Exchange Market Pressure in Nigeria and the Reaction of the Monetary Authority: An Empirical Investigation

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Abstract

The paper used monetary model approach to exchange market pressure developed by Girton and Roper (1977) to construct exchange market pressure (EMP) index for Nigeria and the reaction of the monetary authority in dampening the pressure during managed floating regime spanning 1999Q1 through 2012Q4. Empirical findings from the Vector Autoregressive (VAR) method suggested that interest rate differential and external reserves were important variables in managing EMP, while domestic credit related inversely with EMP. The policy implication of this is that foreign reserves remained the most important determinant of EMP in Nigeria. Essentially, contractionary monetary policy, through increase in short -term interest rate, can be used to ease exchange market pressure.

Keywords: Exchange Market Pressure, Vector Autoregressive, Monetary Authority

JEL Classification: C22, E58, F31

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I. Introduction

The need to evaluate the magnitude of exchange market pressure (EMP) and to explain the development of the exchange rate as well as actions of monetary authorities remains as long as the foreign exchange market exist (Liu and Ni, 2009). However, the question that occurs is how to measure the magnitude of the EMP. The general consensus has been that, EMP is a monetary phenomenon driven by excess supply or demand for domestic currency, which forces the monetary authority to initiate measures to reduce disruptive appreciation or depreciation of the domestic currency. Under the floating exchange rate regime, the EMP is simply the actual depreciation of the currency while in a fixed regime, policy instruments such as domestic credit, interest rate and foreign exchange intervention are used to determine the pressure. Girton and Roper (1977) were the earliest attempt to analytically construct an operational model of EMP using monetary model of exchange rate determination. The main theoretical proposition of the Girton-Roper (G-R) model

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is that an excess supply of money will cause some combination of currency depreciation and an outflow of foreign reserves. The G-R model of EMP had been designed and used to calculate EMP for a number of countries and Nigeria provides another good opportunity to test its theoretical propositions. Nigeria fits into the model of EMP because it is a small open economy unable to influence foreign prices. In addition, changes in Nigeria's exchange rate can be considered to be the product of market forces since the currency is linked to a multicurrency basket. Tanner, (2001) used the VAR framework to empirically model the relationship between EMP and monetary policy in Brazil, Chile, Mexico, Korea, Thailand in the 1990's and found that monetary policy decisions affect EMP as generally expected. There is a general consensus that a contractionary monetary policy helps in dampening depreciation pressure while expansionary monetary policy is not a viable option during appreciation, specifically, in a nation where uncovered interest parity plays limited role in exchange rate dynamics. In such instance, expansionary stance defeats the key objective of price stability and could trigger foreign exchange market instability (Kumah, 2007).

Owing to the importance of foreign exchange in international economic transactions, the management of foreign exchange has been a significant component of national economic management in Nigeria. There had been two phases of exchange rate management in the country. During the first phase, (1970-1985) Nigeria operated a controlled exchange rate regime whereby exchange rate of the naira was pegged to the US dollar. The second phase was in 1986 following the oil glut of early 80s, it became clear that Nigerian economy which depend on oil was not able to sustain the fixed exchange regime due to the combined effects of depleting foreign reserves and mounting foreign debt. As an integral part of the Structural Adjustment Programme introduced in 1986, the country adopted a flexible exchange rate through the Second tier Foreign Exchange Market (SFEM). This was aimed at achieving stability in the foreign exchange market (Obaseki, 2001).

An assessment of the policies adopted in Nigeria showed that managed float has been the predominant characteristic of the foreign exchange market. Under the arrangement, the exchange rate determination was based on economic fundamentals whereby the monetary authority intervenes occasionally to address the disorderly market condition. However, the continued adoption of the float policy by the monetary authority did not completely eliminate the market pressure as depreciation and widening premium of the Naira persisted in the foreign exchange market.

To the best of our knowledge, there exists no study on EMP in Nigeria. Consequently, this paper aims to close that gap. After measuring the pressure at

the foreign exchange market, the paper adopted VAR framework to model and analyze the relationship between the EMP and selected monetary aggregates during managed floating exchange rate regime spanning the period 1999Q1 – 2012Q1. The chosen time span allowed construction of EMP and the empirical examination of monetary policy reaction in stabilizing EMP. In this regard, the paper is divided into six sections. Following the brief introduction, is a comprehensive literature review of EMP in section 2. Trend analysis of the behaviour of Exchange Market in Nigeria is presented in section 3. The methodology of the study is discussed in section 4, while section 5 provides analysis of the findings. Section 6 summarises the paper with policy implication.

II. Theoretical and Empirical Review

II.1 Theories of Exchange Rate Determination

II.1.1 Asset Market Approach

Asset approach models emphasize the adjustment of exchange rates to equilibrate financial markets rather than the traditional trade in goods in the international market. This is because prices of financial assets adjust faster than prices of goods and they are traded continuously on a daily basis unlike the trade in goods. This implies that changes in exchange rates are highly frequent and volatile on the basis of the supply of financial assets. According to this approach, flow of foreign capital could influence the level of external reserves and exchange rates. The asset approach shows that the exchange rate is determined on the basis of the willingness of foreign investors to hold a given country's currency at any given time. In such instance, the expected return on investments plays a key role in exchange rate determination. A fundamental assumption of exchange rates determined on the basis of financial asset approach is the perfect mobility of capital. In such a situation, covered interest arbitrage will ensure interest rate parity and the relationship is expected to be constant over time, while spot and forward exchange rates will adjust rapidly to the changing conditions in the financial markets.

Within the asset approach models, there are the monetary and portfolio balance approaches. In the monetary approach, the exchange rates between currencies of any two countries are determined by relative money demand and supply of these countries. This means that the relative supplies of domestic and foreign bonds are irrelevant. However, unlike the monetary approach of exchange rate determination, the portfolio balance approach indicates that relative bond supplies and demand are very important in the determination of exchange rates as well as relative money market conditions. This implies that while monetary approach models view domestic and foreign bonds as perfect substitutes,

portfolio balance models assume imperfect substitutability. However, if domestic and foreign bonds are perfect substitutes, then buyers will be indifferent about the denominated currencies of the bonds insofar as the expected return is the same. Therefore, there is no risk premium in holding foreign bonds. On the other hand, in the presence of imperfect substitutability, buyers exercise choices in distributing their portfolio over a broad range of assets in various countries. They will hold the stock of a country's assets if the premium paid on those assets accounts for the risk of holding them. Therefore, portfolio balance models have risk premiums in the forward exchange rate as a function of relative asset supplies.

The monetary model is represented in equation (1) as a function of money supply and demand, thus;

$$-\hat{E} = \hat{\pi}^F + \hat{Y} - \hat{C} \qquad (1)$$

Where, $\hat{E}$ is the percentage change in exchange rate, $\hat{\pi}^F$ is foreign inflation rate, $\hat{Y}$ is the percentage change in domestic income and $\hat{C}$ is the percentage change in domestic credit.

Thus, change in exchange rates is a function of money supply $\hat{C}$and money demand $\hat{\pi}^F + \hat{Y}$.

On the other hand, the portfolio balance models can be represented thus,

$$-\hat{E} = \hat{\pi}^F + \hat{Y} - \hat{C} + \hat{\beta}^F - \hat{\beta} \qquad (2)$$

Equation (2) can be seen as a modification of (1) incorporating the percentage changes of supply of foreign bonds $\hat{\beta}^F$ relative to the percentage change in supply of domestic bonds $\hat{\beta}$.

Therefore, an increase in the supply of foreign bonds $\hat{\beta}^F$causes the domestic currency to appreciate at a faster rate or depreciates at a slower rate. Analogously, an increase in domestic supply $\hat{\beta}$ causes the domestic currency to depreciate at a faster rate or appreciate at a slower rate.

II.1.2 The Monetary Models

With the collapse of the Bretton Woods system in 1971, the monetary approach to exchange rate determination became prominent (Yaaba, Bawa & Idrisa, undated). This arose out of the difficulty of financial economists to determine and forecast the variation in exchange rates. The monetary approach presents exchange rate as the relative price of two currencies, and tries to model the exchange rate in terms of the relativity of the currency prices within the supply

and demand paradigm. Thus, the existence of a long run equilibrium relationship between the nominal exchange rate and a country's monetary fundamentals are the hallmarks of the monetary model of exchange rate determination. Basically, in the monetary conditions, the monetary model assumes an equilibrium position between domestic and foreign currencies.

$$m_t = p_t + ky_t - \lambda i_t \quad (3)$$

$$m_t^* = p_t^* + ky_t^* - \lambda i_t^* \quad (4)$$

Where, m_t is the log of money supply, p_t represents the log of price level, y_t is the log of income and i_t denotes interest rate. The parameters k and λ are positive constants, the asterisk (*) denotes foreign variables. Implicit in these equations is the assumption of perfect capital mobility, thus the real interest is exogenously determined in the long run (Neely and Sarno, 2002 as cited in Yaaba, Bawa & Idrisa, undated).

II.1.3 Dornbusch Overshooting Model

There are various models that have been developed on the basis of the monetary approach framework for exchange rate determination. One of these models is the Dornbusch Overshooting Model. According to Christopher (2012), Dornbusch (1976) overshooting model was path-breaking. It is useful for determining exchange rate overshooting, inherence of the 'Dutch disease', exchange rate regime choice and commodity price volatility. The Dornbusch model was developed to analyse the effect of exchange rates on real variables. In addition to this, real exchange rates are much less volatile when nominal exchange rates are fixed than when they are floating (Mussa, 1986 as cited in Kanamori and Zhao, 2006).

In the Dornbusch model, uncovered interest rate parity and the monetary equilibrium of the simple monetary model are retained. However, the assumption of flexible prices is replaced with sticky prices. The Dornbusch model adopts monetary equilibrium as its first condition:

$$m_t - p_t = \eta i_{t+1} + \emptyset y_t \quad (5)$$

wherem_t is the money supply, p_t is the domestic price level, and y is domestic output, all in logarithms; η and $\emptyset y_t$ are positive parameters.

Equation (5) implies that higher interest rates raise the opportunity cost of holding money and thereby lower the demand for money. However, a higher interest rate also means high costs of speculation, which lowers the demand of money.

On the other hand, an increase in output raises the transaction demand of money. Finally, the demand for money is positively related to the level of prices. The second condition is uncovered interest rate parity, which can be rewritten as

$$i_{t+1} = i^* + E_t(e_{t+1} - e_t) \quad (6)$$

Where e_t is the logarithm of the exchange rate (home currency price of foreign currency), and E_t denotes market expectations based on information at time t.

According to the Dornbusch model, with sticky prices, an adjustment mechanism is necessary for an economy to converge to its equilibrium path in which full employment is realized. Given the magnitude of the real exchange rate's departure from its long-term equilibrium, the force to pull it back to equilibrium will increase. A fundamental assumption in the model is that if the real exchange rate rises over its long-term equilibrium level, or if the foreign currency is overvalued or the domestic currency is undervalued, the demand for domestic goods will increase. Conversely, if the real exchange rate falls below its long-term equilibrium level, or the foreign currency is undervalued or domestic currency is overvalued, then the demand of domestic goods will fall. In this connection, the third condition is an adjustment mechanism of the demand for domestic goods, which can be expressed as

$$y_t^d = \bar{y} + \delta(e_t + p^* - p_t - \bar{q}) = \bar{y} + \delta(q_t - \bar{q}) \quad (7)$$

Where p_t and $p^*$are, logarithms of the domestic and foreign price levels respectively while q_t and $\bar{q}$ represent demand for domestic and foreign goods respectively, δ is a constant greater than zero,

There are a number of deductions from the Dornbusch model. First, the model is well known for its overshooting phenomenon, which states that one permanent change in the money supply must lead to a proportionate change in the price level and the exchange rate in the long run. In the short-run, however, the price level is fixed and the nominal exchange rate must overshoot its long-run equilibrium (Kanamori and Zhao, 2006).

Second, the impact on the exchange rate of a monetary shock is greater when prices are sticky than when they are flexible. Third, the exchange rate converges to its flexible-price equilibrium value following an initial overshooting after a shock; and the nominal exchange rate is more volatile than the real exchange rate when $\psi\delta < 1$. There are also important policy implications of the model. With sticky prices and flexible exchange rates, purely monetary shocks will have a significant impact on the real economy, leading to large changes in prices and output and prolonged adjustment. If the exchange rate is fixed, the real effects

of money demand shocks can be eliminated by setting money supply to money demand.

Finally, the model states that the exchange rate policy is to some extent inconsistent with the independence of monetary policy (Kanamori and Zhao, 2006). When a real shock occurs, say a long-run rise in the real exchange rate, buffeting the economy, the model forecasts that a new full employment equilibrium adjustment will occur immediately under a floating exchange rate regime, and need not change the price level. If the exchange rate were fixed, in order to recover the real economy to equilibrium, the entire burden would have to be borne by the prices of goods. But because these prices are sticky, it is a time-consuming process for the economy to reach equilibrium.

II.2 Empirical Review

In their seminal paper, Girton and Roper (1977) applied monetary model of exchange rate determination to measure the EMP index in Canada. They estimated EMP as a function of domestic credit, money supply growth, domestic output and world (USA) output. Their findings showed that, the Canadian central bank had little influence in pursuing independent monetary policy through the fixed exchange rate regime. The result further showed that under managed floating regime, an increase in domestic credit mirrored the change in exchange rate, change in the level of foreign reserves or the combination of both. The G-R EMP model was also applied by Connolly and Silveira (1979) to Brazilian data. The G-R EMP model was modified, thus, - money demand, money supply, purchasing power parity and money equilibrium. The outcome showed that growth in domestic credit significantly impacted on EMP through depreciation in the exchange rate and loss in foreign reserves.

Modeste (1981) equally adopted the modified version of G-R monetary model using quarterly observations for Argentina from 1972-1978. The result from the ordinary least square estimates showed that domestic credit affects EMP and that monetary authority responds to external sector imbalances by using both exchange rate adjustment and loss in foreign reserves. For South Korea, Kim (1985) used monetary model of EMP based on monthly data from March 1980 to July 1983. The regression result supported the theoretical forecasts that increased domestic credits induced pressure on the exchange rate. In addition, the findings further showed that increased domestic output and foreign price encouraged foreign capital inflow thereby, impacting positively to the EMP. The paper revealed that the Korean monetary authority mostly utilized foreign exchange reserves in relieving pressure due to the fear that exchange rate depreciation could affect domestic inflation and debt burden.

The re-examination of G-R model for Canadia was conducted by Burdekin and Burkett (1990) using quarterly data ranging 1963 to 1988. The monetary model was re-estimated to further validate the exchange rate movement after the adoption of floating exchange rate regime in 1970. The authors included other variables (GDP deflators and 3-month Treasury bill rates) for Canada and US. The result was consistent with the theoretical literature that growth in domestic credit increases EMP.

Study by Thornton (1995) uses G-R model to measure EMP in Costa Rica for the period 1986 to 1992. The study showed evidenced of strong relationship between domestic credit and EMP and that most of the pressure was absorbed by changes in external reserves. Bahmani-Oskooee and Bernstein (1999) employ G-R model to measure EMP in G7 countries namely Canada, France, Germany, Italy, Japan, UK and the US using quarterly data from 1973 to 1993. The findings revealed that the coefficient of domestic credit was only positive for Canada and UK. Using modified G-R EMP model suggested by Connolly and Silveira (1979), the result showed that most of the pressure was absorbed through depletion in foreign exchange reserves rather than depreciation of the exchange rate. Similar study was conducted by Englama et al, (2009) who empirically examined the determinants of demand pressure in the Nigeria's foreign exchange market using OLS techniques for the period 1986 to 2007. The results showed that interest rate, reserves and degree of openness impacted significantly on the demand pressure.

Tanner (2001) empirically investigated the EMP in selected Asian and Latin American countries namely Brazil, Chile, Mexico, Indonesia, Korea, and Thailand. The paper utilized time series data comprises of EMP, domestic credit and interest rate differential from 1990 to 1998 and employed Vector Autoregressive (VAR) techniques. The findings showed that contractionary monetary policy assisted in moderating EMP. Tanner (2002) further re-examined the relationship between EMP and monetary variables for 32 emerging market economies comprises of three variables (real money demand, money supply and real exchange rate). The results of the VAR methods indicated significant relationship between domestic credit and EMP. A number of scholars including Karfakis and Moschos (1999), Kamaly and Erbil (2000), Gochoco-Bautista and Bautista (2005) used the VAR techniques to examine the determinants of EMP and response by the monetary authority and in all their results showed that contractionary monetary policy helped in moderating EMP as evidenced in strong relationship between domestic credit and EMP.

Using Markov-switching VAR (MS – VAR) method, Kumah (2007) estimated EMP, identified and characterized exchange rate movements under three regimes

(depreciation, normal and appreciation periods) in Kyrgyz Republic for the period 1996 to 2006. The results suggested that contractionary monetary policy decelerated depreciation while expansionary policy may not be appropriate during appreciation specifically in a nation were uncovered interest parity plays limited role in exchange rate movement. In such instance, expansionary stance overthrows the key objective of price stability and could generate foreign exchange market instability. Study by Deressa (2012) assessed the impact of monetary policy on EMP in Ethiopia for the period 1993 to 2005 using OLS and VAR methods. The results confirmed strong relationship between domestic credit and EMP and most of the pressure was absorbed by depleting the reserves. Ziaei (2012) employed Structural VAR (SVAR) model to estimate EMP in Iran for the period 2003 to 2010. The result identified massive EMP as exchange rate stabilization became difficult. Findings from impulse responses function showed that any unexpected shock to EMP would cause an increase in the CPI and government deficit and reduction in domestic credit.

III. Trend Analysis of the Behavior of Exchange Market in Nigeria

The management of exchange rate is vested with the Central Bank of Nigeria, with the policy objectives of ensuring price stability, conserving the foreign reserves and defending the external value of the naira amongst others. In order to achieved these objectives, variants of exchange rate regimes were adopted starting with fixed exchange rate regime (1959 – 1986) and flexible regime (1986 – 2012). The fixed regime was characterized with foreign exchange control and the exchange rate maintained parity with the British pound sterling for the period 1959 to1967. However, with the devaluation of pound sterling by 10.0 per cent in November 1967, the currency was allowed to move freely with the pound sterling and pegged to the basket of seven currencies, US dollar included. In 1973, the parity with pound sterling ended and replaced with naira as the domestic currency at par value with US dollar. Within the same month, the US dollar was devalued by 10.0 per cent, thus the naira also devalued by the same percentage. That was due to the fact that the Nigerian authority recognized the significance of external competitiveness, implications of overvalued exchange rate and reduced capital outflows.

In order to improved economic performance and curb inflationary pressure, the country attempted an independent exchange rate policy whereby the naira was pegged to the pound sterling and the US dollar in 1974 and 1976. This coincided with the positive oil prices shocks at the international market, thus the exchange rate appreciated during the period. However, the oil glut of 1976 and 1978 necessitated changes in the exchange rate management; hence the naira was pegged to the basket of Nigeria's major trading partners. The policy was

abolished in 1985 due to high incidence of arbitrage and the domestic currency was quoted against the US dollar.

Flexible exchange rate regime commenced in September 1986. Accordingly, the Second-tier Foreign Exchange Market (SFEM) was established with the aim of achieving an effective mechanism of naira exchange rate determination and foreign exchange allocations under the Structural Adjustment Programme (SAP). A dual exchange rate system operated during the SFEM period comprised of administered exchange rate for public transactians and private sector transactions based on market forces. The dual practice was merged into an enlarged single foreign exchange market in July 1987 and all transactions were based on the market rate. Similarly, Retail Dutch Auction System (rDAS) was introduced to enhance professionalism in the bidding system. The system was insufficient to curb the excessive market pressure as witnessed by multiple exchange rates and further depreciation of the naira.

In January 1989, interbank foreign exchange market (IFEM) was formed and later BDC segment was established to provide foreign exchange for small end-users. However, the instability in the foreign exchange market persisted which informed further modification of the IFEM procedures with the re-introduction of rDAS in December 1990. Despite this development, the pressure intensified and the naira further depreciated to N9.91/US$ and N17.3/US$ in 1991 and 1992, respectively. Similarly, the premium between the official and parallel market widened from 19.6 per cent in 1990 to 35.7 per cent in 1991 and peaked at 79.2 per cent in the early 1992. Consequently, the CBN deregulated the foreign exchange market in March 1992 with the aim of reducing the premium and enhance efficiency in foreign exchange market.

The fixed exchange rate regime was re-introduced in 1993, naira was fixed at N21.89/US$. The goal of exchange market stability was not realized largely due to the continued depreciation of the exchange rate at the parallel market, increased demand pressure, rent-seeking and speculative activities. The parallel market premium widened from 64.3 per cent in 1993 to 289.9 and 302.9 in 1997 and 1998, respectively. The period witnessed intensified pressure in the foreign exchange market, thus, worsening balance of payments deficit. Following the failure of the system, a dual exchange rate system was re-introduced by the CBN in 1995 in the form of "guided deregulation" and BDCs were allowed to buy and sell foreign exchange. The foreign exchange market was fully deregulated in 1999 to reduce rent-seeking and established some degree of macroeconomic stability. The IFEM was re-introduced in October 1999 to further deepen the market while the CBN moderated the market through intervention. The exchange rate depreciated from N92.69/US$ in 1999 to N102.11/US$ and N111.94/US$ in

2000 and 2001, respectively. In July 2002, the rDAS was re-introduced by the CBN to curtail the outflow of foreign reserves and to align the naira exchange rate. The exchange rate depreciated to N120.97/US$, N129.36/US$ and N133.50/US$ in 2002, 2003 and 2004, respectively as the premium narrowed from 18.3 per cent in 2001 to 13.5, 9.3 and 5.2 per cent.

The improved economic conditions of the country and the success of the rDAS informed the adoption of the Wholesale Dutch Auction System (wDAS) in 2006 to further liberalize the foreign exchange market. The naira appreciated to N128.65/US$ in 2006 and further to N125.83/US$ and N118.57/US$ in 2007 and 2008, respectively. The adverse effect of global economic crisis resulting in a sudden capital reversal and sharp decline in the crude oil prices exacerbated pressure in the foreign exchange, and caused the naira to fall to N148.88/US$ in 2009. The CBN re-introduced rDAS in February 2009 and suspended foreign exchange cash sales to BDCs to promote stability in the market. However, the pressure moderated in the second quarter of 2009 and the monetary authority reverted to wDAS in July 2009 as a mechanism of exchange rate management in Nigeria. Under the system, the naira depreciated further to N150.30/US$, N153.86/US$ and N157.50/US$ in 2010, 2011 and 2012, respectively as shown in figure 1 and 2.

Figure 1: Exchange Rate Movements in Nigeria

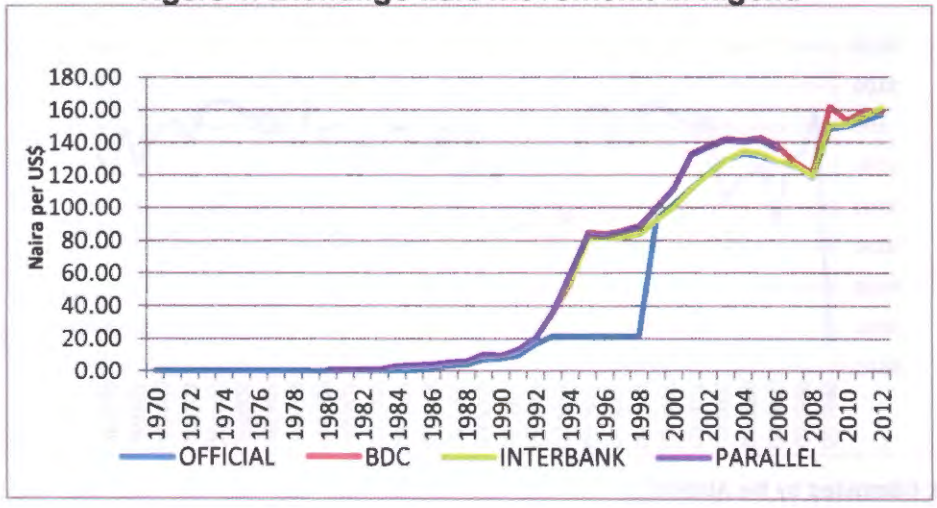
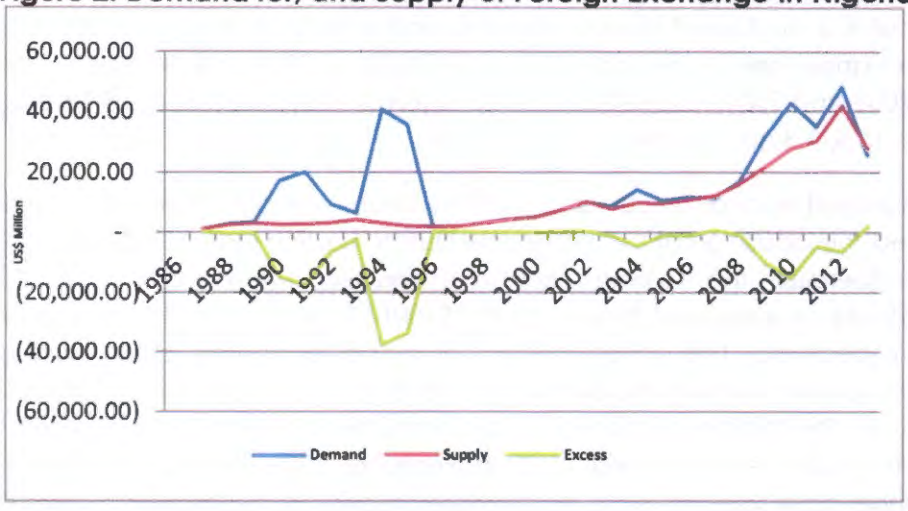


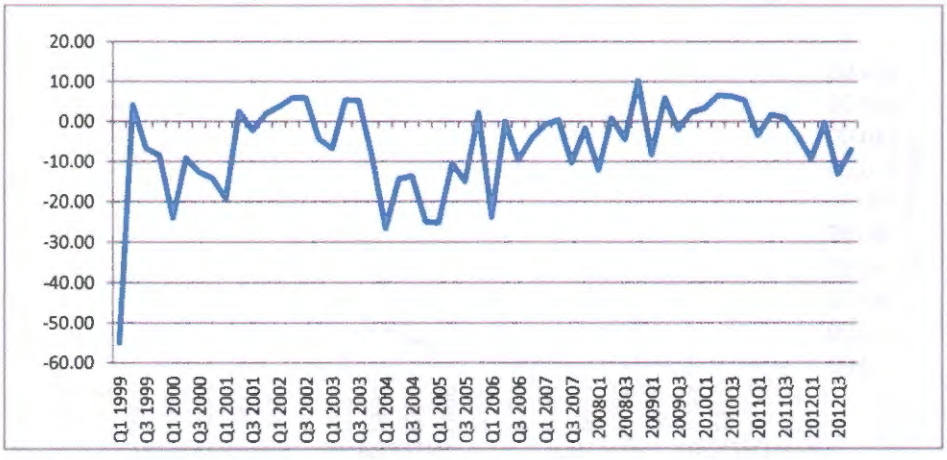
Figure 2: Demand for, and Supply of Foreign Exchange in Nigeria



Source:

The exchange market pressure index for Nigeria was constructed during the returned of floating exchange rate regime from 1999:Q1 to 2012:Q4 using weighted sum of changes in the exchange rate and the changes in the external reserves as suggested by Girton-Roper (1977).

Figure 3: Exchange market Pressure Index (EMPI) for Nigeria 1999Q1 - 2012Q4



Source: Computed by the Authors

IV. Methodology of the Study

IV.1 Variables and Data Sources

The study used quarterly data spanning the period 1999Q1 to 2012Q4. The variables comprise nominal exchange rate, foreign reserves, net domestic credit and 3-month Nigeria's Treasury Bills (TB) rate, which were sourced from Central Bank of Nigeria (CBN) Statistical Bulletin. The US 3-month TB rate was sourced from Federal Reserve Bank, online data base. The exchange market pressure index was constructed in line with Girton and Roper (1977) whereby the sum of changes in exchange rate and foreign reserves stand for the EMP. The interest rate differential was derived by taking the differences between the Nigerian TB rate and US TB rate.

IV.2 Vector Autoregressive (VAR) Method

Attempts to estimate the EMP using the simple OLS would not produce robust results suitable for policy analysis (Kamaly & Erbil, 2000). This is because of endogeneity problems that could arise as a result of the possible effect ofEMP on domestic credit in the case of sterilization or the reaction of interest rates to EMP in the case of interest rate defense if nothing is done to correct the source of bias. Therefore, we employ the Vector Auto-Regression (VAR) methodology for our analysis. Various reasons justify the use of VAR in the estimation of these parameters. VAR with three endogenous variables: EMP, domestic credit and interest rate differential will enable us circumvent the endogeneity problems that exist in the relationship. Secondly, VAR offers a useful explanation on the ways in which a system reacts to shocks in one of its components through its impulse response functions. These are important given that the reaction of monetary authorities to short term shocks in EMP is of interest to policy makers.

More specifically, we specify a VAR-X where EMP, interest rate differential(ird),log of domestic credit (ldc)and log of foreign reserves (lr) are the endogenous variables. Interest rate differential is defined as the excess of domestic interest rate over foreign interest rate. The use of interest rate differential in place of domestic interest rates offers certain advantages. International inflation (π^*) enters as exogenous variable in the equation. This variable enters this way since it is determined outside the system and is independent of EMP especially in a small open economy such as Nigeria.

The VAR-X equation is written as:

$$Y_t = \sum_{j=1}^{p} A_j Y_{i-j} + \pi_t^* + u_t \qquad (8)$$

Where Y_t=[EMP IRD LDC LR],

$$[u_t] \equiv iid(0, \sum_u)$$

$p = \text{argMin}\{Cr_t(p): p = 0,1,..p\}$ Where $Cr_t(p)$ is a specific information criteria and u_t is the error term matrix with variance covariance matrix $\sum_u$ which is symmetric and positive definite.

The ordering of our VAR-X implies that our EMP is the most endogenous. The paper basically employs the EMP model adopted by Tanner (2001), Kamaly and Erbil (2000), Deressa (2012) and Khawaja (2007) to examine the monetary policy variables reaction to EMP using Vector Autoregressive (VAR) method.

V. Analysis of Findings

V.1 Lag Length Selection Criteria

The optimal lag length for the VAR model was determined using lag selection criteria. The result showed that with the exception of Schwarz information criterion (SC), other criteria suggested a lag length of two as appropriate. (See table 1)

Table 1: Lag Length Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-955.6575	NA	2.60e+11	37.63363	37.78514	37.69153
1	-752.3522	366.7468	1.68e+08	30.28832	31.04590*	30.57782
2	-730.1364	36.59086*	1.33e+08*	30.04456*	31.40821	30.56565*
3	-717.7658	18.43464	1.59e+08	30.18689	32.15660	30.93957
4	-706.2660	15.33295	2.01e+08	30.36337	32.93914	31.34765
5	-693.5858	14.91795	2.53e+08	30.49356	33.67539	31.70943

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

V.2 Stability Test

A test was carried out to check the stability of the VAR model is presented in table 2. The result indicated that the root characteristic of the polynomial lies within the unit cycle which implies that the model is stable.

Table 2: Stability Test

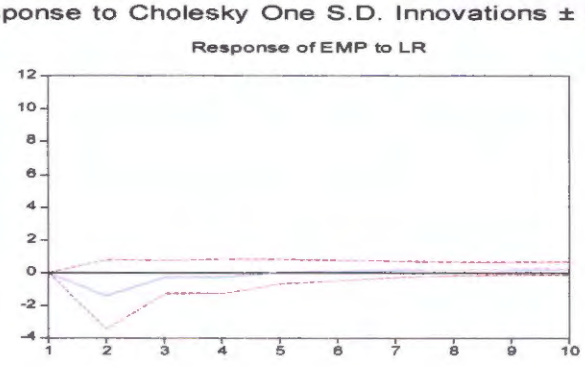
Root	Modulus
0.967438	0.967438
0.860836	0.860836
0.576549 - 0.106495i	0.586302
0.576549 + 0.106495i	0.586302
0.486007 - 0.259486i	0.550940
0.486007 + 0.259486i	0.550940
0.410553	0.410553
-0.379039	0.379039

No root lies outside the unit circle.
VAR satisfies the stability condition.

V.3 Impulse Response Functions

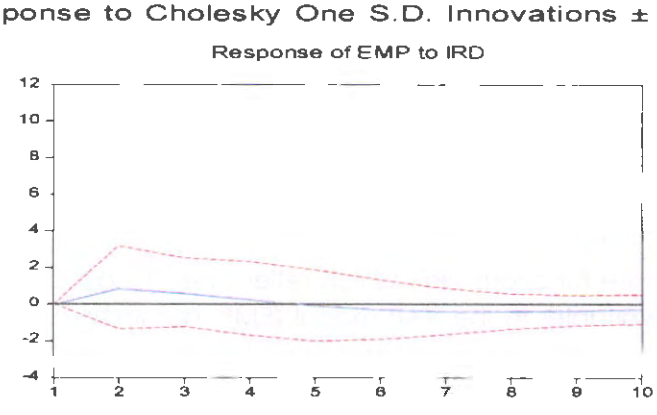
The impulse response functions (IRF) which reflect the dynamic simulation of the responses of the variables in the VAR model (EMP, domestic credit, interest rate differentials and reserves) over a forecast period of ten quarters showed that the response of EMP to change in foreign reserves was negative at initial period according to expectation. The EMP's response to increase in reserves was quick as it fell drastically in the first quarter until the second quarter. The process of adjustment to equilibrium seems to be quick and immediately as the EMP began to move toward the origin after the second quarter and eventually died out in quarter five. This result implies that accretion to reserves is important in stabilizing foreign exchange pressure in Nigeria.

Figure 4: Response of Exchange Market Pressure to External Reserves



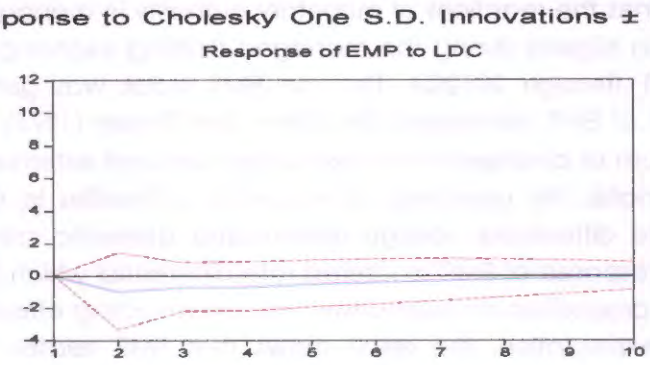
The response of EMP to interest rate differential was positive and immediate. It rose sharply in the first quarter and peaked at quarter two and eventually started moving towards the origin petering-out in quarter six. The aprior expectation is that increase in domestic interest rate should reduce market pressure due to inflow of foreign capital provided that output is not sticky in the short-run. This implies that interest rate differential is critical in explaining market pressure in Nigeria and also a clear indication that a relative high domestic interest rate over the global interest rate could be an effective policy only in the short-run as the EMP began to surface after quarter seven.

Figure 5: Response of Exchange Market Pressure to Interest Rate differential



The estimated IRF of EMP to domestic credit was negative contrary to the expectation. This relationship is a reflection of import dependent nature and the dominance of crude oil as a major source of foreign exchange earnings of the economy which downplay the role of domestic credit growth. This result corroborated that of Ziaei (2012) who found weak and decreasing response of EMP to domestic credit in Iran; a country with similar characteristics with Nigeria being an oil exporting country.

Figure 6: Response of EMP to Domestic credit Growth



V.4 Variance Decomposition

The variance decomposition showed that in the first quarter, innovation in exchange market pressure accounted for 100.0 per cent of its own shock. Reserves accounted for 1.1 per cent, 3.1 per cent, 4.9 per cent and 5.2 per cent in the 2nd, 4th, 8thand 10thquarters, respectively. The effect of IRD increased from 1.0 per cent in the 2ndquarter to almost 2.0 per cent in quarter eight. The results generally indicate that the EMP is essentially self-propagating but the most external influence comes from reserves.

Table 3: Variance Decomposition of EMP

Period	S.E.	EMP	IDF	LDC	LR
1	8.517956	100.0000	0.000000	0.000000	0.000000
2	8.874177	97.09329	1.017788	0.817346	1.071581
3	9.239794	95.71065	1.418738	0.808547	2.062070
4	9.329152	94.60968	1.503102	0.800825	3.086394
5	9.375193	93.89942	1.495426	0.798582	3.806575
6	9.406088	93.29157	1.591485	0.802850	4.314091
7	9.439886	92.76647	1.764241	0.810242	4.659052
8	9.480047	92.34542	1.930756	0.818437	4.905383
9	9.523364	92.02505	2.052559	0.830607	5.091781
10	9.567305	91.78258	2.127072	0.848524	5.241824

VI. Summary and Policy Implications

The paper examines the reactions of monetary authority in managing exchange market pressure in Nigeria during the managed floating exchange rate regime spanning 1999Q1 through 2012Q4. First, an EMP index was generated using monetary model of EMP developed by Girton and Roper (1977) where EMP is measured as a sum of changes in the exchange rate and external reserves. The VAR model estimates the responses of monetary authorities in stabilizing EMP using interest rate differential, foreign reservesand domestic credit. The result showed positive response of EMP to interest rate differential which confirmed the Mundell-Fleming proposition on exchange rate overshooting effect. Contrary to the theoretical expectation, the result shows that EMP relates inversely with domestic credit. This corroborated with the findings of Bahmani-Oskooee and Bernstein (1999) for G7 countries and Ziaei (2012) for Iran. The result further evidenced negative response of EMP to foreign reserves in Nigeria. The negative relationship follows the true position in Nigeria, as speculative demand for foreign exchange market increases if accretion to reserves falls, hence, increased pressure on the exchange rate and vice-versa. The policy implication of the findings is that foreign reserves remained the most important determinant in managing exchange market pressure in Nigeria. Similarly, contractionary monetary policy through increase in short term interest rate (treasury bills) assisted in relieving the foreign exchange market pressure.

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