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The Impact of Exchange Rates on Inflation in Nigeria (1981-2015)

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ABSTRACT:
This study examines the impact of exchange rate on inflation in Nigeria over the period of 1981-2015. Secondary data were collected from the CBN statistical Bulletin World Bank Data File and those of the Federal Bureau of Statistics in order to establish the relationship between the dependent variable (inflation rate) and the independent variables (exchange rate, Non-oil export, and money supply). The research adopted the Vector Error Correction Mechanism (VECM) and the results of the analysis show that that the fluctuating exchange rate has significantly impacted on the persistence inflation that the country has witnessed. As high exchange rate has led to imported inflation as such the monetary authority in their quest to curb inflation should not totally rely on this instrument to control inflation, but should use it to complement other macro-economic policies. The research recommends that efforts should be intensified to increase the volume of non-oil export to make up for the extra demand for foreign exchange that may be created by the depreciation of Naira.

Keywords: *Economy, Inflation, Exchange rates, Economic growth*

INTRODUCTION

One of the key challenges to policy management everywhere the planet and notably in rising and developing economies has been the result of changes in exchange rates on inflation and economic activities. It is believed that rate of exchange movements would produce domestic economic distortions and have an effect on a country's economic aggressiveness. The hurtful result of rate of exchange placement is well documented within the literature and there's usually reluctance on the aspect of policymakers to regulate exchange rates, thanks to the perceived negative effect on the economy, mainly due to pass-through effects. Mehdi (2014) state that the effect of exchange rate on inflation rate varies in different countries asserting that one of the factors determining the way exchange rate affects inflation rate is the development level of each country's financial markets revealing that new theories emphasize the high correlation between economic growth and innovation.

Exchange rate influence domestic prices through their effects on aggregate supply and demand. In general, once a currency depreciates it'll end in higher import costs if the country is a global value taker, whereas lower import costs result from appreciation. The potentially higher value of foreign inputs related to rate of exchange depreciation will increase marginal prices and ends up in a better value of domestically made merchandise (Kandil, 2004). Also, import-competing companies may increase costs in response to foreign rival value will increase to

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boost profit margins. However, the extent of such value adjustment depends on a spread of things like market structure, the relative number of domestic and foreign firms in the market, the nature of government exchange rate policy and product substitutability (Fouquin, 2001).

The problem of a way to cut back inflation has been a central issue among policymakers since the Nineteen Seventies. Although obtainable knowledge show that the Nigerian economy has on the common veteran moderate inflation within the pre-SAP amount, the unfavorable consequences of inflation have since assumed an intolerable dimension since the period of SAP and after SAP until the present day. Inflation as in the fourth quarter of 2016 was at 18.67% from 8.7 % it was in 2015 (NBS, 2016). Several authorities have attributed it to the enlargement of public expenditure arising from the rise in oil revenue, which culminated into a vast expansion of aggregate demand and the inelastic supply of domestic output.

The rapid climb in funds arising from the proof of oil earnings conjointly exerted AN upward pressure generally indicant. When the price of crude oil slumped in 2015, Nigeria's crude oil, which sold at slightly above US$100 per barrel in 2014, fell to less than US$50 by August 2016. This triggered off a series of developments in the economy (Oleh, 2015). One example of such developments is the state of fiscal crisis as reflected in the persistent budget deficit, which culminated to approximately N44.88 billion in 2015 (CBN 2015). Monetary policy became extremely expansionary as an outsized a part of the deficit incurred throughout this era were supported through the creation of credit therefore the native domestic credit to the economy and most of the increase was attributable to the net claim by the government. However, the rate of inflation in 2016, which stood above 18% is often explained in terms of acute shortage of imported goods and services imposed by inadequate foreign exchange earnings, a derivation of the steep fall in crude oil prices (Gabriel and Ujah, 2015).

In addition to the on top of, the frequent fiscal deficit operation in the last two decades in which budget deficit is financed through banks has further exerted upward pressure on the general price level. This suggests that this inflation might are caused by these factors. While the channels through that rate of exchange depreciation have an effect on costs are accepted, the extent to that this development engenders value inflation in Nigeria is one in all the explanations for the study.

The fluctuation in export earnings due to fall and rise in the oil price in the international market has led to the problem of exchange rate fluctuation. Nigeria government despite adopting a series of exchange rate policies has failed to keep the naira value stable over time. Nigeria currency keeps on falling in relation to the dollar. The current decline in the value of naira has led to a series of economic problem like economic recession, high inflation, high unemployment among other macroeconomic problem.

While some social scientist disputes the power of modification within the real charge per unit to enhance the balance of developing countries (Hinkle, 1999) thanks to snap of their low export, others believe that structural policies might, however, modification the long-run trends within the terms of trade and therefore the prospects for export-led growth. Instabilities of the foreign exchange rate are also a problem to the economy as it determines the value of the country currency in acting as a medium of exchange. The main thrust of this study is to evaluate the impact of exchange rate on inflation in Nigeria over the period of 1981-2015.

Literature Review

Several empirical studies that have undertaken to spot the attainable determinants of inflation in African nation et al. have known charge per unit as another inflation deciding variable. Honoham and Lane (2003) for instance, reported a variety of regressions, explain annual inflation differentials across the Eurozone over the period 1999-2001, and found a substantial role for the variation in nominal effective charge per unit movements in explaining divergent inflation rates. Honoham and Lane (2004) in a related study confirm that exchange rate matter for EMU inflation rates during the periods of Euro appreciation (2002-2003) as well as during the periods of Euro depreciation (1999-2001). Aigbokhan(2013) showed that the level of the real exchange rate was a primary determinant of the rate of inflation in Mexico during the 1980s and 1990s.

Chhibber (1991) developed in depth political economy model, which takes into account both monetary and structural factors while investigating the causes of inflation in Zimbabwe. Their investigation shows that financial growth, foreign price, exchange rate, interest rate, unit labor cost, and real income, are the chief determinants of inflation in this country. A similar macroeconomic model of inflation was employed for Ghana by Chhibber and Shafik (2005). This study, that lined the amount 1965–1988, suggests that the growth of money supply is one key variable explaining the Ghanian inflationary process. Such variables as the official exchange rate and real wages could not exert any significant influence on inflation. However, a significant positive relationship was found between the parallel exchange rate and the general price level. Still, on the difficulty of inflation, Chhibber planned that there's only 1 relationship between charge per unit and value inflation. Basing his argument on empirical studies of some African countries, one of his main conclusions is that devaluation could exert upward pressure in the general price level through its increased cost of production in the short-run. Owoeye and Ogunmakin (2013) using two proxies for bank performance (loan loss to total advances ratio and capital deposit ratio) examined the impact of unstable exchange rate on bank performance in Nigeria. Their specified models suggest that the impact of exchange rate on bank performance is sensitive to the type of proxy used to capture bank performance. Loan loss to total advance quantitative relation shows that unsteady charge per unit might have an effect on the power of lenders to manage loans ensuing into a high level of unhealthy loans whereas capital deposit ratio does not have a significant relationship with the exchange rate.

Dada and Oyeranti (2012) examine the exchange rate and macroeconomic aggregates in Nigeria. The result shows that there is no evidence of a strong direction between changes in the exchange rate and GDP growth. Rather, the country's growth has been directly affected by fiscal and monetary policies and other economic variables particularly the growth of exports which is major oil. In short, the nature of the effect of exchange rate volatility on investment and growth is yet unresolved. There is, therefore, the need for more empirical research on the subject matter. This is significantly necessary visible of the character of charge per unit in developing countries like African nation.

Ettah (2011) focused on the effects of price and exchange rate fluctuations on Agricultural exports (cocoa) in Nigeria. Data were applied to an export supply function for cocoa specified and estimated using the Ordinary Least Squares Regression. Results showed that charge per unit fluctuations and agricultural credits completely have an effect on cocoa exports in African nation. Results also revealed that relative prices of cocoa are insignificantly related to the quantity of export. Their result, therefore, implied a positive significant effect of exchange rate volatility on cocoa exports in Nigeria. They recommend that agricultural credit schemes should be restructured in a way that should meet the needs of farmers, and such credit facilities should be made available and accessible to cocoa farmers in order to boost their production capacity while there should be a free market determination of exchange rate for export of cocoa in Nigeria.

Bakare (2011) supports the replacement of the floating exchange regime while adopting purchasing power parity which has been considered by past studies to be more appropriate in determining realistic exchange rate for Nigerian monetary unit and contribute completely to political economy performances in African nation.

In another work, Omojimite and Akpokodje (2010) investigated the effect of exchange rate reforms on Nigeria’s trade performance during the period 1986-2007. The study found a minimal positive effect of exchange rate reforms on non-oil exports through the depreciation of the value of the country’s currency. It was additionally found that the structure of imports that is pro-consumer merchandise remained unchanged even when the adoption of charge per unit reforms. Exchange rate reforms were found to not constrain imports as anticipated. Rather, they stimulate imports, albeit insignificantly. These authors suggest that exchange rate reforms are not sufficient to diversify the economy and change the structure of imports.

Aliyu (2009) examined the exchange rate pass-through in Nigeria for the period 1986 to 2007. Quarterly series was employed and a Vector Error Correction Model estimation was used in the estimation process. The authors found that charge per unit pass-through in African nation throughout the amount into account was low and declined at the side of the worth chain, which partly overturns the conventional wisdom in the literature that charge per unit pass-through is often significantly higher in developing countries than developed countries. The authors conclude that within the long-term, have would seemingly increase and financial policy ought to be designed to accommodate the impact.

Another study by Mireille (2007) argues that overvaluation of exchange rates has official a serious black eye within the recovery method of African nation and Benin Republic. In addition, the author suggests that devaluation among well-targeted measures aboard AN upward adjustment within the domestic worth of tradable product, could restore exchange rate equilibrium and improve economic performance.

The few studies on contractionary devaluation supported multivariate analysis embody those of Edwards (1989), Agénor (1991), and Morley (1992). In a pool-time series/ cross-country sample, Edwards (1989) regressed the $64000 GDP on nominal and real exchange rates, government spending, the terms of trade, and measures of money growth. He found that devaluation tended to reduce the output in the short term even where other factors remained constant. His results for the long impact of a true devaluation were a lot of mixed, however as an entire, it was suggested that the initial contractionary effect was not reversed subsequently. In the same manner, Agénor (1995) employing a sample of twenty-three developing countries, regressed output growth on contemporaneous and lagged levels of the real exchange rate and on deviations of actual changes from expected ones within the real rate, government disbursement, the money supply, and foreign income. The results showed that surprises in the real exchange rate depreciation actually boosted output growth, but that depreciation of the level of the real exchange rate exerted a contractionary effect.

Odusola and Akinlo (2001) examined the linkage among exchange rate, inflation, and output in Nigeria. A structural power unit model was utilized that captured the interactions between rate and output. Evidence from the contemporaneous models showed a contractionary impact of the parallel rate on output solely within the short term. Prices, parallel rate, and lending rate were found to be important sources of perturbations in the official exchange rate. In addition, output and parallel rate were important determinants of inflation dynamics in African nation. The authors ended by suggesting a lot of conjunct efforts by the financial organization towards taming the parallel rate behavior and formulating financial policies that enhance financial gain growth. Largely the findings were informative. Batini (2004) and Mordi (2006) present similar arguments in different studies in Nigeria. On the contrary, Aliyu (2009) find that prices react less proportionately to exchange rate shock in Nigeria.

Mauna and Reza (2001) studied the effect of trade liberalization, real exchange rate and trade diversification on selected North Africa countries Morocco, Algeria, and Tunisia. By rotten in real rate into basic and financial determinants, and by using both standard statistical measures of exchange rate fluctuation and the measures of exchange rate risk developed by Puree and Steinher (1989), they reached the conclusion that exchange rate depreciation has a positive effect on the quantity or manufactured exports while exchange rate misalignment, volatility or fluctuation has a negative effect. According to them, the motivating result is that all manufacturing sub-sectors are responsive to exchange rate change but the degree of responsiveness differs across sectors.

Broda and Romails (2003) found that real exchange rate volatility depresses trade in differentiated goods. The study used bilateral trade model, where the oils (ordinary least square) and GMM (Generalized method of the moment) methods were used. After taking into consideration the direction of relation, they ascertained that a 10 percent increase in volatility depresses differentiated product trade by 0.7 percent, while a 10 percent increase in trade reduces rate volatility by zero.3 percent. Their OLS calculable results showed that the impact or volatility on trade is reduced by 70 percent. They even the result by tilt that a lot of of the correlation between trade and alter to the impact that trade has in depressing fluctuation. Their study further revealed that a 10 percent increase in the intensity of bilateral trading relationship reduces the volatility if the associated exchange rate by 0.3 percent.

RESEARCH METHOD

Model Specification

From the review of the theoretical framework, we specify our model. This study is anchored on the monetary theory of exchange rate which is predicated on the importance of money. It identifies- the exchange rate as a function of the relative shift in the money stock. It is important to know that the Purchasing Power Parity (PPP) is a major component of the monetary approach. Monetary approach in the theory exchange rate determination views the exchange rate as being the relative prices of two assets (national monies) is determined primarily by the relative supplies of and demand for those monies and that the equilibrium exchange rate is attained when the existing stocks of the two monies are willingly held (Gbosi, 2003:105), the model is specified below as follows.

INF = f (EXR, NOX, MS) 1

The model uses Inflation rate (INF), Exchange of US Dollar to Nigeria' Naira (EXR), Non-oil export (NOX) and money supply (MS) as the specific objective is to examine the impact of exchange rate fluctuations on inflation in Nigeria. Thus, the model specified below is used to estimate the relationship between exchange rate fluctuation and inflation rate with the aid of linear equation. The mean equation is given by:

$INF = c + \beta 1EXRt + \beta 2NOXt + \beta 3MSt + ut$

Model Estimation

In this study, the following tests shall be conducted:

Unit root test

Co-integration test

Vector Error Correction Mechanism

Unit Root Test: It is used to test for the stationarity of the time series data in order to avoid spurious regression results. Augmented Dickey fuller will be used in the process. Cointegration Test: It is used to test for the long run relationship between the variables. And a protracted run relationship is found on these variables during which we are going to study. Johansen Co-integration Approach will be undertaken by the researcher in the course of the analysis.

Vector Error Correction Mechanism (VECM): The purpose of the error correction model is to indicate the speed of adjustment from the short-run equilibrium to the long-run equilibrium state. The bigger the constant of the parameter, the upper the speed of adjustment of the model from the short-term to the long-term equilibrium.

Sources of Data

Secondary data comprising of data of the above-discussed variables were used. These variables were collected from the Central Bank of Nigeria Statistical Bulletin, World Bank Data File and those of the Federal Bureau of Statistics. Its period of coverage spanned from 1981-2015. All the variables were measured in monetary terms using Nigeria's currency (Naira). The study captured the systematic annual time series of the considered variables in the model specification.

Data Presentation and Analysis of Results

The attempt to study the relationship between inflation and exchange rate in Nigeria led the researcher to subject the data collected to Unit Root, Cointegration, and Vector Error Correction. The variables considered in this research work are: Inflation Rate (INF) (dependent variable) and the independent variables include, Exchange rate, Non-Oil Export, and Money Supply. The empirical results are presented below:

Unit Root Test

In other to test for the presence or absence of unit root in the data used for the empirical analysis, the Augmented Dickey-Fuller (ADF) test was employed and the test result is as presented below:

Table 1: Unit Root Test Result

Variable	Level		1st difference		ORDER OF INTEGRATION	REMARKS
	ADF VALUE	5% CV	ADF VALUE	5% CV		
INF	-3.102490	-3.548490	-5.839618	-3.552973	I(1)	Stationary
EXR	-2.556946	-3.548490	-5.754111	-3.552973	I(1)	Stationary
NOX	-1.661517	-3.548490	-4.215383	-3.552973	I(1)	Stationary
MS	2.347712	-3.548490	-3.803120	-3.552973	I(1)	Stationary

Source: Researcher's Computation (See Appendix)

Table 2: Cointegration Result
Trend assumption: Linear deterministic trend
Series: INF EXR NOX MS
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.545746	53.93312	47.85613	0.0121
At most 1	0.462066	27.89289	29.79707	0.0816
At most 2	0.196836	7.432258	15.49471	0.5279
At most 3	0.006006	0.198781	3.841466	0.6557

Trace test indicates 1 cointegratingeqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Source: Researcher's Computation (See Appendix)

Table 1 above, showed that none of the variables was stationary at level as there ADF values (3.102490, 2.556946, 1.661517 and 2.347712) were less than 0.05 critical value (3.548490, 3.548490, 3.548490 and 3.548490), but at first differencing all the variables (INF, EXR, NOX and MS) became stationary as their ADF values (5.839618, 5.754111, 4.215383 and 3.803120) became greater than their 0.05 critical value (3.552973, 3.552973, 3.552973 and 3.552973). These indicate that all the variables were stationary and integrated at first difference, that is order 1, I(1). Since the variables are not integrated at level but were all integrated at the same level at order one, we, therefore, proceed to conduct cointegration test and short-run speed of adjustment from long-run disequilibrium.

Cointegration Test

Empirical results from the Johansen cointegration analysis are presented in table 2 below. The Johansen's check is geared toward crucial whether or not a long relationship exists between the series, and start with the null hypothesis that there is no cointegrating relation. We test that there is at least one cointegrating equation. Since there are four variables in the model, we then test whether the number of cointegrating equations is zero, one, two, three or four.

The results of the cointegration in the table above indicated that the trace statistics is greater than the critical value at 5 percent level of significance in one of the equations. This shows that there is a cointegrating relationship among the variables used to model the relationship between Inflation and Exchange Rate in Nigeria for the period under study. Specifically, they are 53.93312>47.85613. Also, the p-value is less than 0.05 (0.0121). In alternative words, the null hypothesis of no cointegration among the variables is rejected. Hence, the test result shows the existence of a long-run relationship in one cointegrating equation at 5% significance level.

The normalized cointegrating coefficients for one co-integrating equation given by the long-run relationship is

INF= 0.068230EXR+ 0.651669NOX- 0.053798MS
(0.13527) (0.20529) (0.01576)

Where INF is the dependent variable, 0.068230 is the coefficient of EXR while 0.651669 is the coefficient of NOX and -0.053798 is the coefficient of Money Supply. The sign borne by the adjusted coefficient estimates of EXR and NOX is positive while that of M2 is negative. This implies that the long run relationship between Inflation, Non-Oil Export, and the Exchange rate is positive while that of the money supply is negative. This conforms to apriori expectation of the relationship between inflation and exchange rate

Vector Error Correction Model (VECM)

In view of the presence of a cointegrating vector among the variables as evidenced by the cointegration tests, VECM will be conducted to check the speed of adjustment from short-run dynamics to their long-run static disposition:

From the table ECM (1) was consistent by assuming a negative value. It suggests that the ECM could correct any deviation from the long-run equilibrium relationship between INF and the explanatory variables. The coefficient indicates a speedy adjustment of 16.9% per annum. This implies that following short-run disequilibrium, 16.9% of the adjustment to the long-run takes place within one year. The above result shows that the R2 is 0.74, which shows that the model explains about 74% of the total variations in INF are explained by the independent variables during the period of the study while the remaining 26% is explained by a variable not included in the model.

The result also shows that exchange rate and lag inflation by one were statistically significant considering its probability value which was less than 0.05, but for NOX and MS the p-values were greater than 0.05 meaning that they are statistically insignificant. At 2.00; the Durbin-Watson statistics suggest evidence of no serial auto-correlation. This is an indication that the dependent variable (INF) is well explained by the independent variables.

Implications of the Study

The VECM result above showed that of all the explanatory variables used in the model, only the exchange rate was statistically significant and had a negative impact on inflation. Non-Oil export had a positive impact but was not statistically significant, so as money supply which negates the apriori expectation was also not statistically significant. The general observation from the estimates so far is that the literal notion that inflationary pressure in Nigeria has been much more occasioned by the expansionary monetary policy is not justified, as exchange rate fluctuation has also contributed significantly to the persistence increase in the general price level, as an increase in exchange rate has ultimately resulted in high cost of imported goods (Finished goods and Raw materials).

The R- square which was 74% and depicts goodness of fit as it shows that the explanatory could explain about 74% of the fluctuation in the inflation rate. The coefficient of the ECM also was consistent by assuming a negative value of -0.169 indicating that a deviation in the inflation rate from equilibrium is corrected by as low as 16.9 percent the following year.

Table 3: VECM Result

Variable	Coefficient	Std. Error	t-Statistic	Prob
C	10.88961	5.75456	1.89234	0.0611
D(INF(-1))	0.133729	0.02885	4.63532	0.0000
D(EXR(-1))	-0.537755	0.25157	-2.13758	0.0348
D(NOX(-1))	0.055020	0.05280	1.04211	0.2997
D(MS(-1))	-0.018296	0.01155	-1.58433	0.1160
ECM(-1)	-0.169428	0.10625	-1.59468	0.1137

R-squared = 0.74 F-statistic = 1.67 Durbin-Watson =2.00
SOURCE: Researcher's Own Computation (See Appendix II)

CONCLUSION

This study has shown that the fluctuating exchange rate has significantly impacted on the persistence inflation that the country has witnessed. As high exchange rate has led to imported inflation as such the monetary authority in their quest to curb inflation should not totally rely on this instrument to control inflation, but should use it to complement other macro-economic policies. More so, policies should be put in place to increase the domestic production of export commodities, which are currently short-supplied. The negative effect of the exchange rate has led to the persistence of inflation. In fact, the naira exchange to $1.00 is N450.00 at the parallel market instead of the official rate of N350.00. This is as a result of the naira being cheaper compared to the dollar. The demand for dollar has remained so high, hence the increase in the exchange rate and ultimately resulting in the high cost of imported goods cum imported inflation.

RECOMMENDATIONS

The results show that inflation in Nigeria is highly responsive to exchange rate depreciation, indicating that the model has a self-adjusting mechanism for correcting any deviation of the variables from equilibrium.

1. The government should make the economic investment friendly by putting in place political stability, security of lives and good economic climate to draw home foreign investors to boost the nation's productivity. This will also reduce capital flight plaguing the country.
2. The government should be serious with its economic reforms i.e Small and Medium Enterprises Equity Investment Scheme (SMEEIS) and others as this will enhance and promote the production of local goods, reduce pressure on imported goods which will automatically reduce the demand for the dollar. This would lead to a favorable exchange rate for the country
3. Efforts should be intensified to increase the volume of non-oil export to make up for the extra demand for foreign exchange that may be created by the depreciation of Naira.

REFERENCES

Adelowokan, V. (2012). The Impact of Exchange Rate Fluctuations on International Trade in Nigeria, *International Research Journal of Finance and Economics*, 23(9), 4-6.

Akeju K. (2014). Real Exchange Rates, Terms of Trade and Economic Growth in Nigeria, *Journal of Economics Theory*, 8 (2) 19-23.

Akonji, Z. (2013). Real Exchange Rate Misalignment and Economic Growth: An empirical Study for Maghreb Countries, *International Journal of Economics and Finance*, 3 (3), 190–201

Akpokodje, G. (2009). Exchange Rate Volatility and External Trade: The Experience of Selected African Courtiers. In AdeolaAdenikinju, DipoBusari and Sam Olofin (ed.). Applied Econometrics and Macroeconomic Modeling in Nigeria.

Aliyu, S.R.U. (2009). Impact of Oil Price Shock and Exchange Rate Volatility on Economic Growth in Nigeria: An Empirical Investigation, *Research Journal of International Studies*, 4 (2), 8-9.

Aliyu, S.U.R (2009a). Exchange Rate Volatility and Export Trade in Nigeria: An Empirical Investigation. MPRA Paper No. 1349. Retrieved from http://mpra.ub.unimuenchen.de/13490/pdf.

Aliyu, S.U.R (2009b). Impact of Oil Price Shock and Exchange Rate Volatility on Macroeconomic Growth in Nigeria: An Empirical Investigation. MPRA Paper No.16319. Available at: http://mpra.ub.unimuenchen.de/16319/pdf.

Aliyu, S.U.R (2010). Exchange Rate Pass - Through in Nigeria: Evidence from a Vector Error Correction Modeling. Conference Paper Presented in the University of Oxford. Available at: http://www.csae.ox.ac.uk/conference/2010-EDIA/papers/012-Aliyu.pdf.

Aliyu, S.U.R (2011). Impact of Oil Price Shock and Exchange Rate Volatility on Macroeconomic Growth in Nigeria: An Empirical Investigation. Research Journal of International Studies. Issue 11.

Anyanwu, J.C. (1993). *Monetary Economics Theory.* Onitsha: Hybrid Publishers.

Asinya, I. A. and Takon, L. (2014). Aid, Rear Exchange Rate Misalignment, and Economic Growth in Sub-Saharan Africa, *World Development*, 40 (4), 681–700.

Azeez, B.A., Kolapo, F.T. and Ajayi, L. B. (2012). Effect of Exchange Rate Volatility on Macroeconomic Performance in Nigeria. *Interdisciplinary Journal of Contemporary Research in Business*, (1), 149-155.

Babatunde, W. A. and Akinwade, A. A. (2010). Exchange Rate Volatility in Nigeria: Consistency, Persistency and Severity Analysis. *Central Bank of Nigeria Journal Applied Statistics*, 2 (2).

Bakare A.S. (2011). The Consequences of Foreign Exchange Rate Reforms on the Performances of Private Domestic Investment in Nigeria. *International Journal of Economics and Management Sciences*, 1 (1), 25-31.

Bakoulas. J. T., Baum, C. and Caglayan, M. (2002). Exchange Rate Effect on the Volume and Volatility of Trade Flows. *Journal of International Money and Finance*, 21 (1), 481-486.

Balami, D. H. (2006). *Macroeconomic Theory and Practice*, Salawe prints, Off Leventies, Wulari, Maiduguri.

Benita, G. and Lauterback, B. (2007). Policy Factors and Exchange Rate Volatility: A Panel Data versus a Specific Country Analysis. *International Research Journal of Finance and Economics*.

Brada, J. C. and Romails J. A. (2003). Exchange Rate Risk, Exchange Rate Regime and the Volume of International Trade, Kylos. *Journal of Economics and Finance*, 41, 263–280.

Calvo, G. and Reinhart, C. (2002). Fear of Floating. *Quarterly Journal of Economics*, 117 (2), p. 408.

Carrera, J. and Vuletin, G. (2003). The Effects of Exchange Rate Volatility: A Panel Data Approach. Unpublished Paper, Commercial Bank Plc, Research and Planning Unit.

CBN, (2008). The Foreign Exchange Market in Nigeria Available at: http://www.cenbank.org/IntOps \/FXMarket.asp

Central Bank of Nigeria, (2008). Annual Report and Statement of Account. Central Bank of Nigeria, Abuja.

Chong, F. and Tan, O. (2008). Exchange Misalignment and Its Effects on Agricultural Producer Support Estimate: *Empirical Evidence from India and China International Food Policy Research Institute* (IFPRI), MTID Discussion Paper, 81(9) 34-39, Washington DC.

Dada A. and Oyeranti O. A. (2012). Exchange Rate and Macroeconomic Aggregates in Nigeria.

Dewett, R. (1982). An Assessment of Currency Devaluation in Developing Countries. *Essays in International Finance*, 4 (6) 54-58. Princeton, N.J.: Princeton University.

Ebiringa, O. T. and Anyaogu, N. B. (2014). Exchange Rate, Inflation and Interest Rates Relationships: An Autoregressive Distributed Lag Analysis. *Journal of Economics and Development Studies*, 2 (2), 263-279.

Edwards, S. (1989). *Real Exchange Rates, Devaluation and Adjustment: Exchange Rate Policy in Developing Countries*. Cambridge, Mass.: MIT Press.

Egware, J. E. (2002). *The Theory of International Economic Policy*: *The Balance of Payment*, Oxford University Press, Oxford.

Eichengreen, B. and Lablang, D. (2003). Exchange Rates and Cohesion. Historical Perspective and Political Economy Considerations. *Journal of Common Market Studies*, 41 (1), 797-822.

Engle, R. F. and Granger, C. W. J. (1987). Cointegration and Error Correction: Representation, Estimation and Testing. *Econometrica*, 55 (2), 1-87.

Ettah, B. E. (2011). Effects of Price and Exchange Rate Fluctuations on Agricultural Exports in Nigeria. *International Journal of Economic Development Research and Investment*, 2 (1), 12-21.

Ewa, A. (2011). The Impact of Exchange Rate Fluctuation on the Nigeria Economic Growth (1980–2010). Unpublished B.Sc Thesis of Caritas University Emene, Enugu State, Nigeria.

Eze, T. and Okpala, A. A. (2014). Exchange Rate Volatility and Bank Performance in Nigeria *Asian Economic and Financial Review*, 3 (2), 178-185.

Fidelis, M. (2009). The Effects of Changes in Exchange Rate on Output, Prices and the Balance of Payments, *Journal of International Economics*, 8(6), 65-74.

Fouquin, S. (1999). Has the European Monetary System Led to More Exports? Evidence from Four European Union Countries, *Economic Letters*, 62, 357-363.

Gabriel, O. and Ujah, E. (2015). CBN Devalues Naira, Vanguard, 2 November, 2014: *Vanguard.com*. Web. 4 March, 2015.

Gbosi B. E. (2003). Exchange Rate behavior under Alternative Arrangement; Mimeo *International Monetary Fund.*

Gbosi, A. (2001). Fiscal Policy and Macroeconomic Stability in a Developing economy. Lessons from Nigeria Experience (1975). *First Bank of Nigeria Review*, 38-40.

Gbosi, A. N. (1994). *Money, Monetary Policy and the Economy*, Port Harcourt: Sodek.

Gold, K (1993). Exchange Rate Variability and the Level of International Trade. *Journal of International Economics*, 34 (3-4), 269–287.

Hinkle, K. (1999). Sectoral Effects of Exchange Rate Volatility on the U.S.A. Exports. *Journal of International Money and Finance*, 9, 222-322.

Imimole, B. and Enoma, A. (2011). Exchange Rate Depreciation and Inflation in Nigeria (1986–2008). *Business and Economics Journal*, BEJ (28), 1-12.

Jameela, O. Y. (2010). Exchange Rate Changes and Output Performance in Nigeria. *Pakistan Journal of Social Sciences*, 7 (5), 380-387.

Jhingan, M. L. (1997). *Macroeconomic Theory*, New Delhi: Vriuda Publication United Kin.

Kandil I. (2004). Exchange Fluctuations and Disaggregated Economic Activity in the US: Theory and Evidence. *Journal of International Money and Finance*, 1 – 31.

Lranlett, F. (1977). Classifying Exchange Rate Regimes: Deeds Vs. Words. *European Economic Review*, 49, 1603-1635.

Mahmood, I. and Ali, S. Z. (2011). Impact of Exchange Rate Volatility of Macroeconomic Performance of Pakistan. *International Journal of Finance and Economics*, 64 (1), 1450- 2887.

Mauna, P. and Reza, A. (2001). Algeria-The Real Exchange Rate, Export Diversification, and Trade, Protection*,* Policy Development and Review Department, *International Monetary Fund*.

Mehdi B. (2014). The Effect of Exchange Rate Fluctuations on Economic Growth Considering the Level of Development of Financial Markets in Selected Developing Countries. *Asian Economic and Financial Review*, 4 (4), 517-528.

Mireille, L. (2007). The Impact of the Real Exchange Rate on Manufacturing Exports in Benin, *Africa Region Working Paper Series*, 10 (7).

Mordi, C. N. (2006). Challenges of Exchange Rate Volatility in Economic Management in Nigeria. *CBN Bullion*, 30 (5), 17-25.

Nzotta, S. M. (2004). *Money Banking and Finance: Theory and Practice*. Hudson-Judge Nigerian Publishers, Owerri.

Obaseki, P. J. (1990). The Purchasing Power Parity Measure of Naira's Equilibrium Exchange Rate, *CBN Economic and Financial Review*, 36, 1-21.

Odusola, A.F. and Akinlo, A.E. (2001). Trade Growth and Causality in Nigeria. Ibadan: *The Nigerian Economic Society*, (45), 19-22.

Ogunleye, E. R. (2009). *Exchange Rate Volatility and Foreign Direct Investment (FDI) in Sub- Saharan Africa: Evidence from Nigeria and South Africa*. In Adeola Adenikinju, Dipo Basari and Sam Olofin (ed.). Applied Econometrics and Macroeconomic Modeling in Nigeria. Ibadan University Press.

Oleh, U. (2015). Battered Naira to Exchange- Economic Experts on Implications of High Exchange Rate, *Encomium*, *2 February*, *2015. Encomium.com.* Web. 4 March, 2015.

Olisadebe, E. U. (1995). The Role of Central Bank of Nigeria. *CBN Publication,* Lagos.

Olowe, R. A. (2009). Modeling Naira/Dollar Exchange Rate Volatility. Application of GARCH and Asymmetric Models. *International Review Journal of Business Research Papers*, 5 (3), 377-398.

Omojimite, B. U. and Akpokodje, A. (2010). The Impact of Exchange Rate Reforms on Trade Performance in Nigeria, *Journal of Social Science*, 23 (1), 53-62.

Onuoha, I. J (2014). Impact of Exchange Rate Variation and Inflation on the Economic Growth of Nigeria: An Empirical Approach. *Research Journal of Finance and Accounting*, 5 (22), 166-177.

Owoeye, T. and Ogunmakin A. A. (2013). Exchange Rate Volatility and Bank Performance in Nigeria *Asian Economic and Financial Review*, 3 (2), 178-185.

Paul, I. (1996). Assessing the Equilibrium Exchange Rate of the Malaysian Ringgit: A Comparison of Alternative Approaches. *Asian Economic Journal*, 22 (2), 179-208.

Philippe, A., Philippe, B., Romania, R. and Kenneth, R. (2006). Exchange Rate Volatility and Productivity Growth: The Role of Financial Development. NBER Working Paper No. 3468.

Razazadekarsalani, A., Haghir, F. and Behrooznia, A. (2011). The Effect of Exchange Rate Fluctuations on Real Gross Domestic Product (GDP) in Iran. *American Journal of Science Research*, 26 (1), 6-18.

Rasaq A. D. (2013). The Impact of Exchange Rate Volatility on the Macroeconomic Variables in Nigeria, *European Scientific Journal*, 9 (7), 32-41.

Usman, D. (2010). The Effect of Exchange Rate Fluctuations on the Nigerian Manufacturing Sector. *African Journal of Business Management*, 4 (14), 2994-2998.

Victor, O. and Eze, O. R. (2013). Effect of Bank Lending Rate on the Performance of Nigeria Deposit Money Banks. *International Journal of Business and Management Review*, 1 (1), 34-43.

Yakubu, A. (2007). Mutual Trade Flows and Exchange Risk. *Review of Economics and Statistics*, 69 (12), 488-495.

Yinusa, D. O. and Akinlo, E. A. (2005). Exchange Rate Volatility, Currency Substitution and Monetary Policy in Nigeria. MPRA Paper No. 16225.

APPENDIX

Data for Regression Analysis

YEAR	INF (%)	EXR (₦ : $)	NOX (₦' BILLION)	MS (₦' BILLION)
1981	20.555	0.6100	0.3	14.47
1982	5.882	0.6729	0.2	15.79
1983	22.222	0.7241	0.3	17.69
1984	40.909	0.7649	0.2	20.11
1985	3.226	0.8938	0.5	22.30
1986	6.25	2.0206	0.6	23.81
1987	11.765	4.0179	2.2	27.57
1988	34.211	4.5367	2.8	38.36
1989	49.02	7.3916	3.0	45.90
1990	7.895	8.0378	3.3	52.86
1991	12.195	9.9095	4.7	75.40
1992	44.565	17.2984	4.2	111.11
1993	57.143	22.0511	5.0	165.34
1994	57.416	21.8861	5.3	230.29
1995	72.729	81.0228	23.1	289.09
1996	29.291	81.2528	23.3	345.85
1997	10.673	81.6494	29.2	413.28
1998	7.862	83.8072	34.1	488.15
1999	6.618	92.3428	19.5	628.95
2000	6.938	101.7740	24.8	878.46
2001	18.869	111.4872	28.0	1,269.32
2002	12.883	120.6528	94.7	1,505.96
2003	14.033	129.2230	94.8	1,952.92
2004	15.001	133.0008	113.3	2,131.82
2005	17.856	131.1004	106.0	2,637.91
2006	8.218	128.1420	133.6	3,797.91
2007	5.413	125.0660	199.3	5,127.40
2008	11.581	117.7823	525.9	8,008.20
2009	12.543	147.2718	500.9	9,411.11
2010	13.72	148.3100	711.0	11,034.94
2011	10.841	151.8269	913.5	12,172.49
2012	12.217	155.4502	879.3	13,895.39
2013	8.476	155.2537	1,130.2	15,160.29
2014	8.057	156.4848	953.5	17,679.29
2015	9.00	191.8035	660.7	18,901.30

Regression Results

Unit Root

INF @ LEVEL

Null Hypothesis: INF has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=0)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.102490	0.1219
Test critical values:	1% level	-4.252879	
	5% level	-3.548490	
	10% level	-3.207094	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INF)
Method: Least Squares
Date: 11/13/17 Time: 17:30
Sample (adjusted): 1982 2015
Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF(-1)	-0.469889	0.151455	-3.102490	0.0041
C	14.30462	6.790297	2.106627	0.0433
@TREND("1981")	-0.302123	0.268952	-1.123331	0.2699

R-squared	0.237691	Mean dependent var	-0.339853
Adjusted R-squared	0.188509	S.D. dependent var	16.29147
S.E. of regression	14.67581	Akaike info criterion	8.294376
Sum squared resid	6676.762	Schwarz criterion	8.429054
Log likelihood	-138.0044	Hannan-Quinn criter.	8.340305
F-statistic	4.832949	Durbin-Watson stat	1.714594
Prob(F-statistic)	0.014895		

INF @ 1ST Difference

Null Hypothesis: D(INF) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=0)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.839618	0.0002
Test critical values:	1% level	-4.262735	
	5% level	-3.552973	
	10% level	-3.209642	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INF,2)
Method: Least Squares
Date: 11/13/17 Time: 17:31
Sample (adjusted): 1983 2015
Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INF(-1))	-1.049211	0.179671	-5.839618	0.0000
C	2.614058	6.256433	0.417819	0.6791
@TREND("1981")	-0.141012	0.307378	-0.458756	0.6497

R-squared	0.532415	Mean dependent var	0.473212
Adjusted R-squared	0.501242	S.D. dependent var	23.79071
S.E. of regression	16.80166	Akaike info criterion	8.567341
Sum squared resid	8468.878	Schwarz criterion	8.703387
Log likelihood	-138.3611	Hannan-Quinn criter.	8.613116
F-statistic	17.07970	Durbin-Watson stat	1.960231
Prob(F-statistic)	0.000011		

EXR @ Level

Null Hypothesis: EXR has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=0)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.556946	0.3009
Test critical values:	1% level	-4.252879	
	5% level	-3.548490	
	10% level	-3.207094	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXR)
Method: Least Squares
Date: 11/13/17 Time: 17:32
Sample (adjusted): 1982 2015
Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXR(-1)	-0.318297	0.124483	-2.556946	0.0157
C	-6.931562	5.408977	-1.281492	0.2095
@TREND("1981")	2.072840	0.761436	2.722277	0.0105

R-squared	0.194272	Mean dependent var	5.623338
Adjusted R-squared	0.142289	S.D. dependent var	12.51621
S.E. of regression	11.59160	Akaike info criterion	7.822535
Sum squared resid	4165.320	Schwarz criterion	7.957214
Log likelihood	-129.9831	Hannan-Quinn criter.	7.868465
F-statistic	3.737250	Durbin-Watson stat	1.889790
Prob(F-statistic)	0.035150		

EXR @ 1^{ST} Difference

Null Hypothesis: D(EXR) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=0)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.754111	0.0002
Test critical values:	1% level	-4.262735	
	5% level	-3.552973	
	10% level	-3.209642	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXR,2)
Method: Least Squares
Date: 11/13/17 Time: 17:33
Sample (adjusted): 1983 2015
Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXR(-1))	-1.134373	0.197141	-5.754111	0.0000
C	3.023965	4.848609	0.623677	0.5376
@TREND("1981")	0.189032	0.235265	0.803486	0.4280

R-squared	0.527187	Mean dependent var	1.068358
Adjusted R-squared	0.495666	S.D. dependent var	18.10755
S.E. of regression	12.85934	Akaike info criterion	8.032526
Sum squared resid	4960.879	Schwarz criterion	8.168572
Log likelihood	-129.5367	Hannan-Quinn criter.	8.078301
F-statistic	16.72502	Durbin-Watson stat	1.884697
Prob(F-statistic)	0.000013		

NOX @ LEVEL

Null Hypothesis: NOX has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=0)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.661517	0.7463
Test critical values:	1% level	-4.252879	
	5% level	-3.548490	
	10% level	-3.207094	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(NOX)
Method: Least Squares
Date: 11/13/17 Time: 17:34
Sample (adjusted): 1982 2015
Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NOX(-1)	-0.140612	0.084628	-1.661517	0.1067
C	-39.66840	42.40886	-0.935380	0.3568
@TREND("1981")	4.929458	2.830958	1.741269	0.0916

R-squared	0.095982	Mean dependent var	19.42353
Adjusted R-squared	0.037658	S.D. dependent var	106.0653
S.E. of regression	104.0490	Akaike info criterion	12.21170
Sum squared resid	335611.8	Schwarz criterion	12.34638
Log likelihood	-204.5989	Hannan-Quinn criter.	12.25763
F-statistic	1.645679	Durbin-Watson stat	1.582176
Prob(F-statistic)	0.209288		

NOX @ 1^{ST} Difference

Null Hypothesis: D(NOX) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=0)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.215383	0.0112
Test critical values:	1% level	-4.262735	
	5% level	-3.552973	
	10% level	-3.209642	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(NOX,2)
Method: Least Squares
Date: 11/13/17 Time: 17:35
Sample (adjusted): 1983 2015
Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(NOX(-1))	-0.949508	0.225248	-4.215383	0.0002
C	-2.603856	41.57786	-0.062626	0.9505
@TREND("1981")	1.175586	2.142944	0.548585	0.5874

R-squared	0.383268	Mean dependent var	-8.869697
Adjusted R-squared	0.342152	S.D. dependent var	135.9730
S.E. of regression	110.2847	Akaike info criterion	12.33052
Sum squared resid	364881.7	Schwarz criterion	12.46656
Log likelihood	-200.4535	Hannan-Quinn criter.	12.37629
F-statistic	9.321735	Durbin-Watson stat	1.720551
Prob(F-statistic)	0.000710		

MS @ LEVEL

Null Hypothesis: MS has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=0)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		2.347712	1.0000
Test critical values:	1% level	-4.252879	
	5% level	-3.548490	
	10% level	-3.207094	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(MS)
Method: Least Squares
Date: 11/13/17 Time: 17:35
Sample (adjusted): 1982 2015
Included observations: 34 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MS(-1)	0.061017	0.025990	2.347712	0.0254
C	-281.5639	190.3364	-1.479296	0.1492
@TREND("1981")	36.58338	13.36997	2.736235	0.0102

R-squared	0.681731	Mean dependent var	555.4950
Adjusted R-squared	0.661197	S.D. dependent var	779.1103
S.E. of regression	453.4947	Akaike info criterion	15.15594
Sum squared resid	6375382.	Schwarz criterion	15.29062
Log likelihood	-254.6510	Hannan-Quinn criter.	15.20187
F-statistic	33.20094	Durbin-Watson stat	1.576311
Prob(F-statistic)	0.000000		

MS @ 1ST Difference

Null Hypothesis: D(MS) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=0)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.803120	0.0290
Test critical values:	1% level	-4.262735	
	5% level	-3.552973	
	10% level	-3.209642	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(MS,2)
Method: Least Squares
Date: 11/13/17 Time: 17:36
Sample (adjusted): 1983 2015
Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(MS(-1))	-0.643456	0.169192	-3.803120	0.0007
C	-369.8341	200.0876	-1.848361	0.0744
@TREND("1981")	41.73696	13.68469	3.049902	0.0048

R-squared	0.325380	Mean dependent var	36.99061
Adjusted R-squared	0.280406	S.D. dependent var	541.3738
S.E. of regression	459.2415	Akaike info criterion	15.18354
Sum squared resid	6327082.	Schwarz criterion	15.31958
Log likelihood	-247.5284	Hannan-Quinn criter.	15.22931
F-statistic	7.234749	Durbin-Watson stat	2.220649
Prob(F-statistic)	0.002728		

Cointegration Result

Date: 11/13/17 Time: 17:37
Sample (adjusted): 1983 2015
Included observations: 33 after adjustments
Trend assumption: Linear deterministic trend
Series: INF EXR NOX MS
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.545746	53.93312	47.85613	0.0121
At most 1	0.462066	27.89289	29.79707	0.0816
At most 2	0.196836	7.432258	15.49471	0.5279
At most 3	0.006006	0.198781	3.841466	0.6557

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

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.545746	26.04024	27.58434	0.0777
At most 1	0.462066	20.46063	21.13162	0.0618
At most 2	0.196836	7.233477	14.26460	0.4619
At most 3	0.006006	0.198781	3.841466	0.6557

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

INF	EXR	NOX	MS
-0.039277	-0.002680	-0.025596	0.002113
-0.066668	-0.011766	0.018968	-0.001459
0.009794	0.003182	0.023234	-0.001418
-0.013233	0.028414	0.023952	-0.001985

Unrestricted Adjustment Coefficients (alpha):

D(INF)	4.313642	6.189477	-1.159126	-0.744684
D(EXR)	-4.943589	-1.137493	0.763782	-0.730887

D(NOX)	18.87760	-13.31736	-43.70874	1.285273
D(MS)	306.1702	-162.8379	-1.755227	-0.319643

1 Cointegrating Equation(s):		Log likelihood	-694.4932
Normalized cointegrating coefficients (standard error in parentheses)			
INF	EXR	NOX	MS
1.000000	0.068230	0.651669	-0.053798
	(0.13527)	(0.20529)	(0.01576)
Adjustment coefficients (standard error in parentheses)			
D(INF)	-0.169428		
	(0.10625)		
D(EXR)	0.194170		
	(0.08108)		
D(NOX)	-0.741458		
	(0.78048)		
D(MS)	-12.02549		
	(2.78188)		

2 Cointegrating Equation(s):		Log likelihood	-684.2629
Normalized cointegrating coefficients (standard error in parentheses)			
INF	EXR	NOX	MS
1.000000	0.000000	1.241703	-0.101496
		(0.30891)	(0.02327)
0.000000	1.000000	-8.647759	0.699076
		(2.05988)	(0.15519)
Adjustment coefficients (standard error in parentheses)			
D(INF)	-0.582069	-0.084386	
	(0.18792)	(0.02931)	
D(EXR)	0.270005	0.026632	
	(0.15883)	(0.02477)	
D(NOX)	0.146385	0.106103	
	(1.52475)	(0.23779)	
D(MS)	-1.169388	1.095460	
	(4.91478)	(0.76648)	

3 Cointegrating Equation(s):		Log likelihood	-680.6461
Normalized cointegrating coefficients (standard error in parentheses)			
INF	EXR	NOX	MS
1.000000	0.000000	0.000000	-0.016275
0.000000	1.000000	0.000000	0.105565
0.000000	0.000000	1.000000	-0.068632
Adjustment coefficients (standard error in parentheses)			
D(INF)	-0.593421	-0.088074	-0.019942
	(0.18862)	(0.03018)	(0.09536)
D(EXR)	0.277485	0.029062	0.122705
	(0.15969)	(0.02555)	(0.08073)
D(NOX)	-0.281707	-0.032981	-1.751329
	(1.38984)	(0.22239)	(0.70263)

D(MS)	-1.186579	1.089875	-10.96609
	(4.95393)	(0.79267)	(2.50445)

VEC Result

Vector Error Correction Estimates
Date: 11/13/17 Time: 17:39
Sample (adjusted): 1983 2015
Included observations: 33 after adjustments
Standard errors in ( ) & t-statistics in [ ]

CointegratingEq:	CointEq1
INF(-1)	1.000000
EXR(-1)	0.068230
	(0.13527)
	[0.50440]
NOX(-1)	0.651669
	(0.20529)
	[3.17435]
MS(-1)	-0.053798
	(0.01576)
	[-3.41313]
C	23.91773

Error Correction:	D(INF)	D(EXR)	D(NOX)	D(MS)
CointEq1	-0.169428	0.194170	-0.741458	-12.02549
	(0.10625)	(0.08108)	(0.78048)	(2.78188)
	[-1.59468]	[2.39480]	[-0.95000]	[-4.32280]
D(INF(-1))	0.133729	-0.035244	0.286179	3.414265
	(0.07885)	(0.13649)	(1.31385)	(4.68295)
	[4.635326]	[-0.25822]	[0.21782]	[0.72908]
D(EXR(-1))	-0.537755	-0.199282	1.303101	5.719473
	(0.25157)	(0.19198)	(1.84806)	(6.58703)
	[-2.13758]	[-1.03802]	[0.70512]	[0.86829]
D(NOX(-1))	0.055020	-0.096784	0.376776	6.416230
	(0.05280)	(0.04029)	(0.38785)	(1.38240)
	[1.04211]	[-2.40212]	[0.97146]	[4.64138]
D(MS(-1))	-0.018296	0.024955	-0.068327	-0.545596
	(0.01155)	(0.00881)	(0.08483)	(0.30236)
	[-1.58433]	[2.83170]	[-0.80545]	[-1.80444]
C	10.88961	-3.842824	39.66074	653.2900

	(5.75456)	(4.39151)	(42.2731)	(150.674)
	[1.89234]	[-0.87506]	[0.93820]	[4.33578]
R-squared	0.737200	0.260992	0.051309	0.773287
Adj. R-squared	0.695941	0.124139	-0.124375	0.731303
Sum sq. resids	6519.600	3796.857	351824.0	4469649.
S.E. equation	15.53920	11.85851	114.1513	406.8692
F-statistic	1.679183	1.907093	0.292053	18.41865
Log likelihood	-134.0450	-125.1244	-199.8522	-241.7941
Akaike AIC	8.487574	7.946935	12.47589	15.01783
Schwarz SC	8.759666	8.219027	12.74798	15.28992
Mean dependent	0.094485	5.791836	20.01515	572.2882
S.D. dependent	16.34294	12.67105	107.6528	784.9165

Determinant resid covariance (dof adj.)	4.99E+13
Determinant resid covariance	2.24E+13
Log likelihood	-694.4932
Akaike information criterion	43.78747
Schwarz criterion	45.05723

System Equation

System: UNTITLED
Estimation Method: Least Squares
Date: 11/14/17 Time: 10:55
Sample: 1983 2015
Included observations: 33
Total system (balanced) observations 132

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.169428	0.106246	-1.594676	0.1137
C(2)	0.133729	0.028852	4.635325	0.0000
C(3)	-0.537755	0.251573	-2.137575	0.0348
C(4)	0.055020	0.052797	1.042109	0.2997
C(5)	-0.018296	0.011548	-1.584329	0.1160
C(6)	10.88961	5.754560	1.892344	0.0611
C(7)	0.194170	0.081080	2.394799	0.0184
C(8)	-0.035244	0.136488	-0.258223	0.7967
C(9)	-0.199282	0.191984	-1.038016	0.3016
C(10)	-0.096784	0.040291	-2.402116	0.0180
C(11)	0.024955	0.008813	2.831702	0.0055
C(12)	-3.842824	4.391509	-0.875058	0.3835
C(13)	-0.741458	0.780484	-0.949999	0.3442
C(14)	0.286179	1.313849	0.217817	0.8280
C(15)	1.303101	1.848058	0.705119	0.4823
C(16)	0.376776	0.387846	0.971458	0.3335
C(17)	-0.068327	0.084831	-0.805451	0.4223
C(18)	39.66074	42.27312	0.938202	0.3502
C(19)	-12.02549	2.781877	-4.322798	0.0000
C(20)	3.414265	4.682948	0.729084	0.4675
C(21)	5.719473	6.587029	0.868293	0.3872
C(22)	6.416230	1.382398	4.641376	0.0000
C(23)	-0.545596	0.302364	-1.804436	0.0739
C(24)	653.2900	150.6740	4.335784	0.0000

Determinant residual covariance		2.24E+13		

Equation: D(INF) = C(1)*(INF(-1) + 0.0682297244465*EXR(-1) + 0.651669111353*NOX(-1) - 0.0537978917667*MS(-1) + 23.9177290848) + C(2)*D(INF(-1)) + C(3)*D(EXR(-1)) + C(4)*D(NOX(-1)) + C(5)*D(MS(-1)) + C(6)
Observations: 33

R-squared	0.237200	Mean dependent var	0.094485
Adjusted R-squared	0.095941	S.D. dependent var	16.34294
S.E. of regression	15.53920	Sum squared resid	6519.600

Durbin-Watson stat	2.003450

Equation: D(EXR) = C(7)*(INF(-1) + 0.0682297244465*EXR(-1) + 0.651669111353*NOX(-1) - 0.0537978917667*MS(-1) + 23.9177290848) + C(8)*D(INF(-1)) + C(9)*D(EXR(-1)) + C(10)*D(NOX(-1)) + C(11)*D(MS(-1)) + C(12)

Observations: 33

R-squared	0.260992	Mean dependent var	5.791836
Adjusted R-squared	0.124139	S.D. dependent var	12.67105
S.E. of regression	11.85851	Sum squared resid	3796.857
Durbin-Watson stat	2.015349		

Equation: D(NOX) = C(13)*(INF(-1) + 0.0682297244465*EXR(-1) + 0.651669111353*NOX(-1) - 0.0537978917667*MS(-1) + 23.9177290848) + C(14)*D(INF(-1)) + C(15)*D(EXR(-1)) + C(16) *D(NOX(-1)) + C(17)*D(MS(-1)) + C(18)

Observations: 33

R-squared	0.051309	Mean dependent var	20.01515
Adjusted R-squared	-0.124375	S.D. dependent var	107.6528
S.E. of regression	114.1513	Sum squared resid	351824.0
Durbin-Watson stat	1.703052		

Equation: D(MS) = C(19)*(INF(-1) + 0.0682297244465*EXR(-1) + 0.651669111353*NOX(-1) - 0.0537978917667*MS(-1) + 23.9177290848) + C(20)*D(INF(-1)) + C(21)*D(EXR(-1)) + C(22) *D(NOX(-1)) + C(23)*D(MS(-1)) + C(24)

Observations: 33

R-squared	0.773287	Mean dependent var	572.2882
Adjusted R-squared	0.731303	S.D. dependent var	784.9165
S.E. of regression	406.8692	Sum squared resid	4469650.
Durbin-Watson stat	1.856473		