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Notes to Contributors

Information on manuscript submission is provided on the last and inside back cover of the Review.

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Foreign Direct Investment-Trade Nexus in Nigeria: Do Structural Breaks Matter?

Mohammed S. and B. I. Ekundayo*

Abstract

In this paper, three innovations are introduced to the literature on the Foreign Direct Investment (FDI)-trade nexus: identification and consideration of structural breaks in the underlying time series data; use of disaggregated data set that captures the oil and non-oil dichotomy of the Nigerian economy; and introduction of identified break in the short-run model. We found the existence of a co-integrating relationship between the variables amidst observed breaks in 1980 and 1992. Thus, considering structural breaks in estimations cannot be downplayed as ignoring this may yield biased and inconsistent estimates. Findings revealed a one-way causal linkage between non-oil imports and oil exports to oil FDI with no reverse causality observed, while non-oil FDI was found to Granger cause non-oil exports. The results made a case for further diversification of trade in a bid to dampen the effects of exogenous shocks as well as gearing more efforts towards the provision of an enabling environment, particularly in the non-oil sector to spur direct investments.

Keywords: Foreign direct investment, trade, structural breaks, oil, non-oil, causality

JEL Classification Numbers:C30, F14, F21, Q40

I. Introduction

Foreign direct investments (FDI) and trade are critical components of development and their relationship has continued to attract attention. Specifically, the question as to whether they are complements or substitutes, particularly in view of structural changes, has been given little or no attention in the literature. It is against this background that this study seeks to peruse this linkage in

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Nigeria, an oil-dependent economy, vulnerable to the global crude oil market that makes it susceptible to sudden shocks through the finance and trade channels.

Unprecedented growth of international trade flows over the last decades has been matched by a no less dramatic surge in the activities of Multinational Enterprises (MNEs) and a common measure of such activity is FDI (Bowen, Hollander and Viaene, 1998). The growing importance of FDI is reflected in the values of international production, which has witnessed significant expansion in the last two decades and is presently of considerable importance in the world economy (Forte, 2004). Quite a number of studies have examined this crucial relationship and the dominant argument is that larger flow of FDIs stimulates increased volume of trade as well as other benefits such as high rates of total factor productivity and output growth. Aizenman and Noy (2005), for example, found a strong feedback effect between FDI and manufacturing trade, while Fontagne and Freudenberg (1999) opined that until the mid1980s, international trade generated FDIs, but after this period, the cause and effect linkage seems to have reversed with FDI heavily influencing trade.

Nevertheless, studies have shown that international trade and FDIs are complements rather than substitutes if trade between two countries is based on comparative advantage (Chaisrisawatsuk and Chaisrisawatsuk, 2007). It follows therefore to expect that the relationship between FDI and trade will be bi-directional, but it is less evident whether the impact of trade on FDI should be different for a resource-dependent economy and, the nature of the relationship if structural breaks are taken into account.

Few studies have examined jointly the causal links between FDI and trade, particularly in view of the oil and non-oil dichotomy, which exemplifies the structure of the Nigerian economy. Studies that distinguished between oil and non-oil FDI, as well as oil and non-oil exports and imports are scarce. In addition, such empirical exercises are sparsely considered, if ever carried out in Nigeria's context. In this study, an attempt is made to bridge these gaps by investigating the causal links between oil and non-oil components of FDI, as well as exports and imports in Nigeria. The methodology relies on Granger non-causality testing, predicated on a modified Wald (MWALD) Vector Autoregression (VAR) based model, where all the variables, including the identified break points are treated as endogenous. Its potency lies in its ability to identify both direct and indirect causalities between the variables considered.

The rest of the paper is organised as follows: Section 2 presents a synoptic background to the study, while Section 3 reviews the theoretical and empirical links between FDI and trade. Section 4 provides an exposition of the methodology and Section 5 discusses the results. Section 6 concludes the paper with some policy implications.

II. Stylised Facts

This section presented stylised facts on the evolution of FDI, import and export (Total trade) in Nigeria between 1960 and 2010. The trends of the highlighted macroeconomic variables were cautiously examined and discussed. Table(s) and pictorial representations of the data were used to reinforce the observed patterns. Descriptive approach was used in this section.

Table 1: Average FDI and Trade Flows for Oil and Non-Oil in Nigeria: 1960-2010 (₦ million)

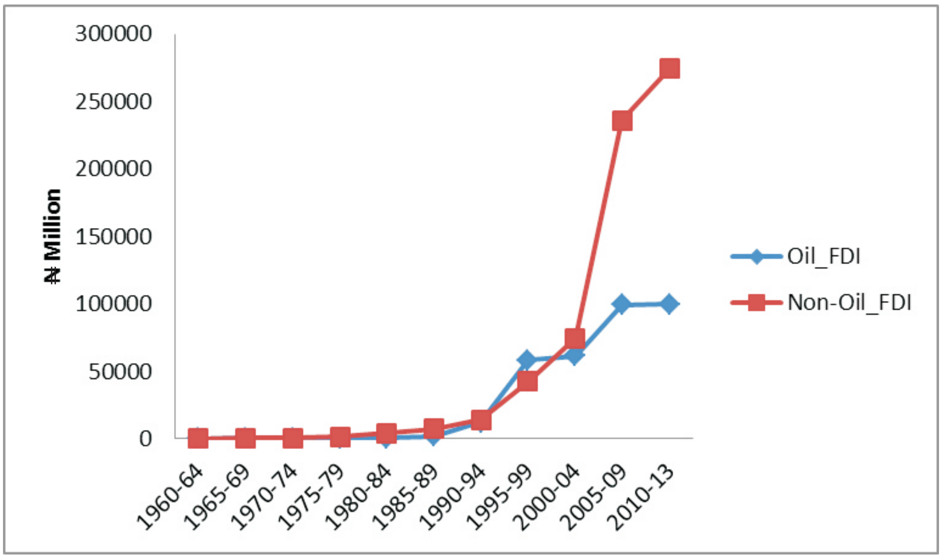
	FDI		Import		Export		Total Trade	
Year	Oil	Non-Oil	Oil	Non-Oil	Oil	Non-Oil	Oil	Non-Oil
1960-64	136.65	290.57	35.05	406.12	34.16	332.19	69.21	738.31
1965-69	422.12	444.5	35.11	442.22	160.17	369.57	195.28	811.80
1970-74	762.5	690.18	45.54	1111.96	1979.60	357.69	2025.15	1469.65
1975-79	771.48	1695.24	131.04	6198.54	6705.18	536.52	6836.22	6735.06
1980-84	678.28	4023.52	205.34	9552.2	9671.56	329.82	9876.9	9882.02
1985-89	1910.86	7264.02	2522.1	14120.66	26250.6	1782.6	28772.7	15903.26
1990-94	12213.14	14253.68	23378.5	97976.6	167871.5	4501	191250	102477.6
1995-99	58317.38	42577.6	174484.6	598196.4	1062709	25830	1237193	624026.4
2000-04	61577.9	74597.34	307334.3	1277301	2578575	71129.83	2885909	1348431
2005-09	99222.7	235771.9	945296.6	3077436	8084610	195160.1	9029906	3272597
2010-13	99993.43	274326	2311220.87	5719946.9	12287803.17	455194.21	14599024.04	6175141.11

Source: *CBN, 2011.*

Table 1 showed the level of FDI, import, export and total trade in the oil and non-oil sectors from 1960 to 2013. It is evident from the table that all the macroeconomic variables considered trended upward. Some of what could be responsible for the upward trend included: the prevailing economic conditions; bilateral relations and trade agreements; exploration of crude oil in commercial quantities that led to the influx of multinational companies; huge increases in oil-based exports; and global economic condition, among other reasons.

Oil FDI increased progressively all through the study period. On the contrary, non-oil FDI increased moderately until the period 2000-2004 when there was substantial jump from ₦74.6 billion to ₦235.8 billion in the period 2005-09. Thereafter, non-oil FDI was relatively stable, although marginal increase was observed in the period 2010-2013 when it increased to ₦274.3 billion. Evolution of oil and non-oil FDI from 1960 to 2013 is illustrated in Figure 1.

Figure 1: Average Oil and Non-Oil FDI: 1960-2013

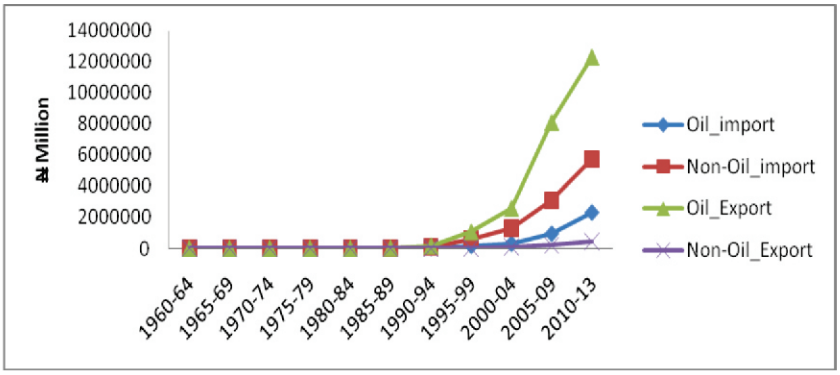


Source: *CBN Statistical Bulletin, 2011.*

Oil import increased marginally from 1960 to 1984, but substantial increases were observed thereafter. For the period 1960-1964, non-oil FDI stood at ₦35.05 million, which was about the lowest during the period considered, but gradually rose to ₦205.34 million in the period 1980-1984. The increase was more than ten-fold in the period 1985-89 (₦2552.1 million) in relation to the preceding period. The geometric increase in import persisted in the period 2010-13. Non-oil Import assumed similar trend with oil import, only that the slope of the trend of non-oil import was conspicuously steeper from the period 1990-94 relative to oil import in the same period (see Figure 2).

As depicted in Figure 2, there was no striking difference between the volume of oil and non-oil export until the period 1995-99, when oil export rose precipitously above its counterpart. Oil export rose from ₦34.16 million in the period 1960-64 to ₦9671.56 million in the period 1980-84. Thereafter, it rose from ₦26250.6 million in the period 1985-89 to the peak of ₦112.3 trillion in 2010. On the contrary, non-oil export was ₦332.19 million in the period 1960-1964 and reached ₦536.32 million in the period 1975-79. There was decline in volume of non-oil export in the period 1980-84 relative to the preceding period. However, the trend consistently increased from the period 1985 to 1989 through the period 2010-13, but the rate of increase in non-oil export was smaller relative to oil export.

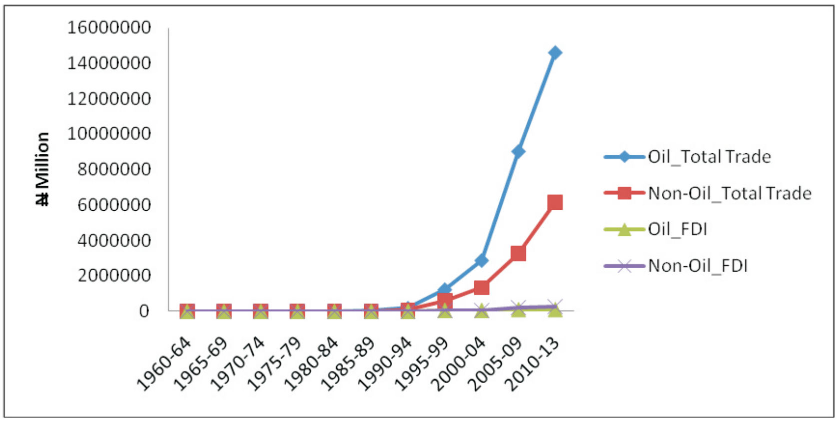
Figure 2: Average Oil and Non-Oil for Import and Export: 1960-2013



Source: CBN, 2011.

Total oil trade persistently increased all through the study period, ranging between ₦69.21 million and N14.6 trillion (oil) as well as ₦738.31million and ₦6.2 trillion (non-oil) in the periods 1960-64 and 2010-13, respectively. One striking feature of the evolution of total trade is that the rate of growth and volume of oil significantly increased faster than that of the non-oil, especially in the 1970s when oil took over from agriculture as the mainstay of the economy. A comparative analysis of the evolution of FDI and total trade for both categories (oil and non-oil) showed that the slopes of oil and non-oil total trade were significantly steeper than that of the FDI for both classes, especially from the period 1990 to 1994 (see Figure 3). This cursory observation suggested that there is divergence among the patterns of FDI and trade in Nigeria, reinforcing the need to empirically validate the nature of the relationships that exist between the duo (FDI and total trade).

Figure 3: Average Oil and Non-Oil for FDI and Total Trade: 1960-2010



Source: *CBN, 2011.*

III. Literature Review and Theoretical Framework

The international trade literature makes provision for the relationship between FDI and exports. Mundell (1957), using the H-O-S (Heckscher-Ohlin-Samuelson) model demonstrated that the difference in comparative advantage is the basis of trade. Neutralising the assumption of factor mobility, trade between two countries takes place to a level at which factor price tends to equalize in both countries, in absolute as well as in relative terms. However, once capital is allowed to move freely across the countries, i.e., from the capital-abundant to capital-scarce country, the difference in factor prices are reduced, while the difference in comparative cost will diminish. Hence, trade will decline and will be substituted completely by FDI. Evidently, the conclusion that both trade in goods and factors are substitutes is derived from the H-O factor endowment theory, which assumes perfectly competitive markets, identical constant returns to scale production function and the absence of transportation cost.

On the other hand, the complementary relationship between FDI and trade is exemplified by the Flying Geese model introduced in the early 1960s. The model assumes that Multinational Enterprises (MNEs) relocate production based on cost of labour inputs to reduce production cost and maintain competitiveness. Using the host country's abundant factor, the MNEs increase the export supply capacity of the host country and bring in new technology, capital equipment, and managerial expertise as well. Vernon (1966), Product Life Cycle (PLC) hypothesis also explained a positive role of FDI in promoting exports from host countries. He argued that technology passes through four stages of production, namely innovation, growth, maturity and decline[2] .

The proximity concentration hypothesis postulates that greater transaction costs resulting from higher trade barriers and transportation cost, lead to horizontal cross-border production expansion and thus, stimulate international investment. This implies that international trade is more or less a substitute for international investment. The factor proportion hypothesis predicts that international trade and investment are complements as firms take advantage of factor price differences through cross-border vertical production integration.

A pertinent observation from the literature is that the thrust of this linkage has viewed FDI as market seeking, resource seeking or as efficiency seeking (Sadiq and Bolbol, 2001). Nonetheless, it is pertinent to note that there is also a tendency to characterise market- and resource-seeking FDI as trade-diverting, while efficiency-seeking FDI may be viewed as trade-creating given the possibility that FDI to host countries might also

2 This view assumes that FDI comes only in those sectors in which the host country has comparative disadvantage. Such FDIs come only to supply domestic market of host countries and hence plays no role in increasing exports. So FDI replace imports with domestic production.
Applying Vernon model at industry level, Kojima (1973, 1985) found when FDI is made in the sector in which the country of origin has comparative disadvantage and the host country has comparative advantage, then this kind of investment has trade creating effect implying that the host country's export will increase.

service other market(s) (Tadesse and Ryan, 2002). The inclusion of issues such as market size, proximity of the sources of demand and globalisation processes are added, the debate on whether movements in factors create or divert trade becomes increasingly clouded as it adds an additional dimension to the problem: the competitiveness of both the investing; and the host country industries (ibid.).

It, thus, follows that if FDI displaces trade, exports will be at least replaced by domestic sales in foreign markets and this is detrimental to the domestic industry of the investing country. On the contrary, if trade and FDI are complements, investing abroad might lead to greater competitiveness of the foreign market and this is beneficial to exports from the investing country and therefore to its industries. It is therefore important to include as many heterogeneous host nations as possible in the sample, while evaluating the FDI-trade link (Tadesse and Ryan, 2002). While early international trade literature suggest that factor and product movements are substitutes rather than complements (Mundell, 1957), recent theoretical and empirical investigations have failed to support this conclusion. To a large extent, this conclusion seem to differ following the nature of investment (resource-, market-or efficiency-seeking), and host- and home-country relationships (proximity, bilateral and multilateral trade and investment agreements). An important aspect that is missing from the empirical literature is that very few of the studies evaluate the FDI-trade link while simultaneously controlling the geographic, development, and markets servicing (mainly host, regional, home or non-regional markets) diversity of the host nations.

Waheed and Jawaid (2010) investigated the impact of inward foreign direct investment (FDI) on aggregate imports in Pakistan using the annual time series data for the period, 1981 to 2007. Their results suggested the existence of a significant long-run equilibrium relationship between inward FDI and aggregate imports in Pakistan, while the parsimonious short-term dynamic error-correction model confirmed a significant positive short-run relationship with high speed of adjustment. The causality result showed unidirectional causality running from inward FDI to aggregate imports in the country. The sensitivity analysis carried out in the study confirmed the robustness of the results.

Fontagne and Pajot (1997) demonstrated why and how much trade and FDI are complements at the macroeconomic level. They argued that spillovers between firms, within industries, and between industries, within the manufacturing sector, are a key issue and that biased estimates when models do not control for the fact that competitive industries export and invest more abroad are also an important concern. They took into cognizance these pertinent issues in their study and concluded that investing abroad improved the competitiveness of French industries. In the case of the US, they found that outward FDI flows complement trade flows whereas investing abroad was detrimental to the sectoral trade balance, or at best only slightly beneficial, depending on the combination of specific effects. They concluded that inward FDI is detrimental to the trade balance in the industries considered in both US and France.

Tadesse and Ryan (2002) examined the extent to which the FDI-trade nexus was influenced by host-country heterogeneities associated with the development (income) and market servicing roles of Japanese FDI host countries. Using the counts and values of Japanese aggregate FDI and trade flows into more than 100 geographically and developmentally diverse countries, they showed that Japanese FDI in the 1990s was generally trade creating. However, the extent to which FDI complemented trade varied by geographic, developmental and market servicing status of the host countries. Their findings also indicated that higher factor costs and exchange rate volatility lowered the occurrence and value of Japanese FDI and observed that Japanese FDI was mostly tariff jumping.

Aminian, Fung and Ilzaca (2007) examined the trend and nature of East Asian trade as well as ascertained the role of FDI in import and export behaviour of East-Asian intra-regional trade. They opined that the increased importance of East Asia as a trading region was due partially to the rising trade in components and parts. Premised on a gravity model, their analysis revealed that in general, FDI was important in explaining imports and exports of intra-East Asian trade and in particular, FDI was especially important in explaining trade in components and parts, followed by trade in capital goods. Their finding lent support to the fact that FDI and trade associated with production fragmentation in East Asia is complementary.

Abdel-Rahman (2007) used both multivariate granger causality and Johansen cointegration to examine the relationship between foreign investment and international trade in Bangladesh in the period 1972 to 2007. The results revealed that a long-run relationship existed between export, imports and FDI, but found that FDI Granger-caused imports and not exports, and contrary to expectations trade did not granger cause FDI.

Chaisrisawatsuk and Chaisrisawatsuk(2007) investigated bi-directional effects between international trade and investment using data from 26 Organisation for the Economic Cooperation and Development (OECD) and 6 Association of the Southeast Asian Nations (ASEAN) countries. They found that exports or imports were complementary with FDI inflows. The study identified trade facilitation as a key factor to induce FDI inflows to the host country from the home country. Bilateral FDI inflows were observed to have feedback effect on exports of not only the home and host countries, but also on those of other trading partners. Similar linkages between bilateral FDI inflows and imports were also observed.

Bezuidenhout and Naude (2008) investigated the relationship between trade and FDI for the Southern African Development Community (SADC) members and the countries which could potentially be SADC members for the period 1973-2004. Using the modified gravity model and panel methods of estimations, they found a positive relationship between exports and FDI. Political instability and distance were found to negatively influence FDI in SADC. Their results revealed differences in the patterns and determinants of FDI to SADC whether it was from the USA and UK or from Europe. Furthermore, they found a complementary relationship between FDI and trade to SADC in the case of Europe. The results were similar to that of Chaisrisawatsuket al. (2007).

Sultan (2013) examined the nature of relationship between export and FDI in India over the period, 1980 to 2010. He relied on Johansen co-integration method and found the existence of a stable long-run equilibrium relationship between FDI and export growth. The result of Granger causality based on vector error correction model (VECM) showed that causality runs from export to FDI inflow direction and not from FDI inflow to export direction. In the short-run, however, neither export Granger-caused FDI inflow nor FDI inflow Granger- caused export from India.

Duong, Anh and Phuong (2012) assessed the linkage between FDI and trade in the case of Vietnam. The authors found that there was a one-way causal linkage between trade and FDI. They also found a two-way causal linkage between import and FDI. Aizenman and Noy (2005) argued that while it is common to expect bi-directional linkages between FDI and trade in goods, it is difficult to indicate whether inflows and outflows of FDI distinctly affect trade in different goods. They found the existence of bidirectional causality from FDI flows to trade openness. Raff (2004) investigated the effect of Free Trade Agreement (FTA) on FDI location selection and its impacts on social welfare. He found that economic integration, through tariff reduction led to greater FDI inflows and invariably led to social welfare improvement.

Okpe and Abu (2009) investigated the effect of foreign private investment on poverty in Nigeria. The study covered the period 1975 to 2003 and employed ordinary least square technique. The analysis carried out demonstrated that the inflow of foreign private investment and foreign loan significantly alleviated poverty in Nigeria. The authors advocated for inflow of foreign private investment as well as infrastructural development, especially in the rural area. Awolusi (2012) investigated the long-and short-run equilibrium relationship among economic growth, FDI, trade and domestic investment in Nigeria for the period, 1970 to 2010. Multivariate cointegration technique and vector error-correction model were employed in the study. The findings affirmed the existence of cointegrated vectors, suggesting the existence of long-run relationship among economic growth, FDI, trade and domestic investment. Further, unidirectional and bidirectional causality were also reported among the employed variables. The study advocated for infrastructural development and enactment of policies that would attract FDI in the service sector, against the resource and market seeking FDI from developed economies.

Ndem et al., (2014) examined the determinants of foreign direct investment and their impact on the Nigerian economy from the period, 1975 to 2010. Ordinary least square, cointegration and error correction techniques were employed. The authors found that market size, openness, investment in infrastructure, and exchange rate positively influenced FDI, while political instability exerted negative influence on FDI. They recommended infrastructural improvement, political stability, enabling social-economic environment and technological improvement through knowledge spill over. Olufemi and Keke (2014) explored the impact of foreign private investment on economic growth in Nigeria. The study employed cointegration and error correction model techniques. The results showed that a substantial proportion of capital inflow were not productive, while political environment significantly eroded some of the productive portion of capital inflow. The authors submitted that the prospect of foreign investment in fast-tracking economic growth is enormous. However, certain conditions such as political and macroeconomic stability were identified to be germane to foreign private investment inflows. The literature on the FDI-Trade nexus is dominated by country- and group of country level studies. Studies in the category of the latter include (Blonigen, 2001 and Liu et al., 2001), while the former include (Nkuna, 2012 and List, 2001).

Although some of the aforementioned FDI-trade link literature showed that trade and FDI are substitutes, others maintained that trade and FDI were complementary. This is particularly true when competition in multiple foreign economies and under imperfect markets and uncertainty are considered (Helpman, 1984 and Markusen and Venables, 1998) and under this scenario, the link often turns out to be complementary. The huge strand of the empirical evidence concurs to the notion that trade and FDI are important modes of internationalisation that complement one another. In this regard, FDI might induce trade (Yamawaki, 1991) or trade might induce FDI (Eaton and Tamura, 1994).

Major issues arise from the empirical literature could be categorised in as follows. First, the use of highly aggregated FDI and trade data make it difficult to capture the precise relationship. Second, the studies ignored the role of structural breaks on the performance of FDI inflows and trade. In the case of the former, studies on the relationship between FDI and trade are generally constrained by data shortages. The few existing related researches carried out for Nigeria have not only offered little guidance on the relationship in the event of structural breaks in the time series at a more disaggregated level, but have not considered the FDI-trade nexus explicitly. For instance, Okpe and Abu (2009) examined the effects of foreign private investment on poverty in Nigeria. The study covered the period, 1975 to 2003 and employed ordinary least square technique. Aside that, structural breaks were not accounted for in the analysis and the focus of the study was not on trade.

Similarly, Ndem et al., (2014) investigated the determinants of foreign direct investment as well as its contributory role to the Nigerian economy. Their analysis, which employed ordinary least square and cointegration error correction techniques, did not account for the relationship in the event of structural breaks in the time series. Olufemi and keke (2014) studied the role of foreign private investment in fostering economic growth in Nigeria, but the role of trade was downplayed in the study and the study did not account for structural breaks. Awolusi (2012) attempted to explore the relationship between FDI and trade in Nigeria. The structural break that was not accounted for as well as the aggregative nature of the data employed to capture economic growth suggested re-examination of the outcome from the study. Therefore, the need for a study that addresses these issues to provide better understanding of this crucial nexus in Nigeria is imperative.

IV. Methodology

IV.1 The Model

We start by positing a linear structure for the causal factors of oil and non-oil FDI inflows in the spirit of Aizenman and Noy (2005), but differ from their specification in that we account for structural changes and the oil and non-oil dichotomy of the Nigerian economy. This results in the following specifications:

$$FDI_t(T) \qquad {}_iX_t(T) \qquad {}_t \tag{1}$$

Where the regressand $FDI_t(T)$ refers to FDI inflows at time t and type T (oil and non-oil), while ${}_iX_t(T)$ is a vector of trade variables (oil and non-oil imports and exports). The error term, assumed to be normally distributed with zero mean and constant variance is denoted by ${}_t$. In line with the theoretical literature, we expect a complementary and/or bi-directional relationship between the variables.

IV.2 Estimation Procedure

Unit Root Test

Prior to the cointegration and causality test, the mean reversion test of the series was carried out using the Zivot-Andrew (Z-A) Unit Root Test. Several studies have found that the conventional unit root tests fail to reject the unit root hypothesis for the series that are actually trend stationary with a structural break (Binh et al., 2010). The regression equations for the Z-A unit root are:

$$\Delta y_t = \hat{\mu}^A + \hat{\theta} DU_t(\hat{\lambda}) + \hat{\beta}^A t + \hat{\alpha}^A y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^A \Delta y_{t-j} + \hat{e}_t \quad (2)$$

$$\Delta y_t = \hat{\mu}^B + \hat{\beta}^B t + \hat{\gamma}^B DT_t^*(\hat{\lambda}) + \hat{\alpha}^B y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^B \Delta y_{t-j} + \hat{e}_t \quad (3)$$

$$\Delta y_t = \hat{\mu}^C + \hat{\theta}^C DU_t(\hat{\lambda}) + \hat{\beta}^C t + \hat{\gamma}^C DT_t^*(\hat{\lambda}) + \hat{\alpha}^C y_{t-1} + \sum_{j=1}^{k} \hat{c}_j^C \Delta y_{t-j} + \hat{e}_t \quad (4)$$

Where $DU_t(\hat{\lambda}) = 1$, if $t > T\lambda$, 0 otherwise; $DT_t^*(\lambda) = t - T\lambda$ if $t > T\lambda$, 0 otherwise. The hats indicate the estimated values of the break fraction. Zivot and Andrews (1992) unit root test suggested that we reject the null hypothesis of a unit root if computed *t* is less than the left-tail critical *t* value.

Gregory-Hansen (G-H) Co-integration Test

We employed the Gregory and Hansen (1996) tests for cointegration where the structural break is test-determined and the cointegrating vectors are allowed to change at an unknown time period. As earlier noted, this is because in general, failure to account for breaks can produce misleading results leading to incorrect inference. Esso (2010) opined that the cointegration framework of Engle and Granger, and Johansen have limitations, especially when dealing with economic data containing the structural breaks. In this case, we tend to reject the hypothesis of cointegration, albeit one with stable cointegrating parameters. This is because the residuals from the cointegrating regressions capture unaccounted breaks and, thus, typically exhibit non-stationary behavior.

Therefore, it is necessary to employ non-linear techniques for testing cointegration if the series have structural breaks. One of the widely used methods is the Gregory and Hansen (1996) threshold cointegration test. And the test equations (level shift, level shift and trend, and regime shift) are expressed as follows:

---

3 For comparison, the Augmented Dickey Fuller (ADF) test was conducted.

4 The Engle and Granger cointegration test is also used for comparability purpose.

$$y_{1t} \quad {}_1 \quad {}_{2\ t} \quad {}^{T}y_{2t} \quad e_t \tag{5}$$

$$y_{1t} \quad {}_1 \quad {}_{2\ t} \quad t \quad {}^{T}y_{2t} \quad e_t \tag{6}$$

$$y_{1t} \quad {}_1 \quad {}_{2\ t} \quad {}^{T}y_{2t} \quad {}^{T}y_{2t\ \ t} \quad e_t \tag{7}$$

Where y is the observed data and $_1$ and $_2$ represent the intercept before the shift and the change in the intercept at the time of the shift; φ is the dummy variable that captures structural change; β is the trend slope before the shift; is the slope coefficients and are assumed to be constant. Y_{1t}represents the dependent variable, while $Y_{2t}$is a vector of independent variable(s). The standard method to test the null hypothesis of no cointegration is residual-based and is obtained when equations (5, 6 and 7) are estimated using the ordinary least square (OLS) and the unit root tests are applied to the regression errors (Gregory and Hansen, 1996).

Toda-Yamamoto (T-Y) Granger Causality Test

This paper made use of the T-Y Granger non-causality technique to examine the causal relationship between FDI and trade. As pointed out by Clarke and Mirza (2006), unit root and cointegration might suffer from size distortions, which often imply the use of an inaccurate model for the non-causality test. To obviate some of these problems, based on augmented VAR modelling, T-Y introduced a Wald test statistic that asymptotically has a chi square (χ2) distribution irrespective of the order of integration or cointegration properties of the variables. The T-Y approach fits a standard VAR model on levels of the variables and therefore makes allowance for the long-run information often ignored in systems that require first differencing and pre-whitening (Clarke and Mirza, 2006).

The approach employs a modified Wald test for restrictions on the parameters of the VAR (k) where k is the lag length of the system. The basic idea of the T-Y approach is to artificially augment the correct order, k, by the maximal order of integration, say d_{max}. Once this is done, a $(k+d_{max})^{th}$ order of VAR is estimated and the coefficients of the last lagged d_{max} vectors are ignored (Caporale and Pittis, 1999). The causality test conducted is based on the multivariate system of equations:

$\varphi_t = \begin{bmatrix} 0 \ \ if\ t \le (n\pi) \\ 1 \ \ if\ t > (n\pi) \end{bmatrix}$ where the unknown parameter $0,1$ implies the timing of the break point, and n denotes integer part.

$$\begin{matrix} \ln OFDI_t \\ \ln NOFDI_t \\ \ln OIMP_t \\ \ln NOIMP_t \\ \ln OEXP_t \\ \ln NOEXP_t \\ {}_t \end{matrix} \quad A_0 \quad A_i \begin{matrix} \ln OFDI_{t\ i} \\ \ln NOFDI_{t\ i} \\ \ln OIMP_{t\ i} \\ \ln NOIMP_{t\ i} \\ \ln OEXP_{t\ i} \\ \ln NOEXP_{t\ i} \\ {}_{t\ i} \end{matrix} \quad \ldots \quad A_n \begin{matrix} \ln OFDI_{t\ n} \\ \ln NOFDI_{t\ n} \\ \ln OIMP_{t\ n} \\ \ln NOIMP_{t\ n} \\ \ln OEXP_{t\ n} \\ \ln NOEXP_{t\ n} \\ {}_{t\ n} \end{matrix} \quad \begin{matrix} {}_{\ln OFDI_t} \\ {}_{\ln NOFDI_t} \\ {}_{\ln OIMP_t} \\ {}_{\ln NOIMP_t} \\ {}_{\ln OEXP_t} \\ {}_{\ln NOEXP_t} \\ {}_t \end{matrix} \qquad (8)$$

In equation (8), $A_i \ldots A_n$ are supposedly 7×n matrices of coefficients with A_0 being the 7×1 identity matrix, ε_s are the error terms assumed to be white noise. From equation (8), we can test the hypothesis of Granger non-causality of oil FDI and the other variables that make up the system (excluding non-oil FDI) with the following hypothesis: $Ho \; \sum_{i=1}^{n} \; {}_{1i} \; 0$ and non-causality running from the other variables in the system (excluding to non-oil FDI) to oil FDI with the following hypothesis: $Ho \; \sum_{i=1}^{n} \; {}_{1i} \; 0$

Granger causality implies that the lagged value of non-oil FDI or oil FDI influence oil and non-oil exports and imports significantly in equation 8 and the lagged value of oil and non-oil imports and exports influence oil and non-oil FDI significantly in the system represented by equation 8. In other words, we can jointly test if the estimated lagged coefficients are different from zero using the F-statistic. When the joint test rejects the two null hypotheses that the lagged coefficients are not different from zero, causal relationships between the variables is confirmed.

IV.3 Data Issues

Annual data covering the period 1960 to 2013 were utilised for this paper and the description and source of data are presented in Table 2.

Table 2: The variables: description and sources of data[6]

Variable	Description	Source of data
Oil Foreign Direct Investment (OFDI)	Total annual inflow in million naira	Central Bank of Nigeria Statistical Bulletin 2013 online
Non-Oil Foreign Direct Investment (NOFDI)	Total annual inflow in million naira	Central Bank of Nigeria Statistical Bulletin 2013 online
Oil Imports (OIMP)	Annual in million naira. Cost Insurance and Freight (cif).	Central Bank of Nigeria Statistical Bulletin 2013 online
Non-Oil Imports (NOIMP)	Annual in million naira. Cost Insurance and Freight (cif)	Central Bank of Nigeria Statistical Bulletin 2013 online
Oil Exports (OEXP)	Annual in million naira. Free on Board (fob).	Central Bank of Nigeria Statistical Bulletin 2013 online
Non-Oil Exports (NOEXP)	Annual in million naira. Free on Board (fob).	Central Bank of Nigeria Statistical Bulletin 2013 online

Source: *Compiled by the authors*

V. Discussion of Results

V.1 Unit Root Test

The null hypothesis of the Z-A (1992) is that 1 i.e. the series has a unit root with structural break in constant, trend or constant and trend stationary process. Given our assumption that the break fraction is derived from the estimation of equations 2, 3 and 4 using the critical values provided by Z-A, Table 3 shows sufficient evidence of rejecting the null hypothesis of the presence of a unit root with structural breaks at the 1.0, 5.0 or 10.0 per cent level. For some variables that did not fall within the 1.0, 5.0 and 10.0 per cent critical values, they were found to be significant at levels above the 50% critical value reported in Table 3, panel B, of Zivot and Andrews (2002). Thus, we conclude that the structural breaks in the series are not sturdy enough to generate any divergence with the results of conventional unit root tests.

6. Note: All variables excluding GDP growth rate are in logarithmic form. Due to data limitation, five year moving average was used to generate OFDI and NOFDI for 1960, 1961 and 2010.

Table 3: Zivot-Andrews Unit Root Test Results

Variable	Z-A (1992)								
	Model A			Model B			Model C		
	t	Breakpoint	Lag	t	Breakpoint	Lag	t	Breakpoint	Lag
LNNOEXP	-2.65*	1995	0	-4.39***	1983	0	-5.38***	1987	0
LNNOFDI	-3.62	1995	1	na	na	na	-4.26**	2004	1
LNNOIMP	-3.90**	1991	0	-2.65	2005	0	-3.47**	1995	0
LNOEXP	-3.58***	1969	0	-3.26	2005	0	-3.59**	1995	0
LNOFDI	-3.52**	1991	4	-1.34	1980	4	-3.45**	1992	4
LNOIMP	-4.61***	1986	0	-2.99	1973	0	6.06***	1986	0

*Notes: The break locations i.e. intercept, trend and both, are denoted by Models A, B and C. *, ** and *** imply significance at 10.0, 5.0 and 1.0 per cent respectively, based on percentage points of the asymptotic distribution critical values as provided by Zivot and Andrew (1992) Table 2, page 30.*

Source: *Authors' computation using Eviews 7*

V.2 Cointegration Test

Although our cointegration analysis is predicated on the regime shift model (as in equation 7), we also estimated the level shift as well as level shift and trend models (equations 5 and 6). As noted by Gregory and Hansen (1996), the regime shift model estimates the break point more accurately with smaller standard deviations, compared with the level shift or level shift with trend models. Thus, the implication of this finding for the subsequent analysis is based on the outcome of the regime shift model. The Akaike Information Criteria (AIC) is used to determine the optimal lag- length out of a maximum of 8 lags.

Findings of the G-H cointegration test are presented in Table 4a and 4b. We found evidence of a significant long-run relationship amongst the variables considered, as the augmented ADF, Zt and Za test statistics proposed by Gregory and Hansen (1996) exceeded the critical values at the 10 per cent level (for the level shift) and 5 per cent level (for the level shift with trend and regime shift model). This implies that there is a long-run relationship between oil FDI inflows (LNOFDI) and non-oil exports and imports in the Nigerian economy with an observed break in 1992, which coincided with the 1992 parliamentary elections and build up to the 1993 presidential elections and perhaps, the aftermath of the oil price shock of 1990 consequent upon the invasion of

Kuwait by Iraq. More so, the early 1990s depicted a period of global economic slowdown that spilled over from the 1980s.

Table 4a: Gregory-Hansen Cointegration Test Results (dependent variable: LNOFDI)

Model	Level Shift	Level Shift with Trend	Regime Shift
ADF Procedure			
t-stat	-5.07	-5.15	-6.96
Lag	1	0	0
Break	1993	1986	1988
Phillips Procedure			
Za-stat	-49.41	-49.90	-49.19
Za-break	1992	1992	1992
Zt-stat	-8.02*	-8.17**	-8.08**
Zt-break	1990	1990	1992

*, ** and *** imply significance at 10.0, 5.0 and 1.0 per cent, respectively based on percentage points of the asymptotic distribution critical values as provided by Gregory and Hansen (1996) table 1 page 109 (m=4).
Source: Authors' computation using Eviews 7

However, we found no evidence of cointegration between non-oil FDI (LNNOFDI) and oil and non-oil exports and imports in Nigeria. This may be partly explained by the relatively low FDI inflows and trade volumes in the non-oil sector, compared with that of the oil sector. While this may seem quite puzzling at first, Gregory and Hansen (1996) opined that empirical investigations of long-run relationships would best be served using complementary statistical tests. Thus, on the Engle and Granger ADF-based cointegration test where we included the observed break date to ascertain the long-run relationship between the variables were adopted.

Table 4b: Gregory-Hansen Cointegration Test Results (dependent variable: LNNOFDI)

Model	Level Shift	Level Shift with Trend	Regime Shift
ADF Procedure			
t-stat	-4.55	-4.86	-4.98
Lag	0	2	0
Break	1980	2000	1980
Phillips Procedure			
Za-stat	-31.22	-25.88	-34.93
Za-break	1979	2002	1980
Zt-stat	-4.59	-4.02	-5.03
Zt-break	1980	2002	1980

*, ** and *** imply significance at 10.0, 5.0 and 1.0 per cent respectively based on percentage points of the asymptotic distribution critical values as provided by Gregory and Hansen (1996) table 1 page 109 (m=4).
Source: *Authors' computation using Eviews 7*

Table 5 revealed the significance of the ADF statistic of the residuals of the estimated model in line with the Engle and Granger procedure. Evidently, the result of the residual-based unit root test indicated that there exists a long-run relationship between non-oil FDI inflows and the other variables considered. The implication of this finding is that there exists a causal relationship amongst the variables, but the result provided no indication regarding the direction of causality.

Table 5: ADF-based Cointegration Test

		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-4.301	0.001
Test critical values:	1.0 per cent	-3.560	
	5.0 per cent	-2.918	
	10.0 per cent	-2.607	

Source: Authors' computation using Eviews 7

V.3 Causality Test

The out come of the causality test conducted was based on the estimation of a $(k+d_{max})^{th}$-order VAR model in levels and subsequent tests of general restrictions on the parameter matrices even if the processes may be integrated or cointegrated of an arbitrary order. We ignored the coefficient matrices of the last d_{max} lagged vectors in the model because they are regarded as zeros. We proceeded to test linear or nonlinear restrictions on the first k coefficient matrices using the standard asymptotic theory (See Toda and Yamamoto, 1995; for a lucid exposition of the mechanics).

Basically, the Wald test (block exogeneity test) is applied to the relevant coefficients. This procedure entails testing for causality between integrated variables based on asymptotic theory. We test the null hypothesis of Granger non-causality running from oil and non-oil FDI to oil and non-oil imports and exports with the following hypothesis $Ho \; {}^{n}_{i\,1} \; {}_{1i} \; 0$ and a null hypothesis of Granger non-causality from oil and non-oil exports and imports to oil and non-oil FDI $Ho \; {}^{n}_{i\,1} \; {}_{1i} \; 0$ This is a test for the null hypothesis that no causality exists between the variables against alternatives that causality exists.

The result of the Toda-Yamamoto causality test is presented in Tables 6a and 6b. The results presented in Table 6a indicated that we can reject the null hypothesis of no causality from oil exports (LNOEXP) and non-oil imports (LNNOIMP) to oil FDI inflows. This finding reinforces our cointegration test, which suggested the existence of a long-run relationship between the variables and invariably implies that at least one causal linkage must exist. What makes our finding differ with other previous similar studies may be the fact that they failed to account for structural breaks and considered the nexus in a highly aggregated manner. This could lead to misleading inferences, particularly given the fact that the effect of structural breaks in the series was evident.

The VAR model on the basis of which the Toda-Yamamoto causality test was conducted is presented in Tables 1 and 2 in the Appendix. Table 1 in the appendix revealed that that an increase in the lagged value of oil imports would reduce FDI flows to the oil sector by approximately 2.0 per cent, while oil exports was found to be positively related to oil FDI in Nigeria. While non-oil import was found to be inversely related to oil FDIs; non-oil exports in Nigeria was a positive function of FDI flows in the oil sector. A 1.0 percent increase in the one period lagged value of oil FDI exerted a 7.0 per cent increase in oil imports and exports as well as non-oil imports, while non-oil exports on the other hand increased by almost 10.0 per cent.

Table 6a: Toda-Yamamoto Causality Test Results

Model 1: Dependent Variable LNOFDI	
Null Hypothesis	**MWALD (Prob.)**
LNNOEXP causes LNOFDI	2.356 (0.838)
LNNOIMP causes LNOFDI	5.530 (0.019)
LNOEXP causes LNOFDI	13.330 (0.000)
LNOIMP causes LNOFDI	0.042 (0.838)
LNOFDI causes LNNOEXP	1.019 (0.313)
LNOFDI causes LNNOIMP	0.927 (0.336)
LNOFDI causes LNOEXP	0.277 (0.599)
LNOFDI causes LNOIMP	0.142 (0.707)

Note: Sample (1960-2010), 51 observations were included
Source: Authors' computation using Eviews 7

Distinctly, uni-causal linkage running from non-oil FDI to non-oil import was observed in Table 6b. A plausible explanation why no other causation was found may be attributed to the weak cointegrating relationship from the Gregory-Hansen long-run test. Nevertheless, the existence of at least one causal relationship reinforces the cointegrating relationship revealed from the ADF-based long-run test. The VAR model on which the T-Y causality test result shown in Table 6b is presented in Table 2 of the appendix. The result showed that oil imports and exports as well as non-oil imports and exports were positive functions of the one non-oil FDI inflows and vice versa.

Table 6b: Toda-Yamamoto Causality Test Results

Model 1: Dependent Variable LNNOFDI	
Null Hypothesis	**MWALD (Prob.)**
LNNOEXP causes LNNOFDI	0.003 (0.279)
LNNOIMP causes LNNOFDI	1.173 (0.279)
LNOEXP causes LNNOFDI	1.782 (0.182)
LNOIMP causes LNNOFDI	0.000 (0.991)
LNNOFDI causes LNNOEXP	12.017 (0.001)
LNNOFDI causes LNNOIMP	0.115 (0.734)
LNNOFDI causes LNOEXP	2.608 (0.106)
LNNOFDI causes LNOIMP	0.942 (0.332)

Note: Sample (1960-2010), 48 observations were included
Source: Authors' computation using Eviews 7.

An examination of the residuals based on the LM test signified the absence of serial correlation in our model. The estimated models were dynamically stable as indicated by the inverse root of the AR characteristic polynomial (see Figures 4 and 5), thus, the VAR on the basis of which the Toda-Yamamoto test was conducted satisfied the stationarity condition as indicated by the charts, an indication of the estimated models' stability and robustness.

Figure 4

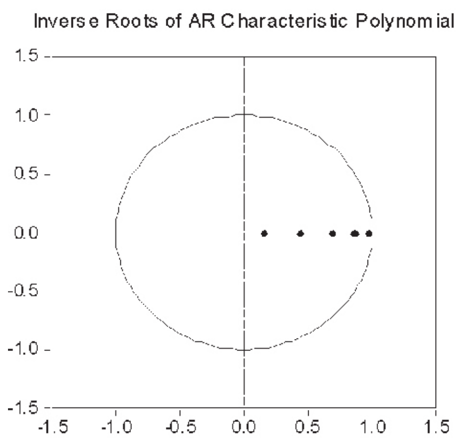
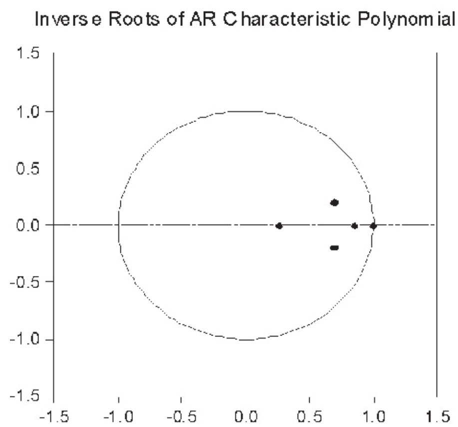


Figure 5



Source: *Graphed by Authors' using Eviews 7.*

VI. Conclusion and Policy Implications

This paper examined the relationships between FDI and trade in Nigeria for the period, 1960 to 2010. Specifically, the piece investigated the causal links between FDI and trade when considered under oil and non-oil for both imports and exports. A modified Wald Vector Autoregression model that treated all the variables and identified break points as endogenous was estimated and tested for causality.

The results showed that the variables employed were found to be stationary, suggesting that the structural breaks in the series were not sufficient to generate any divergence with the results of conventional unit root tests. On the presence of long-run relationship, oil FDI and the other variables considered (oil and non-oil exports and imports) were found to be co-integrated despite observed breaks of 1980, 1988 and 1992, which coincided accordingly with the positive oil price shock, the contemporaneous aftermath of Structural Adjustment Programme (SAP) and the period marred by political uncertainty in addition to agitations for a transition from military to civil rule. On the other hand, there was no evidence of long-run relationship between non-oil FDI and other variables when a break was considered, but a long-run relationship was established when a structural break was not considered. The findings also revealed a one-way causal linkage between non-oil imports and oil exports to oil FDI with no reverse causality observed, while a uni-causal linkage running from non-oil FDI to non-oil exports was recorded. The stability test carried out in the study reinforced the potency of the model.

The results further underscored the need to consider structural breaks in estimations. This implies that when structural breaks are compromised in studies on external sector parameters such as FDI and trade, the estimation techniques may yield biased estimates. This is particularly true given the fact that exogenous shocks were transmitted to the domestic economy through the trade and investment channels. The result of one-way causal linkage running from non-oil imports and oil exports to oil FDI with no reverse causality observed and non-oil FDI granger causing non-oil exports make a case for further diversification of trade such that intermediate input used in production are readily available. This serves as an incentive for multinational corporations who seek least cost production entities. In addition, diversification is expected to help reduce the dependence on oil as the sole revenue earner of government. The causal influence of non-oil imports on oil FDI suggests that reducing trade restrictions through tariff and non-tariff barriers would contribute towards increasing oil FDI inflows.

The findings also suggested that increased oil export earnings serves as an incentive to oil FDI investments given the vast investment opportunities in the oil and gas sector occasioned by reforms such as deregulation of the downstream sector and the proposed petroleum industry bill. The causal link from non-oil FDI to non-oil exports implies that government may consider policies skewed towards further strengthening domestic markets and the provision of favourable investment climate in the non-oil sector to encourage non-oil FDIs, which is expected to boost non-oil exports. To enhance trade diversification, more efforts need to be geared towards creating a conducive investment climate that can spur direct investment in various non-oil sectors of the economy that have dragged over the years, compared with the oil sector.

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APPENDIX

Table 1: VAR Estimates (LNOFDI is the dependent variable)

	LNOFDI	LNOIMP	LNOEXP	LNNOIMP	LNNOEXP
LNOFDI(-1)	0.218994	-0.063579	-0.061288	-0.077851	0.096991
	-0.0908	-0.16885	-0.11647	-0.08084	-0.09608
	[2.41173]	[-0.37655]	[-0.52624]	[-0.96306]	[1.00948]
LNOIMP(-1)	-0.017061	0.69406	0.291358	0.219714	0.242094
	-0.0834	-0.15507	-0.10697	-0.07424	-0.08824
	[-0.20457]	[4.47566]	[2.72384]	[2.95936]	[2.74346]
LNOEXP(-1)	0.362022	0.167505	1.001459	0.260532	-0.045997
	-0.09916	-0.18438	-0.12718	-0.08827	-0.10492
	[3.65098]	[0.90848]	[7.87435]	[2.95142]	[-0.43840]
LNNOIMP(-1)	-0.359256	-0.018012	-0.279922	0.45875	-0.065606
	-0.15277	-0.28407	-0.19594	-0.136	-0.16165
	[-2.35163]	[-0.06341]	[-1.42859]	[3.37316]	[-0.40586]
LNNOEXP(-1)	0.128275	0.167821	-0.064686	-0.021881	0.756813
	-0.08356	-0.15538	-0.10718	-0.07439	-0.08842
	[1.53507]	[1.08005]	[-0.60354]	[-0.29413]	[8.55935]
C	7.24278	0.778211	1.762139	2.220811	0.354189
	-0.95042	-1.76727	-1.21902	-0.8461	-1.00565
	[7.62059]	[0.44035]	[1.44554]	[2.62476]	[0.35220]
DUM_92	-2.751205	-0.874109	0.115818	-0.188938	0.315659
	-0.36321	-0.67537	-0.46585	-0.32334	-0.38431
	[-7.57473]	[-1.29426]	[0.24861]	[-0.58433]	[0.82136]
R-squared	0.983729	0.981901	0.990785	0.99344	0.985364
Adj. R-squared	0.98151	0.979433	0.989528	0.992545	0.983368
Sum sq. resids	4.830829	16.70302	7.947102	3.828532	5.408594
S.E. equation	0.331348	0.616128	0.424989	0.294978	0.350603
F-statistic	443.3726	397.8526	788.4769	1110.544	493.6994
Log likelihood	-12.26727	-43.90185	-24.9609	-6.337589	-15.14803
Akaike AIC	0.755579	1.996151	1.253369	0.523043	0.86855
Schwarz SC	1.020732	2.261304	1.518521	0.788195	1.133703
Mean dependent	8.36092	8.198781	10.56974	10.45351	8.276697
S.D. dependent	2.43681	4.296245	4.15311	3.416469	2.718564
Determinant resid covariance (dof adj.)				2.56E-05	
Determinant resid covariance				1.23E-05	
Log likelihood				-73.44503	
Akaike information criterion				4.252746	
Schwarz criterion				5.578509	

Source: Authors' computation using Eviews 7.

Table 2: VAR Estimates (LNNOFDI is the dependent variable)

	LNNOFDI	LNNOIMP	LNOEXP	LNOIMP	LNNOEXP
LNNOFDI(-1)	0.805594	0.051065	0.33765	0.295177	0.540158
	-0.0788	-0.15027	-0.20909	-0.30406	-0.15582
	[10.2235]	[0.33981]	[1.61484]	[0.97079]	[3.46656]
LNOIMP(-1)	0.066438	0.522166	-0.276752	-0.060517	-0.243358
	-0.06133	-0.11697	-0.16275	-0.23667	-0.12128
	[1.08321]	[4.46421]	[-1.70048]	[-0.25570]	[-2.00651]
LNOEXP(-1)	0.044943	0.197563	0.898111	0.014254	-0.05898
	-0.03367	-0.06421	-0.08935	-0.12992	-0.06658
	[1.33478]	[3.07675]	[10.0522]	[0.10971]	[-0.88583]
LNNOIMP(-1)	0.000405	0.226276	0.262597	0.696158	0.309903
	-0.03653	-0.06967	-0.09695	-0.14098	-0.07225
	[0.01108]	[3.24765]	[2.70872]	[4.93814]	[4.28958]
LNNOEXP(-1)	0.128275	0.167821	-0.064686	-0.021881	0.756813
	-0.08356	-0.15538	-0.10718	-0.07439	-0.08842
	[1.53507]	[1.08005]	[-0.60354]	[-0.29413]	[8.55935]
C	0.619209	1.546313	0.823819	-1.702885	0.088038
	-0.26966	-0.51425	-0.71553	-1.04052	-0.53323
	[2.29629]	[3.00693]	[1.15133]	[-1.63658]	[0.16510]
DUM_92	0.102138	-0.119496	-0.358956	0.376381	-0.719476
	-0.11801	-0.22504	-0.31313	-0.45535	-0.23335
	[0.86552]	[-0.53099]	[-1.14635]	[0.82658]	[-3.08323]
R-squared	0.996034	0.993116	0.990985	0.982171	0.988265
Adj. R-squared	0.995516	0.992218	0.989809	0.979846	0.986735
Sum sq. resids	1.10904	4.033423	7.808823	16.51285	4.336669
S.E. equation	0.155273	0.296113	0.412016	0.599145	0.307043
F-statistic	1925.295	1105.963	842.7471	422.3453	645.6741
Log likelihood	27.26638	-6.948313	-24.45524	-44.30069	-8.869327
Akaike AIC	-0.764769	0.526351	1.18699	1.935875	0.598843
Schwarz SC	-0.504542	0.786579	1.447218	2.196102	0.85907
Mean dependent	9.002984	10.49368	10.62148	8.244858	8.281348
S.D. dependent	2.318891	3.35662	4.081342	4.220329	2.665895
Determinant resid covariance (dof adj.)				5.04E-06	
Determinant resid covariance				2.48E-06	
Log likelihood				-33.97554	
Akaike information criterion				2.602851	
Schwarz criterion				3.903987	

Source: Authors' computation using Eviews 7.

Oil Price Shocks and Real Exchange Rate Movement in Nigeria

Tule M. K. and D. Osude*

Abstract

This paper investigated the relationship between oil price and real exchange rate movement in Nigeria. Crude oil exports account for over 90 per cent of Nigeria's foreign exchange earnings hence, the economy may be vulnerable to instability in international oil prices, which the country as a small open economy, cannot influence. Using monthly data covering the period 2000 to 2013, this study employs GARCH process to test the relationship between oil price and exchange rate volatility in Nigeria. The results of GARCH (1,1) and EGARCH (1,1) suggest the persistence of volatility between real oil prices and the real exchange rate. The Smooth Transition Regression (STR) results also show the expected reaction from the exchange rate following changes in oil prices. Thus, we conclude that oil price fluctuations lead exchange rates movement in Nigeria.

Keywords: Oil Price Shock, Exchange Rate Movement

JEL Classification: *F31, Q43*

I. Introduction

The persistence of swings in global oil prices over the past few years, has reignited the long-standing policy discussion about the role of oil prices in determining external balances and the wider macroeconomic consequences of oil price shocks. From an open economy perspective, it is of interest for monetary policy to identify how oil price shocks affect the real exchange rate. These issues arerelevant, particularly for Nigeria being highly dependent on oil exports for both foreign exchange earnings and government revenue. While positive shocks impacted positively on the country's foreign exchange earnings, the reverse was the case during episodes of plummeting oil prices in periods of glut.

The changes in international oil prices have asymmetric impact on the exchange rate. Anecdotal evidence indicated a direct correlation between oil receipts and government revenue, accumulation of external reserves and exchange rate fluctuations, which underpins the assertion that the economy is fundamentally vulnerable to developments in the oil market. However, there is no conclusive evidence that when international oil price drop the exchange rate will fluctuate.

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In light of the above, this paper addressed two issues: namely, whether oil prices are a leading indicator of exchange rate movement in Nigeria or whether crude oil prices and exchange rate co-move at a low or high level of crude oil prices. Crude oil accounts for over 90.0 per cent of the foreign exchange earnings in Nigeria, making the economy vulnerable to international oil price fluctuations. Again, Nigeria is a small open economy that is essentially a price taker, such that changes in crude oil prices could be termed exogenous terms of trade shocks to the economy.

As an oil dependent economy, high oil prices favour the country by way of increased revenue to government, leading to increased government spending and provide justification for increased subsidy on a number of economic commodities/services. Besides, high oil revenue also encourages increased spending on importation of refined petroleum products because of insufficient domestic refining capacity. The reverse occurs when oil prices drop and the fiscal deficit increases due to revenue falls. This leads to reserves drawdown and implies reduction in the supply of foreign exchange to the market.

Oil price increase also affects the naira exchange rate leading to a "false appreciation", as the rising value of the currency is not as a resultof increased production activity in the real economy, which is expected to boost exports in relation to imports. The exchange rate appreciation erodes the country's competiveness in terms of real exports by making real goods and services more expensive, and bringing up undue pressure. Thus, investors and other speculators monitor movements in oil prices vis-à-vis the reserve level to determine when to exit the economy.

he main thrust of this paper, therefore, is to determine whether crude oil prices are a leading driver of movement in the exchange rate in Nigeria. The paper proceeds as follows: Section 2 reviews the extant theoretical and empirical literature in the oil price-exchange rate nexus. Section 3 presents stylized facts on the exchange rate and oil price movements in Nigeria. Section 4 focuses on the methodology, while the empirical results are presented in Section 5. Section 6 concludes the paper.

II. Review of Theoretical and Empirical Literature

The theoretical expositions on the potential importance of oil prices for exchange rate movements have been well espoused in the literature (Krugman, 1983a, 1983b; and Rogoff, 1991). The inter-temporal models of exchange rate determination have suggested that a fall/rise in oil prices should be accompanied by a real appreciation/depreciation of oil exporters' exchange rates. This conclusion has been derived from three strands of theoretical literature: the terms of trade channel; the balance of payments and international portfolio choices; and the wealth effects (Bodenstein et al., 2011).

The terms of trade channel focuses on oil as a major determinant of the terms of trade. In a two-sector model comprising tradable and non-tradable goods, as proposed in Amano and van Norden (1998), each sector uses both a tradable input (oil) and a non-tradable one (labour). The model assumed that inputs are mobile between the sectors and that both sectors do not make economic profits, with an additional assumption of constant returns to scale technology. The output price of the tradable sector is fixed internationally; hence the real exchange rate corresponds to the output price in the non-tradable sector. A rise in oil price leads to a decrease in the price of labour so as to meet the competitiveness requirement of the tradable sector. If the non-tradable sector is more energy intensive than the tradable one, its output price rises and real exchange rate appreciates. The opposite applies if the non-tradable sector is less energy intensive than the tradable one.

Thus, a negative terms of trade shock, i.e., a fall in oil prices for an oil exporter, drives down the price of non-traded goods in the domestic economy and thereby, the real exchange rate, which is defined as the relative price of a basket of traded and non-traded goods between the domestic and the foreign economy. As prices of non-traded goods may be sticky, the adjustment of the real exchange rate could require nominal exchange rate depreciation too.

A second strand of the literature as espoused in Krugman, (1983a, 1983b) focused on the balance of payments and international portfolio choices. In a three-country world model of Europe, America and OPEC countries, higher oil prices would transfer wealth from the oil importers (America and Europe) to oil exporters (OPEC). The real exchange rate equilibrium in the long-run would depend on the geographic distribution of OPEC imports, but no longer on OPEC portfolio choices. Assuming that oil-exporting countries have a strong preference for dollar-denominated assets but not for US goods, an oil price hike will cause the dollar to appreciate in the short run but not in the long run. In particular, Krugman (1983 a,b) posited that if America is a relatively small share of OPEC's export market, but has a large share of OPEC's import market, then the transfer of wealth from the industrial countries to OPEC would tend to improve the US trade balance.

For the wealth effects, a negative oil price shock transfers wealth from oil exporters to oil importers, leading to large shifts in current account balances and portfolio reallocation (Kilian 2008). In order to restore the external net financial sustainability of oil (exporters), the real exchange rate has to appreciate following a negative shock to the oil price, in order to improve the non-oil trade balance.

The theory, thus, suggests that oil exporters' currencies should depreciate in the wake of negative oil price shocks (and vice versa for positive shocks), There could however, in practice, exist counter-balancing forces that may negate the theoretical channels of the transmission of shocks and effects outlined above. For instance, the monetary authorities may dislike large swings in the nominal exchange rate, and therefore, act to counter exchange rate pressures through the accumulation or reduction of foreign exchange reserves. Another factor is the possibility of the international risk-sharing channel providing an automatic stabiliser through currency exposure. Given that oil exporters have accumulated a large pool of foreign exchange reserves and tend to be 'net long' in foreign currency, a decline in oil price accompanied by a depreciation produces a positive valuation effect – a net gain relative to domestic GDP, thereby, playing a stabilising role. In other words, the exchange rate does not need to depreciate much to ensure external sustainability.

While some studies exploring the apparent relationship between oil price and movement in the exchange rate suggested that oil prices are a leading indicator of exchange rate movement, others could not produce conclusive evidence to validate this hypothesis. Thus, Ferraro et al., (2011) using monthly and quarterly data, investigated the forecasting power of oil prices on the Canadian/US dollar nominal exchange rate and reported slight systematic relationship between the price of oil and movement in exchange rate.The paper found the existence of a very short term robust relationship using daily data. However, the forecasting power of the latter is short-lived after adjusting for instabilities.

Turhan et al., (2012) considered the link between oil prices and exchange rate movement in the emerging economies using daily data. They found that increase in oil price tend to produce considerable appreciation in the currencies of emerging market economies against the US dollar. They also concluded that oil price dynamics have changed significantly in the sample period and the relation between oil prices and exchange rates has become more pertinent after the economic and financial crisis of 2007/2008.

Nikbakht (2009) conducted a panel estimation of seven OPEC countries with monthly series spanning between 2000M1 and 2007M12 to examine the long run relationship between oil prices and exchange rates. It was revealed that real oil prices may have been the dominant source of real exchange rate movements in these countries. Also, the results showed that there was a long-run linkage between real oil prices and real exchange rates.

Basher et al., (2010), using the structural vector autoregression methodology, established a relationship between price of oil, exchange rate and the stock markets of Emerging economies. Their results supportedthe claim that positive shocks to oil prices tend to lower emerging market stock prices and US dollar exchange rates in the short run.

Omojimite (2011) in his paper "the price of oil and exchange rate determination in Nigeria" using cointegration found that the price of oil and the openness of the economy explains the level of exchange rate in Nigeria. Adeniyi et al., (2012) in their study on the relationship between oil price and exchange rate in Nigeria deployed a Generalized Autoregressive conditional heteroscedasticity (GARCH) and Exponential GARCH (EGARCH) to investigate the impact of oil price on the nominal exchange rate. They found that an increase in the price of oil results in an appreciation of the naira against the US dollar. They also found an asymmetric effect with regards to the magnitude, of positive and negative oil price shocks on exchange rate instability.

Muhammad and Suleiman (2011), while investigating the nexus between oil price and exchange rate for Nigeria from 2007 to 2010, using GARCH and Exponential GARCH, found a direct relationship between oil price and naira depreciation. This could be due to the increased demand for the dollar as a result of the rise in the level of money supply, used to attack the exchange rate.

Englama et al., (2010), investigated oil prices and exchange rate volatility in Nigeria. He found that a 1.0 per cent permanent increase in oil price results in a 0.54 per cent change in the exchange rate in the long-run, and in the short-run by 0.02 per cent. He also found that a permanent 1.0 per cent increase in demand for foreign exchange results in exchange rate volatility by 14.8 per cent. The study corroborated the notion that there exist a direct relationship between demand for foreign exchange and oil price volatility with movement in the naira exchange rate.

Empirical investigation on the effects of oil price shock and exchange rate volatility on economic growth in Nigeria conducted by Aliyu (2009), showed that a unidirectional causation runs from oil price to real GDP and that a bi-directional causation exists between real exchange rate and real GDP. The result also indicated that oil price shock and exchange rate appreciation tend to impact positively on Nigeria's economic growth.

The empirical literature, however, fails to show the existence of consensus on the nature of the effect and direction of the causality oil price shocks have on exchange rate movement in Nigeria. This paper, therefore, attempts to fill this gap in the literature.

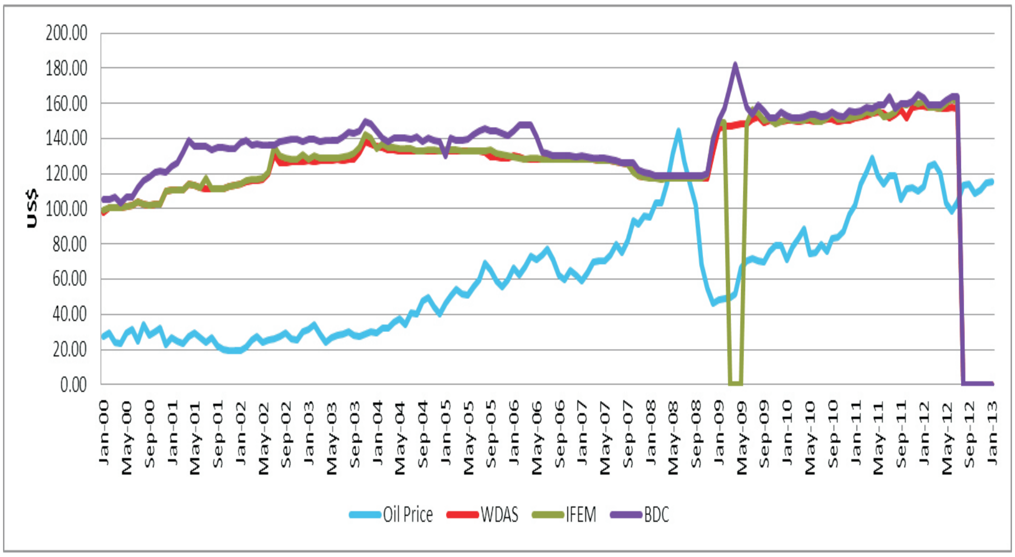
III. Oil Price and Exchange Rate Movement in Nigeria: Some Stylised Facts

Oil prices have shown both co-movement and an inverse relationship with the nominal exchange rate in Nigeria over time. In 2000, exchange rate in the 3 segments of the foreign exchange market moved in tandem with international oil prices. This could be partly as a result of the countries' craze for foreign goods which probably led to more import of foreign goods as shown in increased demand for foreign exchange. However, between November 2003 and November 2008, the naira exchange rate at the official window (wDAS) and at the interbank (IFEM) appreciated as oil prices rose in the same period. At the parallel market (BDC), there was some level of fluctuations between November 2003 and April 2006, probably as a result of policy changes. However, the BDC rate appreciated along with the wDAS and IFEM up to November 2008.

Oil prices rose steadily from US$23.84 in April 2003 and peaked at US$144.27 in June 2008 before crashing to an almost 4-year low of US$46.41 in December 2008. The period coincided with the global economic and financial crisis that started in the US and spread to other parts of the world. During the period, global productive capacity was at its lowest level, banks were distressed and global equities market crumbled. As oil prices crashed in the period, the naira exchange rate in all segments of the market depreciated. When oil prices crashed to a 4-year low, the exchange rate depreciated with the BDC rate moving from N119 in October 2008 to N182 in April 2009. IFEM and w-DAS moved from N117.75 and N117.79 in October, 2008 to N150.04 and N147.36 in September and April, 2009, respectively. The CBN allowed the naira exchange rate to depreciate in order to protect external reserves.

Oil prices rose above US$75 per barrel after August 2010 to another high of US$ 128.71 per barrel in April 2011, and traded around US$112.30 per barrel in January 2013. The naira exchange rate at the official window as at January 2013 was around N157.30,

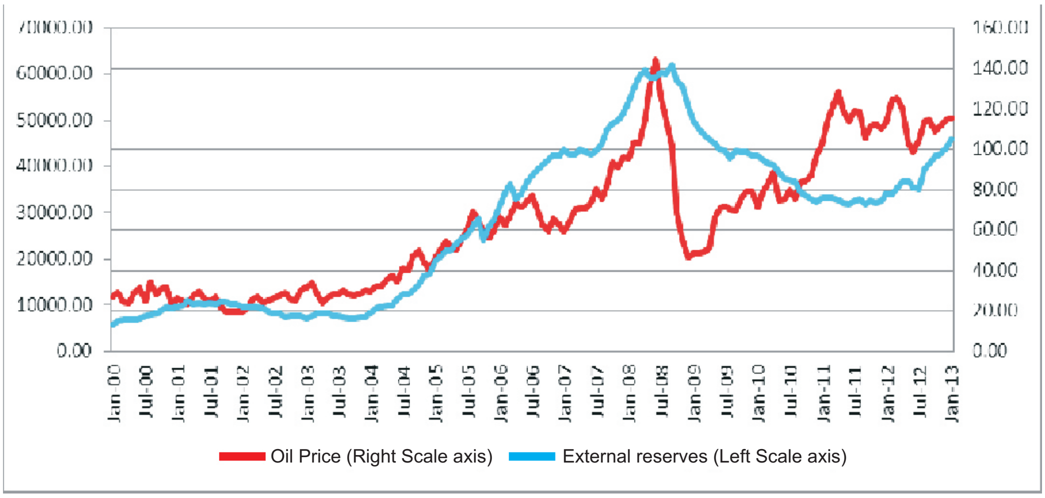
Figure1: Oil Price and Exchange Rate Movements in Nigeria 2000-2013



Source: Data from Reuters and CBN

Oil prices and external reserves moved concomitantly and peaked at US$144.27 per barrel and US$62.08 billion in June 2008 and September 2008, respectively. The period of the global financial crisis resulted in the decline in both the oil price and the reserves. The figure showed that oil price increase since 2010 has had little or no impact on reserves. While oil price rose above US$100, reserve fell to a three year low of US$31.74 billion in September 2011, rising to a new peak of US$45.82 billion in January 2013.

Figure 2: Oil Price and External Reserves Movement 2000-2013



Source: Data from Reuters and CBN

IV. Methodology

IV.1 Data

Monthly data spanning 2000 to 2013 from the Central Bank of Nigeria Statistical bulletins were used for the paper. The series were transformed and subjected to the Augmented Dickey-Fuller (ADF) and Phillips-Perron unit root tests in line with the requirements for a standard regression and the smooth transition regression (STR) model (Jawadi, et al., 2014). Consequently, the oil price and the nominal exchange rate were included in the model in their first difference. For, the volatility models, real exchange rate and real oil price were arrived at by dividing the oil price and nominal exchange rate, respectively.

IV.2 Techniques of Analysis

In the literature, three distinct types of oil price non-linear transformation are recognised. The first is the asymmetric specification which treats increases or decreases in oil price as separate variables, different from the underlining oil price series itself. The second is the scaled specification which takes volatility into account (Lee et al., 1995). The third is the net specification method adopted by Hamilton (1996). We have chosen to apply the scaled specification to enable us study the effect of oil price volatility on the real exchange rate (RER) movement in Nigeria. Secondly, we use the STR to demonstrate the asymmetric role the oil price play in the evolution of the nominal exchange rate.

As in Ghosh (2011), we characterise the linkage between oil prices and exchange rate with the aid of GARCH (p,q) and EGARCH (p,q) models. The mean equation is given by

$$RER_t \quad C \quad ROP_t \quad V_t \qquad (1)$$

Where V_t is the white noise residuals N (0, σ_t^2), RER_t is real exchange rate, and ROP_t is real oil price. In terms of the second moment, the conditional variance equation for the GARCH (p, q) is of the form

$${}_t^2 \quad \overset{p}{\underset{i\ 1}{}} \ i \ {}^2_{t\ 1} \quad \overset{q}{\underset{i\ 1}{}} \ i \ {}_{t\ j^2} \qquad (2)$$

Where the conditions θ >0, φi < 1 and (1 – □i - φi) > 1 hold in the case of a GARCH (1, 1) model. Equation 2 states the conditional variance as a linear expression of p lagged squared disturbances and q lagged conditional variances. In other words, current volatility depends on the volatilities for the past q periods and on the squared residual for the past p. GARCH models with limited values of p and q produce good estimate of volatility with the $p \quad q \quad 1$ case usually sufficient (Ghosh, 2011). In a similar vein, the EGARCH model which allow for oscillation in the conditional variance can be written as:

$$Log \ {}_t^2 \quad \overset{q}{\underset{j\ 1}{}} \ {}_j \log \ {}^2_{t\ j} \quad \overset{p}{\underset{i\ 1}{}} \ {}_i \left| \frac{t\ i}{t\ i} \right| \quad \overset{r}{\underset{k\ 1}{}} \ {}_k \frac{t\ k}{t\ k} \qquad (3)$$

The parameters of equation 3, include the mean of the volatility equation, the size effect which is suggestive of the magnitude of the increase in volatility regardless of the direction of shock. The estimate captures the persistence of shocks and is the sign effect.

To determine effectively whether the movement in oil prices is a leading indicator of the exchange rate is akin to identifying whether what happens to oil prices can translate into movement in the exchange rate. Thus, we use the Logistic Smooth Transition Regression (LSTR) developed by Terasvirta (1994), which has been variously applied in the analysis of optimal inflation and pass-through effects (Espinoza et al., 2010; Mohanty et al., 2011; and Mendoza, 2004). The fact that oil prices and exchange rate are susceptible to regime switching, smooth transition regression captures these breaks and asymmetric dynamics effectively. The standard LSTR model incorporates a logistic smooth function which captures both smooth and continuous transition between two regimes, low and high oil price regimes and estimate the impact of same on exchange rate. It is thus, possible to evaluate whether there is co-movement and if full or partial effects exist. The model also allows identification from the data, the threshold parameter (c) at which the transition occurs as well as the speed of transition (γ). The model is specified as follows:

$$y_t = \beta' z_t + \theta' z_t G(S_t, \gamma, c) + \varepsilon_t, \qquad \varepsilon_t \sim (0, \sigma^2) \tag{4}$$

Where y_t , is the exchange rate, $z_t = (w_t', x_t'),'$ is an ((m + 1) x 1) vector of explanatory variables with $w_t' = (y_{t-1}, \dots \dots, y_{t-d})'$ and $x_t' = (x_{1t}, \dots \dots, x_{kt})'$, while $\beta = (\beta_0, \beta_1, \dots \dots, \beta_m)'$ and $\theta = (\theta_0, \theta_1, \dots \dots, \theta_m)'$, refer to a set of parameters in the linear and nonlinear aspects of the model, respectively. In this study, the explanatory variables included the predetermined level of the nominal exchange rate, as a measure of persistence and the contemporaneous as well as the one and two- period lag of oil prices.
$G(S_t, \gamma, c)$ give the transition relationship, normalised to an interval of 0 and 1, γ tells us how quickly the transition takes place, c is the level of the oil price at which the regime switches from a depreciation to an appreciation or vice versa. A peculiar characteristic of this model is to show that a very large γ produces a steep shape for the transition function G(.) around its threshold value 'c'. Thus, given this behaviour, the

transition relationship follows a logistic specification, thus,

$$G(S_t, \gamma, K) = (1 + \exp[-\gamma(\pi_t - c)])^{-1}, \gamma > 0$$

Thus, the parameters $\beta + \theta G(S_t, \gamma, c)]$ change monotonically with the transition variable S_t (one period lag of oil price) due to the fact that the function G (.) is a smooth and continuous increasing function of S_t. Equation (5) is estimated using the nonlinear least squares method. In order to execute the non-linear optimisation procedure, starting values are generated via a grid search that is linear in 'c' and log linear in 'γ'. The values of 'c' and γ that minimize the residual sum of squares are used as starting values.

V. Presentation and Discussion of Results

V.1 Pre-estimation Analysis

The behavior and time-series properties of data series employed in the subsequent estimations were undertaken. The results are indicated in what follows:

V.1.1 Summary Statistics

Table 1 indicates the summary statistics of the variables involved in the estimation and subsequent analysis. The tableindicated that the statistics associated with Skewness, Kurtosis and Jarque-Beraestablished the non-normality of the variables. The kurtosis statistics showed fat tails (leptokurtic). This suggested that the mean equation should be subjected to autoregressive conditional heteroscedasticity (ARCH) test.

Table 1: Summary Statistics of variables used

Descriptive stat.	Exchange rate	Headline inflation	Oil price	Real exchrate	Real oil price
Mean	132.9048	12.71739	64.07026	12.60686	6.364248
Median	130.29	12.4	61.29	11.74	5.39
Maximum	158.39	28.2	138.74	46.64	25.04
Minimum	101.2	2.17	18.65	4.72	1.06
Std. Dev.	15.77571	4.960233	33.30854	6.70302	4.747837
Skewness	0.040934	0.50748	0.418568	2.209576	1.147745
Kurtosis	2.020963	3.400076	1.966387	9.783122	4.216942
Jarque-Bera	6.153247	7.587546	11.27835	417.8152	43.03265
Probability	0.046115	0.022511	0.003556	0.0000	0.0000
Sum	20334.43	1945.76	9802.75	1928.85	973.73
Sum Sq. Dev.	37828.71	3739.794	168637.7	6829.432	3426.378
Observations	153	153	153	153	153

V.1.2 Unit Roots Tests

The knowledge of the time series properties of the variables of interest is important in order to obviate the possibilities of spurious regression. This was implemented using the conventional – augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) - Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests.

Table 2: Unit Root Tests Using ADF Test Statistic

Variable		Unit Root 1%	Unit Root 5%	ADF test statistic	Conclusion
Oil Price	1st Diff	-3.473967	-2.880591	-8.319946	1(1)
Nominal Exchange Rate	1st Diff	-3.473967	-2.880591	-9.613445	1(1)
Real Exchange Rate	level	-4.019561	-3.439658	-6.802564	1(0)
Real Oil Price	level	-4.019561	-3.439658	-4.130847	1(0)

Table 3: Unit Root Tests Using Phillips-Perron Test Statistic

Variable		Unit Root 1%	Unit Root 5%	ADF test statistic	Conclusion
Oil Price	1st Diff	-3.473967	-2.880591	-8.366864	1(1)
Nominal Exchange Rate	1st Diff	-3.473967	-2.880591	-9.576904	1(1)
Real Exchange Rate	level	-4.019561	-3.439658	-7.039868	1(0)
Real Oil Price	level	-4.019561	-3.439658	-4.130847	1(0)

Results from Table 2 and Table 3, summarise that series of interest (Oil price and Nominal exchange rate) are mean reverting. This gives an indication of the existence of a long-run association between oil price and the exchange rate.

V.1.3 Causality Tests

Implicit in the theoretical proposition concerning the oil-price/ exchange rate nexus is that oil-price causes variations in the exchange rate, and not the other way. A test of this assumption was undertaken, utilising the procedure of Granger causality tests.

Table 4: Pair wise Granger Causality Tests

Null Hypothesis	Obs	F-Statistic	Prob.
Oil Price does not Granger Cause Exchange Rate	151	2.73388	0.0683
Exchange Rate does not Granger Cause Oil Price		3.33796	0.0382

Results in Table 4 confirm the existence of a unidirectional causation running from oil-price to the exchange rate as expected.

V.2 Volatility Analysis

Figures 3 and 4 reflecting the volatility in oil prices and the Naira exchange rates in Nigeria from 2000 to 2013 derive from the volatility models. It could be seen from the figure that the effect of sharp increase in oil price in the June 2006 was reflected in sharp appreciation in exchange rate during the period. The movements of the two variables in the chart are in line with a priori expectations.

Figure 3: Real Oil Price Volatility 2000-2013

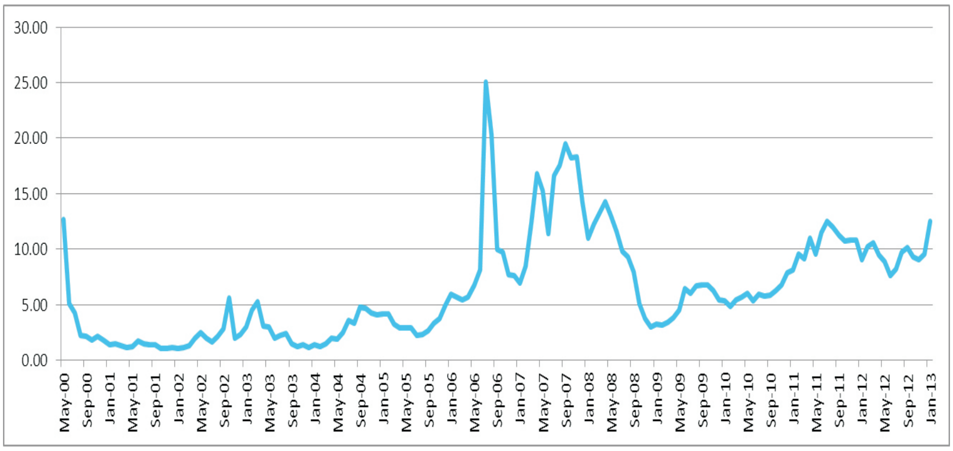


Figure 4: Real Exchange Rate Volatility 2000-2013

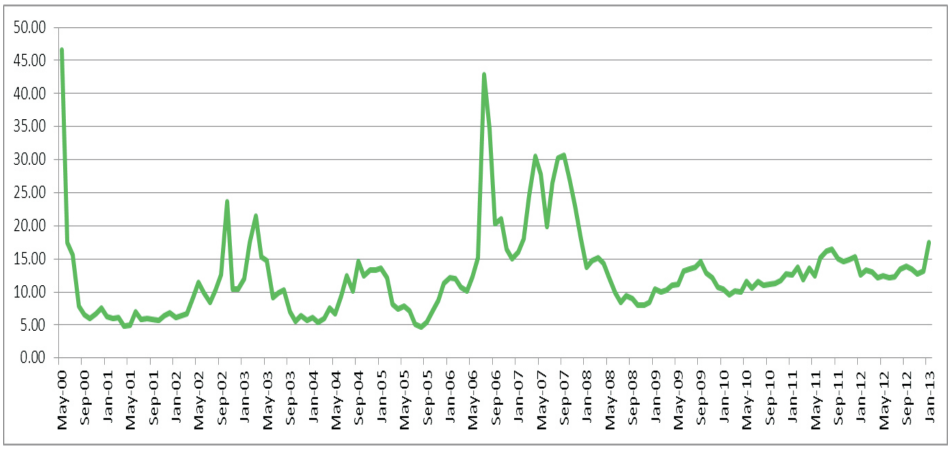
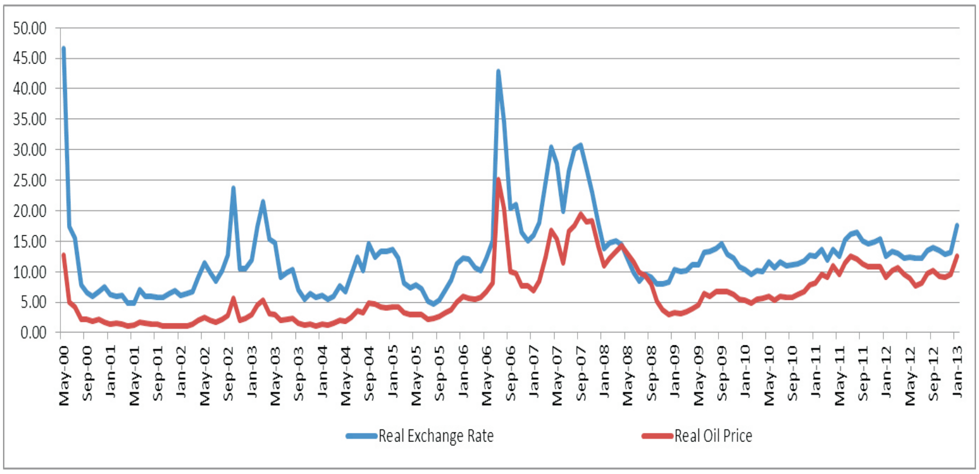


Figure 5: Real Exchange Rate and Real Oil Price Volatilities 2000-2013



As revealed in Table 6, the result of the Generalised Autoregressive Conditional Heteroskedasticity (GARCH) suggests that the volatility shocks between real oil prices and the RER are quite persistent because the associated coefficient of GARCH (1, 1) approximately equals unity (0.968). The mean equation of the GARCH (1, 1) implies that a rise in oil price impacts positively on the real exchange rate. Technically put, a negative shock on oil price would lead to 1.46 per cent depreciation of the naira in relation to the US dollar. A similar result was obtained for the EGARCH (1, 1) model displayed in the last column of Table 6. In this case, however, the magnitude of depreciation was slightly lower standing at about 1.06 per cent.

Finally, it is imperative to analyse the results of the variance equation. The parameter, γ, captures the asymmetry. It was found to be positive and statistically significant suggesting that within sample; shocks to exchange rate have asymmetric effect. In other words, in terms of magnitude, positive and negative shocks have unequal effects on the volatility of exchange rates. The volatility persistence term, β, was positive and statistically significant at 1.0 per cent level.

Table 6: GARCH (1, 1) and EGARCH (1, 1) Model Estimation Results

Parameter/Model	GARCH (1, 1)	EGARCH (1, 1)
I. Mean equation		
c	3.599667 (12.38856)*	4.566145 (39.50771)*
θ	1.461819 (56.54030)*	1.059647 -40.21219
λ	---------	-------
II. Variance equation		
ω	0.814025 -1.521651	-1.224951 (-4.4340888)*
a_1	0.857627 (2.806656)*	-------------
δ_1	0.116082 -0.708642	--------------
a	------------	2.067842 (5.284888)*
γ	-------------	0.230517 (3.778313)*
β		0.623375 (4.737791)*

Source: Author's Computation
Notes: Figures in parenthesis are z-statistics

Table 7: Logistic Smooth Transition Regression Results

Variables	estimate	SD	t-stat	p-value
Linear Regime				
Intercept	0.123	0.057	2.135	0.034
Nominal Exchange Rate (t-1)	1.695	3.970	0.427	0.670
Oil Price (t)	0.537	0.271	1.979	0.050
Oil Price (t-2)	-0.328	0.185	-1.774	0.078
Nonlinear Regime				
Intercept	-0.121	0.058	-2.105	0.037
Nominal Exchange Rate (t-1)	-1.495	3.971	-0.377	0.707
Oil Price (t)	-0.538	0.271	-1.981	0.049
Oil Price (t-1)	-0.030	0.014	-2.112	0.036
Oil Price (t-2)	0.320	0.186	1.721	0.087
Adj. R2	0.381			
Gamma ( )	17.438	32.413	0.538	0.591
C (threshold parameter)	-0.178	0.026	-6.874	0.000

The result from the STR well supported the nonlinearity in the relationship between nominal exchange rate and the oil price. This implied that there exist two switching dynamics that makes the exchange rate react asymmetrically to a rise or fall in oil prices. It confirmed that the threshold parameter (c) is statistically significant suggesting that two regimes, high and low characterize the lead indicator role of oil price in the nominal exchange rate. The threshold parameter thus, incorporates an inbuilt inverse risk factor of approximately 20.0 per cent and locates several months where the transition occurred with the 1-month lag of oil price as an appropriate transition variable.

Intuitively, the finding suggested that contemporaneously, an increase in the price of oil tends to appreciate the nominal exchange rate, while a drop in oil price depreciates the currency. This satisfies a priori expectation that high oil receipts are associated with the creation of reserve buffers, while a drying up of receipts can also put pressure on reserves and hence, depreciate the currency, all things being equal. The impact is apparently similarly but the magnitude is slightly different.

The policy implication of this finding is that a decline or increase in oil price that amounts to about 20.0 per cent is a potential risk factor for a sharp depreciation or appreciation of the exchange rate. At that level oil prices would be an appreciable distance from the oil price fiscal rule and require appropriate action to stem any unusual volatility in the naira exchange rate.

VI. Conclusion and Policy Recommendations

This paper investigated the link between oil prices and exchange rate using monthly time series data covering the period 2000 to 2013 to ascertain whether oil price is a leading indicator of the direction of exchange rate movement in Nigeria. The result from the GARCH (1, 1) and EGARCH (1, 1) tests, suggested the persistence of the volatility term between the real oil prices and the real exchange rate. The STR results also showed the expected reaction from the exchange rate following changes in oil prices. Thus, we concluded that oil price developments lead exchange rates movement in Nigeria. Consequently, measures to tackle the impact of oil price swings would be germane in stabilising the movement in the exchange rate.

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The Sensitivity of Nigerian Stock Exchange Sectors to Macroeconomic Risk Factors

Ikoku A. E.*

Abstract

This paper investigated the sensitivity of sectoral index returns on the Nigerian Stock Exchange to macroeconomic risk factors such as the spread between deposit and lending rates of banks, the slope of the yield curve, broad money supply, interest rates, exchange rates, inflation and the international price of oil. We found that the Banking, Food and Beverage, and Insurance sectors were sensitive to some macroeconomic risk factors but not to others. The Oil and Gas sector was sensitive to the slope of the yield curve only. This study estimated the elasticities of macroeconomic factors in the Nigerian Stock Exchange using the sectoral indices. It is also one of the few studies that has tested the Arbitrage Pricing Theory (APT) on distinct sectors of the Nigerian Stock Exchange. A number of policy implications on prudential guidelines, sectoral inventions, direction of investments and hedging strategies are indicated.

Keywords: Macroeconomic risk factors, Arbitrage Pricing Theory, Nigerian Stock Exchange, Sectoral Indices

JEL Classification:G12, G15

I. Introduction

This paper investigated the sensitivity of the sectoral indices in the Nigerian stock exchange to selected macroeconomic risk factors. We gauge the sensitivity to both short and long-term interest rates, inflation, exchange rates, and the international price of Bonny Light crude oil(due to the structure of Nigeria's economy).In addition, we estimate sensitivity to the interest rate spread, the slope of the yield curve, and broad money supply (M_2). This is broadly in line with Ross (1976); Ross and Stephen (1980); and Chen, Roll and Ross (1986) who tested the arbitrage pricing theory (APT).

A plethora of studies have been done on the sensitivity of the general stock market to macroeconomic variables, and have reported inconclusive results. Some studies, including Hall (2001), done on industries, such as banking, have found that the sensitivity to interest rates depends on the extent to which banking firms are hedged and that the industry-wide adoption of hedging strategies have increased over time.

* *Ikoku Alvan Enyinnaya is a staff of the Central Bank of Nigeria.The usual disclaimer applies.*

It would be interesting to study the sensitivity to macroeconomic factors by industry, which is the approach adopted in this study. Firms in the same industry are likely to have peculiar characteristics, which will affect their reactions to changes in macroeconomic variables. Market structure may also affect the sensitivity of firms to macroeconomic variables. For example, in an oligopolistic structure, firms may be able to pass on cost increases and may not be sensitive to certain macroeconomic variables. For example, in the Nigerian banking industry, there are indications that the particular level of interest rates is not as important as the spread between lending and deposit rates in determining the profitability of firms.

Section 2 reviews the literature, while Section 3 describes the data and methodology. Section 4 presents the empirical results, while the interpretation of results was presented in Section 5. Section 6 concludes the paper and discusses policy implications.

II. Literature Review

The response of stock markets to movements in macroeconomic variables has generated a lot of interest in the conduct of monetary policy. Most of the studies have been on the reaction of stock prices to benchmark interest rates and, to a lesser extent, inflation. Bernanke and Kuttner (2005) showed that a 25 basis point cut in the interest rate typically led to an increase in stock prices of about 1.0 per cent. They illustrated that there were varying reactions to changes in interest rates across various industries. The effect of the rate cuts was as a result of lower cost of capital, which is expected to have a positive impact on the returns of the firm. Also, a rise in interest rate resulted in the depreciation of stock prices brought about by the subsequent lower consumption level as a result of the higher cost of borrowing money in the economy. They also found that changes in rates, which were perceived to be permanent, were larger than changes that were perceived to be temporary, in keeping with the permanent income hypothesis of Milton Friedman.

Drakos (2001) showed that there was a significant relationship between stock market prices and interest rate movements in Greece. As an emerging market, Drakos points out that the lack of a derivatives market in Greece to provide hedging facilities against interest rate shocks could be accountable for the high sensitivity of stocks to interest rates.

Stevenson (2002), referring more specifically to banking stocks, stipulated that prices of banking stocks did respond to changes in interest rates. He further opined that changes in interest rates brought about more stock market reactions in countries within monetary unions than those operating independently. Stevenson, in the same manner as Drakos (2001), goes further to assert that banks that had hedged their interest rate risk were less likely to be affected by changes in the interest rates.

In another study on banks, Benink and Wolff (2003), using panel data, illustrated the negative interest rate sensitivity of the twenty largest U.S banks. They found that the relationship was most significant in the early 1980's but declined in the late 1980's and early 1990's due to the impact of hedging on interest rate risk. Using Australian data, Ryan and Worthington (2004) showedthat banking returns were significantly affected by short and medium-term interest rate changes. However, the Australian banks' returns were less sensitive to changes in long-term interest rates.

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Filardo (2000) found a positive correlation between consumer price inflation and stock prices. He also asserted that a good measure of inflation should include asset prices. He goes on to show that with the tightening of monetary policy rates, the cost of capital increases thereby leading to lower demands for goods, hence, the subsequent drop in inflation. A lower demand, following policy tightening, for goods and services implies lower future earnings for firms, hence, a drop in their share prices.

Tessaromatis (2003) investigated the sensitivity of UK stock prices to nominal and real interest rates and expected inflation. He found that stock prices responded negatively to changes in nominal and real interest rates. For more than half the portfolios examined, the sensitivity of equities to changes in long term inflation expectations was not statistically significant, suggesting that at least some stocks are good hedges against future inflation. The estimated sensitivities also suggested that equities were more sensitive to real interest rates than expected inflation or nominal interest rates.

Staikouras (2005) investigated the issue of whether financial intermediaries' common stock returns incorporated a risk premium for their inherent exposure to unexpected changes in interest rates. Weekly logarithmic returns were calculated for a total of 239 UK firms covering a sample period from 1989 to 2000. Portfolios of stocks from banks, finance firms, insurance companies, investment trusts and property investment companies were employed in order to measure the effect of interest rate risk above and beyond the market portfolio. The systematic market risk was measured by the FTSE All-Share Price Index return and the interest rate factor was represented by the one- and three-month Treasury bill discount rates. A two-factor model with the market portfolio and the changes in market yields, as exogenously specified risk variables, was employed. The model was estimated by means of a seemingly unrelated regression estimation (SURE) framework with both cross-equation restrictions and within equation nonlinear constraints on the parameters. The findings indicated that financial institutions' equity returns incorporated a risk premium for their exposure to market yield surprises.

Following recent revelations of the vulnerability of some depository institutions to changes in interest rates, bank supervisors, especially in the U.S., have placed more emphasis on monitoring the interest rate risk of commercial banks using the duration-based Economic Value Model (EVM), designed by the Federal Reserve Bank to estimate the interest rate sensitivity of banks. Sierra and Yeager (2004) utilised accounting-based bank performance measures such as the net interest margin (NIM), return on assets (ROA), and the book value of equity (BVE), from 1998 to 2002 to test whether measures derived from the Fed's EVM were correlated with the interest rate sensitivity of U.S. community banks. Their combined use of regression analysis, matched pairs, and correlation analysis demonstrated that the Fed's EVM is a useful supervisory tool to assess the relative interest rate risk at community banks.

Hahm (2004) investigated the interest rate and exchange rate exposures of Korean commercial and merchant banking corporations during the pre-crisis liberalization period. The sensitivity of stock returns was adopted as a measure of the exposure. The exposure was estimated in the context of factor models, which include interest rate and exchange rate changes in addition to market portfolio returns. Employing various time-series and panel regressions, the direction and patterns of risk exposures were investigated across different industries and time-periods using monthly stock prices, interest rate and exchange rate data from March 1990 to November 1997.

Closing prices of the last business day of the month were used to compute monthly stock returns, yield changes and currency depreciation rates. In addition to the Korean stock price index (KOSPI), banking and merchant banking industry indices and individual stock prices that were listed at the Korea Stock Exchange at the onset of the financial crisis were employed. The three-year corporate bond yield was used for the interest rate data and the won/dollar spot exchange rate was used for the exchange rate data.The results showed that both commercial and merchant banks became increasingly exposed to interest rate and exchange rate risks in 1994 to 1997. Also, commercial and merchant banks were significantly negatively exposed to the interest rate and exchange rate risks during this sub-period, implying that higher interest rates and exchange rates negatively impacted the firm values of the financial institutions.

Ballester *et al.,* (2009) using weekly bank stock returns for 23 banking firms and weekly data of the average three-month rate of the Spanish interbank market spanning January 1994 through December 2006, empirically investigated the main determinants of the interest rate exposure of Spanish commercial banks, using panel data methodology. The results indicated that interest rate exposure was systematically related to some bank specific characteristics. In particular, a significant positive association was found between bank size, derivative activities, and proportion of loans to total assets and banks' interest rate exposure. On the other hand, the proportion of deposits to total assets was significantly and negatively related to the level of bank's interest rate risk.

Huang and Hueng (2009) had extended the Fama–French three-factor model to include a risk factor that proxies for interest-rate risk faced by firms in an attempt to reduce the pricing errors that the three-factor model could not explain. These pricing errors were observed especially in small size and low book-to-market ratio firms, which were, in general more sensitive to interest-rate risk. Using U.S. monthly stock market data spanning July 2004 to December 2006, they showed that both modifications were essential to improving the performance of the three-factor model and also reduced the aggregate pricing errors generated by the three-factor model by more than 50 per cent. The results showed that their Time-Varying-Loadings Four-Factor (TVL4) model significantly reduced the pricing errors.

A number of relevant studies have been conducted on the Nigerian stock exchange also. Using monthly and quarterly data from 1985 to 2008, Omotor (2010) investigated the relationship between inflation and stock returns in Nigeria. He found support for the Fisher (1930) hypothesis in Nigeria, which suggested a positive relationship between stock returns and inflation.

Using quarterly data, Adaramola (2011) studied the impact of macroeconomic variables on stock prices in Nigeria, between 1985 and 2009. He found that interest rates, exchange rates and the international price of oil had a strong influence on Nigerian stock prices while money supply, inflation rate and GDP had a weaker influence on Nigerian stock prices.

Izedonmi and Abdullahi (2011) conducted a test of the APT using a sectoral approach and three macroeconomic variables—market capitalization, inflation and exchange rates. Surprisingly, they found that macroeconomic variables had no effect on stock prices in Nigeria. Incidentally, their adjusted r-squared of 0.38 was rather low, indicating some model misspecification.

Using quarterly data from 1985 to 2009 and a vector autoregressive approach, Arodoye (2012) investigated the relationship between stock prices and GDP, interest rates and inflation. He found both short-run and long-run relationships among the variables. Perhaps the greatest shortcoming of this study is the fact the sign of the relationships with stock prices tended to oscillate over time, thus making it difficult to establish the true relations among the variables.

This study is different from the previous studies in that it investigates the relationship between stock prices and selected macroeconomic variables using the sectoral indices that were instituted by the Nigerian Stock Exchange in January 2009. Besides using a new data set, this study also recognises that the sensitivity to macroeconomic risk factors may differ by industry, depending on the composition of balance sheets and other industry-specific vulnerabilities. The hypothesis is that the reactions to macroeconomic variables depend on the industry, and studies that investigate the sensitivity of the entire stock market index are unable to delineate the differences by industry.

III. Data and Methodology

III.1 Indices and Macroeconomic Risk Factor Data

Four sectoral indices—banking, insurance, food and beverage and, oil and gas—were utilized in this study. The all-share index was used to gauge the sensitivity of the sectoral indices to systematic risk. In addition to the sectoral indices, we also employed the NSE30 index, which tracks the performance of the 30 largest firms, in terms of market capitalization, on the NSE.

For macroeconomic risk factors, the interbank interest rate, the ten-year Treasury bond interest rate, headline inflation, the nominal naira/US$ Wholesale Dutch Auction (WDAS) exchange rate, the price of Bonny Light crude oil (Nigeria's variety), the spread between prime lending and consolidated deposit rates, the slope of the yield curve (as measured by the difference in yield between the ten-year government bond and 3-month treasury bills), and broad money supply (M_2) were chosen. Two interest rates were employed in order to ascertain the reaction of the sectoral indices to short-term (interbank) versus long-term (ten-year Treasury bond) rates.

The sectoral indices as well as the all-share and NSE30 indices were obtained from the Nigerian Stock Exchange (NSE), the interbank rate, nominal naira/US$ exchange rate, and crude oil prices, the spread variable and M_2 were obtained from the Central Bank of Nigeria (CBN), inflation rate was obtained from the National Bureau of Statistics (NBS), while the ten-year treasury bond rate and yield curve variables were obtained from the Financial Markets Dealers Association (FMDA).

Since the sectoral indices were inaugurated by the NSE in January 2009, the data, with the exception of the Food and Beverage index, were taken from January 2009 to June 2013; the Food and Beverage index was taken from January 2009 to December 2011 as it was reconstituted in January 2012, introducing some discontinuity in the data series. This reduced the number of observation for the Food and Beverage index to 36, compared with 54 for the other variables. The sectoral indices account for64.19 per cent of the total market capitalization.

II.2 Methodology

The elasticities of the sectoral indices to the risk factors were estimated by running the following regressions:

$$\Delta LOG(Banking) = \beta 0 + \beta 1 \Delta LOG(ASI) + \beta 2 \Delta LOG(INFLATION) + \beta 3 \Delta LOG(IBR) + \beta 4 \Delta LOG(TBR) + \beta 5 \Delta LOG(EXR) + \beta 6 \Delta LOG(OIL) + \beta 7 \Delta LOG(SPREAD) + \beta 8 \Delta LOG(YLDCRV) + \beta 9 \Delta LOG(M2) + \varepsilon$$

(1)

$$\Delta LOG(Food\ and\ Bev.) = \beta 0 + \beta 1 \Delta LOG(ASI) + \beta 2 \Delta LOG(INFLATION) + \beta 3 \Delta LOG(IBR) + \beta 4 \Delta LOG(TBR) + \beta 5 \Delta LOG(EXR) + \beta 6 \Delta LOG(OIL) + \beta 7 \Delta LOG(SPREAD) + \beta 8 \Delta LOG(YLDCRV) + \beta 9 \Delta LOG(M2) + \varepsilon$$

(2)

$$\Delta LOG(Insurance) = \beta 0 + \beta 1 \Delta LOG(ASI) + \beta 2 \Delta LOG(INFLATION) + \beta 3 \Delta LOG(IBR) + \beta 4 \Delta LOG(TBR) + \beta 5 \Delta LOG(EXR) + \beta 6 \Delta LOG(OIL) + \beta 7 \Delta LOG(SPREAD) + \beta 8 \Delta LOG(YLDCRV) + \beta 9 \Delta LOG(M2) + \varepsilon$$

(3)

$$\Delta LOG(Oil\ and\ Gas) = \beta 0 + \beta 1 \Delta LOG(ASI) + \beta 2 \Delta LOG(INFLATION) + \beta 3 \Delta LOG(IBR) + \beta 4 \Delta LOG(TBR) + \beta 5 \Delta LOG(EXR) + \beta 6 \Delta LOG(OIL) + \beta 7 \Delta LOG(SPREAD) + \beta 8 \Delta LOG(YLDCRV) + \beta 9 \Delta LOG(M2) + \varepsilon$$

(4)

In addition, we estimate the following equation for the NSE30:

$$\Delta LOG(NSE30) = \beta 0 + \beta 1 \Delta LOG(ASI) + \beta 2 \Delta LOG(INFLATION) + \beta 3 \Delta LOG(IBR) + \beta 4 \Delta LOG(TBR) + \beta 5 \Delta LOG(EXR) + \beta 6 \Delta LOG(OIL) + \beta 7 \Delta LOG(SPREAD) + \beta 8 \Delta LOG(YLDCRV) + \beta 9 \Delta LOG(M2) + \varepsilon$$

Where β_0 is the constant, $\beta_1 \ldots \beta_5$ are the factor sensitivities and ε is the error term, in each equation. By running regressions with the change in the natural logarithms of the indices and risk factors, we compute the percentage change in the indices for each percentage change in the risk factors, or elasticities. Autoregressive moving average (ARMA) terms were used in the econometric equations to ensure white noise error terms.

The precise levels of significance were determined by using probability values, instead of using t-statistics to see if the computed elasticities were significant at the traditional 1.0 per cent, 5.0 per cent or 10.0 per cent levels.

IV. Empirical Results

IV.1 Graphical Plots and Descriptive Statistics

Figures 1 and 2 showed graphical representations of the indices, the index returns,and the macroeconomic variables. Table 1 shows the descriptive statistics for all the variables used in the analysis. With the exception of the all share index, insurance, oil and gas series, and the slope of the yield curve, one cannot reject the hypothesis of normal distribution for the variables, judging by the Jarque-Bera statistic. The yield curve series has the smallest mean of 3.35 while M_2 has the largest mean of 12,039,475.00. However, since the regression model use change in logs specification (i.e., percentage changes), all the variables are on the same scale.

Figure 1: Indices and Index Returns

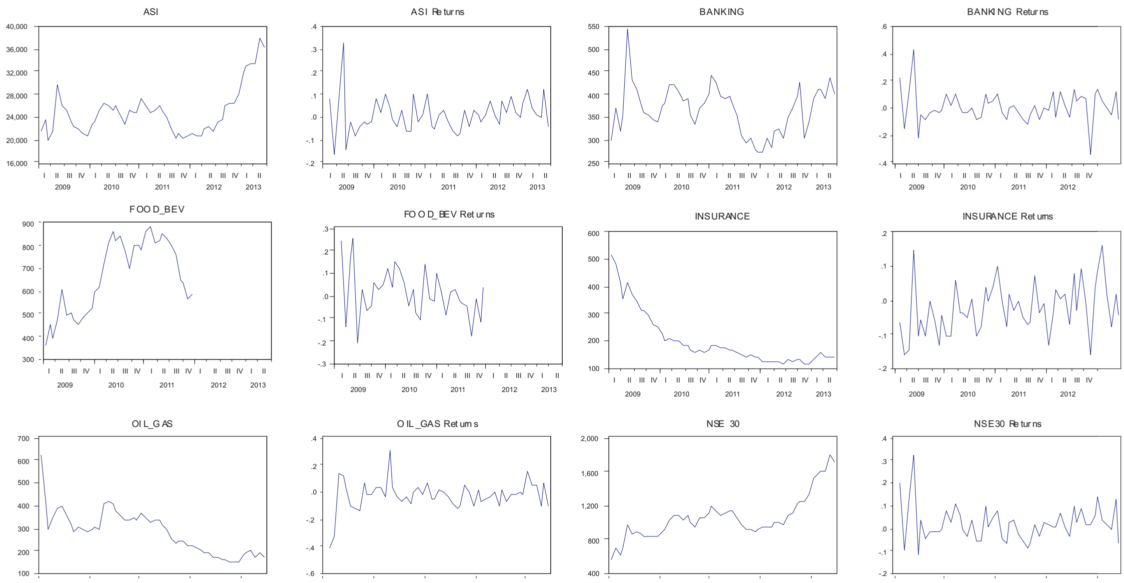

Figure 2: Macroeconomic Variables

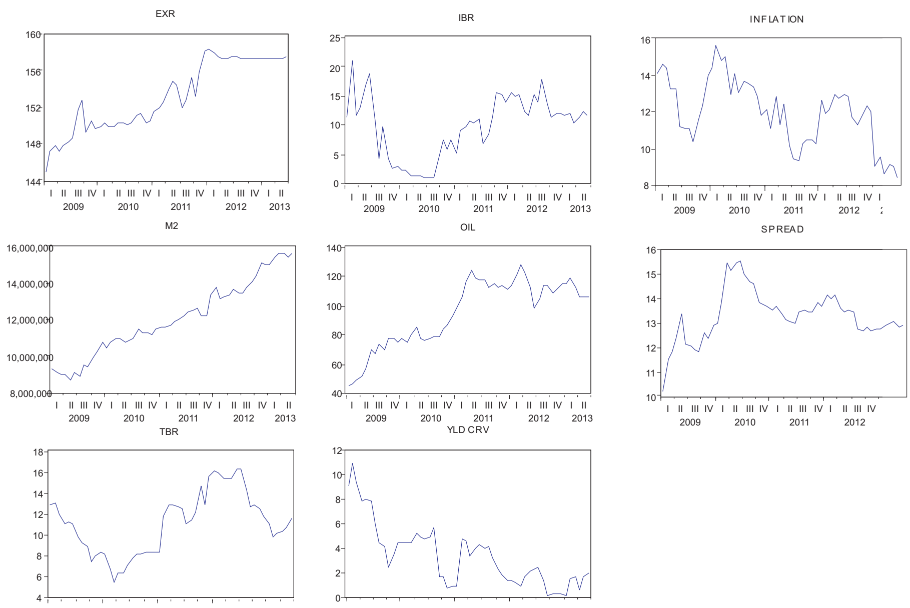

Table 1
Descriptive Statistics

Sample: 2009M01 2013M06

	ASI	BANKING	FOOD_BEV	INSURANCE	OIL_GAS	EXR	IBR	INFLATION	M2	OIL	SPREAD	TBR	YLDCRV
Mean	24868.64	366.81	663.62	201.22	283.58	153.14	9.73	11.98	12039475.00	94.96	13.28	11.13	3.35
Median	24443.04	372.875	672.185	165.37	296.70	152.59	11.155	12.10	11776290.00	105.09	13.38405	11.2275	2.815
Maximum	37794.75	542.45	881.34	515.38	624.91	158.38	21.07	15.65	15622667.00	128.00	15.5581	16.34	10.994
Minimum	19803.60	270.99	355.94	114.07	152.92	144.85	1.10	8.40	8720581.00	45.64	10.1978	5.53	0.07
Std. Dev.	4105.70	52.84	160.10	97.37	93.93	3.78	5.20	1.79	2021246.00	22.83	1.02	2.94	2.58
Skewness	1.35	0.32	-0.26	1.65	0.75	-0.11	-0.21	-0.16	0.17	-0.54	0.00	0.09	0.96
Kurtosis	4.54	3.73	1.64	4.90	4.35	1.71	2.22	2.30	2.07	2.14	3.87	2.08	3.51
Jarque-Bera	21.71	2.11	3.20	32.57	9.09	3.84	1.79	1.34	2.22	4.27	1.71	1.96	8.92
Probability	0.00	0.35	0.20	0.00	0.01	0.15	0.41	0.51	0.33	0.12	0.43	0.38	0.01
Sum	1.34E+06	1.98E+04	2.39E+04	1.09E+04	1.53E+04	8.27E+03	5.25E+02	6.47E+02	6.50E+08	5.13E+03	7.17E+02	6.01E+02	1.81E+02
Sum Sq. Dev.	8.93E+08	1.48E+05	8.97E+05	5.02E+05	4.68E+05	7.58E+02	1.43E+03	1.70E+02	2.17E+14	2.76E+04	5.55E+01	4.57E+02	3.53E+02
Observations	54	54	36	54	54	54	54	54	54	54	54	54	54

Table 2
Correlation Coefficients

Covariance Analysis: Ordinary
Sample (adjusted): 2009M01 2011M12
Included observations: 36 after adjustments

Correlation Probability	ASI	BANKING	FOOD_BEV	INSURANCE	OIL_GAS	EXR	IBR	INFLATION	M2	OIL	SPREAD	TBR	YLDCRV
ASI	1.000000												

BANKING	0.912611	1.000000											
	0.0000	-----											
FOOD_BEV	0.592886	0.337297	1.000000										
	0.0001	0.0442	-----										
INSURANCE	-0.047635	0.159676	-0.760308	1.000000									
	0.7826	0.3523	0.0000	-----									
OIL_GAS	0.418193	0.338471	-0.049909	0.556080	1.000000								
	0.0111	0.0435	0.7725	0.0004	-----								
EXR	-0.161101	-0.333818	0.399987	-0.745948	-0.684865	1.000000							
	0.3479	0.0466	0.0156	0.0000	0.0000	-----							
IBR	-0.118913	-0.082764	-0.382641	0.405253	-0.011524	0.071008	1.000000						
	0.4897	0.6313	0.0213	0.0142	0.9468	0.6807	-----						
INFLATION	0.148989	0.251928	-0.076815	0.297929	0.451766	-0.614754	-0.364189	1.000000					
	0.3858	0.1383	0.6561	0.0776	0.0057	0.0001	0.0290	-----					
M2	-0.091564	-0.354145	0.657699	-0.886758	-0.486997	0.818390	-0.143381	-0.414471	1.000000				
	0.5953	0.0341	0.0000	0.0000	0.0026	0.0000	0.4041	0.0120	-----				
OIL	0.022801	-0.180387	0.621876	-0.813321	-0.531931	0.863627	0.020762	-0.613388	0.897406	1.000000			
	0.8950	0.2924	0.0001	0.0000	0.0008	0.0000	0.9043	0.0001	0.0000	-----			
SPREAD	0.368188	0.201542	0.748473	-0.713319	-0.183989	0.285313	-0.546425	0.185769	0.511384	0.335379	1.000000		
	0.0271	0.2385	0.0000	0.0000	0.2827	0.0917	0.0006	0.2780	0.0014	0.0455	-----		
TBR	-0.287711	-0.357889	-0.199862	0.118903	-0.138621	0.367620	0.825397	-0.494935	0.227390	0.344806	-0.467182	1.000000	
	0.0888	0.0321	0.2425	0.4898	0.4201	0.0274	0.0000	0.0021	0.1823	0.0395	0.0041	-----	
YLDCRV	0.054167	0.186351	-0.474810	0.811516	0.528251	-0.661467	0.355608	0.376811	-0.684953	-0.652748	-0.432471	0.180836	1.000000
	0.7537	0.2765	0.0034	0.0000	0.0009	0.0000	0.0333	0.0235	0.0000	0.0000	0.0084	0.2912	-----

The correlation coefficients are shown in Table 2. Among the indices, the highest correlation coefficient in Table 2 is between the ASI and Banking, at 0.9126. This may be partly explained by the dominance of the banking industry in the Nigerian stock market, accounting for 32 per cent of market capitalisation. In addition, the Banking index is negatively correlated with the exchange rate, M_2 and the Treasury bond rate. The Food and Beverage index is positively correlated with the exchange rate, M_2, oil prices and interest rate spread but negatively correlated with the yield curve. The insurance index is positively correlated with the interbank rate and yield curve, but negatively correlated with the exchange rate, M_2, oil prices, and interest rate spread. Finally, the oil and gas index is positively correlated with inflation and the yield curve, but negatively correlated with the exchange rate, M_2, and oil prices.

Among the risk factors, there are some high values such as 0.8636 for the correlation between the nominal exchange rate and oil prices, 0.8974 for the correlation between M_2 and oil prices, and 0.8254 for the correlation between IBR and TBR. Since Nigeria obtains more than 90 per cent of its export earnings from crude oil sales, one can understand the high correlation between the nominal exchange rate and crude oil price, and between crude oil price and M_2. Since interest rates mostly move in tandem, the high correlation between interbank and ten-year Treasury bond rates is not surprising.

Consistent with the nature of macroeconomic variables, Table 3 showed that most of the variables areI(1) with the exception of the oil and gas index in the Augmented Dickey-Fuller unit root test, which is I(0). However, with the Phillips-Peron test, the insurance and oil and gas indices are I(0) while the rest of the variables are I(1). This suggests that, on the whole, our taking the log differences of the variables is appropriate. Any residual autocorrelation is accounted for by using ARMA terms in the equations. Plots of correlograms and squared residuals suggest that the error terms in the equations are white noise. We utilise White heteroscedasticity-consistent estimation in the regressions.

Table 3
Unit Root Tests

ADF Tests

Null Hypothesis: Variable has a unit root

	Levels		First Differences		
Variable:	McKinnon Prob-values with Trend	McKinnon Prob-values without Trend	McKinnon Prob-values with Trend	McKinnon Prob-values without Trend	**Test Result**
ASI	0.8899	0.8330	0.0000	0.0000	I(1)
BANKING	0.0492	0.0142	0.0000	0.0000	I(1)
EXR	0.0718	0.3020	0.0000	0.0000	I(1)
FOOD_BEV	0.9420	0.2890	0.0000	0.0000	I(1)
IBR	0.2956	0.1694	0.0000	0.0000	I(1)
INFLATION	0.3195	0.2020	0.0000	0.0000	I(1)
INSURANCE	0.0461	0.0001	0.0000	0.0000	I(1)
M2	0.0394	0.9605	0.0000	0.0000	I(1)
OIL	0.6532	0.1869	0.0000	0.0000	I(1)
OIL_GAS	0.0007	0.0031	0.0000	0.0000	I(0)
SPREAD	0.1311	0.1316	0.0000	0.0000	I(1)
TBR	0.6629	0.5965	0.0000	0.0000	I(1)
YLDCRV	0.2330	0.1477	0.0000	0.0000	I(1)

Phillips-Perron Tests

Null Hypothesis: Variable has a unit root

	Levels		First Differences		
Variable:	McKinnon Prob-values with Trend	McKinnon Prob-values without Trend	McKinnon Prob-values with Trend	McKinnon Prob-values without Trend	**Test Result**
ASI	0.9103	0.8632	0.0000	0.0000	I(1)
BANKING	0.0431	0.0121	0.0000	0.0000	I(1)
EXR	0.0613	0.3020	0.0000	0.0000	I(1)
FOOD_BEV	0.9316	0.2750	0.0000	0.0000	I(1)
IBR	0.3743	0.1694	0.0000	0.0000	I(1)
INFLATION	0.3814	0.3626	0.0000	0.0000	I(1)
INSURANCE	0.0023	0.0000	0.0000	0.0000	I(0)
M2	0.0400	0.9982	0.0000	0.0000	I(1)
OIL	0.8432	0.1904	0.0000	0.0000	I(1)
OIL_GAS	0.0006	0.0053	0.0000	0.0000	I(0)
SPREAD	0.1202	0.0191	0.0000	0.0000	I(1)
TBR	0.6088	0.5381	0.0000	0.0000	I(1)
YLDCRV	0.2158	0.1477	0.0000	0.0000	I(1)

IV.2 Regression Results

The regression results are shown in Table 4. The constant in the Banking sector's model was not significantly different from zero, as in the Food and Oil and Gas sectors' models and unlike in the Insurance sector and NSE 30 models, where they were significant at 5.0 per cent level. The Banking sector's beta was estimated at 1.0528 and was significant at the 1.0 per cent level. The Banking sector was found to be sensitive to oil prices, with a positive sign, but sensitive to the yield curve and M_2 with negative signs and all at 5.0 per cent level.We utilised ARMA (2,3) terms in the Banking sector model to obtain white noise error terms. The model seemed to explain the variation in the banking sector quite well, with anadjusted $R^2$of 0.7813.

The Food and Beverage sector's beta was estimated at 1.0577 and was significant at 1.0 per cent level. In addition, the Food and Beverage sector was found to be sensitive to inflation, the exchange rate and oil prices with elasticities of -0.1763, -2.7341 and -0.2558, respectively; the elasticities to inflation and exchange rates were significant at 1.0 per cent level, while the elasticity to oil prices was significant at 10.0 per cent level. The Food and Beverage sector was found to respond positively to a steepening of the yield curve and increases in M_2, with elasticities of 0.0252 and 0.4713, significant at the 5.0 per cent and one per cent levels, respectively. ARMA (1, 2) terms were used in the Food and Beverage sector model to obtain white noise error terms. The model had the second highest adjusted R^2 of 0.8823 among the estimated models.

Table 4
Estimated Sensitivities to Macroeconomic Risk Factors

	Banking		**Food and Beverage**		**Insurance**		**Oil and Gas**		**NSE 30**	
Variable	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
C	0.0013	0.8255	0.0148	0.1892	-0.0263	0.0232 **	-0.0100	0.4635	0.0042	0.0109 **
DLOG(ASI)	1.0528	0.0000 ***	1.0577	0.0000 ***	0.6745	0.0000 ***	0.6210	0.0000 ***	0.9398	0.0000 ***
DLOG(INFLATION)	0.1398	0.2141	-0.1763	0.0001 ***	-0.3233	0.0000 ***	-0.0605	0.5798	-0.0232	0.2321
DLOG(IBR)	-0.0239	0.2013	-0.0322	0.1339	-0.0190	0.2512	-0.0188	0.4765	-0.0013	0.8044
DLOG(TBR)	0.0752	0.2114	0.0751	0.2827	0.0397	0.5771	0.0644	0.6127	-0.0277	0.0432 **
DLOG(EXR)	0.2559	0.7078	-2.7341	0.0002 ***	0.0652	0.9398	-1.3610	0.3036	0.0947	0.6578
DLOG(OIL)	0.2059	0.0297 **	-0.2558	0.0631 *	-0.0145	0.8933	0.1101	0.3766	-0.0155	0.6332
DLOG(SPREAD)	0.0812	0.7888	-0.0074	0.9641	0.5947	0.0573 *	-0.1825	0.5767	-0.0364	0.5682
DLOG(YLDCRV)	-0.0200	0.0293 **	0.0252	0.0304 **	0.0213	0.0003 ***	0.0174	0.0259 **	-0.0010	0.4347
DLOG(M2)	-1.0451	0.0185 **	0.4713	0.0072 ***	-0.1571	0.5170	-0.7823	0.1537	-0.0175	0.8402
AR(1)	-0.0506	0.6833	0.3981	0.0480	-0.4232	0.0839	-0.7041	0.0000	0.8348	0.0000
AR(2)	-0.3483	0.0891	-	-	-	-	0.1977	0.0405	-	-
MA(1)	-0.4797	0.0000	0.5118	0.0224	0.7669	0.0008	0.7417	0.0000	-0.9700	0.0000
MA(2)	0.4799	0.0000	-0.4881	0.0196	0.6637	0.0000	-	-	-	-
MA(3)	-0.9449	0.0000	-	-	0.3852	0.1267	-	-	-	-
MA(4)	-	-			-0.4681	0.0008	-	-	-	-
Adjusted R-squared	0.7813	-	0.8823	-	0.5977	-	0.4003	-	0.9716	-
F-statistic	13.7597	0.0000	21.6234	0.0000	6.4116	0.0000	3.7808	0.0008	159.8812	0.0000
Akaike info criterion	-2.8706	-	-3.5975	-	-3.0104	-	-2.4829	-	-5.7550	-
Schwarz criterion	-2.3024	-	-3.0139	-	-2.4475	-	-1.9905	-	-5.3047	-
Durbin-Watson statistic	1.9698	-	1.7122	-	1.9415	-	1.9139	-	2.1457	-

*** Significant at 1% level. ** Significant at 5% level. * Significant at 10% level.

Models were estimated with White heteroskedasticity-consistent standard errors and covariance.

The Insurance sector's beta, at 0.6745, was significantly less than those of the Banking and Food and Beverage sectors and the NSE 30. However, like the other betas, it was significant at 1.0 per cent level. The Insurance sector was sensitive to inflation, with an elasticity of -0.3233; this was significant at 1.0 per cent level. However, the Insurance sector responded positively to increases in the spread between deposit and lending rates and the slope of the yield curve, with elasticities of 0.5947 and 0.0213, respectively; the elasticity to spread was significant at 10.0 per cent level while the elasticity to the yield curve was significant at 1.0 per cent level. ARMA (1,4) terms were used in the Insurance sector model to ensure white noise error terms. In terms of goodness of fit, the adjusted R^2 of 0.5977 indicates that the Insurance model did not perform as well as the Banking, Food and Beverage and NSE 30 equations.

The Oil and Gas sector's beta was estimated at 0.6210 (significant at 1.0 per cent level), the lowest beta among the estimated models. Moreover, this index is only sensitive to the yield curve, among the macroeconomic risk factors, with an estimated elasticity of 0.0174, which was significant at 5.0 per cent level. Again, ARMA (2,1) terms were used in the Oil and Gas sector model to ensure white noise error terms. The adjusted R^2 of 0.4003 was the lowest among the models.

The NSE 30 beta was estimated at 0.9398 and was significant at the one per cent level. Since this index is made of the thirty largest firms in terms of market capitalization on the Nigerian Stock Exchange, it is not surprising that the beta is close to one. Besides the market index, the NSE 30 was found to be sensitive to the Treasury bond yield, with an elasticity of -0.0277 (significant at 1.0 per cent level). ARMA (1,1) terms were used in the NSE 30 model to ensure white noise error terms. Incidentally, the adjusted R^2 of 0.9716 was the highest among the models estimated.

V. Conclusions and Policy Implications

This study investigated the sensitivity of index returns to selected macroeconomic risk factors, i.e., inflation, the interbank rate, Treasury bond yields, the exchange rates, oil prices, the spread between consolidated deposit and lending rates, the slope of the yield curve,broad money supply or M_2, the spread between deposit and lending rates of banks, the spread between ten year and 3-month Treasury securities, and M_2. Rather than examine sensitivities to macroeconomic variables of the entire stock market, we investigated sensitivities by sector/industry, with the full expectation that these sensitivities should differ by industry. Thus, the paper highlighted the differing reactions of sectors to changes in macroeconomic variables.

Judging by the estimated betas, as shown by the coefficients of DLOG(ASI) in the sector equations, the Food and Beverage sector is the most risky, closely followed by the Banking sector. On the other hand, the estimated betas for the NSE 30 group and the Insurance and Oil and Gas sectors suggest less than average exposures to systematic risk since they are below 1.0.

The Banking sector elasticity of 0.2059 to oil prices could be explained by the concentration of lending to the oil and gas industry. More than 25.0 per cent of loans are routinely issued to this industry. Contrary to expectation, the elasticity to the interest rate spread was not significant. The elasticity to the slope of the yield curve is negative and significant, which may be due to the duration of banks' asset holdings. The greatest sensitivity of the Banking sector was to M_2, estimated at -1.0451. The estimated elasticities suggest that banks' exposure to the oil and gas industry should be closely monitored. A fall in oil prices could lead to an increase in non-performing loans in this sector. Stress tests should be used to gauge the effectiveness of banks' risk management efforts. Banks should also be encouraged to hedge their exposure to the yield curve, even though complete hedging of risk in this area would also eliminate the possibility of profiting from yield curve dynamics.

The Food and Beverage sector elasticities to exchange rates and inflation are strongly negative; in fact, the estimated elasticity to exchange rates of -2.7341 is the greatest number we have among the models, suggesting that a 1.0 per cent depreciation of the exchange rate would lead to a 2.7 per cent reduction in returns in this sector. Given that most of the inputs to these sectors' output are imported, deterioration in the exchange rate would affect profits and stock returns negatively. The same reasoning applies to inflation. However, inflation applies to this sector's input as well as its output and a negative elasticity to inflation implies that the prices of output rise less than those of input, thereby constraining profits. This suggests a measure of competition in this sector and a relative lack of market power. Given the ease with which food and beverage products can be substituted for one another, this would seem to be borne out by reality in Nigeria. The Food and Beverage sector is really a proxy for Nigerian manufacturing and the sensitivity to exchange rates suggests that the manufacturing sector will be negatively impacted by the recent devaluation of the naira. This may be compounded by the sensitivity to inflation as the naira devaluation is likely to increase observed rates of inflation. Thus, the food and beverage (and wider manufacturing) sector may be a candidate for targeted interventions in terms of subsidised credit facilities.

The Insurance sector also has a negative elasticity to inflation. The negative elasticity may be due to the composition of balance sheets in this sector. The lack of sensitivity to short - term or long-term interest rates suggests immunisation against interest rates risk, as in the Banking sector. However, this sector has positive elasticities to spread and the slope of the yield curve. The substantial negative elasticity to inflation would suggest investing in real assets or alternative assets (including farmland, timber, real estate, and some equity securities), which are likely to keep up with inflation.

The lack of sensitivity to most macroeconomic risk factors in the Oil and Gas sector and the relatively low goodness of fit indicate that we could do a better job at identifying the factors driving this sector through further research. This sector may be more sensitive to political risk than the other sectors, especially as it is more heavily regulated (with administratively determined prices and subsidies) than other sectors. However, the Oil and Gas sector was sensitive to the slope of the yield curve. This suggests a better hedging strategy for firms in this sector.

As with the Oil and Gas sector, the NSE 30 was largely insensitive to the macroeconomics risk factors with the exception of the Treasury bond yield, to which it had a negative elasticity. The negative elasticity to the Treasury bond yield may be due to the fact that these firms, due to their size and other characteristics, are more likely to issue bonds in the Nigerian capital market. The risk they bear could of course, be hedged, and so would the profits.

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An Examination of the Structural Inflation Dynamics in Nigeria

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Abstract

The attainment and sustenance of price stability defined as single digit inflation is expected to create an enabling environment for the growth of the real sector. This has been one of the cardinal goals of the Central Bank of Nigeria's monetary policy, since its establishment in 1958. However, in most of the years the attainment of this objective had been elusive as episodes of very high inflation rates were prevalent, especially in the 1980s and 1990s in Nigeria. Among other issues, the Central Bank of Nigeria has regarded inflation as monetary phenomenon, requiring management of monetary aggregates as a means of price stability. Persistent high rates of inflation despite sluggish growth in monetary aggregates suggest that there could be other drivers of inflation outside of monetary factors. Against this backdrop, this study examines the dynamics of inflation in Nigeria, including the structural evolution as well as the direction of its movement with a view to designing appropriate policy measures to rein in the inflationary pressures. Following Argy (1970) and Masha (1996), four (4) hypotheses of structural variables namely; agricultural bottleneck, demand shift, export variability, and foreign exchange scarcity were tested. The study utilised quarterly data from 1970(1) to 2013 (4) except for Bureau de Change (BDC) premium where the duration was 1991(1) to 2013 (4) based on Auto Regressive Distributed Lag (ARDL) model. The results show that structural factors like budget deficit, rainfall, variation in export, exchange rate premium have profound influence on movement in CPI in Nigeria during the period. Exchange rate premium appears to significantly influence inflation in both the short- and long-run equations while most of the other structural variables are significant only in the long-run. The study therefore concludes that the monetary authority should incorporate structural variables in its inflation model in order to holistically rein in inflationary pressures in Nigeria.

Keywords: Price Stability, Monetary Policy, Central Banks

JEL Classification Numbers:E31, E52, E58

I. Introduction

The Central Bank of Nigeria, since its establishment in 1958, has continued to strive to achieve and sustain price stability measured in terms of single digit inflation target, with a view to strengthening real output and employment. In pursuance of this goal, the Bank has relied heavily on monetarist's axiom which believes that inflation

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is always a monetary phenomenon and therefore monetary authority should keep a firm grip on growth in monetary aggregates in order to achieve low and stable price level in the economy. This position derives strength from the classical school of thought which postulates that growth in price level is positively related to growth in money supply. In line with this thesis therefore, the monetary policy of the Central Bank of Nigeria, for a considerable time, focused on direct control of monetary aggregates in order to achieve the ultimate objective of low and stable inflation. Experiences over the years have however shown evidence of persistent rising inflationary trend despite sluggish growth in money supply, suggesting that other factors outside monetary factors are at play in inflationary development in Nigeria.

To reinforce this view, anecdotal evidences have shown that inflationary developments in most developing economies are significantly influenced by non-monetary factors including climatic conditions, the structure of production, level and availability of foreign exchange as well as political and security conditions (Lim 1987, Yeldan 1999, Sowa and Kwakye 1993). Reflecting this position, policy makers and academics have argued that central banks should not focus on the entire gamut of inflation as measured by the headline but should concentrate on the core component given that significant drivers of headline inflation are non-monetary and therefore outside the control of central bank. The counter argument however is that focusing only on a measure of inflation is not sufficient to deliver on economic growth and development which is the ultimate objective of economic policy. Thus, there is a compelling need to have a holistic view of movement in price level, which implies that both monetary and non-monetary factors should be taken into consideration in formulating policies aimed at taming inflation. This, invariably, requires empirical based studies that would identify non-monetary factors which drive inflation in Nigeria in view of the fact that significant deal of effort have been invested on the impact of monetary factors.

Apart from few authors like Masha (1996), Akinnifesi (1984), and Fashoyin (1986) most of the research works on inflation in Nigeria have viewed it from the prism of monetary phenomenon, leaving significant knowledge gap about other factors that could influence price development and by extension constrain policy. Given the apparent disconnect between monetary aggregates and inflation outcomes in recent times, policy makers and academics are now beginning to have a rethink on inflation and monetary growth nexus in Nigeria.

In light of the foregoing, the pertinent questions include: does structural inflation exist in Nigeria? Which element(s) of structural inflation is dominant in Nigeria? What is the dynamic nature of the various elements of structural inflation in Nigeria? Lack of precise answers to these questions, constitute a significant gap in knowledge and by extension effective formulation of monetary policy. This study intends to fill this gap by examining the possibility of structural inflation in Nigeria as well as the relative influence of such structural factors on the movement in price level. Unlike most of the works on Nigeria which employed ordinary least square regression techniques, this study employs bound test cointegration and Auto Regressive Distributed lag (ARDL) methods. This approach provides sufficient insight to the existence of long-run relationship among the variables, hence obviates the likelihood of spurious regression, among others advantages. The output is expected to improve the contents of information provided to the policy makers, especially the Monetary Policy Committee of the Central Bank of Nigeria and other relevant stakeholders.

The remainder of this paper is organised as follows: section two examines both theoretical and empirical literature while section three dwells on the methodology. Section four contains descriptive and empirical analyses while section five concludes the study.

II. Literature Review

II.1 Theoretical Literature

Conceptually, inflation is defined as a sustained increase in the general level of prices for goods and services. It is a phenomenon that affects all economies irrespective of their stages of development, producing undesirable results, and making monetary authorities to direct considerable effort to curbing it. Fundamental economics identify some causes of inflation to include cost push and demand pull. Cost-push inflation arises from increasing factor cost in the production process e.g. rising wages, rising capital cost, etc., while Demand-pull inflation stems from excess demand or expenditure above the currently existing productive capacity of the economy.

Several schools of thought including monetarists, Keynesians, neo-classical and structuralists have attempted to explain the causes of inflation in an economy. The conflict theory asserts the origin of inflation as an outcome of the process of competition amongst economic agents over total factor income in the economy. Price stability would only occur if total factor income claims by the competing agents is less than or equal to actual real economic output. Thus, if wages rises beyond average labour productivity, firms would respond by increasing prices in order to restore their share of total real output.

Both the Keynesian and monetarist schools attribute the cause of inflation to demand factors. In the Keynesian case, inflation arises because of the gap that exists when current aggregate demand exceeds the current full employment output. The

Keynesians assume endogenous money supply. Keynes (1936) provided a soothing exposé about inflation. He noted that there would always be underemployment in the economy and therefore, an increase in money supply would lead to increase in employment and output. However, Keynes' alluded to the possibility of bottleneck in production and the concept of diminishing returns and concluded that at the level of full employment, inflation could occur. Thus, both the Neo-classical and Keynesian postulations are based on demand side analysis.

Monetarists on the other hand, attribute the root cause of inflation to excess supply of money in the economy, too much money chasing too few goods beyond the existing absorptive capacity of the economy. The monetarists' argument relies on the quantity theory of money, which assumes that money supply is exogenously determined and changes in same would result in an equal directional change in price (Friedman, 1956).

The Structuralists trace the origin of inflation to structural bottlenecks, which constrain productive and allocative efficiency in the economy. Inflation is seen to originate from the supply side, which are propagated through the financial sector. Money supply is assumed to be endogenous, while inflation is delinked from money supply and is assumed to be caused by imbalances in the economy that are non-monetary in nature. These imbalances include supply bottlenecks (inelastic food supply), competition by groups over share of factor income that manifests in rent seeking activities and high import dependence for intermediate goods amongst others.

Phillip (1958) maintained that there is a stable inverse relationship between inflation and the rate of unemployment.

Figure 1: Phillips Curve showing relationship between Inflation and rate of Unemployment

That proposition gained wide acceptability among macroeconomists in the 1960s. However, some economists contended that Phillips curve analysis was too simplistic and could not in explain real world problems and trade-offs. That thinking gave impetus to the theory of Non-Accelerating Inflation Rate of Unemployment (NAIRU) that explained the likelihood for the occurrence of stagflation. The argument against Phillips Curve relates to market 'imperfections.' The South American structuralists School emphasised structural rigidities as the principal cause of inflation.

The structuralists agreed with the Neo-classical school that inflation is necessary to engender growth but argued that as the economy develops, some rigidity arises in the system thereby leading to structural inflation. Beginning with non-agricultural income, aggregate demand increases in consonance with high growth rate. The resultant pressure from a growing population and high demand for goods and services induce a rise in the general price level as well as wages. Another cause of structural inflation in developing economies is the adoption of protective measures, which leads to increased prices of the local industrial products (Olivera, 1964). Buttressing this view, Hall and Hitch (1939) argued that the existence of relative price rigidity in markets other than pure competition showed that prices were 'administered'. Furthermore, firms operating in non-perfectly competitive markets fix their own prices arbitrarily.

Olowo (2003) asserted that structural bottlenecks emerge as economies develop and transits from agrarian to manufacturing. Invariably, population growth and upward trending urban wages exert pressures on the system, which kick starts a vicious mechanism that leads to increasing prices of agricultural produce and feeds into increased price levels and further wage increases. This is further aggravated by low capital, financial base and foreign exchange restraints and government intervention to accelerate the industrialisation process by taking a prominent role in industrial, manufacturing and infrastructure development either through deficit financing or monetisation.
Categorically, structuralists posit that inflation results from supply inelasticity; rise in agricultural product prices, worsening terms of trade, devaluation, import substitution, among others. Compared with Phillips curve and the monetarist theory of inflation, structuralists have a broader approach to understanding the inflation phenomenon.

II.2 Empirical Review

The causes of inflation within the traditional monetarists school, underscores the relationship between money supply and inflation. Monetarists see inflation as "always and everywhere a monetary phenomenon" (Friedman, 1956). However, several studies including Akinboade, Niedermeier and Siebrits (2004), have identified non-monetary factors among the key determinants of inflation in both industrialized and emerging economies. In particular, exchange rate depreciation has been identified as a significant cause of inflation, directly through the price of tradable goods, and indirectly through imported inputs and exchange rate indexed nominal wages. Ho and McCauley (2003) in a study on inflation in emerging countries found that exchange rate depreciation affect inflation significantly.

Beside the commonly identified structural elements, the impact of movement in wages on price levels has also been investigated by some authors. For instance Harberger (1963) showed that in Chile, wage changes appear not to cause significant increase on price level. The authors however, emphasized that the finding was probably a reflection of the level of development of the economy given that price level may not react to wage level in developing economies due to myriad of factors including cost of capital that could mask the effect of wage increase. Nonetheless, Greene (1989) found that the general price level could be impacted even in developing economies when the rate of change in wage is higher than the general price level.

Moore and Smith, (1986) and Akinboade, Niedermeier and Siebrits (2004) found that increases in wage level impacted on general price level in South Africa. They found a positive correlation between inflation and wage level, and concluded that wage changes were among the key drivers of structural and cyclically upward trend in inflation.

Argy (1970), appraised the contribution of structural elements to inflation in developing countries by testing four hypothesis namely demand-shift, export variability, agricultural bottleneck, and foreign exchange scarcity. Most of the structural elements performed poorly in the model, thus the author concluded that monetary variables were the main determinants of inflation in developing economies.

Contrary to the finding of Argy, a number of studies have shown that non-monetary factors pose significant threat to price level in many developing economies. Lim (1987), Yeldan (1999), Sowa and Kwakye (1993), and Kwargbo (2011) showed that developments in price level were positively correlated with underlying structural factors in the economy rather than changes in monetary aggregates alone. Kwargbo (2011) found that monetary and credit contraction increases the cost of working capital required for the expansion of the real sector thereby causing short-run stagflation and supply shocks. Reinforcing this position, Adu and Marbuah (2011) identified real output, interest rate, nominal exchange rate, fiscal deficit, terms of trade, expansionary fiscal stance, shock to agricultural output, and government consumption as the major structural elements in most of the developing economies. Furthermore, Durevall and Ndung'u (1999), in a study on inflation dynamics in Kenya between 1974 and 1996, reported that the long run inflation was determined by developments in exchange rate, foreign prices and terms of trade, while developments in money supply and interest rates only impacted on inflation in the short run.

Another strand of the literature investigates the joint impact of both monetary and structural factors on price level. Adusei (2013) estimated an error correction model for South Africa to isolate the short and long run impact of selected monetary and structural factors in inflation. Dummy variables used to capture structural break included stock market crash and collapse of the apartheid regime. The result indicated that degree of openness of the economy as well as monetary variables were the key drivers of inflation in South Africa.

Findings of several studies on inflation in Nigeria broadly corroborate the results in other developing and emerging economies. Adebuga et al (2012) estimated a Quantity Theory of Money type model and reported that Nigeria's inflation was not purely monetary in nature as the results indicated that the elasticity of price with respect to money supply was less than one.

Evidence of structural inflation as well as joint impact of both monetary and structural factors was reported in (Ajayi and Awosika, 1980; Fashoyin, 1986; and Akinnifesi, 1984) on Nigeria. Structural factors commonly identified included development in the oil sector, wage level, imports, exports, and indirect taxes. Asogu (1991) studied the determinants of inflation in Nigeria using 10 different specifications. He found that money and exchange rates were significant determinants of inflation in all equations. Furthermore, the results suggested that inflation was significantly determined by real GDP, price of domestic agricultural produce, output of industrial sector, net exports, exchange rate and money supply. This finding was corroborated by Chete, Egwaikhide, and Fatokun (1994) who found that monetary and structural variables as well as the openness of the Nigerian economy were important determinants of the inflation in Nigeria.

Moser (1995), using an error correction model, established that monetary variable, exchange rate, and real income significantly impact on inflation. He noted that the monetary impact was driven by expansionary fiscal policies and agro-climatic condition. The impact of official and parallel exchange rates was underscored in Masha (1996), and Chete, Egwaikhide, and Fatokun (1994). Masha (1996)based on the results obtained from two stage least squares, pointed out that developments in the parallel foreign exchange market was a significant determinant of inflation in Nigeria. The developments in parallel exchange rate resulted in inflation through increases in production costs, which was passed on to consumers.

In a related study, Itua (2000) argued that structural, demand-pull and cost-push factors were the major causes of inflation in Nigeria between 1981 and 1998. Other authors including Olowo (2003), and Folarin and Sanni (2010) confirmed Itua's findings. Similarly, Olubusoye and Oyaromade (2008) found that past inflation expectation, developments in the oil market and real exchange rate were factors that significantly drive inflation in Nigeria.

Adebayo (2008) put the impact of structural factors in perspective by arguing that strategies to promote industrial and agricultural production must be introduced in addressing inflation in Nigeria.

III. Methodology

III.1 Data

The quarterly data used in this study covers the period 1970(1) to 2013(4), except for the data on Bureau de change (BDC) premium which ranged from 1991:1 to 2013:4. The data were obtained from the Central Bank of Nigeria (CBN) statistical database and National Bureau of Statistics (NBS). The variables include Real GDP (Y), Consumer Price Index (P), Broad Money (M_2), Budget Deficit (BD), Demand Shift (DS), Quarterly Rainfall (QR), Exchange Rate Premium (EP), naira value of external reserves (NR), Variance of Export (VEX); and Excess Demand (ED).

III.2 Model Specification

In line with the literature, we assume that price developments are a function of non-structural/nominal variables (i.e. Money supply [M_2] and output level [Y]), fiscal variables (i.e. budget deficit [BD]) and structural variables (i.e. quarterly rainfall [qr] to estimate the impact of agricultural bottleneck, excess demand [ed], exchange rate premium [EP] and naira value of foreign reserves [nr] to capture the impact of foreign exchange scarcity, demand shift [ds] and export variability [vex]). This is represented in equation (1) and (2).

$$p_t \quad f(M_{2t}, bd_t, qr_t, ed_t, ep_t, ds_t, nr_t, vex_t, y_t) \qquad (1)$$

$$p_t \quad c_t m_{2t} \; bd_t \; qr_t \; ed_t \; ep_t \; ds_t \; nr_t \; vex_t \; y_t \qquad (2)$$

An estimable function is derived from taking logs of equation (2) and is expressed as equation (3), which is the long-run equilibrium relationship. The variables are defined above, while the coefficients represent the elasticity of the variables with respect to price, c is the constant term, and εt is the error term.

$$\ln p_t = c + \alpha \ln m2_t + \beta \ln bd_t + \phi \ln qr_t + \eta \ln ed_t + \delta \ln ep_t + \gamma \ln ds_t + \lambda \ln nr_t + \tau \ln vex_t + \psi \ln y_t + \varepsilon_t \qquad (3)$$

The *apriori* expectations based on theoretical underpinning of the four hypotheses are presented in Table 3. The additional variables included in the model (annual rainfall and the naira values of foreign exchange reserves) are expected to have a negative coefficient. Agriculture in less developed economies, including, Nigeria is essentially rain-fed, rudimentary and subsistence, involving very low level mechanisation. Thus, the higher the average rainfall and the more evenly distributed, the greater the expected agricultural output.

For developing countries, food consumption accounts for a significant proportion of household consumption thereby constituting a significant weight in the CPI basket. Consequently, factors that affect agriculture production invariably impact on inflation. As a country builds up foreign external reserves arising from improved international trade and/or capital receipts, the domestic currency appreciates vis-à-vis the currency of its trading partners. The appreciation of the currency is expected to moderate the impact of imported inflation, thus improvement in external reserves should be negatively signed, all things being equal.

Table 1: A priori expectations of the signs of coefficient

S/N	Variable	A priori coefficient
1	QR	Negative
2	BD	Positive
3	DS	Positive
4	ED	Positive
5	M2	Positive
6	NR	Negative
7	Y	Negative
8	VEX	Positive
9	EP	Positive

Source: Authors' computation

III.2.1 ARDL Methodology

The paper adopted the Auto Regressive Distributed Lag (ARDL) bound test approach developed by Pesaran et al., (1999) to test the existence of cointegration of the variables and Vector Error Correction Model (VECM) to model the long-run and dynamic relationship between the dependent variable, CPI and the independent variables (i.e. fiscal, structural and Monetary). The approach allows the estimation of the cointegration relationship using Ordinary Least Square (OLS) method, subsequent to the identification of the lag order of the model. Significantly, the approach facilitates estimation of variables that are I (0), I (1) or mutually cointegrated and is relatively efficient with small sample sizes.

The bounds test procedure was applied to equation (3) using Vector Auto Regressive (VAR) model of order p in

$$z_t \quad c_0 \quad t \quad {}_{i\ 1}^{p} \quad {}_t z_{t\ i} \quad {}_t, t \quad 1,2,3,\ldots\ldots, \mathrm{T}$$

Where C_0 and ω are a *(k+1)* vector of intercepts and trend coefficients, respectively. In line with Pesaran et al (1999), the derived Vector Equilibrium Correction Model (VECM) for equation (4) is represented by equation (5).

$$z_t \quad c_0 \quad t \quad z_{t\ i} \quad {}_{i\ 1}^{p} \quad {}_i\ z_{t\ i} \quad {}_t, t \quad 1,2,3,\ldots., T$$

The long-run multiplier and short-run dynamic coefficients of the VECM are contained in the *(k+1)*(k+1)* matrices $I_{k\ 1} \quad {}_{i\ 1}^{p} \quad {}_i$ and ${}_i \quad {}_{j\ i\ 1}^{p} \quad {}_i$ respectively.

Z_t is a vector of the dependent I(1) variable Y_t represented in our model as $\ln P_t$ and independent variable, $M2_t, bd_t, qr_t, ed_t, ep_t, ds_t, nr_t, vex_t, y_t$ which forces the I(0) and I(1) variables to be defined with a multivariate identically and independently distributed (i.i.d) zero mean error vector ${}_t \quad ({}_{1t}, {}'_{2t})'$ generated by a homoscedastic process. The existence of a unique long-run relationship between the variables implies that we can represent the conditional VECM (5) as equation (6).

$$y_t \quad c_{y0} \quad t \quad {}_{yy} y_{t\ 1} \quad {}_{xx} x_{t\ 1} \quad {}_{i\ 1}^{p\ 1} \quad {}_i\ y_{t\ 1} \quad {}_{i\ 1}^{p\ 1} \quad {}_i\ x_{t\ 1} \quad {}_{yt}, t \quad 1,2,\ldots.., T \qquad (6)$$

Based on equation (6), the conditional VECM pertaining to our model can be represented as equation (7):

$$\ln p_t \quad c_0 \quad {}_1\ln p_{t\ 1} \quad {}_2\ln m2_{t\ 1} \quad {}_3\ln bd_{t\ 1} \quad {}_4\ln qr_{t\ 1} \quad {}_5\ln ed_{t\ 1}$$

$$ {}_6\ln ep_{t\ 1} \quad {}_7\ln ds_{t\ 1} \quad {}_8\ln nr_{t\ 1} \quad {}_9\ln vex_{t\ 1} \quad {}_{10}\ln y_{t\ 1}$$

$$\overset{p}{\underset{i\ 1}{}} \ln p_{t\ 1} \quad \overset{p}{\underset{i\ 1}{}} \ln m2_{t\ 1} \quad \overset{p}{\underset{i\ 1}{}} \ln bd_{t\ 1} \quad \overset{p}{\underset{i\ 1}{}} \ln qr_{t\ 1} \quad \overset{p}{\underset{i\ 1}{}} \ln ed_{t\ 1}$$

$$\overset{p}{\underset{i\ 1}{}} \ln ep_{t\ 1} \quad \overset{p}{\underset{i\ 1}{}} \ln ds_{t\ 1} \quad \overset{p}{\underset{i\ 1}{}} \ln nr_{t\ 1} \quad \overset{p}{\underset{i\ 1}{}} \ln vex_{t\ 1} \quad \overset{p}{\underset{i\ 1}{}} \ln y_{t\ 1} \quad {}_t$$

Where c_0, ${}_i$ and ${}_t$ represent the constant term, long run multipliers and the error term.

III.2.2 Bounds Testing Procedure

In order to carry out the bounds test, we estimate equation (7) using OLS method and perform an F-test of joint significance of the coefficients of the lagged variables to determine the existence of a long-run relationship. The test that is normalized on P is represented by $F_p(P \mid m2, bd, qr, ed, ep, ds, nr, vex, y)$

This entails testing the null hypothesis:

$H_0:\ {}_1\ {}_2\ {}_3\ {}_4\ {}_5\ {}_6\ {}_7\ {}_8\ {}_9\ {}_{10}\ 0$ against the alternative hypothesis $H_1:\ {}_1\ {}_2\ {}_3\ {}_4\ {}_5\ {}_6\ {}_7\ {}_8\ {}_9\ {}_{10}\ 0$. The critical values provide a test for cointegration for independent variables of order I(d) given that ($0 \quad d \quad 1$). The lower bound indicates that the variables are I(0), while the upper bound indicates that the variables are I(1), the null hypothesis is rejected and the variables are statistically cointegrated in the long-run if the F-statistic is greater than the upper critical value. The null hypothesis is accepted if the F-statistic is below the lower critical value, and the result is deemed inconclusive if the F-statistics lies between the upper and lower bounds.

Having established long-run cointegration, the methodology requires that we estimate the long-run unrestricted ARDL $p_1, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9$ model represented by equation (8) to determine the optimal lag length and the order of the ARDL model.

$$\ln p_t \quad c_0 \quad \overset{p}{\underset{i\ 1}{}} {}_1\ln p_{t\ i} \quad \overset{q1}{\underset{i\ 1}{}} {}_2\ln m2_{t\ i} \quad \overset{q2}{\underset{i\ 1}{}} {}_3\ln bd_{t\ i} \quad \overset{q3}{\underset{i\ 1}{}} {}_4\ln qr_{t\ i} \quad \overset{q4}{\underset{i\ 1}{}} {}_5\ln ed_{t\ i}$$

$$\overset{q5}{\underset{i\ 1}{}} {}_6\ln ep_{t\ i} \quad \overset{q6}{\underset{i\ 1}{}} {}_7\ln ds_{t\ i} \quad \overset{q7}{\underset{i\ 1}{}} {}_8\ln nr_{t\ i} \quad \overset{q8}{\underset{i\ 1}{}} {}_9\ln vex_{t\ i} \quad \overset{q9}{\underset{i\ 1}{}} {}_{10}\ln y_{t\ i} \quad {}_t$$

Finally, an error correction model represented by equation (9) is estimated to obtain the dynamic coefficients associated with the long-run model.

$$\ln p_t \quad c_0 \quad {}^{p}_{i\ 1} \quad {}_{i} \ln p_{t\ i} \quad {}^{q}_{j\ 1} \quad {}_{j} \ln m2_{t\ j} \quad {}^{q}_{k\ 1} \quad {}_{k} \ln bd_{t\ k} \quad {}^{q}_{l\ 1} \quad {}_{l} \ln qr_{t\ l}$$

$$ {}^{q}_{m\ 1} \quad {}_{m} \ln ed_{t\ m} \quad {}^{q}_{n\ 1} \quad {}_{n} \ln ep_{t\ n} \quad {}^{q}_{o\ 1} \quad {}_{o} \ln ds_{t\ o} \quad {}^{q}_{p\ 1} \quad {}_{p} \ln nr_{t\ p} \quad {}^{q}_{r\ 1} \quad {}_{r} \ln vex_{t\ r} \quad {}^{q}_{s\ 1} \quad {}_{s} \ln y_{t\ s} \quad ecm_{t\ 1} \quad {}_{t}$$

The short-run dynamic coefficients are , , , , , , , , *and* while the rate of adjustment to equilibrium is .

IV. Analysis of Results

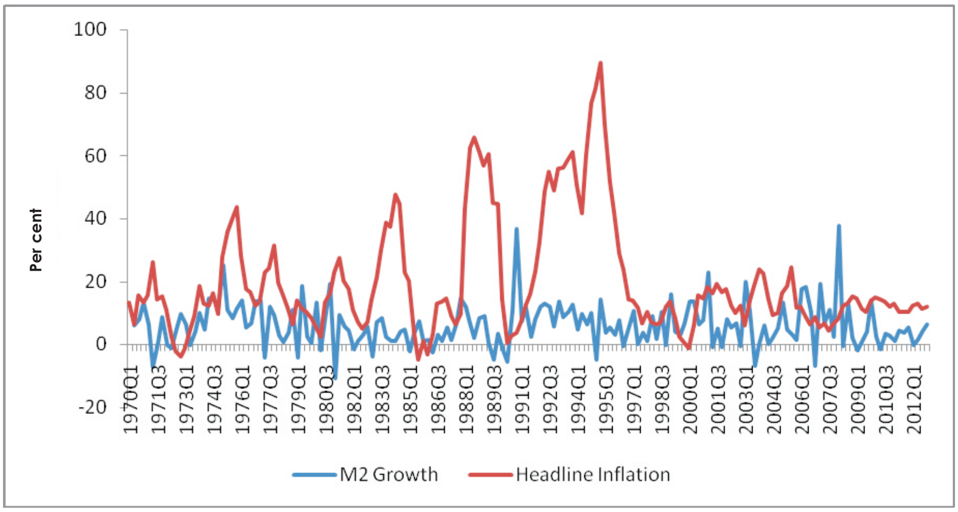
IV.1 Descriptive Analysis

For a considerable time dating back to the commencement of operation by the CBN in 1959, monetary policy was based on direct control of monetary aggregates in order to achieve the ultimate objective of low and stable inflation. Apart from the fact that the monetary authority could not effectively control monetary aggregates during the period, preliminary observation revealed that movements in money supply and inflation were not completely synchronized. On a general note, the outcome of monetary policy has been mixed, albeit dominated by high inflation. The outturns could be classified into three phases; low, moderate and high inflation. We classify as low when inflation was in single digit, while inflation rate within the range of 10 and 14 per cent is classified as moderate. The outturn of above 15 per cent is considered high.

Figure 1.0 below shows the trend of inflation in relation to money supply from 1970 to 2012. Periods of low inflation were generally short, found mostly in the early 1970s and a few years in the 1980s. Moderate inflation characterized the late 1970s to mid-1980s as well as from 2002 to 2012, while the rest of the period exemplified high inflation. The highest inflation rate (75.0 per cent) was recorded in 1994, followed by 60 per cent in 1988, and 40 per cent in 1976 and 1984. This period constituted the high inflation phase.

The overall performance, represented by the growth of broad money, reveals an erratic and seemingly volatile pattern except in the early to mid-1980s.

Figure 2: Growth in Broad money and Inflation



Monetary growth was generally high throughout the 1970s, reaching its peak of 80.0 per cent in 1976, while other periods of growth in excess of 40.0 per cent included the early 1980s, 1990s, and the later part of the 2000s decade.

In terms of co-movement, there seems to be some alignment in trend between the two variables in some periods while wide deviation was visible in other periods. The highest growth of money supply (80 per cent) in 1976 was associated by a significant rise in inflation rate (40.0 per cent) in the same year. Similar trends in movement were also noticed in other periods such as 1988 and 1994. In the early 1980s, late 1990s and 2000s, however, a sharp contrast was observed in the direction of inflation and money supply with the phenomenon being more pronounced in the later part of the 2000s.The divergent in movement of the variables gives credence to the likelihood of structural inflation in the economy.

Apart from diverging movement in the two variables which supports presence of structural inflation, detailed analysis revealed that other factors besides the growth in money supply contributed to high inflation in periods of co-movements. For example the high level of inflation in 1976 was not just due to high growth of money supply but the influence of drought which ravaged the Northern part of the country during the period. Thus, the high level of inflation recorded during the period could also be ascribed to supply shocks.

Similarly, the high inflation in the mid-1970s was attributed to significant distortion in the foreign exchange market. This was a period of fixed exchange rate in which there was a huge premium between the official and the parallel market rates, traced to bottlenecks in the production process. Furthermore, the very high level of inflation (40.0 per cent) in 1985, against a paltry growth of 12 per cent in money supply further reinforced the likelihood of the ascendancy of structural inflation in the country. During the period, significant pressure by external creditors compelled the government to reach an agreement with the International Monetary Fund (IMF) in which the devaluation of the domestic currency was part of the options for consideration. Economic units expected the devaluation of the naira, and consequently factored in the anticipated exchange rate in the pricing regime. The highest level of inflation of 60 - 70 per cent was between 1994 and 1995 when the country was confronted with serious socio-political challenges arising from the political impasse caused by the annulment of the1993 general election, which persisted till 1994. This created an environment that constrained economic activities with the attendant supply shock.
The trend analysis therefore tends to lend credence to the existence of structural inflation in Nigeria during the period.

IV.2 Empirical Results
IV.2.1 Unit Roots Tests

In estimating the ARDL Bound testing procedure, it is pertinent to ensure that none of the variables under consideration are I(2). The time series properties of the data were evaluated by adopting Augmented Dickey Fuller (ADF) and Phillips-Peron (PP) procedures for unit root tests. The results as reported in Table 2 show that all the variables are either stationary at levels or at first difference. Specifically, four out of the ten variables are stationary at level I (0), while six are stationary after first difference I(1).

Table 2: UNIT ROOT TESTS

VARIABLE		TESTS		CONCLUSION
	Order of Integration	ADF	PP	
Buddef (BD)	Level	-1.8711	-0.8791	I(1)
	1st Diff	-3.6688	-5.5316	
Rainfaff (QR)	Level	-3.5404	-14.4036	I(0)
CPI (P)	Level	14.2391	14.166	I(1)
	1st Diff	-10.9922	-9.1462	
Demand Shift (DS)	Level	-3.2315	-5.9559	I(0)
Broad Money (M2)	Level	6.1292	6.0423	I(1)
	1st Diff	-5.356	-10.7838	
NERV (ER)	Level	-0.501	0.648	I(1)
	1st Diff	-4.6293	-13.4465	
VARANEXP (VEX)	Level	-4.678	Money	I(0)
RGDP (Y)	Level	1.2577	0.9316	I(1)
	1st Diff	-5.1479	-19.1724	
EXPREM (EP)	Level	-2.2729	-2.3053	I(1)
	1st Diff	-9.5201	-9.5199	
EXDD2 (ED)	Level	-12.9571	-12.9803	I(0)

Source: Authors' computation.

IV.2.2 Bounds Tests for Cointegration

In line with ARDL analysis procedure, we investigate the presence of long-run relationships in equation (6), using equation (7). Based on the AIC, we chose maximum lag order of 7 for the conditional ARDL-VECM. The results of the bound test are presented in table 4.2 below.

Table 3: Results of Bounds Tests

S/N	Equation	Lag Length (AIC)	F-Obs	F-Lower	F-Upper	Remarks
I	F_P (P|M2,BD,QR,ED,EP,DS,NR,VEX,Y)	7	5.37630	2.54	3.86	Cointegration
II	F_{M2} (M2|P,BD,QR,ED,EP,DS,NR,VEX,Y)	1	2.90930	2.54	3.86	Inconclusive
III	F_{BD} (BD|P,M2,QR,ED,EP,DS,NR,VEX,Y)	8	2.70810	2.54	3.86	Inconclusive
IV	F_{QR} (QR|P,M2,BD,ED,EP,DS,NR,VEX,Y)	7	3.81730	2.54	3.86	Inconclusive
V	F_{EP} (ED|P,M2,BD,QR,EP,DS,NR,VEX,Y)	3	3.60790	2.54	3.86	Inconclusive
VI	F_{EP} (EP|P,M2,BD,QR,ED,DS,NR,VEX,Y)	3	3.06490	2.54	3.86	Inconclusive
VII	F_{DS} (DS|P,M2,BD,QR,ED,EP,NR,VEX,Y)	4	2.84940	2.54	3.86	Inconclusive
VIII	F_{NR} (NR|P,M2,BD,QR,ED,EP,DS,VEX,Y)	5	1.31820	2.54	3.86	No Cointegration
IX	F_{VEX}(VEX|P,M2,BD,QR,ED,EP,DS,NR,Y)	0	5.58420	2.54	3.86	Cointegration
X	F_Y (Y|P,M2,BD,QR,ED,EP,DS,NR,VEX)	5	3.92620	2.54	3.86	Cointegration

Source: Authors' computation

The bound test results in table 3 above indicate that we cannot reject the null hypothesis of no cointegration in the exchange rate scarcity equation while the results are inconclusive on the equations of money supply, budget deficit, quarterly rainfall, excess demand, exchange rate premium, and demand shift. The results, however, suggests that a long run relationship exist between price and other variables including the structural variables.

Having established a long run co integrating relationship in equation (8), we estimate an ARDL equation of the form 7,1,1,1,1,1,1,1,1, 1 as in equation (8). The results are presented in Table 4.

Table 4: Estimated Long Run Coefficient using the ARDL Approach				
Equation (7): ARDL (7,1,1,1,1,1,1,1,1,1) Selected Based on AIC. Dependent Variable is $_t$				
Regressor	**Coefficient**	**S.E**	**T-Ratio**	**Probability**
C	8.1660	2.3479	3.4780	0.0008
$LnM2_t$	1.0952	0.0834	13.1348	0.0000
$LnBD_t$	-0.0108	0.0046	-2.3437	0.0216
$LnQR_t$	0.0199	0.0137	1.4528	0.1503
$LnEP_t$	0.0381	0.0122	3.1268	0.0025
$LnED_t$	0.0159	0.0177	0.8966	0.3727
$LnDS_t$	0.3971	0.0850	4.6715	0.0000
$LnNR_t$	-0.0147	0.0454	-0.3234	0.7473
$LnVEX_t$	0.0146	0.0108	1.3447	0.1826
LnY_t	-1.6144	0.2644	-6.1048	0.0000

Source: Authors' computation.

The results in table 4 based on equation 7 revealed that broad money supply (M2), Exchange rate premium (EP), Demand Shift (DS) and Real Gross Domestic Product (Y) are significant in explaining development in the level of inflation even at 1 per cent. Budget deficit is significant at 5 per cent but the coefficient is negative contrary to apriori expectations, suggesting that an increase in budget deficit leads to moderation in price level. A rationale justification for this observation could be the investment of such expenditure on productivity enhancing projects while simultaneously placing high restrain on monetization of such deficits. The estimated coefficients of the long-run relationship show that a 1 per cent increase in broad money leads to approximately 1.10 per cent increase in inflation, all things being equal. The results further indicate that a 1 per cent increase in exchange rate premium and demand Shift would lead to about 0.04 and 0.41 per cent increase in the level of inflation. Lastly, the sign of the real output growth (RGDP) conforms to the apriori expectation. The results indicate that a one per cent increase in output would lead to about 1.62 per cent decline in inflation.

Figure 3: Plot of Cumulative Sum (Cusum) for Coefficients Stability for ECM Model

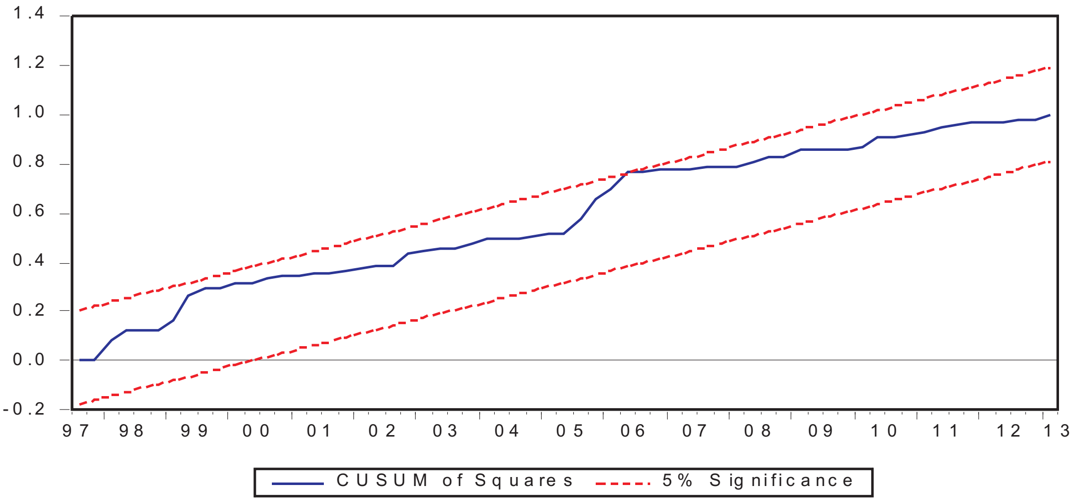
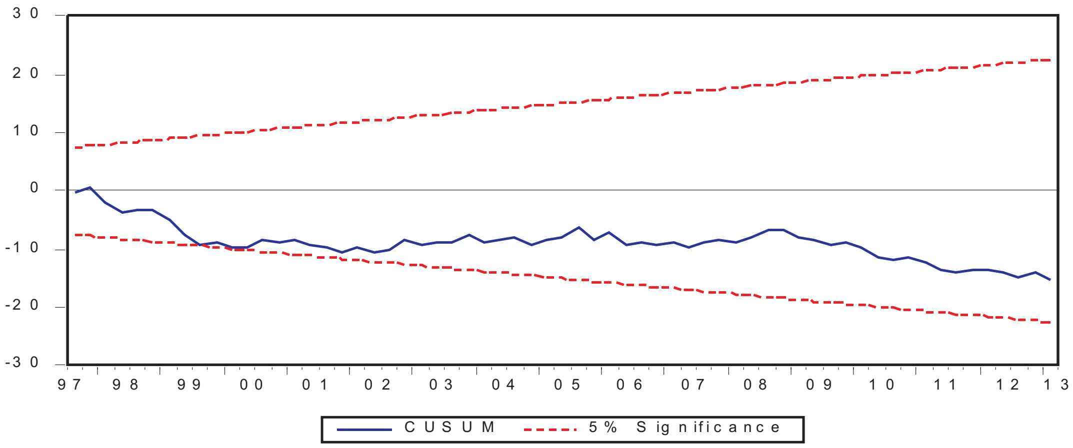


Figure 4: Plot of Cumulative Sum of Squares for Coefficients Stability for ECM Model



The coefficients of the model are stable as indicated by the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMQ) charts which are within the 5 per cent confidence interval. Similarly, the underlying regression of the ARDL equation shows that the model has roots lying inside the unit circle (see Figure 4)

Figure 5: Inverse Roots of AR Characteristic Polynomial

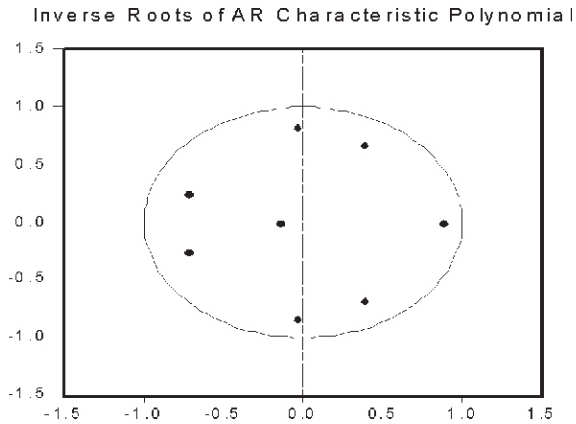


Table 5 presents the results of the short-run dynamic coefficients of the long-run relationships obtained from the ECM equation (9).

Table 5: Error Correction Representation for the Selected ARDL Model

Equation (7): ARDL (7,1,1,1,1,1,1,1,1,1) Selected Based on AIC. Dependent Variable is				
Regressor	**Coefficient**	**S.E**	**T-Ratio**	**Probability**
C	-0.01693	0.01398	-1.21053	0.23060
DM2(-1)	0.06861	0.07980	0.85977	0.39320
DBD(-1)	0.00166	0.00143	1.16154	0.24980
DQR(-1)	-0.00354	0.00223	-1.58592	0.11780
DED(-1)	0.00066	0.00250	0.26296	0.79340
DEP(-1)	0.00602	0.00291	2.06638	0.04290
DDS(-1)	-0.01825	0.02293	-0.79573	0.42920
DNR(-1)	0.01362	0.00813	1.67514	0.09890
DVEX(-1)	0.00068	0.00179	0.38185	0.70390
DY(-1)	0.18722	0.11047	1.69467	0.09510
ECM(-1)	-0.05767	0.02494	-2.31242	0.02400
ecm = lnP + 1.189lnM2 + 0.029lnBD - 0.061lnQR + 0.011lnED + 0.104lnEP -0.316lnDS + 0.236lnNR + 0.012lnVEX - 3.246lnY - 0.294C				
R-Squared = 0.6289		R-Bar Squared = 0.4934		F-stat = 4.6422
SER = 0.0377		DW-Stat = 2.0131		
Akaike Info. Criterion = -3.4907		Schwarz Bayesian Criterion = -2.8105		

Source: Authors' computation.

Only the exchange rate premium is significant at 5 per cent while output and scarcity of foreign exchange are weakly significant at 10 per cent level. The error correction coefficient, estimated at -0.057 is significant at 5 per cent and is correctly signed. The coefficient of the error correction model suggests that about 6.0 per cent of disequilibria in a quarter is corrected in the following quarter which connotes a relatively low speed of adjustment to equilibrium after a shock.

V. Conclusion and Recommendation

The study examines the dynamics of structural inflation in Nigeria, leveraging on the works of Argy, (1970) and Masha, (1996). The motivation was largely due to the fact that exclusive focus on monetary aggregates by the monetary authorities in developing economies has not delivered low inflation on consistent basis, suggesting that non-monetary factors could also be significant drivers of inflation. Trend analysis shows that movements in monetary aggregates and inflation were not perfectly synchronized in a significant part of the study period, lending credence to the presence of structural factors in inflationary process. The Bound test cointegration technique shows that there is a long-run relationship between the structural variables and price level while the error correction model indicates that both exchange rate depreciation and level of rainfall have significant influence on inflation in the short run. The Auto Regressive Distributed Lag (ARDL) model shows that a number of structural variables such as exchange rate premium, demand shift, and real output have significant effect on inflation. In terms of weight, shock to output appears to have the highest impact on inflation as 1 per cent contraction in output would lead to an increase in inflation by 1.6 per cent in the long run. Following output are demand shift and exchange rate premium in terms of influence on inflation.

The findings of the study have profound policy implications. Given the impact of structural factors on inflation, efforts at reining in inflation should go beyond exclusive focus on monetary aggregates to some other non-monetary factors. Specifically, the monetary authority should collaborate with relevant authorities to ensure that disruption to output is minimised. Furthermore, the premium on the exchange rate should be considerably minimized in addition to the need to moderate factors that could cause shift in pattern of demand.

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