THE INFLOW OF FOREIGN PORTFOLIO INVESTMENT AND THE RESPONSE OF MONETARY POLICY IN NIGERIA

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ABSTRACT

The study investigated how foreign portfolio investment responds to monetary policy indicators and vice-versa in Nigeria. It employed high-frequency data for the period 2014:01-2016:12 and used the vector error correction (VEC) approach to investigate the inter-relationship among the endogenous series. It found that there is a uni-causal relationship between monetary policy indicators and FPI. The cointegration results affirmed that there exists a long-run relationship between FPI and treasury bill, while VEC estimates suggested that short-run relationship exists between FPI and MPR. The impulse response function suggested that inflow of FPI responds to monetary policy shocks and vice-versa. The variance decomposition results affirmed that innovations due to monetary policy and FPI constitute sources of variations in the fluctuations of these two variables. It was concluded that there exists a short-run relationship between monetary policy and foreign portfolio investment, but that there is no long-run relationship between the two variables. It was recommended that monetary policymakers should take into account the pattern of inflow of FPI into Nigeria, especially in the short-run when fixing the monetary policy rate.

JEL Classification: F34, E52, C22, C51

1. Introduction

THE Nigerian capital market has been growing modestly since the beginning of 2010 such that the market capitalisation has been on the increase. It rose from about ten Billion Naira in 2010 to about seventeen Billion Naira as at the end of 2015.This represents about 41.17% increase in the market capitalisation within 5 years (CBN 2015). Analysis of the average domestic and foreign participation in equity trading in the market shows that in 2014, the proportion of foreign inflow was 57.52%, while that of domestic transaction of equity participation was 42.48%. In the following year, foreign inflow into the capital market declined to 53.79% while that of domestic transaction increased to 46.21%. In 2016, the market experienced a further decline of foreign inflow to 44.95% while the domestic participation in equity trading increased to 55.05% (NSE 2016). The average inflows of foreign participation in the market equity within the period indicate that foreign inflow was higher by 4.17%.

This flow of funds through foreign portfolio investment (FPI) into a host country may affect the volatility of such market, if it is short-lived, as evidence from the literature suggests that brusque withdrawal of FPI has, in fact, not only enhanced financial crises in some stock markets but has also affected unanticipated behaviour of money supply (Henry, 2003; Knill, 2004; Patro and Wald, 2005). In respect of developing economies, the need to liberalise their economy and allow inflow of funds for investment is crucial for development. The main concern of this study was to find out how capital inflow (FPI) reacts to monetary policy shocks in a developing country like Nigeria. The monthly reports of the Nigerian Stock Exchange in the last three years indicated that foreign portfolio participation in the equity market in terms of inflow of funds into the country was slightly higher by 4.17%, compared to domestic participation (NSE, 2016). Mody, Rasin and Sadkha (2002) opined that inflow of FDI is unidirectional (from developed to developing) for underdeveloped nations, while it is dual for industrialised nations. The one-way flow to developing nations implies that developing nation's look up to this source for improving liquidity in the capital market along with the domestic participation in the equity market. The shock due to the inflow of FPI into the domestic economy is regulated through monetary policy decisions. In the case of an innovation for a contractionary monetary policy by the monetary policymakers in Nigeria, do investors from abroad respond to such domestic monetary policy shocks? Due to this gap in knowledge, empirical evidence on how the inflows of funds respond to monetary policy shocks and vice-versa in Nigeria requires detailed analysis for policy use.

The liberal posture of most governments, such as reduced entry conditions into the financial sector, and the annulment of capital and foreign exchange control that eases the increasing volume of cross-border sales of financial assets in many domestic capital markets engender capital inflow. Consequently, the opportunity for investing in capital markets is not constrained to the equity local market. In addition, the improved economic liberalisation that leads to free flow of funds into and out of a domestic economy could affect the monetary policy decisions in the domestic economy. This is derived from the fact that increased foreign portfolio investment (FPI) enhances liquidity in the capital market, as well as the provision of capital for the use of firms at a reduced cost (Knill, 2004).

Rogoff (2006) and Woodford (2005) have argued that the tendency for inflow of capital from foreign countries has implication for monetary management in many countries, as well as its transmission process. Some recent studies conducted on this corroborated the views of Rogoff and Woodford. (Olani 2016) conducted a

study on the flow of investment into emerging economies by employing structural vector autoregression (SVAR) analysis. The study found from the innovation accounting results that foreign portfolio investment responds more to monetary and exchange rate policies of emerging economies, compared to foreign direct investment. Vega (2017) also investigated how portfolio investments into Mexico respond to United States of America's monetary policy announcements using high-frequency data. The study found that both equity and debt inflow into Mexico reacts to monetary innovations by the US monetary authority, more so if the information is perceived to be negative.

Our review of the literature shows that studies on foreign portfolio investment inflows into developing countries and monetary policy are relatively little. Even such rare studies mostly examined the impact of FPI on economic growth. For example, Dausa and Kassim (2009) examined the case of Malaysia, while Parthapratin (2009) considered the case of India. In Malaysia, it was found that economic growth influences FPI, while this was not the case for India. Recent studies on Nigeria also investigated FPI and economic growth (Ekeocha et al., 2012; Onuorah, 2013; Baghebo and Apore, 2014). The last two studies found that a long-term relationship exists between FPI and economic growth while, Ekeocha (2012) found a long-term relationship between FPI and market capitalisation. Based on this background, one motivation for this study is to fill the knowledge gap on how foreign portfolio investment responds to monetary policy indicators and vice-versa in a developing country like Nigeria.

In this study, and contrary to the earlier studies, the contribution to literature is mainly in the area of pattern of empirical analysis, which suggests detrimental effects of the adverse changes in major monetary policy instruments and indicators on the inflow of FPI to Nigeria. In succinct terms, the study affirmed that both short and long-run relationships exist among the endogenous variables of the study and, in cases of disequilibrium, the variables did not return to their equilibrium position due to how the economy works and responds to monetary innovations. In the second part of the report, theoretical literature are reviewed, while the third part discussed the methodological approach. Part four contains the empirical report, while part five discussed the conclusion and policy implications of the findings.

2. Theoretical Framework

The will of an individual to invest in a stock may be constrained by the trade-off between the risk and return of the financial asset. However, Aggarwal (2013), based on the uncovered interest rate parity (UIRP) theory, explains that the decision

to invest in a foreign or domestic capital market is also partially driven by other factors than the interest rate differential between the two markets. Although other factors like the social, political and economic stability of the host nation are also often considered by the investor. The condition of equality in UIRP is that the return earned by an investor in the domestic capital is equal to that earned in foreign capital market, plus the anticipated change in the rate of exchange. Since the foreign investor is actually inclined to earn income from the shares in his local currency, income from investments abroad is adapted in line with the fluctuations in the domestic exchange rate against the foreign exchange rate.

Given the neoclassical finance rational expectations theory, the future rate of exchange in the domestic market will adjust to equate the difference in the earned income from the foreign stocks. If this condition does not suffice, arbitrage circumstances cannot be avoided. The argument for the failure of UIRP has been widely discussed in the literature (see: McCallum, 1994; Guender, 2013; Backus, Gavazzoni Telmer and Zin, 2013); however, the focus of the current study is not to determine whether or not such condition is attained but to express the view that investors' decisions to invest in a foreign capital market like Nigeria are initially driven by the difference in the return obtained from their home country and the foreign capital market.

The trilemma hypothesis, also referred to as the 'impossible trinity,' was originally advanced by Mundell (1963). It constrains the enhancement of domestic monetary policy and financial liberalisation if exchange rate stability is being considered (Devereux et al., 2006). The proponent of the theory explains that on each side of a triangle are monetary policy freedom, exchange rate resistance and financial integration. For policy use, a country can only at the same time consider two of the three options. The monetary policy regime of the Central Bank of Nigeria is somehow eclectic due to its intention to stabilise domestic inflation and, at the same time, frequently intervene in the foreign exchange market in other to minimise the persistent devaluation of the naira. In these two situations, capital inflows can defeat the objective of the regulatory authority. If a small open economy intends to pursue financial integration as well as monetary policy independence, it has to give up a fixed exchange rate regime. A shock to the economy due to expansionary monetary policy by the regulatory authorities causes a reduction in the interest rate and an increase in domestic money supply. Due to this shock by policymakers, capital flows out of such country in order to earn a better return in another country. The inflows of funds from foreign countries into the domestic capital market undermine the fact that monetary expansion through

the financial institutions is sacrosanct in developing nations. Foreign inflows not only increase the liquidity of the capital market but also the money stock.

The IS-LM framework emphasises one asset price (interest rate) as a transmission channel, whereas other asset prices such as equity price and exchange rate also transmit monetary shocks into the economy. These channels explain the heterogeneity of transmission mechanism of monetary policy (Mishkin, 1995). Mishkin posits that the valuation of stocks using Tobin's *q* ratio provides a source by which monetary policy innovation affects the macro-economy. That is, monetary policy also influences the economy when money supply rises and excess money is invested in the stock market. Furthermore, the inflow of funds from abroad passes through the exchange rate channel where such foreign inflow, which is injected into the domestic economy, adds to the money stock by means of exchange rate effects on net exports. In addition to the asset price channels, the credit channel theory (Bernanke and Gertler, 1995) augments the interest rate channel. Such effects occur when monetary policy innovation alters the interest rate in the open market. This, in turn, has a pass-through effect on the external finance premium (a subtraction between the cost of raising equity or debt and retaining earnings) of the firm. The consequential effect of monetary policy on external finance premium is that monetary policy affects the cost of borrowing in the credit market. In lieu of these theoretical stances, how does FPI respond to monetary policy shocks in a small open developing economy like Nigeria using a recursive VAR model?

3. Methodology

The data for this study were obtained from the Central Bank of Nigeria (CBN) and the Nigerian Stock Exchange (NSE), on a monthly basis, for the period 2014: M01-2016: M12. Foreign portfolio investment (FPI) inflow was obtained from the NSE website and transformed into a natural logarithm. The other variables for the study were monthly monetary policy variables, such as the monetary policy rate (MPR), treasury bill rate (TBR) and nominal effective exchange rate (NEER). They were all obtained from the CBN website for the same period, but NEER was also transformed into natural logarithm for analysis. In order to remove the cyclical monthly movement in the series used, all the variables were seasonally adjusted based on X12 autoregressive integrated moving average (ARIMA) monthly seasonal adjustment procedure by e-views 9.5.

3.1 Empirical model

The model used in the study relied on the unrestricted but recursive vector autoregression (VAR) model, which determines the relationship between the study variables assumed to be endogenous. Hansen (2013) specified a linear VAR (p) model of equation y_t in the form:

$$y_t = \alpha_0 + A_1 y_{t-1} + A_2 y_{t-2} + \cdots A_k y_{t-k} + \varepsilon_t \quad 1$$

Where y_t stands for a k vector of endogenous variables, $A_1, \ldots, A_k$ is a n x n matrix with coefficient estimates and ε_t represent the vector of shocks that satisfies a Gaussian white noise process.

The conjecture of this study is to model a four variable VAR expressed in the form:

$$y_t = \{FPI_t, MPR_t, TBR_t, NEER_t\} \quad 2$$

The consistent vector of shocks in equation 1 is $n\ x1$ vector of ε_t that generalises a white noise condition specified in Hamilton (1994), as follows:

$$E(\varepsilon_t) = 0 \quad 3$$

$$E\left(\varepsilon_t \varepsilon_\tau^{'}\right) = \begin{cases} \Omega & for\ t = \tau \\ 0 & \end{cases} \quad 4$$

Granger causality test can be carried out by estimating the linear VAR model in equation 1 that was stated in compact form in equation 2 and further decomposed and expressed in a recursive form in equations 5-8.

$$TFI_t = \alpha_1 + \beta_{11} TFI_{t-1} + \cdots + \beta_{1q} TFI_{t-q} + \varphi_{11} MPR_{t-1} + \cdots + \varphi_{1q} MPR_{t-q} + \emptyset_{11} TB_{t-1} + \cdots + \emptyset_{1q} TB_{t-q} + \delta_{11} NEER_{t-1} + \cdots + \delta_{1q} NEER_{t-q} + \varepsilon_{1t} \quad 5$$

$$MPR_t = \alpha_2 + \beta_{21} TFI_{t-1} + \cdots + \beta_{2q} TFI_{t-q} + \varphi_{21} MPR_{t-1} + \cdots + \varphi_{2q} MPR_{t-q} \emptyset_{21} TB_{t-1} + \ldots + \emptyset_{2q} TB_{t-q} + \delta_{21} NEER_{t-1} + \cdots + \delta_{2q} NEER_{t-q} + \varepsilon_{2t} \quad 6$$

$$TB_t = \alpha_3 + \beta_{31} TFI_{t-1} + \cdots + \beta_{3q} TFI_{t-q} + \varphi_{31} MPR_{t-1} + \cdots + \varphi_{3q} MPR_{t-q} \emptyset_{31} TB_{t-1} + \ldots + \emptyset_{3q} TB_{t-q} + \delta_{31} NEER_{t-1} + \cdots + \delta_{3q} NEER_{t-q} + \varepsilon_{3t} \quad 7$$

$$NEER_t = \alpha_4 + \beta_{41} TFI_{t-1} + \cdots + \beta_{4q} TFI_{t-q} + \varphi_{41} MPR_{t-1} + \cdots + \varphi_{4q} MPR_{t-q} \emptyset_{41} TB_{t-1} \ldots + \emptyset_{4q} TB_{t-q} + \delta_{41} NEER_{t-1} + \cdots + \delta_{4q} NEER_{t-q} + \varepsilon_{4t} \quad 8$$

Where:
TFI_t is the total financial inflow of foreign portfolio investment from year t to T
MPR_t is the Central Bank of Nigeria monetary policy rate from year t to T
TB_t is the treasury bill rate from year t to T

$NEER_t$ is the nominal effective exchange rate from period t to T
$\alpha, \beta, \varphi, \emptyset \; and \; \delta$ are parameter estimates and $\varepsilon_{1t} \; to \; \varepsilon_{4t}$ are vector of shocks that satisfy the Gaussian white noise process in the recursive models listed (5-8).

3.2 Estimation procedure

The unit root test results of the study variables all indicate I(1) and this leads to the test for a Johansen cointegration relationship between the variables. The study found that a long-term relationship exists between the variables. Consequently, vector error correction model (VECM) was estimated. A VAR (p) model explicitly expressed in equations 5-8 can also be written in the error-correction form (Hamilton, 1994) since y_t expressed in equation 1 affirms some cointegrating relationship. Such error correction equation for estimation in this study, according to Hamilton (1994) is stated in the form:

$$\Delta y_t = \gamma_1 \Delta y_{t-1} + \gamma_2 \Delta y_{t-2} + \cdots + \gamma_{p-1} \Delta y_{t-p+1} + \alpha - B_{zt-1} + \epsilon_t \qquad 9$$

The VAR approach in this study also determines the relationship among the study variables by estimating the impulse response function, innovation accounting and the granger causality tests. In respect of the impulse response analysis from equation 3, a vector VAR is expressed in vector moving average (MA) ∞ as stated in equation 10:

$$y_t = \mu + \varepsilon_t + \psi_1 \varepsilon_{t-1} + \psi_2 \varepsilon_{t-2} + \cdots \psi_p \varepsilon_{t-p} \qquad 10$$

The matrix ψ_s can be expressed in the form:

$$\psi_s = \frac{\partial y_{t+s}}{\partial \varepsilon_t} \qquad 11$$

In equation 11, ψ_s is a square matrix in which the row i^{th} and j^{th} column element explain the effect of a unit change in the j variable at time $t(\varepsilon_{jt})$ for the value of the i^{th} variable at time $t+s$, that is $y_{i,t+s}$ if all other shocks are held constant at all dates. The impulse response function for each of the shocks is estimated by plotting row i and column j element of ψ_s for all values of s. This expression can be stated in the form:

$$\frac{\partial y_{i,t+s}}{\partial \varepsilon_{jt}} \qquad 12$$

In the study, the error forecast for s periods ahead can be expressed in the form:

$$y_{t+s} - \hat{y}_{t+s/t} = \varepsilon_{t+s} + \psi_1\varepsilon_{t+s-1} + \psi_2\varepsilon_{t+s-2} + \ldots + \psi_{s-1}\varepsilon_{t+1} \quad 13$$

The mean square error (MSE) for the *s* period, ante expressed as sum of *n* terms due to shocks from each u_{jt} is stated as follows:

$$MSE(\hat{y}_{t+s/t}) = \sum_{j=1}^{n} \{Var(u_{jt}) \cdot [a_j a_j' + \psi_1 a_j a_j' \psi_1' + \psi_2 a_j a_j' + \ldots + \psi_{s-1} a_j a_j' \psi_{s-1}']\} \quad 14$$

The estimation of the variance decomposition that explains the changes in the vector of endogenous variable sequence due to its own orthogonalized shock and shocks to other endogenous variables in the models (5-8), is allowed through equation 14.

4. Findings

4.1 Results of unit root test

In order to determine the integration order of the study variables, the study employed the augmented Dickey-Fuller (ADF) method to test for the level of integration. The results are reported in table 1. The result showed that all the variables are not stationary at level but are integrated at first difference.

Table 1: Results of unit root test

Variable	*Model type*	*I(0)*	*I(1)*	*Choice of lag length*
TFI	Intercept	-1.1119	-7.0275*	Automatic (AIC)
	Trend/Intercept	-2.4505	-6.9238*	,,
MPR	Intercept	-1.3515	-6.3891*	Automatic (AIC)
	Trend/Intercept	-1.7183	-6.4351*	,,
NEER	Intercept	-0.1237	-5.0109*	Automatic (AIC)
	Trend/Intercept	-1.5808	-5.1040*	,,
TBILL	Intercept	-1.6772	-4.0445*	Automatic (AIC)
	Trend/Intercept	-1.3328	-4.3734*	,,

Critical value @ 1% for intercept - 3.6329, for trend/intercept – 4.2529
*Attests to the rejection of the null hypothesis @ 1% level of significance
AIC – Akaike information criteria

4.2 Results of cointegration test

The unit root results suggest that the study variables are not integrated at level. In spite of this, Hamilton (1994) said that an *nx1* vector time series may be cointegrated if each of I(1) series are subjected to cointegration test. The results in table 2 show that there is at least a cointegrating relationship among the vector of variables based on Johansen's method for testing cointegration relationship. The trace and Max-Eigen value tests result suggest that there is one (1) cointegrating

equation at 5% level of significance. Based on this, the study estimates the vector error correction model (VECM) to determine both the long and short-run relationship between the study variables.

Table 2: Cointegration test results

No of cointegrating Equations	*Trace Statistic*	*Critical value*	*Max-Eigen Statistic*	*Critical Value*	*Prob.Value*
None*	69.2814	47.8561	42.9474	27.5843	0.0003**
At most 1	26.3340	29.7971	20.9474	21.1316	0.0681
At most 2	6.1836	15.4947	6.0747	14.2646	0.6036
At most 3	0.1089	3.8415	0.1089	3.8415	0.7413

* Attests the rejection of the Null-hypothesis of no cointegration equation @ 5% level
** Denotes Mackinnon-Haug-Michelis (1999) Probability Value.
The asterisks (*, **) apply to both Trace and Max Eigen cointegration tests.

4.3 Results of the VECM analysis

The study estimated the long and short-run relationship of the variables based on the Johansen maximum likelihood method and found that there was at least one cointegrating relation (table 2) among the endogenous variables considered. The results of both the long and short-run relationship are reported in table 3. The results from the coefficient vectors indicate that in the long run, an increase in the treasury bill rate by 1% causes 0.15 percentage point reduction in the inflow of foreign portfolio investment (FPI), while a unit increase in the exchange rate (devaluation of the naira) leads to an increase of 3.7 percentage points in the inflow of foreign portfolio investment.

Table 3: Cointegration and Speed of Adjustment Results

Cointegration equation 1	*TFI(-1)*	*MPR(-1)*	*TBILL(-1)*	*NEER(-1)*
		-0.158241	-0.155002	3.716836
Coefficient	1.0000	(0.16452)	(0.042010)	(0.53500)
		[-0.96185]	[-3.68936]*	[6.94737]*
Error Correction	D(TFI)	D(MPR)	D(TBILL)	D(NEER)
	-0.674721	0.827246	1.758619	-0.046725
Adjustment Speed	(0.21767)	(0.30487)	(0.77769)	(0.04318)
	[3.09972]*	[2.71340]*	[2.26134]**	[-1.08218]
C	-0.077752	0.088693	0.035867	0.021910
	(0.05880)	(0.08236)	(0.21010)	(0.01166)
	[-1.32221]	[1.07685]	[0.17072]	[1.87847]

(*, **) - attests to 1% and 5% level of significance of the coefficient estimates
Figures in ( ) and [ ] are the standard error and t-statistics

The study found no evidence that changes in the monetary policy rate significantly affects inflow of foreign portfolio investment into Nigeria in the long run. The speed of adjustment in cases of innovations is also reported in the second part of table 3. It was found that in the short-run, 67% of any shock due to flow of FPI into Nigeria is corrected within one month, while a relatively lower proportion of 4.6% of shocks due to exchange rate fluctuation is corrected within one month, although the variable is not significant. Furthermore, monetary policy rate has a short-run effect on the flow of FPI into Nigeria. The results indicate that monetary policy rate and treasury bill rate have significant effects on FPI. The coefficient vectors of these two variables are positive. This infers that any shock in the system (disequilibrium) due to these two variables further destabilises (very explosively) the possibility of inflow of FPI into Nigeria, as policy rates never converge to their long-run equilibrium relationship.

4.4 Results of VEC granger causality/block exogeneity Wald tests

The short-run causality test among the endogenous variable is shown in table 4. The outcome of the test suggests a weak exogeneity between inflow of FPI and monetary policy. That is, while monetary policy variables do not granger-cause TFI, TFI granger-causes monetary policy rate at 10% level of significance. The inference from the results is that flow of FPI into the country can be used to predict monetary policy rate in Nigeria.

Table 4: VEC granger causality/block exogeneity results

	Dependent		*Variables*					
Regressor	*TFI*	*df*	*MPR*	*df*	*Tbill*	*df*	*NEER*	*df*
TFI	-		(0.0727)	2	(0.4425)	2	(0.1768)	2
MPR	(0.7151)	2	-		(0.1780)	2	(0.0539)	2
Tbill	(0.9155)	2	(0.0049)	2	-		(0.0143)	2
NEER	(0.2140)	2	(0.0105)	2	(0.2086)	2	-	
ALL	(0.3117)	6	(0.0011)	6	(0.2495)	6	(0.0162)	6

NB: Figures in parentheses are the probability values

4.5 Results of the VEC impulse response functions

The main concern of this study was to explain the response of foreign portfolio investment (FPI) to the impulse of monetary policy rate (MPR) among the endogenous variables and vice-versa. These results are shown in figure 2 of the Appendix. The results suggest that the inflow of (FPI) responds positively to shocks due to monetary policy from the second month by 0.11 percentage points. This increases to 0.13 percentage points in the fourth month and drops to 0.10

percentage points in the fifth month. The shock effect due to monetary policy on the inflow of FPI does not return to its equilibrium position within twelve months.

In respect of shocks due to FPI on monetary policy, the monetary policy rate responds to the shock in the first month. It drops to -0.02 percentage points and increases to 0.13 percentage points in the second month. In the third month, it reaches 0.38 percentage points, while it ranges between 0.32 and 0.34 percentage points between the fourth and twelfth month. The general pattern of the impulse response results is that responses do not die out within twelve months for these two cases. The impulse response results complimented the findings from the VECM analysis, which revealed that any shock to the system would not converge to its long-run position. Also, treasury bill rate and exchange rate respond to shock from the inflow of TPI in the first month by 0.05 percentage points and continue to increase gradually, so that by the fourth month, it reaches 1.21 percentage points. Exchange rate also responds to shock from the inflow of TPI, but at a relatively low rate in the first month and subsequent periods, compared to the other two variables.

4.6 Results of variance decomposition analysis

The result of the forecast error variance decomposition (FEVD) analysis that apportioned the variation in each endogenous variable into the integral sources of shocks to the VEC is contained in tables 6-9 of the Appendix. The study found that within 3 months, shock to inflow of FDI (own shock) account for over 60% variation of the fluctuation in the inflow of FPI into Nigeria, while monetary policy rate (MPR) and treasury bill (Tbill) accounted for 17% and 19%, respectively, of such fluctuation in the variance of inflow of FPI. From the beginning of the fourth month, the share of own shock to the flow of FPI started to decline, while innovations due to MPR and Tbill increased gradually. By the end of the 12^{th} month, forecast ahead position reveals that innovation due to MPR causes about 26% of the fluctuation in the variation of flow of FPI into Nigeria, while 53% is due to own shock.

In the case of shock due to monetary policy, the study found that own shock causes 99% fluctuation in the variance of monetary policy in the first month, while shock due to inflow of FPI accounts for 0.28% of the fluctuation in the variance of MPR. However, in the fourth month, the proportion of contribution to the fluctuation in the variance of MPR by shocks due to the inflow of FPI increases to 25%, while own shock declines to 49%. In the twelfth month, own shock for MPR reduces to 40%, while shock due to the inflow of FPI accounts for 27% fluctuation in the variance of MPR. The inference from the results is that inflow of FPI and

monetary policy rate shocks constitute part of the causes of variation in the movement of these variables at least in the short-run.

4.7 Diagnostic test results

In table 5, the summary of post-estimation tests conducted using the residuals of the VEC model is reported. These tests are conducted in order to determine the robustness of the VEC results and how reliable they are for policy use. The test for stability of the VEC model is based on the results of inverse roots. In figure 1, the result shows that all roots of the characteristic polynomial lie inside the unit circle. The VEC model residual diagnosis is based on three methods, shown in table 5. Evidence from the results affirms that the VEC residuals are not serially correlated, with constant variance and are multivariate normally distributed at 1% level of significance.

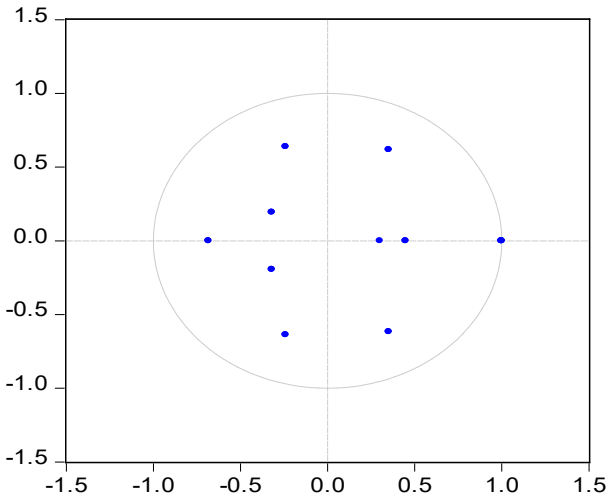

Figure 1: Inverse roots of AR characteristic polynomial

Table 5: VEC model (residual diagnostic tests)

Type of diagnostic test	*DF*	*Test statistic*	*Prob-value*
Serial correlation LM test	16	16.32889	0.4303*
White heteroskedasticity test	180	72.9672	0.6332*
Jarque-Berra normality test	2	3.612708	0.1643*

* Attests to the rejection of the null hypothesis at 1% level.

5. Conclusion and Policy Implications of the Findings

This study analysed the inter-relationship between some endogenous variables comprising of monetary policy variables and inflow of foreign portfolio investment in Nigeria. It conducted an analysis of the data using the VEC method to determine the long and short-run relationship between the series, as well as granger block exogeneity test. In addition, the study estimated the impulse response function and the forecast error variance decomposition analysis for the same series. The findings from the granger block exogeneity test revealed that there was weak exogeneity between the series, while the cointegration test affirmed that there existed a significant relationship between FPI and treasury bill in the long-run. The VEC model results indicated that there was a significant relationship between FPI and MPR in the short run. Furthermore, VEC results showed that any shock into the system (disequilibrium) due to MPR and TBill would further destabilise the possibility of inflow of FPI into Nigeria, as the rates never converge to their long-run equilibrium relationship.

The impulse response function result suggested that monetary policy rate responds to shock from the inflow of FPI from the first month, while FPI responds negatively to MPR shock from the second month. The innovation accounting results showed that shocks due to monetary policy rate cause a relatively higher fluctuation in the variance of the inflow of FPI, compared to those of treasury bill and exchange rate. The study, therefore, concludes that there exists a short-run relationship between monetary policy and foreign portfolio investment, but that there is no long-run relationship between the two variables. Furthermore, in cases of disequilibrium between the series, VEC results indicate that these variables do not converge to their long-run position within twelve months.

The latitude through which CBN can manoeuvre in regulating the domestic economy may be constrained by the extent of the economy's financial openness and capital mobility. Considering the fact that evidence from the study suggests that FPI is one of the major sources of raising funds for business development in Nigeria, there is a need for CBN to exhibit a disciplined monetary policy in order to capture the effects of both domestic and external monetary influences on the economy. This is essential because knowledge of the trend of foreign financial inflow/outflow may guide the decision of the monetary authorities in maintaining relative stability in the domestic financial sector.

The fact that TBR suggests a negative relationship with FPI, a positive change in TBR by the CBN reduces FPI. In cases when the CBN has to borrow on the short term from the domestic market through the issuance of treasury bills, it

should ensure that the relative increase in the rate offered on treasury bills does not significantly reduce the source of inflow of FPI in the equity market. A continuous increase of TBR by the monetary authorities may reduce the long-term source of funds that goes into the capital market from foreign investors.

In the last three decades (after the structural adjustment programme), devaluation of the naira has been a recurring issue in the financial landscape of Nigeria. It is practically evident that stabilizing the exchange rate has been a monumental challenge for the monetary authorities. Evidence from this study shows that devaluation of the naira increases FPI, leading to imported inflation through foreign trade. Nigeria is largely an import-depend nation for consumption of both durable and some non-durable goods. In order to achieve relative success in the two opposing situations, there is the need for CBN to take a new look at the market to investigate the sources of leakages in both the official and parallel market and establish the linkage between the two so as to take remedial measures that can stabilize the exchange rate and establish the appropriate exchange rate for Nigeria.

The period between when action was taken by CBN and when FPI reacted to such action and vice-versa was relatively short. As shown in the results, after one month, FPI reacted to monetary policy actions, while MPR responded to FPI shocks within the month. Unfortunately, these variables did not return to their equilibrium conditions after reacting to innovations by either CBN or FPI. There is, therefore, a need for the CBN to improve its understanding of a small open economy like Nigeria in order to take remedial actions to stabilize the financial or monetary shocks experienced by the economy within a reasonable time. Finally, monetary policymakers should monitor the level of inflow of FPI into Nigeria on regular basis, especially in the short-run, in order to guide their decisions when fixing the monetary policy rate.

References

Aggarwal, S. (2013). *The Uncovered Interest Rate Parity Puzzle in the Foreign Exchange Market*. New York; Stern School of Business, New York University.

Backus, D.K., Gavazzoni F., Telmer C. and Zin S.E. (2013). Monetary policy and the uncovered interest rate parity puzzle. Accessed 12/2/2017 from www.faculty.chicagobooth.edu.

Baghebo, M. and Apere, T.O. (2014). Foreign portfolio investment and economic growth in Nigeria, 1986-2011. *International Journal of Business and Social Sciences,* 5(1):108-115.

Bernanke, B.S. and Gertler, M. (1995). Inside the black box: The credit channel of monetary policy transmission. *Journal of Economic Perspectives* 9(4): 27-48.

Central Bank of Nigeria. (2015). *Statistical Bulletin* (26). Central Bank of Nigeria, Abuja.

Devereux, M. Lane, P.R. and Xu., J. (2006). Exchange rates and monetary policy in emerging market economies. *The Economic Journal,* 116(511).

Dausa., J and Kassim S.H. (2009). Foreign portfolio investment and economic growth in Malaysia. *The Pakistan Development Review,* 48(2):109-123.

Ekeocha., P.C., Ekeocha C.S., Malaolu V. and Oduh M.O. (2012). Modelling the long-run determinants of foreign portfolio investments in Nigeria. *Journal of Economics and Sustainable Development,* 3(8): 194-205.

Guender, A.V. (2013). Monetary policy and the uncovered interest rate parity puzzle: Theory and empirical results for Oceania. Accessed on 12/2/17 from www.econ.cantebury.ac.nz.

Hamilton, J.D. (1994). *Time Series Analysis*. New Jersey; Princeton University Press.

Hansen, B.E. (2013). *Econometrics.* USA; University of Wisconsin.

Henry, P. (2003) Capital-account liberalisation, the cost of capital and economic growth. *American Economic Review,* 93(2): 91–96.

Knill, A. (2004). Can foreign portfolio investment bridge the small firm financing gap around the world? University of Maryland Working Paper.

McCallum, B.T. (1994). A reconsideration of the uncovered interest parity relationship. *Journal of Monetary Economics*, 33: 105-132.

Mishkin, F.S. (1995). Symposium on monetary transmission mechanism. *Journal of Economic Perspectives,* 9(4): 3-10.

Mody, A., Rasin, A. and Sadkha, E. (2002). The role of information in driving FDI: Theory and evidence. Accessed 10/2/2017 from www.biu.ac.il/soc/ec/seminar.

Mundell, R.A. (1963). Capital mobility and stabilization policy under fixed and flexible exchange rates. *Canadian Journal of Economics and Political Science,* 29(4): 475-485.

Nigerian Stock Exchange (2016). Domestic and foreign portfolio participation in equity. Accessed 17/1/2017 from www.nse.org.ng.

Olani, A. (2016). Capital inflow transmission of monetary policy to emerging markets. Queens University Canada Economics Department Working Paper No. 1358.

Onuorah, A.C. (2013). Analysis of foreign investment and identified macroeconomic measures in Nigeria. *Journal of Economics and Sustainable Development* 4(2): 140-149.

Parthapratin, P. (2006). Foreign portfolio investment stock market and economic development: A case study of India. Paper delivered at the annual conference on development change mission, Sao Paulo, Brazil, November 18-20.

Patro, D. and Wald, P. (2005). Firm characteristics and the impact of emerging market liberalisation. *Journal of Banking and Finance,* 29(7): 1671–1695.

Rogoff, K. (2006). Impact of globalization on monetary policy. Paper for a symposium by the Federal Reserve Bank of Kansas City on 'the new economic geography: Effects and policy implications'. Jackson Hole, Wyoming, 24–26 August**.**

Vega, M.A.H. (2017). Portfolio investment response to US monetary policy announcements: An event study analysis using high frequency data from Mexico. Documento de Investigation Banco de Mexico Working Paper No. 2.

Woodford, M. (2005). Central bank communication and policy effectiveness. Paper presented at FRB Kansas City Symposium on 'the Greenspan era: Lessons for the future.' Jackson Hole, Wyoming, 25–27 August.

APPENDIX

Table 6: Variance decomposition of LogFPI

Period	*S.E.*	*LOGTFI_SA*	*MPR_SA*	*TBILL_SA*	*LOGNEER_SA*
1	0.305790	100.0000	0.000000	0.000000	0.000000
2	0.359081	76.62763	10.31135	12.06446	0.996558
3	0.410485	63.29606	16.65354	19.09188	0.958518
4	0.473762	57.06256	20.87370	18.67728	3.386465
5	0.511211	55.69669	22.52042	18.64469	3.138200
6	0.546548	55.86644	23.56320	17.43377	3.136582
7	0.577636	55.97036	23.36163	17.71303	2.954975
8	0.607725	55.18235	24.03814	17.72302	3.056495
9	0.635836	54.17378	24.79821	18.04698	2.981023
10	0.664460	53.55093	25.39439	18.02571	3.028972
11	0.691225	53.21039	25.74757	18.01913	3.022905
12	0.716680	52.96320	26.08204	17.93115	3.023614

Table 7: Variance Decomposition of Monetary policy rate

Period	*S.E.*	*LOGTFI_SA*	*MPR_SA*	*TBILL_SA*	*LOGNEER_SA*
1	0.428295	0.277556	99.72244	0.000000	0.000000
2	0.669053	4.211891	70.70485	6.511550	18.57171
3	0.869397	22.20938	56.70326	7.221646	13.86571
4	1.037819	25.12661	49.43972	9.459700	15.97397
5	1.196423	25.48558	46.99849	10.65723	16.85869
6	1.349035	25.82892	44.10790	12.98327	17.07991
7	1.485151	26.10936	43.35351	14.00838	16.52875
8	1.612507	26.13398	42.60958	14.60919	16.64725
9	1.730087	26.62406	41.85065	14.95375	16.57154
10	1.839392	26.97293	41.13045	15.31149	16.58513
11	1.942342	27.12002	40.70793	15.57451	16.59754
12	2.040969	27.20595	40.32611	15.84696	16.62098

Table 8: Variance decomposition of treasury bill rate

Period	*S.E.*	*LOGTFI_SA*	*MPR_SA*	*TBILL_SA*	*LOGNEER_SA*
1	1.092516	0.250518	25.11378	74.63570	0.000000
2	1.879139	5.738256	35.40315	52.05142	6.807166
3	2.669626	17.11236	28.77131	44.91744	9.198888
4	3.382849	23.37543	23.18993	43.35133	10.08331
5	4.002460	24.45856	21.40344	43.23789	10.90010
6	4.589251	24.18594	20.45986	43.91970	11.43450
7	5.125391	24.26253	20.03418	44.39824	11.30505
8	5.609744	24.38346	19.84449	44.49602	11.27603
9	6.053901	24.63049	19.65026	44.38546	11.33379
10	6.468977	24.89479	19.37542	44.34268	11.38712
11	6.858124	25.04290	19.18200	44.35515	11.41996
12	7.227698	25.09399	19.05553	44.39421	11.45626

Table 9: Variance decomposition of LogNeer

Period	*S.E.*	*LOGTFI_SA*	*MPR_SA*	*TBILL_SA*	*LOGNEER_SA*
1	0.060655	2.313491	3.071038	0.059042	94.55643
2	0.093121	6.381427	2.845461	19.37589	71.39722
3	0.122757	6.504826	3.994434	33.04947	56.45127
4	0.146955	5.660582	8.793506	35.70124	49.84467
5	0.170208	6.174248	9.937901	36.68138	47.20647
6	0.188891	7.840725	10.19467	37.03536	44.92925
7	0.206364	8.407238	10.17946	37.17934	44.23396
8	0.222728	8.659745	10.28224	37.40115	43.65686
9	0.238348	8.828821	10.32059	37.90810	42.94249
10	0.252732	8.947872	10.50900	38.23396	42.30916
11	0.266457	9.050990	10.63684	38.40058	41.91158
12	0.279409	9.210199	10.70354	38.51890	41.56737

Appendix

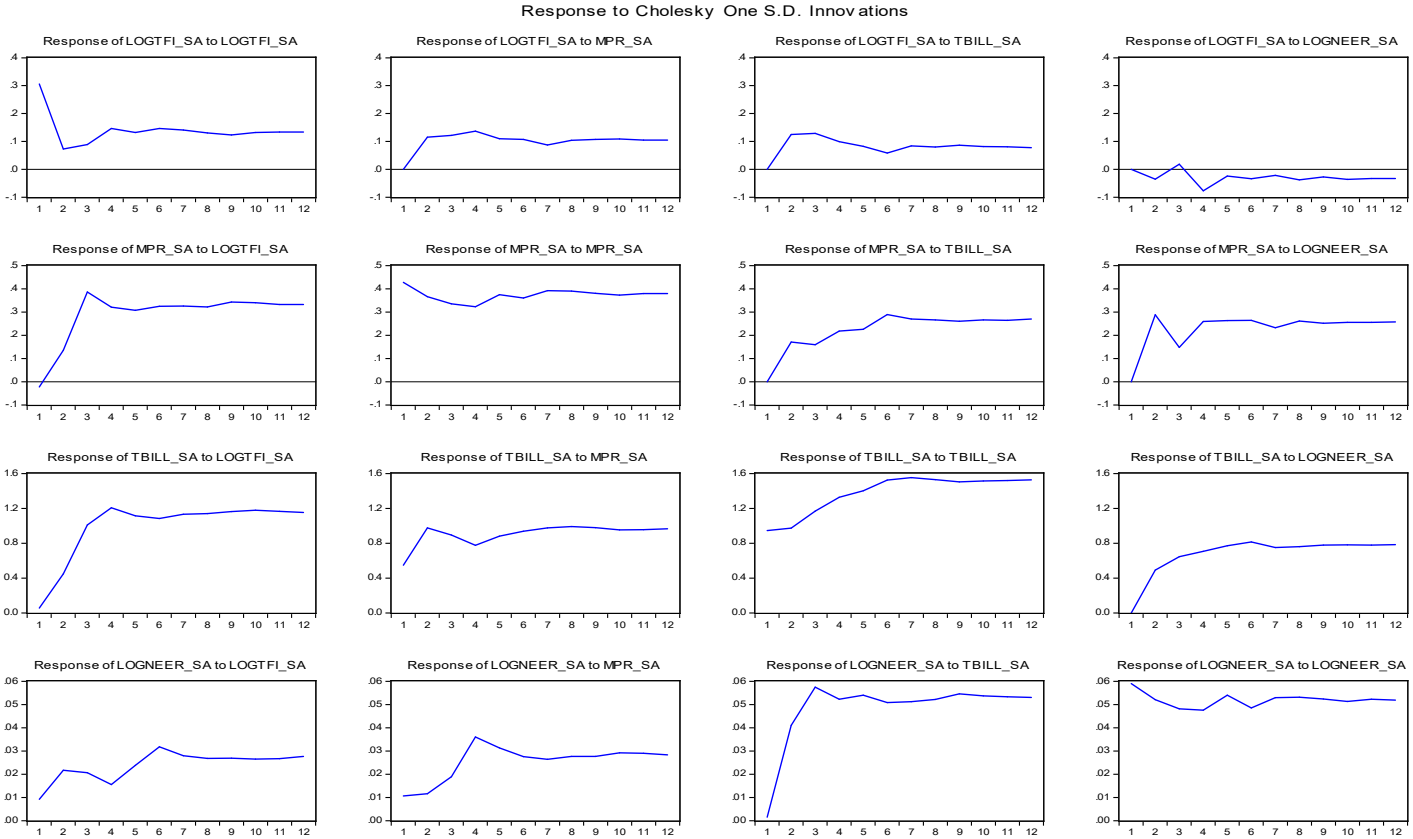

Figure 2: Multiple graphs of impulse response functions of the study variables