News on Stock Market Returns and Conditional Volatility in Nigeria: An EGARCH-in-Mean Approach.

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Abstract

This paper aims at exploring the relationship between news on the stock market returns and conditional volatility in Nigeria. To determine this relationship, the researcher employed the exponential generalized conditional Heteroscedasticity (EGARCH) in mean model since the model accommodates asymmetric and leverage property. The results of the analysis shows that there is a significant relationship between stock market returns and conditional volatility. Secondly, that the persistence of shocks in the market takes a short time to die out, thirdly, that the stock market volatility is less sensitive to market events while asymmetric effect is positive and significant indicating that good news lowers volatility in Nigeria. In the light of the findings, the researcher suggests that Nigeria stock exchange should ensure that company specific information should be reliable with maximum transparency and speedy dissemination. Also, with the already existing good news lowering volatility and cost of capital in the economy, Government should avoid unnecessary modifications of her policies that are capable of changing the market trading pattern. These measures, the researcher believes, will bridge up information asymmetry and enhance the sensitivity of volatility to market events.

Keywords: Stock returns,EGARCH, information asymmetry, bad news.

JEL codes: C32, E32, F1

Introduction

The volatility of the stock return on the Nigerian stock market has been of concern to investors, analysts, market operators and regulators yet few studies have been carried out on the subject in Nigeria. The very few studies carried out in Nigeria on this issue scarcely investigated the asymmetric leverage effect- a gap which this study filled.

Stock market volatility refers to the potential for a given stock to experience a drastic decrease or increase in value within a predetermined period of time. This means that the price of the security can change dramatically over a short time period in either direction. Stock return volatility could be perceived as a measure of risk, the higher the volatility, the riskier the security. Investors evaluate the volatility of stock offering in order to buy additional shares of a stock already in the portfolio, or sell stock currently in the possession of the investor. High volatility in the stock prices has many adverse effects in the economy. The investment decisions by investors may undergo changes due to high volatility, which may lead to a fall in the long-term capital flows from foreign as well as domestic investors. Theory however, generally predicts a positive relation between expected stock returns and volatility, if investors are risk averse. That is, equity premium provides more compensation for risk when volatility is relatively high. In other words, investors require a larger expected return from a security that is riskier.

The understanding of volatility in the stock market is very useful in the determination of cost of capital and in the evaluation of asset allocation decision. The presence of volatility in the stock market would lead investors to demand for a higher risk premium thereby creating higher cost of capital which impedes investment and consequently slows down economic development.

Rational investors invest with some expectations of making returns and as such a fall in stock prices weakens consumers confidence on the true intrinsic value of the firm. The existence of excessive volatility in the market undermines the usefulness of stock prices and thus, signals a fall in the intrinsic value and market efficiency.

In Nigeria, just like in other emerging economies, there has been mixed evidence on the nature of relationship between stock returns and stock market volatility. While some researchers contend that the relationship is positive others maintain that the relationship is negative. The few researchers on the issue spoke with one voice on the existence of volatility clustering which of course characterize the emerging markets. The very few studies on the stock market returns and conditional volatility in emerging economies revealed that negative shocks have more pronounced impact on volatility than positive shocks and that the stock markets also faced persistent volatility clustering.

In the light of these, the study investigated the relationship between stock market returns and volatility, volatility clustering and asymmetric leverage effect on the Nigerian stock market.

1.1 Review of Relevant ARCH Models

The method used for this analysis leans on ARCH family, precisely the exponential Generalized Autoregressive Conditional Hetroscedasticity in mean (EGARCH- in- mean) However, we reviewed the ARCH and GARCH models for the purpose of pin-pointing the analytical lapses/lacuna which EGARCH- in mean model tends to close. It is a common knowledge in econometrics that autocorrelation occurs when error term in any particular period is a significant function of the error term in the previous period. In other words, if the error term in the present period depends upon the error term last year, we call this the first autoregressive scheme. If the present error term depends upon the error term of the last two years it is said to be of second order autoregressive scheme and so on. Thus, autocorrelation is present if the present error term is a function of lagged value(s) of the error term.

In a similar manner, a peculiar type of autocorrelation associated with financial time series (such as stock prices, stock returns, foreign exchange rates, inflation rates etc) has been found to occur in the variance (σ^2) at any time period t with its values lagged one or more periods. This type of autocorrelation peculiar to financial time series is referred to as Auto regressive conditional Hetroscedasticity (ARCH) model. The ARCH model suggests that the hetroscedasticity, (unequal or nonconstant variance) observed over different time periods are autocorrelated.

Thus, ARCH effect originates from serial correlation of heteroskedasticity. Remember that hetroscedasticity has to do with no constant variance in a model. This kind of effect is manifest when there is bunching in the variance or volatility of financial time series producing a pattern that is determined by factors such as changes in trading volume, practices which in turn are driven by macroeconomic policies, shift in investors tolerance etc. In capital market investment, volatility of financial assets indicates risk. This is why ARCH effect is seen as parameter for measuring the risk of an asset.

The simple form of the ARCH effect is modeled as conditional variance σ^2 of the error term as a function of the squared error term lagged by one or more period plus the random term. The simple ARCH effect model is then stated as follows:

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \quad \varepsilon_t$$

In this case the simple ARCH(1) model contains only a single lag of the squared error term. If it is extended to any number of lags say q lags, in such a case, the number of lags q can be determined using Schwartz or Akaike information criterion. The q lags, if used can be referred to as an ARCH (q) model. The ARCH model equation stated, postulates that the conditional variance (volatility) in the present period is a function of its value in the previous period plus a stochastic error term. Positive α_1 suggests that high volatility in the previous period leads to high volatility in the current period. If α_1 is zero, there will be no volatility clustering in the present period.

2.1 The GARCH Model

The autoregressive conditional hetroscedasticity (ARCH) models introduced by Engle (1982) and its extension, the generalized ARCH (GARCH) models introduced by Bollerslev (1986) have been the most commonly employed class of time series models in recent finance literature for studying volatility. The generalized autoregressive conditional heteroscedasiticity (GARCH) methodology examines the residuals for evidence of hetroscedasticity and develops two distinct specifications, one for the conditional mean and the other for conditional variance.

The standard GARCH (1,1) model is specified as follow.

1. $y_t = X_t\theta + \varepsilon_t$

2. $\sigma_t^2 = \omega + \propto_t \varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2$

The first equation is the mean equation which is usually a function of exogenous variables with an error term while the second equation is the conditional variance equation comprising the mean ω, the news about volatility from the previous period (ε_{t-1}^2) measured as the lag of the squared residual from the mean equation (the ARCH term) and the last period's forecast variance σ_{t-1}^2 (the GARCH term). The basic GARCH specification expressed in sigma notation is given by

$$\sigma_t^2 = \omega = \sum_{i=1}^{q} \propto_i \varepsilon_{t-1}^2 + \sum_{i=1}^{p} \beta_j\sigma_{t-j}^2$$

P = the order of the autoregressive GARCH term while q is the order of the moving average ARCH term.

The basic GARCH model requirement for stationarity are that $\propto_i + \beta_j < 1, \propto_t \geq 0, \beta_j \geq 0$ while w > o.

If $a_i + \beta_j$ is approximately 1, it shows high persistence in volatility.

The parameter $\propto_t$ captures the ARCH effect while β captures the GARCH effect. The appeal of the models is that they capture both volatility clustering and unconditional return distributions with heavy tails.

Graphically, the conditional variance of the stock returns in Nigerian stock market can be presented in fig.1.1 followed by the algebraic statement of its volatility clustering conditions.

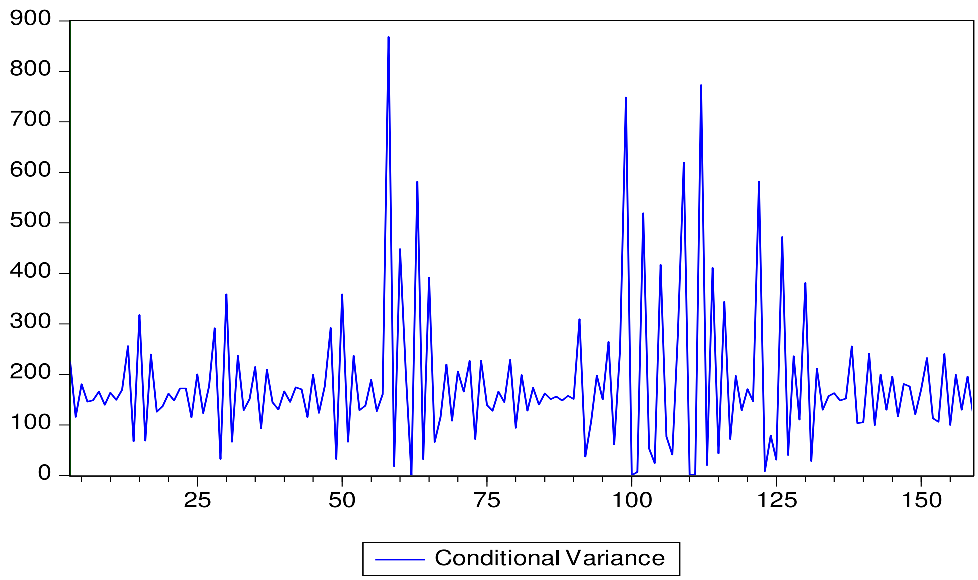

Fig.1.1 Conditional Variance

$$\sigma_t^2 = \omega + \sum_{i=1}^{k} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{m} \beta_j \sigma_{t-j}^2$$

$$\alpha_i + \beta_j < 1, \ \alpha_i \geq 0, \ \beta_j \geq 0 \ , \ \omega = 0$$

The graph shows that market returns do not respond evenly to stock market volatility. There are periods of time when returns change negligibly and this period is referred to as market tranquility and other periods where changes in market returns are as a result of large changes in stock market volatility, the period which is referred to as the period of market turbulence. This suggests that in Nigeria, stock market returns usually respond to the stock market volatility.

However, the GARCH model neither considers the asymmetric property of return, that is negative relationship between return and conditional volatility nor the leverage effect. This therefore necessitates the use of EGARCH model which accommodates the asymmetric and leverage property.

2.12 The EGARCH in Mean Model

An important feature that is often observed when analyzing stock market returns is that the conditional variance, σ_t^2 is not an even function of the past disturbances, U_{t-1}, U_{t-2}, ... U_{t-n} , (Koulakiotis, Papasyriopuolos and Molyneux, 2006). In order to correct this feature, Nelson (1991) proposed the exponential GARCH (EGARCH) model which incorporates leverage effect and observed asymmetric volatility changes with the changes in return sign. In his model, the log of conditional variance implies that the leverage effect is exponential, rather than quadratic and that forecasts of the conditional variance are guaranteed to be nonnegative. Black (1976) was the first to discuss the concept of "leverage effect" when he noted that changes in stock returns display a tendency to be negatively correlated with changes in returns volatility implying that volatility have a tendency to rise in response to bad news and fall in response to good news. A negative asymmetric term implies that negative shocks have a greater positive impact on volatility than positive shocks of the same magnitude. In other words, if asymmetric term is negative and significant stock returns are in turbulent state and this causes the predictable volatility to increase more than unexpected increase in good news of similar magnitude.

On the other hand, a positive asymmetric term implies that positive shocks decrease volatility. However, that significant negative shocks increases volatility more than significant positive shock of similar magnitude results from the fact that investors are more prone to negative news than the positive news.

The conditional variance in EGARCH model is specified as follows.

$$\text{In}\sigma_t^2 = \omega + \beta \text{In}\sigma_{t-1}^2 + \propto \left[\frac{|\varepsilon_{t-1}|}{\sigma_{t-1}} - \frac{2}{\pi}\right] + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}}$$

Where:- $\omega, \beta, \propto, \gamma$ are constant parameters,

$\text{In}\sigma_t^2$ = the one period ahead volatility forecast

ω = the mean level

β = persistence parameter

$\propto$ = volatility clustering coefficient

$\text{In}\sigma_{t-1}^2$ = the past period variance

γ = the leverage effect

Unlike the GARCH model, the EGARCH model allows for leverage effect.

In the analysis of the relationship between expected returns and expected volatility in the Nigerian stock market, the augmented version of the EGARCH-in-mean model following Leon (2008), Kulakiotis et al (2006) is employed.

The choice of the method stems from the fact that in a developing economy for instance, the market consists of risk-averse investors as the opportunity to invest and diversify the investment is not much. Thus, the expected returns on asset should significantly move in the same direction with the expected risk of the asset. We therefore state our return equation as follows

$$R_t = b_0 + b_1 R_{t-1} + b_2 \sigma_t^2 + \varepsilon_t$$

Where

b_0 = autonomous component

b_1 = measures the sensitivity of changes in current returns to a change in the past returns.

b_2 = a measure of the effect of conditional variance on the current return.

R_t = stock market returns at time t

R_{t-1} = last period return accounting for autocorrelation

σ_t^2 = the conditional variance

$b_2\sigma_t^2$ = market rise premium for expected volatility

ε_t = the usual idiosyncratic term with zero mean and conditional variance σ_t^2.

The expected volatility which is approximated by the conditional variance $\sigma_t^2$is related to information set up such that

σ_t^2 = var (R_t/ ψ_{t-1})

Where

ψ_{t-1} is the information set at time, t-1 containing observations on lagged values of R_t and σ_t. That is ($\sigma_{t-1}, \sigma_{t-2}$..... R_{t-1}, R_{t-2} ......).

Thus, the expected returns on asset should significantly move in the same direction with the expected risk of the asset. In the light of this, one can state the return equation together with the log of conditional variance equation and estimate the equations jointly. Thus,

$$R_t = b_0 + b_1R_{t-1} + b_2\sigma_t^2 + \varepsilon_t$$

$$f_{R-1,}\, f_{\delta^2 t} > 0$$

$$\varepsilon_t/\psi_{t-1} \sim N(0, \sigma_t^2)$$

$$\varepsilon_t = z_t\sigma_t \text{ and } z_t \sim N(0,1)$$

$$\text{In}\sigma_t^2 = \omega + \beta\text{In}\sigma_{t-1}^2 + \propto \left[\frac{|\varepsilon_{t-1}|}{\sigma_{t-1}} - \sqrt{\frac{2}{\pi}}\right] + \gamma\frac{\varepsilon_{t-1}}{\sigma_{t-1}}$$

$$f_{\delta^2 t} > 0, \; f_{\propto}, f < 0$$

Where the parameters have been previously defined.

The conditional variance b_2 and the persistent parameter β are expected to be positive while the volatility clustering coefficient α and the leverage effect coefficients γ should be negative.

Decision Rule

If the estimated variance can be used to predict expected returns in the forgone equation, then the value of b_2 should be positive and significant for a risk averse investor. That is to say that the higher the risk of an investment, the higher the reward accruable for having undertaken such a risky investment.

The EGARCH-M model, a refinement of the GARCH model imposes a non-negativity constraint on market variance, and allows for conditional variance to respond asymmetrically to return innovations for different signs.

If γ is negative, leverage effect exists. Black (1976) was the first to note that changes in stock returns display a tendency to be negatively correlated with changes in returns volatility. The leverage effect phenomenon posit that volatility tends to rise in response to "bad news" and to fall in response to "good news". That is unexpected drop in price (bad news) increases predictable volatility more than an unexpected increase in price (good news) of similar magnitude (Black, 1976; Christe, 1982). In other words, negative value of γ indicates that volatility is higher when returns are negative. γ is called the "sign effect". If α is positive, then the conditional volatility tends to rise (fall) when the absolute value of the standardized residuals is larger (smaller). α is called the "magnitude effect".

3.0 **Materials and Methods**

The data for this analysis are the daily share index of the Nigerian stock market sourced from the Nigerian Stock Exchange. In the analysis of the relationship between expected returns and expected volatility in the Nigerian stock market, the augmented version of the EGARCH-in-mean model following Leon (2008) and Kulakiotis et al (2006) is employed.

The choice of the method stems from the fact that in a developing economy for instance, the market consists of risk-averse investors as the opportunity to invest and diversify the investment is not much. Thus, the expected returns on asset should significantly move in the same direction with the expected risk of the asset. We therefore present the estimated returns result in table 3.1 as follows:

Table 3.1 Results of the analysis

b_0	b_1	b_2	ω	α	γ	β
3.02855	0.82615	0.00157	13.22849	-1.737038	2.153481	-0.21377
(118.931)	(68.1961)	(6.55640)	(28.1939)	(-19.5459)	(18.8160)	(-3.80464)
(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0001)

The figures in the brackets in the third row are the z statistics while the figures in the fourth row are the probabilities of the coefficients.

The results from table 3.1 show that the coefficient of conditional volatility (b_2 = 0.001557) is positive and significant, implying that there is a positive and significant relationship between stock market returns and conditional volatility. In other words, the stock market returns in Nigeria is a positive and significant function of stock market volatility. The persistent parameter (β) measuring the persistence in conditional volatility is negative and significant suggesting that the persistence of shocks or volatility of stock returns takes a short time to die out following a crises in the market. We shall recall that the volatility persistence is usually less than 1, (/β/ < 1 is the sufficient condition for the stationarity of EGARCH model) but as the value approaches unity, the persistence of shock increases. The value of magnitude or symmetric effect of the analysis (α) shown in table 3.1 is lower than zero implying that volatility is less sensitive to market events thereby suggesting that a large market surprise induces relatively small volatility. In other words, the news about previous volatility has less explanatory power on current volatility.

The asymmetric leverage effect is positive ($\gamma > 0$) and significant implying that the effects of the previous periods good news generate lower volatility. This means that stock returns are in a state of tranquility and this slows down the velotility.

4.0 Conclusion

This paper presented some valuable empirical results that partly identified the causes of stock return volatility. It tries to measure volatility of financial time series with the method of EGARCH in mean so as to capture asymmetric and leverage effect in the stock market.
i) On the basis of the findings, we deduce that there is a positive and significant relationship between stock market returns and conditional volatility suggesting that higher risks requires higher premium for the risk averse investors to make their normal returns in Nigeria.
ii) The persistence of shocks or volatility of stock returns takes a short time to die out if there is crises affecting stock market in Nigeria.
iii) That volatility is less sensitive to market events thereby suggesting that a large market surprise induces relatively small volatility.
iv)The asymmetric leverage effect is positive and significant implying that the effects of the previous periods good news generate lower volatility in Nigeria.

In the light of these findings, the researcher suggests that the Nigerian stock exchange should ensure that company specific information should be reliable with maximum transparency and speedy dissemination. This measure, the researcher believes will bridge up information asymmetry and enhance the sensitivity of volatility to market events. With the already existing good news lowering volatility and cost of capital in the economy, government should avoid unnecessary modifications of its policies that are capable of changing the market trading pattern.

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