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The Monetary Policy Rate of the Central Bank of Nigeria (CBN) and the Nigerian Stock Market: A Structural Var Analysis

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Abstract

This study examines the dynamic relationship between stock market performance and the CBN monetary policy rate between the period of 1973-2012. We utilized the "all share price index" in the Nigerian stock exchange as a measure of stock market performance and the official rate of interest at which the CBN lends money to money deposit banks in the country as a measure of the monetary policy rate. The author estimated the SVAR model. The major finding in the study is that stock market performance is negatively associated with the CBN monetary policy rate in Nigeria. In effect, if the CBN monetary policy rate was high, investors would move from high risk stock market to invest in low risk bank deposits while, if the CBN policy rate is low, investors may prefer to invest in the stock exchange

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market. Given the peculiarities of Nigerian economy, hikes in the short term CBN monetary policy rate might be counter-productive. The soaring rate of the CBN is amplifying fears in some quarters of the country that the reform measures currently being implemented by the CBN may soon run into a hold-up since bank loans are gradually being priced out of the reach of most economic operators in the economy. Therefore, additional practical measures to enhance the performance of the Nigerian Stock Exchange should be implemented.

Mathematics Subject Classification: C22; D60; A48

Keywords: CBN Monetary Policy Rate;Stock market performance; SVAR; Identification and Nigeria

1 Introduction

Stock exchange market plays an essential role in providing capital required for the growth of an economy in its entirety. No wonder the growth rate of *GDP* of nations depends to a larger extent on investments which require long term funding. According to Aydemir and Demirhan (2009), the most cost effective way for providing long term fund is the issuing of shares to the public at large and distributing the wealth of the nation by facilitating extensive ownership of public company stocks. A very practical idea is that investors can buy shares of publicly listed companies and this makes them owners of the business and as such earns share of profits according to their invested capital. There are different schools of finance with divergent thoughts about the behaviour of a stock price. The *fundamentalist* believe that the value of a stock is determined by expectations regarding future earnings and by the rate at which those earnings are discounted. According to the *technical* school of finance, stock prices tend to follow definite pattern and each price is influenced by previous prices (Smith, 1990).

The school of *random-walk* opined that stock price movements are a function of a probability distribution of different possible outcome (Moore, 1962 and Fama, 1965). The *behavioural* school of finance holds that investors behave irrationally when they do not correctly process all the available information while forming their expectations of a company's future performance. The *macroeconomic* school of thought up-holds the fact that stock prices are influenced by changes in macroeconomic variables such as money supply, interest rate, inflation etc. In view of the preceding, the performance of the stock market is highly predictable by the economic and political conditions that exit in the country. For example, the Nigerian economy has been subjected to series of political and economic reforms. Accordingly, if the overall macroeconomic condition of the country is good, then the stock market earns better returns and if the overall macroeconomic condition of the country is poor, then the stock market returns are poor. Also, if the political situation in the country is unstable, then investors are reluctant to invest in the Nigerian Stock Market which may cause stock prices to decline. The same goes for the *CBN*[3] monetary policy rate of interest which is the anchor for money market and other rates in Nigeria. In light of the foregoing, the paper investigates how changes in the *CBN* monetary policy rate and the activities of the Nigerian Stock Market are related. The paper is organized into six sections: Section two provides a succinct trend analysis of the *CBN* monetary policy rate *(MPR)* and the Nigerian Stock Market. Section three reviews the literature. Theoretical framework, model specification and methodology are done in section four. Results are analyzed section five. Section six concludes the paper.

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[3]The *CBN* monetary policy rate is the official interest rate at which the *CBN* lends to commercial banks in the country.
[2]A stock price is the sum o f the future discounted cash flow divided by the number of shares available.

2 Trend Analysis of CBN Monetary Policy Rate and the Nigerian Stock Market

CBN Monetary Policy Rate

In Nigeria, interest rate decisions are taken by the *Monetary Policy Committee (MPC)* of the Central Bank of Nigeria *(CBN).* In 2012, the *MPC* fixed the *MPR* at 12.0 per cent with interest rate corridor of plus and minus 200 basis points. The *CBN* also increase ***Cash Reserve Ratio (CRR)*** to 12 percent while keeping hold of minimum liquidity ratio and the mid-point of exchange rate at 30.0 per cent and N155/US$1 respectively. The *Inter-bank and Open Buy Back (OBB)* rates both opened at 7.49 per cent but rose to 11.0 per cent and 10.36 per cent respectively on September 15, 2011. Responding positively to the hike in policy rates, both the lending and deposits rates of deposit money banks also moved up in 2011. In 2010, the maximum lending rate increased to 23.21 per cent in December from 21.75 percent in January, 22.02 percent in March, 22.02 percent in June and 22.09 per cent in September, respectively. Similarly, the prime lending rate rose to 16.75 per cent in December from 15.73 percent in January, 15.81 percent in March, 15.76 percent in June and 15.87 percent in September, respectively.

The spread between the maximum lending rate and the average deposit rate which was at 19.22 percentage points in June, 2012 moved up to 20.12 percentage points in December (CBN, 2012). According to Sanusi (2012), the liquidity in banks' vault had provided ammunition for speculative activity in the foreign exchange market with implications for inflationary expectation. The retail lending rates which had remained relatively high, however, declined in 2012. The average maximum lending rate declined to 22.27 percent in August, 2011 from 22.42 per cent in July, 2011. In 2012, the *CBN* increased commercial banks' Cash Reserve Ratio *(CRR)* to 12 per cent from 8 per cent in 2011 and also reduced the *Net Foreign Exchange Open Position (NOP)* to 1.0 per cent from 3.0 per cent n 2011.

The hike in *CRR* was aimed at curbing structural excess liquidity in the banking system amidst high inflationary expectations (CBN, 2012). According to Sanusi (2012), the significant liquidity on the books of banks had not led to intermediation and lending to the real economy as banks continued to take advantage of high yields on government securities to direct credit away from the core private sector. In 2012, credit to core private sector grew by 3.2 percent or 6.4 percent when annualized.

2.1 Nigerian Stock Exchange Market

The fluctuating trend on the Nigerian Stock Exchange *(NSE)* is a continuous exercise. The market indicators for measuring the performance indices namely, the *market capitalisation* and the *all share price index* always appreciate. Specifically, the stock market capitalization appreciated by N3.61 billion to close at N7.912 trillion on Thursday 27, 2013 from N7.908 trillion at which it opened, while the market capitalization index rose by 11.3 bases points to close at 24,765.60 points from 24,754.30 points. Available data shows that Presco Plc led 26 other stocks on the gainers table with a gain of N0.31 to close at N6.53 per share, Costain West Africa Plc followed with a gain of N0.32 to close at N6.75 per share and IHS Plc gained N0.12 to close at N2.60 per share. Other share price gainers include: Vitafoam Nigeria Plc N0.29, National Salt Company Nigeria Plc N0.29, Japaul Oil and Maritime Services Plc N0.06, Access Bank Plc N0.34, FTN Cocoa Processors Plc N0.02, Okomu Oil Palm Plc N0.50, Livestock Feeds Plc N0.02, among others. On the contrary, Wema Bank Plc recorded the highest share price loss on the losers table dropping by N0.07 to close at N1.33 per share, C and I Leasing Plc followed with a loss of N0.08 to close at N1.53 per share and Evans Medical Plc dipped by N0.06 to close at N1.15 per share.

Other share price losers include: John Holt Plc N0.46, A.G Leventis Nigeria Plc N0.13, Vono Product Plc N0.14, Starcomms Plc N0.07, Intercontinental Bank

Plc N0.11, Custodian and Allied Insurance Plc N0.15, Oceanic Bank International Nigeria Plc N0.12, *NSE* 30 which measures the performance of blue chips in the market garnered 0.28 per cent, *NSE* Food and Beverages gained 0.52 per cent, *NSE* Banking rose by 0.39 percent and *NSE* Oil Gas appreciated by 0.19 per cent, *NSE* Insurance dropped by 2.07 percent. A turnover of 210.80 million shares valued at N1.83 billion was recorded in 5,189 deals in contrast to the previous day's turnover of 211.60 million shares valued at N1.67 billion in 3,939 deals. Banking stocks accounted for 52.68 percent of the market turnover with 111.04 million shares valued at 1.04 billion in 2,581 deals. Zenith Bank Plc recorded the highest patronage in the sub-sector.

3 Literature Review

The effects of interest rates on the performance of the stock exchange market are widely discussed topics in the literature of financial and monetary economics. The following studies reported negative relationship between stock prices and rate of interest, Geske and Roll (1983), Chen, Roll, and Ross (1986), Poterba and Summers (1986), Sweeney and Warga (1986), Shiller and Beltratti (1992), Campbell and Ammer (1993), Muradoglu and Metin (1996), Arango et al. (2002), Al-Qenae, Li and Wearing (2002), Wongbampo and Sharma (2002), Nissim and Penman (2003), Hume and Macmillan (2007), Al-Sharkas (2007), Yidirtan (2007), Adam and Twenebboah (2008), Abugri (2008), Kandir (2008), Kyereboah, Anthony and Agyire (2008), Ozbay (2009), Alam and Uddin (2009) etc. These studies reported positive relationship between stock market performance and rate of interest, Flannery and James (1984), Campbell (1987), Ferson (1989), Mukherjee and Naka (1995), Mayasami and Koh (2000), Nwokoma (2002), Gunasekarage et al. (2004), Ologunde, Elumilade and Asaolu (2006), Wickramasinghe (2011)etc. The studies that found mixed empirical evidence include, Maysami et al. (2004), Ozturk (2008), Chen et al. (1986) etc. The study that found no significant evidence on the relationship between stock market performance and interest rate include, Tursoy et al. (2008).

In their study, Geske and Roll (1983) found that a change in real interest rate would cause a change in stock price in an opposite direction. They explained that higher interest rates signals higher unemployment, lower level of economic activity and hence lower earnings of firms. Chen, Roll, and Ross (1986) described stock price as discounted dividend in which the discount rate is a composite of risk-free rate and firm-related risk premiums. The influence of interest rates on stock prices is opposite because increase in risk free rate would increase the discount rate. According to Poterba and Summers (1986), volatility in the discount rate decreases stock prices. Sweeney and Warga (1986) asserted that the present value of dividends would be affected due to decrease in interest rate but that decrease in interest rate would not affect the dividends in the absence of nominal contracting effect. Shiller and Beltratti (1992) find an inverse relationship between stock returns and interest rates. The relationship is corroborated by the results of Campbell and Ammer (1993). The empirical results of Muradoglu and Metin (1996) for Turkey indicate that rates of interest negatively affect stock returns with a significant lag in short run dynamic model. In their empirical study, Arango et al. (2002) found an inverse and non linear relationship between share prices and interest rates. Al-Qenae, Li and Wearing (2002) in their study of the effects of interest rate on the stock prices on Kuwait Stock Exchange discovered that interest rate significantly impact stock prices negatively.

Wongbampo and Sharma (2002), while exploring the relationship between stock returns in five Asian countries namely, Malaysia, Indonesia, Philippines, Singapore and Thailand found a negative relationship between stock prices and interest rate for the Philippines, Singapore and Thailand, but positive for Indonesia and Malaysia. Their study also shows that stock markets usually respond negatively to interest rate increases and positively to interest rate decreases.

Similar results were obtained by Nissim and Penman (2003). According to Hume and Macmillan (2007), U.S and Japan stock prices are negatively correlated to a long term interest rate. Al-Sharkas (2007) for Jordan and Adam and Twenebboah (2008) for Ghana indicate the relationship between stock prices and interest rates is negative and statistically significant. Yidirtan (2007) found that real interest rate on deposits and interest rate differential have an extremely weak, negative impact on stock returns. According to the results of Abugri (2008), the responses of sock return to interest rate is negative and significant for Brazil, Argentina, and Chile, but the response of returns to interest rate for Mexico is insignificant. Kandir (2008) reported that interest rate affect all portfolio returns negatively. Kyereboah, Anthony and Agyire (2008) found that lending rates from deposit money banks have an adverse effect on stock market performance and particularly serve as major hindrance to business growth in Ghana. Ozbay (2009) found negative relationship between stock returns and interest rate for both developed and emerging markets. Alam and Uddin (2009) found a significant negative relationship between interest rate and stock prices and opined that the performance of the stock exchange can be enhanced by controlling interest rate considerably.

To Flannery and James (1984), interest rate fluctuations affects the real value of financial assets and not the real assets and that it should benefit a firm instead of facing a decrease in its stock price if the firm has more financial liabilities than financial assets. Campbell (1987) argued that the term structure of interest rates has positive prediction of stock returns. Ferson (1989) found that one month Treasury bill rate explained small variation of expected stock returns relative to total variations and that the Treasury bill excess returns are positively related to interest rate. Mukherjee and Naka (1995) also employed the *SVAR* method to explore the relationship between the Japanese Stock Market and selected macroeconomic variables. According to their results, Japanese Stock Market is co-integrated with exchange rate, money supply, inflation rate, industrial production, long term government bond rate and the short term call money rate.

The relationship was found to be positive. Mayasami and Koh (2000) examined the long term relationships between the Singapore stock index and selected macroeconomic variables by estimating *SVAR.* Their results reveal that Singapore Stock Market is significantly and positively sensitive to the long and short term interest rates. Nwokoma (2002) found that the level of interest rate, as represented by the 3-month commercial bank deposit rate have a long-run positive relationship with the stock market. He also found that the Nigerian Stock Market responds more to its past prices than changes in macroeconomic variables in the short run.

Gunasekarage et al. (2004) examined the impacts of Treasury bill rate as a measure of interest rates on stock market performance index and found from the *SVAR* estimates that the Treasury bill rate have statistically significant positive influence on the stock market index. Ologunde, Elumilade and Asaolu (2006) found that prevailing interest rate exerts positive influence on stock market capitalization rate. Wickramasinghe (2011) found that there are both short run and long-run causal relationship between stock prices and macroeconomic variables. The study by Maysami et al. (2004) reveals that short-term and long-term interest rates respectively have significant positive and negative relations with the Singapore’s Stock Market. Ozturk (2008) reports that only the lagged overnight interest rate does Granger cause stock returns while stock returns do Granger cause Treasury interest rate and overnight interest rate. Chen et al. (1986) explored amongst other variables, the influence of the spread of long and short term interest rates on US stock returns and found both positive and negative impact of interest rate on expected stock returns. The regression results of Tursoy et al. (2008) indicates absence of significant pricing relationship between stock return and interest rate.

4 Theoretical Framework, Model Specification and Methodology

4.1 Theoretical Basis

Several theories rationalized the existence of a relationship between stock market returns and interest rate. The theoretical framework of this paper is founded on the financial economic theory of Ross (1976), that is, the arbitrage pricing theory[4] *(APT).* The crux of the *APT* model is that stock price is determined by non-correlated factors. With the arbitrage theory, the expected return in an efficient market is a linear combination of each factor's beta (Morel, 2001). In effect, the risk associated with holding a particular security comes from the macroeconomic factors that affect all securities and the idiosyncratic element. Watsham and Parramore (1997) opined that an efficient market is capable of rewarding the risks associated with the macroeconomic factors. The *APT* relates the expected rate of return on a sequence of securities to their factor sensitivities (Gilles and LeRoy, 1990). This suggests that factor risk is fundamental in asset pricing. The arbitrage pricing[2] theorization upholds the fact that arbitrage profit opportunities are quickly eliminated through competitive forces. What this means in effect is that an investor cannot earn a positive expected rate of return on any combination of assets without incurring some risks and without making some net investments (Berry, Burmeister and McElroy, 1988). Theoretically, it is expected that the variation in interest rate will impact negatively on stock market performance because an increase in interest rate prevents investors from making high risk stock market investments compare to low risk interest bearing security investments such as fixed deposits, savings, Treasury bills etc (French et al., 1987).

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[4] The APT gives a characterization of expected returns on assets based on the assumptions that there are no arbitrage opportunities and it is such that returns follow a factor structure and there are homogenous expectations.

4.2 Baseline Model

In this paper, the general specification is a short-run relationship between *CBN* monetary policy rate of interest *(MPR)* and the stock market performance as measured by all share price index *(SMC)* in first difference, assuming trend stationarity.

$$Log(\Delta SMC) = f_1 + f_2(\Delta MPR) + f_3(\Delta W) + \upsilon \qquad (3.1)$$

Where *SMC* is the index of all share prices, *MPR* is the *CBN* monetary policy rate, *W* is a vector of control; variables namely, exchange rate of the naira vis-à-vis the US dollar *(ERT)* and stock market capitalization *(MKP)* and *v* is the stochastic error disturbance.

4.3 Structural VAR Model

In this paper, we estimate a *SVAR* model which does not rely on exogeneity or exclusion restriction. The specification is given as follows:

$$\begin{aligned} Z_{1t} &= \delta_{10} - \varphi_{12} Z_{2t} + \vartheta_{11} Z_{1t-1} + \vartheta_{12} Z_{2t-1} + \mu_{1t} \\ Z_{2t} &= \delta_{20} - \varphi_{21} Z_{1t} + \vartheta_{21} Z_{1t-1} + \vartheta_{22} Z_{2t-1} + \mu_{2t} \end{aligned} \qquad (3.2)$$

The observations in the sample run from $t = 1, 2, 3, ..., T$ and μ's are the independent structural innovations. Using matrix formality, the *SVAR* model as specified in equation (3.1) can be represented as:

$$AZ_t = \delta_0 + \Gamma_1 Z_{t-1} + \mu_t, \quad where \;\; E(\mu_t \mu_t^{'}) = D \qquad (3.3)$$

Where D is a diagonal matrix. Based on lag operators, the *SVAR* model becomes:

$$A(L) Z_t = \delta_0 + \mu_t, \quad where \;\; A(L) = A - \Gamma_1 L \qquad (3.4)$$

The reduced for of the *SVAR* is obtained by multiplying the matrix for of the *SVAR* by A^{-1} and thereafter solving the model for Z_t in terms of Z_{t-1} and μ_t.

$$
\begin{aligned}
Z_t &= A^{-1}\delta_0 + A^{-1}\Gamma_1 Z_{t-1} + A^{-1}\mu_t \\
&= \alpha_0 + WZ_{t-1} + e_t \\
&\equiv A(L)Z_t = \alpha_0 + e_t \\
&\quad where\ \ A(L) = I_2 - A_1 L, \\
&\qquad \alpha_0 = A^{-1}\delta_0, W = A^{-1}\Gamma_1, e_t = A^{-1}\mu_t
\end{aligned} \tag{3.5}
$$

The covariance matrix of the reduced form errors e_t are linear combinations of the structural innovations and have covariance matrix given by:

$$
\begin{aligned}
E(e_t e_t') &= A^{-1}E(\mu_t \mu_t')A^{-1'} \\
&= A^{-1}DA^{-1'} \\
&= \Psi
\end{aligned}
$$

The reduced form of the *VAR*[3] as specified in equation (3.5) is covariance stationary provided the eigenvalues of W have modulus less than unity. The eigenvalues of W satisfies equation (3.5) and are equal to the inverses of the roots to the characteristic equations given in equation (3.6):

$$
\begin{aligned}
&det(I_2\lambda - W_1) = 0 \\
&det(I_2 - W_1 Q) = 0
\end{aligned} \tag{3.6}
$$

Hence, the reduced form of the *SVAR* is stationary provided the roots of (3.6) lie inside the complex unit circle. The moving average *(MA)* or *Wold* representation of the reduced form of the *SVAR* (3.4) is found by multiplying both sides of (3.4) by $W(L)^{-1} = (I_2 - W_1 L)^{-1}$ to obtain:

$$
\begin{aligned}
Z_t &= \upsilon + \Phi(L)e_t \\
&\quad where\, \Phi(L) = (I_2 - W_1 L)^{-1} \\
&\qquad = \sum_{K=0}^{\infty} \Phi_K L^K \\
&\qquad = \Phi_0 = I_2, \Phi_K = W_1^K \\
\upsilon &= W(1)^{-1}\alpha_0 \\
E(e_t e_t') &= \Psi
\end{aligned} \tag{3.7}
$$

The structural moving average of Z_t is based on an infinite moving average of the structural innovations μ_t . Accordingly, substituting $e_t = A^{-1}\mu_t$ in the *Wold* representation yields:

$$\begin{aligned} Z_t &= \upsilon + \Phi(L)A^{-1}\mu_t \\ &= \upsilon + \Omega(L)\mu_t \\ \Omega(L) &= \sum_{K=0}^{\infty}\Omega_K L^K \\ &= \Phi(L)A^{-1} \\ &= A^{-1} + \Phi_1 A^{-1}L + \Phi_2 A^{-1}L^2 + \Phi_3 A^{-1}L^3 + \ldots \\ \textit{Where}\,\Omega_0 &= A^{-1} \neq I_2,\ \Omega_K = \Phi_K A^{-1} = \Phi_1^K A^{-1}, K = 0,1,2,3,\ldots \end{aligned} \tag{3.8}$$

Given that Ω_0 captures initial impacts of structural shocks, it determines further the contemporaneous correlation between Z_{1t} and Z_{2t} . Thus, elements of the Ω_K matrices, $\gamma_{ij}^{(K)}$ give the dynamic multipliers otherwise known as the structural impulse responses of Z_{1t} and Z_{2t} to changes in the structural errors μ_{1t} and μ_{2t} . So, the structural impulse response functions *(IRFs)* at time $t+s$ are derivable from the structural moving average specification for the following bivariate system:

$$\begin{aligned} Z_{1t+s} &= \upsilon_1 + \gamma_{11}^{(0)}\mu_{1t+s} + \ldots + \gamma_{11}^{(s)}\mu_{1t} + \gamma_{12}^{(0)}\mu_{2t+s} + \ldots + \gamma_{12}^{(s)}\mu_{2t} \\ Z_{2t+s} &= \upsilon_2 + \gamma_{21}^{(0)}\mu_{1t+s} + \ldots + \gamma_{21}^{(s)}\mu_{1t} + \gamma_{22}^{(0)}\mu_{2t+s} + \ldots + \gamma_{22}^{(s)}\mu_{2t} \end{aligned} \tag{3.9}$$

The structural impulse response functions (IRFs) are respectively given equations (3.10) through to (3.13):

$$\frac{\partial(Z_{1t+s})}{\partial(\mu_{1t})} = \gamma_{11}^{(s)}$$

$$\frac{\partial(Z_{1t+s})}{\partial(\mu_{2t})} = \gamma_{12}^{(s)}$$

$$\frac{\partial(Z_{2t+s})}{\partial(\mu_{1t})} = \gamma_{21}^{(s)}$$

$$\frac{\partial(Z_{2t+s})}{\partial(\mu_{2t})} = \gamma_{22}^{(s)}$$

The structural impulse response functions *(IRFs)* are the plots of $\gamma_{ij}^{(s)}\ \forall\, s\ and\ i, j = 1, 2$. These plots summarize how unit impulses of the structural shocks at time t impact the level of Z at time $t+s$ for different values of s. The modeling assumption is that the Z vector is covariance stationary as given in equation (3.14):

$$\lim_{s\to\infty} \gamma_{ij}^{(s)} = 0,\ \ \forall i, j = 1, 2 \qquad (3.14)$$

Stationarity of the Z vector implies that no structural shock has a long-run impact on the level of Z. The study also employed the *Wold* representation for period Z_{t+s} to carry out forecast error variance decomposition in order to determine the proportion of the variability of the errors in forecasting Z_{1t} and Z_{2t} at time $t+s$ based on information available at time t that is due to variability in the structural shocks μ_{1t} and μ_{2t} between times t and $t+s$.

$$Z_{t+s} = \upsilon + e_{t+s} + \Phi_1 e_{t+s-1} + \Phi_{s-1} e_{t+1} + \Phi_s e_t + \Phi_{s+1} e_{t-1} + \ldots \qquad (3.15)$$

The unsurpassed linear forecast of Z_{t+s} based on information available at time t and the forecast error are given respectively by:

$$\hat{Z}_{t+s|t} = \upsilon + \Phi_s e_t + \Phi_{s+1} e_{t-1} + \ldots$$

$$Z_{t+s} - \hat{Z}_{t+s|t} = e_{t+s} + \Phi_1 e_{t+s-1} + \ldots + \Phi_{s-1} e_{t+1} \qquad (3.16)$$

To specify the forecast errors in terms of the structural shocks or innovation, we utilize $\mu_t = A^{-1} e_t$ in equation (3.16) to obtain:

$$Z_{t+s} - \hat{Z}_{t+s|t} = A^{-1}\mu_{t+s} + \Phi_1 A^{-1}\mu_{t+s-1} + \ldots + \Phi_{s-1} A^{-1}\mu_{t+1}$$

$$Z_{t+s} - \hat{Z}_{t+s|t} = \Omega_0 \mu_{t+s} + \Omega_1 \mu_{t+s-1} + \ldots + \Omega_{s-1}\mu_{t+1} \qquad (3.17)$$

By way of equation by equation, the forecast errors are given in equations (3.18) and (3.19) respectively:

$$Z_{1t+s} - \hat{Z}_{1t+s|t} = \gamma_{11}^{(0)}\mu_{1t+s} + \ldots + \gamma_{11}^{(s-1)}\mu_{1t+1} + \gamma_{12}^{(0)}\mu_{2t+s} + \ldots + \gamma_{12}^{(s-1)}\mu_{2t+1} \quad (3.18)$$

$$Z_{2t+s} - \hat{Z}_{2t+s|t} = \gamma_{21}^{(0)}\mu_{1t+s} + \ldots + \gamma_{21}^{(s-1)}\mu_{1t+1} + \gamma_{22}^{(0)}\mu_{2t+s} + \ldots + \gamma_{22}^{(s-1)}\mu_{2t+1} \quad (3.19)$$

Since it is assumed that $\mu_t \sim i.i.d\,(0, D)$ where D is diagonal, the variances of the forecast errors in equations (3.18) and (3.19) could be decomposed as:

$$\begin{aligned} Var(Z_{1t+s} - \hat{Z}_{1t+s|t}) &= \sigma_1^2(s) \\ &= \sigma_1^2[(\gamma_{11}^{(0)})^2 + \ldots + (\gamma_{11}^{(s-1)})^2] + \sigma_2^2[(\gamma_{12}^{(0)})^2 + \ldots + (\gamma_{12}^{(s-1)})^2] \quad (3.20) \\ &= \sigma_1^2\left[(\gamma_{11}^{(0)})^2 + \ldots + (\gamma_{11}^{(s-1)})^2\right] + \sigma_2^2\left[(\gamma_{12}^{(0)})^2 + \ldots + (\gamma_{12}^{(s-1)})^2\right] \end{aligned}$$

$$\begin{aligned} Var(Z_{2t+s} - \hat{Z}_{2t+s|t}) &= \sigma_2^2(s) \\ &= \sigma_1^2[(\gamma_{21}^{(0)})^2 + \ldots + (\gamma_{21}^{(s-1)})^2] + \sigma_2^2[(\gamma_{22}^{(0)})^2 + \ldots + (\gamma_{22}^{(s-1)})^2] \quad (3.21) \\ &= \sigma_1^2\left[(\gamma_{21}^{(0)})^2 + \ldots + (\gamma_{21}^{(s-1)})^2\right] + \sigma_2^2\left[(\gamma_{22}^{(0)})^2 + \ldots + (\gamma_{22}^{(s-1)})^2\right] \end{aligned}$$

The proportion of the variances of the forecast error $\sigma_1^2(s)$ and $\sigma_2^2(s)$ of equations (3.20) and (3.21) due to shocks in μ_1 and μ_2 for Z_{1t+s} and Z_{2t+s} are given respectively by:

$$\rho_{1,1}(s) = \frac{\sigma_1^2[(\gamma_{11}^{(0)})^2 + \ldots + (\gamma_{11}^{(s-1)})^2]}{\sigma_1^2(s)} \quad (3.22)$$

$$\rho_{1,1}(s) = \frac{\sigma_1^2[(\gamma_{11}^{(0)})^2 + \ldots + (\gamma_{11}^{(s-1)})^2]}{\sigma_1^2(s)} \quad (3.23)$$

$$\rho_{2,1}(s) = \frac{\sigma_1^2[(\gamma_{21}^{(0)})^2 + \ldots + (\gamma_{21}^{(s-1)})^2]}{\sigma_2^2(s)} \quad (3.24)$$

$$\rho_{2,2}(s) = \frac{\sigma_2^2[(\gamma_{22}^{(0)})^2 + \ldots + (\gamma_{22}^{(s-1)})^2]}{\sigma_2^2(s)} \quad (3.25)$$

4.4 Identification of the SVAR Model

In the modelling of *SVAR*, the choice of information set is essential. Given the over parameterization problem of *VAR* models, a small information set is paramount utility. Accordingly, the need to achieve meaningful results requires the information set to include variables that summarise the main features of the financial system being studied. The choice of variables in the information set is therefore guided by considerations of the institutional features of the Nigerian financial system which include the *CBN*, the money market, the bond market and the bank loan market. The initial contemporaneous identification structure of the *SVAR* model resides in the innovations to the monetary policy rate of the *CBN* which provides an acceptable measure of monetary policy shocks because the *CBN* implements monetary policy actions directly through changes in the monetary policy rate of interest. So, taking after Bernanke and Blinder (1992) and Sims (1992), this paper identifies monetary policy shocks as the innovations in the *MPR* equation of the *SVAR* model. This implies that the contemporaneous values of the other rates are not in the information set of the *CBN* when monetary policy decisions are made. This does, however, not imply that the *CBN* does not look at the development of the other interest rates when forming monetary policy. It only implies that the *CBN* does not respond contemporaneously to shocks to these rates. This could be due to the high frequency noise in these market rates. Thus, the *CBN* only reacts to lower frequency movements in these rates, as summarised by its lags in the policy equation (see Evans and Marshall, 1998).

4.5 Methodology

This paper employs the time series econometric techniques in order to quantify the relationship between stock market performance and the *CBN* monetary policy rate of interest in Nigeria. We indeed utilized *Phillips and Peron and the Augmented Dickey-Fuller (ADF)* tests to examine the presence or otherwise of unit roots in the variables. *ADF* test is an extended version of the original test of Dickey and Fuller (1979) to control for the serial correlation of the error term (Dickey and Fuller, 1981). Mutually, the Phillips-Perron (PP) test due to Phillips and Peron (1988) and the *ADF* unit root tests consider a model of following form:

$$\Delta Y_t = \omega + \varphi Y_{t-1} + \beta t + \sum_i^k \delta_i \Delta Y_{t-1} + \varepsilon_i \qquad (3.26)$$

Where, ΔY is the first difference time series variable and ε is a white noise error term. Testing modus operandi lies on the assessment of the null hypothesis that $\varphi = 1$. In order to examine the long-term relationship between the stock market performance variable and the monetary policy rate, we employ the Johansen co-integration test. Johansen co-integration testing method is based on a following model (Johansen, 1988, 1991).

$$\Delta Y_t = \sum_{i=1}^{q-1} \Pi_i \Delta Y_{t-1} + \Pi_q Y_{t-q} + \upsilon_t \qquad (3.27)$$

Where, Y is an $(n \times 1)$ vector of variables, Π_q is a $(n \times n)$ matrix of rank $r \leq n$, υ is an $(n \times 1)$ vector of residuals. We test for null hypothesis of $H_0 : \Pi_q = \omega\varphi'$. Where ω represents speed of adjustment parameter and φ incorporates r co-integration vectors. To examine any short run causal relationship between stock market performance and the *CBN* policy rate of interest, we use Granger causality test. If we assume two time series variables *X* and *Y* which are *I (1)* and co-integrated, Granger causality test is based on following equations.

$$\Delta X_t = \alpha_X + \sum_i^k \varphi_{X_i} \Delta X_{t-1} + \sum_i^k \delta_{X_i} \Delta X_{t-i} + \theta_X ECT_{X,t-i} + \ell_{X,t} \qquad (3.28)$$

$$\Delta Y_t = \alpha_Y + \sum_i^k \varphi_{Y_i} \Delta Y_{t-1} + \sum_i^k \delta_{Y_i} \Delta X_{t-i} + \theta_Y ECT_{Y,t-i} + \ell_{Y,t} \qquad (3.29)$$

Where, ΔX and ΔY are the first differences of the variables, ϕ_X and ϕ_Y are the parameters of the error correction term *(ECT)*. The *ECT* measures the error correction mechanism that drives the X and Y back to their long run co-integration equilibrium relationship. We tested the following hypothesis:

$$H_0 : \sum_i^k \delta_{Y,_i} = 0$$

$$H_1 : \sum_i^k \delta_{Y,i} \neq 0$$

Further, we utilized the impulse response function *(IRF)* to trace the dynamic interaction between stock market capitalization and the *CBN* monetary policy rate via the responses of *MPR* due to one unit shock to *SMAP* in the model. Each impulse response can be interpreted as a time specific partial derivatives of the vector moving average function (Enders, 1995).

$$\phi_{jk}(i) = \frac{\partial Y_{ji}}{\partial \varepsilon_k}$$

Where, Y_{ji} is a vector moving average function and $\phi_{jk}(i)$ measures the change in the *jth* variable in the t^{th} period due to a unit shock to the k^{th} variable in the current time period. The E-views econometric software package is utilized in estimate the parameters of the structural *SVAR* model.

5 Econometric Analysis

The unit root tests results are shown in *Appendix A.* According to the results, stock market capitalization and the *CBN* monetary policy rate are trend stationary. The Johansen co-integration test results with an intercept and a linear deterministic trend in the data are as reported in *Appendix B.* According to the results, the null hypothesis of nil co-integration between the *CBN* monetary policy rate and stock prices in Nigeria is rejectable. The trace statistics (79.563), (68.432) and (39.245), maximum eigenvalue statistics (55.357), (45.635) and (23.925) were each greater than the 5 per cent and 1 per cent critical values. Therefore, there is evidence of co-integrating relationship between the level series data. It is therefore evident that even though the level series are integrated, that is, *I(1),* a linear combination of these *I(1)* variables becomes *I(0)* when the variables are co-integrated. This indicates stationary long run equilibrium between stock market performance and the short term monetary policy rate of the *CBN*. Pair-wise Granger causality test are as shown in *Appendix C*. The results indicate that causality is evident in the reverse direction. The results show a positive co-movement between stock market performance and the short term monetary policy rate. The *F-statistic* for the test of causality running from stock market performance to the *CBN* short term policy rate at one lag length is 13.562 with a significant probability value of 0.000. Also, the F-statistic for the test of causality running from *CBN* short term policy rate to stock market performance is 10.7856 with a probability value of 0.000. Same analysis holds for the estimates at lag two, through to nine. At one through to nine lags, significant bi-directional causality is found at the 5 per cent and 1 percent levels of statistical significance. In other words, the *CBN* monetary policy rate Granger causes the performance of the Nigerian stock market and stock market performance also Granger causes the *CBN* monetary policy rate. The *CUSUM and CUSUMSQ* test are shown in *Appendix G* shows stability of results as line are inside the unit cycle indicating correct specification of the model. Having established that stock market performance and the short term monetary policy rate of the *CBN* are co-integrated, the *IRF* of the *SVAR* model was estimated in order to trace out dynamic response of stock market performance and the *CBN* policy rate owing to the unanticipated shocks. The impulse response functions of the *SVAR* analysis are shown in *Appendix J*. The analysis of the impulse response functions (*IRF)* reveals significant negative impact on stock market performance as a result of a shock to the *CBN* short term interest rate. This result is consistent with theoretical prediction. The crux of the analysis is that stock market performance gradually declines given the incessant rise in the *CBN* policy rate of interest. In effect, a shock to the *CBN* policy rate has negative effect on stock market performance. Similarly, the *CBN* monetary policy rate falls subsequent to a shock in the performance of the stock market for the first two days and thereafter t increases for three days before finally stabilizing for the remaining days. In sum, a shock to a stock exchange market impact negatively on the *CBN* policy rate and also a shock to the *CBN* policy interest rate impact negatively on the performance of the Nigerian Stock Market. Empirical finding to reckon with is that there is an inverse relationship between stock market and the *CBN* monetary policy rate.

6 Conclusion

This paper sheds light on the interactions between stock market performance and the monetary policy rate of *CBN* in Nigeria. The study found a negative relationship between stock market performance and short term *CBN* monetary policy interest rate. The relationship is dynamic. By implication, if the *CBN* monetary policy rate was high, investors would move from high risk stock market to invest in low risk bank deposits while, if the *CBN* policy rate is low, investors may prefer to invest in the stock exchange market. In reality, the short term *CBN* monetary policy rate has not significantly reduced inflation rate in Nigeria. It has also had little impact on both savings and lending rates. As at today, savings and term deposits attract two to three per cent per year, while commercial banks lending rates exceed twenty per cent. As it were, no meaningful result has been achieved from the incessant adjustment of short term *CBN* monetary policy rate especially when the superlative structure of the Nigerian banking system is yet to be attained, where no bank could influence the market. For example, in Nigeria where there is excess liquidity in the banking sector as a whole more of the liquidity is concentrated in few banks. Given the peculiarities of Nigerian economy, hikes in the short term *CBN* monetary policy rate might be counterproductive. The soaring rate of the *CBN* is amplifying fears in some quarters of the country that the reform measures currently being implemented by the *CBN* may soon run into a hold-up since bank loans are gradually being priced out of the reach of most economic operators in the economy. Therefore, additional practical measures to enhance the performance of the Nigerian Stock Exchange should be implemented.

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References

[1] M. Alam, and G. S. Uddin, Relationship between interest rate and stock price: empirical evidence from Developed and Developing Countries, *International Journal Business & Management*, **43**, (2009),1-9.

[2] L. Arango, A. Gonzalez, and C. Posada, Returns and interest rate: A nonlinear relationship in the Bogota stock market, *Applied Financial Economics*, **12**(11), (2002), 835-42.

[3] O. Aydemir, and E. Demirhan, The relationship between stock prices and exchange rates: evidence from Turkey, *International Research Journal of Finance and Economics*, **23**, (2009),207-215.

[4] J. Campbell, Stock returns and the term structure, *Journal of Financial Economics*, **18**(2), (1987), 373-399.

[5] N.F. Chen, R. Roll, and S.A. Ross, Economic forces and the stock market, *Journal of Business*, **59**(3), (1986), 383-403.

[6] Y.W. Cheung and S. Ng, International evidence on the stock market and aggregate economic activity, *Journal of Empirical Finance*, **5**(3), (1998), 281-296.

[7] D. Tsoukalas, Macroeconomic factors and stock prices in the emerging cypriot equity market, *Managerial Finance*, **29**(4), (2003), 87-9.

[8] D.A. Dickey and W.A. Fuller, Distribution of the estimators for autoregressive time series with a unit root, *Journal of American Statistical Association*, **74**(366), (1979), 427-431.

[9] D.A. Dickey and W.A. Fuller, Likelihood ratio tests for autoregressive time series with a unit root, *Econometrica*, **49**(4), (1981), 1057-1072.

[10] W. Enders, *Applied econometric time series*, John Wiley & Sons Inc., United States, 1995.

[11] M.J. Flannery and C.M. James, The effect of interest rate changes on the common stock returns of financial institutions. *The Journal of Finance,* **39**(4), (1984), 1141-1153.

[12] E.F. Fama and G.W. Schwert, Asset returns and inflation, *Journal of Financial Economics*, **5**(2), (1977),115-146.

[13] W. E. Ferson, Changes in expected security returns, risk, and the level of interest rates, *The Journal of Finance*, **44**(5), (1989), 1191-1217.

[14] K.R. French, G.W. Schwert and R.F. Stanbaugh, Expected stock returns and volatility, *Journal of Financial Economics*, **19**(1), (1987), 3-29.

[15] C. Gan, M. Lee, H.H.A. Yong and J. Zhang, Macroeconomic variables and stock market interactions: New Zealand evidence, *Investment Management and Financial Innovations*, **3**(4), (2006), 89-101.

[16] R. Geske and R. Roll, The fiscal and monetary linkage between stock returns and inflation. *The Journal of Finance*, **38**(1), (1983), 1-33.

[17] G. Gunasekarage, A. Pisedtasalasai and D.M. Power, Macroeconomic influence on the stock market: evidence from an emerging market in South Asia, *Journal of Emerging Market Finance*, **3**(3), (2004), 285-304.

[18] Y. Hsing, Impacts of fiscal policy, monetary policy, and exchange rate policy on real GDP in Brazil: A VAR model, *Brazilian Electronic Journal of Economics*, **6**(1), (2004).

[19] A.K. Husni, Z.S. Walid and J. Mohammad, The relationships between stock market capitalization rate and interest rate: evidence from Jordan,

Perspectives of Innovation in Economics and Business, **2**(2), (2010), 60-66.

[20] S. Johansen, Statistical analysis of co-integration vectors, *Journal of Economic Dynamics and Control*, **12**(2-3), (1988), 231–254.

[21] S. Johansen, Estimation and hypothesis testing of co-integration vectors in Gaussian vector autoregressive models, *Econometrica*, **b**(6), (1991), 1551–1580.

[22] B.J. Lobo, Asymmetric effects of interest rate changes on stock prices, *The Financial Review,* **b**, (2000), 125-144.

[23] R.C. Maysami and T.S. Koh, A vector error correction model of the Singapore stock market, *International Review of Economics and Finance,* **9**(1), (2000), 79-96.

[24] H. Mok, Causality of interest rate, exchange rate and stock prices at stock market open and close in Hong Kong, *Asia Pacific Journal of Management*, **10**(2), (1993), 123-143.

[25] T.K. Mukherjee and A. Naka, Dynamic relations between macroeconomic variables and the Japanese stock market: An application of a vector error correction model, *Journal of Financial Research*, **18**(2), (1995), 223-237.

[26] P. Obuh, Stock market indicators fluctuate further by 0.05%, *Business news*, (January 3, 2011).

[27] E.S. Osuagwu, The effect of monetary policy on stock market performance in Nigeria, (Accessed 21 November 2012), (2009).

[28] P.C.B. Phillips and P. Perron, Testing for a unit root in time series regression, *Biometrika*, **75**(2), (1988),335–346.

[29] S. Poon and S.J. Taylor, Macroeconomic factors and the UK stock market, *Journal of Business and Accounting*, **18**(5), (1991), 619-636.

[30] Poterba, J.M. and L.H. Summers, The persistence of volatility and stock market fluctuations, *The American Economic Review*, **76**(5), (1986), 1142–1151.

[31] A.R. Rahman, N.Z.M. Zidek and F.H. Tafri, Macroeconomic determinants of

Malaysian stock market, *African Journal of Business Management*, **3**(3), (2009), 95-106.

[32] S.A. Ross, The arbitrage theory of capital asset pricing, *Journal of Economic Theory*, **13**(3), (1976), 341-360.

[33] L.P. Samarakoon, Stock market returns and inflation: Sri Lankan evidence, *Sri Lankan Journal of Management*, **1**(4), (1996), 293-311.

[34] G. Wickremasinghe, The Sri Lankan stock market and the macroeconomy: An empirical investigation, *Studies in Economics and Finance*, **28**(3), (2011),179-195.

[35] J. Sanusi, Nigerian's macroeconomic position: controlling the money supply, Paper Presented by the Governor of the CBN at the Meeting of the Honorary Presidential Advisory Council on Investment in Nigeria (HPACI) at Hilton Hotel, Park Lane, London, UK,(2002).

[36] R.J. Sweeney and A.D. Warga, The pricing of interest-rate risk: evidence from the stock market, *The Journal of Finance,* **412**, (1986), 393-410.

Appendices

Appendix A: Unit Root Test Results

Panel A: ADF Unit Root Test Results						
Series	**ADF**	**Critical Value @ 5% (1%)**	**Series**	**ADF**	**Critical Value @ 5% (1%)**	**Remark**
SMC	-1.267	-3.523(-3.927)	Δ *SMC*	-5.829	-3.662(-3.953)	$I(1)$
MPR	-1.556	-3.523(-3.927)	Δ *MPR*	-5.935	-3.662(-3.953)	$I(1)$
ERT	-0.325	-3.523(-3.927)	Δ *ERT*	-6.422	-3.662(-3.953)	$I(1)$
MKP	-2.266	-3.523(-3.927)	Δ *MKP*	-10.245	-3.662(-3.953)	$I(1)$
Panel B: PP Unit Root Test Results						
Series	**PP**	**Critical Value @ 5% (1%)**	**Series**	**PP**	**Critical Value @ 5% (1%)**	**Remark**
SMC	-2.246	-3.768(-4.395)	Δ *SMC*	-10.468	-3.998(-4.528)	$I(1)$
MPR	-2.925	-3.768(-4.395)	Δ *MPR*	-15.926	-3.998(-4.528)	$I(1)$
ERT	-2.564	-3.768(-4.395)	Δ *ERT*	-16.232	-3.998(-4.528)	$I(1)$
MKP	-2.882	-3.768(-4.395)	Δ *MKP*	-25.342	-3.998(-4.528)	$I(1)$

Appendix B: Johansen Co-integration Test Results

Hypothesized No. of CE	Eigenvalue	Trace	Max-eigen	1% (5%) CV	Inference
None**	0.56367	79.563	55.357	39.23 (27.28)	Co-integrated*
At most 1	0.37985	68.432	45.635	28.64 (23.26)	Co-integrated*
At most 2	0.29357	39.245	23.925	22.26 (19.32)	Co-integrated*
* denotes that Trace and Max-eigenvalue tests indicate one co-integrating equation @ both 1% and 5% levels					

Appendix C: Granger causality Test Results

Lag: 1		
Null Hypotheses	F-statistic	Probability
D(LNMPR) does not Granger Cause D(LNSMC)	10.75372	0.0000
D(LNSMC) does not Granger Cause D(LNMPR)	11.00502	0.0000
Lag: 2		
D(LNMPR) does not Granger Cause D(LNSMC)	13.68729	0.0000
D(LNSMC) does not Granger Cause D(LNMPR)	5.38725	0.0000
Lag: 3		
D(LNMPR) does not Granger Cause D(LNSMC)	9.44224	0.0000
D(LNSMC) does not Granger Cause D(LNMPR)	11.19554	0.0000
Lag: 4		
D(LNMPR) does not Granger Cause D(LNSPM)	19.43066	0.0000
D(LNSMC) does not Granger Cause D(LNMPR)	21.45710	0.0000
Lag: 5		
D(LNMPR) does not Granger Cause D(LNSMC)	7.76185	0.0000
D(LNSMC) does not Granger Cause D(LNMPR)	9.42987	0.0000
Lag: 6		
D(LNMPR) does not Granger Cause D(LNSMC)	19.59651	0.0000
D(LNSCM) does not Granger Cause D(LNMPR)	13.40198	0.0000
Lag: 7		
D(LNMPR) does not Granger Cause D(LNSMC)	12.6462	0.0000
D(LNSMC) does not Granger Cause D(LNMPR)	15.7542	0.0000
Lag: 8		
D(LNMPR) does not Granger Cause D(LNSMC)	6.7865	0.0000
D(LNSMC) does not Granger Cause D(LNMPR)	8.9575	0.0000
Lag: 9		
D(LNMPR) does not Granger Cause D(LNSMC)	9.34387	0.0000
D(LNSMC) does not Granger Cause D(LNMPR)	9.57746	0.0000
Note: F-statistics are all significant @ 1% and 5% levels		

Appendix D: Co-integrating Equation

2 Co-integrating Equation(s):		Log likelihood	-811.7277
Normalized co-integrating coefficients (standard error in parentheses)			
SMC	MPR	ERT	MKP
1.000000	0.000000	9.055977	-69.91164
		(1.19219)	(12.9376)
0.000000	1.000000	10.34369	-198.5958
		(3.98235)	(43.2164)
Adjustment coefficients (standard error in parentheses)			
D(SMC)	-1.425819	0.355820	
	(0.43285)	(0.11166)	
D(MPR)	-6.994719	2.860553	
	(1.95186)	(0.50351)	
D(ERT)	0.221016	-0.059685	
	(0.09182)	(0.02369)	
D(MKP)	0.002142	-0.000486	
	(0.00216)	(0.00056)	

Appendix E: Lag Exclusion Wald Test

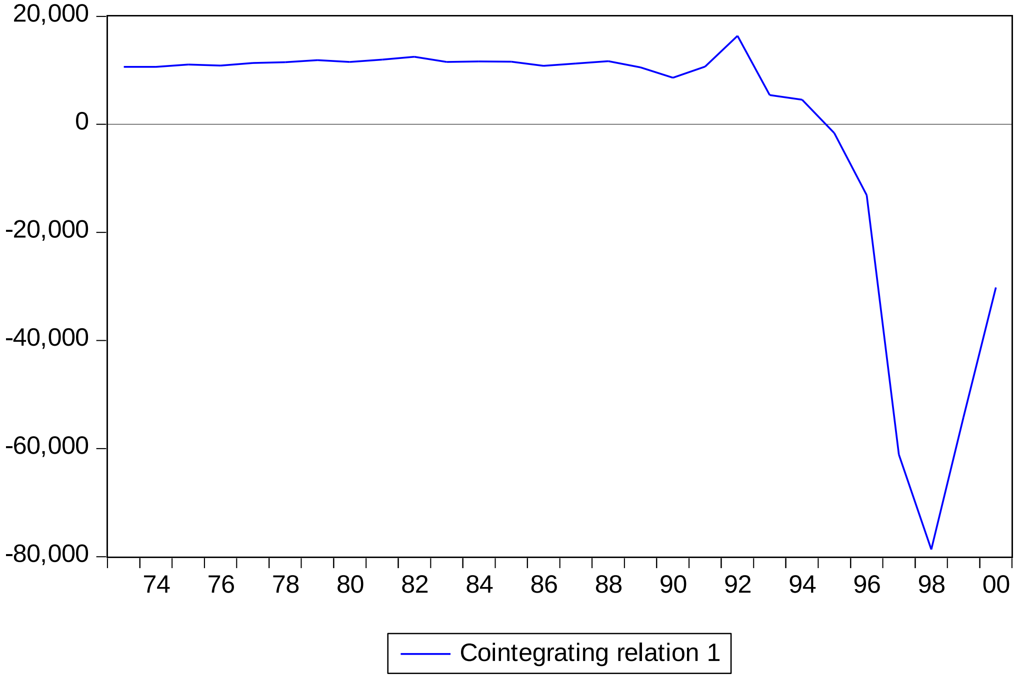
Included observations: 28

Chi-squared test statistics for lag exclusion:

Numbers in [ ] are p-values

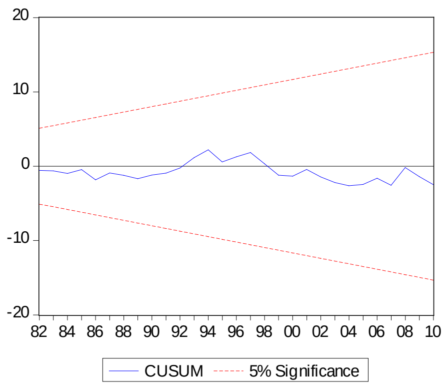
	D(SMC)	D(MPR)	D(ERT)	D(MKP)	Joint
DLag 1	8.996979	91.66470	27.38385	1.464146	224.2825
	[0.061175]	[0.000000]	[1.66e-05]	[0.832973]	[0.000000]
DLag 2	4.441254	53.92528	9.454402	0.829866	65.71155
	[0.349570]	[5.46e-11]	[0.050693]	[0.934400]	[5.55e-08]
df	4	4	4	4	16

Appendix F: Co-integration Graph

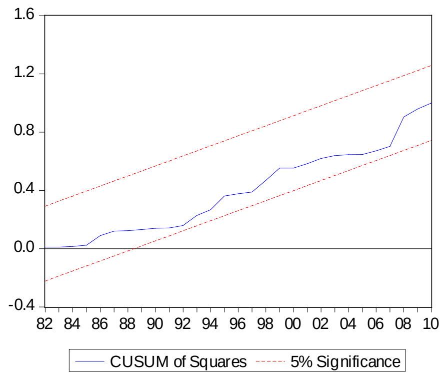


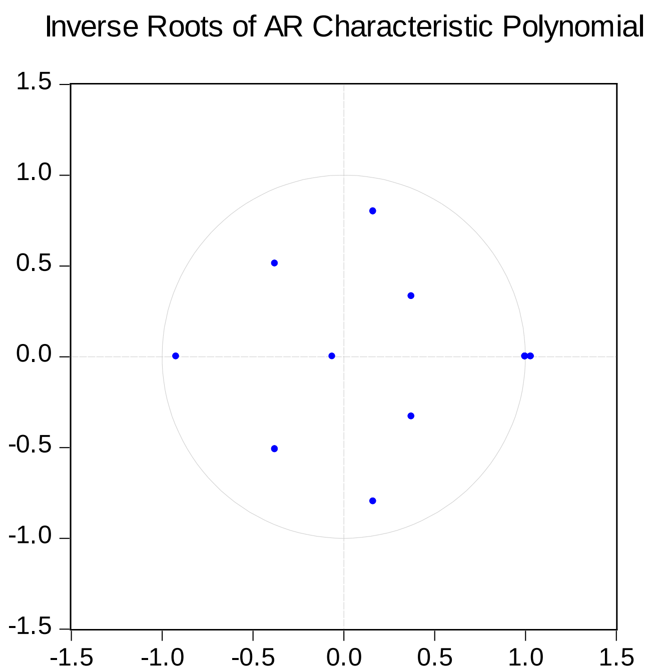
Appendix G: Stability Test Results

CUSUM



CUSUMSQ





Appendix H: SVAR Estimates

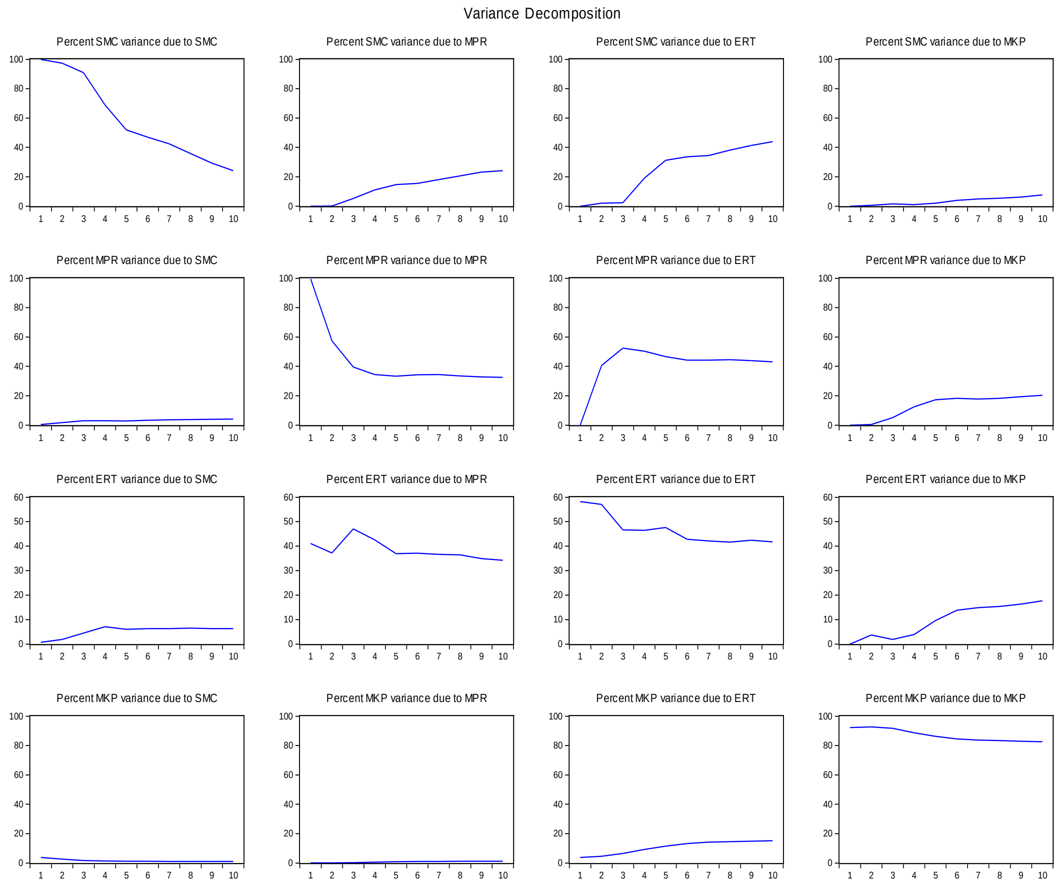
Included observations: 28 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
SMC(-1)	1.000000
MPR(-1)	-0.450875
	(0.08357)
	[-5.39546]
ERT(-1)	4.392268
	(2.50077)
	[3.75636]
MKP(-1)	19.63024
	(8.49702)
	[2.31025]
C	10.77358

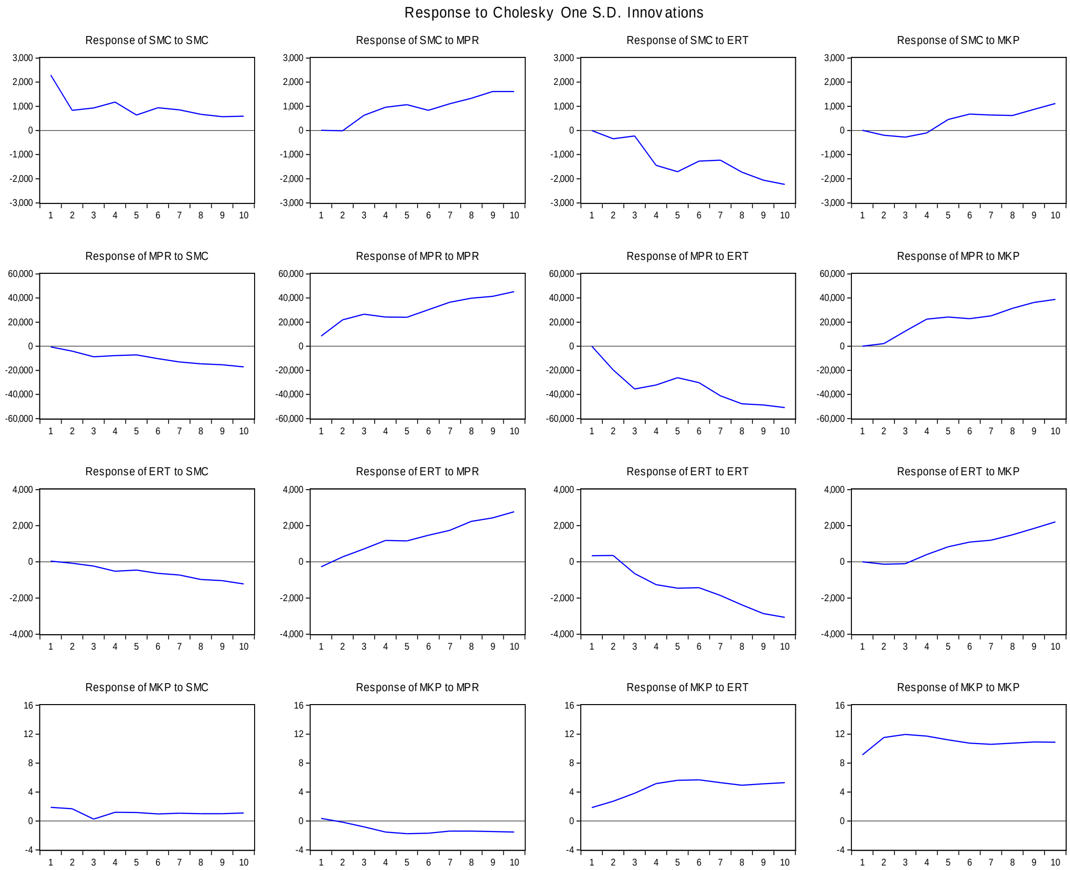
Error Correction:	D(SMC)	D(MPR)	D(ERT)	D(MKP)
CointEq1	-0.132583	-5.673801	0.040958	-2.12E-05
	(0.16483)	(0.60589)	(0.03125)	(0.00068)
	[-9.80434]	[-9.36436]	[1.31068]	[-0.03105]
D(SMC(-1))	-0.479595	4.859656	-0.067439	-0.000291
	(0.30075)	(1.10550)	(0.05702)	(0.00125)
	[-1.59464]	[4.39590]	[-1.18280]	[-0.23363]
D(SMC(-2))	-0.235406	0.869082	-0.030259	-0.000793
	(0.23008)	(0.84573)	(0.04362)	(0.00095)
	[-1.02314]	[1.02761]	[-0.69371]	[-0.83235]
D(MPR(-1))	-0.091699	-2.977481	0.089790	-4.38E-05
	(0.12651)	(0.46502)	(0.02398)	(0.00052)

	[-0.72483]	[-6.40285]	[3.74378]	[-0.08359]
D(MPR(-2))	0.063311	0.277880	-0.012335	-8.14E-05
	(0.05025)	(0.18471)	(0.00953)	(0.00021)
	[1.25988]	[1.50439]	[-1.29480]	[-0.39132]
D(ERT(-1))	-0.349601	-35.72236	-0.033671	0.001252
	(1.01617)	(3.73518)	(0.19264)	(0.00421)
	[-0.34404]	[-9.56375]	[-0.17478]	[0.29763]
D(ERT(-2))	-1.349338	-46.92812	1.085635	0.000352
	(2.01305)	(7.39950)	(0.38163)	(0.00833)
	[-0.67029]	[-6.34207]	[2.84471]	[0.04218]
D(MKP(-1))	-18.96649	339.5760	-14.43581	0.262585
	(58.3534)	(214.493)	(11.0626)	(0.24160)
	[-0.32503]	[1.58316]	[-1.30492]	[1.08686]
D(MKP(-2))	-19.55511	439.1027	-9.555547	-0.004002
	(45.1936)	(166.121)	(8.56776)	(0.18711)
	[-0.43270]	[2.64328]	[-1.11529]	[-0.02139]
C	1920.160	64312.85	-440.2934	5.765288
	(1889.16)	(6944.10)	(358.146)	(7.82166)
	[1.01641]	[9.26151]	[-1.22937]	[0.73709]
R-squared	0.789987	0.945304	0.943072	0.557212
Adj. R-squared	0.664981	0.917955	0.914608	-0.394181
Sum sq. resids	94773256	1.28E+09	3406178.	1624.598
S.E. equation	2294.598	8434.390	435.0082	9.500287
F-statistic	2.081528	34.56549	33.13223	0.318068
Log likelihood	-250.2174	-286.6667	-203.6548	-96.58164
Akaike AIC	18.58696	21.19048	15.26106	7.612974
Schwarz SC	19.06274	21.66626	15.73685	8.088761
Mean dependent	426.8393	10713.24	501.2786	6.464286
S.D. dependent	2676.439	29446.17	1488.640	8.351013

Appendix I: Structural Variance Decomposition



Appendix J: Structural Response Functions



Appendix K: Trend Plots