International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2016, 6(1), 354-360.

Stock Market Response to Economic Growth and Interest Rate Volatility: Evidence from Nigeria

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ABSTRACT

This study examined the relationship between macroeconomic variable volatility and stock market return within the context of Blanchard (1981) extension of the Hicks (1937) IS-LM hypothesis, using exponential general autoregressive conditional heteroskedascity estimation techniques to analysis monthly data sourced on the Nigerian economy from January 1985 to December 2013. Our result shows that stock prices responds significantly to innovations in the interest rate and the real gross domestic product (RGDP), we therefore recommends that policy makers on the one hand should consider volatility in both the interest rate and the RGDP when making policies aimed at enhancing stock market development. On the other hand, market practitioners are expected to make provisions for volatility in interest rate and the RGDP when making portfolio decisions.

Keywords: Interest Rate, Real Gross Domestic Product, All Share Price, Volatility, Exponential General Autoregressive Conditional Heteroskedascity

JEL Classifications: C22, G01, G14, G15

1. INTRODUCTION

The monetary policy rule specified the means through which the monetary policy authority controls the economic activities in an economy, the stock market inclusive. According to this hypothesis, interest rate is the key instrument used in determining the direction at which the economy moves. The theoretical framework that connects the real sector, the stock market and the interest rate has its root in the Hicks (1937) IS-LM hypothesis. Intensive debate has been on as to the ability of interest rate in determining the movement of stock prices as well as on the connections between stock market and the real sector. Determining the impact of interest rate on stock market as it connects to the real sector is of utmost important to virtually all the various economic agents especially the policy makers on the one hand and market practitioners on the other hand. For the market practitioners, the knowledge of the relationship will help in formulating investment decisions that will accommodate both anticipated and unanticipated changes in interest rate, for policy makers on the other hand, the knowledge of this relationship will help in making policies that will be adequate for achieving economic growth and robust stock market development.

Many of the studies that inquired into the relationship between economic growths, interest rate and the stock market focused on the developed economies with few on African economies (Nigeria inclusive). This creates a gap in understanding the link between economic growth, interest rate and stock market especially from Nigeria empirical evidence. This study intend to fill this gap by using exponential general autoregressive conditional heteroskedascity (EGARCH) estimation techniques to analysis monthly data sourced from January, 1985 to December, 2012 on the Nigeria economy within the context of the IS-LM hypothesis.

The rest of this paper is structured as follows: Section 2 deals with the review of both the empirical and theoretical literature; Section 3 deals with the methodology employed; Section 4 provides the results and interpretation of results and Section 5 concludes the study and offers recommendations.

2. LITERATURE REVIEW

2.1. Theoretical Review

2.1.1. The hicks IS-LM hypothesis

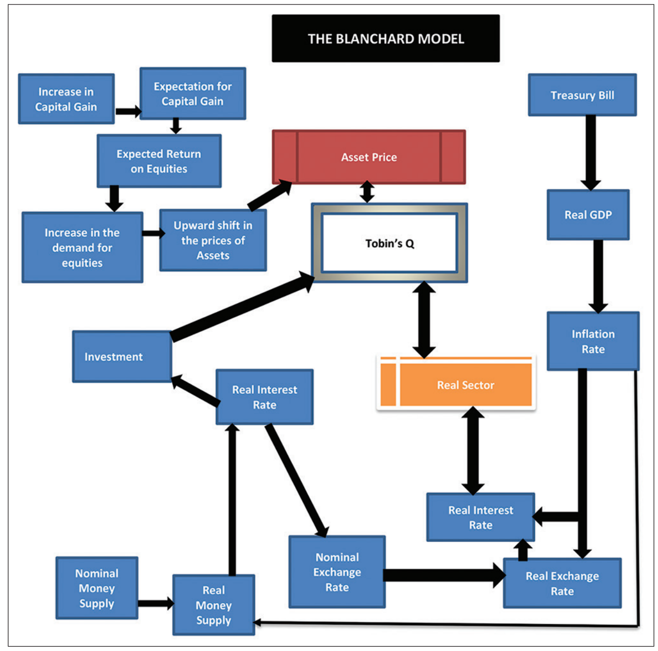
The Hicks IS-LM hypothesis was developed by Hicks (1937) to provide the pipe through which the real sector interacts with the financial sector in an economy. It provides the framework through which macroeconomic tools help reveal the relationship between interest rates and real output in the goods and services markets, and the money and asset markets. As the name IS-LM shows, the hypothesis is made up of interaction between two markets that result into general equilibrium. The model offers two vital interpretations: (i) It explains what happens in the short run to the national income given that the price level is fixed; and (ii) what happens when there are changes in the aggregate demand curve. Thus, the theory provides sound insight to understanding the fluctuations in the economy and available stabilization options. The IS-LM model is a model of multiple interpretations as it offers several interactions between several markets (Krugman and Obstfeld, 2003). For instance, its interpretation of the determinants of interest rate is interesting, a school of thought (the loanable fund view) believed that the supply and demand for saving is the core determinant of interest rate; another school of thought (liquidity preference approach) believed that interest rate is determined by the trade-off between bonds and money. The IS-LM hypothesis was extended by Blanchard (1981) who observed the account of a richer array of financial assets such as money, interest rate, short term bonds, long term bonds and equities as they affect real sector - financial sector nexus.

The core of the Blanchard hypothesis or model centers on the existence of a perfect substitutability between financial assets and short term bonds, and adopts the rational expectation hypothesis as a special solution for model-consistent expectations. This hypothesis also applies the jump variable technique to the resulting (deterministic) dynamic system, which is the bedrock that influences steady state turns out to be at a saddle point. In this hypothesis, the relevance price variable, Tobin's q, instantaneously jumps back onto the stable manifold of saddle point dynamics if the economy (or the equilibrium itself) is perturbed by an exogenous shock (Chiarella et al., 2009).

The strength of this hypothesis as a whole lies in enriching the IS-LM framework by markets for equities and long term bonds. It explained that an increasing expected rate of return on equities lead to increase in demand, which in turn leads to an upward shift in the prices in the market. Furthermore, increase in the capital gain is expected to be accomplished by increase in the expectation for capital gain, the same applies to increase in the expected return. This relationship leads to existence of a positive feedback loop at the aggregate level.

The conceptual flow chart in Figure 1 above shows the links between macroeconomic variables and stock market behavior using the Blanchard (1981) model. It shows the theoretical links between these constructs. It explains that investment demand is induced by Tobin's average q which allows share price dynamics to feed back into the real sector. This feedback mechanism as

Figure 1: Conceptual framework on Blanchard model



Source: Authors 2015

induced by Tobin's q establishes the link between real sector and the financial sector of an economy. The chart also shows that a perfect substitution effect exist between asset prices and real activity.

The center-piece of this hypothesis's extension of the IS-LM model deals with the fact that investment demand essentially depends on the Tobin's average q in the place of the real rate of interest, the implication is that, share price dynamics (excluding long term bond price dynamics) feed back into the real sector, thereby creating a vital link between real sector and the financial sector interaction. The LM or the money market equilibrium, on the other hand, provides the mechanism through which a payback mechanism is channel from the real sector to the financial system. He explained that shocks to macroeconomic variables causes the stock price to jump whilst keeping the output fixed (rather than allowing it to adjust gradually), this eliminates feedback effect on output, once the stock market is on the stable path, output also gradually adjusts.

As noted by Chiarella et al., (2009), a major flaws of the Blanchard hypothesis's treatment of the financial sector is the sudden disappearance of the reaction mechanism after some manipulations of mathematical formula, given that there is no distinction between the actual and expected capital, because all the non-money assets are assumed to exhibit perfect substitutability, this provides a myopic perfect foresight of capital gains.

The Blanchard model observed that unlike the real business cycle model, there exist in principle cross-effects between asset prices and real activity. It explained that aggregate output in an economic are often driven by a combination of both real activity and stock prices through consumption and investment functions.

We follow Semmler (2003) to provide an econometric explanation of the model as follows:

$$\dot{y} = k_y(aq - by + g) \tag{1}$$

$$\dot{q} = k_q f\left(\frac{x + \propto_0 + \propto_1 y}{q} - cy + h(m-p)\right) \tag{2}$$

$$\dot{x} = k_x\left(k_x f\left(\frac{x + \propto_0 + \propto_1 y}{q} - cy + h(m-p)\right) - x\right) \tag{3}$$

Where q represents index of stock prices, g connotes index of fiscal expenditure, y represent output, and d represents the aggregate expenditure.

Given that the $\bar{\epsilon}$ represent the equity premium, we have:

$$\dot{y} = k_y(aq - by + g) \tag{4}$$

$$\dot{q} = k_q f\left(\frac{x + \propto_0 + \propto_1 y}{q} - cy + h(m-p) - \bar{\epsilon}\right) \tag{5}$$

$$\dot{x} = k_x\left(k_x f\left(\frac{x + \propto_0 + \propto_1 y}{q} - cy + h(m-p) - \bar{\epsilon}\right) - x\right) \tag{6}$$

At equilibrium, the system will have:

$$\dot{y} = 0, \dot{q} = 0, \quad \dot{x} = 0 \tag{7}$$

And the values $\bar{y}, \bar{q}$ that solves:

$$aq - by + g = 0$$

$$\frac{\propto_0 + \propto_1 y}{q} = cy + h(m-p)$$

or

$$aq - by + g = 0$$

$$\frac{\propto_0 + \propto_1 y}{q} = cy - h(m-p) + \bar{\epsilon}$$

When we relate the equity premium with the $\delta \equiv h(m-\mu)$ when faced with time varying real balances becomes $\delta_1 - h(m_1 - \mu_1)$. However, when we involve equity premium, $\delta_1 = h(m_1 - \mu_1) - \bar{\epsilon}$ can be thus redefined.

The above system of equations reveals how the original Blanchard model can be recovered from. In the first instance, assumption of perfect foresight holds as we let, $k_x \to \infty$, thus we get:

$$q = x \tag{8}$$

These differential equations y and q are the centerpiece of the dynamical system of Blanchard models.

Adjusting the model, we tends to examine the link between stock market behavior and interest by following Mazzucato and Semmler (2002) such that:

$$d = aq + \beta + g \ (\alpha > 0, 0 \le \beta < 1) \tag{9}$$

Our model stresses that changes in aggregate expenditure will induce output to adjust, such that we derived:

$$\dot{y} = k_y(d - y)$$

$$= k_y(aq - by + g) \tag{10}$$

Given that $b \equiv 1 - \beta$ such that $0 < \beta < 1$, where the speed of adjustment for output is $k_y > 0$

On the other hand, a critical examination of the LM equilibrium in the stock market assumption shows that:

$$i = cy - h(m-p) \qquad (c>0, h) \tag{11}$$

Given that i denote the short term rate of interest, m and p are the logarithm of both the money and price respectively.

We derived the real output equation such as:

$$\pi = \alpha_0 + \alpha_1 y \tag{12}$$

Here, $(x + \alpha_0 + \alpha_1 y)/q$ represent the instantaneous expected real rate of return from holding shares, x represent the expected change in the value of the stock market. Thus the excess return equals:

$$\epsilon = \frac{x + \alpha_0 + \alpha_1 y}{q} - i \tag{13}$$

Blanchard model states that ϵ is always zero. This implies the existence of perfect substitutes and zero arbitrage. When faced with a condition of imperfect substitutability between real and financial assets, the excess demand for stocks (q^d) is positive but bounded function such that:

$$(q^d) = f(\epsilon) \quad (f(0) = 0 \tag{14}$$

With f as shown in the Figure 2.

Furthermore, when we assume that stock market adjust to the excess demand, we have:

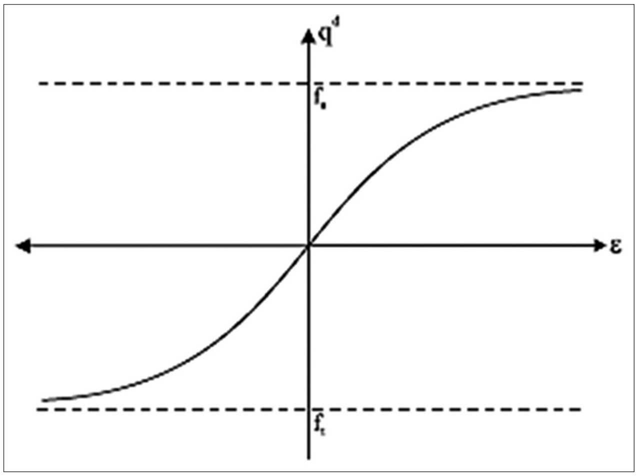
$$\dot{q} = k_q f(\epsilon) \tag{15}$$

or

$$\dot{q} = k_q f(\epsilon - \bar{\epsilon}) \tag{16}$$

Given that $k_q > 0$ represent the speed of adjustment of the response of the asset price to excess demand for stocks. Assuming $k_q = \infty$ such that:

Figure 2: Excess demand for stock (Adopted from Semmler, 2002) Author (2014).



$$\frac{x+\propto_0+\propto_1 y}{q} \tag{17}$$

or

$$\frac{x+\propto_0+\propto_1 y}{q}=i+\bar{\epsilon} \tag{18}$$

The Blanchard model (Blanchard, 1980) discussed in this subsection shows the links between stock market, interest rates and output. This study adopts this model based on the EGARCH estimation techniques to explain the relationship between macroeconomic volatility and stock market behavior in Nigeria.

2.2. Empirical Literature

Most of the empirical literature on the relationship between interest rate and stock market behavior are essentially on developed economies with little or none on the Nigerian economy, thus creating a gap on the impact of interest rate volatility on the Nigerian stock prices movement. This study tends to fill this gap.

A review of Cengiz and Basarir (2014) shows that the study examined the relationship between interest rate and stock market within the framework of real gross domestic product (RGDP) for Turkey for the period 1998-2012 using VAR estimation techniques, and observed that a convincing long run relationship exist between stock market development and interest rate. The study also observed that crisis in the stock market is precluded with the control of interest rate in the long run. The study recommended that in making macroeconomic policy aimed at combatting inflation, unemployment and their macroeconomic imbalances, policy makers should adjust for the impact of stock market volatility.

For the UK economy, Florackis et al. (2014) used both the standard linear model specifications and non-linear models to analysis quarterly data sourced from 1989Q1 to 2012Q2 in order to investigate whether stock market behavior exert on the interest rate and the RGDP among other variables. Their results shows that a negative but significant relationship exist between the stock prices illiquidity and the future GDP growth and interest rate in the UK over and above the conventional control variables, with a stronger impact during eras characterized with higher illiquid market conditions and weak economic growth.

For India, Andries et al. (2014) used cross-wavelet power techniques, the cross wavelet coherency and phase differences methodologies to examine and identify the pattern of co-movement among interest rate, stock price returns and exchange rate for the period 1997M7-2010M12, and observed that there is a link that connects the three variables with the stock market movement lagging behind both exchange rate and interest rate fluctuation, while interest rate plays the leading role in the co-movement (Fernandez-Perez et al. (2014); Kim and Nguyen, 2009).

Marfatia (2014) documented the existence of a negative but significant relationship between the level of uncertainty and the time varying response of S&P 500 stock returns to unanticipated changes in the interest rate induced by unanticipated changes in the monetary policy decision for the US economy. The study used high frequency data on interest rate changes and S&P 500 stock returns using VIX index techniques, and concluded that at higher levels uncertainty, the impact of monetary policy shocks led by interest rate fluctuation on stock market is lower.

For the Euro zone countries, Timo (2011) observed that no correlation exist between stock market and interest rate fluctuation after the introduction of Euro though a negative correlation exist between the stock market prices and interest rate in those economies before they became Euro member countries.

Moya-Martinez et al. (2014) documented the existence of a significant relationship between interest rate changes and stock market prices for the Spanish economy using a wavelet based approach to analysis data sourced from 1993M1 to 2012M12. The study further revealed that the degrees of the movement is stronger at the coarsest scales, and concludes that long term investors are more concerned with interest rate movement and that the fluctuations in the macroeconomic variables when taking investment decisions.

Jedida et al. (2014) used autoregressive distributed lag estimation techniques to analyzed the relationship between financial development proxied by both stock market development and bank credit allocation; and economic growth. Though, the study documented the existence of a bi-lateral relationship between credit allocation and economic growth, it observed that stock market development has no positive impact on economic growth for Tunisia. The study is indifferent as to the impact of economic growth on stock market development.

Sensoy and Sobaci (2014) examined the correlations between exchange rate, interest rate and stock market development in Turkey between January 2003 and September 2013 so as to know if the correlation changes abruptly in high volatile periods with either a permanent or temporary effect. Using dynamic correlations VAR(p)-FIAPARCH(1,d,1)-CDCC(1,1) approach and penalized contrast functions techniques, the study observed that volatility shocks provokes abrupt changes in the dynamic correlations in the short run with effect in the long run.

Bekhet and Matar (2013) used ARDL bound testing techniques to establish a functional relationship between stock market economic growth proxied by real GDP or industrial production growth rate and interest rate alongside other macroeconomic variables for Jordan economy for the period 1998-2010.

For Finland, Petri and Vataja (2011) observed that a bi-directional causality exist between stock market returns and interest rate. Using monthly data sourced from 1987(2) to 2010(1), the study reported that during a crisis-free period, interest rate grangers causes fluctuation in stock prices, while the latter granger causes the former in the period of turbulent.

For South Africa, Chinzara (2011) examined the impact of a number of macroeconomic variables on stock market returns and observed that of all the macroeconomic variables studied - inflation rate, gold prices, oil prices, industrial production, broad money supply (M3) and the exchange rate- the behavior of stock price is most influenced by interest rate and exchange rate.

Olweny and Omodi (2011) used both the EGARCH and TGARCH estimation models to examine the effect of some selected macroeconomic variables on stock market based on monthly data sourced from January 2001 and December 2010. The results on interest rate - stock market nexus shows that leverage effects exists between the dual with bad news having significant impact on stock return volatility.

Alam and Uddin (2009) focused on cross-country examination of stock market - interest rate nexus by examining the relationship between stock market returns and interest rate for 15 African economies. The study shows that most of the economies studied, interest rate fluctuations significantly exerts on stock prices. Their findings was supported by earlier work of Gupta and Modise (2011) who also documented that interest rate have some predictive power over stock market for most African economies. Hsing (2011) documented that stock market is negatively influenced by changes in interest rate, thus lowering interest rate will serve as a boast to the stock prices.

The only relevant study to our study on Nigeria was found in Ologunde et al. (2006) who focused on the pattern of the relationship between stock market capitalization rate and interest rate. Their results show that a significant and positive relationship exist between interest rate and stock market capitalization rate. The study further revealed that government development stock rate has a negative influence on stock market capitalization rate, though the prevailing interest rate exerts negatively on government development stock rate.

3. DATA AND METHODOLOGY

This study used monthly data sourced from the Central Bank of Nigeria Statistical Bulletin (various issues), data on the all share index were transformed into natural log form to avoid the problem of multicollarity.

3.1. Methodology

The study used exponential general autoregressive conditional heteroskedasicity (EGARCH) estimation techniques to analysis the data set so as to know if volatility in interest rate exert on stock market. The EGARCH model was developed by Nelson (1991) as an improved variety of the GARCH (1, 1) estimation model. The ARCH family model are known in literature to yield better results when estimating volatility and vastly used. The EGARCH allows the conditional variance of a series to depend on both the size and sign of the lagged residuals. It is expressed as such:

$$In(h_t) = \alpha 0 + \beta In\ h_{t-1} + \gamma \frac{\epsilon_{t-1}}{h_{t-1}^{1/2}} + \alpha \left[\frac{|\epsilon_{t-1}|}{h_{t-1}^{1/2}} - \sqrt{\frac{2}{\pi}} \right] \quad (19)$$

The essence of the logarithmic specification of the model is to ensure that the conditional variance is always positive without imposing non-negativity constraints, thus overcomes the limitations associated with the basic GARCH models. The β terms represents the magnitude of volatility and captures the effects of prior variance terms on the current conditional variance and the γ term represents the sign of the lagged error term, when the relationship between returns and risks is negative, the model allows asymmetries (Carrol and Kearney, 2009; Fernandez-Villaverde and Rubio-Ramirez, 2013; Brunnermeier et al., 2013; Solakoglu et al., 2009; Martin et al., 2013; Greenberg, 2013; Hill et al., 2012; Ender, 2010).

4. RESULTS AND INTERPRETATIONS

Table 1 presents the result of the statistical properties of the variables used. Our interest lies in the coefficients of the Jarque-Bera (JB), Kurtosis and the Skewness of the variables. The JB test statistics is used to determine if a series follow normal probability distribution. The test is an asymptotic or large sample test that computes the skewness and kurtosis measures and is calculated as follows:

JB = n[S2/6 + (K-3)2/24] (20)

Where n represents the sample size, S represents the skewness coefficient and K represents the Kurtosis coefficient. It is required that a normally distributed variable will have S = 0 and K = 3.

Table 1: Descriptive statistics

Statistics	ASHI	RGDP	INT
Mean	1.821109	306.9515	13.79254
Median	1.706300	0.582900	13.50000
Maximum	38.19780	101941.1	26.00000
Minimum	−30.64160	−99.89820	6.000000
Std. Dev	6.102540	5569.704	4.099604
Skewness	0.293297	18.21886	0.457597
Kurtosis	10.85405	332.9521	3.638130
Jarque-Bera	865.8391	153.8154.	17.37520
Probability	0.000000	0.000000	0.000169
Sum	610.0714	102828.7	4620.500
Sum Sq. Dev	12438.49	1.04E+10	5613.456
Observations	335	335	335

Source: Authors' computation using Eviews 7.2. RGDP: Real gross domestic product

For all the variables under examination, the coefficients of Skewness is significantly high than 0 and K significantly >3, thus they are not normally distributed. This implies that we can the EGARCH estimation techniques.

In testing for stationarity, we adopt the augmented Dickey–Fuller (ADF) test specified as follows:

$$\Delta Y_t = b_0 + \beta Y_{t-1} + \mu_1 Y_{t-1} + \mu_2 Y_{t-2} \ldots\ldots + \mu_p Y_{t-p} \varepsilon_t \qquad (21)$$

Where Y_t is the time series to be tested, b_0 represent the intercept term, β is the coefficient of interest in the unit root test, μ_t is the parameter of the augmented lagged first difference of Y_t that represent the p_{th} order autoregressive process and ε_t represents the white noise error term.

The results of the ADF test of stationarity for all the variables are presented both in the levels and first difference forms in Table 2 above, from the result, we can see that the calculated Dickey Fuller test statistics is less than the critical value at 1% for all the variables except for interest rate. This implies that for all these variables, we reject the null hypothesis, thus the variables are stationary series. However, the null hypothesis is rejected when the ADF test is applied to the first difference for the interest rate, thus we conclude that all the variables are stationary at least at 1(1).

The correlation test results show that interesting relationship exist among the variables. It shows that a positive relationship exist between All Share Interest rate and the independent variables such that when interest rate increase by 1%, the All Share Price returns increases by 10.92%. This implies that the monetary policy can boast stock market return by simply adjusting the interest rate upward. Our result of a positive relationship between the All Share prices and interest rate contradicts the findings of Olweny and Omondi (2011) for Kenya but is line with IS-LM framework of Hicks (1937) and the monetary policy rule of the neo-classical economists (Krugman and Obstfeld, 2003). Similarly, the result on the relationship between the economic growth rate and the stock market returns shows a positive relationship such that when the economic growth rate as proxied by the RGDP increases by 1%, the share price returns increase by 8.4%, again affirming the validity of the IS-LM hypothesis of existence of a linkage between economic growth, interest rate and stock market in Nigeria (Table 3).

From Table 4 above, it can be deduced that the coefficient of α is positive and significant when we measure the volatility of the all share index (ASHI). The coefficient of the γ on the other hand is negative at −0.035261 and not significant. This implies that large shocks in the ASHI as caused by the interest rate volatility and volatility in the growth rate will raise the volatility in stock price return irrespective of the sign of the volatility. The result also shows that the effect of the size of volatilities of both the interest rate and growth rate on All Share Price is large and highly significant as shown by the coefficient of the magnitude of the estimates.

Looking at the interest rate result, one can see that the coefficient of α is positive and highly significant at 10% level of significant while

Table 2: Test for stationarity

Variables	ADF STA	Critical value	Probability	Order of integration
ASHI	−6.187866	−3.449977	0.0000	1 (0)
RGDP	−18.29495	−3.449738	0.0000	1 (0)
INT	−17.87025	−3.449738	0.0000	1 (1)

Source: Authors' computation using Eviews 7.2. ADF: Augmented Dickey–Fuller. RGDP: Real gross domestic product

Table 3: Correlation test results

Variables	ASH	RGDP	INT
ASHI	1.0000	0.084271	0.109340
RGDP	0.084271	1.0000	−0.003745
INT	0.109340	−0.003745	1.0000

Source: Authors' computation using Eviews 7.2. RGDP: Real gross domestic product

that of the γ is negative and significant at 5% level of significant. This implies that once the asymmetric impact of the innovations is account for, the absolute size of the innovation is also important. Our result is supported by earlier findings like Hsing (2011) for South Africa, Bekhet and Matar (2013) for Jordan who observed that fluctuations in interest rate and real GDP do exert on stock market prices but contradicts Jedidah et al. (2014) who document existence of no relationship between the RGDP and Stock market for the Tunisian economy.

The result from the volatility of the economic growth rate as shown in the RGDP volatility indicates that the coefficient of the α is positive and highly significant at 1% level of significant level while the coefficient of the γ is negative and significant at 5% level of significant, this implies that just like under the interest rate measurement, once we account for the asymmetric impact of innovation, it important for us to account for the absolute size of the innovation.

From the results of both interest rate and RGDP volatility measurements, it can be deduced that both the volatilities in interest rate and RGDP have significant impact on the volatility of the stock price returns in Nigeria.

5. CONCLUSION AND IMPLICATIONS

This study examined the impact of both the volatilities of interest rate and economic growth as proxied by RGDP on stock price return within the framework of Blanchard (1981) extension of the IS-LM hypothesis. The IS-LM hypothesis established the existence of a linkage through which fluctuations in interest rate and RGDP do exerts on stock market prices. We adopt the use of EGARCH estimation techniques to analysis monthly data spanned from 1985 to 2012 sourced from the Nigerian economy. Our results show that innovations in the interest rate and economic growth rate as proxied by RGDP exerts on stock market prices in Nigeria. We therefore recommends that in order to achieve stock market development that will aid meaningful economic growth and development, policy makers should try as much as possible to increase the interest rate and pursue policies that attempts to advance economic growth.

Table 4: Results of EGARCH estimates

Parameters	ASHI	Probability	Interest rate	Probability	RGDP	Probability
ω	0.366933	0.0132	−0.168256	0.2815	−0.15104	0.3550
α	0.658982	0.0000	0.742013	0.0000	0.708057	0.0000
γ	−0.035261	0.6121	0.159310	0.0187	−00.16282	0.0179
β	0.73840	0.0000	0.879450	0.0000	0.881057	0.0000

Source: Authors computation using Eview 7.2. RGDP: Real gross domestic product, EGARCH: Exponential general autoregressive conditional heteroskedascity

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