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Market liberalization and maize production in Nigeria

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This study examined the impact of market liberalization on maize production in Nigeria. Time series data for a 29-year period (1970 - 1998) were collected. Zellner's seemingly unrelated regression (SUR) model was used as the estimation technique. Output of maize was found to be more during liberalization. Fertilizer price and hectarage planted to maize were the significant variables affecting maize output. Fertilizer consumption was found to be affected by hectarage planted to maize and crop loan. Retail price of fertilizer was determined by the factory gate and world prices of fertilizer. For hectarage planed to maize, crop loan, government expenditure, and the relative price of maize to millet, were the significant explanatory variables. For output of maize and hectarage planted to maize, the dummy variable (0, for pre-liberalization and 1 for liberalized period) were significant. This means that market liberalization did affect these variables. However for fertilizer consumption and fertilizer price, the dummy variables were non-significant and this implied that market liberalization had no impact on fertilizer consumption and fertilizer price. Conclusion is that market liberalization if properly implemented had a positive impact on maize production in the country.

Key words: Market liberalization, maize production, Nigeria.

INTRODUCTION

Many governments intervene, directly in agricultural product markets, especially food, through taxation and subsidization. Key objectives of the interventions are either to redistribute income, correct market failures and provide incentives to producers assessment of the policy changes on the desired objectives helps to inform and sharp the policy debate on the reform alternatives. Thus, one of the primary goals of policy makers is to provide ex-ante analysis to measure the impact of these policies among different groups.

Liberalization simply means allowing market forces of demand and supply to determine what to provide, for whom to produce, and the method of production to be used in an economy. Liberalization involves deregulation of the foreign exchange rate, interest rate and the trade sector (imports and exports). It also involves removal of subsidies on various items such as petroleum and other petroleum products. Also involved, is the removal or reduction of government's participation in the economy through privatization of some public enterprises and parastatals such as Nigerian postal services, the Nigerian food companies limited among others.

Prior to liberalization in Nigeria, administrative fiat rather than market forces determined product and input prices in the economy. The commodity boards were responsible for determining producers' prices for some agricultural commodities. Those prices were invariably, lower than world market price Philips, (1987). There were internal and external imbalances, resulting from price distortions, thus constraining output levels and general economic development. Farmers who received lower prices were discouraged from producing more. Distortions were in the form of fixed exchange rate system, which led to currency over-valuation and necessitated foreign exchange rationing, restrictive trade and pricing policies, which offer considerable protection to domestic industries, fostering import dependence and imposition of heavy implicit taxation on farmers.

Nigeria adopted the more market-based policy measure in July, 1986. The policy instrument measures aimed at institutional reform entailing the abortion of the commodity boards and the adjustment of the exchange rate. Thus, a market determined exchange rate was adopted from September, 1986, and interest rate from July, 1987.The desired structural change and growth of the Nigerian economy was partly anchored on the development of the agricultural sector, when the structural adjustment program (SAP) was lunched in mid- 1986. This was so, given the crucial role of agriculture to change in the structures of Sub-Saharan African

economies (Oyejide, 1990) and to the development of Nigeria's economy in particular.

With the advent of market reforms, the incentives to produce most agricultural products improved. Fourteen years have passed since the introduction of market reforms. It thus becomes pertinent to ask questions as to the effectiveness or otherwise of market reforms with specific reference to maize production. The core of this study therefore is to determine the factors affecting maize production in Nigeria during liberalization.

MATERIALS AND METHODS

Time series data covering the period 1970 - 1998, was used in study. The choice of time period is predicated on data availability and the need to capture the pre-and during liberalization periods. The data were obtained from Central Bank of Nigeria, International Financial Statistics (IFS) and Federal office of Statistics (FOS).

Method of data analysis

The regression analysis adopted for this study is empirical aggregate models that simultaneously determine input use and maize production. This is in line with Ahmed (1995). The model is specified as follows:

Y_{1t} = f(X_{1t}/X_{2t}, Y_{3t}, X_{6t}/ X_{7t} D) ……..(1) X_{1t} $/X_{2t}$ = f(X_{3t}/X_{2t}, X_{4t}, $/X_{2t}$, D) ……..(2) Y_{3t} = f(X_{2t}/X_{5t} ,X_{8t}/X_{7t} , X_{6t}/ X_{7t} D) ……(3)

Y_{4t} = f(Y_{1t} , X_{1t} / X_{2t} , X_{6t} / X_{7t} , Y_{3t} ,D) ……..(4)

Where
Y_{1t}=consumption of fertilizer (in tonnes)
X_{1t}/X_{2t} = Relative price of fertilizer to price of maize
Y_{3t} = Hectarage planted to maize ('000 hectares)
Y_{4t}= Output of maize (in tonnes)
X_{1t} = Retail price of fertilizer (Naira/tonne)
X_{2t} = Producer price of maize (Naira/tonne)
X_{3t} = Factory gate price of fertilizer (Naira/tonne)
X_{4t} = Border price of fertilizer (Naira/tonne)
X_{5t} = Price of millet (Naira/tonne) X_{6t} = Short term Crop loan (Naira/tonne) X_{7t} = General Price Index
X_{8t} = Government Capital expenditure on Agriculture (N million) D = Dummy variable
0 = non-liberalization years
1 = liberalized years.

Method of estimation

The system of equations (1) ……. (4) were estimated using Zellner's Seemingly Unrelated Regression (SUR) model. SUR model is also known as multivariate regression or Zellner's method. It is a method by which all the equations in a model system are estimated simultaneously.

Other methods of estimating a system of equations (Two-Stage Least Squares, Instrumental variable) are inefficient, because their estimations involve single equation estimation which does not account for the cross-equation correlation among errors and hence leads to loss of efficiency.

Zellner's seemingly Unrelated Regression (SUR) model is efficient where equations are closely interrelated, such that the error term of one equation is correlated with the error term of another.

SUR model involves Generalized Least -Squares (GLS) estimation and achieves an improvement in efficiency by taking into explicit account the fact that cross equation error correction may not be zero (Zellner, 1962). Prior to the application of GLS, there is a need to first obtain estimation of the error covariance between equations. These estimates are obtained by first estimating each single equation using Ordinary Least Square (OLS). SUR estimation is therefore a two stage estimation procedure. This model is adopted because of the expectation of a correlation between the disturbance terms of each equation.

But if no correlation is found, the implication is that there is no relationship between the equations and then OLS estimation would be appropriate.

Statistical and economic criteria were verified using the value of R^2 and F ratios as well as the levels of significance of the variables in the equation. Durbin-Watson statistics was also used to test for autocorrelation. F statistics helps to show the overall significance of the different variables used in the model.

The following a-priori experimentations are considered plausible in the light of evidence from previous studies (Ahmed, 1995):

a. Change in fertilizer Consumption

- Due to change in real price of Fertilizer: negative
- Due to change in volume of crop loan: positive
- Due to change in total land area: positive

b. Change in real price of fertilizer

- Due to change in factory gate price: positive
- Due to change in border price: positive

c. Change in total land area planted to maize

- Due to higher relative price of maize to millet: positive
- Due to government Expenditure/price index: positive
- Due to changes in volume of crop loan: positive

d. Change in maize production

- Due to change in fertilizer use: positive
- Due to total land area: positive

e. Dummy is expected to be significant and it may be either positive or negative. This is because the change in each of the dependent variables with the introduction of market liberalization is indeterminate.

RESULTS AND DISCUSSION

The result of the determinants of maize production is presented in Table 1. In general, the adjusted R^2 values were quite high. Durbin Watson test revealed an in conclusive result for fertilizer consumption, land area planted to maize and maize production equations. However, for the equation with real price, there was no positive autocorrelation.

Fertilizer consumption

From the first block of table with the equation on fertilizer consumption, it is evident that fertilizer consumption is affected by hectarage planted to maize (Y_{3t}) and the real short-term crop loan (X_{6t} / X_{7t}). The two variables are both

.

Table 1. Sure estimates of fertilizer consumption, fertilizer price, hectarage planted.

Functions		Coefficient	T-Statistic	R^2	F-Statistics	Durbin-Watson statistics
(1)Fertilizer consumption (Y_{1t}) constant (intercept)		7.8586	0.423			
Relative price of fertilizer to producer price of maize	X_1/X_2	-1.9786	-0.077	0.98		
Hectarage planted to maize (Y_{2t})		0.2864	5.942***		51.04	1.18
Short term crop loan (X_{6t})		13.172	7.924***	0.82		
Dummy (D)		-10.214	-0.378			
(2) Fertilizer price (X_{10}/X_{2t}) intercept		-0.34424	-7.524	0.63		
Factory gate price (X_{3t}/X_{2t})		0.68051	6.567***		30.67	
Border price (X_{4t}/X_{2t})		0.20076	2.456***	0.99		0.91
Dummy (D)		0.11838	1.293			
(3) Hectarage planted to maize (Y_{2t}) intercept		5590.2	8.704***			
Relative price of maize to millet (X_2/X_5)		-2247.4	-6.321***	0.72		
Government expenditure (X_{8t}/X_{7t})		-293.37	-3.978**		21.42	1.58
Crop loan (X_{7t})		-86.708	-2.432	0.74		
		2634.1	7.089			
(4) Output of maize (Y_{3t}) intercept		-55.271	-0.187			
Fertilizer consumption (Y_{1t})		2.2886	0.968	0.83		
Fertilizer price (X_{1t}/X_{2t})		823.14	2.039**		31.04	1.16
Crop loan (X_6/X_7)		8.8413	0.210***	0.92		
Hectarage planted to maize (Y_{3t})		0.91808	8.840***			
Dummy (D)		-834.24	-1.949			

Note: R^2 relates to separate OLS
*** t value significant at 1%
** t value significant at 5%.

significant at one percent level. The relative price (X_{1t}/X_{2t}) and the dummy variables have no significant impact on fertilizer consumption. In light of the above, the larger the area planted to maize, the larger the quantity of fertilizer used.

Similarly, an increase in short-term credit would lead to increase in the level of fertilizer consumed by maize farmers. The activities of the Agricultural Development Projects have also led to substantial increase in the improved varieties of maize cultivated by farmers. Since improved varieties of maize requires the use of fertilizer, then the significance of the land area planted to maize with respect to fertilizer consumption is very much appropriate. Besides, the relative importance of maize (becoming a national crop) and the need to use fertilizer in the northern area of the country can also be an important factor. Similarly, real short-term credit is an important variable since farmers would need working capital especially to purchase fertilizer for their farm operations. This situation perhaps underscores the recent emphasis on the provision of micro-credit to small-scale farmers as well as serving as a pointer to the usefulness of the Nigerian Agriculture and Rural Development Bank (NARDB). It also goes to show the importance of credit availability for the adoption of improved farm practices by farmers. In all, a one percent change in the hectarage planted to maize will lead to about five percent change in the quantity of fertilizer consumed by farmers while one percent increase in the real value of crop loan will lead to about eleven percent increase in the quantity of fertilizer consumed. The non-significance of the dummy variable shows that fertilizer consumption before market liberalization years is not statistically different from the level attained during market liberalization years.

Relative price of fertilizer to price of maize

In the second block of Table 1 with relative fertilizer - maize price equation, the relative factory-maize price (X_{3t}/X_{2t}) and the relative border - maize price (X_{4t}/X_{2t}) are the main determinants. Both variables conform to a prior expectation of having positive influence on the relative fertilizer - maize variable even at one percent. The implication of this is that an increase or decrease in the factory gate price as well as border price of fertilizer will lead to an increase or decrease in what is actually paid by farmers. The three variables co-move in the same

direction. The dummy variable is not significant.

Hectarage planted to maize

The third block of the table shows the change in total land area planted to maize. From the result, all the explanatory variables are significant. Relative price of maize to millet, government expenditure and loans, are significant at 1 and 5% levels respectively. Contrary to expectation however, the signs of these explanatory variables are negative. A one percent change in the higher relative price of maize to millet, will lead to about 120% decrease in the hectarage planted to maize. Similarly, hectarage planted to maize will decrease by 15 and 4% respectively, as a result of real government expenditure and crop loan.

Contrary to expectations however, the sign of all the explanatory variables are negative. This means that, higher relative price of maize to millet does not necessarily lead to more hectarage being planted to maize. This is so because millet is a staple food crop in the northern part of Nigeria. The climatic condition of the northern zone also favors the cultivation of this crop. Therefore, whether or not, the price of maize is high relative to millet, some hectarage will still be planted to millet. Maize is mainly grown in the southern zone where the climatic conditions favor its growth. Maize is just being recently cultivated in the north, and may even require fertilizer, so as to do very well.

Again, real government expenditure does not lead into an increase in hectarage planted to maize probably because what is budgeted for agriculture is not what is actually released. This no doubt, reflects the rate of corruption in the Nigerian society. Similarly, the expected positive change from the crop loan is not so, because the loans goes to unintended, rather than the intended beneficiaries. The loans if received by farmers at all may also be untimely. The liberalization dummy is positive and significant at 1%. This indicates that market liberalization policy measures have a positive impact on the total land area planted to maize.

Output of maize

In the last block of Table 1 is the equation showing the output of maize. From the result shown, fertilizer price is significant at 5%, while the total area planted to maize has a significance level of 1%. The elasticity values also shows that a one percent change in relative price of fertilizer to maize, will lead to about 42% change in maize output. Similarly, output of maize will increase by about 0.9% following a 1% change in hectarage planted to maize. Fertilizer consumption and crop loan are not significant, meaning that these variables have no significant influence on the output of maize.

From a priori expectations, the coefficient of the dummy should not be significantly different from zero. This is because the impact of liberalization on production occurs through the impact on the levels of input use, particularly in the case of fertilizer. The productiveness of inputs is not expected to be influenced by the liberalization measures. Since shifts in productivity are more, a function of technological change.

From the result of this study however, the coefficient of the dummy variable is significantly different from zero. This implies that the observed change in maize production as a result of market liberalization was realized not from changes in the levels of input used, but rather from technical changes outside those of fertilizer price and hectarage planted to maize.

Summary of major findings

Result showed that retail price of fertilizer was determined mainly by the factory and world prices of fertilizer. Prior to market liberalization retail prices were quite low, as a result of subsidy from the government. This scenario however changed with the removal of subsidy, which is one of the policy measures of market liberalization. Retail price of fertilizer therefore rose during liberalization.

In addition, fertilizer consumption before and during market liberalization were almost the same. Relative factory gate fertilizer -maize price (X_3 / X_2 t) and the relative world fertilizer-maize price (X_{4t} / X_{2t}) were found to be the main determinants of relative fertilizer - maize price equation. By implication, an increase in the factory gate price as well as border price of fertilizer, will lead to an increase in what is actually paid by farmers (relative price of fertilizer).

IMPLICATIONS OF RESULT/RECOMMENDATIONS

From the result obtained, maize output was found to be determined by fertilizer consumption, relative fertilizer - maize price as well as hectarage planted to maize. A 1% change in relative fertilizer - maize price leads to 41.48% in output of maize. Similarly, maize output will increase by 0.86%, when hectarage planted to maize increase by 1%. One may therefore conclude that market liberalization, had a positive impact on maize production.

Also, retail or real price of fertilizer is dependent on the factory as well as world prices. An increase in factory and world prices leads to an increase in real price of fertilizer. The reverse is also true. This is a strong indicator that market forces should be allowed to function so as to make fertilizer available and accessible to farmers as and at when needed.

Again, an increase in short-term credit leads to increase in level of fertilizer consumed. Farmers need working capital especially to purchase fertilizer for their farm operations. Thus the importance of micro-credit to farmers cannot be over emphasized. This serves as a

pointer to the usefulness of such financial institutions as Nigerian Agricultural and Cooperative Bank (NACB), the Agricultural Credit Guarantee Scheme (ACGS) as well as the Nigerian Agriculture and Rural Development Bank (NARDB).

Result also shows that crop loan did not contribute positively to hectarage planted as expected. This is probably because what is actually released for agricultural production is not what is budgeted. This may be also being due to the fact that the loan goes to unintended rather than intended beneficiaries. If loans are received at all by farmers, they may be untimely. It is therefore recommend that the loan disbursement activities of financial institutions, be monitored.

In addition, maize may require fertilizer, especially in the northern part of the country in order to do well. None or untimely availability as well as high cost of fertilizer may however affect maize production. In order to checkmate the high increment in retail price of fertilizer and make it affordable by farmers, there is a need for government to stop the smuggling of fertilizer to neighboring countries.

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