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Dayo O.A. Phillip

RESPONSIVENESS OF SELECTED AGRICULTURAL EXPORT COMMODITIES TO EXCHANGE RATE DEVALUATION IN NIGERIA: AN ECONOMETRIC ANALYSIS

By
Dr. Dayo O.A. Phillip*

The Key focus of this paper was to estimate the responsiveness of selected agricultural export commodities to changes in the exchange rate in Nigeria over the 1974-92 sample period. This study was considered as relevant and topical to the exchange rate liberalisation adopted in 1986, which was intended in part to diversify the export base of the country. The results obtained suggests that, with the exception of natural rubber, the export elasticities for the commodities studied (cocoa, palm kernels, and processed/semi-processed products) were generally of low order even in the longrun. The low elasticity estimates were interpreted as suggesting potentially limited volume of agricultural export earnings in response to the devaluation of the local currency (The Naira). The need to periodically revise these estimates in the light of new information about agricultural tradables was emphasized.

1. INTRODUCTION

The Nigerian agricultural sector has always been expected to perform the roles of providing employment for the labour force, staple food and raw materials for domestic and export needs. Until the early 1970s Nigeria depended mainly on agriculture for its export revenue. In 1960, the contribution of agriculture to foreign exchange earnings was about 83 per cent. From 1960 to 1970, the export crop subsector contributed, on the average 58.4 per cent annually to the total foreign exchange revenue (Ojo, 1989). However, the contribution per annum averaged only 5.2 per cent over the 1971-85 period; infact, the figure has averaged less than 3 per cent per annum since 1985 (Anon., 1987; Anon., 1989)

The reasons advanced for the decline in Nigeria's agricultural sector in general and the export crop subsector in particular, include random occurrencies such as drought, pests and diseases, the boom in the oil sector and faulty agricultural policies, especially during and before 1960s.

During much of the 1970s, Nigeria experienced substantial capital inflow, largely in the form of oil sector earnings. The large oil revenue, coupled with the accumulation of reserves in major foreign currencies, became the enabling factor in the decision to revalue the Naira (Anon., 1974). Between 1970 and 1980, the nominal and real exchange rates were revalued 22.5 and 55.1 per cent, respectively (Oyejide, 1986).

Prior to the mid-1980s, policies about agricultural prices were especially rigid, often amounting to shifting the terms of trade against the agricultural sector. The revaluation of

*Dr. D.O.A. Phillip is in the Department of Agricultural Economics and Rural Sociology, Institute for Agricultural Research, Ahmadu Bello University, Zaira. Views expressed are those of the author.

the Naira, while reflecting an apparently healthy balance of payments position in the 1970s, effectively discouraged agricultural export. In the same vein, the pegging of interest rates were mostly beneficial to the "big" borrower farmers (Ojo, 1989). The domestic prices paid to export crop producers relative to the external prices received by the erstwhile commodity boards were low, virtually amounting to implicit taxation or negative protection of farmers (Abalu, 1975).

Towards correcting the above and other distortions in its economy, Nigeria opted in September 1986 for a structural adjustment programme (SAP). The broad aim of the SAP has been to "effectively alter and restructure the consumption and production patterns of the economy, as well as eliminate price distortions and heavy dependence on the export of crude oil and imports of consumer and producer goods" (Anon., 1986). The strategy for pursuing this objective include, inter alia, the adoption of (a) a realistic exchange rate policy, coupled with the liberalization of external trade and payments system and (b) appropriate pricing policies in all sectors with greater reliance on market forces and reduction in complex administrative control (Anon., 1986).

The present study is broadly focused on the impact of exchange rate policy on the performance of Nigeria's export crop subsector. Specifically, the study (i) briefly reviews, within a generalized theoretical framework, the potential impact of foreign exchange devaluation on agricultural export response and revenue; (ii) estimates the responsiveness of selected agricultural export commodities to changes in the foreign exchange rates.

2. THEORETICAL FRAMEWORK

2.1 The Case for Exchange Rate Devaluation

The currencies of the various economies are traded continuously against one another on the foreign exchange market. The amount of the domestic currency required to obtain a unit of a foreign currency is called the exchange rate (e). The exchange rate is a principal trade variable in the determination of import and export responses at any point in time.

The exchange rate should, in principle, be left to the vagaries of the market forces of demand and supply. In practice, however, no government ever really hands-off completely the determination of the exchange rate. It is common for authorities to fix the exchange rate (e) at some level (say e^*) which is often different from the competitive market rate (e^{**}). In some cases, the temptation has been to revalue the domestic currency (i.e., fix e^* to be less than e^{**}). This policy, which often stems from domestic political pressure, leads to persistent excess demand for foreign exchange, to meet increased demand for the relatively cheap imports.

Exchange rate devaluation by an economy conceptually creates both substitution effect and income effect. The devaluation of a domestic currency reduces the prices of domestic tradable goods relative to the prices of foreign goods. This induces increased demand by foreigners for the products of the country (substitution effect). The increase in the exchange rate reduces the real income of the domestic consumers and increase the real income of the foreign consumers (income effect). The real income effect thus reinforces the substitution effect to stimulate export response when a country devalues its currency.

The conditions under which export earnings from foreign exchange devaluation can be

increased and sustained is now briefly examined. The total value of foreign currency earned from exports, V, may be represented by:

$$V = \frac{P(N)}{e} X \quad , \qquad (1)$$

where P(N) is the domestic price of 1 unit of exports, and

$$X = g(e) \quad , g'(e) > 0 \qquad (2)$$

is the export response function.

Eq. (1) can be further simplified, without loss of generality, by setting P(N) equal to unity so that:

$$V = \frac{1}{e} g(e) \qquad (3)$$

The relationship between the exchange rate, e, and export earning, V, is not immediately obvious from Eq. (3). This is because when the exchange rate e increases, export will tend to increases in real terms, given that g' (e) > 0. However, the value of the foreign exchange required to fulfill this higher export response, i.e., g (e) /e, may not necessarily increase since the foreign exchange price per unit of exports (1/e) declines (Meyer, 1980). Thus, the resultant effect of a change in the exchange rate on export earnings depend on the elasticity of response of an economy's exports. If we explore Eq. (3) a little further by differentiating it with respect to e, we obtain :

$$dV / de = 1/e \; [\; dg(e) / de - g(e) / e \;] \qquad (4)$$

Then, rearranging terms in Eq. (4), gives:

$$dV / de = \frac{g(e)}{e^2} [\; k - 1 \;] \quad , \qquad (5)$$

where k [= dg(e)/de . e/g(e)] is interpreted as the elasticity of response of domestic exports. This coefficient must exceed unity (i.e., k>1) if increased export earnings are to follow from exchange rate devaluation. In other words, it is required that export be elastic to changes in the exchange rate for the relevant set or group of tradable agricultural commodities. We now specify a model for the estimation of the responsiveness of selected Nigeria's export commodities to changes in the exchange rate.

2.2. The Estimated Model

For the purpose of empirical investigation of the relationship between commodity export and foreign exchange rate, the bivariate relationship implied by Eq. (2) must be suitably specified and modified. In this regard, it will be assumed that the quantity of commodity i exported in period t (denoted by X_{it}) depends principally on the exchange rate in period t (e_t). The export variable X_{it} is expressed here in physical terms, which is in agreement

with the nature of the data to be employed later to test the model. Equally important is that, in Eq. (1) the export variable X is linearly related to the export earnings variable V. Thus, our use of X as an econometric proxy for V appears to be in order. Eq. (2) can be further modified for empirical investigation by assuming that the level of export in period t linearly depends on the level of export of the commodity in period t-1 (i.e, $X_{i,t-1}$) and on some variable d_t which indicates the existence or otherwise of the structural adjustment programme. Variable d_t is specifically assigned zero values in the pre-SAP years and unity in the SAP years (i.e, beginning from 1986, inclusive).

The equation estimated is of the following structure :

$$\ln X_{it} = b_1 + b_2 \ln X_{i,t-1} + b_3 \ln e_t + b_4 d_t + w_t \qquad (6)$$

where the b's are the unknown regression coefficients and w_t is an error term, which we assume to have desirable properties. Since the lag variable $X_{i,t-1}$ is autoregressively related to X_{it}, b_2 is theoretically expected to be positively signed and less than unity. And, coefficient b_3 is expected to be positively signed, keeping in mind the assumptions about Eq. (2).

The indicator or dummy variable d_t is expected to shift the functional relationship of export level and the exchange rate between pre-SAP and SAP periods, provided this variable was validly included in the model estimated. A priori, the algebraic sign on coefficient b_4 is expected to be positive; that is, at each exchange rate value, we expect the export level associated with a SAP period to exceed a pre-SAP period.

Given the structure of Eq. (6), estimate of b_3 gives the shortrun elasticity of export with respect to e, while the estimate of $b_3 /(1-b_2)$ measures the longrun elasticity of export. Theoretically, it is expected that shortrun estimates of elasticities will be lower than their longrun counterparts. The reason relates mainly to the time available for necessary adjustments by the various economic actors affected by a policy change. Longrun elasticity values will tend to be larger because, in our present study, more time will be available for adjusting all relevant institutions and technical units to the changes in the exchange rate by domestic producers, foreign consumers, and so on. Actually, the assumption here is that all economic actors concerned will be technically capable of responding to the policy change. Although the shortrun and longrun elasticity values will be estimated within a static framework, they nevertheless can provide good indications about the ease with which economic agents will respond to a change in a policy variable, such as the exchange rate.

Eq. (6) is essentially an adaptation of the pioneering model discussed and applied by Nerlove (1958), and later by Phillip and Abalu (1987) and Phillip (1989), in which various measures of crop production have been regressed on suitable proxies for farmers' expected commodity prices.

3. DATA

Equation (6) was estimated using the information available over the 1974-92 period in the various annual reports of the Central Bank of Nigeria (CBN). Information on export quantities were consistently available for only four commodity groups, namely, cocoa, palm kernels, natural rubber, and processed/semi-processed products, e.g., cocoa butter, cocoa cake, palm kernel oil, cocoa paste and cocoa liquor. Commodities such as palm oil

and groundnuts were not exported in any recordable quantities in the 1980s, which was in sharp contrast to the information available in preceeding years.

4. RESULTS AND DISCUSSION

The results of the regression analysis are summarized in Table 1. The t statistics of the parameter estimates are enclosed in parentheses. The exchange rate variable has the expected sign in each of the equations estimated but was statistically significant only at the 10 percent level (two-tail test). The estimate of the parameter on the lagged dependent variable was properly signed in eaeh estimated equation, and in three of the four equations, was statistically significant at the 5 per cent level.

The estimate of the parameter on the dummy variable was not statistically significant in the equations estimated for cocoa, palm kernels and processed/semi-processed products; it was however significant for natural rubber. Our earlier theoretical expectation of the sign on the dummy variable coefficient has been met in the equations estimated for cocoa, palm kernel and natural rubber. In the equation estimated for the processed/semi-processed products, the empirical sign was reversed. Furthermore, it was expected that the dummy variable will contribute significantly to the regression equations estimated, in view of the unprecedented and persistent devaluation of the Naira since 1986.

The explanatory variables specified in Eq. (6) accounted for 51.7, 49.3, 58.5 and 40.2 percent of the variability in the observed exports of cocoa, palm kernels, natural rubber and processed/semi-processed products, respectively (after adjusting for the intercept terms). The Durbin's h statistics for the estimated cocoa, palm kernel, natural rubber and processed/ semi-processed product models were 1.84, 1.67, 1.94 and 1.66, respectively. Although Durbin's h is an asymptotic statistic, theoretically, these estimates suggest the absence of serially correlated disturbances, in spite of the presence of a lagged dependent variable in Eq. (6).

Table 2 shows the estimates of the export elasticities for the four commodity groups indicated. The shortrun elasticity estimate is obviously implied by the coefficient on the exchange rate variable in Eq. (6). Estimates of the shortrun export elasticities are noted to be very low for the commodities investigated. In addition, but not unexpectedly, they are lower than their longrun counterparts. In the shortrun the elasticity estimates varies from 0.0377 for processed/semi-processed products to 0.2375 for palm kernels. The longrun estimates varies from 0.0854 for processed/semi-processed products to 2.2373 for natural rubber. These elasticity estimates are easily interpreted. Taking the cocoa estimates for example, a 10 percent change in the exchange rate will result in shortrun 1.875 percent change and longrun 2.231 percent change in the level of cocoa export. Also, a 10 percent change in the exchange rate will result in longrun 22.373 percent change in the level of natural rubber export. Other estimates can similarly interpreted.

5. CONCLUSION

The length of the available data for the study undertaken was somewhat limited in relation to the SAP period evaluated. However, some indications have been provided on the responsiveness of agricultural exports to changes in the exchange rate in Nigeria. The export elasticity estimates for the commodity groups studied were generally of low order even in the longrun, with the exception of natural rubber. It will be recalled that increase in the export earnings from foreign exchange devaluation requires that export be highly elastic to changes in the exchange rate [see Eq. (5)].

Going strictly by the results in this study, the only commodity for which potential exist for increased export revenue from foreign exchange devaluation, even in the longrun, is natural rubber. This is certainly contravariant to the observed fact that cocoa and processed/ semi-processed products (which are mainly cocoa-based) accounted for 60-65 per cent of the total agricultural export revenue annually during the sample period, but have yielded in this study relatively low longrun elasticity values.

Further studies will be needed to obtain similar estimates for the other agricultural commodity groups for which data availability was a problem during the present study. Also, it will be useful to update the current estimates as more sample periods become available on the set of commodities investigated in this paper.

Table 1. Summary results of the regression analysis

Explanatory variables	Cocoa	Estimated equation for : Palm kernels	Natural rubber	Processed/semi-processed products
constant	4.139 (2.789)a	1.0136 (1.022)c	-.286 (-0.259)c	1.4727 (1.822)b
lagged dep. variable	.1594 (1.970)b	.7291 (3.643)a	.9385 (3.450)a	.5583 (2.712)a
exchange rate variable	.1875 (1.780)b	.2375 (1.780)b	.1376 (1.908)b	.0377 (1.786)b
dummy variable	.5039 (1.090)c	.7439 (1.024)c	2.2610 (2.683)a	-.1834 (-0.201)c
Durbin's h	1.84	1.67	1.94	1.66
std crror of estimated	.4379	.4995	.4525	.6495
R-sq. (adj)	51.7%	49.35	58.5%	40.2%

a: stastically significant at the 5% level
b: stastically significant at the 10% level
c: not significant at the 10% level
Note: all variables except the dummy variable are in natural logarithm.

Table 2. Elasticities of export response for selected agricultural commodities, Nigeria.

Commodity	Shortrun elasticity (*)	Longrun elasticity
Cocoa	.1875	.2231
Palm kernels	.2375	.8767
Natural rubber	.1376	2.2373
Processed/semi-processed products	.0377	.0854

(*) copied directly from Table 1.

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