Exchange Rate Volatility and Export Trade in Nigeria: An Empirical Investigation

Aliyu, Shehu Usman Rano

Bayero University Kano, Nigeria

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Shehu Usman Rano Aliyu[1]

Abstract

The paper seeks to quantitatively assess the impact of exchange rate volatility on non oil export flows in Nigeria. Theoretically, volatility-trade link is ambiguous, although a strand of studies reported inverse link between export flow and volatility. The paper employed fundamental analysis where the flow of non oil exports from the Nigerian economy is assumed to be predicated on fundamental variables: the naira exchange rate volatility, the US dollar volatility, Nigeria's terms of trade (TOT) and index of openness (OPN). Empirical results showed presence of unit root at level, however, the null hypothesis of nonstationarity was rejected at first difference. Cointegration results revealed that a stable long run equilibrium relationship exists between non oil exports and the fundamental variables. Using quarterly observations for twenty years, vector cointegration estimate revealed that the naira exchange rate volatility decreased non oil exports by 3.65% while the same estimate for the US dollar volatility increased export of non oil in Nigeria by 5.2% in the year 2003. The paper recommends measures that would promote greater openness of the economy and exchange rate stability in the economy.

Keywords: exchange rate volatility, non oil exports, terms of trade, index of openness, unit root and cointegration analysis.

1.0 Introduction

Research related to exchange rate management still remains of interest to economists, especially in developing countries, despite a relatively enormous body of literature in the area. This is largely because the exchange rate in whatever conceptualization, is not only an important relative price, which connects domestic and world markets for goods and assets, but it also signals the competitiveness of a country's exchange power vis-à-vis the rest of the world in a pure market. Besides, it also serves as an anchor which supports sustainable internal and external macroeconomic balances over the medium-to-long term. There is, however, no simple answer to what determine the equilibrium exchange rate, and estimating equilibrium exchange rates and the degree of exchange rate misalignment remains one of the most challenging empirical problems in open-economy macroeconomics (Williamson, 1994).

[1] The author lectures at Bayero University, Kano and he is at the time of writing this paper with the Research Department of Central Bank of Nigeria on a Sabbatical leave. I am grateful to A. Englama, *PhD.,* who is the head of External Sector Division, Research Department, Central Bank of Nigeria for his useful contributions and to all the staff in the Division for their support.

The fundamental difficulty is that the equilibrium value of the exchange rate is not observable. While the exchange rate misalignment refers to a situation in which a country's actual exchange rate deviates from such an unobservable equilibrium, an exchange rate is said to be "undervalued" when it depreciates more than its equilibrium, and "overvalued" when it appreciates more than its equilibrium. The issue is, unless the "equilibrium" is explicitly specified, the concept of exchange rate misalignment remains subjective. The problem of subjectivity is, especially so, according to Chang and David (2005) because exchange rate equilibrium or misalignment is measured over different time horizons. Notwithstanding, Edwards (1989) states that the equilibrium real exchange rate (*RER*) prevails when given sustainable values for other relevant variables, such as terms of trade, capital and aid flows, and technology, the economy achieves both *internal* and *external* equilibrium.

There is growing agreement in the literature that prolonged and substantial exchange rate misalignment can create severe macroeconomic disequilibria and the correction of external balance will require both exchange rate devaluation and demand management policies. The main intuition behind this is that an increase in exchange rate volatility leads to uncertainty which might have a negative impact on trade flows or according to Anderton and Skudely (2001) the economic logic underpinning the negative link is the aversion of firms to engage in a risky activity, namely trade. Baldwin, Skudelny and Taglioni (2005) discovered that the effect of exchange rate uncertainty on trade in the European Union (EU) countries is negative; trade increases as volatility falls and gets progressively larger as volatility approaches zero. While numerous studies were conducted on the extent of naira exchange rate and its misalignment in Nigeria (see Soludo and Adenikinju, 1997; Agu, 2002; Omotosho and Wambai, 2005; Obaseki, 2001; CBN, 2007*a*; CBN, 2007*b*; CBN, 2008), assessment of the impact of exchange rate volatility on export has in the recent past been nonexistent.

Against this background, this paper seeks to quantitatively measure the impact of exchange rate volatility on non oil export trade in Nigeria from 1986Q1 to 2006Q4. The rest of the paper is organized as follows. Section two presents a survey of the literature and theoretical issues relating to exchange rate volatility and trade flows. Section three discusses the methodology employed in the study while section four analyses the empirical results. Finally, section five contains conclusions and recommendations.

2.0 Literature Review and Theoretical Issues

The traditionalist view on the impact of currency depreciation on trade indicates that it leads to an expansion in trade via lower export prices. The structuralist school, however, stresses some contractionary effects, Meade (1951). Hirschman (1949) points out that currency depreciation from an initial trade deficit reduces real national income and may lead to a fall in aggregate demand. Kandil and Mirzaie (2002) argued that currency depreciation gives with one hand, by lowering export prices and takes away with the other hand, by raising import prices. They observed that if trade is in balance and terms of trade remain unchanged, these price changes offset each other, especially when the famous Marshall-Lerner[2] condition is not satisfied. If imports exceed exports, the end result is a reduction in real income within a country, Cooper (1971). See Diaz-Alejandro (1984), Krugman and Taylor (1978) and Edward (1986)

Recently, it is a widely accepted tenet that chronic misalignment in the real exchange rate has been a major source of slow growth in Africa and Latin America, while prudent macroeconomic, trade and exchange rate policies have fostered growth in Asia (World Bank, 1984; Edwards, 1988; Ghura and Grennes, 1993; Rodrik, 1994 and Yotopoulos 1996). According to Yotopoulos and Sawada (2005), systematic deviations of nominal exchange rate (NER) from their purchasing power parity (PPP) levels may engender serious instabilities of the international macroeconomic system. According to Baldwin, Skudelny and Taglioni (2005), disequilibrium exchange rate values have been conclusively shown to have negative link with trade (see inter alia, European Commission, 1995). Some authors, however, argue that under the existence of forward exchange markets, exchange rate uncertainty can be completely covered so that there is no impact of exchange rate uncertainty on trade (Ethier, 1973 and Baron, 1976). However, Viaene and de Vries (1992) argued that even under the forward exchange markets there may be an indirect effect of exchange rate volatility on trade if hedging is costly.

[2] A condition when exchange rate changes restore equilibrium in BOP by devaluing a country's currency. This holds when the sum of price elasticicities of demand for exports and imports in absolute terms is greater than unity, devaluation will improve the country's BOP, that is, $e_x + e_m > 1$.

Empirical studies in the past that applied time series analysis and found no significant relationship between volatility and trade. The few that found a link suggest that the effect was very small (see Khan (1974), Koray and Lastrapes (1989), Belanger and Gutierrez (1998), Bini-Smaghi (1991), Kenen and Rodrik (1986) and Sekkat (1998). Meese and Rogoff (1983), in a work which predates the cointegration literature, forecast exchange rates by simply regressing the exchange rate on the macroeconomic fundamentals and then using these parameter estimates and the ex post realized and revised values of the future economic fundamentals to predict the future exchange rate. Cross-sectional studies were also carried out by Hooper and Kohlhagen (1978), De Grauwe (1987), Brada and Méndez (1988), De Grauwe and Verfaille (1988), Savvides (1992), Sapir, Sekkat and Weber (1994) and Eichengreen and Irwin (1995) find evidence of a negative effect of exchange rate uncertainty on export. Again, this effect, in most cases, was relatively small.

Some studies employed co-integration analysis, for example, Koray and Lastrapes (1989), Arize (1997, 1998a and b), Fountas and Aristotelous (1999) and Flam and Jansson (2000). A detailed empirical review of this strand of literature is reported in Baldwin, Skudenly and Taglioni (2005). The results of the studies taking into consideration the trend characteristics of the time-series appeared to be more clear-cut and most suggest a significant negative effect of exchange rate uncertainty on the trade variables. For instance, Fountas and Aristotelous (1999) found a significant negative long run effect of exchange rate uncertainty on trade. Wei (1999) found a negative and statistically significant effect for foreign exchange rate volatility on exports taking account of futures and options instruments to hedge risk. Recently, Baum *et al* (2004) showed evidence of a positive relationship between exchange rate volatility and trade using a *poisson* flexible lag structure, while Klaassen (2004) did not find evidence of any significant effect of exchange rate volatility on trade for G7 economies.

Caporale and Doroodian (1994) used a generalized autoregressive conditional heteroskedasticity (GARCH) technique to measure the volatility of exchange rate and discovered significant negative effect of volatility on import trade. McKenzie and Brooks (1997) and McKenzie (1999) used ARCH modeling and introduced an exchange rate volatility term into their export trade models for both German-US and Australian trade flows respectively. Their results were statistically significant but, showed positive impact of volatility on trade, while for McKenzie (1999), the results were mixed.

Furthermore, studies that employed panel estimation techniques, according to Anderton and Skudelny (2001) emerge with better results. For example, Abrams (1980), Thursby and Thursby (1987), Dell'Ariccia (1998), Pugh, *et al* (1999) and Rose (1999), all found significant negative effect of the proxy for exchange rate uncertainty. In particular, while Dell'Ariccia (1998) found that the trade gains resulting from the elimination of exchange rate volatility would have been 10 percent. Anderson and Skudelny (2005) discovered that exchange rate volatility would decrease extra-euro area imports by around 10 percent.

Another strand of empirical studies apply gravity-type trade model to assess the impact of exchange rate volatility on bilateral trade. Pugh, *et al* (1999) use 16 OECD countries and showed that volatility leads to a once and for all decrease in the level of trade by around 8 percent and Rose (2000) estimated a gravity trade model for 186 countries using a 5-year moving average of the variance of the nominal exchange rate return and discovers that exchange rate volatility has a significant negative impact on trade (estimates show that zero exchange rate volatility would have resulted in a 13 percent increase in trade). It was this seminal work (Rose (2000)) that started the debate that countries participating in a currency union seemed to trade three times more than expected – even when one controls for the impact of exchange rate volatility. This discovery was christened the *Rose effect*. Rose and Engel (2002) and Glick and Rose (2002) found empirical evidence in support of the *Rose effect*. Furthermore, Aliyu (2007*a*) uses a gravitational model for Nigeria-India bilateral trade and discovered that the exchange rate coefficient is theoretically consistent and statistically significant in the import model for the Indian economy but not for the Nigerian economy.

A number of empirical studies on Nigeria were carried out by Ojo, *et al* (1978), Osagie (1985), and all downplayed the role of exchange rate in the import-export trade in the country. This was largely possible in view of the system of exchange rate regime prior to the introduction of structural adjustment programme in Nigeria in July 1986. However, Oyejide (1986), Omolola (1992), Akanji (1992), Ihimodu (1993) Osuntogun, *et al* (1993) World Bank (1994), Aliyu (1994 & 2001) discovered that exchange rate depreciation caused significant changes in the structure and volume of Nigeria's agricultural exports. Egwaikhide (1999) in his dynamic specification model of import determinants in Nigeria from 1953 to 1989 discovered that short run changes in the availability of foreign exchange earnings, relative prices, and real output (income), significantly explained the growth in total imports in Nigeria. On exchange rate instability, Nnanna (2002) links exchange rate instability in

Nigeria to adverse monetary policy outcome, inflation, interest rate and growth in money supply; and the failure of monetary policy was linked to fiscal dominance in the economy. Aliyu (2007*b*) showed that exchange rate significantly affects imports more than exports due largely to the monocultural nature of Nigeria's exports and inexhaustible and multifarious nature of its imports. According to a study by the CBN (2007) using fundamental variables; TOT, nominal effective exchange rate (NEER) and lagged real exchange rate; findings suggest that the three variables accounted for 22, 55 and 99 percent of variations in the dependent variable, respectively.

Theoretically, the volatility-trade link is ambiguous according to Baldwin, Skudelny and Taglioni (2005). Dornbusch (1993) observed that the effect of an appreciated exchange rate on trade would be to make production of tradable unprofitable and non-tradable goods more profitable. In other words, imports will be high, while exports will tend to be discouraged. Cottani, *et al* (1990) found that misalignment was strongly related to lower per capita GDP growth, and to low productivity, slow export growth and slow agricultural growth. Loaza, *et al* (2002) also found a negative relationship between overvaluation and growth, holding other macroeconomic variables constant[3].

It is evident from the above review that studies on the impact of exchange rate volatility on trade have no dominant approach. The choice of a particular approach or methodology and expected outcomes depend on a particular economy and nature and availability of data. Gala and Luccinda (2006) state that two main methods of dealing with exchange rate misalignment are the purchasing power parity (PPP) approach and fundamental analysis. The PPP approach, on one hand, is based on relative prices and considers high international price levels as proxy for exchange rate overvaluation for a given GDP per capita level. Fundamental analysis, on the other hand, considers economic fundamentals in modeling exchange rate misalignment. These include terms of trade (TOT), balance of payments (BOP) financing condition, fiscal policy stance (surplus or deficit spending), degree of openness (OPN), GDP per capita, etc.

[3] For more extended review of literature on the effect of exchange rate volatility on trade, see IMF (1984), Cote (1994), McKenzie (1999), Shatz and Tarr (2001), Skudelny (2002) and Taglioni (2002).

It has also been established in the literature that a drop in exchange rate volatility can increase the volume of trade in two not mutually exclusive ways – by producing more exports, and by increasing the number of firms that are engaged in exporting. It is this theorization that accounts for a negative volatility-trade link, Baldwin, Skudelny and Taglioni (2005). Generally, the transmission mechanism through which exchange rate volatility affects non oil exports in Nigeria could be both from the supply and demand channels. The supply side effects are related to the fact that exchange rate volatility could affect input prices. This induces some producers to lower output and in the face of volatile exchange rate, makes the exports less competitive. Exchange rate volatility could also affect consumer confidence in importing countries and thus lowers demand. It also adversely affects investment indirectly by increasing producers' cost. Against this background, this paper seeks to assess the link between exchange rate and non oil export trade performance in Nigeria. Other additional variables would too incorporated in the model.

3.0 Research Methodology

In line with the methodology employed by Koray and Lastrapes (1989), Arize (1997) and (1998*a* and *b*) and Fountas and Aristotelous (1999), this paper adopts a vector error correction (VEC) methodology in analyzing the effect of exchange rate volatility on Nigeria's non oil exports between 1986Q1 and 2006Q4. Total non oil exports (*nexp*) in Nigeria is assumed to follow the path dictated by fundamentals such as exchange rate volatility in Nigeria (vol_n) and Nigeria's trading partner (vol_p) (the United States' dollar volatility was used as proxy), Nigeria's terms of trade (*tot*) and index of openness (*opn*). The paper uses the Johansen's cointegration analysis to identify the long run relationships among the variables. Before estimating the cointegrated VAR by Johansen's method, the stochastic properties of the data was checked using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. In the ADF test, the hypothesis $\delta = 0$ *or* $\rho = 1$ of nonstationarity or unit root is tested against the alternative which states that a series is stationary if $-1 < \rho < 1$. The PP test on the other hand uses nonparametric statistical methods to account for the serial correlation in the error term, without necessarily adding lagged difference terms as in the ADF case. Appropriate lags were selected on the basis of Schwarz information criteria (SIC) in order to ensure independence in the residual series.

The purpose of the cointegration test is to determine whether a group of nonstationary series is cointegrated or not and as a starting point, the presence of a cointegrating relation forms the basis of the VEC specification. Johansen (1991, 1995) developed a VAR-based cointegration tests the specification of which runs as follows:

Consider a VAR of order:

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + Bx_t + \varepsilon_t \qquad (1)$$

Equation (1) is saying that y_t is a *k* vector of endogenous variable, x_t is a *d* vector of exogenous variables (constants, trends and dummies), A_1 …. A_p and *B* are matrices of coefficients to be estimated, and ε_t is a vector of innovations or impulses or shocks. Rewriting the above equation in the following VEC form:

$$\Delta y_t = \Pi\, y_{t-1} + \sum_{i=1}^{\rho-1} \Gamma_i \Delta\, y_{t-i} + Bx_t + \varepsilon_t \qquad (2)$$

Granger's representation theorem asserts that if the coefficient matrix Π has reduced rank $r < k$, then there exist k x r matrices α and β each with rank r such that $\Pi = \alpha\,\beta'$ and $\beta'\, y_t$ is I(0). r is the number of cointegrating relations (*the cointegrating rank*) and each column of β is the cointegrating vector. The elements of α are known as the adjustment parameters in the VEC model. Johansen's method is to estimate the Π matrix from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of Π.

Meanwhile, the first step is to establish the order of integration of each of the variables. It is only then that they would form the basis for estimating the long run relationship between them and if not, to establish the order of their integration or the number of times they have to be differenced to become stationary. For the purpose of this study, the variables used in the analysis are: *nexp*, vol_n, vol_p, *tot* and *opn*. The cointegration equation, with all the series converted into natural log, is expressed as follows:

$$lnexp = \alpha_0 + \beta_1\, lvol_n + \beta_2\, lvol_p + \beta_3\, ltot + \beta_4\, lopn + \varepsilon_t \qquad (3)$$

By converting them into log, we are interested in measuring the rate of change, which would be captured by the coefficients of the regressors. Equation (3) is thus saying that total non oil exports in Nigeria is explained by the right hand side variables, which were earlier defined.

The equation is estimated by system of least squares. The next section is on definition of variables.

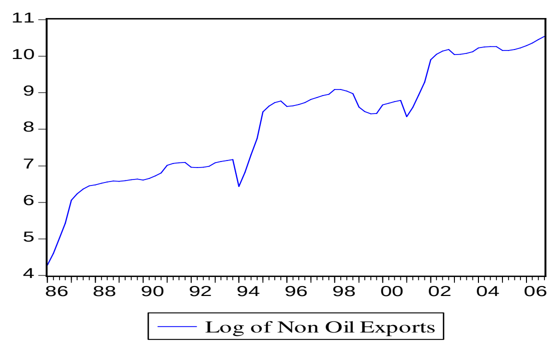
3.1 Measurement of Variables Used in the Estimation

As stated earlier in the theoretical foundation of the model, the fundamental variables that were used to explain the pattern of Nigeria's non oil exports trade include naira and US dollar exchange rate volatility, Nigeria's term of trade and index of openness. The variables are defined as they were applied in the analysis.

Total Non Oil Exports

Data on Nigeria's total non oil exports (fob) were obtained from various issues of Central Bank of Nigeria (CBN) Statistical bulletin in nominal terms from 1986Q1 to 2006Q4. This was converted into natural log and was tested for stationarity. The data was tested for unit root and was then differenced *d* times to attain stationarity. Figure 1 presents the graph of the log of quarterly series of total non oil exports in Nigeria from 1986Q1 to 2006Q4.

Figure 1



Exchange Rate Volatility

There is armful literature on the measurement of exchange rate volatility. Depending on the approach one adopts, Anderton and Skudelny (2001), for instance, measured exchange rate volatility as the quarterly variance of the weekly nominal exchange rate while Zubair and Jega (2008) measured volatility by the standard deviation of each series through their sample. Gujarati (2003) suggested the use of mean-adjusted and the squared deviation of (variance) of each series in a sample. This paper, in line with Zubair and Jega's paper measures exchange rate volatility as the standard deviation of each series of quarterly observation from the average nominal exchange rate of the naira vis-à-vis the US dollar.

$$voln \quad = \quad \sqrt{\Sigma(NER_{ij} - \overline{NER_j})^2} \qquad (4)$$

Quarterly data on nominal exchange rate of the naira was obtained from the Research Department of the CBN. This measurement approach allows the VEC model to capture not only current volatility but, contemporaneously along with some history of past volatility when the model is opened to higher lag orders. The standard deviation series was converted in to natural log and then tested for stationarity. The same procedure was applied to arrive at the measure of volatility of the US dollar. The nominal effective exchange rate (NEER) in the case of the US was obtained from the IFS **(**nec**)** on quarterly basis and the standard deviation was computed there from and was tested for stationarity as well. Theoretically, volatility relates inversely with real export, but, empirical findings suggest that the coefficient could also bear positive sign. Figures 2 and 3 present the graph of the Nigeria's naira and the US dollar volatility

Figure 2

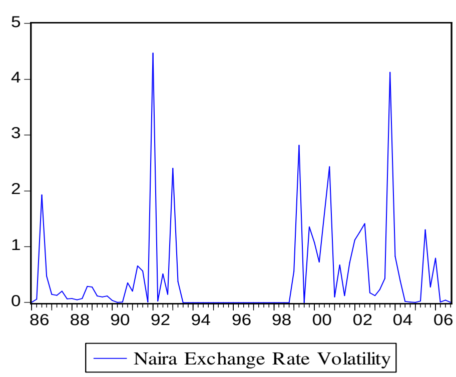
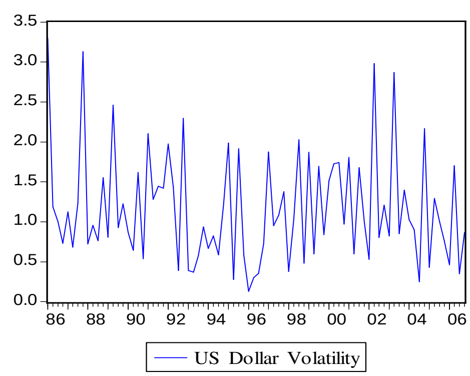


Figure 3



Terms of Trade

This is computed as the ratio of export price index (P_x) to import price index (P_m). Baffes, Elbadawi and O'Connell (1997) develop a measure of terms of trade and trade policy. The measure in addition to *tot,* captures the domestic trade policy stance. It is given as:

$$\frac{P_x}{P_m} = \frac{\varphi}{\eta}, \qquad \varphi \equiv \frac{P_x}{P_m}, \quad \eta \equiv \frac{1 + t_m}{1 + t_x} \qquad (5)$$

Where t_m and t_x measure tariff on imports and exports respectively. For the purpose of this analysis, only the ratio of the Nigeria's consumer price index and the US's producer price index is taken as proxy as former's terms of trade. The two series were obtained from CBN's statistical bulletin and international financial statistics (IFS) line 63a for Nigeria and US respectively. The base year of the two series was adjusted to 2000 = 100. The series was tested for unit root and has to be differenced to attain stationarity. It is expressed as the differenced form of log of terms of trade (*dltot*).

Figure 4

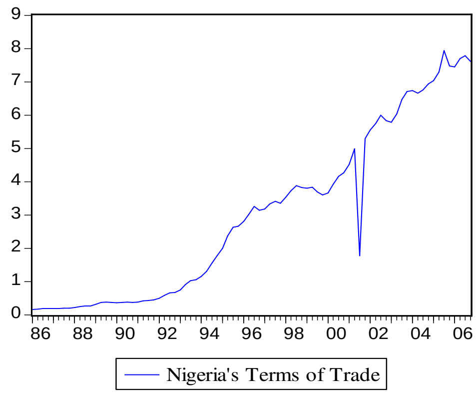
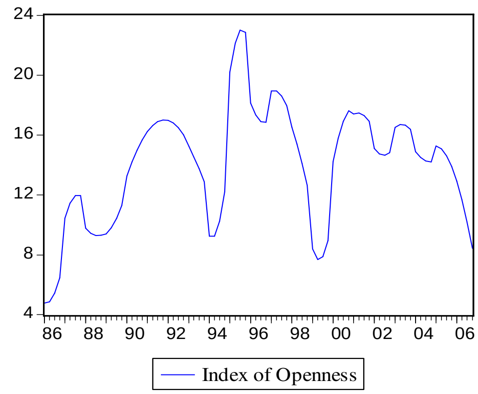


Figure 5



Note that the measure did not, however, incorporate such information on the level of import and export taxes largely due to the difficulty in obtaining information on them and /or reliable information on their levels. The above figure 4 presents the graph of the log of terms of trade.

Index of Openness

The variable is measured as the sum of total trade, imports and exports divided by gross domestic product. Data was obtained from various issues of Statistical Bulletin published by the Central Bank of Nigeria. The series was converted into log and was tested for stationarity. Theoretically, an increase in openness is assumed to be arising from a decline in tariff rates, leading to a fall in the domestic prices of importables. This will lead to high demand of foreign currency (to take advantage of cheap imports), and less demand for domestic currency. Hence this is expected to lessen exchange rate volatility, increase competitiveness and promote more exports. As a result, the openness variable is expected to carry a positive sign. Figure 5 presents the graph of the log of index of openness in Nigeria.

4.0 Results and Discussions

From the outset, this section starts with the presentation of results of unit root tests. This was followed with the cointegration test based on the specification given in equation (2). Table 1 summarizes the results of the ADF and the PP tests applied to the variables. When tested at levels, the volatility measures - *voln* and *volp,* were found to be stationary while the others were not. At first difference, however, the others, that is, *lnexp, ltot* and *lopn* were stationary at 1 percent for the first two and 10 percent level for the latter using ADF test with a constant.

Table 1: Augmented Dickey Fuller and Phillips-Perron Stationarity Tests

	ADF- Test				Phillips- Perron Test			
	With Intercept		With intercept & Trend		With Intercept		With intercept and Trend	
Variable/ coefficient	t-Statistic	Decision Rule	t-Statistic	Decision Rule	t-Statistic	Decision Rule	t-Statistic	Decision Rule
lnexp	-4.20*	I(1)	-4.13*	I(1)	-5.94*	I(1)	-5.96*	I(1)
lvoln	-8.24*	I(0)	-8.31*	I(0)	-8.27*	I(0)	8.31*	I(0)
lvolp	-12.14*	I(0)	-12.07*	I(0)	-11.94*	I(0)	-11.88*	I(0)
ltot	-10.04*	I(1)	-10.21*	I(1)	-17.84*	I(1)	-21.19*	I(1)
lopn	-2.61***	I(1)	2.97	N.E	-5.33	I(1)	-5.45	I(1)

Note: One and three asterisks denote rejection of the Null hypothesis at 1%, and 10%, respectively, based on the MacKinnon critical values.

Thus, the null hypothesis of nonstationarity or unit root is rejected. The next step is to test for cointegration or the long run relationship between the real export and its fundamentals.

4.2 Cointegration Results

The result of the unrestricted Johansen cointegration test using the specification in equation (2) is presented in Table 2. The standard statistics used in the interpretation of the test are the eigenvalue and the trace statistic at given level of significance.

Results in Table 2 show the existence of only one cointegration equation on the basis of trace statistic. The presence of one cointegration unveils the existence of a long run equilibrium relationship between real non oil export and the fundamentals used in the model. The hypothesis of no cointegration could not, however, be rejected on the basis of maximum eigenvalue because the hypothesized value is greater than the calculated.

Table 2: Johansen Cointegration Test

Maximum Rank/ Number of Cointegrating Equations	Maximum Eigenvalue	Critical Value (Eigenvalue)	Trace Statistic	Critical Value (Trace Statistic)	Probability**
0*	31.64	33.88	79.49	69.82	0.0069
1	21.68	27.58	47.86	47.86	0.0500
2	17.15	21.13	26.18	29.80	0.1236
3	9.021	14.26	9.025	15.49	0.3631
4	0.004	03.84	0.004	03.84	0.9465

Trace test indicates 1 cointegrating equations at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Although not encountered here, but, the existence of multiple cointegrating vectors complicates the interpretation of an equilibrium condition (Johansen and Juselius, 1992, Dibooglu and Enders, 1995, Wickens, 1996, MacDonald and Nagayasu, 1998, Clark and MacDonald, 1999). Neither is the case of a single cointegrating vector the most desired outcome because such makes it unclear if the vector represents a structural or reduced form relationship. Therefore, while interpreting the cointegrating vectors obtained from the Johansen procedure as was pointed out by Cheng and Orden, 2005 and Ilimi, 2006, one needs to note that what the reduced rank regression provides is information on how many unique cointegrating vectors *span* the cointegrating space, while any linear combination of the stationary vectors is itself a stationary vector.

Thus, from the above, we apply the Johansen procedure to obtain the long run coefficients of the model. Table 3 presents the normalized coefficients *(β)* of the variables in the model. All the coefficients were correctly signed and statistically significant at 1 the percent level. The first two coefficients of the naira and US dollar volatility have negative and positive signs respectively. This implies that while naira volatility adversely affects non oil exports, volatility in the US dollar promotes it. These findings are consistent with those reported by Baum *et al* (2004) who discovered positive link between export and volatility on one hand and those reported by Caporale and Doroodian (1994), Pugh, *et al.* (1999), Wei (1999), Rose and Engle (2002), Anderton and Skudelny (2005) on the other hand. However, McKenzie and

Brooks (1997) and McKenzie (1999) using ARCH modeling reported mixed effects of exchange rate volatility on the level of exports.

Table 3: Normalized cointegrating Eigenvector (β')

Unrestricted Coefficients	
Cointegrating Equation:	CointEq1
lnexp(-1)	1.000
lvoln(-1)	-0.885*
	(-4.87)
lvolp(-1)	1.819*
	(4.31)
ltot(-1)	0.509*
	(14.4)
lopn(-1)	0.091*
	(3.23)
C	3.726

( ) report values of t- ratios
* Indicates significance at 1% level

The result further shows a strong and statistically significant positive link between exports and both the terms of trade and index of openness are export enhancing. Based on the estimated cointegrating vector *β,* the long-run equilibrium equation can be written as:

$$lnexp = 3.726 - \underset{(0.205)}{0.885}*lvoln + \underset{(0.373)}{1.819}*lvolp + \underset{(0.035)}{0.509}*ltot + \underset{(0.028)}{0.091}*lopn \qquad (6)$$

The above cointegrating equation reveals a negative relationship between non oil exports and the naira exchange rate volatility while positive relationship subsists in the others. Economically speaking, a volatile currency could hamper inter temporal contracts and could have both supply and demand implications. A weak naira, for instance, could, all things being equal, make Nigeria's non oil exports highly competitive[4], although at the same time, this could have serious supply side implications by way of increase in the cost of production at industry and firm levels. Equally, the sign of coefficient of dollar volatility along with those

[4] This is, however, not to discount the famous argument of Singer-Presbisch thesis, which unrevealed deteriorating conditions in the terms of trade in developing countries in their trade with the developed nations. Although the thesis has lost some of its relevance in the last 30 years, when developing countries outside of Africa begin exporting simple manufacture, Nigeria's non oil exports still compose large components primary exports.

of terms of trade and openness suggest that non oil exports in Nigeria is positively affected in the long run by a change in any of the regressors.

The above findings are reinforced by the results reported in Table 4 showing alpha adjustment coefficients of the model. Here the alpha is viewed as the speed of adjustment parameter. Meaning, if the system is out of long run equilibrium condition, adjustment comes through the alpha. Therefore, the numerical value and statistical significance of each α coefficient is very important in the evaluation of the extent of speed of adjustment for any shock that destabilizes the long run equilibrium condition.

Table 4: Alpha Adjustment Coefficients

(Standard errors in Parenthesis)

Variable	Coefficient & Standard Errors
lnexp(-1)	-0.054
	(-1.05)
lvoln(-1)	-0.731*
	(2.79)
lvolp(-1)	0.532*
	(2.80)
ltot(-1)	0.205
	(1.64)
lopn(-1)	-0.212
	(-0.60)

* denote significance at 1%

Based on restriction imposed on *lnexp* alpha coefficient, the result shows that the two volatility adjustment parameters were statistically significant. The results imply that if the system is out of equilibrium condition, adjustment back to steady state comes from the two volatility coefficient – naira exchange rate and dollar volatility. The former decreases while the latter increases in the restoration of the equilibrium condition. This attests to the influence of exchange rate volatility on the level of non oil export in Nigeria in the long run. To assess the short run equilibrium dynamics, a vector error correction model was estimated by incorporating an error correcting mechanism in the cointegrating equation (3). The error term was obtained from a conventional regression using ordinary least squares (OLS) method applied to the same equation. The results presented in Table 5 show that the error correction variable is correctly signed and significant at 1 percent level.

Table 5: Short run Vector Error Correction Model

Dependent Variable: DLNEXP
Method: Least Squares
Date: 02/16/09 Time: 09:38
Sample (adjusted): 1986Q3 2006Q3
Included observations: 81 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ecm (-1)	-0.20186*	0.058652	-3.44166	0.0010
lvoln	-0.01748	0.022357	-0.78181	0.4369
lvolp	-0.01950	0.031484	-0.61949	0.5376
dltot	0.10893*	0.039441	2.76196	0.0073
dlopn	0.08328*	0.012453	6.68777	0.0000
lvoln(1)	-0.00182	0.022662	-0.08019	0.9363
lvolp(-1)	-0.00136	0.032086	-0.04251	0.9662
dltot(-1)	0.07362	0.038036	1.935696	0.0569
dlopn(-1)	-0.02112	0.012864	-1.64214	0.1050
C	0.08636	0.058976	1.464429	0.1475
R-squared	0.469063	Akaike info criterion		-0.71953
Adj. R-squared	0.401762	Schwarz criterion		-0.42391
SSR	1.804229	F-statistic		6.96954
D.W	1.198330	Prob. (F-statistic)		0.00000

* indicates significance at 1 percent level.

The results confirm that non oil exports in Nigeria has an automatic adjustment mechanism and that non oil exports in Nigeria responds to deviations from equilibrium in a balancing manner. A value of -0.20186 for the *ecm(-1)* coefficient suggests that a fast speed of adjustment of roughly eight quarters or two years[5]. See appendix for normality and residual tests.

4.3 Impact of Exchange Rate Volatility on Non oil Exports

The above analysis, beside the fact that the coefficients of volatility measure sensitivity of non oil exports to a shock in exchange rate; we can also use the same coefficients to assess the impact of volatility on the level of non oil exports in real terms. The paper, calculates the impact of exchange rate volatility by multiplying the values of exchange rate volatility variables over the sample by the respective vector coefficients of the naira and US dollar

[5] The coefficients measure the average number of times that a given shock is corrected in the model. This is given as $(1 - \alpha)^t$, which is, $(1 - \alpha)$, where *t* is the number of years and α is the absolute value of the adjustment parameter.

volatility, that is, -0.885 and 1.819 respectively. Figure 5 shows that the naira exchange rate volatility reduced non oil exports by about 4 percent in the first quarter of 1992 and by 3.65 percent in 2003Q4. The impact was nil between 1993Q4 and 1998Q4 because an exchange rate of N21.886 to a US dollar was maintained throughout the range. The average impact for the entire sample is 0.45 percent

Figure 5: Impact of Naira Volatility on Non oil Exports

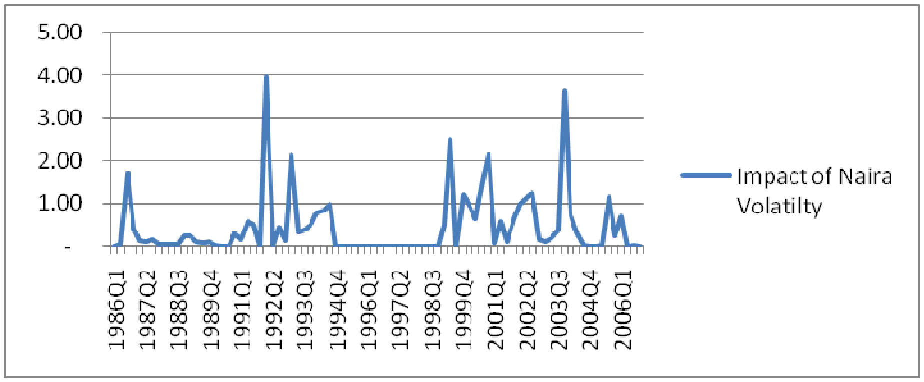
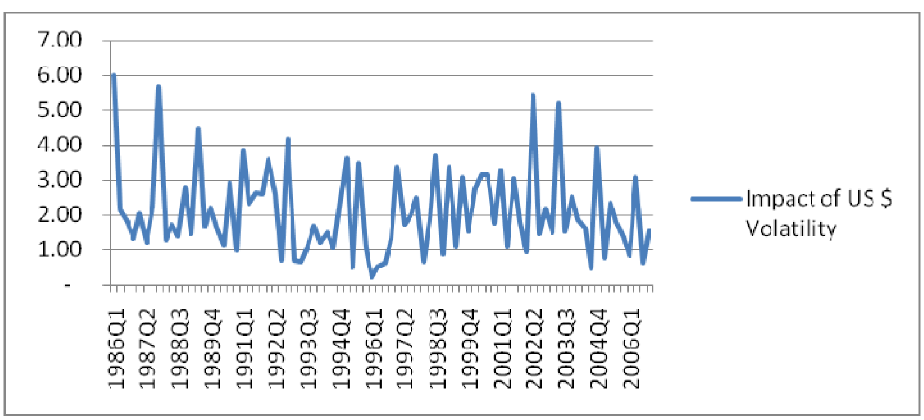


Figure 6 shows that the impact of dollar volatility on non oil exports in Nigeria is a bit more violent relative to that of the naira volatility. The figure shows that the average impact stood at 2.1 percent between 1986Q1 to 2006Q4. Specifically, evidence shows that the US dollar volatility may have increased non oil exports in Nigeria in 1986Q1 by up to 6 percent. Others include by 5.4 percent in 2002Q2 and 5.2 percent 2003Q2. Similar findings were reported elsewhere by Anderton and Skudelny (2001) in their analysis of trade effect of the euro. For instance, they showed using the same approach that extra-euro exchange rate volatility may have decreased extra-euro imports by 10 percent.

Figure 6: Impact of Dollar Volatility on Non Oil Exports



Above findings are valid and consistent with some early empirical studies on assessment of impact of structural adjustment programme (SAP) on non oil sector export subsector in Nigeria, Omolola (1992), Akanji (1994) and Aliyu (1994). The studies discovered that persistent exchange rate depreciation – above evidence suggests that naira is volatile because it persistently looses it value over a long period against the US dollar and the US dollar is consistently gaining more value against the naira and is therefore volatile, promoted non oil exports at the initial stage. The adverse effect of low exchange rates and inflation, however, discouraged export of non oil at a later stage due to hike in cost of production and other supply side constraints; poor infrastructural development, dominance of the oil sector, policy inconsistency, etc.

5.0 Conclusion and Recommendations

The purpose of this paper is to empirically investigate the impact of exchange rate volatility on export trade in Nigeria. After the literature review in the area, the paper situates itself within the premise that non oil export trade in Nigeria is predicated on a number of exogenous variables and this fact makes the fundamental approach most the suitable instrument of analysis. Time series data was collected on some key variables from 1986Q1 to 2006Q4. Unit root tests and the Johansen cointegration tests were applied.

Empirical results show evidence of stationarity at level for some variables while for some at first difference. Evidence of cointegration among the variables was also established using the Johansen procedure. This implies that a stable long run equilibrium condition exists among the fundamental variables. Error correction variable from an estimated short run dynamic model showed reasonable speed of adjustment towards the long run equilibrium path, that is, any short run disturbance, which may offset the economy along the long equilibrium path rebounds itself within two years as the evidence suggests. Furthermore, analysis of the impact of the naira exchange rate and the US dollar volatility revealed that while the former discouraged non oil exports in Nigeria, the latter promoted it by -0.885 and 1.819 for any unit change in volatility respectively. By keying this into the long run model, the naira exchange rate volatility was found to have an average adverse effect on non oil exports of -0.45 percent while the average for the US dollar volatility stood at 2.1 percent.

The paper recommends the pursuance of a sustainable and stable exchange rate policy and to put in place, measures that will promote greater exchange rate stability and improve terms of trade conditions, promote greater openness of the economy in order to enhance non oil exports. There is the need for the government to deliver efficient infrastructural services, especially power supply and other energy resources. Lastly, while there is little that can be done to contain the effect of dollar volatility since the US continues to be one of our major trading partners, it is hoped that coming up with the above measures could greatly promote more export trade.

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Appendix 1: Normality and Regression Residual Tests

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	9.077666	Prob. F(2,69)	0.000316
Obs*R-squared	16.87311	Prob. Chi-Square(2)	0.000217

ARCH LM Test:

F-statistic	5.053202	Prob. F(2,76)	0.008701
Obs*R-squared	9.272318	Prob. Chi-Square(2)	0.009695

White Heteroskedasticity Test: (no Cross terms)

F-statistic	1.557841	Prob. F(18,62)	0.100785
Obs*R-squared	25.2255	Prob. Chi-Square(18)	0.11883

White Heteroskedasticity Test: (cross terms)

F-statistic	0.499819	Prob. F(54,26)	0.984056
Obs*R-squared	41.25682	Prob. Chi-Square(54)	0.898498