The Effect of Unexpected Changes in Monetary Policy Variables on Commercial Bank Performance in Nigeria: A Structural VAR Approach

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Abstract

Motivated by the scanty literature on the subject area, this study examines the effects of unexpected changes in monetary policy variables (monetary policy rate and treasury bills rate) on the performance of deposit money banks in Nigeria using structural VAR methods. Three commercial banks (First Bank, Access Bank and United Bank for Africa) are included in the studyand monthly data from 2002M01 to 2016M12 are used. The results are mixed. While unexpected changes in both monetary policy rate and treasury bills ratehave effect on both ACCESS Bank and UBA, they show no effect on First Bank. Specifically, there is evidence that unexpected change in monetary policy rate has a negative and significant causal impact on both ACCESS Bank and UBA performance in the stock market. An increase in monetary policy rate would lead to a decrease in the return on both securities in the stock market. The effect of unexpected change in Treasury Bill rate is positive for ACCESS bank stock but negative for UBA stock. However, there is no evidence of a causal relationship between Treasury Bill rate and the performance of these stocks. The results hold controlling for the effects of both inflation and exchange rate.

Key words: Monetary policy, bank performance, SVAR

Introduction

Monetary policy is generally known as a deliberate control of the cost and availability of money and credit by the monetary authorities to achieve non-inflationary economic growth. In Nigeria, the Central Bank through the Monetary Policy Committee (MPC) is responsible for the conduct of monetary policy, with the main instrument being the monetary policy rate. The monetary policy influences the real economy through some intermediate variables or transmission path. The transmission path describes the channels through which changes in money supplyor monetary policy rate affect the real economy. The main transmission channels, according to CBN (2011), include short-term interest

rate, exchange rate, asset prices and credit channels or bank lending and balance sheets channel.

Commercial banks as financial intermediaries play a front-line role in the implementation of monetary policy. They are directly influenced by the actions of the monetary authorities. Because, banks mobilise savings from the surplus units and extend loans to firms for investment purposes, they are exposed to asymmetric information problems. Thus, the way they adjust lending in response to policy shocks is important for the success of monetary policy.

Although, changes in the monetary policy rates are necessary for maintaining the stability of the real economy, there is however, growing concern especially in Europe and other developed countries after the great financial crisis that these changes may have unfavourable side effects on bank profitability and the banking sector stability in general (Borio, Gambacorta & Hofmann, 2015). Thus, considering the ralationship between monetary policy and bank performance especially, in an emerging economy will provide more empirical insight on how banks are directly affected in their roles in the transmission process of the monetray policy.

The aim of the present study is to examine the effects of unexpected changes in monetary policy variables (monetary policy rate and treasury bills rate) on the performance of deposit money banks in the Nigeria. This study differs from previous studies in two distinct ways. First, the previous international studies focus mainly on the banks debt structure, risk takingor transmission of risks to the economy, and thus, neglecting the shareholders' reward for taking the overall bank risks. This study fills this gap by focusing on the bank market values. Second, unlike previous Nigerian banking studies which mostly use annual data, this study uses monthly data which we consider more appropriate for measuring impact of unexpected monetary policy changes since monetary authorities track the impact of their actions almost on monthly basis.

The rest of this paper is structured into four sections. The next section is the literature review. Section 3 describes the data and methods used in this study. Section 4 contains empirical analysis, interpretation and discussion of findings. The study is summarized and concluded in section 5.

Some Empirical Evidence

There is much consideration of therole ofbanks in the transmission process of monetary policy. On the contrary, however, there is little consideration of the link between bank performance and changes in monetary policy variables. What appears to be the focus of most of the previous studies is the link between bank profitability and business conditions, with the relationship between the term structure of interest rate and bank profitability being only a by-product (Borio, Gambacorta & Hofmann, 2015).

One of the first attempts to empirically link bank profitability to macroeconomic factors such as interest rates is the study by Demirgüç-Kunt and Huizinga (1999). Using bank-level data for 80 countries from to 1995, they find that higher real interest rates lead to higher interest margin and bank profits, especially in developing economies where, according to authors, demand deposits pay zero or below market rates.

Altunbas, Gambacorta and Marques-Ibanez (2010) examine the link between short-term interest rates and bank riskfor 643 listed banks in the European Union and the United

States for the period from 1998 to 2008. They report evidence that interest rate has a negative relationship with bank risk. An unusually low interest rate over an extended period lead to an increase in bank risk.

Zaheer, Ongena and Van Wijnbergen (2013) consider the differences in banks' responses to monetary policy shocks acrosssize, liquidity, and type (Islamic vs conventional banks) in Pakistan over the period from 2002Q2 to 2010QI. The results show that following a monetary contraction, small banks with liquidity reduce their lending less than other small banks. On the contrary, there is no impact on large banks irrespective of their liquidity positions. Islamic banks, though similar in size to small banks, respond to monetary policy shocks as large banks. Hence, ceteris paribus, the credit channel of monetary policy may weaken when Islamic banking grows in relative importance.

Zaman, Arslan, Sohail and Malik (2014) investigate the correlation between monetary policy andthe stability and performance of the banking sector in Pakistan using the Pearson product moment correlation and regression analysis. The results show among other things that interest rate has a significant inverse relationship with firm financial performance measured, by both ROA and ROE.

Using the probit model, Ioannidou, Ongena and Peydró (2014) examine the impact of monetary policy on bank loan risk-taking, pricing and expected returns using monthly data from 1999 to 2003.They find, among other things, that a decrease inmonetary policy rate increases thetendency of banks to grant loans to bad borrowers, reducesboth bank internal ratings and ex-post performance, and the effects are stronger for smaller firms borrowing from several banks.

A recent study by Angeloni, Faia and Duca (2015) employs the VAR methodology to examine the effects of monetary policy on banks' risk exposure in the United States using monthly data from January 1980 to September 2011. The results provide evidence that expansionary monetary policy increases bank propensity to take risk.

Ndugbu and Okere (2015) consider the effect of monetary policy on the performance of deposit money banks in Nigeria for the period from 1993 to 2013 using annual data. The results show, among other things, that bank lending rate has a significant but inverse relationship with total bank deposit in Nigeria.

Using a non-linear approach, Borio, Gambacorta and Hofmann (2015) examine how monetary policy influences bank profitability using. They used data for 109 large international banks headquartered in 14 major advanced economies for the period from 1995 to 2012, a period covering different economic cycles, a wave of consolidation, and the Great Financial Crisis. The study finds a positive relationship between the return on assets and both short-term interest rate and the slope of the yield curve (interest rate structure). The higher the level of interest rate and the steeper the yield curve, the higher the profitability of banks.

Bhaumik, Kutan and Majumdar (2016) examine the impact of monetary policy on the borrowing pattern of several firms in India. The study covers a period from 2001 to 2008 and the firms examined include including state-owned companies, foreign companies, business group affiliated and unaffiliated private firms. They find that in an expansionary monetary regime, changes in interest rate have no effect in bank credit, change in total debt and the ratio of bank credit to total debt for firms in India. However, in a

contractionary monetary regime, monetary policy shocks affect the borrowing behaviour of firms, with the unaffiliated private firms being the most affected.
Dell'Ariccia, Laeven and Suarez (2017) examine the relationship between Bank leverage and monetary policy's risk□taking channelusing data on banks' internal ratings on Loans in the United Stated for the period from 1997 to 2011.They find that banks' risk taking has a negative relationship with short-term interest rates, and that the effect of interest rate on risk taking is more pronounced for banks with higher capitalization and less pronounced for banks with lower capitalization.

Data and Methods

Data

We usebank-levelprice data observed monthly from 2002M01 to 2016M12. The companies, which are conveniently selected from the banking index of the Nigerian stock exchange, include Access Bank, First Bank and United Bank for Africa (UBA). We use monetary policy rate (MPR) and Treasury Bills rate (TBR) as monetary policy variables. Although, liquidity ratio and cash reserve ratio are both monetary policy variables, they are however, not considered because the data on both variables are irregular and relatively constant over time. We also use Inflation rate (INFL)and end period exchange rate (EXR) as control variables to measure the full impact of monetary policy on bank performance. Thus, they do not fit the purpose of the study. Thebank-level data is the monthly average of daily closing prices and are obtained from the official website of Cashcraft asset management limited,while the macroeconomic data are obtained from the Central Bank of Nigeria database. The company data are transformed into returns as follows:

$$R_t = \text{dlog(security price)} = Ln\left(\frac{P_t}{P_{t-1}}\right)$$

where $R_t =$ the current returns on individual security, d = difference, log = logarithm, $Ln =$ natural logarithm, $P_t =$ security closing price at the current month and P_{t-1}= security closing price at the previous month.
Since unexpected change in a variable is defined as the difference between the actual observation on the variable and its expected value (Brooks, 2008), we transform all the macroeconomic variables into their differences, except exchange rate which is converted into growth rate, with the assumption that investors use current realized value of a variable as its expected value. Figure 1 shows the graphical description of the variables. As we can see, the variables all appear to be stationary as the there are no observable trend in the series.

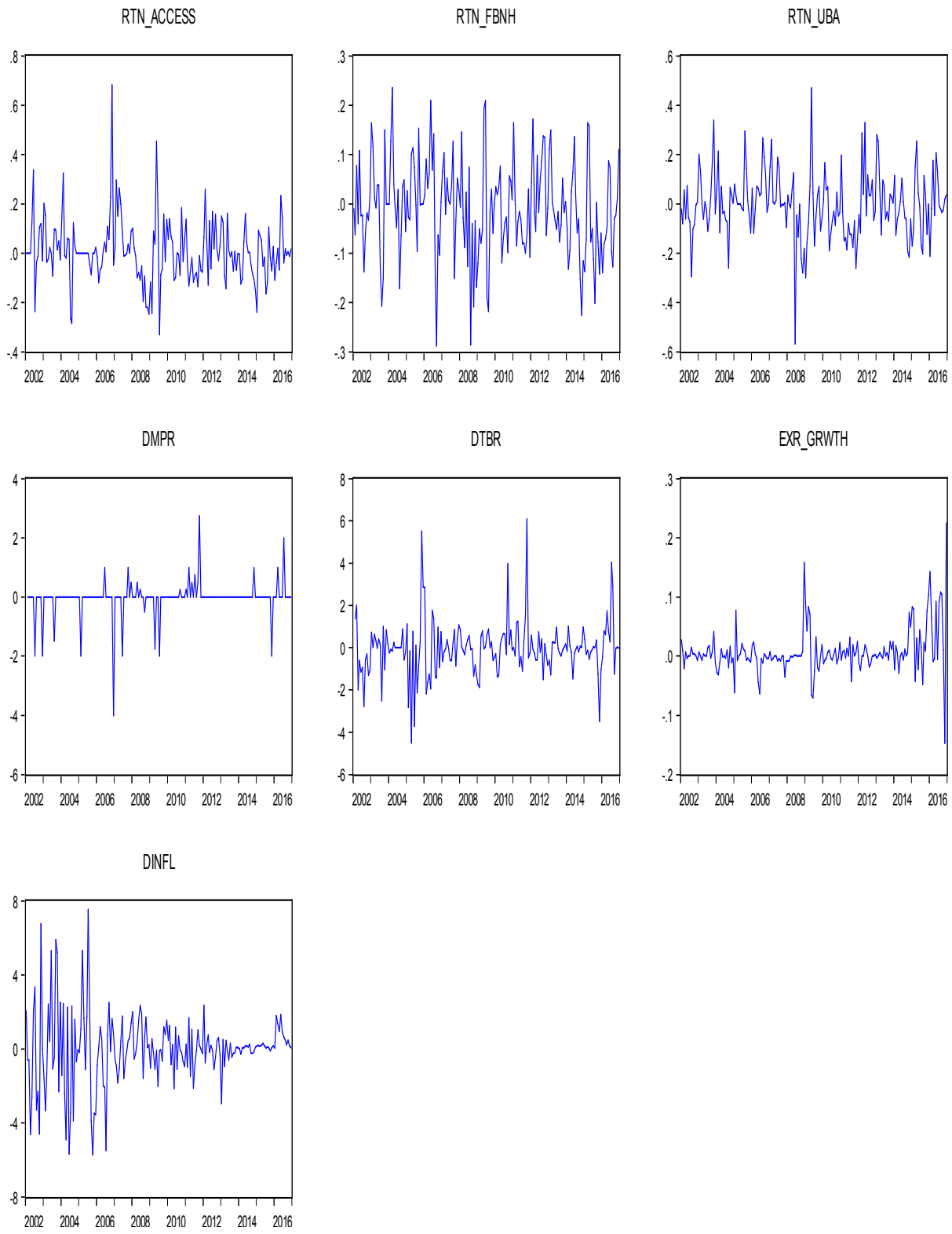

Figure 1: Graphical plot of the data

Methods

We examine the dynamic relationship between security returns and unexpected changes in monetary policyvariables using the Structural VAR methodological framework. Unlike simultaneous equations models, the structural VAR models have been found in many practical applications to be usefultools for analysing the effect of structural shocks on economic and financial time series (Ouliaris, Pagan, & Restrepo,2016). First, we employ the reduced form VAR so that we can determine the appropriate VAR specification and the stability of the coefficients, which are required for a meaningful structural analysis. Since, unrestricted VAR requires that equal lag length is used for all equations (Brooks, 2008), we use the multivariate generalization of Akaike information criterion (MAIC) to determine the appropriate lag length for the reduced form VAR model.

The reduced form VAR(p) specification, incorporating security returns, monetary policy rate, treasury bills rate, exchange rate and inflation is thus, given by:

$$y_t = \phi + H_1 y_{t-1} + H_2 y_{t-2} + \cdots + H_p y_{t-p} + u_t \quad (3.1)$$

where $y_t$is a vector of endogenous variables;

$y_t = (N \times 1)$vector of endogenous variables $(RTN_t, MPR_t, TBR_t, EXR\_GRWTH_t, INFL_t)$, $\phi = (N \times 1)$ vector of constants, $H_i = (N \times N)$ matrix of coefficients and $u_t = (N \times i)$ vector of classical error terms. It is worthy of note that there are no contemporaneous terms in (3.1) and the usual OLS technique can effectively estimate each VAR equation.

The structural VAR model which incorporates contemporaneous terms are as follows:

$$\mathrm{A}y_t = \theta + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \cdots + \beta_p y_{t-p} + e_t \quad (3.2)$$

where: $\mathrm{A}^{-1}\mathrm{A} = \mathrm{I}$; e_t= structural shocks or innovations, $\mathbf{A} = (n \times n)$ matrix which relates the forecast errors of the reduced-form VAR, $u_t$and the structural shocks e_t so that $u_t = \mathrm{A}^{-1} e_t$.

Data analysis

EmpiricalResults and Discussion

Since all variables in a VAR model must be stationary, we start by subjecting all our variables to stationarity test using the popular Augmented Dickey Fuller (ADF) unit root/nonstationarity tests. Akaike information criterion is used to select the optimum lag for the ADF test, with a maximum of 13 lags allowed for each variable. Table 2 shows the results. As shown in this table, all variables are stationary, with the tau-statistic having a zero p-value for all variables and thus, clearly rejecting the null hypothesis of unit root. This is consistent with the graphical description of the variables in the previous section. Thus, unrestricted VAR models can be used to estimate the relationships being investigated.

Table 2: The unit root/nonstationarity test

Variable	tau-statistic	*p*-value	Interpretation
RTN_ACCESS	-10.08570	0.0000	Stationary
RTN_FBHN	-9.669683	0.0000	Stationary
RTN_UBA	-9.871991	0.0000	Stationary
DMPR	-13.02076	0.0000	Stationary
DTBR	-11.00139	0.0000	Stationary
EXR_GRWTH	-9.580094	0.0000	Stationary
DINFL	-11.86336	0.0000	Stationary

Table 3 shows the VAR order selection for the three banks. However, we do not include any exogenous variable in the VAR specification. As shown in this table, MAIC selects a VAR with 1 lag for all the banks. Thus, a VAR (1) model is appropriate for estimating the full dynamic relationship between monetary policy and security returns.

The VAR diagnostic tests in tables 4 and 5 indicate that the estimated model VAR(1) model is stable and has no specification problems. All the inverted VAR roots in table 4 have modulus less than 1, which means that the stability condition is satisfied, implying that structural analysis can be conducted using the impulse response function, Granger causality test and variance decomposition. The model diagnostic tests in table 5 indicate that the model is free from autocorrelation, with both LM and Q-statistics failing to reject the null hypothesis of serial correlation at 5% level of significant.

Table 3: VAR Lag selection –MAIC

Lag	ACCESS	FBNH	UBA
1	4.032619*	3.644060*	4.337417*
2	4.193973	3.752120	4.463405
3	4.257131	3.752305	4.511942
4	4.352160	3.804536	4.608935
5	4.445376	3.880079	4.709046
6	4.441191	3.865675	4.792048

*** denotes selected lag order**

Table 4: VAR Stability test

PANEL A					
Root	**Modulus**	**Root**	**Modulus**	**Root**	**Modulus**
ACCESS		**FBNH**		**UBA**	
0.415425	0.415425	0.317382 - 0.018999i	0.317950	0.330294 - 0.057555i	0.335271
0.248175 - 0.061732i	0.255738	0.317382 + 0.018999i	0.317950	0.330294 + 0.057555i	0.335271
0.248175 + 0.061732i	0.255738	0.058095	0.058095	0.067738	0.067738
-0.167760	0.167760	-0.021321 - 0.025345i	0.033120	-0.012198 - 0.024786i	0.027625
-0.006122	0.006122	-0.021321 + 0.025345i	0.033120	-0.012198 + 0.024786i	0.027625

Table 5: Model diagnostic tests

Test statistic	ACCESS	FBNH	UBA
Q-stat (2)	20.46678 (0.7219)	35.21019 (0.0845)	24.24174 (0.5054)
LM-stat (2)	21.11627 (0.6861)	37.57894 (0.0508)	24.72365 (0.4779)

ACCESS Bank

The response of ACCESS Bank returns to unexpected changes in monetary policy rate, treasury bills rate, growth in exchange rate and inflation for ten periods (months) is shown in figure 2. As can be seen from this figure, all the variables have effect on the performance of ACCESS Bank in the stock market, except the unexpected growth in exchange rate. While, unexpected changes in monetary policy rate and inflation rate both have negative effects, unexpected change in treasury bills rate has a positive effect. However, and expectedly, the effects of these shocks die out to zero almost at the fourth month, confirming that the estimated VAR for ACCESS Bank returns is stationary.

The forecast error variance decomposition of ACCESS Bank returns is given in table 6. The results in this table suggest that own shock is the main source of variation in this security returns, with all other endogenous variables contributing less than 4% of the error variance even at the 10^{th} period. Out of the about 3.5% variation accounted for by the other variables, monetary policy rate and treasury bills rate jointly account for more than 2.5% while unexpected changes in inflation and exchange rate growth account for less than 1%. This result is not in agreement with the view that variations in security returns are caused by systematic macroeconomic factors. Thus, the observed variation in the security returns has very little or nothing to do with monetary policy shocks.

In table 7, we present the result of the Granger causality/Blocked exogeneity test, which tests whether unexpected changes in monetary policy rate, treasury bills, exchange rate growth and inflation rate have an individual and/or joint exogenous causal impact on ACCESS Bank performance in the stock market. The results indicate that none of the endogenous variables has an exogenous causal impact on ACCESS Bank returns, except the monetary policy rate. The Chi-sq. statistic corresponding to DMPR in table 7 has a p-value that is below 5%, indicating that the test is significant at 5% level. Thus, there is evidence that unexpected change in monetary policy rate has a negative and significant causal effect on ACCESS Bank returns.

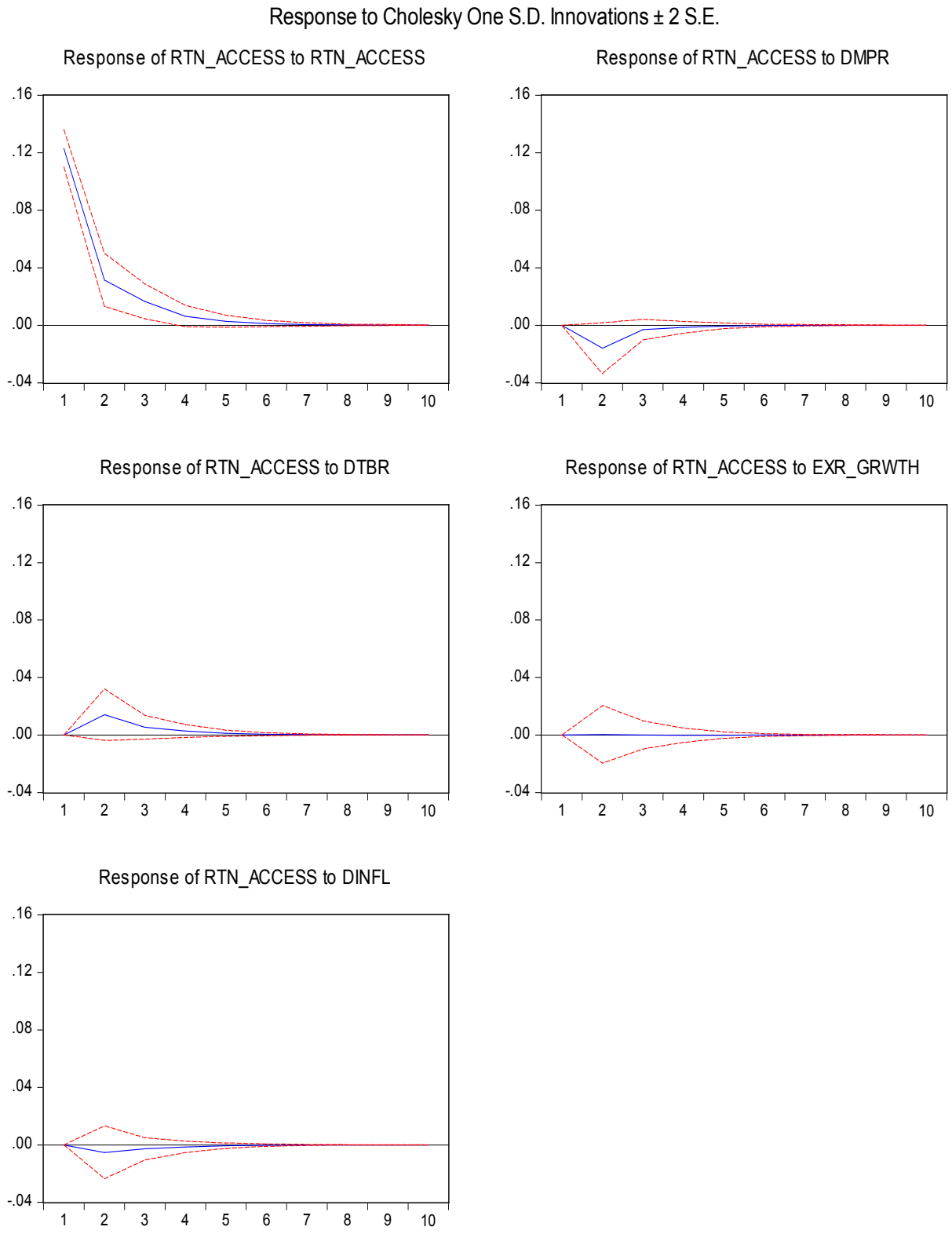

Figure 2: Impulse responses of ACCESS BANK returns.

Table 6: Error variance of ACCESS Bank returns

Period	RTN_ACCESS	DMPR	DTBR	EXR_GRWTH	DINFL
1	100.0000	0.0000	0.0000	0.0000	0.0000
2	97.1064	1.5212	1.1991	0.0008	0.1723
3	96.8938	1.5474	1.3392	0.0008	0.2186
4	96.8314	1.5566	1.3784	0.0012	0.2322
5	96.8209	1.5572	1.3852	0.0014	0.2351
6	96.8188	1.5572	1.3865	0.0015	0.2357
7	96.8185	1.5572	1.3867	0.0015	0.2358
8	96.8184	1.5573	1.3867	0.0015	0.2358
9	96.8184	1.5573	1.3867	0.0015	0.2358
10	96.8184	1.5573	1.3867	0.0015	0.2358

Table 7: Granger causality/Blocked exogeneity Wald test (ACCESS Bank)

Excluded	Chi-sq	*p*-value
DMPR	5.298375	0.0213
DTBR	2.356691	0.1247
EXR_GRWTH	0.003948	0.9499
DINFL	0.339550	0.5601
All	**6.433917**	**0.1690**

United BANK for Africa

The analysis of the effect of structural shocks on UBA returns is reported in figure 3 and tables 8 and 9. The impulse response function in figure 3 shows that unexpected change in monetary policy rate, treasury bills rate and exchange rate all have a negative impact on the UBA performance in the stock market, while unexpected change in inflation almost has no effect. However, the effects of these shocks fade out completely around the fifth period.

On the variation in the UBA returns shown in table 8, similar to the results for ACCESS Bank, own shock contributes more than 96% throughout the response periods while shocks to other endogenous variables contribute less than 4%. For the contribution of other endogenous variables, monetary policy rate has the highest contribution, accounting for more than 2.5% while other variables have very little and insignificant contribution.

Further, like the case of ACCESS Bank, the Granger causality/Blocked exogeneity test results in table 9 indicate that none of the endogenous variables can be treated as exogenous, except the monetary policy rate, which is significant at 5% level. This gives evidence that unexpected change in monetary policy rate has a negative and significant causal impact on the security performance in the stock market.

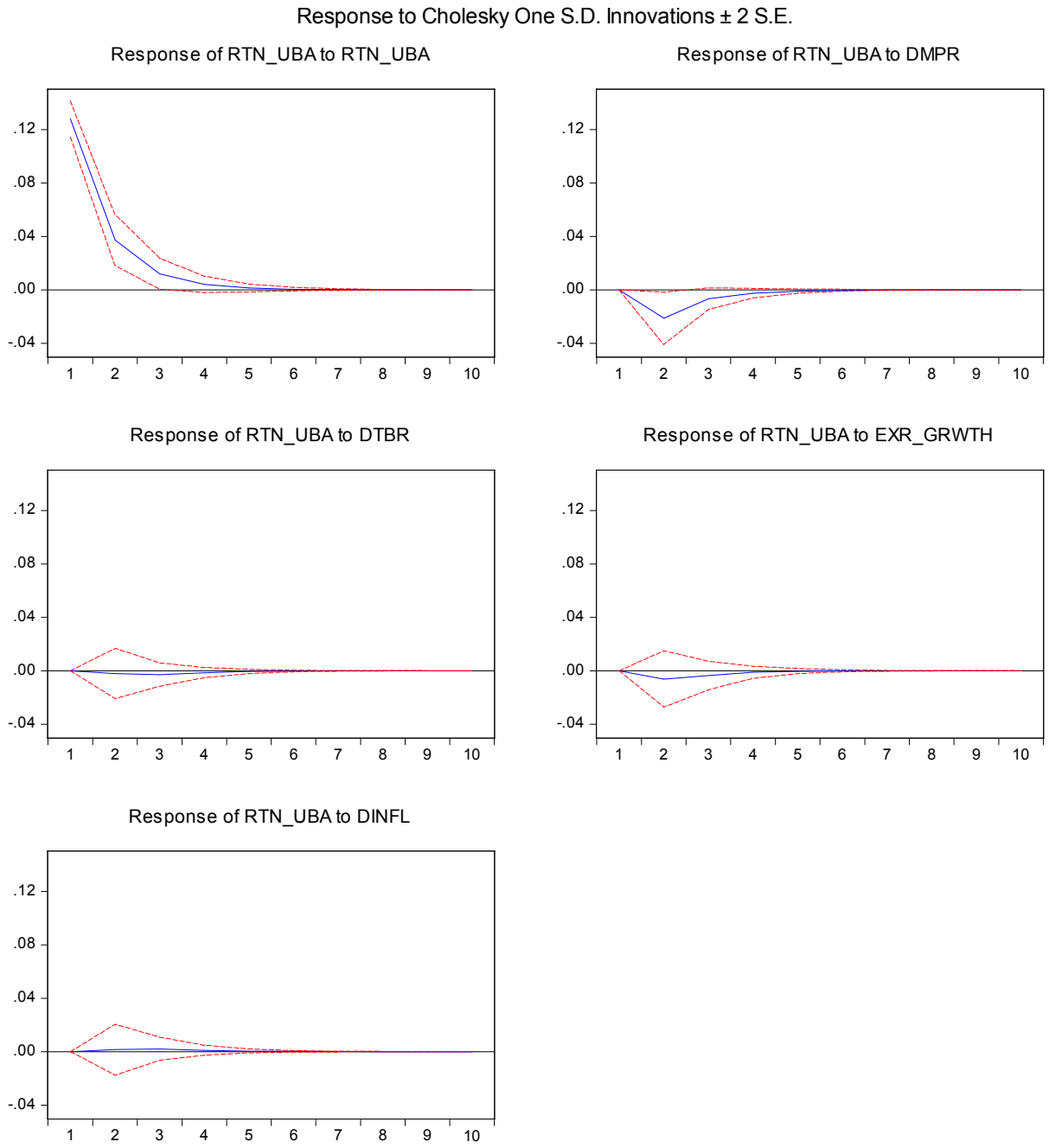

Figure 2: Impulse responses of UBA returns.

Table 8: Error variance of UBA returns

Period	RTN_UBA	DMPR	DTBR	EXR_GRWTH	DINFL
1	100.0000	0.000000	0.000000	0.000000	0.000000
2	97.28388	2.472679	0.023414	0.208560	0.011470
3	96.93221	2.688333	0.068520	0.275219	0.035714
4	96.87837	2.718903	0.078668	0.282027	0.042027
5	96.87064	2.723135	0.080380	0.282593	0.043254
6	96.86960	2.723682	0.080634	0.282632	0.043455
7	96.86946	2.723748	0.080669	0.282634	0.043485
8	96.86945	2.723755	0.080673	0.282634	0.043489
9	96.86945	2.723756	0.080674	0.282634	0.043489
10	96.86945	2.723756	0.080674	0.282634	0.043489

Table 9: Granger causality/Blocked exogeneity Wald test (UBA)

Excluded	Chi-sq.	*p*-value
DMPR	4.136779	0.0420
DTBR	0.060562	0.8056
EXR_GRWTH	0.346202	0.5563
DINFL	0.022943	0.8796
All	**5.296637**	**0.2582**

First Bank

The analysis of the effect of structural shocks for First Bank is presented in figure 4 and tables 10 and 11. The impulse response function in figure 4 shows that exchange rate growth and inflation shocks both have effect onFirst Bank performance. On the contrary, unexpected changes in monetary policy rate and treasury bills rate both have very little or no effect. However, while the effect of exchange rate shock is negative, the effect of inflation shock is positive. These effects die out to zero around the third period, again confirming that the estimated VAR(1) for First Bank returns is stable.

As shown in table 10, the fact that monetary policy shocks have very little or no contribution to the variation in security returns is also evidenced in the case of First Bank. The contribution of own shock to the variation in First Bank returns is approximately 98% even at the 10^{th} period, leaving the remaining 2% to the contribution of monetary policy rate, treasury bills rate, inflation and exchange rate growth. Again, this result disagrees with the Arbitrage pricing theory of Ross (1976).

The Granger causality/Blocked exogeneity test results in table 11 indicate that none of the endogenous variables can be treated as exogenous, with the Chi-sq. statistic being insignificant for all variables Thus, contrary to the results for both ACCESS Bank and UBA, there is no evidence that monetary policy shocks have significant effect on security returns.

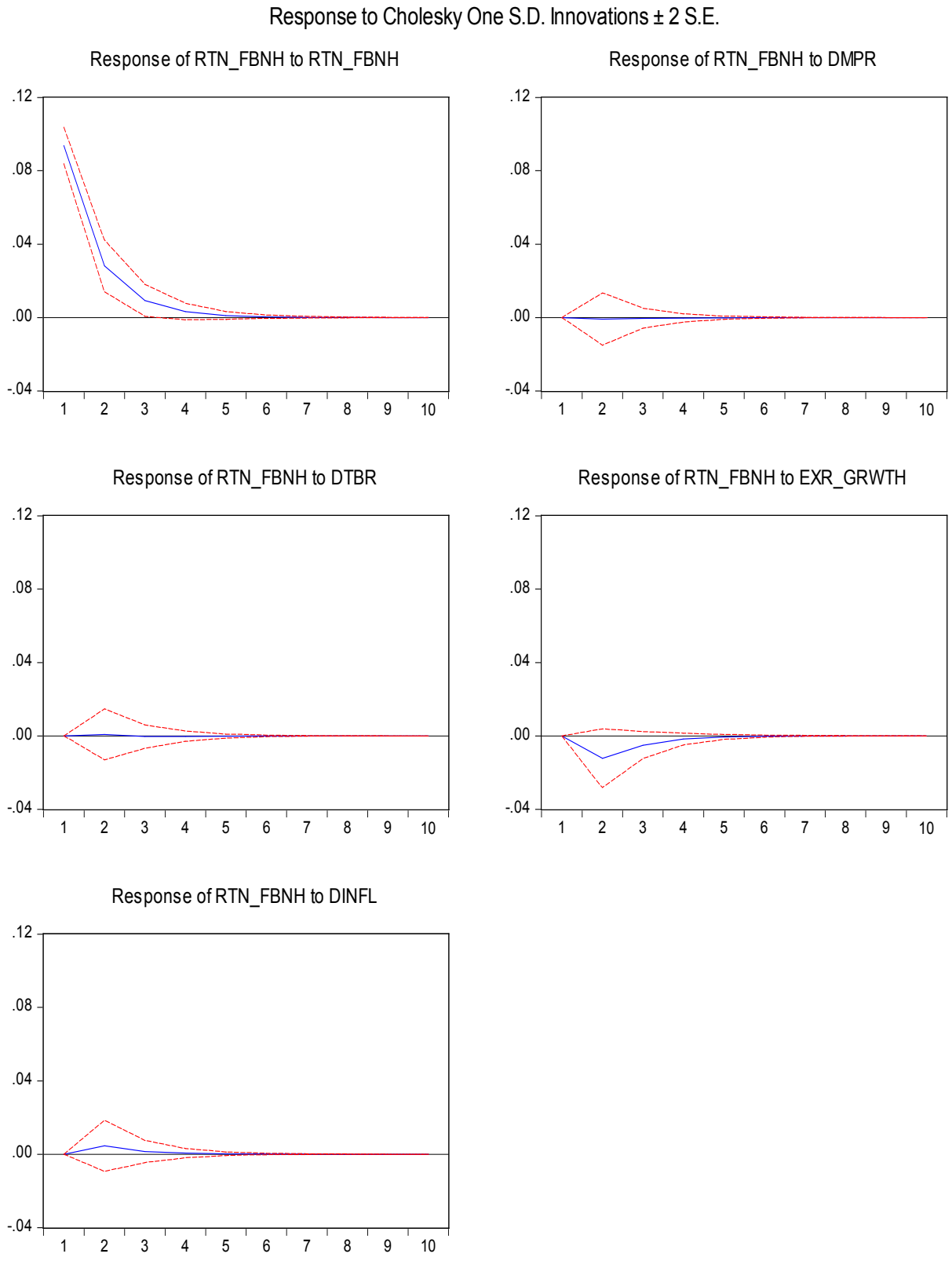

Figure 4: Impulse responses of FIRST BANK returns.

Table 10: Error variance of First Bank returns

Period	RTN_FBNH	DMPR	DTBR	EXR_GRWTH	DINFL
1	100.0000	0.000000	0.000000	0.000000	0.000000
2	98.24836	0.007541	0.005770	1.528467	0.209858
3	97.98322	0.009284	0.007638	1.770904	0.228952
4	97.94954	0.009985	0.008313	1.800299	0.231867
5	97.94525	0.010114	0.008456	1.803844	0.232336
6	97.94472	0.010134	0.008481	1.804261	0.232405
7	97.94465	0.010137	0.008485	1.804310	0.232414
8	97.94465	0.010137	0.008485	1.804315	0.232416
9	97.94465	0.010137	0.008485	1.804316	0.232416
10	97.94465	0.010137	0.008485	1.804316	0.232416

Table 11: Granger causality/Blocked exogeneity Wald test (First Bank)

Excluded	Chi-sq	*p*-value
DMPR	0.025113	0.8741
DTBR	0.000717	0.9786
EXR_GRWTH	2.317317	0.1279
DINFL	0.420144	0.5169
All	**2.755871**	**0.5995**

Summary and Conclusions

The aim of this study is to examine the effects of unexpected changes in monetary policy variables (monetary policy rate and treasury bills rate) on the performance of deposit money banks in Nigeria using structural VAR methods. The study is based on monthly data from 2002M01 to 2016M12.

The results are mixed. While unexpected changes in monetary policy variables (Monetary policy rate and Treasury Bills rate) have effect on both ACCESS Bank and UBA, they show no effect on FBN. The results show that unexpected change in monetary policy rate has a negative and significant causal impact on both ACCESS Bank and UBA performance in the stock market. An increase in monetary policy rate would lead to a decrease in the return on both securities in the stock market. The effect of unexpected change in Treasury Bill rate is positive for ACCESS bank stock but negative for UBA stock. However, there is no evidence of a causal relationship between Treasury Bill rate and the performance of these stocks. The results hold controlling for the effects of both inflation and exchange rate.

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