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IMPACT OF FERTILIZER SUBSIDY ON MAIZE OUTPUT IN NIGERIA: 1987-2019

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ABSTRACT

The research investigates the impacts of fertilizer subsidy on maize output from the period of 1987-2019 built on refined Cobb-Douglass production function often referred to as AK growth model. As an imperative for the growing population in the country, an improved system of farming through government efforts of subsidizing agricultural input (most especially fertilizer) in order to aid the production of farm output like maize at a large scale remained significant and must be accorded with highest order of priority. The study utilized ARDL Bound Test and Dynamic OLS as a method of estimation. The result obtained from the bound test revealed that there exist long run relationship between fertilizer subsidy and maize output in Nigeria; while the result of DOLS discovered that all the examined explanatory variables: fertilizer subsidy, labour input and institutional quality exact positive impact on maize output. Though, the positive impact of fertilizer subsidy on maize output only become significant after taking one lagged period; while the positive impact of labour input and institutional quality are significant at both current and one lagged period. The study therefore, recommends that while government is encouraged to improve on its fertilizer subsidy program, it must also ensure strengthening of institutions responsible for administration of subsidized fertilizer input to guarantee delivery of right quality and quantity to the intended farmers at a very right time.

KEY WORDS: Fertilizer subsidy, Maize Output, DOLS, ARDL Bound Test.

1. INTRODUCTION

Admittedly, Nigeria is richly endowed with both human and natural resources that hold the potentials to attain security in food production at a sustainable manner. It is blessed with vast arable land surfaces of 923,768 km^2 and with approximately 200 million populations that are sufficient enough to cultivate the land surface for feeding itself and other neighbouring nations in the African continent thereby fostering the social and economic advancement of the country (Akinyemi & Isiugo-Abanihe, 2014). In this view, the influencing roles agriculture play in socio-economic development of many countries most especially developing countries like Nigeria cannot be overstated. Importantly, crop, most especially maize crop is one of the most consumed staple foods in Nigeria that has also been a major source of local ‘cash crop’ for almost every part of Nigeria where at least 30% of the crop land is allotted to small-scale maize production under several cropping systems (Ayeni, 1991).

Precisely, Nigeria being the largest producer of maize in Africa and 10th largest world producer of maize, yet, the total output of maize in the country is found below the consumption needs in the country (IITA, 2008; USAID, 2010). For instance, in 2017, Nigeria recorded 10.4 million mt of total maize produced; while the total maize consumption needs (by both household and industry) in the country stood at 10.9 million mt in the same year 2017 leaving the gaps of 500,000 mt between the total production and total consumption needs (Gain and Harvestplus, 2019). Consequently, maize production in particular and crop production in general require greater attention if adequate security in food production is to be attained and sustained.

Following from this point, it is imperative to enhance productivity in crop production particularly, maize through agriculture enhancement programs such as farm input subsidy most specifically, fertilizer subsidy. This is because Agriculture has from time immemorial in Nigeria to the present represented a leading sector that absorbs more workforces and highest contributing sector to the Nigerian GDP prior to the discovery of oil in 1956 as well major source of food for the habitant (citizenry) (Alhassan, Salis & Sulu-Gambari, 2020; World Bank 2012; Binuomote & Odeniyi, 2016; Daneji, 2011). However, the discovery of oil in Nigeria has led to neglect of the agriculture sector hence, become less attractive due to the less attention given to the sector by the government of Nigeria, and this subsequently put the country at the risk of attaining self-sufficiency in food security which is one of the fundamental themes of the Agricultural policy in Nigeria over the years (Alhassan, Salis & Sulu-Gambari, 2020). Indeed, agricultural outputs in Nigeria have over the years remained unchanged or decreasing, raising worries about the sector’s continuity and efforts to alleviate rural poverty in a specific and precise term.

The Nigerian government has since 1970s implemented several fertilizer subsidy programs where both Federal and State governments actively hold key stands in the administration of fertilizer subsidy programs (Liverpool-Tasie & Takeshima, 2013). While commercial sales of fertilizer remained un-prohibited in Nigeria; Nigerian government has in the history allotted significant shares of agricultural capital spending to fertilizer subsidy (Mogues Morris, Freinkman, Adubi and Ehui, 2012). Subsequently, the initial quantity of fertilizer earmarked for subsidy generally has been large relative to actual fertilizer consumption in Nigeria and this amounts to the revelation of substantial leakage of subsidized fertilizer into the commercial “unsubsidized” market (Liverpool-Tasie and Takeshima 2013). Resultantly, this has caused reduction in the volume of subsidized fertilizer offer to the farmers by the government with consequential effects on farm yields particularly, maize yield. For instance, Liverpool-Tasie and Takeshima (2013) shared the view that, in some years in the past, the amount of subsidized fertilizer by the Federal and State governments (under the government's fertilizer subsidy program) amounted to more than 90% of the actual fertilizer consumed in the country thereby culminating the fertilizer subsidy program into deceitful venture in the country that thus left the aim for which fertilizer subsidy is intended defeated.

In view thereof, the fertilizer subsidy programs assumed another dimension of incorporating rural farmers by promoting their full participation into the policy program particularly in the area of distribution process of the subsidized fertilizer for effectual translation of the program into higher agriculture yield (most especially maize). This therefore birthed the reform of most of the agriculture programmes specifically fertilizer subsidy program. For instance, the agricultural transformation agenda (ATA) witnessed the shift from general subsidies to targeted subsidies, and from consumption to production subsidies where the subsidized fertilizer and other farm inputs were tie to the prospective yield of the participated farmers in a way to cut out drained treasury due to fraud that accompanied the subsidy program in the previous years (Adesina, 2014). Also, the current liberation of fertilizer subsidy policy often referred to as the presidential fertilizer Initiatives (PFI) 2017 under the general theme of Anchor Borrower-agriculture financing scheme where the farmer obtained subsidized farm input (including subsidized fertilizer) as a soft-loan and repay back with farm outputs is another phase of fertilizer subsidy program in Nigeria (CBN, 2016) and a host of others; among others and this has led to the significant improvement in the usage of fertilizer that thus results to increasing maize output in the country (e.g. increase from 10,420 mt in 2017 to 11, 000 mt 2018 representing 5.57%) (WDI, 2017; Jayash & Christine, 2017; Ogunfowora, 1994).

In this regards, successive governments in Nigeria have embarked on the derivative measures in revamping the sector for the attainment of the fundamental goal of Agricultural policy through the grant of agricultural input subsidy particularly, fertilizer subsidy to the participant in the sector as an impetus to the realization of security in food production (e.g maize) through raising productivity and rising output in the country (Ministry of Agricultural and rural development report, 2011). This is because food security cannot be achieved under a farming system that depends almost wholly on human muscle power and other manual methods. Therefore, improved system of farming through government subsidizing of agricultural input (most especially fertilizer) to aids the production of farm output like maize at a large scales remained significant and with high order of priority (Jayash and Christine, 2017; Ammani, Alamu & Kudi, 2010). This is necessarily so because, securing food particularly staple foods like maize for the increasing population is a key and critical focus that the captains of this country must to contend with in order to guarantee hunger-free nation.

In this regards therefore, there has been a tremendous effort by the successive government in revamping agricultural sector in Nigeria through introduction of fertilizer subsidy like liberalization of fertilizer policy and Presidential Fertilizer Initiatives (PFI) in 2017. However, most of these fertilizer policies have thus been hindered by such factors as activities of middle-men, administrative bottleneck due to poor institutional quality or governance problem, late deliveries of subsidized fertilizer among others that thus cause the impact of fertilizer subsidy not effectively translated to an increasing crop output particularly, maize yield. In view thereof, this study examined the relationship between maize output and fertilizer subsidy, and impacting effects of fertilizer subsidy on maize output in Nigeria.

2. LITERATURE REVIEW

This section briefly defines the key concepts used in the context of this research, review the relevant literatures and introduce the theoretical framework underpinning this research work.

2.1 Conceptual Background

2.1.1 Maize Output

Sequel to the importance of maize in Nigeria for both household consumption and industrial use, it is ranked fourth cereal crops mostly consumed (FAOSTAT, 2012; Ogunniyi, 2011; Juma, 2010). This induced the growing demand for maize crop for which its production must be enhanced through production incentive (like fertilizer subsidy) as a means of curtailing the impending shortage of its supply in the country. Consequently, Maize yield can be broadly means the total amount of maize harvest in a specific area at a given period of time (Benson &Fermont, 2011).

2.1.2 The fertilizer subsidy: The fertilizer subsidy is the least of agricultural program that government has over the years given priority when considering subsidy in agricultural sector because of the direct impacts it bears on farm yield. The concept of fertilizer subsidy in a specific term is central to the agricultural policy of any government in Nigeria in driving the Agricultural sector towards achieving food security in the country (Mogues, Morris, Freinkman, Adubi and Ehui, 2012). Subsequently, FAO (2000; 2004) defined fertilizer subsidy as an incentive giving to the farmers on fertilizers to allow for the purchase of required quantity of fertilizer at a less than prevailing market price. This is in consonance with efforts to maximize the nation’s agricultural output through increased use of fertilizer input on the cultivated land area because access to affordable and quality fertilizer input is essential to enhancing agricultural productivity (particularly maize production) (Bello, 2016). It therefore entails that, fertilizer subsidy in the context of this study, is conceptualized to mean an economic incentive on fertilizer offers to the maize producing farmers for inducing them to substantially increase the maize yields and improve food security in the country.

2.3 Theoretical Framework

This paper is hinged on Arrow Kenneth (AK) growth model of 1962. The AK growth model is a refined form of Cobb-Douglas production that incorporate technological progress as an accidental result of producing fresh capital goods, a phenomenon called “learning by doing” (Tuna, 2012; Acemoglu, 2002). Concisely, the technological progress is subjected to aggregate production of capital goods and the sizes of firms such that technological progress can be assumed given independent of their own production of capital. Hence, each firm maximize profit by paying for only two factor inputs (say labour and capital) for their marginal product, since the technological progress is assumed to be a component of these factor inputs. And so, marginal product of capital raises by technological progress is thus offset by the diminishing return to capital (Robbert & Xavier, 2004). Consequently, AK model is specified in terms of total output in relation to only capital and labour as the input factors in the production function as:

$Q = (K, L)$

2.4 Empirical Review

In spite the acknowledgement of the fact that the fertilizer subsidy has been identified as a major impetus for raising fertilizer usage thereby enhancing productivity in agriculture sector, there exist a scanty empirical studies in literature on the impacting results of fertilizer subsidy on agricultural output particularly, maize output in Nigeria. Therefore, the empirical studies are reviewed on the basis of studies pertinent to the investigation of the nexus between fertilizer subsidies and agricultural output particularly, maize output in Nigeria. For instance, the empirical study by Eric, Oliver and Ebele (2006) on the effect of fertilizer subsidy on the output of rural farmers using Gini ratio as method of estimation and analysis to investigate the improvement in income generation of rural farmers due to effects of fertilizer subsidy and concluded that fertilizer subsidy is of high potentials to double-fold the agricultural yield (particularly crops) of the rural farmers in Nigeria. Similarly, Ayinde, Adewumi, and Omotosho (2009) studied the effects of fertilizer on crop production in Nigeria, using descriptive statistics, t-test and regression model to discover that fertilizer usage account for increased crop yield even though there are other factors like price of fertilizer and the quantity of fertilizer distributed are key to the determinant of fertilizer usage in Nigeria.

Also, Ammani A. et al. (2010) examined the effects of fertilizer subsidy on aggregate maize production in Nigeria, using the transformed time series data from 1990-2006 to run multiple regressions for the study where it is revealed that the average maize output has over the time under the purview increased significantly due to the subsidized fertilizer made available to the rural farmers at the right time and quantity. Similarly, Oko (2011) investigated the impact of fertilizer policy on crop production in Nigeria, the study utilizes descriptive statistics, students' t-statistics and regression model as method of estimation and analysis to found that the rate of fertilizer usage, cost price of fertilizer and fertilizer policy impacts positively on agricultural output in Nigeria.

More so, Kasim, Mad, Rusli and Alias (2014) studied technical efficiency in maize production and its determinants: a survey of farms across agro ecological zones in Northern Nigeria. The study utilizes Stochastic frontier production function and Tobit models to analysed the survey data to reveals that technical efficiency of maize output from various states and modelling agro ecological zones to observes the impact of variation in climate and production practices on the technical inefficiency. Also reveal by the study that labour, seeds, fertilizer and chemicals are key factor inputs contributing positively and significantly to the growing of maize output in the ecological zones of northern Nigeria.

Furthermore, Lonester, Alastair and Sophia (2015) examined the impact of farm input subsidy on maize marketing size in Malawi, the study utilizes correlated random effects method of analysing linear and non-linear panel data models and reveals that fertilizer subsidy increases maize output for the farmers hence, farmers' market participation as sellers, quantity sold and commercialization of maize increases slightly pointing to the need to further enhance farm household earnings from maize sales. Similarly, Binuomote, and Odeniyi (2016) on the effects of fertilizer subsidy on agricultural production and its implication on food security in Nigeria (1981-2012) utilizing Johansen Cointegration and error correction model to unveil that capital, foreign direct investment into the Nigerian agricultural sector and fertilizer subsidy cost exhibits positive effects on agricultural production in Nigeria at a significant level of statistics. Also, the coefficient of error correction mechanism (ECM) (-1.234) indicates that any deviation of agricultural production from the long-run equilibrium level in the preceding year can be corrected by almost 123% speed of adjustment in the year.

Likewise, Lenis, Bolarin, Awa and Wale (2016) investigated the profitability of the increased inorganic fertilizer use for maize production in SSA: evidence from Nigeria, the study adopted panel regression to found that low profitability use of fertilizer can be attributed to the low marginal physical product and high transportation cost in Nigeria. Also, soil quality, timely access to fertilizer product and availability of complementary inputs (like improved seeds irrigation and credit), among others are some other constraints inhibiting an enhancement in agricultural productivity in Nigeria.

3.0 Methodology

3.1 Type and Sources of Data

This study utilized secondary data spanned for the period of thirty-two years after the introduction of SAP to date, that is, 1987-2019. The data for the study is obtained from such sources as International Country Risk Guide (ICRG, 2017), Statistical Bulletin of Central Bank of Nigeria (CBN, 2018) and International Labour Organisation (ILO, 2018). Where there is missing data point in the series from the original sources stated, the moving average of interpolation is adopted to augment for the missing observations.

3.2 Model Specification

Based on the theoretical literature, the model is specified in terms of output-input relationship as:

$$Q = f(C, L) \quad \ldots\ldots (3.2.1)$$

Where Q is the total output; C is the amounts of capital employed in the production process which is proxied by the amount of capital expend on subsidizing fertilizer input to the farmers measured in terms of percentage of fertilizer production consumed by the farmers and; L is the amount labour employed in the production process which is proxied by the percentage of labour in agricultural sector. And so, the mathematical form of the functional equation (3.1) is expressed as:

$$Q = C + L \quad \ldots\ldots (3.2.2)$$

Subsequently, the administration of fertilizer subsidy must entail full entrenchment of good governance through established quality institutions for its impact on the targeted farmers (say maize producers) to be felt. This therefore necessitates inclusion of institutional quality as an additional explanatory variable and restatement of equation (3.2) follows as:

$$MQ = C + L + INSQ \quad \ldots\ldots (3.2.3)$$

And the econometric form of the equation (3.3) is stated as:

$$MQ_t = {}_0 + {}_1C_t + {}_2L_t + {}_3INSQ_t + {}_t \quad \ldots\ldots (3.2.4)$$

3.3 Model estimation Procedure

Firstly, the study test the stochastic properties of the series employed for the variables specified in the model using complementary test of ADF and PP unit root test frameworks. The PP unit root test is employed to complement ADF for its greater reliability than the ADF due to robustness in the midst of serial correlation and hetersokedasticity (Hamilton, 1994). The unit root test for variables is carried out with both trend and intercept using the following specification:

$MQ_t = {}_0 + {}_1MQ_{t-1} + {}_2T + {}_{t-i} + {}_t$ .... (3.3.1)

Where, ${}_0$, ${}_1$, ${}_2$ and $i ..._n$ are parameters to be estimated, and ε_t is the disturbance error term.

The unit root test is followed by the test for cointegration using Auto-regressive Distributed Lag model otherwise referred to as ARDL Bound test by Pesaran, Shin & Smith (2001) and Narayan (2004). The ARDL Bound test is preferred for its accommodating power of conducting cointegration test for the combined stationary and non-stationary series and also considering the entire variable in the cointegrating equation as endogenous (Pesaran et al., 2001). Thus, the estimated ARDL cointegration test model is specified as:

$InMQ. = {}_0 + InMQ._{t-1} + InFC_{t-1} + InAGL_{t-1} + InMQ_{t-1} + InFC_{t-1} + InAGL_{t-1} + {}_t$ .... (3.3.4)

Subsequent to the analysis of the cointegrating equation, it is stressed that the existence of cointegration among set of time series variables denotes the likelihood of the explanatory variable(s) in the cointegrating relationship to tell on the dependent variable at both current and succeeding period or even in the preceding period. In this view, the Dynamic Ordinary Least Square (DOLS) estimator developed by Stock and Watson (1993) is adopted in the study to examine cointegrating vectors of the variable(s). This technique is mainly useful because it brings forth dynamics in the specified model. Hence, the DOLS estimator of the cointegrating regression equation combines all variables in levels and in first order of integration, in addition to leads and lags of values of the change in the explanatory variables. The estimated DOLS is specified as:

$MQ_t = {}_0 + {}_1FC_t + {}_2AGL_t + {}_3INSQ_t + {}_1\Delta FC_{t-1} + {}_2\Delta AGL_{t-1} + {}_i\Delta FC_{t-1} + {}_3\Delta INSQ._{t-1} + \mu_t$ .... (3.3.5)

Where: MQ_t is the total maize output; $FC_t$is the total kilogram of fertilizer consumption; AGL is the total number of labour force in agriculture which is the direct of labour engaged in maize production; INSQ is the institutional quality measured by beaurocratic quality; Δ is the lag operator and; μ_t is the error term in the specified model. In order to dazed the problem related to the non-normal distribution of the standard errors of the cointegrating regression equation, the specified model was estimated by OLS using the Newey and West's (1987) Heteroscedastic and Autocorrelation Consistent (HAC) covariance matrix estimator, whose standard errors are robust and make inferences about the coefficients of the variables entering the regressors in levels to be valid. The model is then estimated by including 1 lead and 1 lags of the change in the regressors, while lag selection was based on the Schwarz Bayesian Criterion (SBC).Based on Hendry's (1986) General to Specific (GETS) methodology, the frugality of dynamic OLS results are offered. The estimated residual diagnostics include tests for serial correlation, misspecification, normality, heteroscedasticity and stability of estimated coefficients.

4. Result and Discussions

4.1 The results of complementary Unit root tests of ADF and PP (with both intercept and trend) is shown in table 4.1

Table 4.1: Results of Unit Root Tests

Variables	T-Statistics		Order of integration	Probability	Decision Rule
	ADF	PP			
InMQ	-6.899089	-6.898414	I (1)	0.000	Stationary
InFC	-4.323018	-4.323018	I (0)	0.008	Stationary
InAGL	-4.955983	-4.931639	I (1)	0.002	Stationary
INSQ	-5.590321	-4.251416	I (1)	0.000 (0.0108)	Stationary

Source: Author's Computation

The table 4.1 shows the results of complementary ADF and PP unit root test where it is revealed by both tests that all the variables under examination except fertilizer consumption are stationary at first order of integration; while the fertilizer consumption is stationary at level and 1% statistical significant level.

4.2: Cointegration (ARDL Bound Test)

As outlined in the theory, the principle of ARDL Bound test suggests that, the lower bound (I/0) critical values assumes that the examined explanatory variables are integrated of order zero (i.e. I/0), while the upper bound (i.e I/1) critical values assume that the examined explanatory variables are integrated of order one (i.e. I/1) (Pesaran *et al.*, 2001; Narayan, 2006). Hence, when the computed F-statistic is less than the lower bound (i.e. I/0) critical values, there is absence of cointegrating or long-run relationship among the examined variables. However, when the computed F-statistics is greater than upper (i.e. I/1) bound critical values; there exist cointegrating or long-run relationships among the examined variables. Furthermore, when the computed F-statistics falls in-between the lower (i.e. I/0) and upper bound (i.e. I/1) critical values, the results are inconclusive and the dynamic error correction model can be put to test through a re-parameterization of ARDL model (Pesaran *et al.*, 2001).

Table 4.2: The Result of Cointegration Test (ARDL Bound Test)

Variables		Functions		F-Statistics		Degree of Freedom	
MQ		F(InFC, InAGL, INSQ)		**6.339659**		**3**	
Critical Values Bounds							
10%		5%		2.5%		1%	
I (0)	I (1)	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)
2.37	3.20	2.79	3.67	3.15	4.08	3.65	4.66

Source: Authors' Computation

Therefore, the computed F-statistics reported in table 4.2 was based on Narayan (2004) modification of ARDL bound test for when the sample observations for a study is less than 100 sample size or sample observations as against Pesaran et al., (2001) computed F-statistics of 100 and above, and from the obtained F-statistics computed (**6.339659)**, it is evident that there is presence of cointegration or long run relationship between total maize output and fertilizer consumption since the computed F-statistics (**6.339659)** is greater than upper bound critical value at 1% level of significance. Hence, in order to maximize maize output in Nigeria, fertilizer consumption must be encouraged through subsidizing the fertilizer usage in the country.

4.3 The Estimated DOLS Result

The estimated result in Table 4.3 shows that, with the exception of fertilizer consumption (InFC), all the explanatory variables that positively impacted on total output of maize in the country at statistical significant level during the production of maize in the current year; while all the same variables exhibits significant positive impacts on maize output with one (1) lag period. And this by implication means that, institutional quality and labour force in the production process are in the both current period and lagged period vital factor inputs to the encouragement of fertilizer usage through efficient and effective administration of fertilizer subsidy in order to impacts positively and significantly on maize output in succeeding period in Nigeria.

Table 4.3: The Result of Estimated DOLS

Variables	Coefficient	Std. Error	t-Statistics	Probability
C	-75.81202	6.963913	-10.88641	0.0000
InFC	0.004798	0.079491	0.060358	0.9526
InAGL	4.996788	0.416391	12.00024	0.0000
INSQ	0.775057	0.102362	7.571700	0.0000
Δ InFC (-1)	0.109658	0.045969	2.385486	0.0442
Δ InAGL (-1)	4.485113	0.239935	18.69305	0.0000
Δ INSQ (-1)	0.804623	0.058355	13.78841	0.0000
C	-67.79520	3.966634	-17.09137	0.0000

Source: Authors' Computation

4.4 Interpretations and Discussion

The interpretations and discussion of results for the examined explanatory variable is thus presented in the following order:

i. Fertilizer consumption (InFC): The result in table 4.3 shows that fertilizer consumption is at both current period and one lagged period impacted positively on total maize output, though the result is insignificant at current period; whereas it is significant when the estimated model is lagged by one-year period. And by implication, it means that, the expenditure by government on subsidizing fertilizer input for the production of maize tends to take some time before it reflects positive and significant impact on the output of maize in Nigeria. This could be understood when factoring inefficient administrative process of dispensing subsidized fertilizer to the intended farmers (says maize producers) owing to the bureaucratic bottlenecks, and so the effects of such intervention of government can be immediately felt positively but not necessarily at significant level during the current time, rather needs some time for such impact to be significant as thus shown by the obtained result. Also, from the obtained result, one unit increase in the rate of dispensed fertilizer subsidy leads to corresponding increase in maize output by 0.007 mt (i.e 0.7%) in the same current period and 0.109 mt (i.e 10.9%) in the succeeding period. This result is of course consistent to the findings by Binuomote and Odeniyi (2016); Lonester, Alastair and Sophia (2015); Ayinde, Adewumi, and Omotosho (2009) and; Eric, Oliver and Ebele (2006) that found positive impacts of fertilizer subsidy on agriculture output in general term and on maize output in specific term.

ii. Labour input (InAGL): The study reveals that labour input in the production of maize (proxied by total number of labour in agricultural sector) is at both current period and one lagged period impacted positively and significantly on maize output in Nigeria. This result corroborates the findings in a study by Kasim, Mad, Rusli and Alias (2014) that labour input among other farm inputs (like fertilizer, seeds and chemicals) is the highest contributor to the growing of maize output in Nigeria. As shown in the table 4.3, a unit increase of labour input in the production of maize leads the maize output to increase by 4.996788 and 4.485113 in the current and lagged period (one) respectively.

iii. Institutional quality (INSQ): As shown in table 4.3, institutional quality is at both current and one lagged period played positive and significant role in the production of maize in Nigeria through efficient and effective administrative process of subsidized fertilizer input to the maize producers (maize farmers). This result also confirm the assertion made in a study by Ibukun, Opeyemi, Matthew, Ezekiel and Raphael (2020) that fertilizer policy instrument (like fertilizer subsidy) cannot be said to independently move agricultural sector in a sufficient progressive manner unless such fertilizer subsidy policy is complemented with system of good governance. As reported in the table 4.3, institutional quality in the administration of subsidized fertilizer input to the maize farmers induces maize output to increase by 0.775057 and 0.804623 in both current period and when estimated model is lagged by one-year period respectively, and both at statistical significant level.

4.5 Results of Residual Diagnostics Test

Furthermore, the result of residual diagnostics tests reveals that there is minimum size of disturbance error term since the level error tolerance in the estimated model is below 10% (i.e 0.098548). This means that the estimated regression result exhibit both explanatory and predictive power of the nexus between fertilizer subsidy and maize output in Nigeria. More so, the estimated model is said to be free from such problem as heteroskedasticity, serial correlation and normality of the distribution of error term since the P-value of the respective test is greater than 0.05 statistical level.

Table 4.4: Result of Residual Diagnostics Test

Tests			Outcomes	
			Coefficients	Probability
Serial Correlation	BPG	F-Stat.	0.691758	0.4138
		Obs (R^2)	0.896504	0.3437
Heteroskedasticity	BPG	F- Stat.	2.129671	0.0854
		Obs (R^2)	10.82367	0.0940
Normality	Jarque-Berra		1.839473	0.398624
R^2		**0.969678**		
Adjusted R^2		**0.901452**		

4.4.1 Stability Tests

Again, the estimated coefficients in the model is well stable as thus presented in both fig. 4.1 (CUSUM) and fig. 4.2 (CUSUMSQ) where the critical line of the both tests line in-between the critical bound levels.

Fig. 4.4.1 Cumulative Sum

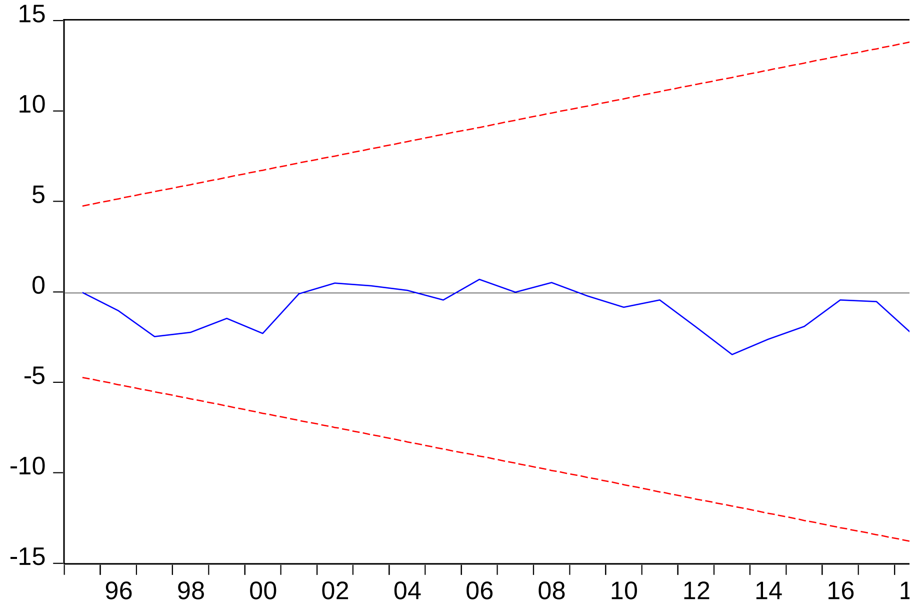
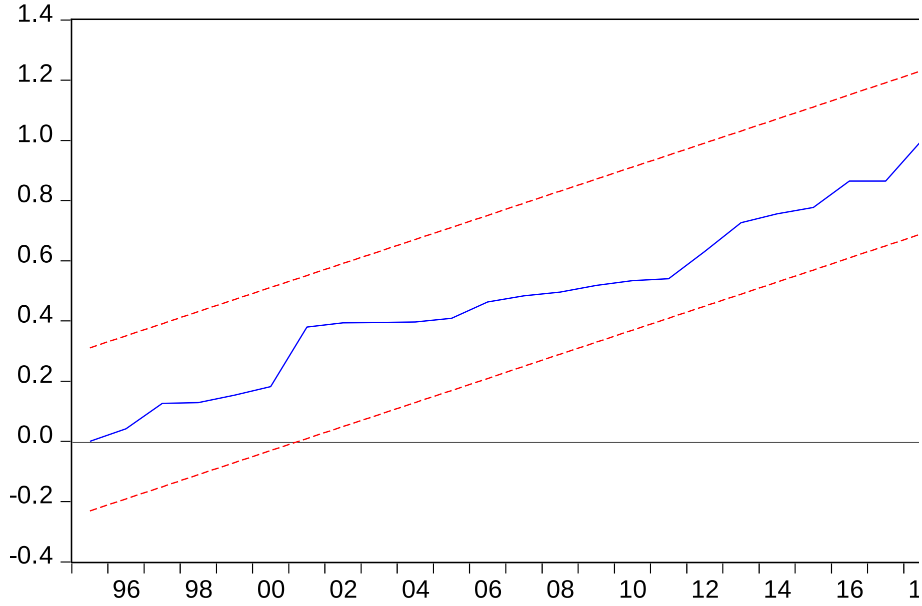


Fig 4.4.2 Cumulative Sum of Squares



5. Conclusion and Recommendations

The results of the paper which analysed the impact of fertilizer subsidy on maize output in Nigeria from the period of 1987 to 2019 built on Kenneth Arrow growth model and, employed ARDL Bound Test and Dynamic Ordinary Least Square method to analyse the impacting influence of explanatory variables particularly, fertilizer subsidy on maize output in Nigeria. The study therefore found that fertilizer subsidy is though impacted positively on maize output in Nigeria but needs some times (e.g one-year time) before such positive impact bears significance on maize output in Nigeria. More so, labour and institutional quality impacted positively and significantly on maize output in Nigeria both in the current period and when lagged by one-year period. Based on the findings above, the following recommendations are hereby suggested:

i. For sustainable security in food production (like maize) to be achieved, government must encourage farmers of certain farm produce (e.g maize) through incentivizing farm input like fertilizer at a subsidized rate.

ii. The institutional quality which serves as regulations on the effective and efficient administration of subsidized farm input like fertilizer must be strengthened to allow for full entrenchment of the policy on the direction upon which it is formulated.

iii. Also, the institutions charged with the responsibility of distributing subsidized fertilizer input must ensure delivery of right quantity and quality of the subsidized fertilizer inputs to the targeted farmers (e.g maize farmers) at a very right time most especially before the commencement of farm period as a way of preparing the said farmers adequately for the production of the intended crop (e.g maize).

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