Reactions of stock market to monetary policy shocks during the global financial crisis: the Nigerian case

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Reactions of Stock Market to Monetary Policy Shocks during the Global Financial Crisis: The Nigerian Case

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Abstract

This paper seeks to assess the reactions of Nigeria's stock market to monetary policy innovations during the period of global financial crisis on the basis of monthly data over the period January, 2007 to August, 2011. In particular, stock market return was regressed against major monetary policy instruments; money stock (M_1, and M_2) and monetary policy rate (MPR). The theoretical basis for the paper stems from the works of new classical macroeconomics, rational expectation hypothesis. Lucas (1972) postulates that the unanticipated and not anticipated monetary shock influences real economic activity. Using the GARCH by developed Engle and Bollerslev (1986) and EGARCH by Nelson (1991) methodologies, the paper empirically assessed the impact monetary policy innovations exerts on stock returns in the Nigeria's Stock Exchange (NSE) market during the period of the crisis. Results from the empirical analysis revealed that the unaticipated component of policy innovations on M_2 and MPR exerts distabilizing effect on NSE's returns, whereas the anticipated component does not. This lends support to the REH argument for the Nigerian stock market. The pqper strongly recommends realistic and timely policy pronouncements by the MPC to achieve stability in the market.

JEL Classification: E44, E52, G01

Key Words: Monetary Policy, GARCH, EGARCH, Rational Expectation Hypothesis.

1.1 Introduction

Among others, the mandate of the Central Bank of Nigeria (CBN) is the promotion of monetary and price stability and a virile financial system. Achieving these would entail the use of wide range of instruments at the disposal of the CBN such as the monetary policy rate, open market operations through buying and selling of government securities and changes in monetary aggregate; narrow and broad money, CBN certificates, special Nigerian treasury bills (NTBs), discount window operations, repurchases transactions (repo) bills discounting, pledges and open buy back (OBB). The overall aim is to maintain a favorable and conducive environment for economic growth and development.

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Literature a bound on the link between monetary policy and other broad macroeconomic aggregates; output, employment, prices, exchange rates, balance of payments, and the like. Equally, there is a strong connect between stock market performance and sound financial system, which monetary policy seeks to create. The theoretical basis for this stems from the works of new classical macroeconomics, *rational expectation hypothesis (REH)*, in the early 1970s. The hypothesis according to Lucas (1972) postulates that unanticipated, and not anticipated monetary shocks can influence real economic activity. The anticipated component according to him would be rationally taken into account by economic agents in their decision making, and hence will evoke no effect on output and employment. In a way, the hypothesis supports the neutrality[2] of anticipated monetary shock. Early investigations in the area started with the works of Blanchard (1981) and Svensson (1986) on the theoretical analyses of stock market response to monetary shocks using rational expectations models with sticky goods prices and flexible asset prices. A classic empirical study by Kuttner (2001) verified the effect of unanticipated changes in the US policy rate on financial variables in line with rational expectations arguments and discovered it had no impact. Other empirical studies focusing on stock market response to monetary shocks, report that a 25-basis point increase in the Fed funds rate is associated with an immediate decrease in broad US stock indices that ranges from 0.6 to 2.2 percent, sample size and estimation method aside; Craine and Martin (2004), Rigobon and Sack (2004), Bernanke and Kuttner (2005) and Bjornland and Leitemo (2009). Earlier, Christiano et al. (1999) carried out an extensive survey of empirical studies on the effect of monetary policy shocks on macroeconomic variables. Juat-Hong (2009) reveals that only the anticipated component of money supply shock affects the volatility of equity returns in Malaysian market but the unanticipated components do not.

1.2 Background of the Study

Monetary policy management is a routine thing, while the desire to attain a specific macroeconomic objective often conflicts with the attainment of other competing objectives. It is,

[2] The proponents of *neutrality* of money ague that a change in the stock of money affects only nominal variables in the economy such as prices, wages and exchange rates but no effect on real (inflation-adjusted) variables, like employment, real GDP, and real consumption. The term was originally coined by Friedrich Hayek (1933), and then later the Keynesian economists.

therefore difficult, especially given the above theoretical underpinning, to disentangle the conduct of monetary policy from events in the economy at large and to the Nigerian Stock exchange market (NSE) in particular. More profoundly, this is when the permutations coincides with a particular episode – the global financial crisis. The impact of the crisis on the financial sector of the economy in general and the NSE in particular was limited, largely owing to the low level of financial integration with the global economy was not felt until the third quarter of 2008. The market, however, had a breeze of life during the banking sector consolidation/ recapitalization which started in 2005 and up until 2008. Thus, the market experienced sustained increase in stock prices with investors reaping tremendous profits[3].

The advent of the crisis rattled the market and caused the market indices to crash. Evidences, for instance, from the market show that market capitalization (MC), which stood at 10.18 trillion Naira in the year 2007 dropped to 6.96 trillion in 2008 and further down to 4.99 in 2009. This heaved up in 2010 to 6.29 trillion. In similar vein, the All-Share index (ASI), which was 57,990.12 Naira in 2007, dropped to 31,450.78 and 20,827.17 in 2008 and 2009, respectively, and eventually picked up at 25,861.93 in the year 2010. Policy responses during the turmoil by the NSE and regulators like the Securities and Exchange Commission (SEC) were: review of trading rules and regulations, delisting of some 19 moribund companies. The corporate governance framework was also strengthened in both the NSE, and the regulator, SEC, market signals were sharpened and standards were raised.

In what seems to be a bail out attempt by the CBN and the Bank of industry (BOI), a number of schemes and revival funds were established for revitalization of the real sector of the economy. For instance, N200 and N300 billion were raised through debenture stock issued by the BOI for restructuring and refinancing of small and medium scale enterprises (SMEs) and as intervention fund in the power and aviation industries. Similarly, the CBN in collaboration with affected ministries packaged credit guarantee schemes in the areas of agriculture, SMEs and Textile

[3] Aliyu, S. U. R. (2009) "Stock Prices and Exchange Rate Interactions in Nigeria: A Maiden Intra-Global Financial Crisis Investigation", The Icfai University *Journal of Financial Economics*, Vol. VII, Nos. 3 & 4, pp. 5 – 17.

industries in the country to the tune of N500 billion. Last not the least, the CBN injected N620 billion into 10 ailing banks in June, 2009 as a long-term capital loan at 11.0 percent and later 8.0 percent to ease illiquidity in the banks. Given the magnitude and short span of the intervention – between early 2009 and 2010, the combustion and meltdown in the global economy, the combined effects of these policy interventions, no doubt pose a serious monetary policy challenges, especially to the CBN and the specific implications for the NSE.

Macroeconomic indicators such as the level of foreign reserves, for instance, dramatically went down due to large scale monetization of the economy due to shortfall in the level of oil revenues. The reserve, which stood at $62.08 billion as at September, 2008, before the crises, dropped to $42.4 billion as at December, 2009. The exchange rate, which has a strong tie with stock market, which hitherto remained stable at N116.20, depreciated by up to 12.95%, that is, N131.5 in December, 2008. Although the CBN returned to the Retail Dutch Auction System (RDAS), yet the exchange rate keeps on depreciating. It stood at N162.00 in June, 2010. This was largely due to mounting pressure from the demand side.

The broad money supply, M_2 was equally expanded through the indirect instruments in order to ease pressure on both money and capital markets in the economy. According to the CBN (2010), the persistence of illiquidity in the banking system against the backdrop of global financial crises, prompted the adoption of far-reaching liquidity enhancing measures by the monetary authorities. The combined effects of a cut in the liquidity ratio from 40 percent to 30 percent, reduction in monetary policy rate to 9.75 percent from 10.25 percent, cash reserve ratio to 2 percent from 4 percent and open market operations (OMO) by the CBN, for instance, led to the growth in the reserve money above the benchmark level by 3.9 percent, that is, from N1,606 billion to N1,668 billion, in 2009. Consequently, the policy induced monetary expansion resulted in an end of year inflation rate of 13.9 percent in 2009, which noentheless, is slightly lower than 15.1 percent recorded a year before. The rate, however, fluctuated between 12.9 and 15.6 percent in 2010.

Given these developments, evaluating and discerning the effects of monetary policy on stock markets is important to monetary authorities for many reasons. This study adopts a micro-level approach by examining the roles of smoothed and cyclical monetary shocks on stock returns and volatility of the NSE. This is useful in the following areas:

- It helps in better understanding of the effects of anticipated and unanticipated policy shocks on stock returns and volatility. This lend support to the relevance of the so called "stock market channel" of the monetary transmission mechanism – see Chami, Cosimano and Fullerkamp (1999).
- The study moves away from the traditional approach adopted by most empirical studies of using output or employment by using stock returns and volatility as a measure of economic activity.
- In line with standard life cycle and permanent income models, stock can affect households' consumption; reason because assets are components of life time wealth. The effect is larger in those countries where stock ownership is higher among household.
- Lastly, results will help to determine whether monetary policy shocks favorably supports stability of the NSE.

Against this background, this paper seeks to assess the reactions of the Nigeria's stock market retuens to monetary policy innovations during the period of global financial crisis. The empirical analysis covers the period of January, 2007 to August, 2011, which incorporates not only the global financial crisis era, but, post banking sector consolidation era, as well. The *before-after* approach employed by the paper allows for the effect to be tracked up to and after the global financial crisis, while at the same time yielding a reasonable sample for the kind of methodology employed. The variables of interest are the stock market returns, M_1, and M_2 money supply aggregates and the monetary policy rate (MPR). The rest of the paper is structured as follows. The next section, which follows the introduction, provides short survey of related theoretical and empirical literature on the link between monetary policy shocks and stock market responses. Section three discusses the methodology of the paper while section four contains the empirical results and discussions. Lastly, section five summarizes and concludes the paper.

2.1 Theoretical and Empirical Evidences

In recent times, the relationship between monetary policy and asset prices has attracted considerable attention among researchers and policymakers. Academics and policymakers alike have debated whether monetary policy should respond to developments in financial markets – see Bernanke and Gertler (2000) and Rigobon and Sack (2001), and when it does, the extent to which such swings might have been caused by monetary policy itself. To understand all these, a strong theoretical underpinning becomes very necessary. Chami, Cosimano and Fullerkamp

(1999), for example, suggest the existence of a stock market channel of monetary policy besides the traditional interest rate and the credit channels. In their view, inflation induced by monetary expansion reduces the real value of the firms' assets which acts as a tax on capital stock. This could be viewed from two perspectives: first, the real value of the flow of dividends is reduced with higher inflation, and second, dividends are reduced because higher inflation reduces the supply of labor, and hence fall in production. The traditional interest rate channel was also equally investigated by Bernanke and Blinder (1992), Thorbecke (1997) and Rigobon and Sack (2003).

Alternatively, the discounted cash flow model argues that stock prices are equal to the present value of expected future net cash flows. A model by Campbell (1991) applied by Bernanke and Kuttner (2005), showed that a surprise increase in the MPR decreases stock prices in three ways: (i) decreasing the expected future dividends, (ii) increasing the future risk-free rate (iii) increasing the equity premium (above the risk free rate) required to hold equities. Monetary policy should, thus, play an important role in determining equity returns either by altering the discount rate used by market participants or by influencing market participants' expectations of future economic activity. In this regard, restrictive monetary policy is associated with lower stock prices given the higher discount rate for the expected stream of cash flows and/or lower future economic activity, while expansionary policy is commonly viewed as good news because it is usually associated with low interest rates, increases in economic activity and higher earnings for the firms in the economy. A study by Fair (2002) showed that one-third of the changes in the equity prices are associated with news on monetary policy.

From the foregoing, the impact of monetary policy shocks on stock prices during crisis can be different in a number of direct and indirect ways – Pennings, Ramayandi and Tang (2011). A rise in the MPR, which leads to first round falls in stock prices, they argued could lead to a second round of selling induced by margin calls. Mishkin (2009) found that a cut in the MPR during crisis leads to a larger-than-normal rise in expected future dividends, and hence a larger-than-normal rise in stock prices. Conversely, when MPR cuts are passed on to firms, then the effect of policy on future profitability is weaker, and so policy changes during the crisis have smaller effect on stock prices. However, policy announcements that involve keeping the rates lower for longer period during crisis, such as in the US during the global financial crisis, may reduce the expected risk free rate by more than is normally expected. Mishkin (2009) further argued that a change in MPR may also have a stronger effect on risk premia during crisis and this concurs with the earlier study by Bernanke and Kuttner (2005) for the US economy.

Another important channel of monetary policy transmission identified in the literature is expectation or perception of economic agents on the actions of the monetary authorities. Monetary shocks could influence expectations about the future course of real activity – labor income, unemployment, sales and profits, in the economy, and the confidence with which those expectations are held (in addition to the inflation expectations already mentioned). The direction in which such effects work is hard to predict, and can vary from time to time. A rise in the monetary policy rate (MPR) could, for instance, be interpreted as indicating that the monetary policy committee (MPC) believes that the economy is likely to be growing faster than previously thought, giving a boost to expectations of future growth and confidence in general. In contrast, same could be interpreted as signaling that the MPC recognizes the need to slow the growth in the economy in order to hit the inflation target, and this could dent expectations of future growth and lower confidence. Jensen and Johnson (1995) demonstrated that monetary policy developments are associated with patterns in stock returns. They showed that long-term stock returns following discount rate decreases are higher and less volatile than returns following rate increases. Their study builds on Waud's (1970) suggestion that discount rate changes affect market participants' expectations about monetary policy. In line with the earlier argument by the rational expectation model, this paper seeks to distill the effect of monetary policy shocks into anticipated and transitory components.

From the empirical corridor, a number of studies have applied different methodologies to assess the effects of monetary policy shocks on stock market returns volatility. Jensen, Mercer and Johnson (1996) suggested that monetary environment affects investors' required returns. See also Fama and French (1989), Jensen et al. (1996), Booth and Booth, 1997). Other empirical studies indicated an asymmetry between business conditions and stock returns; business conditions could predict future stock returns only in periods of expansive monetary policy. Relating this to the US stock market, Conover, Jensen and Johnson (1999) argued that not only the US stock returns, but also returns on foreign markets hinge with the US monetary environments (as well as their local monetary environment). They found that stock returns in twelve OECD countries over the period 1956-1995 are generally higher in expansive US and local monetary environments than they are in restrictive environments.

Thorbecke (1997) using a VAR methodology found that that monetary policy shocks have a greater impact on smaller capitalization stocks, which is in line with the hypothesis that monetary policy affects firms' access to credit (see Gertler and Gilchrist, 1993). Furthermore, he showed that expansionary monetary policy exerts a large and statistically significant positive effect on monthly stock returns. Similarly, Cassola and Morana (2004) applied the cointegrated VAR system which includes real GDP, inflation, real M_3 balances, short term interest rate, bond yield, and real stock prices to examine the transmission mechanism of monetary policy in the Euro area. Their results from impulse response analysis indicate that a permanent positive monetary shock has a temporary positive effect on real stock prices.

Chiang and Chiang (1996) examined the impact of predicted money growth volatility, predicted real output volatility, predicted exchange rate volatility and predicted US stock market volatility on the market volatility of Canada, Japan, United Kingdom and Germany markets. Their findings showed that only the US market volatility has a significant positive impact on the four countries' stock return volatility. Kearney and Daly (1998) presented evidence that the conditional volatility of interest rate and inflation are directly related to the Australian stock market volatility whereas money supply, industrial production and current account deficit are indirectly related to the market's stock volatility. Money supply was found to be the most significant variable in the model. Moreover, Beltratti and Morana (2006) explored the casual linkages from macroeconomic volatility to stock market volatility. They reported that a prolonged period of high stock market volatility during the phase of economic growth is associated with an increase in money growth volatility.

Empirical findings by Farka (2008) indicated that an unanticipated rise in policy rate by 1 percent causes a decline of around 5.6 percent in stock returns. This exceeds the typical estimates of 2.5 – 4 percent found in previous studies (see, for example, Jensen, Johnson, and Mercer

(1996), Reinhart and Simin (1997), Thorbecke (1997), Fair (2002), Jensen and Mercer (2002), Rigobon and Sack (2004), and Bernanke and Kuttner (2005)). Farka (2008) further showed that policy shocks have a significant impact on the conditional volatility of stock returns with the latter displaying a tent-shaped pattern, that is, abnormally low several hours before announcement — *calm-before-the-storm-effect,* increasing significantly during the announcement period, declining steadily while still remaining elevated after the announcement, and continuing to decrease on the day following the policy release. See also Lobo (2000, 2002) and Bomfim (2003) who report similar volatility pattern using a daily data on

A more recent study by Abdul Qayyum and Anwar (2011) showed that markets returns in Pakistan are not only affected significantly by its lag, but, by monetary policy via variations in the repo rates. An increase (decrease) in the repo rates, indicating a monetary policy tightening (expansionary), according to them decreases (increases) the returns to the stock market. This implies that the monetary policy has a positive impact on the volatility of the stock market.

3.1 Methodological Issues

GARCH models are the most widely used statistical models to describe the unique features of financial markets; volatility clustering, leptokurtic and asymmetry of the stock return distribution. Derived from the work by Engle (1982), Autoregressive Conditional Heteroscedasticity models (ARCH) explains the effects of previous error terms to the conditional variance of current term. Later Bollerslev (1986) extended the concept of ARCH models to General Autoregressive Conditional Heteroscedasticity (GARCH) models which broaden the sources of current conditional variance to both previous error terms and previous conditional variance.

However, GARCH models cannot capture the leverage or asymmetric effect. As a result, several asymmetry GARCH models were developed among which the exponential GARCH was introduced by Nelson (1991). The EGARCH model incorporates the asymmetric or leverage effect[4] and specifies the conditional variance in the logarithmic form. This paper, which seeks to assess the response of stock returns to monetary innovations, applied both the GARCH and the

[4] *Leverage effect*: the tendency for volatility to rise more following a large price fall than following a price rise of the same magnitude, (Brooks, 2008)

GARCH and EGARCH methodologies. Meanwhile, in line with the applications by Aliyu (2009) and Juat-Hong (2009) the paper employed the Hodrick-Prescott filter (HP) to disaggregate the monetary policy instruments; M_1, M_2 and MPR, into trend (anticipated) and cyclical (unanticipated) components. Ash, et al (2002) evaluated the usefulness of the Hodrick-Prescott filter as a proxy for rational expectation. Their study concluded that although the HP series are not fully rational in the sense of Muth (1961), but they do meet the criterion of "weak rationality". The Augmented Dickey-Fuller (ADF) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit root test were applied to assess the time series properties of the variables.

3.1.1 Generalized Autoregressive Conditional Heteroskedasticity (GARCH)

The GARCH model of the Bollerslev (1986) allows for the conditional variance to depend on past information and, therefore, vary over time. Thus, the conditional variance is predicted by past forecast errors and past variance. GARCH model addresses the issues of heteroskedasticity and volatility clustering, which largely characterize financial time series data. We begin with the simplest GARCH (1, 1) specification:

$$Y_t = X_t{}'\theta + \varepsilon_t \qquad (1)$$

$$\varepsilon_t = z_t\sqrt{h_t} \qquad (2)$$

$$z_t \sim N(0, 1) \qquad (3)$$

$$\sigma_t^2 = \omega + \alpha\,\varepsilon^2_{t-1} + \beta\,\sigma^2_{t-1} \qquad (4)$$

in which the mean equation given in (1) is written as a function of exogenous variables with an error term, which is distributed as z_t given in equation(2). Equation (3) shows that the variance h_t is identically and independently distributed (iid). In this paper, Y_t is the dependent variable and stands for monthly continuously compounding return[5], calculated as: 100 x log (P_t/P_{t-1}), where P_t is the end of month *All Share Price* index in the Nigeria's Stock Exchange. X_t is a *1'k* vector of lagged endogenous variables, that is, the monetary policy variables decomposed into trend and cyclical components, included in the information set. θ is a *k'1* vector of unknown parameters. Summarily, the conditional variance equation specified in (4) is a function of three terms:

- A constant term: ω.

[5] See: Kun, Huang (2011) *Modeling Volatility in S&P 500 Index Daily Returns: A comparison between model based forecasts and implied volatility*, Department of Finance and Statistics, Hanken School of Economics, Vasa

- News about volatility from the previous period, measured as the lag of the squared residual from the mean equation: ε^2_{t-1} (the ARCH term).
- Last period's forecast variance: σ^2_{t-1} (the GARCH term).

σ^2 is measurable with respect to Y_t, which is the monthly stock market returns, $\omega > 0, \alpha > 0, \beta \geq 0$, and $\alpha + \beta < 1$, such that the model is covariance stationary, that is, the first two moments of the unconditional distribution of the return series is time invariant.

3.1.2 Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH)

The EGARCH model unlike the GARCH model imposes no restriction on parameters. The specification for the conditional variance is:

$$ln\,(\sigma^2) = \omega + \beta_j\, ln\,(\sigma^2_{t-1}) + \gamma\left(\frac{u_{t-1}}{\sqrt{\sigma^2_{t-1}}}\right) + \alpha\left(\frac{|u_{t-1}|}{\sqrt{\sigma^2_{t-1}}}\right) \qquad (5)$$

The left-hand side is the *natural log* of the conditional variance. This implies that the leverage, that is, asymmetric effect is exponential, rather than quadratic, and that the forecasts of the conditional variance are guaranteed to be nonnegative. The γ parameter measures the leverage effect, which is usually negative, implying that positive shocks generate less volatility than negative shocks of the same magnitude. This feature sanctions the capture of the sign effect by allowing negative and positive innovations to have different effects on volatility. For instance, when $\gamma = 0$, then the model is symmetric, meaning that negative and positive shocks have the same effect on volatility. When $\gamma < 0$, then positive shocks (good news) generate less volatility than negative shocks (bad news). When $\gamma > 0$, it implies that positive innovations are more destabilizing than negative innovations. Meaning, the anticipated innovations should exert a stabilizing effect on stock volatility and vice versa for unanticipated innovations.

The EGARCH model is more preferred over the symmetrical GARCH model because of its unique advantages. First, since the conditional variance is modeled in the logarithmic form, the variance will always be positive even if the parameters are negative. Second, asymmetries are allowed in the EGARCH. Meaning, if the relationship between volatility and stock returns is negative, the parameter of the asymmetry term, γ, will be negative. Third, the EGRCH, model is stationary and has finite kurtosis if $|\beta| < 1$. Thus, there is no restriction on the leverage effect that the model can represent imposed by the positivity, stationary or the finite fourth order moment restrictions.

4.1 Empirical Results and Discussions

This section presents the results of empirical analysis. As stated earlier, data are monthly from January, 2007 to August 2011, a total of 55 observations. The summary of statistics from preliminary analysis is reported in Table 1.

Table 4.1: Preliminary Data Analysis – Summary of Statistics

Variable / Statistic	Log of Nominal Stock Returns	M_1 Money Stock	M_2 Money Stock	Monetary Policy Rate (MPR)
Mean	-0.8520	15.2501	15.9509	8.0545
Median	-0.8701	15.3244	16.0212	8.0000
Maximum	32.3515	15.5854	16.3325	10.250
Minimum	-36.5883	14.5935	15.1765	6.0000
Std. Dev.	9.62471	0.26015	0.31230	1.6664
Skewness	-0.40314	-0.97269	-0.83937	-0.0964
Kurtosis	7.4815	2.86193	2.59979	1.3646
Jarque-Bera	46.6525**	8.71652*	6.82530*	6.2143*
Probability	0.00000	0.01280	0.03295	0.0447
Ljung-Box (24)	32.470	246.8**	296.89**	319.3**

Notes: ** (*) indicate significance at the 1% and 5% level. The Ljung-Box *Q*-statistic at lag *k* is a test statistic for the null hypothesis that there is no autocorrelation up to order *k*. If there is no serial correlation, the autocorrelations and partial autocorrelations at all lags should be nearly zero, and all *Q*-statistics should be insignificant with large *p*-values.

As can be seen in Table 1, all the series are non-normally distributed. The null hypothesis of normal distribution is rejected for the log of stock returns at the 1% level, and at the 5% level for the rest of the series. The mean and median of log stock return were negative and high at 0.85% and 0.87%, respectively. This suggests that stock returns especially at the beginning of the financial crisis were significantly negative and in line with traditional asset pricing theory, higher average returns either ways – negative or positive, implies larger risk exposure, Su and Fleisher (1998) and Chang Su (2010). Figure 1 further depicts the upheavals in the stock market returns from mid 2008 up to early 2009. The market, however, slowly inched up afterwards. Except the index of nominal stock returns, the rest of the series show evidence of platykurtic distribution with a Kurtosis less than 3.0. The ARCH test carried out using the LB Q-statistic shows evidence of serial correlation at all lag levels at the 1% level.

The ADF and KPSS tests of stationarity showed mixed results. Some series were found to be stationary at level; log of stock returns, M_2 and MPR – although the latter two were at a lower level of significance. All the variables were found to be stationary at first difference at the 1% level for both the ADF and KPSS tests. See appendix 1 for the results.

Figure 1. Log of Stock Returns Volatility

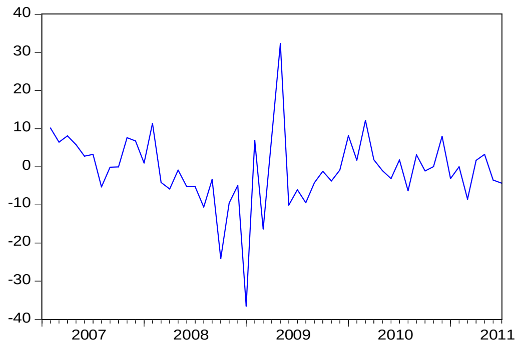


Figure 2. M1 Aggregate - Cyclical Component

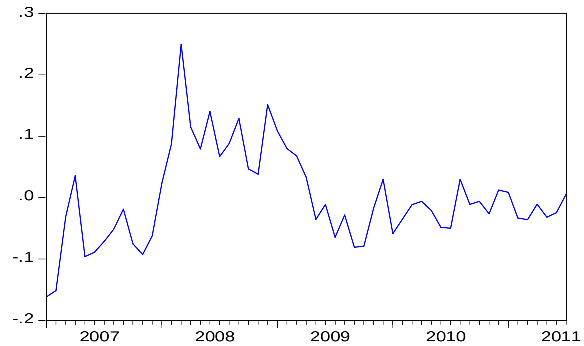


Figure 3. M2 Aggregate - Cyclical Component

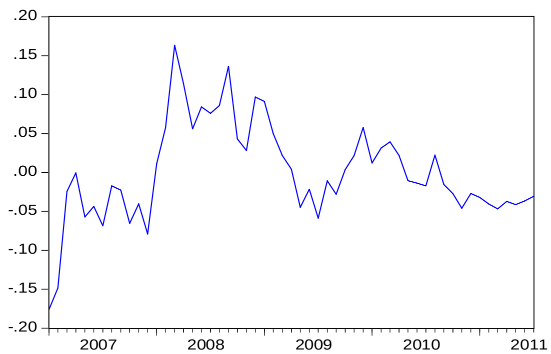
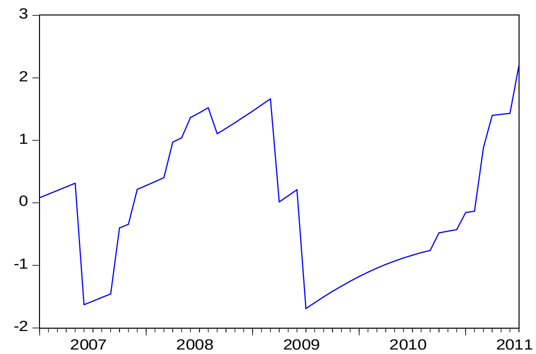


Figure 4. Monetary Policy Rate - Cyclical Component



4.1.1 Evidence of Time-varying Volatility

Table 4.2 presents results of restricted GARCH and EGARCH models. The mean equations for the two models reveal strong and statistically significant coefficients[6]. The intercept of the variance equation, ω representing the long term average is not statistically significant. However, the value of the coefficient of ARCH, information about volatility observed in the previous period, and GARCH, last period's forecast variance, in the GARCH(1,1) model show

[6] Results for the mean equation for all the estimated models – restricted and unrestricted, are not presented here but available with the author upon request.

statistically significant and consistent estimates, implying the presence of both ARCH and GARCH effects. The *Wald* test for volatility persistence, that is, the sum of ($\alpha + \beta$) is above one, indicating that volatility is quite persistent. This is a common result often observed in high frequency financial data and in particular, this confirms volatility persistence in the Nigeria's stock market returns.

Table 4.2: Results of Restricted GARCH and EGARCH Models

	GARCH (1,1)			EGARCH (1,1)		
Variance Equation	Coefficient	Standard Error	Probability	Coefficient	Standard Error	Probability
ω	0.0004	0.0005	0.3813	-3.0652*	1.1474	0.0076
α	0.4137	0.2140	0.0532	0.9827*	0.3357	0.0034
β	0.6309*	0.1877	0.0008	0.3662	0.2586	0.1568
γ				0.5553*	0.2182	0.0109
Diagnostic Test	Coefficient		Probability	Coefficient		Probability
ARCH LM (2)	0.7734*		0.467	0.1882*		0.829
LB Q-stat. (24)	18.619*		0.669	23.359*		0.382
LB Q^2-stat. (24)	17.819*		0.717	33.538		0.055
Jacque-Bera	3.9733*		0.137	1.9814*		0.371
SC	-1.87			-1.74		
LL	61.40			59.93		

* Indicates significance at the 5% or better level.

Similarly, the variance equation for the EGARCH (1,1) model show a strong and statistically significant intercept, and although the GARCH coefficient is not statistically significant, the ARCH and leverage effect coefficients are correctly signed and significant ant the 5 percent or better level. Moreover, the positive sign of the leverage coefficient implies that positive innovations play more significant impact on stock return than negative innovations of the same magnitude. A simple interpretation would be that good macroeconomic policies, stable prices and exchange rate, strong institutions, are better determinants of stock returns as against bad macroeconomic policies, unstable prices and exchange rate and weak institutions. Equally, the *Wald* test reveals very high degree of volatility persistence, that is, larger positive or negative return will lead future forecasts of the variance to be high for a protracted period. The results for instance, suggest that stock return volatility in Nigeria in the current period is explained by the forecast error variance in the GARCH and EGARCH model approximately 63.1 percent and 36.6 percent, respectively. Somewhat similar results using the GARCH model of 60 percent was reported by Aliyu (2010), while using the EGARCH model, Sarmidi (2010) reported a moderate level of 15.3 percent for Nigeria.

To test the robustness of the results, the ARCH effects in the residuals were investigated in the models using the Lagrangian multiplier and the LB (Q) and LB (Q^2) statistics. Results for both GARCH(1,1) and EGARCH(1,1) models indicate that null hypothesis of autocorrelation and partial autocorrelation in the residual is rejected. Furthermore, Jacque-Bera statistic shows that the residuals in the two models are normally distributed. The SC model selection criterion, however, suggests that the GARCH(1,1) model is superior to the EGARCH(1,1) model

4.1.2 Monetary Policy Innovations and Stock Returns Volatility

The paper sets out to assess the responses of stock market response to monetary policy innovations in Nigeria. The methodology employed allowed the effect of monetary policy shocks to be decomposed into two components; anticipated and unanticipated components. Using the M_2[7] money supply and MPR as policy instruments, an unrestricted GARCH and EGARCH models were estimated. Results presented in Table 4.3 show that like its corrollary above, the unrestricted GARCH model has an intercept which is not statistically significant although it maintains a low value. The ARCH and the lagged conditional variance coefficients are statistically significant although the later violates the nonnegative sign restriction imposed by the GARCH model. However, the sum of the two coefficients is less than one (0.9168), suggesting that the model is covariance stationary with high degree of persistence and long memory in the conditional variance.

Evidences further show that the coefficients of anticipated monetary innovations on the MPR and M_2 monetary aggregate are statistically insignificant though the latter is correctly signed. Conversely, the coefficients of the unanticipated components are all statistically significant at the 5 percent or better level. A logical explanation is that that a positive shock (expansioning) on M_2 aggregate which lowers MPR and improves availability of credits would increase the cash-rate in the economy and henceforth, would also raise the speculative behavior of the stock market. Similarly, effect of a positive shock (tightening) on the MPR could trigger higher stock return

[7] M_1 aggregate was dropped because it consistently yields statistically insignificant coefficient, besides, as a narrow measure of money supply, it is not a widely used in policymaking

volatility in the NSE through inflow of financial resources. Furthermore, Campbell (1991) adapted by Bernanke and Kuttner (2005) stated that a surprise increase in the MPR decreases stock prices in three ways: (i) decreasing the expected future dividends, (ii) increasing the future risk-free rate (iii) increasing the equity premium (above the risk free rate) required to hold equities. While the above findings show that a 1 percent change in the policy variables; MPR and M_2 result in 5 basis points and 1.34 percent increases in stock volatility, respectively, Farka (2008) indicated that an unanticipated rise in policy rate by 1 percent causes a decline of around 5.6 percent in stock returns. The range reported in the literature lies between 2.5 and 4 percent.

Relating the findings to the theoretical arguments of the *REH*, it is clear that the smoothed component (anticipated) of M_2 has the expected sign although not statistically significant. However, the coefficients of unanticipated components for both the MPR and M_2 are positive and this suggests that monetary policy shock on either instrument has more destabilizing effect on stock returns than a shock negative of the same magnitude.

Table 4.3: Results of Unrestricted GARCH and EGARCH Models

	GARCH (1,1)			EGARCH (1,1)		
Variance Equation	Coefficient	Standard Error	Probability	Coefficient	Standard Error	Probability
Constant (ω)	0.0058	0.0068	0.3943	-4.6230*	0.8228	0.0000
ARCH (1) (α)	-0.1420*	0.0239	0.0000	-0.7027*	0.0295	0.0000
GARCH (1) (β)	1.0588*	0.0076	0.0000	-0.3655	0.4214	0.3857
Anticipated MPR (ζ)	1.95E-05	0.0001	0.8736			
Unanticipated MPR (λ)	0.0005*	0.0002	0.0298			
Anticipated M_2 (ζ)	-0.0003	0.0004	0.4007			
Unanticipated M_2 (λ)	0.0134*	0.0041	0.0010			
EGARCH (1) (γ)				0.8393*	0.1376	0.0000
MPR (φ)				0.1182*	0.0129	0.0000
M_2 (θ)				0.2073*	0.0000	0.0000
Diagnostic Test	Coefficient		Probability	Coefficient		Probability
ARCH LM (2)	0.1668*		0.8468	1.8794*		0.1637
LB Q-stat. (24)	18.227*		0.6920	18.597*		0.6700
LB Q^2-stat. (24)	10.200*		0.9840	10.576*		0.9800
Jacque-Bera	2.372*		0.3055	1.233*		0.5397
SC	-1.98			-2.17		
LL	72.37			75.45		
DW	2.02			1.62		

***** indicates significance at 5 percent or better level. LB stands for Ljung Box statistic and SC for Schwarz Criterion. SC criterion is superior to the Akaike Information Criterion (AIC) because it imposes a larger penalty for additional coefficients.

Although Juat-Hong (2009) reported negative sign for both cyclical and trend effects using broad and narrow money supply, Abdul Qayyum and Anwar (2011) reported a positive leverage and repo rate effects on stock returns volatility using an EGARCH methodology for Pakistan. Thus, the finding by this paper affirms the argument of the REH that only the unanticipated as against the anticipated monetary shocks influences real economic activity.

Figure 5: Unrestricted GARCH(1,1) Model

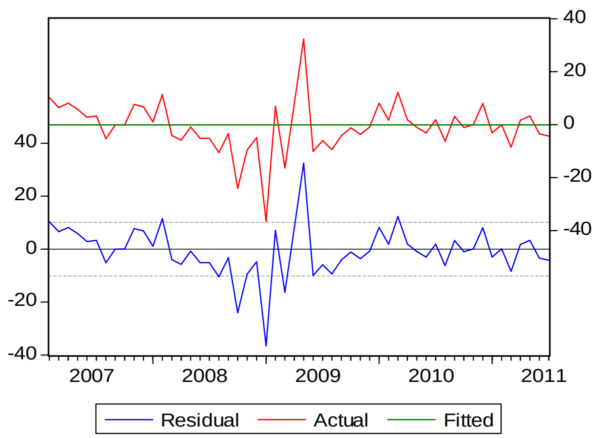
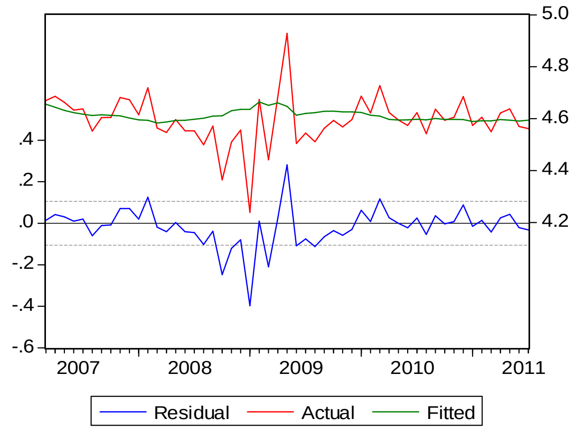


Figure 6: Unrestricted EGARCH(1,1) Model



For the EGARCH unrestricted model, the intercept and the ARCH information effect are strong and statistically significant suggesting that volatility is sensitive to market events, while the GARCH effect is negative and insignificant as was obtained in the restricted model. However, since the conditional variance is modeled in the logarithmic form, the variance will always be positive even if the parameters are negative. The leverage effect (γ) of policy innovations is positive and very strong at the 1 percent level. This implies that monetary policy has a positive effect on volatility of stock returns in the NSE, and this conforms to findings by empirical studies reported above. The coefficients of MPR and M_2 money supply are both correctly signed and statistically significant at the 1 percent level. The two suggest positive effect of policy innovations on stock returns volatility.

Summarily, Figures 5 and 6 affirm the numerical accuracy of the two models in terms of capturing volatility of stock returns in the NSE during the period of the crisis. According to Zivot (2008) the numerical accuracy of model estimates can be examined by comparing the volatility estimates of the GARCH model with the volatility estimates from ARCH (p) models. If the volatility estimates from the different models exhibit similar dynamics, then coefficient estimates from of the models are appropriate. Looking at the shapes of the residual plots of the GARCH and EGARCH models, it is clear that both explicitly track the tremendous volatility of stock returns in the NSE from mid of 2008 until 2009.

Results of robustness tests reveal that the SC model selection criterion suggest that the EGARCH model proves to be superior to GARCH because it records significantly smaller value. Furthermore, Likelihood ratio test between EGARCH models using conventional Gaussian error distribution demonstrates that an EGARCH model specification offers a better fit of the sample data than GARCH model. Investigation of the ARCH effect in the residuals using the Lagrangian multiplier and the LB (Q) and LB (Q^2) statistics was carried out. Results for both GARCH(1,1) and EGARCH(1,1) models indicate that null hypothesis of autocorrelation and partial autocorrelation in the residuals is rejected. This is further supported by the D.W statistic, which reveals absence of first order serial correlation in the residuals from the two models. The Jacque-Bera statistic for normal distribution shows that the residuals in the two models are normally distributed.

5.1 Conclusions and Recommendations

The paper seeks to assess the responses of the Nigeria's stock market to monetary policy innovations during the period of global financial crisis and post banking sector consolidation. The study period is from January, 2007 to August, 2011, including a total number of 55 observations. Uniquely, the paper in line with some empirical studies in the area decomposed monetary policy innovations into anticipated and unanticipated components in order to test the theoretical postulation of the rational expectation hypothesis. The monetary policy instruments used are the M_1, M_2 and MPR as regressors while All Share Index stands as the regressand.

The paper's preliminary investigation into the nature and time series properties of the data reveals that the data is characterized by a non normal distribution and a negative average monthly returns (in natural log) of -0.85% and a standard deviation of monthly returns of 9.62%. Evidence of autocorrelations using the Ljung-Box statistic was also established in the variables. With exception of log of dtock returns which was stationary at level, others were stationary at first difference. These portray a picture of a market in turmoil with evidence of high volatility in the level of stock returns during the study period.

Results from restricted GARCH(1,1) and EGARCH(1,1) show evidence of tstrong ARCH and GARCH effects. The *Wald* test, for instance, suggests that volatility is quite persistent. Moreover, the positive sign of the leverage coefficient from the EGARCH model implies that positive innovations play more significant impact on stock returns than negative innovations of the same magnitude. The unrestricted GARCH model confirms strong evidence of ARCH GARCH effects, while the EGARCH speicfication yields a strong ARCH effect. The later model however, offers a strong and statistically significant positive leverage effect. Furthermore, only the unanticipated component of policy innovations on the broad money supply, M_2 and MPR carry statistically significant coefficients whereas the unanticipated component does not. Results show that the unaticipated monetary policy innovations matter for stability of NSE because of their distabilizing effect on stock returns volatility. This confirms the postulations of the *Rational Expectation Hypothesis* that only the unanticipated components of policy changes would work while the anticipated component would be brought to naught because of economic agents' rationally behavior. The study conquer with the findings reported by Abdul Qayyum and Anwar (2011) on Pakistan's stock market, notwithstanding the fact that it is dissimilar to the finding by Juat-Hong (2009) on Malaysian stock market.

One key policy implication policymakers should rekon with is that market participants at the NSE do not buy in for surprises in monetary policy pronouncements. The MPC should unequivocally declare realistic and achievable monetray targets on broad money supply, MPR and exchange rate as well. It should also strive to maintain low level of inflation through a realistic and robust inflation targeting framework. These will go along way in promoting stability and confidence desired in the market.

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Appendix 1

Table 2: Stationarity Test

Variable	**Series at Level**		**First Difference**		**Decision**
	ADF	KPSS	ADF	KPSS	
LASI	-6.622**	0.137**	-9.147**	0.069**	*I*(1)
LM_1	-2.397	0.905	-7.945**	0.334**	*I*(1)
LM_2	-3.101*	0.842	-7.223**	0.567*	*I*(1)
MPR	-1.418	0.549*	-6.772**	0.201**	*I*(1)

Note: **(*) 1 (5) % levels of significance ADF & KPSS. Statistics are: 3.56 (2.93) and 0.739 (0.463) at the 1 and 5% levels, respectively.