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RESPONSE OF NIGERIAN CASSAVA EXPANSION INITIATIVES TO CLIMATE CHANGES, ECONOMIC GROWTH AND SOME POLICY INSTRUMENT (1970-2012)

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Abstract

This study considered the limiting response of Nigeria cassava expansion initiative to climate changes, economic growth and some policy instruments. The presidential initiative to make cassava a foreign exchange earner as well as ensuring that national demand are satisfied has made cassava a significant economic crop and resource input of industrial and international status. Currently, its derivatives such as animal feed, starch, ethanol, cassava chip, cassava flour, cassava liquor etc are in high demand. Having gained international recognition some factors need be examined to ascertain the limiting response of this economic crop some exogenous factors. The specific objectives of interest were to ascertain the response of cassava output expansion to rainfall, temperature, imports, exports, credit allocation to agribusiness, exchange rate, nominal interest rate, inflation and GDP from 1970 – 2012. Also, it examined the short and long run effects of these variables to cassava output so as to know how much adjustment it makes to reach the equilibrium. Secondary data were used for this research work. The technique of data analysis was auto- regressive modeling regression. To capture the long run and short run dynamics of cassava output behavior, the error correction model (ECM) using the Engle-Granger methodology was adopted. The result revealed a very high rate of adjustment to long run equilibrium and the variables are correlated which means that impact of each variable on cassava output behavior in the economy is inseparable. The Error correction coefficient of -0.975 measures the speed of adjustment towards long run equilibrium earned the expected negative sign and is statistically significant at 1% risk level. Thus, this study recommends that the emerging cassava economy of Nigeria would be adequately empowered for efficient productivity if the Government stipulate policies that will encourage domestic output expansion to meet the national and foreign demands while avoiding increase in inflation, importation of goods and services and proper checks and balances of the increase and decrease of temperature and rainfall using effective and efficient metrological centre.

Key words: *Climate change, economic growth, cassava expansion*

1. Introduction

Nigeria is an agrarian society despite the dominant contribution of the petroleum sector to the country's GDP (Sanusi, 2010; Izuchukwu, 2011). Despite the 40.3% contribution of Agriculture to the Gross Domestic Production (GDP) of Nigeria in the period 2001 – 2009, the growth rate in the sector has been undulating and mostly attributed to the lopped sided policies, climate changes, instability in macroeconomic variables, over dependency on rain fed agriculture and increasing food import (Jeter, 2004).

There has been relative decline in the past output of crop production which is attributed to disinvestment in the sector partly, due to inadequate money supply. However, government re-forcing the agricultural sector considering the recent financial sector restructuring policies has not yielded much perceivable benefits (Onwumere *et al*, 2008). The acute shortage of credit is one of the most critical factors limiting increased agricultural output in developing economies and the lack of it in reasonable term can be a serious disincentive to agribusiness expansion (Mbachu, 2001).Government realizing the significance of agricultural sector has severally intervened to regulate activities in the sector. "The knowledge of food output (Cassava) behavior to any agricultural policy under quasi-market-oriented economy like Nigeria is imperative. Some scholars argued that increase output behavior could increase farmer's income risks and uncertainties due to anticipating price volatility", (Ukoha, 2007). Ukoha (2007) opined that increased government concern in making agriculture major foreign exchange earner and contributor to the nation's gross domestic product as part of its economic diversification agenda leads directly to a need for information about its cassava production having assumed a centre stage as a potential export crop and in spite of constituting a significant proportion of staple diets of Nigerians. Nigeria has been reported to be food deficient and import dependent. Hence, the substitution of food imports for food crop production in the country as an issue of concern. Here Nigeria has comparative resource advantage in the production of cassava and is the world's leading producer with 33 million metric tons of fresh tubers per annum (FAO, 2004). Cassava is a very important crop in Nigeria based on its enclosure use especially as a staple food to most Nigerians (Abdullahi, 2003) and because of the high export demand of some of its products namely starch, chips, pallets, flour etc. It is well adapted to various climatic and soil conditions and yields mostly above 22.0 metric tonnes per hectare even on poor soils which gives it superior advantage over other tuber crops like yam, coco-yams and potato, (Abang & Agom 2004). Consequently, there are declining per capita production, high and rising inflation, increased food imports and growing deterioration of lands as a result of changes in climate which directly or indirectly affects farming and cassava production inclusive.

The question is how much should be done in response to the threat of climate changes? And since the problem is global in scope what could each country or the world agree to do? What should be the policy instrument tackle cassava production given the varying climate changes? It is feasible for cassava for to be in the international scene without affecting the local consumption of Nigeria? Does cassava output respond to the changes in exchange rate, interest rate, export, import, rainfall, temperature, GDP and Inflation?

To combat the influences of climate change: Nordhaus and Boyer (2000) suggested the Dice model. The DICE model implied dynamic integrated model of climate and the economy. The model combined a simple growth model with a basic representation of carbon emissions atmosphere concentration and expected temperature increase. They identified rising temperature and increasing atmosphere gas (C_{02}) as important factors making the economy less efficient. This outcome implied that these factors are responsible for economic damages, reduction both in output of cassava and returns on agribusiness investment. The

researchers opined further that there is a risk of a large catastrophic loss of 3% of global output. The probability of this catastrophe is low, but increases with rising temperature.

Odusola and Akinlo (2001) examined the link between naira depreciation, inflation and output in Nigeria adopting Vector Auto regression (VAR) and its structural variant. Their result tends to suggest that adoption of flexible exchange rate system does not necessarily lead to output expansion, particularly in short runs. An international trader with a given price, the major source of uncertainty is the exchange rate at which they can translate their sales revenue in foreign currency into local currency. In order to manage this turbulence some developing countries have grossly overvalued their exchange rates and the extent to which this over valuations is done discriminates against imports and exports particularly in the agricultural sector.

Export oriented economies are opened to foreign competition which may lead to closure of local industries once they cannot withstand the competition. Exports has to do with production of goods and services in one country and selling it to earn foreign exchange which can be used to purchase goods and services from another country thus leading to specialization Jafiya (2004). High Interest Rate attracts domestic savings but at the same time it discourages Local investors. High level of inflation reduces the rates of interest thus discouraging people from saving. According to Adoju (2007), exchange rate is argued to have a greater influence on the economy through its effect on the value of domestic currency, domestic inflation, the external sector; capital flows and financial stability. Increased exchange rate directly affects the prices of imported commodities and thus increases in the price of imported goods and services contribute directly to increase in inflation (CBN, 2008).

This study is posed to analyze the response of cassava output behavior to climatic changes (rainfall and temperature), some policy instrument (Exchange rate, interest rate, Export, Imports, Inflation and credit allocation to Agriculture) and Economic growth proxy by GDP (Gross Domestic Product). Also, it examined the short and long run effects of these variables to cassava output so as to know how much adjustment it makes to reach the equilibrium.

The emergence of cassava as great poverty fighter and a source of pure gold to Nigerians (Nweke *et al*, 2002) based on its hot demand both locally and internationally will help to increase the investment given to non-oil products in Nigeria and help increase the GDP of Nigeria as much foreign currency is invested in pursuit to purchase cassava or its derivatives.

2. Methodology

The study location is Nigeria. Nigeria is made of 36 states and 774 Local Government Areas. She is situated on the east of West Africa, bounded by Niger republic (due North), Benue Republic (due West), Chad Republic and Cameroon (due East). The nation has an estimated land mass of 923,768 Sq km^2 (statistical bulletin CBN, 2008) transverse with two major rivers, River Niger (1174.6km) and River Benue (796.5km).

The climatic variables that affect Nigeria include temperature, relative humidity, precipitation etc. The seasons in Nigeria are two – The dry and wet seasons. Agriculture in Nigeria contributes 40% of GDP with economic crops like cassava, cocoa, palm oil, cotton etc. (NBS 2008). The study used principally secondary data obtained from the Central Bank of Nigeria CBN statistical bulletin, NBS Annual Abstract of statistics. FAOSTAT and Nigeria meteorological Agency (NIMET) covering a period of 42 years (1970 – 2012) Error correction model involving multiple regressions was used for the analysis.

2.1. Model Specification

To capture the short run and long run dynamics of cassava output behavior, the Error Correction Model (ECM) using Engle-Granger Methodology was estimated. The model used to estimate the responses of cassava to climate changes, some selected policy instrument and economic growth in both short run and long run periods is given as.

$Lncasoutput = a_o + a_1 LN\ creditall_t + a_2 LN\ creditall_{t-1} + a_3 LNexport_t + a_4 LNexport_{t-1} + a_5 LNexrate_t + a_6 LNexrate_{t-1} + a_7 LNGDP_t + a_8 LNGDP_{t-1} + a_9 LNimport_t + a_{10} LNimport_{t-1} + a_{11} LNinf_t + a_{12} LNinf_{t-1} + a_{13} LNintrate_t + a_{14} LNintrate_{t-1} + a_{15} LNrf_t + a_{16} LNrf_{t-1} + a_{17} LNtemp_t + a_{18} + Ntemp_{t-1} + a_{19} ECM_{t-1} + U$

Where:

LN	=	Natural logarithm of variables
$credit_t$	=	Credit allocation to agriculture in period $_t$
$credit_{t-I}$	=	Credit allocation to agriculture in period $_{t-I}$
$export_t$	=	Export in period $_t$
$export_{t-I}$	=	Export in period $_{t-I}$
$exrate_t$	=	Exchange rate in period $_t$
$exrate_{t-I}$	=	Exchange rate in period $_{t-I}$
GDP_t	=	GDP in period $_t$
GDP_{t-I}	=	GDP in period $_{t-I}$
$Import_t$	=	Importation of food in period $_t$
$Import_{t-I}$	=	Importation of food in period of $_{t-I}$
Inf_t	=	Inflation rate in period of $_t$
Inf_{t-I}	=	Inflation rate in period of $_{t-I}$
$Intrate_t$	=	Interest rate in period of $_t$
$Intrate_{t-I}$	=	Interest rate in period of $_{t-I}$
Rf_t	=	Rainfall in period of $_t$
Rf_{t-I}	=	Rainfall in period of $_{t-I}$
$Temp_t$	=	Temperature in period of $_t$
$Temp_{t-I}$	=	Temperature in period of $_{t-I}$
ECM	=	Error Correction Mechanism
U	=	Stochastic Variable/Error Term
$a_o - a_{19}$	=	Parameters Estimates

Prior to the estimates of the Error Correction Model co-integration test was carried out to determine the existence of co-integration among the variables and to determine the number of co-integrating equations. This was done by testing the co-efficient of the residuals obtained from the OLS regression performed on the variable at level for the existence of a unit root. The error correction model was then estimated as the lagged residual term from the OLS regression that was performed earlier.

The Durbin-Watson technique was used to test for the presence of several auto-correlations among the independent variable. The Augmented Dickey-Fuller test technique was used in testing for unit root in the residual obtained from the regression. When the co-efficient of the lagged residual terms from the first stage regression is negative, it suggests that the response or system comes back to the long-run or adjusts. Therefore, there exists an error correction mechanism.

3. Results and Discussion

The study examines the limiting response of cassava output behavior to rainfall; temperature, imports, exports, credit allocation to agriculture, exchange rate, nominal interest rate, inflation and GDP from 1970 – 2012. A prior real output of cassava is expected to be positively related to rain fall.

Before estimation of the error correction model (ECM), co-integration test was performed using ADF test technique. This is to ascertain the existence of long run relationship between cassava output and the selected variable. Prior to the co integrating test; the ordinary least square estimation was performed on the variables in levels and tested the residuals for the presence of unit roots. The result of the co-integrating test is presented below in table 1 below.

Table 1. Presentation of co-integration test using ADF technique

Crop	ADF	Probability
Cassava output	-5.69545	0.0002

Critical values at 1%, 5%, 10% are -4.21186, -3.5397 and -3.1964.
Source: Output of analysis from E-view (2012)

The result of the co-integrating test which is a pre-condition for the specification of an error model indicates that there is the presence of co-integration in the variable used. This is evident as shown by the stationary of the residual of the statics regression for the crop during the periods, therefore, the error correction model is specified. In the specification of the error-correction model the one period lagged residual as data represent the error correction terms is used in the model estimating the response of cassava output to these variables.

Table 2:   Result of Error Correction Model showing the long run effects

Variable	Coefficient	std. error	t – value	Prob.
Constant	27.75506	11.86637	2.338968	0.0262
LOG (credit)	0.993823	0.434533	2.287107	0.0294
LOG (export)	1.371911	0.607462	2.258429	0.313
LOG (exrate)	0.674422	0.418223	1.612587	0.1173
LOG (GDP)	0.909787	0.249545	3.645788	0.0009
LOG (imports)	-1.165825	0.394196	2.957475	0.0059
LOG inflation)	-0.077453	0.399557	-0.193848	0.8476
LOG (interest rate)	-1.128106	0.223394	-5.049840	0.0000
LOG (rainfall)	1.768514	0.837246	2.112300	0.0431
LOG (tempt.)	-5.770723	5.792375	-0.996262	0.3271

R – squared	0.889605
Adjusted R – squared	0.836487
S. E. of regression	1.661169
Sum squared resids.	82.78448
Log likelihood	-71.30476
Durbin-Watson stat	1.907419
Mean dependent var	9.822805
S.D dependent Var	2.615081
Akaike infor criterion	4.065238
Schwarz criterion	4.487458
F – statistic	7.405685

Source: Data Analysis

Table 2 shows the results of the ECM estimates for cassava outputs response to rainfall, temperature, exchange rate, interest rate, export, imports, inflation, credit allocation to agriculture and GDP in Nigeria

Error correction estimate: The existence of co-integration among the dependent variable and their fundamentals necessitated the specification of ECM for this study.

Table 3: Result of error correction model showing the short runs effects

Variable	Coefficient	std. error	t – value	Prob
LOG (credi$_{t-1}$)	2.553282	1.025414	2.490001	0.0185
LOG (export$_{t-1}$)	1.697853	0.421678	4.026417	0.0003
LOG (exrate$_{t-1}$)	1.867153	0.741085	2.519484	0.0169
LOG (GDP$_{t-1}$)	2.251597	0.833722	2.700657	0.00111
LOG (imports$_{t-1}$)	-2.901686	0.845094	-3.433564	0.0018
LOG (inflation$_{t-1}$)	-0.744577	0.314865	-2.364753	0.00247
LOG (interest rate$_{t-1}$)	-2.775411	0.842267	-3.295169	0.0024
LOG (rainfall$_{t-1}$)	3.803730	1.540458	2.469219	0.0191
LOG (temperature-I)	-0.996206	3.360071	-0.296484	0.7690
ECM$_{t-I}$	-0.975766	0.116367	-8.385267	0.0000
C	-1.914762	11.47798	-0.166820	0.8687

R – Squared	0.892298
Adjusted R – Squared	0.855160
S. E. of Regression	0.995244
Sum Squared resid.	28.72483
Log likelihood	-50.13519
Durbin – Watson stat	1.987130
Mean – dependent Var	9.822805
S.D dependent Var	2.615081
Akaike info enterion	3.056760
Schwarz enterion	3.521201
F – statistic	24.02621

Source – Data analysis

All the explanatory variables jointly explained 89% and 88% of the variables in cassava output in the short and long run respectively. An increase in the exchange rate in the short run will lead to increase in aggregate cassava output. This is in line with Adubi and Okunmadewa (1999). The exchange rate elasticity in the short run is 1.867153 and significant at 5% level. This shows that 1% increase in the exchange rate will lead to a 187 expansion in the aggregate cassava output in the short run. The co-integration test showed that all the variables are integrated of first order, evidence suggest that cassava output responds positively to increases in the exchange rate, in the short run. A possible explanation is that increases in the exchange rate lead to increases in aggregate cassava output probably due to more foreign exchange earnings by farmers through exportation of their products.

Inflation: This means that the long run increase in the inflation rate would lead to decrease in cassava output behavior in the country. The result is plausible because cassava and its

derivative is a normal food crop widely cultivated, consumed and is among the most affordable food commodities in Nigeria. Therefore, increase in inflation rate would constrain demand of cassava and its derivatives as well as its production activities. This inverse relationship could also be attributed to high inflation rate during these periods that devalued the naira currency faster and makes cassava less competitive in the international science. The estimated short run of credit allocation to Agriculture had a positive sign and was statistically significant at 5% which means a unit change or increase in credit allocation to agriculture will lead to 993 in the output of cassava which explains that previous and current credit allocation to agriculture increases the output of cassava.

Gross domestic product response was significant and positively related to cassava output. Thus high economic growth will lead to greater allocation to agriculture for cassava production. In both periods, importation of food was negative, this indicates a unit increase in importation of food will lead to 165 decreases in the output of cassava which implies that importation of substitute foods like wheat, and rice etc reduced the consumption of cassava and damages the infant industries.

Nominal interest rate in both periods was negatively significant at 1% level which shows that high interest rate attracts domestic savings but at the same time discourages local investors.

Rainfall in both long and short run are positively significant at 5% which implies that much decrease on rainfall will lead to corresponding decrease in the output of cassava, while over flooding will also lead to damage of crop there by reducing production. However, adequate precipitation will boost output of cassava realized in the country.

Cassava has a range or required amount of temperature needs for it's survival; despite its ability to withstand turbulence excess of temperature, yet much excess of it will cause the crop to die. This therefore, explains the negative significant in the response of cassava to temperature. Export in both periods was significantly and positively related to cassava output which indicates that the higher exportation of economic crops the more the investment in foreign exchange causing an increase in the GDP of the country and the corresponding expansion in the cassava production.

The error correction co-efficient -0.975 measuring the speed of adjustment towards long-run equilibrium carried the expected negative sign and is statistically significant at 1% level. This indicates that a feed back of 9.75 percent of the previous year disequilibrium from the long run value of the independent variables was observed. This indicates a very high rate of adjustment to long run equilibrium. Therefore cassava output has a high response to rainfall, temperature, exchange rate, export, and importation of food, credit allocation to agriculture, nominal interest rate and GDP of Nigeria.

4. Conclusion

Climatic factors such as temperature and rainfalls were proved to have perceivable concomitant effects on Nigerian cassava expansion. The Nigerian cassava expansion initiative holds a capacity to garner a huge benefit to the nation if only adequate consideration and regulation is given to such factors as exchange rate, inflation and credit allocation to agriculture via GDP. The study modeled the short and long run cassava output behavior response to climate changes (rainfall and temperature), GDP (economic growth) and some policy instruments (exchange rate, interest rate, export, import, credit allocation to agriculture and inflation).

From the outcomes above, tinkering with inflation, imports, and adverse increase in temperature trends will definitely bring positive effects on the nation's cassava output. It is

advisable to ensure that Nigerian cassava expansion initiative will actualize the dream of making the crop a frontier among foreign exchange earner for the country.

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