

DETERMINANTS OF MACROECONOMIC VARIABLES THAT AFFECT AGRICULTURAL PRODUCTION IN NIGERIA.

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Abstract:

This study investigated the determinants of macroeconomic variables that affect agricultural production in Nigeria. Time-series data, covering the period of 1977-2007, culled basically from the central bank of Nigeria statistical bulletin, 2009, were used. Two-Stage Least Squares (TSLS) regression technique was fitted to the data. Result showed that all the modeled determinants of the Index of Agricultural Production (IAP) were positively significant at 1% α – level, except for World Agricultural Commodity Prices (WP) and Annual Rate of Inflation (RI) that were significant at 5 % α – level and negatively correlated with IAP respectively. Government Expenditure in Agriculture was found to be the most important estimated macroeconomic variable required to spur growth and development in the agricultural sector while World Agricultural Commodity Prices was the least. Thus, this study recommends that Nigerian government should pursue macroeconomic policies that: would encourage increased long-term sustainable government investment in agriculture; stabilize favourable nominal exchange rate; boost commercial banks' liquidity in a way that will ensure farmers' adequate access to credit at low interest rate; reduce the rate of inflation; favour foreign private investment in agriculture; and make farmers respond proactively to the opportunities that emanate from soaring global food prices.

Key words: Agriculture, macro-economic variables, agricultural production, growth, development.

Introduction:

The desirability of maintaining high levels of agricultural development in Nigeria seems clear. Agriculture, despite facing a steady decline, is the single largest contributor to the wellbeing of the rural poor, sustaining about 86 percent of rural households in Nigeria (Nwachukwu *et al.*, 2009). The sector is also an important source of economic development, especially in countries such as Nigeria where poverty is mainly rural (World bank, 2007). According to the Central Bank of Nigeria (2006), the agricultural sector accounted for about 41.8 percent of the Nigerian Gross Domestic Product (GDP) in 2006 followed by the non-oil industry (26.1 percent), while crude oil only accounted for 21.9 percent. Therefore, agriculture constitutes a major sector for the development and growth of the Nigerian economy.

Nevertheless, the sector had not performed to its desired level because of several decades of neglect from successive Nigerian government in creating appropriate macroeconomic policies that will cushion the effects of internal and external macroeconomic shocks on farmers' incentives to produce (Manyong *et al.*, 2003). Consequently, from 1970 to 2000, the agricultural sector grew at 1.7 percent per annum, very low when compared with Nigerian population growth of 2.7 percent within the period (WDI, 2008). This is a key reason why the country still has one of the weakest economies and highest poverty rates in the world.

Ultimately, efforts to fortify the Nigerian agriculture have not yielded the required results in the sector. In recent times where traces of upward trend in agricultural output have been observed however, it was largely derived from the expansion of cultivated land and is not sustainable in the long run (Shenggen *et al.*, 2008). Moreover, these recent traces of upward trend in agricultural output have not been able to trickle down to the poorest of the poor, and has neither helped the country tackle the

problem of unemployment nor achieve her overarching goal of food security (Shenggen *et al.*, 2008). Therefore, in order to achieve desired social and economic development in Nigeria through agriculture, evidence-based macroeconomic policy objectives are needed for government and other stakeholders to develop synergy in prioritizing their policy and investment interventions in agriculture. This is necessary because it is not debatable that the performance of agricultural sector to a very large extent depends on the macroeconomic environment, which is shaped by the level of achievement of the cardinal macroeconomic objectives of the federal government. What has been primary in the debate is the nature of the relationship between agricultural output growth and its macroeconomic determinants.

Nevertheless, there is considerable lack of detailed empirical knowledge in this regard. Most previous studies on related areas were historical in nature (Oluba, 2007); while others like Eyo (2008), adopted a single equation system which probably, yielded biased estimates of the identified parameters and incapable of capturing completely the direct and indirect influences exerted by these variables on agricultural production. Thus, these works cannot adequately serve as a policy guide for policy-makers.

To bridge this gap in knowledge therefore this study seeks to determine the effect of selected macroeconomic variables on agricultural production in Nigeria, using simultaneous equation system approach. This hopefully, will fill the lapses of past studies in this area and create a macroeconomic policy framework that will ensure that Nigeria makes optimum utilization of her naturally endowed and environmental friendly agricultural sector.

Materials and methods:

The study was carried out in the Federal Republic of Nigeria. Time-series data, covering the period of 1997-2007, culled basically, from the Central Bank of Nigeria's Statistical Bulletin, 2009 were used. The simultaneous equation system (SES) model adopted to capture the determinants of selected macroeconomic variables that affect agricultural production is given in equations 1 to 3. This is a modification and adaptation of the structural response model employed by Kwanashie *et al.*, (1997), Umoh (2003) and Eyo (2008). All the variables modeled in this methodology are not strictly inputs in the agricultural production function but they strongly influence the domestic output (production) and development of the sector in Nigeria through the incentives farmers receive

(Kwanashie *et al.*, 1997; Karbasi and Tavana, 2008; Walkenhorst, 2007).

The model is implicitly expressed thus:

$$IAP = f(GEA, EXR, IR, RI, CR, FPI_{Agr}, WP, T) \text{--- (1)}$$

$$FPI_{Agr} = f(EXR, IR, RI, CR, IAP, LR, T) \text{--- (2)}$$

$$CR = f(IR, FPI_{Agr}, IAP, LR, CRR, MRR, T) \text{--- (3)}$$

Where:

IAP = Index of Agricultural production

FPI_{Agr} = Cumulative Foreign Private Investment in Agriculture in Naira per million (₦/million)

CR = Total credit accessed by farmers from commercial banks in Naira per million (₦/million)

EXR = Nominal exchange rate in Naira per US dollar (₦/\$)

GEA = Total government expenditure in Agriculture in Naira per million (₦/ million)

IR = Interest rate (lending rate) in percent (%)

RI = Annual rate of inflation in percent (%)

WP = Index of World Agricultural Commodity Prices in Naira per Tonne (₦/ton)

LR = Liquidity Ratio of commercial banks in percent (%)

CRR = Cash Reserve Ratio of commercial banks in percent (%)

MRR = Minimum Rediscount Rate of commercial banks in percent (%)

T = Time Trend variable in years (Yrs)

The above simultaneous equation system is mathematically complete in the sense that it contains three equations in three endogenous variables, IAP, FPI_{Agr}, and CR. The equations are explicitly represented thus:

$$IAP = a_0 + a_1GEA + a_2EXR + a_3IR + a_4RI + a_5CR + a_6FPI_{Agr} + a_7WP + a_8T + e \text{--- (4)}$$

$$(a_0, a_1, a_2, a_5, a_6, a_7, a_8 > 0; a_3, a_4 < 0)$$

$$FPI_{Agr} = b_0 + b_1EXR + b_2IR + b_3RI + b_4CR + b_5IAP + b_6LR + b_7T + e \text{--- (5)}$$

$$(b_i > 0 (i = 0 \text{ to } 7))$$

$$CR = c_0 + c_1IR + c_2FPI_{Agr} + c_3IAP + c_4LR + c_5CRR + c_6MRR + c_7T + e \text{--- (6)}$$

$$(c_0, c_2, c_3, c_4, c_7 > 0; c_1, c_5, c_6 < 0)$$

Where:

a₀, b₀, c₀ = Constant / intercepts

a_i, b_i, c_i = Parameter estimates

Other variables remain as previously defined.

The identification conditions for this system of structural equations were considered using both order and rank conditions (Koutsoyiannis, 2003). The equations were found to be over identified and were estimated using the Two Stage Least Square regression technique.

Results and discussion:

The result of the system equation estimation as presented in Table 1 showed that most of the coefficients in the estimated system were statistically significant at 1 percent α – level.

The estimated macroeconomic determinants of the Index of Agricultural Production function (endogenous variable 1) as shown in Table 1 supports the findings of many previous studies (see Eyo, 2008; Orebiyi, 2004). The result showed that improvements in the nominal exchange rate, increased government expenditure in agriculture, high values of world agricultural commodity prices, improved foreign private investment in agriculture, and considerable amount of interest rate (lending rate) have all contributed significantly to increasing the index of agricultural production. Whereas increased annual rate of inflation has significant negative effect on the index of agricultural production at 1 percent α – level. It therefore follows that all these macroeconomic variables are statistically significant determinants of the index of agricultural production in Nigeria at 1 percent α – level, except for world agricultural commodity prices that was significant at 5 percent α – level.

It was also observed in Table 1 that all the determinants of cumulative agricultural foreign private investment function (FPI_{Agr}) (endogenous variable 2) made statistically significant positive contribution to the growth of FPI_{Agr} in Nigeria at 1 percent α – level. This conformed to their respective *a priori* expectations. Nevertheless, Adeleke (2005) reported a contrary significant negative relationship of inflation rate with FPI_{Agr} at 5 percent α – level.

The estimated determinants of farmers' credit stock function from commercial banks (endogenous variable 3) in Table 1 showed that any marginal increase in interest rate, cumulative foreign private investment, index of agricultural production, commercial banks' liquidity ratio and cash reserve ratio (at constant values of other explanatory variables) will significantly spur a corresponding 17.3891, 14.3912, 16.0342, 14.8122 and 19.4803 million Naira increases in total credit accessed by farmers from commercial banks respectively.

Table 1: Liner 2SLS Macroeconomic Determinants of agricultural Production in Nigeria: Simultaneous Equation system.

Variables	Index of Agricultural Production (IAP) (Endogenous variable 1)	Cumulative Foreign Private Investment in Agriculture (FPI_{Agr}) (Endo.var.2)	Credit stock accessed by farmers from commercial banks (Endo. Var.3)
Constant	15.0924	13.1159	11.0025
GEA	16.3817 (3.9282)**	-	-
EXR	18.0046 (3.0665)**	14.3904 (4.1415)**	-
IR	10.9204 (3.2199)**	16.0113 (3.9967)**	17.3891 (2.1725)*
RI	-14.5021 (-3.8047)**	12.9026 (4.2024)**	-
CR	20.1792 (3.0111)**	17.5219 (3.4597)**	-
FPI_{Agr}	18.5521 (3.9217)**	-	14.3912 (2.8305)**
WP	12.6604 (2.3182)*	-	-
IAP	-	18.1902 (2.9462)**	16.0342 (2.2283)*
LR	-	13.0903 (3.1372)**	14.8122 (2.1964)*
CRR	-	-	19.4803 (2.4262)*
MRR	-	-	-14.9248 (4.8405)**
T	15.4553 (3.2865)**	14.9304 (4.8768)**	10.6503 (2.6579)**
S.E	19.5603	15.0542	13.4463
R ²	0.8519	0.8956	0.8705
R ² (Adj.)	0.7986	0.8643	0.8317
F-Value	15.8937**	28.4317**	21.2168**

Figures in parenthesis () are the respective t- coefficients

** Coefficient significant at 1% α – level

* Coefficient significant at 5% α – level

Source: Regression result computed from CBN data, 2009.

The t-statistics of the estimated determinants of the index of agricultural production function in Table 1 showed that the estimated coefficient of federal government expenditure in agriculture (GEA) was the most statistically significant. Thus, it is the most important estimated macroeconomic variable required to spur growth and development in the agricultural sector followed by cumulative foreign private investment in agriculture (FPI_{Agr}), annual rate of inflation (RI), Time trend variable (T), interest rate (IR), nominal exchange rate (EXR), farmers' credit stock accessed from commercial banks (CR), and world agricultural commodity prices (WP), arranged in descending order of importance.

The parameter estimate of federal government expenditure in agriculture (GEA) was significant at 1 percent α - level and positively correlated with the index of agricultural production. This implies that a percentage increase in the magnitude of federal government expenditure in agriculture will induce a corresponding 16.3817 increase in the index of agricultural production in Nigeria, while holding other explanatory variables constant. In other words, government expenditure in agriculture served as a positive incentive for the country's predominantly rural agriculture, and could stimulate growth and poverty reduction if appropriately targeted. This empirical evidence suggests the importance of capital expenditure on the agricultural sector. It also conformed to its *a priori* expectation and the findings of Eyo (2008) who reported similar significant positive relationship of GEA and IAP, though at 5 percent α - level.

Table 1 also showed that a unit increase in the nominal exchange rate (EXR) (at constant values of other explanatory variables) will not only directly spur a significant 18.0046 increase on the index of agricultural production (Equation 1) at 1 percent α - level but also, it will indirectly increase the index of agricultural production (IAP) by attracting a corresponding 14.3904 million Naira increase in cumulative foreign private investment in the sector (Equation 2). Eyo (2008) reported a similar significant positive relationship of EXR and IAP, though at 5 percent α - level. The result is in line with the economic criteria. Thus, it could be stated that high exchange rate (i.e. undervalued exchange rate) protects domestic producers from imports and gives them greater incentives to export and compete internationally.

The parameter estimate for interest rate (IR) was significant at 1 percent α - level and positively correlated with the index of agricultural production, contrary to its negative *a priori* expectation. Eyo

(2008) reported a similar positive, though insignificant relationship between IR and IAP. High and positive interest rate to farmers was expected to discourage more investment in the agricultural sector. Nevertheless, the contrary result in this study could be as a result of interest rate subsidy for agricultural loans before deregulation by the federal government, thereby making any marginal increase in interest rate not to have the corresponding marginal decreasing effect in agricultural loans and investments. Moreover, high and positive interest rate increases the marginal willingness-to-lend by commercial banks for an extra unit of loan demanded by farmers. However, despite this supportive contrary view for high interest rate, it is advisable for monetary authorities to follow a policy of discriminatory interest rate, charging high interest rates for non-essential and unproductive uses and low interest rates for productive uses like agriculture.

The estimated results in Table 1 also showed that the estimated coefficients for annual rate of inflation (RI) was significant at 1 percent α - level and negatively correlated with the index of agricultural production (IAP). The implication of the result is that any marginal percentage increase in the annual rate of inflation will exert a corresponding 14.5021 decreasing effect on the index of agricultural production in Nigeria, holding other explanatory variables constant. This agrees with *a priori* expectation and the result of Eyo (2008) who reported a similar inverse but insignificant relationship between RI and IAP

It was also found in Table 1 that a unit increase in the values of cumulative foreign private investment in agriculture and commercial banks' credit stock accessed by farmers will not only directly increase the index of agricultural production by 18.5521 and 20.1792 respectively but also, will indirectly spur significant additional increases in the index of agricultural production by simultaneously attracting a corresponding 14.3912 million Naira and 17.5219 million Naira increases in total commercial banks' credit accessed by farmers and cumulative foreign private investment in agriculture respectively (Equation 2 and 3).

Furthermore, the F-statistic values of 15.8937, 28.4317, and 21.2168 for the estimated functions of index of agricultural production, cumulative foreign private investment, and commercial banks credit accessed by farmers respectively were all statistically significant at 1 percent α - level. This implies that the functions are adequate for use in further analysis.

Conclusion and recommendations:

In conclusion therefore, it has been empirically shown in this study that the Nigerian agricultural sector has the potential to be the country's dynamic engine of pro-poor growth if effective macroeconomic policies are made in such a way that will ensure adequate government investment in the agricultural sector, maintain favourable exchange rate that protects domestic producers from external price shocks, reduce the rate of inflation, and make commercial banks' credit accessible to farmers at low interest rate.

It is therefore recommended that the Nigerian government should double its efforts in designing sector-specific agricultural policies that will facilitate increased long-term sustainable government investment in agriculture, favour foreign private investment in agriculture, maintain favourable exchange rate, make commercial banks' credit accessible to farmers at low interest rate, reduce the annual rate of inflation and make farmers respond positively to the opportunities that emanate from soaring global food prices. These will act as incentives to farmers for increased agricultural production in Nigeria.

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