



Determinants of Wheat Production in Nigeria (1981 – 2019): A Bounds Testing Approach

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Abstract:

The study examined the analysis of trends and determinants of wheat production in Nigeria between 1981 and 2019. The data for this study are time series data at macro level spanning from 1981 to 2019. All the data were largely sourced from Food and Agriculture Organization (FAO) statistical data base, Penn world data of the university of Pennsylvania and Central Bank of Nigeria (CBN) statistical bulletin. The data include output of wheat in Nigeria, local and international price of wheat, real exchange rate, and external reserve. The data were analyzed using autoregressive distributed lags to access the relationship between wheat output and factors affecting wheat production in Nigeria. Results showed that external reserve, per capita income, market reforms and technological advancement

significantly increased wheat production in Nigeria. Consistency of government policies and policy actions geared towards reducing wheat imports should especially pursued by the government.

Keywords: *Wheat, Nigeria, ECM, Production, Cointegration, Bounds Testing.*

Introduction

According to Binuomote et al (2010), Wheat is a fadama crop grown under irrigation in Northern Nigeria especially in the Lake Chad basin. Between 1970 and 1971 in Nigeria, it was estimated that 21,000 hectares of land were planted with wheat with the average yield of about 1682kg/ha and the domestic production estimate was about 19,000 tons. Also between 1974 and 1975, the estimated wheat production was 20,000 tons while between 1979 and 1980, the target local production in Nigeria was about 0.20million tons (Phillips, 1983). It has also been reported that up to 1985, domestic annual production of wheat was about 15,000 metric tons (Isitor, et al.,1990).

Wheat is one of the most important food crops, providing nearly one – fifth of the World's Calories supplies. About 19% of its World's production is traded internationally, primarily as exports from the countries of the Organization for Economic Co-operation and Development (OECD) – including Australia, Canada and European Union (EU) and the United State to developing countries to supply basic food needs and the growing demand for products made from wheat flour such as: Bread, Pasta and Noodles. Most of the trade in processed products has been between developed countries. During 1999 – 2001 about 85% of global exports and 77% of global imports of processed wheat product whereby traded between developed countries. Developing countries primarily imports wheat rather than



wheat products, with about 80% of total expenditure on grain going for wheat import during 1999 – 2001 (World Grain January, 2003, 2006).

As an industrial raw material, wheat is undoubtedly the most important grain in Nigeria today, which helps to provide employment directly and indirectly to millions of Nigerians. There are about twenty-five (25) milling companies spread across Nigeria, these have a combined installed milling of over (5) million metric tons of wheat per annum (Jibir, 1998). Apart from the facts that wheat supplies raw materials for the domestic pasta industries, cracker and biscuit industries and poultry feeds industries and even flour milling industries, it also contributes to the growth of the Nigeria local market which indirectly increases by capital income through employment opportunities in these industries. Wheat production also serves as source of government revenue through tax payment of these industries. Wheat production also alleviates the problem of food insecurity in Nigeria in diverse ways because all the industries that make use of wheat end up in food production either directly or indirectly (Jibir, 1998).

There is a high demand for wheat-based products in Nigeria, with an annual wheat consumption at 3.8 million tons in 2013/2014. Yet, despite its potential for production for both domestic consumption and export, domestic wheat production is about 70,000 tons in the same year (USDA, 2014). Nigeria has the potential for increasing its production of wheat under both irrigated and rainfed conditions. Several northern states are conducive to wheat production under irrigation, including Borno, Yobe, Bauchi, Jigawa, Gombe, Kano, Katsina, Kebbi, Zamfara and Sokoto states (Olabanji, 2016). It is estimated that there are 650,000 ha suitable for wheat production in these areas. Rainfed wheat can be grown on the highlands including Mambilla Plateau in Taraba State, Jos Plateau in Plateau State and Obudu in Cross River State

In an attempt to make Nigeria self-sufficient in wheat production, several measures were put in

place by the federal government of Nigeria. These measures include launching of several agricultural programmes and establishing several institutes aimed at stimulating interest in local production of wheat. Some of these were the National Cereal Research Institute (NCRI) in 1974, National Seed Service (NSS) in 1975, Operation Feed the Nation (OFN) in 1976, Basin Development Authority (RDBA), Agricultural Development Projects (ADP) (1975), National Grain Production Programmes (NGPP) and Accelerated Wheat Production Programme (AWPP), just to mention but a few. Also, the federal government of Nigeria, at different times, raised the tariff on wheat importation in order to protect local producers against massive imports of wheat. Despite the various interventions, however, there is still a wide gap between domestic demand and supply of wheat in the country. This is partly because wheat production in many parts of the country has remained at subsistence-oriented level despite its comparative advantage of producing in large quantity for commercialization (Falola, et al, 2017)

Perhaps the second most important reason for the decline in wheat production is the failure of past government to produce implements and sound policies annual at improving the lot of wheat farmers. As the cost of inputs increased and world price of the commodity fluctuated, government policies failed to respond to the needs of these farmers. The result was a rapid decline in the income of farmers which led to most of them abandoning their farms is no meaningful investment went into their operation.

This study is important in view of the declining trend of wheat production and its attendant effect on the income of farmers, the gross domestic product and the balance of payment position. A study of this kind is also important, as it will enable policy makers to identify the determinants of wheat production in Nigeria and to formulate policies to significantly boost its production and address the fall in production level and its attendant effect of food security.

Methodology

Study Area

The area of study is Nigeria, it is located on the southern coast of West Africa between 2° and 15°E longitude and 5° and 15°N latitude. It has basically in the tropics and its climate favours agricultural production. The country possesses a diversity of environment, ranging from the belt of man-grooves swamp and tropical rainforest in the lower elevations along the coast to the open woodland and savannah on the low plateau which extends through much of the central part of the country to the semi and plains in north and the highland to the east Nigeria, area of land is about 98 million hectares, with about 75% suitable for cultivation of almost all typical crops, out of which only about 1400 is under cultivation of any form. Nigeria has five main vegetation belts; these are the mangrove forest around the estuaries along the southern coastline followed by the equatorial deciduous forests, savannah grassland and the semi-desert scrubland in extreme north of the country.

The country has a wide range of climate condition but as a tropical country, it is generally hot and humid. Two seasons are discernable, the wet season and the dry season. The wet season falls between April or May to November, when the prevailing monsoon wind blows from southwest and the dry season is between the December to march when the harmattan blows from 4000mm in the south eastern parts of the country to 500mm in the north eastern parts of the country giving Nigeria diversity, which is reflected in large variety of crops produced. The average temperature for most of the country is between 24° and 27°C in the eastern highlands and on the Jos Plateau, the average annual temperature is around 12°C in the extreme north, the average high and average low annual temperature are about 43°C and 10°C respectively. Nigeria has about 190.77million people with about 60% of the population widely engaged in agricultural productions.

Sources of Data

The data for this study are time series data at macro level spanning from 1981 to 2019. The

data used for this study was secondary data and was obtained from data bank of the Central Bank of Nigeria (CBN) annual report and statement of account. The data collected includes local production of wheat, gross domestic product (GDP) for four countries who sales prices of wheat for four different countries. The regression analysis was used to examine the determinants of wheat production in Nigeria.

Analytical Technique: ARDL Modelling Approach to Cointegration

This study applied the Autoregressive Distributed Lags (ARDL) modelling approach to Cointegration, also known as Bounds testing (following Binuomote et al, 2010, Nwani and Bassey Orie (2016) and Nwani et al. (2016), to study the determinants of wheat output in Nigeria. Following the theory of production, it is hypothesised in this study that the production of wheat in Nigeria is a function of the relative price of wheat, external reserve, exchange rate and market reforms – since the ability of a nation to import will be a function of her available external reserve, per- capita income, relative price of wheat, price of substitute commodity and real exchange rate.

Empirically, the model is stated as:

$$LY = \alpha + \delta_1 LEX_t + \delta_2 LER_t + \delta_3 LP_w + \delta_4 SAP + \varepsilon_t \quad (1)$$

where LQ is the quantity of Wheat produced in Nigeria,

LEX is the real exchange rate,

LER is Nigeria's external reserve

LP_w is the relative price of wheat

LY Per- capita income and

SAP is structural adjustment programme.

All the variables are expressed in the natural logarithmic form. The dummy variable SAP is included in this study to examine the effect of market reforms policies on Wheat production in

Nigeria. It is expected that market reform will increase domestic Wheat production and consequently lower the import.

ARDL Model Specification

As obtained in Fosu and Magnus (2008), in order to empirically analyse the long-run relationships and dynamic interactions among the variables of interest, the model has been estimated by using the Bounds testing (or autoregressive distributed lag (ARDL)) cointegration procedure, developed by Pesaran et al (2001). The procedure is adopted for the following three reasons. Firstly, the bounds test procedure is simple. As opposed to other multivariate cointegration techniques such as Johansen and Juselius (1990), it allows the cointegration relationship to be estimated by OLS once the lag order of the model is identified. Secondly, the Bounds testing procedure does not require the pre-testing of the variables included in the model for unit roots unlike other techniques such as the Johansen approach. It is applicable irrespective of whether the regressors in the model are purely I (0) purely I (1) or mutually cointegrated. Thirdly, the test is relatively more efficient in small or finite sample data sizes as is the case in this study. The procedure will however crash in the presence of I (2) series. Following Pesaran et al (2001), we apply the bounds test procedure by modelling the long-run equation (6) as a general vector autoregressive (VAR) model of order p, in

$$z_t = c_o + \beta t + \sum_{i=1}^p \phi_i z_{t-i} + \varepsilon_t, \quad t = 1, 2, 3, \dots, T \quad (2)$$

with c_o representing a $(k+1)$ -vector of intercepts (drift) and β denoting a $(k+1)$ -vector of trend coefficients. Pesaran et al (2001) further derived the following vector equilibrium correction model (VECM) corresponding to (6)

$$\Delta z_t = c_o + \beta t + \pi z_{t-1} + \sum_{i=1}^p \Gamma_i \Delta z_{t-i} + \varepsilon_t, \quad t = 1, 2, 3, \dots, T \quad (3)$$

Where the $(k+1) \times (k+1)$ matrices

$$\Pi = I_{k+1} + \sum_{i=1}^p \psi_i \quad \text{and} \quad \Gamma_i = -$$

$$\Pi = \sum_{j=i+1}^p \psi_j, \quad i = 1, 2, \dots, p-1$$

contain the long-run multipliers and short-run dynamic coefficients of the VECM. Z_t is the vector of variables y_t and x_t , respectively. y_t is an I(1) dependent variable defined as LM_t and

$LQ = (LY, LEX, LER, LP_R, SAP)$ is a vector matrix of ‘forcing’ I(0) and I(1) regressors as already defined with a multivariate identically and independently distributed (i.i.d) zero mean error vector $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t})$ and a homoskedastic process. Further assuming that a unique long-run relationship exists among the variables, the conditional VECM can now become:

$$\Delta y_t = C_{yo} \beta t + \delta_{yy} y_{t-1} + \delta_{xx} x_{t-1} + \sum_{i=1}^{p-1} \lambda_i \Delta y_{t-i} + \sum_{i=0}^{p-1} \xi \Delta x_{t-i} + \varepsilon_{yt}, \quad t = 1, 2, \dots, T \quad (4)$$

On the basis of equation (4) above, the conditional VECM of interest can now be specified as

$$\Delta LQ = \alpha + \delta_1 LM_{t-1} + \delta_2 LEX_{t-1} + \delta_3 LER_{t-1} + \delta_4 LP_{wt-1} + \delta_5 LY_{t-1} + \sum_{h=1}^p \eta \Delta LQ_{t-h} + \sum_{i=1}^q \phi l \Delta LEX_{t-d} + \sum_{j=1}^q w \Delta LER_{t-z} + \sum_{k=1}^q \phi \Delta LP_{Rt-w} + \sum_{l=1}^q \ell \Delta LY_{t-g} + \pi SAP \quad (5)$$

Where δ are the long run multipliers, c_0 is the drift and ϵ_t are white noise errors. All variables are as previously defined.

There are 3 steps in testing the co integration relationship between rice import demand and its explanatory variables. First, we estimated equation above by ordinary least square (OLS) technique. The presence of cointegration can be traced by conducting an F-test for the joint significance of the coefficients of the lagged levels of the variables. That is, the null hypothesis

$H_0 : \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$ against the alternative.

$H_A : \delta_1$ or δ_2 or δ_3 or δ_4 or $\delta_5 \neq 0$.

We denote the test which normalize on M by $Q = F_M(Y, EX, ER, P_R, SAP)$. Two asymptotic critical values bounds provide a test for cointegration when the independent variables are $I(d)$ (where $0 \leq d \leq 1$): a lower value assuming the regressors are $I(0)$ and an upper value assuming purely $I(1)$ regressors. If the computed F- statistic is less than lower bound critical value, then we do not reject the null hypothesis of no cointegration. Conversely, if the computed F- statistic is greater than upper bound critical value, then we reject the null hypothesis and conclude that there exists steady state equilibrium between the variables under study. However, if the computed F - value falls within lower and upper bound critical values, then the result is inconclusive. The appropriate critical values for the F-tests are obtained. Critical values for the $I(0)$ series are referred to as the upper bound critical values while the critical values for the $I(1)$ series are referred to as lower bound critical values.

For the second step, once the cointegration has been established consequent upon which a unique long run relationship exists among variables of interest, we specify a conditional ARDL ($P, q_1, q_2, q_3, q_4, q_5, q_6$) long run model for LQ as

$$LQ = c + \sum_{h=1}^p \delta_1 LQ_{t-1} + \sum_{i=0}^q \delta_2 LEX_{t-i} + \sum_{j=0}^q \delta_3 LER_{t-1} + \sum_{k=0}^q \delta_4 LP_{Rt-1} + \sum_{l=0}^q \delta_5 LY_{t-1} + \pi SAP \quad (6)$$

The lags length in the ARDL model is selected based on Schwarz Bayesian criterion (SBC). For Wheat, a maximum of 2 lags was selected.

In the final step, we obtain the short-run dynamic elasticities by estimating an error correction model associated with the long run estimates. This is specified as follows:

$$\Delta LQ = C_0 + \sum_{h=1}^p \eta \Delta LIM_{t-n} + \sum_{i=1}^q \phi_i \Delta LEX_{t-d} + \sum_{j=1}^q \omega_j \Delta LER_{t-z} + \sum_{k=1}^q \phi_k \Delta LP_{Rt-w} + \sum_{l=1}^q \ell_l \Delta LY_{t-g} + \pi SAP + \lambda ECM_{t-1} \quad (7)$$

The symbols η, ϕ, ω, ϕ , and ℓ are the short-run dynamic elasticities of the model's convergence to long-run equilibrium and λ is the speed of adjustment. Δ represents the first difference operator and ECM_{t-1} is the one period lagged error correction term. The coefficient measures the speed of adjustment to obtain equilibrium in the event of shocks to the system. General – to – specific modelling technique of Hendry and Erricson (1991) is followed in selecting the preferred ECM. This procedure first estimate the ECM with different lag lengths for the difference terms and, then, simplify the representation by eliminating the lags with insignificant parameters. A correctly indicated ECM model has to pass a series of diagnosed tests. These include the Autoregressive LM (Lagrange multiplier) test and/or Durbin-Watson test for serial correlation in the residual, the Autoregressive LM test for normality distribution of the residuals in a regression model, the ARCH and the White test for heteroscedasticity in errors. These tests were conducted to ensure reliability of results.

Results and Discussion

Co-Integration Test

The table 1 below shows the bound co-integration test. The test shows that there's a long-run relationship between the dependent variable and the independent variables, this shows that there is co-integration in the specified equation.

Table 1. Co-Integration Test for Long-Run Relationship for the Selected Variables

Critical values	FQ (M/Y,EX,ER,P, SAP) k = 5	4.9555
	Lower bound I (0)	Upper bound I (1)
1%	4.011	5.331
5%	3.189	4.329
10%	2.782	3.827

Source: Data Analysis, 2021

Long and Short Run Correction and Diagnostic

The solved static long-run equation for wheat production in Nigeria as well as its short-run equation is given in Table 2 below. The R² value of 0.552 for the ECM in the Table 2 shows that the overall goodness of fit of the ECM is satisfactory. However, a number of other diagnostic tests were also carried out in order to test the validity of the estimate and their suitability for policy discussion. The autoregressive conditional heteroscedasticity (ARCH) test for heteroscedasticity in the error process in the model has an F-statistic of 0.271 which is statistically insignificant. The diagnostics tests show that the results are valid for true econometrics interpretations and are valid for policy actions.

It could also be observed from the result in the Table 2 that the co-efficient of per capital income (LY) in the long-run is not significant. The coefficient for per capital income in the short-run is 0.128 and it is also insignificant even though it is positive. When it comes to the coefficient of real exchange rate (LEX), it is -0.006 in the long-run but insignificant. Same is

the results in the short run. This result is not in line with the theoretical expectation has the devaluation of the nation's currency which is one of the major component of SAP is expected to increase wheat production in the country and significantly discourage imports.

The coefficient of external reserve (LER) in the long-run is 0.321 and it is significant at 1%. Also in the short-run, the coefficient is 0.297. The result suggested that a unit increase in the external reserve, increase the wheat output by 0.321 and 0.297 in the long and short-run respectively. Although a high external reserve is expected to encourage import, it could also be a good encouragement to local production if the resources are mobilized towards the acquisition of inputs, raw materials and technologies which will significantly contribute to local wheat production in Nigeria.

The coefficient for relative price (LP) in the long-run is -0.526 and it is significant at 5%. The coefficient is -0.382 in the short-run and it is significant at 10%. It therefore supports the expectation that import price relative to domestic price will be negatively related to wheat production. The relative price as an indirect relationship with wheat output because it is negative so an increase in the relative price will result to a decrease in wheat output. This contradicts the result of Bashir et al. (2010), Buriro et al. (2015), Chandio et al. (2016, 2018b)

The coefficient of SAP is -2.856 in the long-run and is significant at 1% while in the short-run, the coefficient is -0.487 and it is statistically insignificant. A proper implementation of market reforms policy in Nigeria policy will increase the wheat output in the long-run and encourage local production of wheat through liberalization of input and output market. However, since the coefficient of SAP in this case is negative, it suggests that market reforms significantly inhibits wheat production in Nigeria.

Trend has a coefficient of 0.104 which is statistically significant at 1% in the long-run. Trends has a direct relationship with wheat production because it is positive, this economically implies that a percentage increase

in trends will result to 10.4% increase in wheat production in the long-run. Trend is a very important factor in wheat production because is a combination of technological innovations which are expected to significantly boost wheat production.

The error correction modelling (ECM) carries the expected position sign and it is significant at

1%. The significant of ECM supports co-integration and suggests the existence of long-run steady state equilibrium between wheat production and other determining factors in the specified model. The coefficient of -0.568 indicates that the deviation of wheat production from the long-run equilibrium level is corrected by about 56.8% in the current period.

Table 2: Static Long – Run and Short – Run Modeling of Wheat Production in Nigeria

Static Long – run Result			Short – run Result		
Constant	17.277	(1.840)	Constant	-0.895	(-0.111)
LY	-0.956	(-1.240)	LY	0.128	(0.179)
LEX	-0.006	(-1.007)	LEX	-0.037	(-0.619)
LER	0.321	(4.099)***	LER	0.298	(3.514)***
LP	-0.526	(-2.214) **	LP	-0.382	(-1.849)*
SAP	-2.857	(-6.805) ***	SAP	-0.487	(-0.878)
Trends	0.104	(3.856) ***	ECM	-0.568	(-5.032)***
			R2	= 0.552	
			AR F (1.27)	= 1.469 (0.236)	
			ARCH L F (1.27)	= 1.260 (0.271)	
			Normality X ²	= 93.240 (0.230)	

Source: Data Analysis 2021

$$ECM = LQ - 17.277 + 0.956LY + 0.006 LEX - 0.321 LER + 0.526 LP + 2.857 SAP - 0.104 Trend$$

* Indicates Significance at 10%

** Indicates Significance at 5%

*** Indicates significance at 1%

Conclusion and Recommendations

The elastic nature of domestic wheat production in the long-run suggests that policies geared towards reducing wheat import by increasing domestic wheat production significantly achieve its objective in the long term. Thus, there is need for government to implement policies that will favour increased domestic wheat production in Nigeria possibly by encouragement of the farmers through the provision of incentives, provision of subsidy and favourable price policies. Wheat imports in Nigeria will continue to increase as long as there is an increased

demand even in the face of increased exchange rate since increased exchange is likely to affect local wheat production as a result of costly and scarce input (e. g fertilizer, chemicals, imported wheat varieties etc.) thereby leading to a decline in domestic wheat production and which could encourage wheat imports. The study recommended that in order to ensure increased wheat productivity in Nigeria, sub-sector policies such as institutional, technology and infrastructural must be developed to achieve increased wheat output. The effectiveness of policies must be towards increased wheat productivity in Nigeria depending greatly on a matrix of price, resource development. There is also need for policy consistency on the part of Nigeria government. Thus, policy action geared towards reducing wheat imports should also focus on exploring alternative measures such as trade agreements and perhaps restriction of wheat imports to a level that will not lead to food insecurity, taking note that wheat is one of the major staple foods in Nigeria.

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