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CONTENTS

An Econometric Investigation of the Determinants of Food Shortage in Developing Countries: A Case of Nigeria

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Abstract

Food is not only essential to life itself, but adequate and properly balanced diets are needed if people are to be healthy, productive and enjoy long life. Considering the detrimental effects of food shortage, this study empirically examined the basic factors responsible for food shortage in the Nigerian economy. In carrying out this study, a model of demand for, and supply of food was specified. Our econometric methodology follows the general-to-specific error correction modeling. In estimating the model, secondary data covering the period 1970-2002 were collected and analyzed. The time series properties were examined and the results of error correction model confirm the existence of long run relationship between food import and other explanatory variables employed. The study found three main factors to be quite responsible for the current food situation in Nigeria. These include increase in prices of food which might have occurred as a result of demand management policies of the government, depreciation of the naira exchange rate against some major currencies, and the increase in per capita income of some cross-section of the population relative to others. This study therefore recommends vibrant pricing and income policies that could positively impact on the food market in Nigeria. The study also suggests that the exchange rate policy cannot be reliably adopted to curtail food importation in Nigeria.

Introduction

One of the necessities of life is food. Provision of nutritious food is essential for the maintenance of the body's immune system, resistance to infection, sustained productivity and long life. Food shortage leads to under-nutrition and micronutrients deficiency and this has a very high cost to the society. The costs of food shortage in terms to human suffering and national development are high and translate to loss of human potentials that no country can afford. Food shortages also result in a range of adverse health effects and this reduces the resources and income earning capacity of already poor households. This contributes to social and economic problems.

According to the *United Nations Food and Agricultural Organization's (FAO)* 1998 report, 'food shortage is one of the major problems facing nearly all countries of the world today'. The *FAO's* estimates for Africa has also indicated that the percentage of the population undernourished due to food shortage has increased from one hundred and three (103) million in 1970 to two hundred and fifteen (215) million in 1990. *The World Development Report (WDR, 1981)* pointed

out that food production per *capita* had risen on average by only five (5) *per cent* in ten years in low-income countries, and had actually fallen on average if China and India were excluded from the sample. Moreover the *World Food Programme (WEP, 1998)* reported that food shortages round the world were on the rise with more people suffering from malnutrition and hunger compared to that of 1996. Collaborating the above, the *Integrated Regional Information Network for West Africa (IRIN, 2002)* also reported that Southern Africa's food shortages had taken a serious dimension. The network also maintained that 'during food shortages, affected population adopts a variety of coping mechanisms to survive'. Strategies often include: finding additional sources of food or income, moonlighting, migrating, dropping out of school, engaging in hazardous work and more worrisome; prostitution.

In the Nigerian context, though the *'oil boom'* in the 1970s coupled with increased revenue from crude oil exports enabled the Federal Government to assume greater responsibility for agricultural production, little or no improvement has been achieved in this sector (Evbuomwan, 1996). In an attempt to boost agricultural production, more inputs were supplied and credit control and other allocation policies were directed in favour of agriculture. However, despite these measures, available data on the Nigerian economy revealed dwindling volumes of agricultural export and food shortages, measured by a dramatic rise in food import bill, was also witnessed. Moreover, agro-allied industries relied on imported raw materials that could be produced locally.

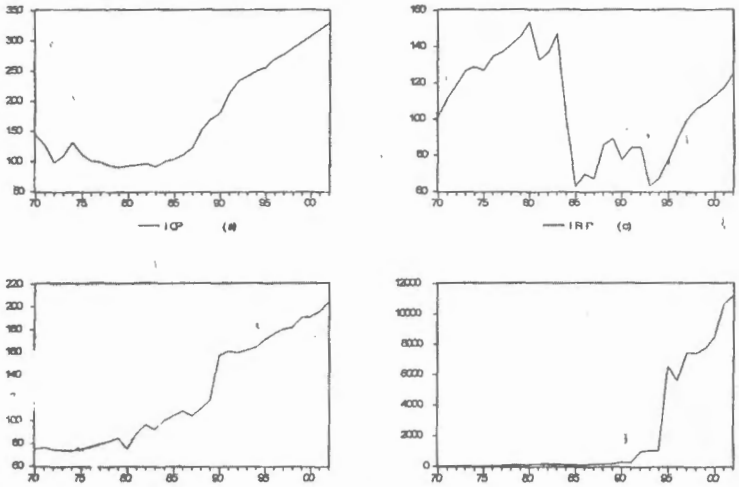
Major indicators of food availability in Nigeria (see *figure 1.*) are the *Index of Crop Production (ICP), Index of Livestock Production (ILP), Index of Fish Production (IFP)* and the *Index of the Value of Food Import* (IVFI). *Figure 1.0* indicates that crop and livestock production has increased at decreasing rate (*Fig. 1a & Fig. 1c.*), while fish production (*Fig. 1b.*) has largely remained unstable. These situations, in the face of rapidly growing population have led to increased food import as indicated by the *Index in the Value of Food Import (IVFI),* which has risen astronomically in the country since mid-1990's. This is an indication of food shortage: a situation where food is in short supply relative to its demand.

Considering all the policies that have been put in place to boost agriculture in order to avert food shortage and their insignificant impact on food production and supply, it becomes pertinent to pose the questions:

1. what are the main causes of food shortage in Nigeria?
2. What policy measures could be adopted to avert food crises?

Being motivated to empirically provide an insight into the above questions, this study examines the main determinants of food shortage in the light of the available data from the Nigerian economy. This study becomes justifiable considering the costs of food shortage on the society and the need to proffer appropriate policy measures for mitigating it.

Figure 1: Indices of Food Availability in Nigeria



(a) Index of crop production (ICP), (b) Index of Livestock production (ILP), (c) Index of Fish Production (IFIP) and (d) Index of Value of food import (IVFI)
Sources: Federal Office of Statistics, FAO production Yearbook & Central Bank of Nigeria

2. Theoretical Framework and Literature Review

Despite the great strides made over the few decades to improve food availability and nutrition, hunger and malnutrition persist in many countries and have significantly increased among certain population groups. Achieving food security for today's hungry, who constitute twenty (20) *per cent* of the population of developing countries (Nigeria inclusive); require policies that make it possible for them to produce, or buy, the food they need. This is particularly worrisome in Africa, where progress in increasing *per-capita* food supplies has been slow and uneven and where many countries have suffered setbacks in their already fragile security and nutrition situation (Thompson, 1998).

The first and systematic attempt to theorize the causes and effects of food shortages in the history of economic thought was Thomas Malthus, (1766 – 1834). In his essay on the 'Principles of Population', the Anglican Economist postulated that 'food is necessary to the existence of man' and that 'the passion between the sexes is necessary, and will remain nearly in its present state'. He maintained that the instinct for marriage is permanent, though there were admittedly individual exceptions, and that the operation of the principles of population would make it impossible to attain the millennium. Malthus argued that the potential increase in population, when unchecked, is in a geometrical ratio, whereas means of subsistence or food production can increase only in arithmetical progression. This implies that strong and constantly operating check on population becomes necessary in the light of difficulty of sustaining subsistence.

In his essay, Malthus implicitly assumed the tendency of diminishing returns on land. In addition, there was also the assumption that technology is constant. From the contradiction between the geometric ratio of population growth and the arithmetic ratio of growth of food supply, Malthus concluded that the population increase must necessarily be checked in some manners. He surmised that positive checks of miseries and vices and preventive checks of moral restraint would put a halt to population growth. Moral restraint is interpreted to mean the postponement of marriage until such time as a family can adequately be supported, and the practice of continence outside of marriage. Malthus further observed that vices and miseries were the primary checks in ancient and primitive societies, whereas moral restraint predominates in modern civilizations. Prudential restraint became the only morally accepted check to Malthus. 'Educate the individual,' he argued, 'to postpone marriage until he is capable of supporting a family and avoid irregular gratification.'

The principle of population presented by Malthus was received as a major contribution to political economy though it provoked great protests. The view was seen to have undermined the potentials of technology and therefore pessimistic in nature. Although Malthus population theory was greatly attacked for its inapplicability in advanced industrial countries his supporters widely claimed that the theory could be applied to *Less Developed Countries (LDCs)*. These advocates of Malthus idea maintained that due to rapid increase in population, *LDCs* relied heavily on food import. They further noted that *LDCs* as a group had recorded more than twice the rate of population growth of Europe and Ameica whereas their domestic production of food had scarcely kept pace with population growth. In view of the development in *LDCs* advocates of Malthus ideas called for population control, pointing out modern medical facilities that had reduced death rates in the *LDCs* but had not been able to popularise modern techniques of birth control.

David Ricardo, (1817), a classical economist, and a contemporary of Malthus focused on the limit of growth. He reasoned that with limited arable land, food shortages would emerge and price of food would rise, therefore squeezing profits and reducing labour's standard of living.

A concise analysis of Malthus and Ricardian theory indicates two main factors that could cause food shortages. According to Malthus, a rapid population growth, faster than the growth in the means of subsistence would cause food shortages which could lead to starvation and death. Ricardo, on the other hand viewed shortage of arable land as the main factor that could result in food shortages.

These theoretical explorations, so far, have thrown light into the cause and effect of food shortages. It could be summarized that rapid growth of population and shortages of arable land could cause food inadequacies, which in turn, could lead to starvation, outbreak of diseases, and high prices of food. These effects are costs to the society.

Studies have been conducted to investigate the extent of food availability and causes and effects of food shortage in developing countries, Nigeria inclusive. In a global study on the prospects of food and agriculture, *FAO* (1995) indicated that Sub-Sahara Africa is today worse off nutritionally than it was thirty (30) years ago. The study also maintained that 'looking at the future, under nutrition globally is expected to remain a major problem affecting about six hundred and eighty (680) million people, down only marginally from today's 840 million. The scourge of under-nutrition in terms of absolute number affected will tend to shift from South Asia to Sub-Saharan Africa' Thompson, (1998) reiterated that Africa is suffering from a crisis in food and agricultural production. The author noted that from its shivery *per capital* output, food production had steadily decreased in the continent of Africa, with an average annual rate of growth of less than 2%, which had failed to keep pace with a 3% annual average growth rate of population.

In Nigeria, little, to our knowledge has been done to empirically investigate the causes of food shortage. Egbon (1994) observed that the high demand and high price of crude oil between 1971 and 1985, coupled with high foreign exchange earning from the oil sector is mainly responsible for lesser attention to the agricultural sector and hence food shortages in the country. He further opined that the top-down approach to development planning in Nigeria led to the phenomenal growth of the urban sector at the expense of the rural areas which support the agricultural population. The consequence of the oil boom is the rural-urban migration of able bodied youth who are the backbone of rural agricultural enterprise. Thus resulting to lower agricultural production relative to the demand for it.

Olashore (1991) associated the present food shortages with the decline in agricultural production. According to him agriculture was responsible for almost all Nigeria's foreign exchange earnings until the 1980's when this source of earning became insignificant. He further noted that the declining agricultural production resulted to higher price of food items which could partly explain the increased pressure for enhanced wages at that time. This had the overall consequence of distorted price levels in the economy which finally built up into structural distortions. Ojo (1991) aptly shown that between 1960 and 1975, food supply grew at an annual rate of 2.3 percent while domestic demand grew at 3.4 percent annually. This disequilibrium in supply and demand for food, according to the author arose from such factors as population increase, rapid urbanisation, *per capita* income growth, monetisation of national income and shifts in consumers' preferences, among others. It was also observed that the food shortages was made more difficult as a result of the Sahelian drought of 1972-1973, which spread to seven states in Nigeria, thereby causing considerable damage to agricultural production for export and local market.

In the light of few studies on the topic under investigation, this study attempts to fill the gap in the literature by investigating the main causes of food shortage in the

Nigerian economy. This study becomes crucial since the result emerging therefrom, will provide a basis for making useful policy recommendations for combating food shortages in Nigeria.

3. Model Specification

In an attempt to empirically investigate the main determinants of food shortage in Nigeria this study adopts a disequilibrium model which takes into account the demand and supply side of the food market in Nigeria. This becomes crucial in the light of the fact that the problem of food shortage occurs under disequilibrium situation when the demand for food exceeds its supply in the economy. In this dimension, the demand for food, like the demand for other commodities, is postulated as a function of its price, the level of income of consumers, the size of the population and other factors. Moreover, the supply of food in the current year, depends on previous year's price, the weather condition, the index of oil production in the Nigerian economy (a measure to capture the shift from agricultural sector to the new booming oil sector), as well as time factor. Therefore, the demand and supply functions for food in Nigeria could be specified as:

$$D_t^f = \psi (P_t, N_t, Y_t, Z) \quad \ldots\ldots(1)$$

$$\psi_1 < 0, \psi_2 > 0, \psi_3 > 0.$$

$$S_t^f = g (P_{t-1}, W_t, IOP_t, T, Z") \quad \ldots\ldots(2)$$

$$g_1 > 0, g_2 \gtrless 0, g_3 \gtrless 0, g_3 > 0.$$

where:

D_t^f : Demand for food;
P_t : Price of food: proxied by the food price index;
N_t : Size of the population;
Y_t : The level of real income proxied by the *GDP* at constant 1984 prices;
S_t^f Supply of food;
P_{t-1} : Previous year's food price index;
IOP_t : Index of oil production;
w_t : Index of weather conditions;
T : Time trend; and
Z & Z" : Other factors.

From the supply function represented by *Equation (2),* the inclusion of the variable, P_{t-1}, (previous year's food price index) as a factor influencing the supply of food in Nigeria, draws from the *Cobweb Model* which maintains that supplier of agricultural commodities do not adjust their output instantaneously to price but after a period of time (Henderson and Quandt, 1980). Second, the variable, *IOP* – index of oil production is introduced to capture the effect of increased crude oil exploration on agricultural activities and therefore food production in Nigeria. Moreover, the

inclusion of time as a variable is meant to capture the effect of time factor on production. In this dimension, Sankhayan (1988) maintained that time mainly influences production in four ways.

1. The contribution of fixed inputs towards output may depend on the length of production period. A good example of this is provided by the dependence of the quantity of wool obtained from a sheep on the length of time after which the cutting is taken;
2. The capacity of a set of fixed inputs may be influenced by the time factor. For example, the capacity of a piece of land to produce crops may be increased or decreased over time, depending on whether problems such as soil erosion and water logging have been controlled or have become more severe;
3. Pattern of input utilization or output generation or the time sequence may influence the yields. It is common in agriculture that the yield on a crop is influenced by the pattern of input use. For example, the yield of a crop may be different, depending on whether all the fertilizer is used at the sowing time or spread over three or four equal doses at the time of sowing and hoeing, and
4. Time may influence yields through carry-over effects of some inputs called the residual effect, which may not be completely utilized in a single production period during which they are applied. The carry-over effects of farmyard manure on the crop yields are quite common phenomena in agriculture.

Thus, the excess demand function can be specified as

$$EXD_t^f = D_t^f - S_t^t \quad \text{——————————(3)}$$

From the theoretical standpoint, the shortage of supplies in the domestic market created the existence of E*quation 3, i.e.,* the disequilibrium in the food market based on the equilibrium framework. The consequence of this will be an increase in food price. However, increase in food price will lead to erosion of welfare of consumers and the average and poor people in the society will be seriously affected.

Thus, in a bid to return to market equilibrium by quantity adjustment, the evident possibility is through importation of food. This implies that the excess demand in the food market is accounted for by food import. In this regard, *equation 3* can be understood as:

Total Demand = Domestic Supply + Import of Food

This could be written in symbols as:

$$TD_t^f = DS_t^f + M_t^f \quad \text{.....(4)}$$

Equation 4 is the market clearing condition such that the Walrasian Law would have been satisfied. Thus, *Equation 4* can be rewritten as:

$$M_t^f = TD_t^f - DS_t^f \quad \text{.....(5)}$$

Which can be identified with *Equation 3* such that:

$$M_t^f = EXD_t^f \quad \text{.....(6)}$$

However, the food import function can be specified as follows:

$$M_t^f = h(Y_t, ER_t, Z''') \quad \text{.....(7)}$$

Note that the a *priori* expectations are $h_1>0$, $h_2<0$, *while* Z''' captures other factors not explicitly accounted for in the equation and *ER* in the naira exchange rate proxied by the nominal effective exchange rate.

By substituting *Equation 1, 2* and *7 in Equation 5*, it follows that:

$$M_t^f = Q(P_t, P_{t-1}, N_t, Y_t, W_t, IOP_t, T, ER_t, Z_t) \quad \text{.....(8)}$$

With a *priori* expectations such that:

$\varphi_1 > 0$, $\varphi_2 > 0$, $\varphi_3 > 0$, $\varphi_4 > 0$, $\varphi_5 < 0$, $\varphi_6 < 0$, $\varphi_7 < 0$, $\varphi_8 < 0$. $\varphi_5 \gtrless \varphi_6 \gtrless 0$, $\varphi_7 \gtrless$

Equation 8 is an implicit domestic food shortage function. There is however, the need for a precaution in specifying the mathematical formulation in order to derive the explicit and estimable form of the model. According to Sankhayan, (1988), 'the usefulness of an economic model in drawing valid conclusions depends on how closely and precisely it approximates the real world phenomenon'. Consequently, in searching for the causes of food shortage in Nigeria, we explore three different mathematical formulation namely the linear, the semi-logarithmic and double logarithmic forms. The explicit specifications of *Equation 8*, following these three formulations are as follows:

$$M_t^f = X_0 + \sum_{i=1}^{8} x_i X_i + \mu_t \quad \text{.....(9)}$$

$$\text{Log}(M_t^f) = X_0 + \sum_{i=1}^{8} x_i X_i + \mu_t \quad \text{.....(10)}$$

$$M_t^f = X_0 \prod_{i=1}^{8} X_i + \mu_t \quad \text{.....(11)}$$

A double logarithmic transformation of *Equation 11*or from the implicit expession as in *Equation 8* gives:

$$\text{Log}(M_t^f = Log\ X_0 + \sum_{i=1}^{8} Log\ X_i^{x_i} + \mu_t \quad \text{.....(12)}$$

Where: *X*0: constant term

Xi: coefficients of variable *Xi*

Xi: components of vector *X* defined as the different explanatory variables considered in the model i.e. *Equation 8*

The random term v_t is a white noise that captures the influence of other factors not explicitly included in the model.

Data Sources and Measurement of Variables

Our study is based on annual data covering the period 1970-2002. The variables used in our empirical work are *Index of Real Food Import (IRFI), Food Price Index (FPI), Lagged Value of Food Price Index (LFPI_1), Index of Real Income Per Capita (IRYPC),* weather *(W), Index of Crude Oil Production (IOP), Naira Exchange Rate,* captured by the Nominal Effective *Exchange Rate (ER)* and a *Dummy Variable (DUM).*

The real import is proxied by the value of food and live animal imports by *S.I.T.C* deflated by the consumer price index (1984 - 100). Moreover, *Food Price Index* is proxied by the composite *Food Price Index,* and *Real Gross Domestic Product* is measured by deflating the nominal gross domestic product at current factor cost by the consumer price index, while weather condition is also proxied by the annual average rainfall. The exchange rate is also measured by the nominal effective exchange rate of the naira to US dollar. Data on these variables and others, as specified above, were obtained from various issues of the *Central Bank of Nigeria: Statistical Bulletin and the Annual Reports and Statement of Accounts*; as well as *Federal Office of Statistics – Annual Abstract of Statistics.* The introduction of dummy variable was necessitated by the trend in food imports over the years, as could be seen from Figure 1(d). Thus, the dummy variable takes the value of 0 between 1970 and 1986 and 1 after.

Analysis of Results

Recent innovation in econometric modeling has revealed that most time-series are non-stationary in levels and could adequately be represented by first difference. In econometric parlance, these variables are said to be integrated of order 1, and are denoted as I(1). Non-stationarity in economic data give rise to the possibility of spurious relationship among the levels of economic variables. The implication of this is that estimated parameters are inconsistent and the conventional hypothesis testing procedure becomes unreliable.

To overcome the problem arising from nonstationarity of variables, we begin the analysis by examining the time-series properties of the variables employed in this study. To carry out this exercise, we initially tested for unit root of these variables selected in their ordinary forms and found that they cannot entirely be regarded as I(1) series. In the light of this discovery, all variables were transformed into their logarithmic form. It is this form that we subsequently adopted in this study. *Figure 2* shows the behaviour of variables overtime. It is apparent that these variables are characterized by the stochastic processes which is popularly referred to as random

walks. For instance, *Variables Capturing Index of Real Income Per Capita (LIRYPC)*, weather *(LW)*, and *Index of Crude Oil Production (LIOP)*, display seasonal pattern, while index of *Real Income Per Capita (LIRYPC), Exchange Rate (LER), Food Price Index* and its *Lagged Value (FPI and FPI_1)* show either upward or downward drift.

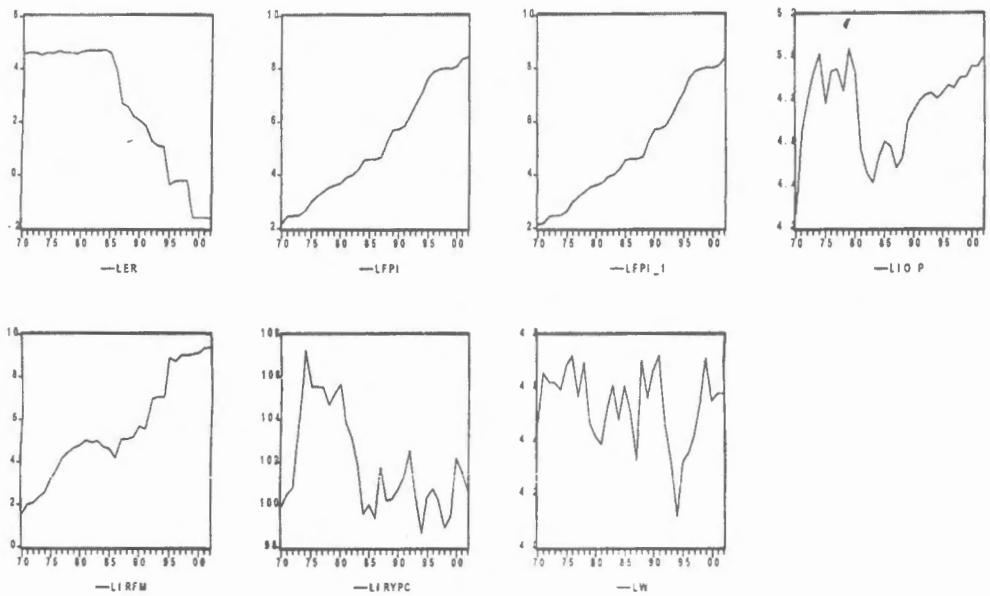


Figure 2: The Behaviour of Variables Overtime

In testing for existence or otherwise of unit root, we employed the Augmented Dickey Fuller (ADF) and Philips-Perron test. The motivation for this test is informed by the understanding that the stochastic terms characterizing the relationship among economic variables are not white noise.

The ADF test statistic assumes that the series is an AR(p) process which can be modeled by including a constant, a constant and linear trend, or by excluding these assumptions in the test regression. These assumptions could be represented by the following three equations respectively.

$$\Delta Y_t \alpha + \delta Y_{t-1} + \sum_{i=1}^{p} \psi_i \Delta Y_{t-i} + \varepsilon_t \quad \text{.....(13)}$$

$$\Delta Y_t \alpha + \beta + \delta Y_{t-1} + \sum_{i=1}^{p} \psi_i \Delta Y_{t-i} + \varepsilon_t \quad \text{.....(14)}$$

$$\Delta Y_t = \delta Y_{t-1} + \sum_{i=1}^{p} \psi_i \Delta Y_{t-i} + \varepsilon_t \quad \text{.....(15)}$$

*Table 1: **Unit Root Test***

Variable	*ADF* (1 lag)*		*PP* (3 lags)*		*d**
	With Constant (No trend)	*With Constant & trend)*	*With Constant (No trend)*	*With Constant & trend)*	
LIREM	-1.9247	-1.8557	-2.4985	-2.5842	I(1)
DLIRFM	-4.5624	-4.5236	-7.8099	-7.7368	I(0)
LFPI	0.0574	-2.6415	0.2232	-1.9228	I(1)
DLFPI	-43590	-4.2409	-3.5706	-3.5412	I(0)
LFPI (1)	0.1892	-2.2617	0.6443	-1.9701	I(1)
DLFPI (-1)	-4.2388	-4.4454	-3.6193	-3.6009	I(0)
LIRYPC	-1.9676	-3.2290	-1.9543	-2.7950	I(1)
DLIRYPC	-4.3311	-4.3151	-5.0784	-5.0426	I(0)
LW	-2.6080	-2.6284	-3.3326	-3.4989	I(1)
DLW	-4.4007	-4.3453	-7.3281	-7.2299	I(0)
LER	0.7710	-1.8866	1.0087	-1.8399	I(1)
DLER	-3.7316	-4.2226	-5.3640	-5.8570	I(0)
LIOP	-2.0796	-2.1365	-3.0887	-3.0048	I(1)
DLIOP	-4.3328	-4.2400	-5.4199	-5.2470	I(0)
Critical Val. @ 5% Level	-2.9591	-3.5614	-2.9558	-3.5562	
1st Difference	-2.9627	-3.5670	-29591	-3.5614	

*Notes: * ADF, PP and d denote Augmented Dickey Fuller, Philips-Perron test and decision about the order of integration, respectively.*

From Table 1 above, it is obvious that all variables are of unit root. In the light of this discovery it becomes essential to further test for cointegration to ascertain whether there is a long-run relationship between these variables.

Given that all variables in a vector of variable, X_t, are *I(1)*, it is possible that a linear combination of these variables is stationary. When this occurs, the variables are said to be cointgrated.

In testing for cointegration several methods have been adopted. Granger (1983), maintained that a vector X_t, where all the variables are of the same order of integration, the components of X_t are cointegrated only if the vector of error terms, ε_t, in the following equation is a stationary process.

$$Y = \beta Xt + \varepsilon_t \text{ for } \beta = 0 \quad \ldots\ldots (16)$$

The *ADF test* can be applied to determine whether the residual is stationary or not. An alternative approach to the test of cointegration is the Sargan Bhargava, (1983) *Cointegration Regression Durbin Watson (SBCRDW).* Although various cointegration test exist, a more powerful multivariate approach that uncover possible cointegration among variables, however, is that proposed by Johansen, (1988) and Johansen and Juseliu, (1990). Under this approach two likelihood ratio test statistics (that is, *trace test and maximum eigenvalue test)* are used to test the null hypothesis of at most *r* cointegrating relationship among variables. The maximum eigenvalue and trace statistics can be calculated using the formulae.

$$\lambda_{trace}(k) = -N \sum_{i=k+1}^{n} \ln(1 - \phi^2_i)$$

$$\lambda_{max}(k,k+1) = -N \ln(1 - \varphi^2_{k+1})$$

Where N is the sample size and ϕ^2_i are squares of canonical correlations between two residuals ($\varepsilon_{1,t}$ & $\varepsilon_{2,t}$)[1].

In the *trace test*, the null hypothesis is that the number of cointegrating vectors is less than or equal to k, where k = 0, 1 or 2. In each case the null hypothesis is tested against the general alternative. The maximum *eigenvalue statistic test* for the null hypothesis, k = 0 against the alternative that k = 1, k = 1 is tested against the alternative k = 2 *etc.*

Adopting the Johansen, (1988) and Johansen-Juseliu (1990) methodology, all variable tested for cointegration were found to be I(1) series. *Table 2* reports the result of the Maximal *Eigenvalue test* and the *Trace Test.* It is apparent from these test statistics that there are two cointegrating vectors among the variables employed in this study. Using the maximal *eigenvalue test* (with n = 7, including one exogenous variable: *DUM,* in the *VAR*) the null hypothesis that there is no cointegration (r=0) is rejected against the alternative hypothesis that there is at most one (*i.e., r=1*) cointegrating vector at the five (5) *per cent* level. Moreover, the null hypothesis that there is at most one cointegrating vector (r = 1) is rejected against the alternative hypothesis of two cointegrating vectors (r=2) at the ten (10) *per cent* significant level. The implication of this is that the alternative hypothesis that r=2 cannot be rejected. The maximal *eigenvalue test* is further supported by the *trace test* which

rejects the null hypothesis of at most one cointegrating vector against the alternative hypothesis of more than 1 cointegrating vector at the five (5) *per cent* significant level.

Having established that there are two cointegrating relationships among the variables employed, *Table 3* reports the result of our parsimonious and general –to-specific error correction model. It could be observed from the diagnostic test that the model is a good one. The *LM serial correlation test* indicates that the model is free from the problem of serial correlation. Furthermore, the *Akaike and Schartz Information Criteria* are minima relative to other specifications experimented, while the *Jaque-Bera normality test* that computes the skewness and kurtosis of residuals indicates a reasonable high p-value of 0.581. This means that the null hypothesis that the residuals are normally distributed cannot be rejected. Apart from the *LM test*, Information criteria and *JB normality test*, the *White's Heteroscedacity test* also indicates that the null hypothesis of no heteroscedacity cannot be rejected. This means that, the homoscedacity assumption, being one of the cardinal assumptions, of *OLS* is fulfilled.

Table 3: Johansen's Multivariate Cointegration Test: Maximal Eigenvalue Test (vMax)

H0:	*H1:*	*Likelihood Ratio*	*Critical Value*	
			5% level	*10% level*
r = 0	r = 1	58.586*	39.760	36.930
r < 1	r = 2	32.462**	33.140	30.700
r < 2	r =3	17.111	27.270	24.840
		Trace Test (VTrace)		
r = 0	r ≥ 0	58.586*	39.760	36.930
r < 1	r ≥ 1	32.462*	33.140	0.700
r ≤ 2	r ≥ 2	17.111	27.270	24.840

*Notes: The cointegration VAR = [LIRFM, LFPI, LIRYPC, LW, LIOP, LER, and DUM) where DUM is entered in the VAR as exogenous variable. *(**) indicates statistical significance at 5% and 10% levels. Moreover, the VAR is of order 1 and it is computed under the assumption of no intercepts or trends.*

Table 3: An Error Correction Model of Food Import (LIFM)

Regressor	*Coefficients*	*STD Error*	*T-Ratio*	*P-value*
Constant	-0.07119	0.13622	-0.52262	0.6070
DLFPI	1.46590	0.42862	3.42000	0.0030
DLFPI_1	-0.10722	0.45099	-0.23776	0.8140
DLFPI_2	0.35678	0.42307	0.84332	0.4090
DLRYPC	0.16424	0.04904	3.349320	0.0030
DLW	-0.27088	0.40563	-0.66779	0.5120
DLER	-0.35050	0.16689	-2.10010	0.0490
DLIOP	-1.03290	0.59567	-1.73150	0.0990
DUM	-0.15134	0.13628	-1.11050	0.2800
ECM(-1)	-0.56882	0.21338	-2.66580	0.0150

Note: R-Squared = 0.70; SER = 0.318; RSS = 1.902; AIC = -11.193; SIC = -18.199; Log Likelihood Ratio = -1.193; D.W Statistic = 1.8675; LM Test: F(9,20) = 0.11043[0.743]; RAMSEY'S RESET: F(9,20) = 5.888(0.025); JB Normality Test: $x^{2(2)}$ *= 1.084[0.581]; Heteroscedasticity Test: F(1,28) = 0.116 [0.736).*

An inspection of the results in *Table 3* further reveal that the coefficient of *DLPFI,* which is the food price index, appears with the hypothesised sign and statistically significant at the five (5) *per cent* level. The implication of this is that there is a positive and contemporaneous relationship between the price of food and food import in Nigeria. One possible explanation of this is that an increase in food prices resulting from excessive growth in aggregate expenditure relative to output leads to shortage in domestic production, as this occurs food shortage emanates resulting in increase in food import. It could also be seen from *Table 3* that though the first lag of price (*DLFP_1*) appears with a wrong a *priori* sign, the second lag of this variable (*DLFP_2*) conforms with the a *priori* sign but statistically insignificant at the five (5) *per cent* level. The insignificance of previous levels of food prices means that price expectation has no role in food supply function in Nigeria. This means that the postulate of the *Cobweb model* which tends to explain food supply as an increasing function of previous year's food price index is not verified. Hence, *contemporaneous food price index* and not *lagged food price index* is a major determinant of food supply in Nigeria.

With respect to the income *per capita* variable (*LRYPC*), it is obvious that this variable appear with the theoretical sign and is statistically significant at the five (5) *per cent* level. This means that the higher the income *per capita,* the higher the demand for foreign food. This relationship may be explained in two ways. First, an increase in income operating through the demand side may create excess demand in

the food market, as this occurs food shortage emerged domestically, thereby raising the demand for foreign goods. The second explanation is that the increase in the income *per* head of some cross section due to the expansion in the oil industry might have the led to a shift of a considerable number of agricultural population to the urban centres, particularly the oil sector. As this occurs the supply of food declines. Although this study has found a positive relationship between food import and income *per* head, it further shows that food import is inelastic with respect to income *per capita (i.e.,* 0.16424). This implies that when income *per capita* changes, the responsiveness of an average Nigerian, on the aggregate, to the importation of food is very low.

The results presented in *Table 3* further show that the coefficient of *DLW* (a variable that captures the impact of weather conditions on food import, hence food shortage) emerged with the theoretical sign but insignificant. This means that weather conditions (contrary to expectation) is not a major determinants of food import in Nigeria. In another dimension, the *Index of Oil production (LIOP*), which is a variable that captures the link between oil production and food supply, hence the food situation in the country, came out with a wrong sign. This is actually contrary to our expectations. One of the explanations for food shortage and therefore food import in Nigeria is that the increased crude oil production and the sectoral effect on income, has led to the relegation of the agricultural sector. Under this situation, the demand for food exceeds its supply. The wrong sign of the oil variable *(LIOP)* and its consequential insignificance, therefore, makes it difficult to pin down this assertion. Therefore, when this variable was dropped from the model, there was no significant change in the estimated parameter and calculated statistics.

Another crucial variable in our regression in the exchange rate, captured by the nominal effective exchange rate *(LER).* This variable emerged with the a priori sign and is statistically significant at the five (5) *per cent* level. The negative coefficient indicates that depreciation of domestic currency relative to other international currencies leads to the reduction of food import thereby worsening the food situation in the country. Although this variable is significant, the responsiveness of food import to exchange rate depreciation is very slow. This means that Nigerians have great propensity for import and tend to reduce their food import gradually when exchange rate depreciates. This is compatible with the theoretical prescriptions. *The Dummy Variable (DUM)* also reveals that major reform in the economy in terms of the adoption of the *Structural Adjustment Programme (SAP)* does not in any way improve the food situation in the country.

In our regression, the *Lagged Error Correction Term (ecm_1)* is a crucial variable whose presence is a necessary condition for the model. From assessment. this variable appears with the correct sign and at the same time statistically significant at the five (5) *per cent* level. The error correction term captures the speed of

adjustment from short-run disequilibrium situation to a long-run equilibrium. The coefficient indicates that the contemporaneous adjustment of the food market to long-run equilibrium due to certain disequilibrium is about 57 *per cent.* This speed of adjustment is rather on the average and is not disturbing in the light of the understanding that the agricultural production and therefore food supply responds to demand with a considerable lag.

Overall, the main finding which emerged from this study has identified food prices, income *per* head and exchange rate as the main determinants of food import and therefore domestic food shortage in Nigeria. An increase in food price resulting from expansionary macroeconomic policy result to excess demand for food causing food shortage. This situation also exerts positive effect on food import. Our findings also reveals that the *Cobweb model* cannot be relied on to explain the food situation in Nigeria as the price expectation variables in our model are rather insignificant or with wrong sign. This implies that appropriate pricing, income and exchange rate policy has to be adopted to ameiorate the food demand and supply situation in Nigeria.

Policy Implications

This study has found that the domestic prices of food, income per head and exchange rate are the main determinants of food shortage proxied by food imports in Nigeria. The study has also indicated that price expectation plays no role in the supply of agricultural products in Nigeria. Given these findings, the following policy implications could be drawn.

First, the government needs to invest heavily in infrastructural facilities such as construction of feeder roads. This measure will help to minimize the bottleneck associated with the supply of food products in Nigeria. Given as economy characterized by good transportation system and where bottleneck in supply of food products are non-existence, an optimal price, clearing both the demand and supply side of the food market will prevail in the economy.

Second, measures improving the level of income of agricultural population need to be put in place in the country. The situation in Nigeria is such that a lot of the agricultural population have been highly impoverished. This has adversely affected the supply of agricultural product in the country. To boost the income of farmers, farm inputs could be supplied at free or subsidized rate. With more input, the supply of agricultural products will be enhanced.

Finally, exchange rate and trade policy that favours the importation of farm machines and other agricultural inputs should be put in place. For instance, the appreciation of naira in terms of other currencies will lower the prices of imported farm machines. Moreover, free duties on imported farm inputs will lower their costs. With this measure, the quantity of farm machines will increase locally, thereby encouraging the production of food products in the country.

Conclusions

Food is a basic necessity of life and its availability in the right quantity and quality is essential to enhance growth, productivity and welfare. The food situation in Nigeria, recently, has been so critical, that the country has to engage seriously in food importation to sustain her teeming population. In this study, we have studied the determinants of food shortage proxied by food import. We carried out an evaluation of the problem of food shortage as it affects Africa and Nigeria in particular. We assessed the severity of the situation by reviewing some food indices including: *Index of Crop Production, Index of Livestock Production, Index of Fish Production and Index of Value of Food Import.* We also observed that several policies were put in place by government to stem the menace of food shortage yet the result was seemingly dismal. Out literature also buttressed this food shortage hypothesis.

The theoretical underpinning was drawn from the Malthusian Population Theory and Ricardian theory of the limit to growth which tended to explain food shortage by population growth and limited arable and respectively. We thus developed a conceptual framework that incorporates other pertinent variables designed to explain the phenomenon of food shortage in Nigeria. The study has found three main factors to be quite responsible for the current food situation in Nigeria. These factors are prices of food which might have occurred as a result of demand management policies of the government, depreciation of the naira exchange rate against some major currencies, and the increase in *per capita* income giving room for excessive demand for food. This study therefore recommends vibrant pricing, income and exchange rate policy that could positively impact on the food market in Nigeria.

Footnotes

[1]The different goals of the firm as identified include profit maximization (i.e. profitability); maximization of sales revenue; output maximization; satisfaction maximization; preferences for prestige, high salaries and security; and utility or growth maximization, among others. See Jhingan (1997) for detailed discussions on these different goals or objectives of the firm.

[2] Johansen's method involves the estimation of the following k^{th} order vector autoregressive (VAR) equations:

$$\Delta X_t = \Gamma_1 \Delta X_{t-1} + \ldots\ldots\ldots + \Gamma_k \Delta X_{t-k} + \varepsilon_{1,t}$$

$$X_{t-k} = \Gamma_1 \Delta X_{t-1} + \ldots\ldots\ldots + \Gamma_{k-1} \Delta X_{t-k+1} + \varepsilon_{2,t}$$

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