EFFECT OF EXCHANGE RATE ADJUSTMENT ON THE OUTPUT OF NIGERIAN AGRICULTURE

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ABSTRACT

The study determined the effect of exchange rate adjustment (devaluation) on aggregate agricultural output using secondary data. Tables, means, percentages and the t-test were used to compare aggregate agricultural output in the pre-devaluation period (1973 – 1985) with aggregate agricultural output in the devaluation period (1988 – 2000). The ordinary least squares multiple regression technique was used to identify factors that determine aggregate agricultural output. Chow's test was used to determine and verify changes in the output function between the two periods. While aggregate agricultural output significantly increased as a result of devaluation, its rate of growth was not significantly higher in the devaluation period. The value of food imports and the policy regime significantly and positively influenced aggregate output while the value of credit to agriculture was a significant but negative determinant of output. The conclusion of this study is that devaluation slowed down the rate of new investments in agriculture and as a result may not be the appropriate price incentive policy instrument for increasing aggregate agricultural output. A restriction on food imports through the use of import taxes or the outright prohibition of food imports in general or specific food commodities appear to be a more appropriate price policy instrument. Under a regime of devaluation, a significant increase in the rate of growth of aggregate agricultural output will require complimentary measures that increase the profitability of investments in agriculture relative to the non-farm sector such as an output price incentive scheme.

Key words: Devaluation, Agric. Output, Food Imports

INTRODUCTION

According to Scobie and Jacobsen (1995), Structural Adjustment (SA) is not a concept specific to the developing world. SA has universal applicability to the extent that it leads to policies that strive for efficient and equitable growth. Its applicability is not limited to distressed economies. Purportedly healthy economies can experience macro-economic imbalances and instability. Macro-economic imbalances can occur when opportunities for import substitution have been exhausted and new engines of growth are yet to be developed, while market imperfections and rigidities may lead to instability (Scobie and Jacobsen, 1995). Also when growth is too rapid, domestic supply may be exhausted and inflation rates high, making adjustment necessary.

Devarajan and Rodrick (1992) posited that a primary reason for SA in agriculture is the wide fluctuation in the world prices of agricultural commodities, which causes sharp swings in the terms of trade of countries that rely on these commodities for their foreign exchange earnings. Adverse terms of trade, technological backwardness, coupled with high real interest rates and a cessation of foreign capital inflows account for the decline in the output and productivity of Sub-Saharan African agriculture (killick, 1993, Scobie and Jacobsen, 1995).

Agriculture accounts for about one third of the Gross Domestic Product (GDP) in low income developing countries (Golden and Winters, 1992). As a result, Killick (1993) contended that since the economies of most SSA countries are predominantly agricultural, the decline in the performance of the agricultural sector was an obstacle to improving the nutritional and living standards of the rural people and to strengthening the Balance of Payments (BOP). Ultimately, the poor performance of the agricultural sector constituted a major drag on overall economic expansion. Therefore, reversing the decline in agricultural output and productivity in developing economies was a desirable policy objective. Accordingly most SSA countries adopted price incentive measures such as devaluation as instruments of agricultural adjustment.

In order to formulate an effective price policy for agriculture, there is need for reliable empirical knowledge on the degree of responsiveness of agricultural output to the relevant price movements. The degree of responsiveness of output to price movements will vary with location and time. This suggests that the price elasticity of output must be estimated separately for different regions and for different periods (Krishna, 1967).

In Nigeria, as in most parts of SSA, most of the studies on agricultural adjustment are estimations of the elasticity of response of individual export crops (Phillips, 1996, Chidebelu *et.al*; 1998; Gbetnkom and Khan, 2002). The focus on export crops can be appreciated given the fact that since the economies of most SSA countries are predominantly agrarian, agricultural exports are important for foreign exchange earnings. However, Kwanashie *et.al.* (1998), contended that the analysis of sub-sectoral and sectoral aggregate output response and not just individual crop responses is important for the evaluation of agricultural adjustment. The paucity of empirical work on the response of aggregate agricultural output to price incentives, is therefore a cause for worry. Krishna (1967) contended that this gap in empirical knowledge is especially regrettable because knowledge of this response is crucial for the formulation of price policy for agricultural development. This study is an attempt to fill this gap.

In evaluating the response of agricultural output to exchange rate adjustment (devaluation), the questions that need to be addressed include: (i) did devaluation lead to an increase in aggregate agricultural output? and (ii) did the growth rate of aggregate agricultural output increase as a result of devaluation?

OBJECTIVE OF THE STUDY

The objective of this study was to determine the effect of exchange rate adjustment (devaluation) on aggregate agricultural output. In order to achieve this objective the study:

(i) compared the aggregate output of agriculture before and after devaluation
(ii) identified factors that determine aggregate agricultural output.
(iii) made policy recommendations on the use of devaluation as a price policy instrument of agricultural adjustment.

LITERATURE REVIEW

In a mixed economy as is the case with Nigeria, the relative roles of the state and markets in agriculture borders on the uses and limitations of agricultural pricing policies.

Prices are the conduit through which structural adjustment policies are expected to affect agricultural variables such as output, supply, exports and income (Kwanashie et.al; 1998). The growth of aggregate agricultural output is related to the movement of the agricultural price index relative to the movement of the prices of manufactured inputs and consumption goods purchased by farmers. The domestic terms of trade is therefore important because it provides an indication of the price incentives for agriculture as a whole as distinct from incentives for specific crops. Adverse terms of trade for agriculture as a whole can lead to a relative and possibly absolute migration of capital and labour out of agriculture and reduce the productive capacity of agriculture. Killick (1993) contended that inadequate price incentives, have contributed to the declining performance of African agriculture as indicated by the long-term downward global trend in the real prices of agricultural and other primary export products on which SSA depends. According to Killick, the unintended effects of state intervention have magnified the effects of such adverse trends in some cases.

The exchange rate is considered the single most important price in the economy (Killick, 1993). The exchange rate policy can be used to change the level of domestic production, industrialization and exports (Amin, 1996). As a result the exchange rate policy and the relationship between the real exchange rate and price incentives have become a major focus in the study of African economic and agricultural decline (Fosu, 1992; Oyejide, 1986). The modeling of the real exchange rate and output has raised questions as to whether the real exchange rate affects output directly or indirectly through relative prices (Amin, 1996). The use of the real exchange rate as an explanatory variable in an output or export response model (Jaeger, 1991) suggests that it directly influences output or export supply. Fosu (1992) argued that the real exchange rate hardly affects output directly and that it's influence is through the incentive structure. In addition to price factors such as the real exchange rate, non-price variables such as investment in research, population, agro-climatic factors etc are also considered important for the response of agriculture (Killick, 1990; Oyejide, 1990; Diaskosavvas 1989).

METHODOLOGY

Nigeria has about 69.62 million hectares of cultivable land (Olayide *et.al*; 1972), 'ample' water resources and a population projected at about 128.3 million by the end of 2009 from 88.5 million in 1991 at an annual growth rate of 2.5%. These are indications that the potential for agricultural production in Nigeria is great. The economy is mixed and largely agrarian. Prior to the Structural Adjustment Programme (SAP), the economy was characterized by complex administrative controls, misalignment of relative prices and public sector inefficiency (Olanrewaju, 1994).

Secondary data, collected from various publications of the Central Bank of Nigeria (CBN), Federal Office of Statistics (FOS), and other relevant literature were used for the study. Data were collected for the pre-devaluation period (1973 – 1985) and the devaluation period (1988 – 2000). Tables, means, percentages and the t-test were used to compare aggregate agricultural output and its growth rate in both periods. To identity factors that influence agricultural output, the ordinary least squares multiple regression technique was used.

Theoretical Framework for Model Specification

The supply of a commodity depends on factors such as the price of the commodity (P), the price of inputs or factors of production (P_f), the state of technology (T), the prices of other commodities (Pc), and weather (W). A supply function can therefore in implicit form be given as $Q = f(P, P_F, T, P_C, W)$. Following from the law of supply, the quantity supplied will be positively related to the price of the commodity. Also the quantity supplied will be positively related to the state of technology and weather but negatively related to the price of factors of production and the price of other (substitute) commodities. Consequently the aggregate output (supply) response model used in this study was specified in implicit form as follows:

DOP_t = F (RER_{t-1}, VIM_{t-1}, VLA_t, CEA t, AARt)

DOP_t = Aggregate Output of Agriculture in Grain Equivalent in Period t.

RER_{t-1} = Real Exchange Rate in Period t-1

VIM_{t-1} = Value of Food Imports in Period t –1

VLA_t = Value of Loans to Agriculture in period t.

CEA_t = Capital Expenditure on Agriculture in period t.

AAR_t = Average Annual Rainfall (mm) in period t.

The real exchange rate was used as a proxy for price incentives. According to Killick (1993), the exchange rate is the single most important price in the economy. Variations in the exchange rate will lead to variations in the prices of tradable commodities and alter the incentive structure for their production. The value of food imports was used as a proxy for the price of substitute products since food imports are a substitute for domestic output. Loan value was used to proxy availability of credit for agricultural production and also production costs. Capital expenditure on agriculture was used as a proxy for the state of agricultural technology on the premise that it is positively and highly correlated to the state of agricultural technology while rainfall was used to capture the influence of weather on output.

The model was used to run two regressions – one for each period. To test for equality between the coefficients from the two regressions, data for the two periods were pooled together and used to run a third regression. The residual sums of squares from the three regressions were used to compute chow's F^* - statistic which was compared to the tabulated F* ratio. The computed Chow's F^* is given as:

$$F^* = \frac{\sum e32 - (\sum e_1^2 + \sum e_2^2)}{K_3 - (K_1 + K_2)} \Big/ \frac{\sum e_1^2 + \sum e_2^2}{K_1 + K_2}$$

$K_1 = n_1 - m$; $K_2 = n_2 - m$; $K_3 = n_1 + n_2 - m$;

n_1 = sample size for first regression; n_2 = sample size for second regression; m = number of parameter estimates including the intercept.

Chow's test was again used to verify changes in the output function between the two periods. A dummy variable S_t was introduced into the model. In the pre-devaluation period $S_t = 0$ and in the devaluation period $S_t = 1$.

Using the pooled data, the new model was used to run a fourth regression. The residual sum of squares from the third and fourth regressions were used to compute chow's F^+ statistic which was compared to the tabulated f* ratio. The computed Chow's F^+ statistic is given as:

$$F^+ = \frac{\Sigma e_3^2 - \Sigma e_4^2}{K_3 - K_4} \Big/ \frac{\Sigma e_4^2}{K_4}$$

$K_3 = n_3 - m$; $K_4 = n_4 - m$; n_3 = sample size for third regression; n_4 = sample size for fourth regression; m is as earlier defined.

RESULTS AND DISCUSSION

Aggregate Agricultural Output

Aggregate agricultural output increased from an average of about 15.7 million tones grain equivalent (GE) in the pre-devaluation period to an average of about 43.5 million tones GE in the devaluation period. There was a significant difference (t = 7.738) in the mean outputs of agriculture between the two periods. This indicates that devaluation may have led to an increase in agricultural output. Similarly there was an increase in the average growth rate of agricultural output from about 2.8% in the pre-devaluation period to about 10% in the devaluation period. The difference in the average growth rates of agricultural output between the two periods was however not significant (t = .996).

Chukuigwe *et.al*; (1998) also reported that quantity increases recorded slow growth following exchange rate liberalization. The non-significance of the difference in the mean growth rates of agricultural output in the two periods suggests that devaluation did not lead to any significant internal reallocation of resources from other sectors of the economy to agriculture i.e. the rate of investment in agriculture was not significantly higher as result of devaluation. Studies have shown that production costs during devaluation were much higher than average production costs before devaluation (Akinyosoye, *et al*; 1998). The higher cost of production as a result of devaluation is probably a disincentive to greater investments in agricultural production. As a result the growth rate of output is slow. The growth rate of aggregate agricultural output is shown in table 4.1.

Table 1 Growth Rate of Aggregate Agricultural Output.

PERIOD			
Before Devaluation		After Devaluation	
Year	Change in output (%)	Year	Change in output (%)
1973	11.30	1988	-1.59
1974	35.11	1989	21.96
1975	-24.03	1990	68.22
1976	- 5.12	1991	6.73
1977	-3.72	1992	13.28
1978	-7.03	1993	-0.25
1979	-1.46	1994	2.01
1980	5.74	1995	5.30
1981	1.16	1996	4.63
1982	3.34	1997	2.89
1983	-2.32	1998	3.99
1984	14.74	1999	2.69
1985	8.59	2000	3.84

Source: Derived from Output Data from Various Issues of CBN Annual Reports and Statement of Accounts.

Determinants of Aggregate Agricultural output

The regression results of the determinants of aggregate agricultural output are shown in table 4.2.

The double – log model was chosen as the lead equation over the semi log because the constant term in the equation was not significant in the semi-log model. The value of food imports in the previous year, the value of loans to agriculture and the policy regime were significant determinants of aggregate agricultural output. The value of food imports in the previous year was positively related to aggregate output the next year. As the value of food imports increases due to devaluation, food imports become more expensive than domestic output. The demand for domestic output will increase as consumers switch expenditures from imported food to local substitutes. The increase in demand will probably lead to an increase in the prices of domestic food products. The increase in price will act as an incentive to farmers to increase output. Since the farm firm's production plan is subject to a time lag, the increase in output will be realized the next year. The elasticity of response of output relative to the value of food imports was greater than unity. It suggests that a 10% increase in the value of food imports will probably lead to about 39% increase in aggregate domestic agricultural output.

Loan value was negatively related to aggregate agricultural output. This indicates that aggregate agricultural output decreased as aggregate credit to agriculture increased and vice versa. This relationship, which is contrary to a priori expectation, is probably an indication that credit to agriculture may have been diverted to non-agricultural uses. Devaluation may have induced the diversion of investment funds (agricultural credit) to commercial and distributive ventures that are less risky and faster yielding relative to agriculture. The value of loans to agriculture may also be used as a proxy for production cost. In this case aggregate output increased as production costs decreased and vice versa. A decrease in production costs implies that farm firms can acquire and use more inputs leading to an increase in output. On the other hand an increase in production costs due to higher input prices will reduce the level of farmer's investments. As a result the growth rate of output will be slow. This is probably why the growth rate of output was not significantly different before and after devaluation since devaluation led to higher production costs.

Table 2: Regression Results of the Determinants of Aggregate Agricultural output.

	MODEL			
Variable	**Linear**	**Exponential**	**Semi log**	**Double Log**
Constant	22491.474 (3.055)***	9.777 (37.77)***	-13690.24 (-.310)	9.064 (5.459)***
Real Exchange Rate	1081.452 (1.154)	5.013 (1.521)	1822.589 (.640)	6.711E-02 (.627)
Annual Rainfall	-6.783 (-1.286)	-1.724 (-.930)	1219.949 (.200)	1.222E–02 (.053)
Value of Food Imports	.156 (1.79)*	4.221 (1.376)	5803.799 (5.218)***	.141 (3.381)***
Loans to Agri-culture	1.079E-02 (.300)	5.906E–07 (.467)	-1465.078 (-2.313)**	-4.086E-02 (-1.717)*
Capital Expenditure On Agriculture	-.163 (-.088)	-2.395 (-.367)	-1213.28 (-.711)	-2.320E – 02 (-.362)
Policy Regime	20831.370 (6.400)***	.809 (7.070)***	19078.807 (5.152)***	.772 (5.549)***
R^2	0.94	0.93	0.95	0.94
R^{-2}	0.92	0.91	0.94	0.92
F	47.424***	44.319***	62.782***	51.044***
DW	1.920	1.883	2.047	1.896[a]

*** Significant at 1%. ** Significant at 5%. * Significant at 10%. Figures in Parenthesis are t – ratios. DW = Durbin Watson Statistics. a=No Positive or Negative Serial Autocorrelation at 1%(4-du (2.365)DW (1.896)³du (1.635)

The policy regime was positively related to output. This indicates that devaluation led to an increase in output. Chow's test indicated that the coefficients from the pre-devaluation and devaluation regressions were not equal ($F_{cal} = 5.07 > F_{tab} = 2.85$). Also the intercept of the fitted functions for the pre-devaluation and devaluation periods differed significantly ($F_{cal} = 68.78 > F_{tab} = 4.38$) i.e. there is a tendency for significant differences in aggregate agricultural output in the pre-devaluation and devaluation periods.

SUMMARY, POLICY RECOMMENDATIONS AND CONCLUSION.

The results of this study show that aggregate agricultural output significantly increased as a result of devaluation and on the average, the growth rate of aggregate agricultural output was not significantly different in the pre-devaluation and devaluation periods. The slow growth rate of agricultural output suggests that in terms of investment, agriculture may have been at a disadvantage relative to other sectors of the economy as a result of devaluation. The value of food imports, and the policy regime were significant and positive determinants of aggregate output of agriculture while the value of aggregate credit to agriculture was a significant and negative determinant of aggregate agricultural output.

The policy implications of the results of the study include:

(1) a restriction on food imports is necessary for a sustained increase in aggregate domestic agricultural output. Restriction on food imports can be achieved through higher prices of food imports relative to domestic output as a result of devaluation (monetary policy) or high import taxes (fiscal policy) or through the prohibition of the import of all food imports or specific food commodities (rules and regulation).

(2) An increase in the profitability of investments in agriculture relative to other sectors of the economy is necessary to induce a reallocation of resources to agriculture and to avoid the diversion of agricultural resources such as credit to the non-agricultural sector. A significant reallocation of resources to agriculture will lead to a significant increase in the growth rate of output. The profitability of investments in agriculture is a function of production costs. Since devaluation increases production costs, it may have slowed down the rate of investment in agriculture and consequently the growth rate of output.

Since devaluation slows down the rate of new investments in agriculture due to higher production costs, it may not be the appropriate price incentive policy instrument for increasing aggregate agricultural output. The use of import taxes or the prohibition of food imports may be more appropriate. However, under a regime of devaluation, complimentary measures such as output price incentive schemes or input cost reduction schemes that increase the profitability of investments in agriculture relative to other sectors of the economy are essential for a significant increase in the growth rate of output.

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