CSCanada
International Business and Management
Vol. 9, No. 2, 2014, pp. 70-79
DOI:10.3968/5726

ISSN 1923-841X [Print]
ISSN 1923-8428 [Online]
www.cscanada.net
www.cscanada.org

Exchange Rate Volatility and Non-oil Exports in Nigeria: 1986-2008

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Received 30 July 2014; accepted 2 September 2014
Published online 30 November 2014

Abstract

The paper investigates the impact of exchange rate volatility on non-oil exports in Nigeria, 1986(1)–2008(4). The paper confirms the existence of statistically significant relationship between real exports and exchange rate volatility. The results show that exchange rate, exchange rate volatility and foreign income have significant positive effects on non-oil exports in the long run. Imports, on the other hand, have a statistically negative effect on exports in the long run. The ECM results show that lagged foreign income has significant positive effect on non-oil exports. The coefficient of imports is positive supporting the import compression hypothesis in the short run. The results show that short run impact of the exchange rate volatility is statistically insignificant. The positive coefficient of the exchange rate variable (though not significant) suggests that an appreciable depreciation of the exchange rate could lead to increase in non-oil exports in Nigeria. Essentially, the results suggest that the exchange rate volatility is only effective in the long run but not in the short run in the case of Nigeria.

Key words: Exchange rate volatility; Exports; Error correction; Nigeria

Akinlo, A. E., & Adejumo, V. A. (2014). Exchange Rate Volatility and Non-oil Exports in Nigeria: 1986-2008. *International Business and Management, 9*(2), 70-79. Available from: http://www.cscanada.net/index.php/ibm/article/view/5726
DOI: http://dx.doi.org/10.3968/5726

INTRODUCTION

Sequel to the adoption of a floating exchange rate regime in 1973, measuring the effects of exchange rate volatility has engaged the attention of development economists. The traditional argument views the unexpected exchange rate fluctuations as a potential source of risk. Consequently, risk-averse agents tend to reduce their export-import activity and reallocate production to domestic markets. For example, Hooper and Kohlhagen (1978) argue that higher exchange rate volatility leads to higher cost for risk averse traders and to less foreign trade. However, a number of studies have also argued that uncertainty could be hedged through the forward exchange markets leaving the trade flows unaffected[1].

Empirically, most existing studies have yielded conflicting results on the nature of the relationship between exchange rate volatility and trade. While some studies found evidence of adverse exchange rate volatility on trade flows, others reported the obverse. Few others provided evidence of no effect at all[2]. However, the general observation from the literature is that most studies on the impact of exchange rate volatility on trade flows have focused on developed and Asian economies.

[1] For example, De Grauwe (1988) provided theoretical explanation as to why exchange rate uncertainty could have positive or negative effects on the trade flows.

[2] For example, Akhtar and Hilton (1984), Kenen and Rodrick (1986), Koray and Lastrapes (1989) and Chowdhury (1993), Kumar and Dhawan (1991), Doroodian (1999) and Arize et al. (2000), inter alias, provide evidence in support of negative relationship between exchange rate volatility and volume of trade. On the other hand, McKenzie and Brooks (1997), and Klein (1990) find some evidence for a positive effect of exchange rate volatility on trade flows. However, the study by Warner and Kreinin (1983) fail to report any firm relationship between export flows and exchange rate volatility.

Although, few studies based exclusively on African data exist on the subject matter; rarely is Nigeria considered. This gap could be as a result of the argument that since oil is a major part of Nigeria's exports which is priced in US dollars; fluctuation in the Naira-dollar rates might not have an impact on oil exports, thus no impact on total exports. Moreover, the relatively recent origin of flexible exchange rate system in the country, when compared with other countries in Latin America, Asia and other industrialized economies could be a factor. Interestingly, many studies have provided evidence of high exchange rate volatility in Nigeria arising from the deregulation of the exchange rate in mid 1986 (Akpokodje, 2007; Yinusa & Akinlo, 2008; Yinusa, 2008). This has raised concerns on the impact of exchange rate volatility on exports especially the non-oil exports. Hence, the main objective of the paper is to examine the impact of the exchange rate volatility on non-oil exports in Nigeria over the period of deregulation (1986–2008). This is very important because one of the main reasons for switching to flexible exchange rate system is to diversify the economy from oil to non-oil exports so as to reduce the instability that often results from oil price variation.

This study differs from few existing ones in Nigeria in the following ways[3]. One, the paper focuses exclusively on the period 1986–2008. This period coincides with period when the external trade and exchange rate were indeed liberalized which, no doubt, will have implication on the empirical results[4]. Moreover, unlike few previous studies on the subject matter in Nigeria that have assumed data stationarity, the time series properties of all relevant variables were ascertained using unit root test. In addition, we employed multivariate cointegration test to determine whether the variables share a common trend while error correction approach was adopted to obtain the short run and the speed of adjustment of the non-oil export volume to changes in the regressors. Finally, we check for the adequacy of the fitted model using the various econometric tests such as Chow breakpoint, Arch LM test and structural instability tests.

The rest of the paper is organized into six sections. In section 2, the paper provides a brief review of the trends of exports (oil and non-oil), real exchange and exchange rate volatility over the period 1986–2008. Section 3 contains a capsule summary of the theoretical and empirical issues on the relationship between exchange rate volatility and exports. The specification of the model is contained in section 4. Section 5 provides the empirical results. The last section contains the concluding remarks.

[3] For example, the work of Akpokodje (2007).

[4] Most existing studies in Nigeria combined both periods of fixed and liberalized exchange rate regimes in their analysis (as an example, see Akpokodje, 2007). However, restricting the analysis to the period of flexible exchange rate will allow us to address the stability over time of the estimated dynamics models during the period.

1. TRENDS OF EXPORTS (OIL AND NON-OIL), REAL EXCHANGE RATE AND EXCHANGE RATE VOLATILITY

Over the period 1986 to 2008, Nigeria's aggregate exports experienced remarkable growth. This is clearly illustrated in Figure 1 which shows the trends of oil, non-oil and total exports between 1986 and 2008. In value terms, Nigeria's total exports, which stood at ₦8,920.50 million in 1986, increased phenomenally to ₦30,360.6 million in 1987. This represents an increase of over 240 per cent. The sharp increase in export value in 1987 was as a result of the sharp depreciation of exchange rate following the introduction of the second tier foreign exchange market in 1987. The value of total exports fluctuated upwards to a peak of ₦218,770.1 million in 1993, dropped in 1994 and later increased steadily to ₦1,309,543.5 million in 1996. Total export value dropped sharply to ₦751,856.7 million in 1998 only to increase to ₦1,945, 723.3 million in 2000. From 2001 to 2008, the total export value experienced upward trend to reach a peak of ₦9,774,510.9 million in 2008. The sharp increase in total export values observed for most years between 1986 and 2008 could be traceable to two main factors namely; depreciation of the exchange rate of the naira and increases in the export price of crude oil.

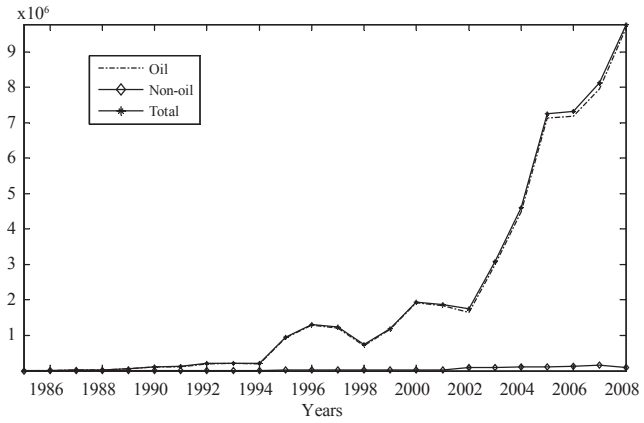


Figure 1
Trends of Oil, Non-Oil and Total Exports in Nigeria, 1986 - 2008

However, one striking feature of the export volume in Nigeria during the study period was the dominance of oil. In general, oil accounted for over 90 per cent of Nigeria's exports over the period 1986–2008. Oil export value increased steadily from ₦8,368.5 million in 1986 to ₦1,920, 900.4 million in 2000. However, the oil export figure experienced slight deceleration in 1994 and 1998. The value of total oil exports fluctuated upward to a peak of ₦9,680,194.2 million in 2008.

The share of non-oil exports in the total exports, though relatively small compared to oil exports, witnessed tremendous increase over the period 1986 and 2008. For example, the total non-oil exports in 1986 was ₦552.1

million. The figure increased to ₦2,152.0 million in 1987. The corresponding figure in 1995 was ₦23,096.1 million and in the year 2007, it increased to ₦169,709.7 million. The upward trend was however reversed in 2008 with total non-oil exports declining to ₦94,316.7 million.

Sequel to the introduction of floating exchange rate system in mid 1986, Nigerian naira depreciated against the major intervention currency, the United States dollar. The average exchange rate over the period 1970-1985 was ₦0.67 = US$1.00. The rate depreciated to an average of ₦9.91, ₦17.30 and ₦22.05 = US$1.00 in 1991, 1992 and 1993 respectively. The exchange rate further depreciated to an average of ₦111.70, ₦126.26 and ₦134.04 = US$1.00 in 20001, 2002 and 2003 respectively. However, the exchange rate experienced little appreciation over the period 2004 and 2008 following the various monetary policy measures introduced by the monetary authorities. These measures include among others the banking sector consolidation in 2004, strengthening of the Dutch Auction Market, and narrowing of the premium between the DAS, Bureau De Change and Inter-Bank rates and introduction of the Monetary Policy Rate as a replacement to Minimum Rediscount Rate.

One major concern about the naira exchange rate over the study period was its high instability. Several studies including Mordi (2006), Yinusa (2008), and Yinusa and Akinlo (2008) have shown that the naira exchange rate was highly volatile during the period under study. Figure 2 generated using the generalized autoregressive conditional heteroscedaciticy model (GARCH) shows the volatility of the exchange rate series over the period 1986-2008. Evidence from Figure 2 below confirms high volatility of the exchange rate series over the study period.

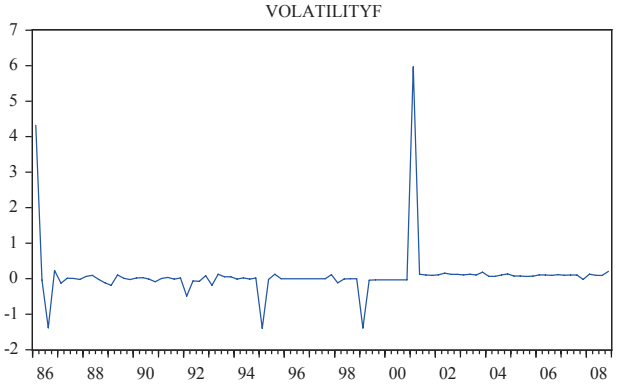


Figure 2
Exchange Rate Volatility Series

The question then arises as to the impact of the high exchange rate volatility on non-oil exports during the study period.

2. THEORETICAL AND EMPIRICAL ISSUES

2.1 Theoretical Issues

Several studies have articulated theoretically and empirically the effect of exchange rate volatility on trade flows.[5] Theoretically, many studies including Clark (1973), Cushman (1986), Peree and Steinheir (1989) and Ethier (1993), have identified several channels through which exchange rate volatility could depress the trade flows. Contrariwise, Demer's de Grauwe (1988), Bailey and Tavlas (1988), Franke (1991) among others argued that exchange rate volatility might impact positively on the trade flows. In short, theoretical literature on the exchange rate volatility - trade flows nexus is yet unsettled.

2.2 Empirical Evidence

Many empirical works have been provided on the relationship between exchange rate volatility and trade flows. The general observation from these studies is that that the results have been mixed depending on many factors including sample periods, methodology adopted, estimation techniques, measures of volatility adopted and the countries considered (developed or developing). Several studies including Ethier (1973), Cushman (1983, 1986, 1988), Akhter and Hilton (1984), Arize et al. (2000, 2005), Chit (2008), Hondroyiannis et al (2008) and Ozturk and Kalyoncu (2009) found significant negative effect of exchange rate volatility on trade flows. However, the studies by Brada and Mendez (1988), Klein (1990), Mckenzie and Brooks (1997) Doyle (2001) Bredin et al (2003) and Kasman and Kasman (2005) provided evidence of positive effects of exchange rate volatility on trade flows. Yet, few others including Hooper and Kohlhagen (1978), Mckenzie (1998, 1999) and Aristotelous (2001) reported no significant relationship between exchange rate volatility and trade flows.

Essentially, what the summary of literature reviewed above suggests is that more empirical studies need to be conducted on the exchange rate volatility – trade flows nexus particularly in the developing economies.

3. THE MODEL

We begin by specifying the traditional export demand function with an addition of a measure of exchange rate volatility written as:[6]

$$rtep_t = \alpha + \beta_1 foy_t + \beta_2 rimp_t + \beta_3 nexr_t + \beta_4 exrf_t + \mu_t \quad (1)$$

where all variables are expressed in logarithms. $rtep_t$ is real non-oil exports at time t. The nominal non-oil exports values expressed in millions of domestic currency

[5] We only provide a brief summary of the theoretical and empirical evidence on the relationship between exchange rate volatility and trade flows as many studies have properly documented it. For details one can see the works of Akhtar and Hilton (1984), De Grauwe (1988), Hooper and Kohlhagen (1978), Vergil (2002) among several others.

[6] A variant of this model has been used by previous researchers such as Arize (1996), Asafu-Adjaye (1999), Ozturk and Kalyoncu (2008). However, unlike many previous ones that excluded imports as an independent variable, we introduced it in our model to ascertain its impact on exports. This is considered important because the huge resources from oil have made the country to rely heavily on imports for production in the economy.

were deflated by consumer price index to obtain the real values. foy_t is a measure of real foreign income (index of world income) at time t. This is proxied by the index of industrial production in OECD member countries. $rimp_t$ is a measure of real intermediate imports at time t. The nominal intermediate imports are deflated by relative price of intermediate imports to obtain the real values. $nexr_t$ is a measure of real exchange rate at time t. Following Akinlo (2001), real exchange rate is measured as the product of the nominal exchange rate and the world price level (GDP deflator) divided by the domestic GDP deflator. Finally the $exrf_t$ variable is a measure of real exchange rate volatility at time t and μ_t is the error term. Before presentation of the empirical results, it is important to explain our measure of exchange rate volatility. The exchange rate volatility is extracted via a state space representation (a form of signal to noise extraction) in the form:

$$E_t = \sigma\varepsilon_t e^{\frac{1}{2}ht} \ldots\ldots\ldots\ldots\ldots iid\ (0,1) \quad (2)$$

where,

$$h_{t+1} = \pi h_t + \mu_t \ \ldots\ldots\ldots\ldots\ldots NID\ (0, \sigma^2_{\mu})\ |\pi| \leq 1 \quad (3)$$

E_t is the real effective exchange rate. The term σ^2 is a scale factor and subsumes the effect of a constant in the regression of h_t. π is a parameter, μ_t is a disturbance term that is uncorrelated with ε_t, ε_t is an *iid* (0, 1) are random disturbances symmetrically distributed about zero. The h_t equation is a transition equation in autoregressive form where the absolute value of π is less than unity to ensure that the process in equation (2) is stationary (Ndung'u, 2001; Yinusa & Akinlo, 2008). These equations generate the conditional volatility of the exchange rate used in our estimation.

All quarterly data on real effective exchange rate, non-oil exports, foreign income, and intermediate imports were obtained from International Monetary Fund, International Statistics CD-ROM (2007) and Central Bank of Nigeria, Statistical Bulletin 2008 and 2009 editions.

4. EMPIRICAL RESULTS

4.1 The Estimation Techniques and Presentation of Estimation

In estimation, the study used the cointegration and error correction methodology[7]. First, the data series were tested for stationarity using both the Argument Dickey-Fuller (ADF) test (Dickey & Fuller, 1981) with a constant and deterministic trend and Phillips-Perron (PP) test (Phillips-Perron, 1988). The results of the two tests show that all the variables are integrated of order one, I(1)[8]. As it has been established that the variables are *I*(1), we applied the Johansen-Juselius (1990) technique to determine whether there exists at least one linear combination of these variables that is I (0)[9].

Table 1
Cointegration Results (with a Linear) Where *r* in the Number of Co-integrating Vectors

Panel A: Estimates of λ-max and trace Tests

Null	Alternative r	λ-max	Critical value 95%	Trace	Critical value 95%
0	1	55.33	38.33	147.68	88.80
≤1	2	50.36	32.11	92.36	63.87
≤2	3	21.99	25.82	42.00	42.92
≤3	4	14.41	19.38	20.01	25.87
≤4	5	5.60	12.52	5.60	12.52

Panel B: Estimates of co-integrating vector

rtep	nexr	exrf	rimp	foy
1.00	- 0.12	- 0.0007	0.72	- 2.66
	(- 2.14)**	(- 1.98)**	(2.45)**	(- 3.51)***

Note. t ratios are below in parentheses
** and *** denote significant at 5% and 1% respectively.

Given that a cointegrating relationship is present among the selected variables in level, an error correction (EC) model can be estimated, that is, a model that combines both the short-run properties of the economic relationships in the first difference form of equation (10), as well as the long-run information provided by the data in level form. The results of the λ-max and trace tests are as presented in panel A of Table 1. The cointegrating equation normalized on the non-oil exports variable is as shown in panel B of Table 1. The results in panel A of Table 1 shows that the null hypothesis of no cointegration i.e. 0 can be rejected using either λ-max or the trace tests statistics. They are both greater than critical values. Consequently, these test results indicate that, non-oil export is cointegrated with the measures of foreign income, exchange rate, exchange rate volatility and real imports. The co-integrating equation (normalized on non-oil exports variable) shown in panel B of Table 1 indicates that foreign income, real exchange rate and exchange rate volatility have positive sign while real import is negative (the signs are reversed because of the normalization process). All the coefficients are statistically significant

[7] Since the cointegration and error correction methodology is fairly common place and is well documented elsewhere, we need not restate the procedure here. For details one may consult Banerjee, et al. (1993); Engle and Granger (1987), Johansen (1988); Johansen and Juselius (1990).

[8] The results of the unit root tests are not reported here to conserve space but are available from author upon request.

[9] The Johansen-procedure is preferred to Engle and Granger's (1987) regression based technique because it not only captures the underlying time series properties of the data but also gives the estimates of all the cointegrating vectors that exist within a vector of variables. More importantly, it reveals clearly whether the system consists of a unique cointegrating vector or a linear combination of several cointegrating vectors. Finally, as argued by Hendry and Ericsson (1991), Johansen's technique seems to be more discerning in its ability to reject a false null hypothesis.

as shown by the t-ratios indicated in parenthesis[10]. More specifically, the results show that a 1 per cent increase in foreign income raises non-oil exports by an estimated 2.66 per cent in the long-run. Furthermore, ceteris paribus, 1 per cent depreciation of the exchange rate increases non-oil exports by 0.11 per cent. Exchange rate volatility measure seems to have positive effect on non-oil exports in the long-run. The coefficient is however low (0.0007). Finally, a 1 per cent increase in import reduces non-oil exports by 0.71 per cent in the long-run.

After ascertaining that the variables are cointegrated, we used the information provided by the L.R. tests to generate a set of error correction models (EC) to capture the short run and long-run behaviour of the exports relationship. The changes in the relevant variables represent short-run elasticities, while the coefficients of the EC term represents the speed of adjustment back to the long-run relationship among variables. Table 2 provides the results for the real export growth and exchange rate volatility relationship for the period 1986 (1) to 2008 (4).[11]

The results in Table 2 shows that exchange rate volatility both current and one lagged values have a negative effect on real non-oil exports. However, the coefficient of the exchange rate volatility is not significant in all the equations in Table 2[12]. The results tend to contradict the finding of Akpokodje (2007) for Nigeria[13], which found a positive relationship between exchange rate volatility and exports[14]. In line with de Grauwe (1988), this possibly suggests that the substitution effect of exchange rate volatility outweighs the income effect. This means that the reduction in the attractiveness of risky activities occasioned by increased exchange rate volatility which leads people to reduce these activities outweighs the increased inflow of resources in the export sector in order to offset the decline expected (total) utility of export revenue[15]. This evidence further suggests that exchange rate volatility may have effects on the allocation of resources as market participants attempt to minimize exposure to the effects of exchange rate risk. However, as the coefficient of exchange rate volatility is not significant firm conclusion cannot be based on it.

Table 2
Nigeria: Error-correction Model Dependent Variable: $\Delta lnrtep_t$

Variables	OLS	Regressions	
	1	2	3
Constant	0.39 (2.05)**	0.55 (2.68)**	0.50 (2.47)**
$\Delta lnfoy_f$	0.07 (0.25)		-
$\Delta lnfoy_{t-3}$		0.65 (2.24)**	0.63 (2.21)**
$\Delta lnnexr_t$	0.0053 (0.20)	0.003 (0.11)	0.005 (0.15)
$\Delta lnexrf_t$	- 0.0003 (- 0.99)		- 0.0002 (- 0.67)
$\Delta lnexrf_{t-1}$		- 0.00007 (- 0.23)	
$\Delta lnrimp_t$	0.16 (1.89)*	0.13 (1.57)*	0.13 (1.55)*
$\Delta lnrimp_{t-1}$	0.16 (1.79)*	0.15 (1.80)*	0.15 (1.79)*
$\Delta rtep_{t-1}$	0.19 (1.82)*	0.20 (1.98)*	0.20 (1.94)*
EC_{t-1}	- 0.12 (- 3.13)***	- 0.13 (- 3.04)***	- 0.13 (- 3.06)***
R^{-2}	0.13	0.16	0.17
S.E	0.19	0.18	0.18
D.W	2.07	2.07	2.06
F-statistic	2.96	3.40	3.48

Note. The numbers in parentheses beneath the estimated coefficients are *t*-statistics. ***, ** and * denote significant at 1%, 5% and 10% respectively.

The results in Table 2 show that foreign income has positive effect on non-oil exports. The coefficient of the lagged value is significant at 5 percent level. The finding supports Akpokodje (2007) results for 15 selected sub-Saharan African countries. Similar results have equally been obtained for many other countries Arize (1997) for G-7 among others. The magnitude of the coefficient of foreign income is higher than that obtained by Akpokodje (2007)[16].

The results show that imports exert a significant positive influence on exports in the short run. This

[10] The results obtained when we included constant were not significantly different from the one reported above. The only difference was the coefficient of foreign economic activity which dropped slightly.

[11] Equation 1 in Table 2 incorporates current value of foreign income and exchange rate volatility, while equation 2 uses their values. Equation 3 on the other hand, uses lagged values of foreign income and current value of exchange rate volatility.

[12] Some previous studies have equally provided evidence of non significant short run impact of exchange rate rate volatility on exports. For example Ozturk and Kalyoncu (2009) for South Korea and Turkey and Soric 2007) for Croatia

[13] Several other previous studies have found negative effect of exchange rate volatility on real exports for both developed and developing countries. These include Chowdhury (1993) for G-7 countries, Thursby and Thursby (1987) and Arize (1997) for Denmark, Germany, Italy, Japan, Switzerland, UK and the US.

[14] The differences in two results might not be unconnected the fact that Akpokodje (2007) used total exports which included oil export. Also, he combined both periods of fixed and flexible exchange rate systems in his analysis.

[15] Thus one can say that risk-averse market participants react to exchange rate volatility by favouring domestic to foreign trade.

[16] The high foreign income elasticity obtained is not new in the literature. For example, Riedel (1988) obtained estimates ranging from 0.5 and 1.5 while Asafu-Ajaye (1999) obtained 1.4 for Fiji. Several reasons have been adduced for high foreign income coefficients in developing countries including increased export world market penetration (Arize, 1990; Arize et al., 2003) and greater adaptation of exports in the importing countries (see Adler, 1970).

result provides strong support for the import compression hypothesis in the short run. This seems to suggest that in Nigeria, imports of intermediate and capital goods are necessary inputs in the production of exports and consequently, import compression can adversely affect export performance especially in the short run. This corroborates the results of Akpokodje (2007) for selected countries in SSA, Nigeria inclusive. Asafu-Adjaye and Chakraborty (1999) equally obtained similar results for Nigeria.

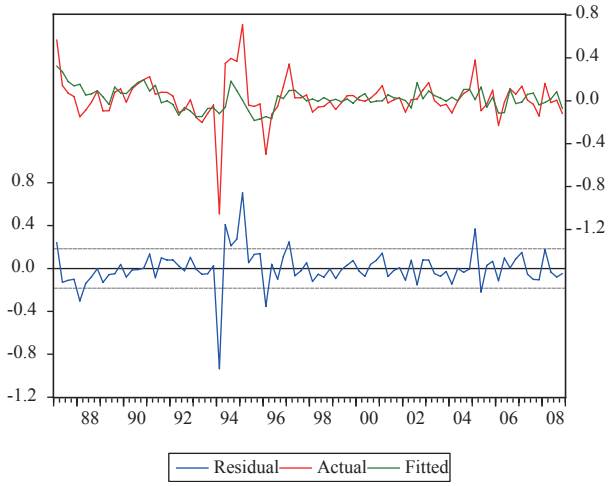
The coefficient of exchange rate is positive but very small. This simply suggests that real depreciation will stimulate non-oil exports. However, it will require appreciable depreciation of the currency to have significant effect on the non-oil exports in the country. However, the coefficient is not significant in the short run.

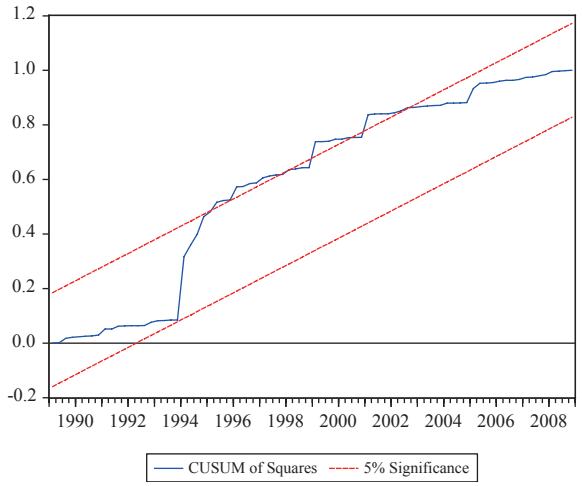
Finally, the one-lagged error-correction term, EC_{t-1} appears with a statistically significant coefficient and displays the appropriate (negative) sign. This finding supports the validity of an equilibrium relationship among the variables in the cointegrating equation. This shows that overlooking the cointegratedness of the variables would have introduced mis-specification in the underlying dynamic structure, and it should also be pointed out that literature on cointegrated systems suggests that only EC_{t-1} is needed to represent the cointegrating scheme[17].

Moreover, the change in real non-oil exports per quarter that is attributed to the disequilibrium between the actual and equilibrium levels in measured by the absolute value of the coefficient on the error correction term of each equation.

The speed of adjustments to the last period's disequilibrium for the three equations in Table 2 remains almost the same. This implies that the adjustment of non-oil export volume to changes in the regressors may take a considerable long term 18. The result shows that a deviation from long run equilibrium level this period is corrected by about 12-13 per cent in the next quarter. Stability tests were also undertaken to determine whether the null hypothesis of no structural break could be rejected at the 5 per cent level. The recursive test for stability was conducted using both the CUSUM test, CUSUM sum of squares test and the one and n step forecast tests. The CUSUM test and CUSUM sum of Squares test indicate a case of variance instability or the presence of structural break in exports. Both one step and n-step forecast tests show sign of instability. As shown in Figure 3, structural break was detected in export data, in the first quarter of 1994 and 1999. The Chow breakpoint tests equally suggested that the hypothesis could not be rejected for the chosen period 1994: 1 (ρ = 0.8676) and 2004: 4 (ρ = 0.2266).

The EC models were used to track the historical data on export. The reported Theil inequality coefficients of 0.210, 0.258 and 0.248 for equations 1, 2 and 3 respectively, were well below the threshold level of 0.3 and their variance, bias and covariance statistics are also close to their theoretical values (see Theil, 1966). Figure 3 corresponding to equation 3, provides further visual evidence of the ability of the EC model to track the turning points in the actual series.





[17] As pointed out by Muscatelli and Papi (1990) the reason for the inclusion of non linear error-correction terms is to allow for the possibility that economic agents react more strongly to large equilibrium error terms through some type of non-linear relationship (one might also consult Hendry and Ericsson (1991) for more details on this issue).

[18] The relatively slow speed of adjustment should not come as a surprise. This is because a large proportion of non-oil exports in Nigeria are made up agricultural products such as coffee, cocoa and timber among others. Their production requires a long gestation period. Hence, export supply response to changes in determining factors takes a considerable long time.

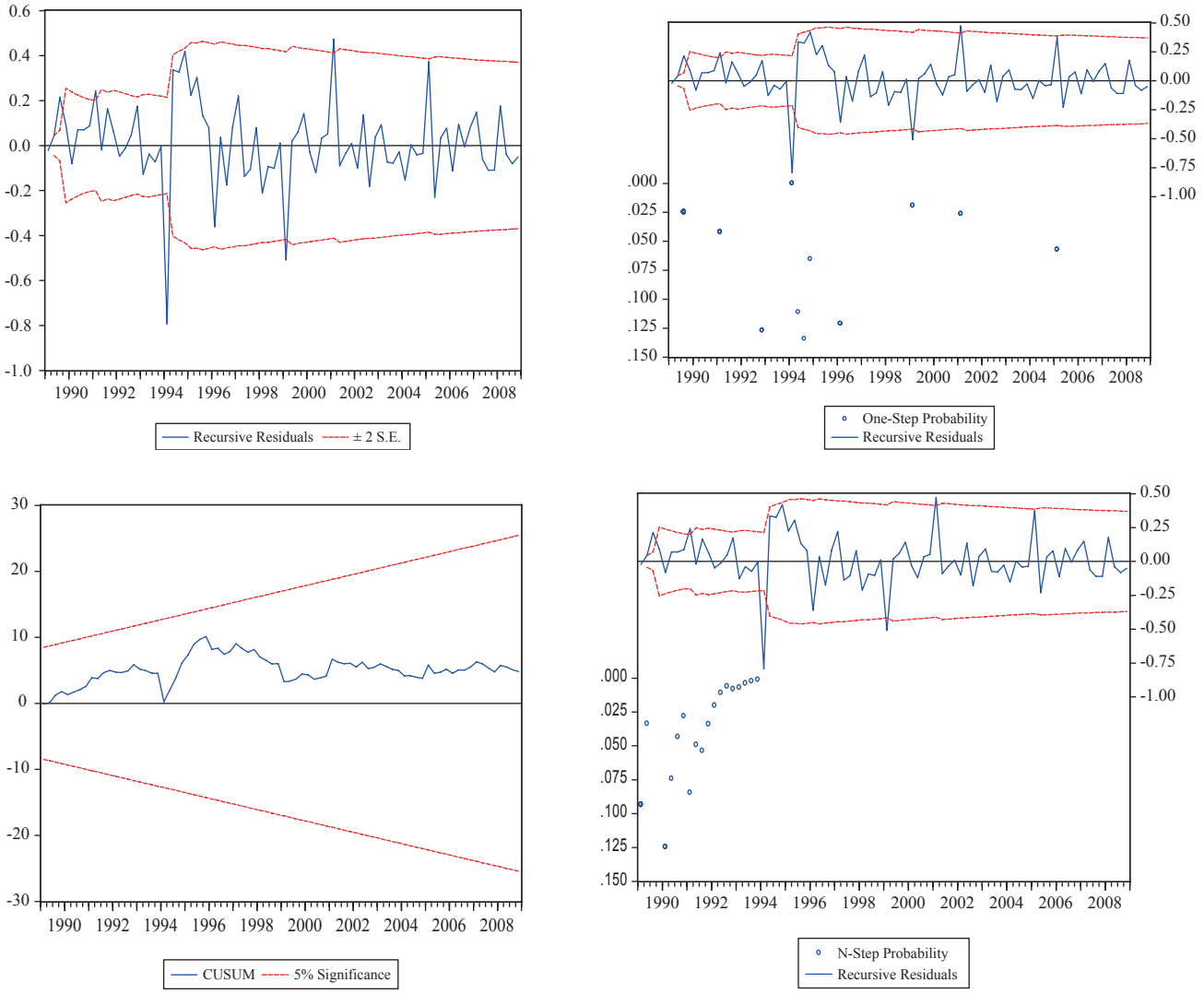


Figure 3
Recursive Estimates for the Short Run Non-oil Exports

Note. The top graph in the first column presents the plot of actual and fitted values of non-oil exports. The top graph in the second column presents CUSUM of squares test. The two middle graphs (first and second columns) are Recursive residuals and one step forecast test respectively. The bottom graph in the first column presents the CUSUM test, while the bottom graph in the second column presents the N-step-forecast test.

4.2 Assessment of the dynamic interactions of variables

To assess the dynamic interactions of the variables in the export function, the study estimated a multivariate error correction model (VECM), treating the variables as endogenous. Figure 4 shows the Cholesky impulse responses of the variables in question to a unitary shock in their own values and the rest of the variables over 40 quarters period[19]. It can be readily ascertained that the response of non-oil exports to a one standard deviation (SD) innovation in exchange rate volatility is negative but remain almost constant in the long run, while the reverse line of "causation" is positive maintaining constancy after the 4th quarter. Figure 4 also shows that the lagged response of non-oil exports to a one (SD) innovation in exchange rate is positive but remain relatively constant throughout the entire period, while the reverse is not supported (and in fact becomes negative after the 2nd quarter). One standard deviation shock to foreign income has a negative impact on non-oil exports, while the reverse causation is positive. The response of the non-oil exports to one (SD) innovation in import is positive. Likewise, the reverse line of "causation" is positive and considerably larger though dissipates after the 4th quarter. The response of exchange rate volatility to import is negative and the reverse causation is equally supported but smaller.

19 One major criticism of the Cholesky decomposition is its arbitrariness and sensitivity to variable ordering. However, to take care of this shortcoming, we re-estimated the model by reversing the order of the first and last variables to check for robustness. The results obtained were not significantly different from the one reported here.

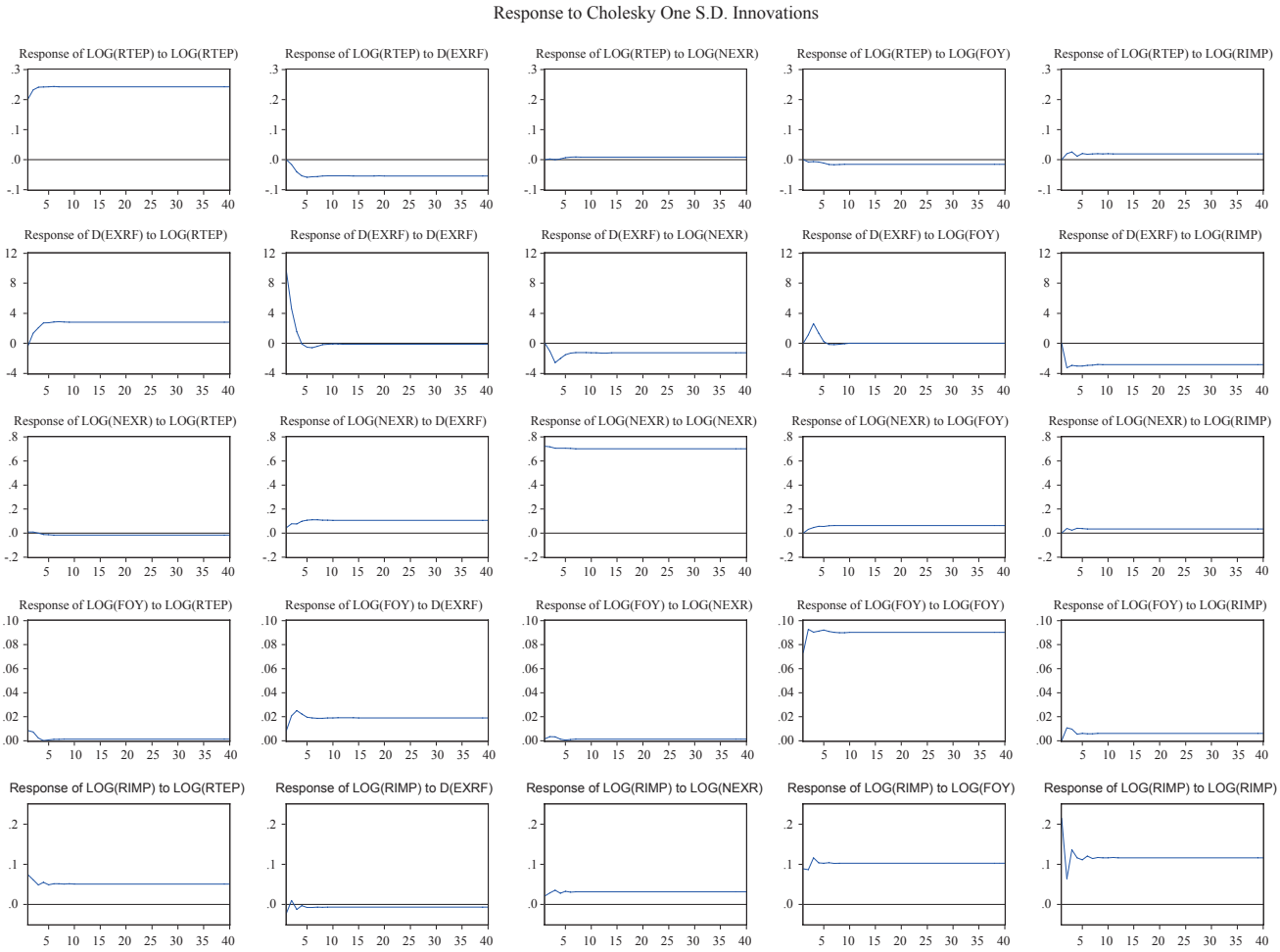


Figure 4
Cholesky Impulse Response to One SD Innovations

Next, this study traced the variance decomposition (VDC) of each variable over a 40 quarter period. The VDC gives information about the relative importance of each random (one-standard deviation) shock to the endogenous variables in the VECM. The results (available upon request) suggest that, after 40 quarters, a unitary shock in exchange rate volatility explains only 5 per cent of the accumulated forecast error variance of non-oil exports and 0.2 per cent that of imports. Again both proportions are insignificant while the reverse proportions (viz., the accumulated percentage variance of exchange rate volatility to non-oil exports and the accumulated percentage variation of exchange rate volatility due to import) are 36 per cent and 39 per cent respectively. A unitary shock in import explains only 1 per cent of the accumulated variance in the non-oil exports, while the reverse proportion is 9 per cent.[20] Finally, a unitary shock in exchange rate explains less than 1 per cent of the accumulated variation in non-oil exports. In the same way, the reverse proportion is less than 1 per cent.

[20] In order to conserve space, the VDC table is not reported but is available upon request.

CONCLUSION

The impact of exchange rate volatility on real exports by employing the techniques of multivariate cointegration and error-correction modeling has been investigated in this paper. The basis of this analysis is an export demand function estimated on quarterly export data for Nigeria over the liberalized exchange rate period 1986 (1)–2008(4). In the specific function considered, real export depends upon foreign income, real exchange rate, exchange rate volatility, and real imports. The estimated model satisfies several econometric tests in the analysis of time-series for such issues such as cointegration, stationarity, specification errors, residual correlation, residual normality and structural stability. Our empirical results suggest the following conclusions:

First the results clearly confirm the presence of single unit root in virtually all variables at the normal significance levels. This is in line with the macroeconomic literature (Nelson & Plosser, 1982). The implication of this is that testing for stationary of the series is essential for meaningful results. Hence, the use of log-level specification in most previous studies suggests that the results could be subject to the spurious regression phenomenon.

Second, the results show that real non-oil real exports are cointegrated with foreign income, real exchange rate, exchange rate volatility and real imports.

Three, import has a statistical significant positive impact on the real exports in Nigeria in the short run. This finding is consistent with the argument that industrial and other production activities in most African countries rely heavily on imported inputs (Gyimah-Brempong & Gyapong, 1993). Foreign income has a significant positive effect on non-oil exports both in the short and long run.

Finally, the low volatility *t*-values in the error correction models instruct us that, unlike the long run, in the short run there does not exist a statistically significant relationship between volatility and non-oil export volume.

The main implication is that policy makers must take into consideration the stability and level of the real exchange rate especially in the short run, if trade policy actions aimed at stabilizing the export market are to produce appropriate results. However, as the results suggest that the use of import controls instruments such as tariffs, quotas and licensing systems could adversely affect non-oil export performance, a useful area of policy interventions could be the use of fiscal and monetary tools. This is based on the finding that monetary shocks in the country exacerbate exchange rate volatility (Akpokodje, 2007). Suitable and sustainable monetary and fiscal policies that reduce the level of money supply into the economy, stem the tide of inflationary pressure and enhance output would help to stabilize the exchange rate with possible positive effect on non-oil exports.

In conclusion, this paper only examined the effect of exchange rate volatility on non-oil export volume. A more comprehensive approach to the research of the current Central Bank Nigeria exchange rate policy would entail examining the impact of exchange rate volatility on the movements in the country's external debt, production volume and lending policy of commercial banks amongst others. This, of course, constitutes our next area of future research.

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