Effectiveness of Foreign Aid on the Growth of the Agricultural Sector in Nigeria

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Abstract

This paper examined the effectiveness of foreign aid to the growth of the agricultural sector in Nigeria using the ARDL and the ECM approach and quarterly data covering the period 1981 to 2009. While all the variables used were found to be I(I), four cointegration relationships exist between the dependent and the independent variables. Contrary to expectation, the parameter estimate of foreign aid has a negative and insignificant relationship with agricultural output in the short and long run. On the contrary, savings and technological trend are significant and have positive relationship with agricultural output both in the short run and long run. A major policy implication of the result is that improved technology is imperative to the increase in agricultural output in both the short run and the long run rather than encourage foreign aid for agricultural growth in Nigeria.

Key words: Aid, Autoregressive Distributed Lag, Error Correction Model

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1. Introduction

Nigeria is very rich in agricultural resource base though these resources have to be adequately harnessed in order to diversify the economy and reduce over the dependence on crude oil. In spite of this rich resource endowment, there has been a gradual decline in agriculture's contributions to the nation's economy. The trend in the share of agriculture in the gross domestic product shows a substantial variation and long-term decline from 60 percent in the early 1960s through 48.8 percent in the 1970s and about 22.2 percent in the 1980s. The agricultural sector is the most important non-oil economic activity; it is also the single largest employer of labor forces (70 percent according to NBS, 2009) and contributed 40.07% of Gross Domestic Products (GDP) in 2010. Low agricultural output has a negative impact on the economy of Nigeria which may result to low capacity utilization in the industry.

Important resources needed to improve on agricultural output are capital related and these are largely inadequate domestically, which consequently warrants the need for external capital (Kargbo, 2012). Theoretically, aid is meant to bridge the savings - investment gap that poor and emerging economies face. The effectiveness of foreign aid has been the subject of much debate in economics. Previous studies of the aid-growth nexus have produced ambiguous results and have been criticized on the ground that most of the studies are based on cross-country regression. They lump together countries of heterogeneous characteristics and size; hence, cannot be used for country specific policy. Gomanee, Girma & Morrissey (2001) argue that aid may not influence all policies and therefore, it is difficult to assess the impact of aid on policy at least in a cross country framework.

Studies on aid – growth nexus for Nigeria are either cross country studies e.g. (Adamu & Ighodaro, 2011; Uneze, 2011) or if it is country specific study, it is usually on the impact of aid on the overall economy, for example, (Fasanya & Onakoya, 2012; Bakare, 2011; Abidemi, Abidemi & Olawale, 2011). These studies did not consider the effectiveness of aid on sectoral growth. One of the studies on aid - agricultural growth relationship for Nigeria is Akpokodje & Omojimite (2008). They use a simultaneous equation model in their estimation. A major criticism of such model is that existing theory may not be sufficiently precise to suggest compelling causal models; in the process of model specification and identification, compromises may be made that vitiate the assumptions of the original theory (Fergusson, 1995). This study fills this gap by empirically considering the effectiveness of aid on the agricultural output in Nigeria using quarterly data from 1981 to 2009 as well as the ARDL and the ECM estimation techniques. Following section 1, section 2 reviews some related literature, theoretical framework and model specification are considered in section three while section 4 dwells on presentation, interpretation and discussion of results. Section 6 provides policy implications of results and conclusion.

2. Review of Related Literature

The effectiveness of aid can be traced back to the two-gap model (Chenery & Strout, 1966), which remains the most influential theoretical underpinning of the effectiveness of aid literature. In this model, developing countries face constraints on savings and export earnings that hamper investment and economic growth. Aid flows are meant to fill the gap between investment needs and domestic savings. Bacha (1990); Taylor (1994) also recognize that government(s) of some developing countries simply do not have the revenue raising capacity to cover a desired level of investment. Foreign aid provided directly to the government(s) can potentially relax this fiscal gap as long as it is used for public investment purposes. Akpokodje & Omojimite (2008) use a simultaneous equation model to investigate the effect of foreign aid on agricultural growth during 1970-2007 for Nigeria. Using agricultural growth, savings, aid and agricultural imports as endogenous variables, they find that foreign aid has a significant positive effect on agricultural growth in Nigeria. However, the results do not support the view that foreign aid flows more to countries with low savings.

Using cross country data, Adamu & Ighodaro (2011) attempted to ascertain the impact of foreign aid on economic growth in ECOWAS countries using panel data for 14 countries covering the period 1999 through 2009. The model allowed for both language and country effects which were found to be significant. Foreign aid was found to have a significant and positive effect on growth among the ECOWAS countries. The effect of foreign aid on economic growth was found to be stronger in the French- speaking countries. The non-linear effect of foreign aid on economic growth was tested but was found not to be significant. Uneze (2011) on his part tested the impact of foreign aid and aid uncertainty on private investment in West Africa using an unbalanced panel data from 1975 to 2004. The results show that multilateral aid affects private investment positively, but not bilateral aid, and uncertainty, measured as the coefficient of variation has a negative impact on private investment. Malik (2008) examined the effectiveness of foreign aid on economic growth using a cointegration and the ECM for the period 1965-2005 in the six poorest highly aid dependent African countries (Central African Republic, Malawi, Mali, Niger, Sierra Leone and Togo). The empirical result estimated for each country shows that in the five out of the six countries, foreign aid has a significant negative long run effect on economic growth, the only exception was Togo. Foreign aid has a long run positive impact on growth in Togo. In the short run aid has no significant effect on economic growth per capita for most of the countries except for Niger. In a recent study, Alabi (2014) attempted to establish the impact of agricultural foreign aid on agricultural growth in Sub-Saharan Africa using a dynamic specification, Generalized Method of Moments (GMM) framework. The econometric analysis suggests that foreign agricultural aid has a positive and significant impact on agricultural GDP and agricultural productivity.

3. Theoretical Framework and Model Specification

Given a generalized neoclassical aggregate production function that follows Inada condition (assumptions about the shape of a production function) augmented with exports as below:

$$Y_t = A_t F(K_t, P_t, X_t) \qquad \textbf{(1)}$$

Where Y_t is the aggregate output, K_t is capital inputs, P_t is population, and X_t is total exports. The production function, equation (1) is the export growth model originally proposed by Ballasa (1978). To introduce foreign aid, we follow Burke & Ahmadi-Esfahani (2006) with the assumption that capital can be decomposed into domestic savings and foreign aid. The "savings gap" is the idea behind disaggregating capital into savings and foreign aid. According to Chenery & Strout (1966), foreign aid can be used to solve the problem of domestic savings which could be directed to investment and for the purpose of this study, investment into the agricultural sector. Foreign aid and savings in equation (1) can be rewritten as:

$$Y_t = A_t (S_t, F_t, P_t, X_t) \qquad \textbf{(2)}$$

Where S_t is aggregate domestic savings; F_t is foreign aid and other variables are as earlier defined apart from the dependent variables which is taken to be output of the agricultural sector. To know the contribution of each of the variable to the growth of the agricultural sector, equation (2) can be re written as:

$$Y_t = A_t (S_t^{\alpha}, F_t^{\beta}, P_t^{\delta}, X_t^{\gamma}) \qquad \textbf{(3)}$$

Where A_t is technological trend.

To interpret the coefficients as elasticity, we take the logarithms of both sides of equation (3), resulting in the equation below:

$$LNY_t = \alpha LNS_t + \beta LNF_t + \delta LNP_t + \gamma LNX_t + A_t \qquad \textbf{(4)}$$

A priori, it is expected that $\alpha, \beta, \delta, \gamma, \succ 0$. The major interest here is to know the sign of the parameter β. Noting that $LNY_t = AGRGDP_t$;

$LNS_t = LNSAVG_t; LNF_t = LNFAID_t;$ $LNP_t = LNPOPL_t;$ $LNX_t = TEXPT_t$ and $A_t = T_t$. Therefore, equation (4) becomes:

$$LNAGRGDP_t = \alpha LNSAVG_t + \beta LNFAID_t + \delta LNPOPL_t + \gamma LNTEXPT_t + T_t \tag{5}$$

3.1 Methodology and Data Sources

The sample period for this study covers quarterly data from 1981 to 2009. This period is chosen as it corresponds to the period where uniform and consistent data on the relevant variables are available. All the relevant data were obtained from the Central Bank of Nigeria Statistical Bulletin (various issues) and the National Bureau of Statistics (various issues). The autoregressive distributed lag (ARDL) method and the Error Correction Models are applied in the study using the Microfit 4.0 for Windows software.

3.2 Econometric Procedure

(a) The Stationarity Test:

The Augmented Dickey Fuller (ADF) test is employed to ascertain the stationarity of the variables. The specification is expressed as:

$$\Delta Z_t = \gamma_0 + \gamma_1 Z_{t-1} + \sum_{i=1}^{\infty} \mu_i \Delta Z_{t-1} + \varepsilon_t \tag{6}$$

$$\Delta Z_t = \gamma_0 + \gamma_1 Z_{t-1} + \gamma_1 t + \sum_{i=1}^{\infty} \mu_i \Delta Z_{t-1} + \varepsilon_t \tag{7}$$

Equations (6) and (7) are specified with only trend and trend plus intercept, where: ε_t is the residual term and

$$Z_t = (LNAGRGDP_t; LNSAVG_t; LNFAID_t; LNPOPL_t; LNTEXPT_t).$$

(b) Johansen Co-integration Test

Cointegration test was done using the Johansen & Juselius (1990) method. This involves cointegration test based on Maximal Eigenvalue of the Stochastic Matrix and the Trace of the Stochastic Matrix as specified as the equations below:

$$\lambda_{\max}(r, r+1) = -T \sum_{i=r=1}^{n} \ln(1 - \hat{\lambda}_{r+1}) \quad \textbf{(8)}$$

$$\lambda_{trace}(r) = -T \sum_{i=r=1}^{n} \ln(1 - \hat{\lambda}_i) \quad \textbf{(9)}$$

where $\hat{\lambda}$ is the estimated values of the characteristics roots (called eigenvalues). The first is called the maximum eigenvalue test. It ascertains the hypothesis that there are r co-integrating vectors versus the hypothesis that there are $r+1$ co-integrating vectors. The second is known as the trace test. It tests the hypothesis that there are at most r co-integrating vectors. In this test, λ_{trace} equal to zero when all the λ_i are zeros.

(c) The Error Correction Model (ECM)

The acceptance of cointegration between two series implies that there exists a long run relationship between them and this means that an error-correction model (ECM) exists. Equation (5) can be rewritten to have the error correction component

Δ is lag operator

$ecm(-1)$ is one period lag of the specified below as:

$$\Delta LNAGRGDP_t = \eta + \sum_{i=1}^{j} \lambda \Delta LNSAVG_{t-i} + \sum_{i=1}^{k} \pi \Delta LNFAID_{t-i} + \sum_{i=1}^{l} \sigma \Delta LNPOPL_{t-i} +$$
$$\sum_{i-1}^{m} \tau \Delta LNTEXPT_{t-i} + \sum_{i=1}^{n} \vartheta \Delta T_{t-i} + \psi ecm(-1) + \mu_t \quad \textbf{(10)}$$

where:

Δ is lag operator

$ecm(-1)$ is one period lag of the residual

η is the constant term

$\lambda, \pi, \sigma, \tau, \vartheta, \psi$ are respective parameters

μ_t is the error term

4. Presentation, Interpretation and Discussion of Results

4.1 Unit Root Result

The empirical results obtained from the unit root test show that the variables are all I(1) as presented in Table 1 below.

Table 1: ADF Stationarity Results

Variable	ADF Test (Intercept but not Trend)	Conclusion	ADF Test (Trend & Intercept)	Conclusion
LNAGRGDP	-1.1388 (-2.8874)	Non-Stationary	1.8554 (-3.4504)	Non-Stationary
	-4.2109 (-2.8877)	Stationary I(1)	-4.3298 (-3.4508)	Stationary I(1)
LNSAVG	-0.3382 (-2.8874)	Non-Stationary	-2.2415 (-3.4504)	Non-Stationary
	-3.9924 (-2.8877)	Stationary I(1)	-4.0528 (-3.4504)	Stationary I(1)
LNFAID	-2.1619 (-2.8877)	Non-Stationary	-1.0047 (-3.4508)	Non-Stationary
	-7.7145 (-2.8879)	Stationary I(1)	-7.6851 (-3.4512)	Stationary I(1)
LNPOPL	-1.0230 (-2.8874)	Non-Stationary	-1.4724 (-3.4504)	Non-Stationary
	-8.1653 (-2.8877)	Stationary I(1)	-4.8222 (-3.4508)	Stationary I(1)
LNTEXPT	-0.71464 (-2.8874)	Non-Stationary	-2.8285 (-34504)	Non-Stationary
	-6.6463 (-2.8877)	Stationary I(1)	-6.6226 (-3.4508)	Stationary I(1)

Figure in parenthesis are the critical value (5%)

4.2 Cointegration Results

The Johansen cointegration result reveals the existence of four long run relationship (determined at the points where the test statistic is greater than the 95% Critical Value) between the dependent and the explanatory variables based on Maximal Eigenvalue of the Stochastic Matrix (Table 2a) and the Trace of the Stochastic Matrix (Table 2b).

Table 2a: Cointegration Based on Maximal Eigenvalue of the Stochastic

Cointegration with no intercepts or trends in the VAR

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix

115 observations from 1981Q2 to 2009Q4. Order of VAR = 1.

List of variables included in the cointegrating vector:

LNAGRGDP LNSAVG LNFAID LNPOPL LNTEXPT

List of eigenvalues in descending order:

.99125 .41186 .24229 .12046 .0053061

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	545.0147	29.9500	27.5700
r<= 1	r = 2	61.0415	23.9200	21.5800
r<= 2	r = 3	31.9072	17.6800	15.5700
r<= 3	r = 4	14.7612	11.0300	9.2800
r<= 4	r = 5	.61182	4.1600	3.0400

Use the above table to determine r (the number of cointegrating vectors).

Table 2b: Cointegration Based on Trace of the Stochastic Matrix
Cointegration with no intercepts or trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix

115 observations from 1981Q2 to 2009Q4. Order of VAR = 1.
List of variables included in the cointegrating vector:
LNAGRGDP LNSAVG LNFAID LNPOPL LNTEXPT
List of eigenvalues in descending order:
.99125 .41186 .24229 .12046 .0053061

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	653.3364	59.3300	55.4200
r<= 1	r = 2	108.3217	39.8100	36.6900
r<= 2	r = 3	47.2802	24.050	21.4600
r<= 3	r = 4	15.3730	12.3600	10.2500
r<= 4	r = 5	.61182	4.1600	3.0400

Use the above table to determine r (the number of cointegrating vectors).

An examination of the result in Table 3 below shows that the one period lag value of agricultural output positively and significantly determines its present value. This implies that previous quarter's production of agricultural products provides incentives to produce more this in the current quarters probably as a result of the increase in the income of farmers. Domestic savings impact positively and significant in the determination of agricultural output in the country. However, its one period lag value impacted negatively on agricultural output. The implication of this is that in the previous quarters, rather than investing in agriculture, farmers preferred to save their income resulting to low agricultural output in the current period. The exposure of the country to foreign aid surprisingly impacts negatively and insignificantly on the growth of the agricultural sector of the country contrary to the result obtained by Akpokodje & Omojimite (2008); Alabi (2014). This implies that higher foreign aid have been associated with lower agricultural output contrary to expectation. The Population variable has a positively signed coefficient estimate in line with economic theory. It suggests that higher level of population is associated with higher growth of agricultural output.

This finding shows that the consequence of population on Nigeria's economic growth will manifest directly through increases agricultural output. Contrary to expectation, the coefficient of total exports is negatively signed and insignificant in the determination of agricultural output. As expected, the current value of technological trend is significant and has a positive relationship with agricultural output. However, its lag value is significant and has a negative relationship with agricultural output. The model has a good fit. It explains more than 96 percent of the systematic variation in the dependent variable. Moreover, the absence of any serious problem of autocorrelation is shown by the value of Durbin's h-statistic, 1.8152. The F – statistic value of 418.2568 shows the existence of a significant relationship between the dependent variable and the regressors.

Table 3: ARDL (1,2,0,0,0) selected based on Akaike Information Criterion

Autoregressive Distributed Lag Estimates

ARDL(1,1,0,1,0,1) selected based on Akaike Information Criterion

Dependent variable is LNAGRGDP
115 observations used for estimation from 1981Q2 to 2009Q4

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
LNAGRGDP(-1)	.29653	.069590	4.2610[.000]
LNSAVG	.27376	.15040	1.8202[.072]
LNSAVG(-1)	-.19568	.14007	-1.3970[.165]
LNFAID	-.016943	.020970	-.80798[.421]
LNPOPL	104.1912	12.8404	8.1144[.000]
LNPOPL(-1)	-116.4571	13.1091	-8.8837[.000]
LNTEXPT	-.0043144	.029360	-.14695[.883]
T	57.7290	9.0287	6.3940[.000]
T(-1)	-57.6356	9.0151	-6.3932[.000]

R-Squared	.96929	R-Bar-Squared	.96698
S.E. of Regression	.095610	F-stat. F(8, 106)	418.2568[.000]
Mean of Dependent Variable	10.2390	S.D. of Dependent Variable	.52613
Residual Sum of Squares	.96898	Equation Log-likelihood	111.4678
Akaike Info. Criterion	102.4678	Schwarz Bayesian Criterion	90.1156
DW-statistic	1.7747	Durbin's h-statistic	1.8152[.070]

Table 4: Estimated Long run Coefficients using the ARDL Approach

Estimated Long Run Coefficients using the ARDL Approach

ARDL(1,1,0,1,0,1) selected based on Akaike Information Criterion

Dependent variable is LNAGRGDP

115 observations used for estimation from 1981Q2 to 2009Q4

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
LNSAVG	.11100	.045752	2.4261[.017]
LNFAID	-.024085	.029951	-.80415[.423]
LNPOPL	-17.4362	2.7158	-6.4202[.000]
LNTEXPT	-.0061332	.041683	-.14714[.883]
T	.13270	.017303	7.6693[.000]

Table 4 reveals that only savings and technological trend are significant and have positive relationship with agricultural output both in the short run and long run. This is in line with economic theory as increase in both saving and technological trend would have increasing effect on agricultural output. For example, when savings of farmers increase significantly, they are likely to have enough money to buy farm inputs like fertilizers and other farm implements during farming season. Apart from that, they are also likely to have enough money from savings to hire more farm labourers and agricultural equipment which most likely leads to increased agricultural output when efficiently used. With respect to technological trend, a new farming technology like new farm equipment, new improved seeds/seedlings, insecticides, fungicides, etc will increase agricultural output in the long run. Contrary to expectation, the parameter estimate of foreign aid has a negative relationship with agricultural output in the long run. This implies that foreign aid are either not adequately channeled to the agricultural sector or if the reverse is the case, the level of corruption in the sector particularly in the distribution of certain farm inputs has made it not to positively impact on the agricultural sector. Unfortunately and contrary to expectation, population has a contrary negative sign, though; significant in the determination of agricultural output. The negative sign may be interpreted to mean that as the population increases, rather than people go into agriculture, most of them would prefer white collar jobs. Furthermore, total exports impacted negatively on agricultural output contrary to expectation and it is not significant. The strongest impact on agricultural output in the long run is technological trend.

4.3 Error correction representation

The results of the error correction representation of the models are presented in Table 5 below.

Table 5: Error Correction Representation for the selected ARDL Model

Error Correction Representation for the Selected ARDL Model

ARDL(1,1,0,1,0,1) selected based on Akaike Information Criterion

Dependent variable is dLNAGRGDP

115 observations used for estimation from 1981Q2 to 2009Q4

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
dLNSAVG	.27376	.15040	1.8202[.071]
dLNFAID	-.016943	.020970	-.80798[.421]
dLNPOPL	104.1912	12.8404	8.1144[.000]
dLNTEXPT	-.0043144	.029360	-.14695[.883]
dT	57.7290	9.0287	6.3940[.000]
ecm(-1)	-.70347	.069590	-10.1088[.000]

List of additional temporary variables created:

dLNAGRGDP = LNAGRGDP-LNAGRGDP(-1)

dLNSAVG = LNSAVG-LNSAVG(-1)

dLNFAID = LNFAID-LNFAID(-1)

dLNPOPL = LNPOPL-LNPOPL(-1)

dLNTEXPT = LNTEXPT-LNTEXPT(-1)

dT = T-T(-1)

ecm = LNAGRGDP - .11100*LNSAVG + .024085*LNFAID + 17.4362*LNPOPL + .006133
2*LNTEXPT -.13270*T

R-Squared	.62695	R-Bar-Squared	.59880
S.E. of Regression	.095610	F-stat. F(5, 109)	35.6294[.000]
Mean of Dependent Variable	.016608	S.D. of Dependent Variable	.15095
Residual Sum of Squares	.96898	Equation Log-likelihood	111.4678
Akaike Info. Criterion	102.4678	Schwarz Bayesian Criterion	90.1156
DW-statistic	1.7747		

R-Squared and R-Bar-Squared measures refer to the dependent variable dLNAGRGDP and in cases where the error correction model is highly restricted, these measures could become negative.

As expected, the error correction variable ecm(-1) has negative sign and statistically significant (Table 5). The coefficient of ecm(-1), -0.70347 as in Table 5 suggests that adjustment process is good and more than 70% of the previous quarter's disequilibrium in agricultural output from its equilibrium path will be corrected in the current quarter. The result further shows that population increases has been a major contribution to agricultural production in Nigeria in the short run. This may be due to the fact that majority of the populace may be engaged in agriculture in the short run, meaning more hands on the farm as population increases. On the long run, most of those who entered into agriculture in the short run may have lost interest in agriculture due to poor incentives.

5. Conclusions and Policy Implications of Results

The paper attempted to investigate the effectiveness of foreign aid on the growth of the agricultural sector in Nigeria. The result reveals that any increase in domestic savings, in both short run and long run will impact positively on the agricultural sector in Nigeria. On the other hand, foreign aid is not beneficial to the agricultural sector in Nigeria in both the short run and the long run. Population impacts positively on the agricultural sector in the short run while it was significantly negative in the long run. The size of the absolute value of the error- correction coefficient indicates that the speed of restoration to equilibrium in the event of any temporary displacement of the variables of interest is very high. A major policy implication of the results is that policy makers in Nigeria should encourage savings. This can be done by increasing deposit interest rate as such savings could be used by farmers to acquire important farming inputs like fertilizers and new crop varieties during planting season. It may also enable them to acquire loans from the bank and such loan could be channeled into viable agricultural practices. The use of fertilizer and new crop variety will in the short and long run increase agricultural output. Furthermore, improved technology is imperative to the increase in agricultural output in both the short run and the long run.

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