REAL EXCHANGE RATE MOVEMENTS AND EXPORT GROWTH: NIGERIA, 1960-1990

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EXECUTIVE SUMMARY

Context

The growth of Nigeria's non-oil exports has been rather sluggish in the post independence period. It averaged about 2.3% during 1960–1990, but in relative terms declined systematically as the proportion of total exports fell from about 60% in 1960 to about 3% in 1990. In addition, the range of non-oil export items also declined over this period. Many factors likely combined to yield these adverse developments, but the country's exchange rate policy has often been identified as a major contributor.

What is the problem?

The maintenance of an appropriate exchange rate regime is a necessary but not sufficient condition for the achievement of macroeconomic objectives. The stability and proper alignment of the exchange rates are absolutely essential to the restoration of growth in the tradeable goods sector and the economy as a whole. *A misaligned and volatile real exchange rate, such as Nigeria's, can adversely affect export growth.*

The study compares the results of two different approaches to the analysis of the effect of the movements of the real exchange rate (RER) on the growth of non-oil exports in Nigeria.

Nigeria's external sector policies and the real exchange rate

Four distinct periods of exchange rate policy can be identified in Nigeria during 1960–1990: the fixed rate regime of 1960–1970; the adjustable peg regime of 1974–1978; the managed float regime of 1978–1985; and the flexible rate regime of 1986–1990. In 1972–1974 there was a brief period of confusion in exchange rate policy.

These regimes correspond roughly with other external sector policies. The early 1960s were marked by an explicit import substitution industrialization strategy with an import-inhibiting tariff structure. The oil boom of the 1970s had several influences: a substantial reduction in tariff rates, a liberalized and generous foreign exchange policy, and greater use of quantitative restrictions rather than import tariffs. In 1973–1978—the oil boom years—a deliberate policy of naira appreciation was pursued and given the tremendous fiscal response of the government to windfall oil profits, a real appreciation of the exchange rate resulted.

The end of the oil boom around 1980 brought a huge rise in the level of Nigeria's external debt, which grew at the phenomenal annual rate of 76% between 1982 and 1985. Tariff rates on a variety of imports were hiked substantially—rates of 150% were common—and the extent and use of quantitative restrictions were unprecedented in the country's history. In essence, therefore, over 1960–1985 the real exchange rate appears to have been appreciated by restrictions, oil windfalls and external debt.

A structural adjustment programme introduced in 1986 reversed most of these policy measures and considerably narrowed quantitative restrictions. An interim tariff structure implemented in 1988 reduced tariff rates on most imports to below 50%; a further review planned for 1994 was to produce a uniform tariff structure for the country. An auction system for determining the exchange rate was introduced in 1986 and effectively checked the over-valuation of the nominal exchange rate. The external debt stock continued to soar, however, and appears to have been the major factor accounting for changes in the real exchange rate after 1985.

Issues in RER movements

The real exchange rate is commonly defined as the price of tradeables relative to non-tradeables. It is thus an implicit rather than explicit price. As a result, there is much controversy surrounding its definition and measurement procedures.

This study uses two theoretical frameworks for analysing the RER: the purchasing power parity (PPP) approach and an econometric model approach. The model approach generally interprets exchange rate movements in terms of risk, which will elicit different responses from different exporters.

An exporter is considered either more or less risk averse. The more risk averse exporters

view adverse exchange rate movements as permanent, and in order to protect their income level they may increase their export activities. This will tend to increase export volume. The less risk averse exporter generally sees exchange rate movements in terms of greater risk and will divert resources from export activities to domestic substitutes. This will result in declining export volume. A comparison of the income substitution effects associated with such exchange rate risk is necessary in order to ascertain its overall macro effect on export growth.

Study results

The study finds among other things that restrictive trade practices can significantly appreciate the RER, confirming that sustaining a liberalization process requires an exchange rate depreciation. Furthermore, the results suggest that productivity improvements or technological progress are faster in the non-tradeable goods sector of the country, which causes the RER to depreciate.

The most potent determinants of short-run movements in the RER, according to the study, are the nominal exchange rate, excess domestic credits and net capital inflow. However, nominal exchange rate devaluation is found to bear relatively greater influence on the RER.

The study also finds that the current levels of RER misalignment and volatility both generate a negative effect on non-oil export growth in Nigeria. Overall, the results appear to suggest that in the context of the framework used in the study, the Nigerian export producers are generally less risk averse, and would react to any adverse exchange rate movement by reducing exports.

Implications for policy makers

The econometric results fit the conventional wisdom that an improvement in the terms of trade, increase in net capital inflows, increase in government expenditure on non-tradeables and excess credit creation cause RER appreciation. Conversely, an increase in openness, technological progress and nominal devaluation of the nominal exchange rate cause RER depreciation.

It is recommended that Nigerian authorities introduce and maintain policies that would reduce the misalignment of the real exchange rate and produce a stable exchange rate system in order to enhance the growth of the country's non-oil exports.

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Real exchange rate movements and export growth: Nigeria, 1960–1990

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Abstract

This report analyses the effects of real exchange rate (RER) movements (defined in terms of misalignment and volatility) on the growth of non-oil exports in Nigeria over the period 1960–1990. RER is defined as the relative price of tradeables to non-tradeables, and RER misalignments are derived using a model based approach and the purchasing power parity (PPP) approach. Under both frameworks, RER volatility is defined in terms of the coefficient of variations of the RER. The results show that irrespective of the misalignment generating framework adopted, both RER misalignment and volatility adversely affected the country's non-oil export growth. However, the results under the model based approach appear to be relatively more credible.

I. Introduction and background

The growth of Nigeria's non-oil exports has been rather sluggish in the post independence period. It averaged about 2.3% during 1960–1990, but, in relative terms, declined systematically as the proportion of total exports fell from about 60% in 1960 to about 3% in 1990. In addition, the spread of the non-oil export items experienced considerable decline in the reference period.[1]

Although many factors may have combined to explain the general adverse developments, the exchange rate policy of the country has frequently been identified as a major contributor (see, e.g., World Bank, 1984). With the exception of a brief period of confusion in exchange rate policy formulation in the country (i.e., 1972–1974), four distinct regimes of exchange rate were observed between 1960 and 1990: the fixed rate regime of 1960–1970, the adjustable peg regime of 1974–1978, the managed float regime of 1978–1985 and the flexible rate regime of 1986–1990. Whereas the first three regimes have been criticized for generating relatively greater exchange rate misalignment in the country, the last regime has been noted for its unprecedented level of volatile exchange rates (see Pinto, 1987; Oyejide and Ogun, 1995).

Theoretically, it has been recognized that the maintenance of an appropriate exchange rate regime is a necessary but not a sufficient condition for the achievement of desired macroeconomic objectives; the stability and proper alignment of the exchange rates are absolutely essential to the restoration of growth in the tradeable goods sector and indeed, the aggregate economy (see Frenkel and Goldstein, 1988; Edwards, 1988, 1989; Caballero and Corbo, 1989; Cottani et al., 1990). The aim in this study, therefore, is to analyse the effect of RER movements in terms of misalignment and volatility on the growth of non-oil exports in Nigeria over the period 1960–1990. The study is designed to fill the gap in the Nigerian literature, which has focused exclusively on the level of RER and its macroeconomic implications and determinants (see, e.g., Olopoenia, 1992; Ogun, 1993a/b, 1995a/b; Oyejide and Ogun, 1992; Osuntogun et al., 1993). Its main finding is that RER misalignment and volatility adversely affected the growth of the country's non-oil export in the relevant period.

II. Nigeria's external sector policies and the RER

Protectionist trade policies in Nigeria emerged in the early 1960s following the explicit adoption of an import substitution industrialization strategy as well as the deterioration in the country's terms of trade (TOT) and its associated balance of payments disequilibrium in the wake of the expiration of the commodity export boom of the post World War II era. Thus, an import-prohibiting tariff structure (comprising mostly duties above 50%) was put in place. The civil war of the late 1960s appears to have given further impetus to the protectionist tendencies, as an appreciation of the NER was deliberately permitted.

Apart from its well known "spending effect", the oil boom of 1973–1980 appears to have influenced changes in the country's external sector policy on three fronts.[2] First, a substantial reduction in tariff rates (with import duties mostly below 50%) was made. Second, a liberalized (and indeed generous) foreign exchange and import payments policy was implemented. Third, there was a relatively greater use of quantitative restrictions (as opposed to import tariffs) in the period, especially following the first oil glut of 1976–1978 and the resulting balance of payments disequilibrium. However, in 1973–1978, a deliberate policy of naira appreciation was pursued and given the tremendous fiscal response of the government to the oil windfalls, a real appreciation of the exchange rate resulted. In the context of the Dutch disease phenomenon, such a real appreciation of the exchange rate in the period of an export boom was theoretically efficient; the long-run implication of such a development, however, especially in terms of sustainability, appears to have been missed or disregarded in policy circles.[3]

The end of the oil boom around 1980 brought about a phenomenal rise in the level of Nigeria's external debt, which grew at an unprecedented annual rate of 76% between 1982 and 1985 (see Ogun, 1995b). Further, tariff rates on a variety of imports were hiked substantially as tariff rates in excess of 150% became a common feature of Nigerian trade policy. In addition, the extent and use of quantitative restrictions in the period were unprecedented in the economic history of the country. In essence, therefore, over the period 1960–1985, the RER of the country appears to have been appreciated by restrictions, oil windfall and external debt.

In the spirit of the structural adjustment programme introduced in 1986, most of the aforementioned policy measures were reversed as quantitative restrictions became considerably narrowed. An interim tariff structure implemented in 1988 reduced tariff rates on most imports to below 50% and a further tariff review planned for 1994 was to produce a uniform tariff structure for the country. And as noted in the preceding section, the auction market for exchange rate determination, which was introduced in 1986, appeared to have effectively checked the over-valuation of the NER. However, over

1985–1990, the country's external debt stock grew at an approximate average rate of 70% to about US$33 billion. Essentially, therefore, the external debt burden of the country appears to have constituted the prime factor accounting for changes in the RER in the post 1985 period.

Figure 1 depicts the trends in the RER and NER for the period 1960–1990. The RER index fell below the corresponding NER index only in the liberalized trade policy era of 1986–1990. This would appear to reflect the RER realignment policies of the period.

Figure 1: Real and nominal exchange rates, Nigeria, 1960–1990
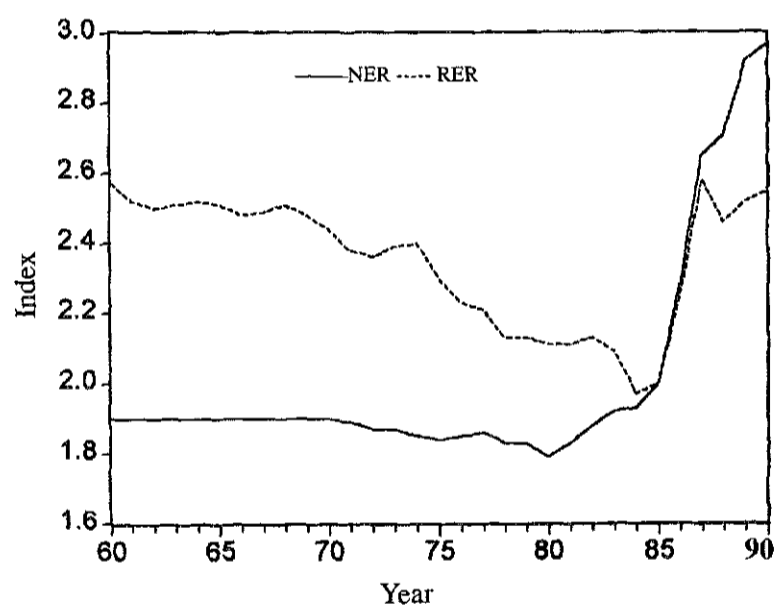
III. Theoretical issues in RER movements

The RER, which is commonly defined as the relative price of tradeables to non-tradeables, is an implicit rather than an explicit price. As a result, its definition and measurement procedure can sometimes be subjects of controversy. Over time, three different concepts and measurement frameworks have been used for the equilibrium RER.

The first approach is the purchasing power parity (PPP) doctrine, which associates the equilibrium exchange rate with the value of the nominal exchange rate (NER) in a period of external balance (known as the base year), adjusted for inter-country differences in inflation rates between the current and the base year.

Three defects are usually associated with the PPP approach. First, it is not easy to find an equilibrium base period. For example, in Nigeria, external equilibrium could be associated with some years during the oil boom. However, using any of these years as a representative equilibrium base year could be misleading since the value of the NER in the period was sustained by a transitory phenomenon. Second, under the PPP approach, equilibrium RER is deemed a constant that does not change. However, in a world in which domestic and foreign goods are imperfect substitutes and there are real shocks to the system, it is desirable to have deviations from PPP; the reason is that the RER must adjust to the shock and this will require movements in the NER and domestic and foreign price levels (see Balassa, 1964; Flood, 1981; Mussa, 1982, McGuirk, 1983; Baldwin and Krugman, 1987). Third, PPP does not seem to hold very well in the short run and probably not in the long run, either (Dornbusch, 1980a; Frenkel, 1981; Dornbusch and Frenkel, 1987).

The second approach (which is sometimes regarded as complementary to the first) is the underlying balance approach under which the equilibrium (real) exchange rate is defined as that rate that would yield equilibrium in the "underlying" (however defined) balance of payments over some medium term (see, e.g., Artus, 1978). A common definition of underlying balance of payments equilibrium under this approach is that the current account (i.e., the actual current account adjusted for temporary factors) be equal to normal net capital flows over the next two to three years, given anticipated real output and inflation paths, and the delayed effect of past exchange rates (see Frenkel and Goldstein, 1988). The main difficulty with this definition lies in the calculation of normal net capital flows. The normal net capital flows of a country are influenced by the savings and investment trends of its trade partners and these trends are usually determined by several factors. The general equilibrium nature of the exercise could be daunting. In addition, neither the current account nor balance of payments seems to explain actual exchange rate changes better than the other factors (Frenkel and Goldstein, 1988).

The third approach is the sustainability approach. The idea under this approach is to identify the market's implicit forecast for the future path of the exchange rate, based on the current exchange rate, interest rate differentials and other data, and to assess the consequences of this forecast exchange rate path for the balance of payments and external indebtedness.

A critique of this approach is that it is less ambitious than the others since it seeks only to identify an unsustainable rate, and by implication, the likely future direction of exchange rate changes. Perhaps a more serious criticism of the approach is that it disregards the difference between sustainability and optimality, and hence, can at best yield a less than optimal outcome for the domestic economy (see, e.g., Frenkel, 1987).

Edwards (1988, 1989) has produced a classical exposition on RER determinants and misalignment. Working from the position that there is not one equilibrium RER, but rather a path of equilibrium RERs through time, Edwards distinguished between equilibrium and non-equilibrium movements in RER. He defined equilibrium RER as that relative price of tradeables to non-tradeables that for given equilibrium or sustainable values of other relevant variables such as trade taxes, international prices, capital and aid flows, and technology, results in the simultaneous attainment of internal and external equilibrium.

Furthermore, equilibrium movements in RER could be occasioned by real events in the economy such as technological progress, movements in external terms of trade, changes in taxation, etc. Such equilibrium movements do not require policy intervention. Contrariwise, non-equilibrium movements in RER, which are otherwise known as misalignments, are usually policy induced. The errant policies could take the form of quantitative restrictions such as import tariffs, quotas and export taxes; exchange and capital controls; subsidies and other taxes; and the composition of government expenditure. Eliminating the inconsistent policies is a way of returning the RER to equilibrium.

The macroeconomic policy induced misalignment described above is to be distinguished from structural misalignment. According to Edwards (1988, 1989), structural misalignment takes place when changes in the real determinants of the equilibrium RER, such as the terms of trade, are not translated in the short run into actual changes in RER. However, like its counterpart, it can be corrected through policy intervention.

IV. The analytical framework

A variety of models exist as frameworks for analysing the effect of exchange rate movements on export growth (see, e.g., De Grauwe, 1988; Caballero and Corbo, 1989). Although a microeconomic perspective is adopted in all the models, their analyses generate important implications for the macroeconomy. Another strand common to the models is their general interpretation of exchange rate movements in terms of risk, which will elicit different reaction responses from exporters. Under this setting, an exporter is either very risk averse or less risk averse. Risk averse exporters view adverse exchange rate movements as permanent, and in order to protect their income levels, may increase export activities. This is an income effect that tends to increase export volume. Conversely, where the exporter is less risk averse, adverse exchange rate movement is usually interpreted in terms of greater risk. Consequently, the exporter would divert resources from export activities into their domestic substitutes. Such a substitution effect would be mirrored in declining export volume. In the final analysis, a comparison of the income and substitution effects associated with such exchange rate risk is necessary in order to ascertain its overall macro effect on export growth.

Risk-defining model

Consider an individual farmer who produces for both foreign and domestic markets. The farmer's gross revenue would be represented as:

$$\tilde{Y} = \tilde{e}P_f q(X_f) + P_d q(X_d) \tag{1}$$

where a tilde on any variable indicates its random nature; e is exchange rate; P_f is the price of the output sold in the foreign market measured in domestic currency; P_d is the price of the output sold domestically; and $\tilde{e}P_f = P_d$, suggesting an absence of market segmentation. If it is assumed that similar technology is used in producing for both foreign and domestic markets, then q (X_f) refers to the quantity produced for the foreign market from using X_f amount of resources, and q (X_d) is the quantity produced for the domestic market from using (X_d) amount of resources.

The farmer maximizes expected utility defined over gross revenue so that,[4]

$$\max E\{U(\tilde{Y})\} = E\{U[\tilde{e}P_f q(X_f) + P_d q(X_d)]\} \tag{2}$$

where U is a concave function of Y. In other words, the farmer is assumed to be risk averse.

The first order condition for a maximum is,

$$\delta E \,/\, \delta X_f = E\{U'\,(\tilde{Y})[\tilde{e}P_f q(X_f) - P_d q(X_d)]\} \tag{3}$$

which can be rewritten as:

$$E[U'\,(\tilde{Y})\tilde{e}] = P_d \,/\, P_f \,.\, q'\,(X_d) \,/\, q'\,(X_f) \,.\, U'\,(Y) \tag{4}$$

To demonstrate how an increase in movement of $\tilde{e}$ affects the optimal amount of resources put into export production (i.e., X_f), we follow De Grauwe (1988) by considering how a "mean-preserving" spread in $\tilde{e}$ affects $E[U'\,(\tilde{Y})\tilde{e}]$. If such an increase raises $E[U'\,(\tilde{Y})\tilde{e}]$, then the right-hand side of Equation 4 must also increase, and this can only occur if X_f increases. In other words, if exchange rate movement increases the expected marginal utility of gross revenue, then such a movement will lead to more export production and vice versa.

The overriding issue now is whether the function $U'\,(\tilde{Y})\tilde{e}$ is convex or concave in $\tilde{e}$. If it is convex (concave), then every mean-preserving increase in the spread of $\tilde{e}$ will increase (decrease) the expected value of the function $U'\,(\tilde{Y})\tilde{e}$. The condition under which the function $U'\,(\tilde{Y})\tilde{e}$ is convex or concave can be found by differentiating it twice with respect to e. This yields after some manipulations:

$$d^{2U'(Y)e} \,/\, d^2 e = 1 \,/\, e[R(1-R) + R'\,Y] \tag{5}$$

where $R = U''(Y)/U'(Y)$ is the coefficient of relative risk aversion. If Equation 5 is positive (negative), then the function $U'(Y)$ is convex (concave). It follows therefore that convexity or concavity depends on the degree of risk aversion. If it is assumed conventionally that the coefficient of relative risk aversion R is constant, then $R' = 0$. By implication, convexity holds if $R > 1$ and concavity holds if $R < 1$.

Thus, if farmers are sufficiently risk averse $(R > 1)$, an increase in exchange rate risk raises the expected marginal utility of gross revenue and therefore induces them to increase their export activity. However, if farmers are not very risk averse $(R < 1)$, a higher exchange rate reduces the expected marginal utility of gross revenue and therefore leads them to produce less for export.

The empirical model

An appropriate equation of export growth for the country would be one that combines the effect of RER movements as demonstrated in the preceding section with the other

factors suggested by conventional trade theory as influencing export growth.[5] Thus, we can have that,

$$X = X(y^*, q, TOT, M, V) \qquad (6)$$
$$(+) (+) (+) (-) (-)$$

where X is export volume, y^* is foreign (trade partners') real income, q is relative prices (RER), TOT is other exogenous variables affecting export growth, and M and V are RER misalignment and volatility, respectively. The signs under the variables denote a partial derivative of the variables with respect to the dependent variable. In econometric terms, the equation can be expressed as:

$$\Delta X = \alpha_0 + \alpha_1 \Delta y^* + \alpha_2 \Delta q + \alpha_3 TOT + \alpha_4 M + \alpha_5 V + \varepsilon_t \qquad (6)$$

where Δ represents first difference and ε_t is a stochastic error term. For the hypothesis that exchange rate misalignment and volatility adversely affect export growth to be accepted, neither $\alpha 4$ nor $\alpha 5$ is expected to be significantly different from zero.

V. The measurement framework

The standard formula for computing the RER is usually given as:[6]

$$e = EP_T^* / P_N \qquad (7)$$

where e is RER, E is NER index, P_T^* is the index of foreign prices for tradeable goods and P_N is an index of domestic prices for non-tradeables. Conventionally, P_T^* is usually proxied by any price index that reflects more of tradeable goods' prices in its composition (usually the wholesale price index of the trading partner), while P_N is proxied by the consumer price index, which contains more of non-tradeable goods' prices in its composition.

The practice in the literature is to define volatility and misalignment in terms of movements in RER. Thus, volatility refers to the short-term fluctuations of RER about its longer-term trends (Frenkel and Goldstein, 1988). In contrast, misalignment refers to a sustained departure of the actual RER from its long-run equilibrium level (Edwards, 1989). Hence, when the actual RER is below the equilibrium RER, reference is made to over-valuation; otherwise the term, "RER under-valuation" is used (Edwards, 1989: 8).

A significant number of studies has been devoted to the empirical analysis of the macroeconomic effects of RER volatility and/or misalignment (see, e.g., Dornbusch, 1980b; Cushman, 1983; Aktar and Hilton, 1984; Gotur, 1985; Bailey et al., 1986; Edwards, 1987, 1989; De Grauwe, 1988; Cottani et al., 1990; Caballero and Corbo, 1989; Ghura and Grennes, 1992; Elbadawi, 1992, 1994; Mwega, 1993). Accordingly, some measurement standards have tended to develop in the literature.

RER volatility is conventionally measured in terms of standard deviations or the coefficient of variation of RER around its mean for a sample period (see DeGrauwe, 1988; Edwards, 1987; Caballero and Corbo, 1989; Ghura and Grennes, 1992; Savvides, 1992). The apparent disability imposed on this study by the existence of only one figure for standard deviation was dealt with by using the concept of moving standard deviations in generating the coefficient of variation.[7]

Two measures of RER misalignment are used in this study. The first is the PPP measure, which takes an average of highest RER values to represent equilibrium RER. By Cottani et al. (1990); Cavallo et al. (1986), and Ghura and Grennes (1992), the highest RER values for three years appear to have become the standard. Thus, RER misalignment (RERM) can be measured as:

$$RERMIS_t = [(S_j maxRER_j / RER_t) / 3 - 1] * 100, \qquad (8)$$

where $[(S_j maxRER_j) / 3]$ $(j=1,2,3)$ is the average of the three highest values of RER.

The second approach, which is generally accepted as more scientific, is model based. It attempts to measure RER misalignment using the fitted values of a regression involving RER determinants (see Cottani, Cavallo and Khan, 1990; Edwards, 1988, 1989; Ghura and Grennes, 1992; Elbadawi, 1992, 1994; Mwega, 1993; M'bet and Madeleine, 1994). Following Edwards (1989), RER misalignment (RERM) can be specified as the difference between equilibrium RER (ERER) and observed RER in percentage of the observed RER, i.e.,

$$RERM = (ERER - RER)/RER * 100 \tag{9}$$

and RER determinants can be specified as:

$$logRER = a_0 + a_1 logTOT + a_2 logCAPFLOW + a_3 logEXCHCONTROLS$$
$$+ a_4 logGCN + a_5 logTECHPRO + a_6 \Delta(Z\text{-}Z^*) \tag{10}$$
$$+ a_7 \Delta logNER + a_8 logRER_{t\text{-}1} + M$$

where TOT is external terms of trade, CAPFLOW is net capital inflows, EXCHCONTROLS is an index of severity of trade restrictions and capital controls, GCN is government expenditure on non-tradeables, TECHPRO is a measure of technical progress, $Z\text{-}Z^*$ is an index of macroeconomic imbalances, and $RER_{t\text{-}1}$ is lagged RER.[8]

In terms of the expected signs of the variables, the TOT may not be readily signed a priori. This is because, theoretically, changes in it generate both an income effect and a substitution effect; if the income effect dominates, then a deterioration in the TOT will require equilibrium RER depreciation. In other words, deteriorating TOT causes RER over-valuation. The opposite will apply if the substitution effect dominates.[9] An increase in net capital inflows will tend to increase spending on all goods. The ensuing demand pressure will raise the prices of non-tradeable goods higher than those of tradeables, hence, RER appreciation (see, e.g., Cottani et al., 1990; Cavallo et al., 1986; Edwards, 1988).

Trade liberalization measures such as tariff reductions and elimination or reduction of quantitative restrictions will tend to cause equilibrium RER depreciation due to a greater pressure from increased competition on the price of non-tradeables relative to tradeables.[10] By implication, trade liberalization is not attainable without commensurate RER depreciation (Elbadawi, 1994: 106).[11]

Moreover, the effect of an increase in government expenditures on ERER will depend on its composition. If it consists more of non-tradeable expenditures, RER over-valuation or ERER depreciation will result (Edwards, 1988, 1989). Changes in ERER may also result from technological factors. If, as a result of technological progress, productivity improvements are concentrated in the tradeable sectors, the ERER will tend to fall. The converse holds if technological progress favours the non-tradeables sector.

Furthermore, macroeconomic imbalances denoted by excess credit expansion cause ERER depreciation. Finally, changes in RER will, to a large extent, reflect changes in NER. Hence, a rise in NER will be mirrored in RER over-valuation, causing ERER depreciation.

VI. Methodology and data

The time series properties of the data are examined by conducting the tests for stationarity and cointegration. Whereas the test for stationarity is designed to examine the order of integration of the variables, that for cointegration is to check for the existence of cointegrating relationships between non-stationary explanatory variables (i.e., variables not of the order of I[0]) and the dependent variable. If cointegration is established, the relationship between the independent and the dependent variables will be most efficiently represented by an error-correction model (see Engle and Granger, 1987). The error-correction specification will not only facilitate the analysis of the short-run impacts on the dependent variable, but will also suggest the speed of adjustments to long-run equilibrium. In addition, it will permit an equilibrium interpretation of the estimates.

The tests for stationarity and cointegration are conducted according to three procedures — the Sargan-Bhargava Durbin-Watson (SBDW) test, the Dickey Fuller (DF) test and the augmented Dickey Fuller (ADF).[12] In the case of cointegration, the tests are conducted on the residuals from the cointegrating regression.

A major obstacle encountered in the estimation of RER determinants is data unavailability. Most of the variables cannot be estimated directly, hence they are proxied. Following Edwards (1988), Cottani et al. (1990), Ghura and Grennes (1992), and Mwega (1993), the following proxies are used in the RER equation.

Net capital inflow (CAPFLOW) is proxied by the balance on the capital account of the balance of payments. EXCHCONTROLS is proxied by the parallel market exchange rate premium, which, due to the dominating influence of oil exports in the country's total exports, is preferred to the conventional trade ratio as a measure of degree of openness. The TOT data available were adjusted to derive the income TOT in order to accommodate the problem posed by the obvious changes in the composition of the country's basic TOT.[13] TECHPRO is proxied by the rate of growth of real income (log Y). This is consistent with the so-called Ricardo-Balassa effect (see Edwards 1988). Finally, Z-Z^* is proxied by (DC/M2 - log Y - log NER - log Pf), where DC is domestic credit and Pf is foreign prices as represented by the U.S. wholesale price index. All other variables are represented by actual data series. The econometric procedures are conducted within the provisions of the PC-GIVE software of Hendry (1989).

The data used in the analysis were obtained from the Central Bank of Nigeria, *Statistical Bulletin*, various issues; International Monetary Fund, *International Financial Statistics*, Yearbook, various issues, and *Supplement on Trade Statistics*, various issues; United Nations Conference on Trade and Development, *Handbook of International Trade and Development Statistics*, various issues; United Nations Monthly *Bulletin of Statistics*, various issues; publications of the World Bank, including *Global Trends in Real Exchange Rates, 1960 to 1984*, and *African Development Indicators*, various issues.

VII. Empirical analysis

The results of the tests of stationarity of RER determinants are presented in Table 1. RER, openness, real government expenditure on non-tradeables (GCN) and real GDP (Y) are shown to be I(1). NER is I(2).[14] Three series, TOT, CAPFLOW and Z-Z*, are stationary at their levels, suggesting that the relative variations of both series experienced little change over time.

Table 1: Tests of data stationarity

Variables	SBDW	DF	ADF	Order of integration
log RER	0.2477	-1.6774	-1.7368	1
Δlog RER	1.5059	-3.8240	-2.8729^{1}	0
log TOT	1.4176	-5.3904	-2.9578^{2}	0
log CAPFLOW	2.1301	-5.3290	-2.4953	0
log OPEN	0.3449	-2.4762	-2.0490^{1}	1,0,0
Δlog OPEN	1.2093	-3.6228	-3.8839^{1}	10
log GCN	0.1737	-1.0244	-1.1603	1
Δlog GCN	2.3776	-3.3280	-2.7510^{2}	0
log Y	0.0730	-1.1523	-0.9070	1
Δlog Y	1.5473	-3.5366	-2.9032^{2}	0
log NER	0.0879	0.2572	-2.1396^{2}	2,1,0
Δlog NER	0.8883	-1.9271	-1.6756	1
$\Delta\Delta$log NER	2.5344	-4.6514	-3.4217^{2}	0
Z-Z*	1.9153	-2.9412	-2.6704^{2}	0

Critical values at 5%: SBDW, 0.78 to 1.56 (about 1.25 at n = 30)
DF and ADF, -1.95
[1] implies that estimation was carried out at 2 lags.
[2] implies that estimation was carried out at 3 lags.

Table 2 shows the tests for cointegration. The test was carried out on the residuals of the static cointegrating regression involving the non-stationary real determinants of RER. A general test involving all non-stationary real variables was performed, as well as tests for each independent variable.

Table 2: Tests of cointegration between the dependent and the explanatory variables

	SBDW	DF	ADF
TOT, OPEN, GCN	0.59	-1.4082	-1.3199
OPEN, GCN	0.59	-1.0450	-1.7164
OPEN	0.44	-1.3581	-2.0541
GCN	0.52	-1.9532	-1.9174
TOT	0.23	-1.7137	-1.7421

Critical values at 5%: SBDW, 1.10; DF, -4.35; ADF, -3.98.

The three tests unanimously reject the hypothesis that the variables are cointegrated. Thus, it is not possible to categorize the RER fundamentals into "real" factors (with long-term effects through their impact on the equilibrium RER) and "nominal" variables with mainly short-term effects. In the context of Nigeria, therefore, all the fundamentals have only short-term effects on RER.

An over-parameterized RER equation was therefore estimated. The results are shown in Table 3.[15]

Table 3: Modeling ΔlogRER by OLS (1965–1990)

Variable		Coefficient	Std error	HCSE	t-value	Partial R^2
ΔlogRER	1	.1760979	.07016	.03304	2.50982	.2957
ΔlogRER	2	-.1532276	.07832	.06636	-1.95653	.2033
ΔTOT		-.0829068	.08014	.06863	-1.03457	.0666
ΔlogCAPFLOW	2	-.1579666	.03979	.03393	-3.96978	.5123
ΔlogOPEN		-.0831844	.03306	.03585	-2.516525	.2968
ΔlogGCN	1	-.0835673	.04003	.04151	-2.08759	.2251
ΔlogGCN	2	-.0812875	.04505	.04951	-1.80419	.1783
ΔlogY	3	.3337835	.13093	.16098	2.54942	.3023
ΔlogNER		.5433534	.10397	.09670	5.22592	.6455
Δ(Z-Z*)		-.0566677	.01848	.01426	-3.06591	.3852
CONSTANT		-.0226880	.00735	.00842	-3.08667	.3884

R^2 = .961198 F(10, 15) = 37.16 [.0000] σ = .0248471 DW = 2.41
RSS = .0092606710 for 11 variables and 26 observations.
Testing for serial correlation from lags 1 to 3
CHI^2(3) = 2.879 and F-Form (3,12) = .50[.6905]
ARCH TEST
CHI^2(3) = 3.171 with F(3,9) = .48[.7043]

The equation is shown as explaining over 90% of the variations in the RER. It has a standard error of about 2.5% and is moderately subject to serial correlation. All coefficients

have the expected signs and except for TOT, all are statistically significant at the 5% level of testing.

Although insignificant, the sign of the coefficient of the terms of trade (TOT) suggests that an improvement in the TOT causes RER appreciation. By implication, the income effect associated with a change in TOT appears to dominate the substitution effect. For contrast, the net capital inflows strongly generate RER appreciation in the country. Given the oil windfalls of the 1970s and the external indebtedness of the 1980s, this result appears not surprising.

Restrictive trade practices produce a significantly appreciating effect on RER, confirming that sustaining a liberalization process requires frequent exchange rate depreciation. Further, the coefficient of the real income variable appears to suggest that productivity improvements or technological progress are faster in the non-tradeable goods sector of the country thereby causing its RER to depreciate.[16]

It appears that the most potent determinants of short-run movements in RER in the country are the nominal exchange rate, excess domestic credits and net capital inflow. However, nominal exchange rate devaluation appears to bear a relatively greater influence on the RER.[17]

Although at a risk of model instability, RER misalignment was generated on the basis of the cointegration tests performed earlier. The fitted value of the equations is approximated to equilibrium RER while its residuals are taken as indicators of RER misalignment. A similar result will be obtained if the misalignment is computed on the basis of Equation 9. The emerging series together with RER misalignment under the PPP measure are graphically presented in Figure 2. As can be seen from the figure, the misalignment series under the PPP measure is apparently larger. However, as pointed out earlier, the measure is theoretically defective. Hence, the associated misalignment series may not accurately describe the true state of RER misalignment in the economy.

Figure 3 presents the RER volatility series as computed using the coefficient of variation. Some peaks and troughs can be associated with RER variation since the late 1960s. However, the sharp rise between 1985 and 1987 and the associated steep fall between 1988 and 1990 appear to be unprecedented in the entire period of 1960 to 1990.

In the estimation and analysis of the non-oil export equations, the data driven methodology had to be applied in the context of tests of stationarity and cointegration. The results of the data stationarity tests are presented in Table 4.[18]

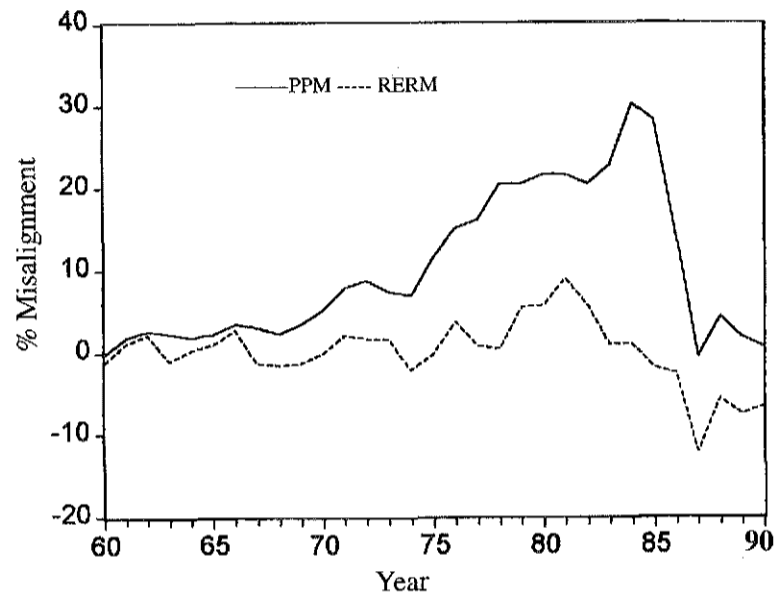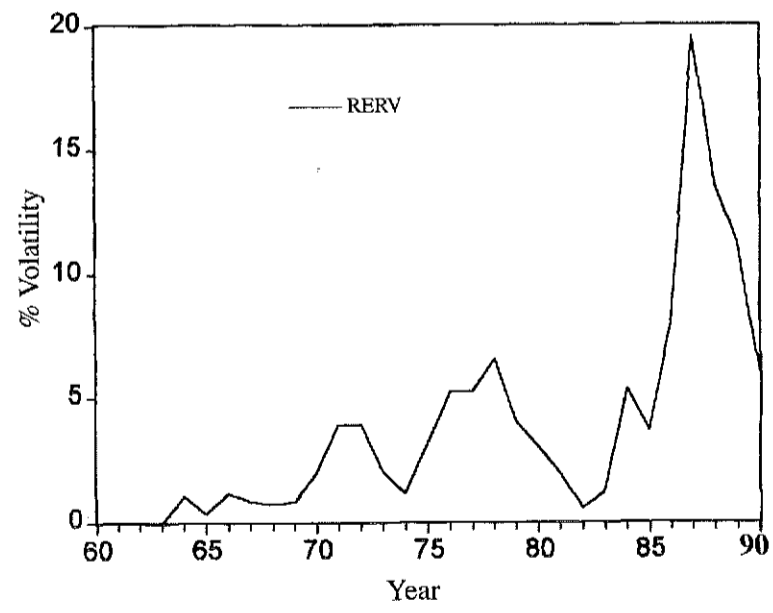**Figure 2: Real exchange rate misalignments, Nigeria, 1960–1990**

Figure 3: Real exchange rate volatility, Nigeria, 1960–1990

Table 4: Tests of data stationarity in export equations

	SBDW	DF	ADF	Order of integration
log X	0.2689	-1.2232	-1.3070	1
Δlog X	2.3088	-3.0760	-2.6031	0
logy*	0.0426	-1.7455	-1.4671	1
Δlogy*	1.8696	-4.3571	-3.2532	0
log TOT	0.3498	-1.7470	-0.9712	1
Δlog TOT	1.4333	-4.2658	-2.2125	0
RERM	0.5527	-1.2830	-1.6579	1
ΔRERM	2.4644	-4.2338	-3.3007	0
RERV	0.5224	-2.1862	-2.7712	1,0,0
ΔRERV	1.8791	-3.4229	-3.0822	0
PPPM	0.2840	-1.8600	-1.7406	1
ΔPPPM	1.3614	-4.1373	-2.8110	0

All variables in the export equations appear to be I(1).

The results of the tests for cointegration are presented in Table 5. There is clearly a lack of cointegrating relationship between the dependent and independent variables in the two export equations. Thus, as in the RER equations, all the determinants of non-oil exports of Nigeria generate mainly short-term effects.

Table 5: Tests of cointegration between the dependent and the explanatory variables in export equations

	SBDW	DF	ADF
y*, TOT, RERM, RERV	0.89	-2.2309	-2.7413
TOT, RERM, RERV	0.40	-2.1973	-2.2604
TOT	0.23	-1.4670	-1.6317
RERM	0.21	-1.4237	-1.6016
RERV	0.34	-1.7129	-1.9901
y*	1.43	-2.1789	-2.7090
y*, TOT, PPPM, RERV	1.45	-4.0985	-0.5685
PPPM	0.40	-0.9155	-0.4012

Critical values at 5%:   SBDW, 1.10 to 1.28; DF, -4.35 to -4.75; ADF, -3.98 to -4.15

The simplification of the over-parameterized export equations corresponding to the PPP measure is presented in Table 6.[19]

Table 6: Modeling ΔlogX by OLS. (1968–1990)

Variable		Coefficient	Std error	HCSE	t-value	Partial R²
ΔlogX	1	-.3454829	.17190	.13169	-2.00976	.2371
ΔlogX	2	.4281501	.14246	.12738	3.00551	.4100
Δlogy*		5.2951116	1.52029	.95146	3.48295	.4827
Δlogy*	2	-7.6510189	1.85508	1.68691	-4.12437	.5668
ΔlogRER	1	1.17517320	.63237	.46899	2.77012	.3712
ΔlogTOT	1	.7722396	.16296	.21321	4.73883	.6334
ΔlogTOT	2	.5811107	.16926	.14697	3.43331	.4755
ΔPPPM		-.0840133	.01248	.01435	-6.73446	.7772
ΔRERV		-.0674833	.01790	.02126	-3.76935	.5222
ΔRERV	2	-.0525620	.02131	.01660	-2.46675	.3188
CONSTANT		.0850101	.09140	.07908	.93007	.0624

R^2 = .892486 $F(10,13)$ = 10.79[.0001] σ = .1851469 DW = 2.12
RSS = .4456320496 for 11 variables and 24 observations.
Testing for serial correlation from lags 1 to 2.
CHI²(2) =1.956 and F-Form (2, 11) = .49[..6265]
ARCH TEST
CHI²(2) = .588 with F(2, 9) = .12[.8853]

The results show that the explanatory variables account for a high proportion (about 89%) of the variations in the country's non-oil exports; the equation has a standard error of about 19% and is only marginally subject to serial correlation. Apart from the one period lagged export variable and the two periods lagged foreign real income, all variables have the expected signs and are mostly significant. In particular, the results show that RER misalignment occurring in the current period adversely affects the country's non-oil exports' supply. For contrast, both current and lagged values of RER volatility exert a negative effect on the growth of non-oil exports. Comparatively, RER misalignment shows the strongest influence on non-oil exports.

The over-parameterized results of the counterpart export equations incorporating the model based RER misalignment are presented in Table 7.

Table 7: Modeling ΔlogX by OLS (1969–1990)

Variable		Coefficient	Std error	HCSE	t-value	Partial R^2
ΔlogX	2	.3862317	.16500	.10414	2.34074	.2813
Δlogy*		4.6623059	2.16804	1.62598	2.15047	.2483
ΔlogRER		1.9006697	.76910	.52747	2.47128	.3037
ΔlogRER	1	1.4139537	.60875	.51057	2.32273	.2782
ΔlogTOT		.6284625	.25630	.20429	2.45210	.3004
ΔlogTOT	2	.6891039	.22979	.26132	2.99882	.3911
ΔRERM		-.0498996	.02298	.02159	-2.17164	.2520
ΔRERV		-.0467901	.02291	.02485	-2.04210	.2295
ΔRERV	2	-.0327290	.02208	.01296	-1.48205	.1356
CONSTANT		-.1210856	.07793	.06849	-1.55386	.1471

$R^2 = .774501$ $F(9,14) = 5.34[.0028]$ $\sigma = .2583837$ DW = 2.22
RSS = .9346695728 for 10 variables and 24 observations.
Testing for serial correlation from lags 1 to 2
$CHI^2(2) = .816$ and F-Form (2, 12) = .21[.8126]
ARCH TEST
$CHI^2(2) = .340$ with F(2, 10) = .08[.9251]

On a comparative basis, the results are less robust, with a R^2 of about 77%, higher standard error and slightly less serial correlation. However, all variables have the expected signs. Except for the lagged value of RER volatility, they are all statistically significant. The current levels of both RER misalignment and volatility are shown as generating a negative effect on non-oil export growth in the country. Given that the results under the PPP framework presented in Table 6 are not sustainable without the inclusion of the lagged value of foreign income generating a strong negative effect on non-oil export growth, the results under the model based approach to RER misalignment appear to be more credible. This would appear to confirm our earlier conjecture that the misalignment series derived using the PPP framework may not accurately capture the true state of RER misalignment in the economy. Overall, the results appear to suggest that in the context of the analytical framework used in the study, the Nigerian export producers are generally less risk averse and would react to any adverse exchange rate movement by reducing exports.

VIII. Conclusions

Since the early 1960s the Nigerian economy has been faced with the problem of continuing decline in its traditional (non-oil) export subsector. Although various programmes to encourage growth in the subsector were introduced over time, it was not until the country's adoption of structural adjustment that a bold attempt was made to tackle the issue of exchange rate changes as they affect non-oil export supply. A major aim of the SAP was to reduce exchange rate misalignment and produce a stable exchange rate system for the country.

This study was designed to measure and analyse the effects of exchange rate movements in terms of RER misalignment and volatility on the growth of non-oil exports in the country over the period 1960–1990. The prime hypothesis tested in the study was that RER misalignment and volatility adversely affected the growth of non-oil exports in the country during the study period.

Two approaches were used to generate the misalignment term – the model based approach à la Edwards and the purchasing power parity (PPP) method. The volatility measure was defined in terms of the coefficient of variation of the RER. A data driven methodology was adopted in the analysis.

The preliminary data analysis suggests an absence of cointegration between the RER and its fundamentals, which were terms of trade, government expenditure on non-tradeables and "openness". Hence, all the explanatory variables in the RER equations are, in the context of Nigeria, taken to have only short-term effects on the RER.

The econometric results fit the conventional wisdom in the sense that an improvement in the terms of trade, increase in net capital inflows, increase in government expenditure on non-tradeables and excess credit creation cause RER appreciation. Conversely, an increase in "openness", technological progress and nominal devaluation of NER cause RER depreciation.

The two non-oil exports equations estimated in the study could not be specified as error-correction models because of the lack of cointegration between the explained and explanatory variables as in the RER equations. However, in the over-parameterized equations estimated, there is evidence that both RER misalignment and volatility generated adverse effects on the non-oil exports supply of the country. The results under the model based approach were found to be relatively more credible. Generally, it appears that exporters in the country are less risk averse and would readily substitute other activities for exporting should adverse movements in RER occur. In effect, the introduction and maintenance of policies that would reduce RER misalignment and produce a stable exchange rate system in Nigeria would serve to benefit the growth of the country's non-oil exports.

In conclusion, it may be necessary for future studies on this subject to explore the possibility of adopting the systems cointegration approach to cointegration analysis. This is in order to ascertain whether any of the exogenous variables in the study are actually endogenous. The procedure for achieving this could also constitute a secondary check on the type of cointegration results obtained in this study.

Notes

1. As at 1990, agricultural exports accounted for about 90% of Nigeria's total non-oil exports with cocoa beans remaining the dominant non-oil export item since the late 1970s.
2. For details, see Ogun (1993a).
3. For an insight into analysis of the Dutch Disease phenomenon in the context of the country, see, e.g., Neary and van Wijnbergen (1986), Gelb (1981).
4. De Grauwe (1988) assumes that the utility function is separable into its two components – domestic and export revenue. This enables him to conduct the analysis in terms of maximizing the marginal utility of export revenue. In this study, such a separation of the utility function is deemed unnecessary since export revenue usually forms a disproportionately large fraction of gross revenue of the farmer. Besides, the more successful farmer in the typical developing area is likely to be an export crop producer. Hence, the optimization analysis could be conducted on the gross revenue without any loss of relevance.
5. See, for example, Dornbusch (1980b).
6. Where trade distortions are present, the RER equations may need to be slightly modified. For an elaboration, see Cavallo, Cottani and Khan (1986).
7. The coefficient of variation is an unconditional volatility measure, which may not be as efficient as conditional measures such as the ARCH and GARCH types.
8. Under the model based RER approach, the variables M and V may not need to be entered in log form since they are generated from variables already in log.
9. For further details, see, e.g., Edwards (1989); Elbadawi (1994).
10. Mwega (1993), quoting Krum (1990), notes that the opposite effect may hold where effective protection is negative; the fact that non-tradeables are more capital intensive than tradeables may cause the substitution effect to dominate the income effect.
11. See also Balassa (1982: 16) and Edwards (1989: 26).
12. In some contexts, the DF and ADF are regarded as the same. For the purpose of this study, the ADF differs from the DF because it corrects for the possible bias in the DF test as a result of autocorrelation. It takes the form of using lags of the dependent variable as part of the explanatory variables. For further details, see, for example, Banerjee et al. (1993).
13. The income terms of trade (TOT) was computed as the sum of the ratio of TOTgain to GDP and current account deficit to GDP, where TOTgain reflects the import capacity of the country and is computed as the difference between the ratios of export to import unit value and export to export unit value at constant prices. For details, see, for example, the World Bank, *World Tables*.

14. Mixed results were obtained for both the openness index and NER at level testing. Subsequent tests at first difference confirm that they are not stationary at their levels.
15. The terms of trade variable was not entered in log since it derives from variables already in log.
16. This result appears to be a contradiction of the Ricardo-Balassa effect.
17. In line with the results of the stationarity test, the RER equation with the second order difference NER is shown below:

Modeling ΔLogRER by OLS (1965–1990)

Variable		Coefficient	Std error	HCSE	t-value	Partial R^2
ΔlogRER	1	.6188788	.11866	.08981	5.21576	.6297
ΔTOT	4	-.1146236	.12914	.10775	-.88757	.0469
ΔlogCAPFLOW	2	-.2084839	.04426	.03591	-4.71044	.5810
ΔlogOPEN		-.0999284	.04862	.04752	-2.05521	.2089
ΔlogGCN	1	-.1184513	.05123	.04598	-2.31235	.2505
ΔlogGCN	2	-.0582944	.05015	.05032	-1.16243	.0779
ΔlogY	3	.2044263	.14787	.10430	1.38244	.1067
ΔDlogNER		.4343387	.12241	.10806	3.54818	.4404
Δ(Z-Z*)		-.0467802	.02207	.02952	-2.11917	.2192
CONSTANT		.0008311	.00662	.00515	.12560	.0010

R^2 = .938383 F(9,16) =27.07[.0000] σ = .0303169 DW = 2.04
RSS = .0147058531 for 10 variables and 26 observations
Testing for serial correlation from Lags 1 to 4
CHI²(4) = 4.004 and F-Form (4,12) = .55[.7053]
ARCH TEST
CHI²(4) = 1.283 with F(4,8) = .12[.9698]

18. The TOT variable in the non-oil export equations refers to the real commodity price index where commodity price is represented by the price index of cocoa and the deflator is the price index of manufactured exports of industrial countries.

19. In the non-oil export equations, the variables TOT, M (or RERM) and V (or RERV) are entered in first difference in line with the outcome of the tests for stationarity.

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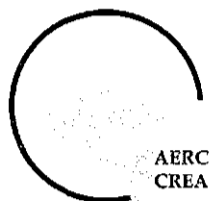
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