BOT)	-0.324778	-1.208197	0.019287	0.070435
Ln(BOT)-1	0.014475	-1.378538	0.049944	0.972965
Ln(BOT)-2	-0.565423	0.066838	-0.014126	-0.292351
D	-2.416857	-2.331219**	-0.035575	-0.643790
D Ln(DPM/DPXR)	0.980693	-1.912128**	0.019287	0.070435
ECMt-1	-0.882327	1.948205**	-0.168690	-1.081989
R <sup>2</sup>	0.725475	-5.124748*	0.899601	
Adjusted R <sup>2</sup>	0.575734		0.899601	
Durbin Watson	1.556023		1.949220	

\* Significant at 1%

\*\* Significant at 5%

\*\*\* Significant at 10%

Source: Extracted from ECM analysis for rubber

related ( $P < 0.1$ ) to the dependent variable. Also in the equation under food index, Gross Domestic Price lagged by one year is significant at 1% and was negatively related to the dependent variable. The adjustment level as depicted by the ECM showed that this is faster for food-Palmkernel export price relative (73%) compared with the housing-Palmkernel export price ratio (Yusuf, 2000).

## CONCLUSION

The incidence of trade and exchange rate analysis showed that equations with housing index as proxy for home goods recorded higher values of incidence parameter than that of food index except in the case of agricultural export. The incidence of parameter was significant in the

**Table V: ECM results for palmkernel export**

Independent variables	Dependent Ln (DPH/DPXP)		Variables Ln (DPF/DPXP)	
	Coefficient	t-Statistic	Coefficient	t-statistic
	Constant	-0.240638	-1.106107	0.030029
Ln(DPM/DPXP)	-0.478495	-0.777915	0.004549	0.026044
Ln(DPM/DPXP)-1	-0.704514	-2.07321***	0.199983	0.19998***
Ln(DPM/DPXP)-2	-0.266584	-0.846253	0.018948	0.227540
Ln(GDP)	-0.350466	-0.771905	-0.113213	-1.019307
Ln(GDP)-1	0.789958	1.92867***	-0.367271	-3.471041*
Ln(GDP)-2	-0.319733	-0.852652	0.159842	1.679802
Ln(BOT)	-0.129745	-0.478939	0.089470	1.300318
Ln(BOT)-1	0.024828	0.100480	0.006166	0.096953
Ln(BOT)-2	-0.182327	-0.570463	0.029958	0.356497
D	-4.279966	-1.685197	-0.07965	-0.123245
D Ln(DPM/DPXP)	1.254972	1.522479	0.111685	0.479296
ECMt-1	-0.571413	-3.538478*	-0.729468	-3.337069*
R <sup>2</sup>	0.500039		0.629513	
Adjusted R <sup>2</sup>	0.227333		0.427429	
Durbin Watson	2.002265		1.673493	

Extracted from ECM analysis for palmkernel

\* Significant at 1%

\*\* Significant at 5%

\*\*\* Significant at 10%Source

two equations (food index & housing index) in all the agricultural products the only exception was in the case of cocoa export, which only significant in the food index equation. Hence, indicating the allocation of resources between home goods and tradable to be significantly influenced by the existing trade and exchange rate regimes. However, agricultural exports and home goods were found to be close substitutes because of the low values of the incidence parameter. The significance of product of dummy and relative import-export price variable in the analysis for total agricultural, cocoa and rubber exports showed that incidence of trade during liberalization differed significantly from that obtained in the pre-liberalization era. The adjustment level as depicted by the ECM in all the four cases shows that it is faster for food compared with the housing (proxy for home good).

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