MARKET SUPPLY RESPONSE AND DEMAND FOR LOCAL RICE IN NIGERIA: IMPLICATIONS FOR SELF-SUFFICIENCY POLICY

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ABSTRACT

This study examined the supply response and demand for local rice in Nigeria between 1960 and 2004. A system of equations using secondary data was estimated by OLS and 2SLS techniques. Area planted with local rice is mainly affected by expected price of output, agriculture wage rate and by the partial adjustment coefficient. The short-run response elasticity is 0.077. The implied long-run response elasticity is 1.578. The partial adjustment measure is 0.049. This, points to the difficulty of supply response to changing economic conditions. The price elasticity of demand obtained is 0.841. The demand for local rice is thus price inelastic. Rice income elasticity is 0.3378. It is also inelastic. The ban on rice importation in Nigeria could be said to be a step in the right direction. This policy should be continued and policed. However, price, output and non-price incentives that can exert significant influence on rice supply response and demand are required if the self-sufficiency goal is to be achieved.

Keywords: Supply response, rice self –sufficiency, demand for local rice, Nigeria.

INTRODUCTION

Up till the early 1960's, Nigeria was self-sufficient in food production [27]. The Nigerian agriculture, with a near total dependence on rain produced food and raw materials to the industrial sector of the economy. As from 1970, the decline in farming activities became more pronounced [30]. There were widening food supply-demand gaps and rising food import bills [7]. The food self-sufficiency index- ratio of aggregate local food supply to the aggregate food demand fell [31]. The output of local rice was estimated to be three million tons while the demand amounted to five million tons [7]. The Federal Government, in an attempt to, boost rice production allocated N1.5 billion for certified seeds multiplication and distribution to rice farmers [26].

Self-sufficiency in rice production is now an important political-economic goal of the Nigerian government [3]. As a development strategy, it is a necessary precursor to the ultimate goal of self-reliance standards which is a desirable goal of society.

Such an economic policy has major implications for the dynamics of the socio-economic and institutional environments within which farmers operate. It has been justified as a means through which farmers can enhance their efficiency and productivity. But, in the unfolding process of agricultural and economic reforms since independence - over four decades ago, what has been the farmers' response especially in terms of rice production in Nigeria? How has rice import-ban, triggered by the self-sufficiency drive, impacted on the short-run and long-run rice supply response in Nigeria? Are the policies put in place effective as supply shifters for adequate rice supply response by the farmers? Are the price, output and non-price incentives adequate? Can these rice farmers change set habit of production?

Rice is widely grown in Nigeria under the upland rain fed, inland shallow swamp, deep water/floating and lowland irrigated production systems [28]. The land area under rice cultivation in Nigeria was about 1.64 million hectares. This decreased to about 1.25 million hectares in 2004 [25]. Improved rice management production practices have been developed and disseminated to farmers for years in Nigeria. The rate of adoption has however been reported to be low [2]. The rate of use of the adopted practices relative to the recommended level is reported to be equally low [37].

Misari et al; [19] reported that the ban on rice importation in 1986 led to an increased rice production from 0.94 in 1986 to 2.54 million tons in 1994. But Nigeria expends N250 billion yearly to import agricultural products. Rice alone gulps N60 billion [1,20]. In 1990, Nigeria imported 224,000 metric tons of rice valued at US 60 million dollars. This increased to 345,000 metric tons in 1996 with a value of US130 million dollars. By 2001, rice import increased to 1.51 million metric tons valued at US288.1 million dollars [9]. These figures indicate a 500 percent rise in foreign exchange expenditure on rice imports within eleven years. With an exchange rate of US1 dollar to N140, this constitutes a great drain on the nation's foreign exchange. The possible trade imbalances that the import of such a single item could cause prompted the government to embark on measures targeted at rice self-sufficiency.

Nigeria is known to have the potential to produce enough rice for its needs and even export [3, 21]. Hence, the government seeks ways of reducing external payment imbalances through a renewed interest in agricultural supply response policy [14]. As a result, a clear understanding of the principles and factors influencing the dynamics of local rice supply and demand in Nigeria can constitute a major issue in her policy formulation. This study is therefore deemed to be of immediate application in rice production policy decisions in Nigeria and in other African countries facing similar situation.

The main objective of this study is to apply a supply response model to rice production in Nigeria. The specific objectives include to: estimate elasticity of demand and supply for local rice; determine the short-run and long-run supply response of rice producers; ascertain the nature of price expectations by rice farmers; examine the nature of producers' adjustment in local rice production; and assess the policy implications of the results of the study

MATERIALS AND METHODS

Data Sources

The study covers the period 1960 to 2004. The data used were sourced from Federal office of Statistics (FOS), FAO [10], Central Bank of Nigeria (CBN) [5] and other relevant publications. Hence, secondary data were used in the subseqeunt analysis.

Method of Data Analysis

Regression analysis was used to estimate the supply response model for rice in Nigeria. The adopted model borrows from the work of [16] and [17]. The econometric specification is as follows:

$$LnA_t = B_{10} + E\ln({}^{Pt}/_{Lt}) + B_{12}\ln A_{t-1} + U_{it} \quad (1)$$

$$LnY_t = B_{20} + B_{21}Wt + B_{22}\ln T_t + U_{2t} \quad (2)$$

$$LnQ^d_t = B_{30} + \eta\ln({}^{Pt}/_{Dt}) + B_{31}\ln({}^{It}/_{Dt}) + U_{3t} \quad (3)$$

$$Q^d{}_I = A_t . Y_t \quad (4)$$

Where : A_t is the area of rice planted in year t. At planting time, farmers do not know with certainty what price they will receive at harvest. Hence, the land size in hectare is hypothesized to be a function of the expected price (P_t) and area planted in the preceding year (A_{t-1}). In this setting land and labour are the major inputs of production [8]. Labour wage rate is used as a proxy for cost of production. Labour input accounts for over 70 percent of total outlay [8] and over-two –thirds of the variable costs. The agricultural wage rate (L_t) is used to deflate this price. This imposes the homogeneity of degree zero on the area planted equation.

A_{t-1} is the area planned in the previous year. Its influence depends on the degree of partial adjustments producers make with respect to changing economic conditions as well as the fixity of factors of production and psychological inducements to continue to produce (Cobweb effects). Y_t is the yield per unit of land. It is believed that this is mainly affected by weather conditions and technology over the years. W_t represents the effect of weather on yield and is measured with a Stalling index [35]. Yield is regressed on time to obtain expected yield. The weather variable is then defined as the ratio of the actual to the predicted yield. This index includes not only the effects of various direct components of weather such as rainfall and temperature, but also indirect effects such as insects, diseases and pests [35].

T_t is the trend variable which serves as a proxy for the available rice production technology with 1,2,……., n observations.

$Q^d t$ is the quantity demanded. Equation (3) is specified as being quantity-dependent with price (P_t) and consumer income (I_t) as independent variables. Homogeneously of degree zero is imposed on the demand equation by dividing the explanatory variables by the consumer price index (D_t). Money illusion is thus precluded from the model. P_t is the actual producer price. And I_t is proxied by Gross Domestic Product (GDP) at current factor cost.

Estimation methods

Ordinary least squares (OLS) is used to estimate equations (1) and (2) since they do not contain endogenous variables as explanatory variables. However, a 2SLS is used to estimate equation (3) as suggested by .Koutsoyiannis [15] and used by Lopez and Ramos [16]. In the first stage, equation (3) is re-specified as being price-dependent with quantity supplied (Q^d_i) and income (It) as the arguments. With homogeneity condition imposed, it is used to predict P_t/D_t. In the second stage, the predicted value is used to estimate the quantity – dependent equation (3).

Price /Expectation Model

This model is adopted from [16] it experiments with the data to test for price expectations by the producers. The estimating equation is specified as:

$LnA_t = B_{40} + aB_{41} \ln({}^{Pt}/_{Pt-1}) + B_{42} \ln({}^{Pt-1}/_{Lt}) + B_{43} \ln A_{t-1}$…… (5)

Where: P_t is the price forecast following McCallum technique [18]. Hence, hypothesis has to be based and tested on how price expectations are formed, a = parameter that weights the relevance of the cobweb model [18]. The test of interest is:

H_o : a = O. That price expectation follows the cobweb model.

$H_{1:}$ a ≠ O. That price expectation aligns with the rational expectation hypothesis; OLS is used to estimate the equation.

Non inclusion of prices of other crops

Following conventional specification of market models which include supply response, an econometric model can be specified with three behavioural equations to capture area cultivated, yield and demand responses plus an equation that represents market equilibrium [17, 34].

In the literature, [16] included the price of substitute in the study of fresh tomatoes in the US and import was also considered and used as an explanatory variable. In the estimated model, the coefficient of the price of substitute was not significantly different from zero. In another study, [17] stated that farm level demand for basic grains is derived from consumers` demand. Hence, following consumer choice theory, the quantity demanded of basic grains is stipulated to be a function of their prices and the consumers` income. So the price of substiture was not included nor was import used as an explanatory variable in the study Further more demand is specified as being quantity-dependent. However, demand can also be specified as being price-dependent. In this case, price is assumed to be determined by the quantity produced locally and the consumers` income [17].

Typicall, agricultural economists have modeled expected output prices as being determined by past prices (Cobweb behaviour, ditributed lags and adaptive expectation models). Farmers are supposed to react to recent past information and there is no use of current information. In addition to this, a recent study [17], considered the cobweb model appropriate for basic grains and that the price farmers expect is the price they received in the preceding period.

In line with [22], the models portraying the structural relationship in the production of local rice can be postulated as output and hectarage (area) response. Following the partial adjustment model, the price of substitute is never considered see [4, 12, 13]. In this study, we utilize the Nerlovian adjustment model [24] as according to [33], there are several approaches available for estimating the response of supply to changes in prices and other variables, the most common is the class of models due to [22, 23]. Hence, our study borrows from the works of these authorities.

RESULTS AND DISCUSSION

Table 1 contains the result of the estimated area planted equation. The R^2 value of 0.96 indicates a good fit for the model. All the estimated parameters are significantly different from zero at the 1% level. They collectively explain about 96 percent of the variation in area of rice planted.

Table 1: Estimated Parameters for Equation (1)

Variables	Parameters	t-values
$Ln(P_t/L_t)$	0.0771	2.9119
LnA_{t-1}	0.9512	15.0542
Intercept (K)	0.7201	8.5674
$R^2 = 0.9554$		

The short-run elasticity of supply (E), measured by the percentage change in area planted with respect to the expected price, is 0.077. [32] obtained a value of 0.259 while [16] reported a value of 0.222. This difference in result could be attributed to the fact that they considered both import and export of rice in their model. Here, only domestic supply which is equal to domestic demand is considered. Import and export of local rice are assumed to be zero.

The coefficient of area adjustment is 0.0488. This is the rate at which land size in hectare of rice moves to the expected level. The coefficient of lagged area is 0.9512 and it is highly significant. This parameter is subtracted from one to obtain the adjustment coefficient of 0.0488. This implies that there is a slow rate of adjustment by the farmers. Hence, local rice has a strong tendency to continue to be cultivated in spite of price-cost conditions. The implied long-run supply response is 1.5779 which is elastic. However, [36] obtained a value of 0.58 while [16] reported a value of 0.296. Based on this result, the long-run prospects of achieving rice self-sufficiency can be said to be bright.

Table 2 presents the result for the yield equation. The R^2 value is 0.8707. This means that the variables explained about 87 percent of the variation in yield. All the parameters are significant at the 1% level. The model can thus be said to display a good fit. The coefficient of the weather variable (W_t) is about thrice that of time trend (T_t). The increases in yield of local rice thus tend to be influenced more by weather than technology as proxied by time trend.

Table 2: Estimated Parameters for Equation (2): Yield

Variables	Parameters	t-values
W_t	0.2783	3.4916
LnT_t	0.1090	3.0588
Intercept (K)	9.3774	87.6447
$R^2 = 0.8797$		

Table 3 indicates that the price elasticity of demand (η) is –0.8406. The demand for local rice is thus found to be price inelastic. This tends to reflect the reluctance of the consumers to change the quantity purchased in spite of price savings. The income elasticity of 0.3378 shows that local rice is a normal good but is income inelastic.

Table 3: Estimated Parameters for Equation (3): Demand

Variables	Parameters	t-values
$Ln(P_t/D_t)$	0.8406	19.5988
$Ln(I_t/D_t)$	0.3378	3.5279
Intercept (K)	10.4414	16.6200
$R^2 = 0.90411$		

Table 4 indicates that the variable (P_t/P_{t-1}) has a negative but insignificant parameter even at the 10% level. However, B_{42} which is the coefficient for P_{t-1}/L_t is positive and significantly different from zero at the 1% level. This result formed the basis for the acceptance of the null hypothesis (H_o: a=O). This implies that rice producers followed the cobweb theorem in the formation of their price expectation.

Table 4: OLS Estimated Parameters for Equation (5)

Variables	Parameters	t-values
$ln(P_t/P_{t-1})$	-0.0419	-1.0995
$ln(P_{t-1}/L_t)$	0.0518	2.5893
LnA_{t-1}	0.9067	11.7169
Intercept	1.4088	13.0184
R^2=0.9564		

Source: Data Analysis, 2005

As regards the parameter of land area lagged in equation (5), it is positive and significant at the 1% level. This result is similar both in sign and magnitude to that obtained in equation (1). The R^2 value of 0.96 for equation (5) implies that the included variables explain about 96 percent of the variation in area planted. This signifies a good fit for the model.

Cobweb Theorem

Prices of agricultural goods fluctuate ove time because of unplanned variations in supply and the difficulty of altering supply in the short-run. This fluctaution in prices is explained by the Cobweb theorem which represents a dynamic model that farmers base their production decisions for next year (Q_{t+1}) on the current price (P_t). Generally,the higher the current price the more they will be willing to produce next year. This implies that the quantity to be supplied next year is a function of the current price. This means that current supply quantity(Q_t) is a function of last year`s price(P_{t-1}) and that current supply is not a function of current price. However. The current demand for the commodity ia affected by and is a function of the current price. Over all, fluctuations in the price from one year to the other may steadily approach the equilibrium price resulting in convergent cobweb model or the fluations may become wider and wider over successive peroids leading to a divergent cobweb model.

Test of Autocorrelation

The Durbin-Watson (DW) statistic is the most popular and reliable test for detecting autocorrelation.However, the test is valid only if the following conditions are fulfilled: the study uses a time series data, autocorrelation is of the first order, there is a constant in the equation, and the equation does not include lagged values of the dependent variable as regressor.

In our study, equations (2) and (3)satisfy these conditions while (1) and (5) do not. For equations (2) and (3), their DW are 1.736 and 2.247 respectively. The first has an estimated coefficient of autocorrelation (ρ) of 0.132. This implies that there is some indication of positive first-order autocorrelation in the estimated equation. The second has a ρ value of -0.1235. This means that there is an evidence of negative first-order autocorrelation in its equation.

Since equations (1) and (5) have lagged value of the dependent variable as regressor, a variant of DW known as Durbin h statistic is used to carry out the test [6]. The test statistic is represented as

$$h = (1- 1/2DW) \sqrt{n} / 1 - (n \text{ var } b) ;$$

where , DW= computed DW statistic

n = sample size, and

var(b) = variance of the coefficient of the lagged dependent variable.

The h statistic for the two equations are -0.6037 and -1.3387 respectively. These are compared with the critical Z-value at 5% level of significance of 1.6449.. Since both h values are less than the critical value, the null hypothesis that ρ = 0 and that there is no autocorrelation in the two equatiions is accepted [29]. These resullts are consistent with those of [11].

Implications of the Results

If the short-run is taken to be a period of 5 years, at most, then with a supply response of 0.077, the policy of ban on rice will not lead to the achievement of the desired self-sufficiency in its production. However, with a long-run supply response elasticity coefficient of 1.5779, there is possibility of attaining self-sufficiency in rice production over the long-run. The fear, however, is that the goal of rice self-sufficiency is premised on the ban of rice importation and the provision of production incentives/inputs especially certified seeds, fertilizers and agro-chemicals. A lack of continuity in the current ban policy may spell disaster for the self-sufficiency goal. The ban period of 1986-1996 produced some gains [19]. Yet the ban on rice importation was lifted in 1996 only to be reintroduced in 2003/2004 by the Obasanjo's administration.

The enactment, implementation and discontinuation of rice ban must be based on a clear understanding of the principle of comparative advantage and of the dynamics of local rice supply and demand in Nigeria. For the ban to stimulate local rice production, other policies must be enacted. An effective anti-smuggling measure is a must. The feasibility of such a measure remains a debatable issue. The cost of policing the porous borders will be enormous. The complementary policy of providing processing technology at the farm level is a must. This is needed to improve the quality and grain status of local rice to make it attractive to the consumers.

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