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Evaluation of Volatility Persistence and Asymmetric Effect in Nigerian Capital Market

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Abstract: *This study focused on the evaluation of volatility persistence and examining the asymmetric effect on the Nigerian capital market. This study employed Exponential Generalized Autoregressive Conditional Heteroscedasticity (EGARCH-in-Mean) model in order to accommodate the asymmetric effect. The estimates from EGARCH model supported the existence of asymmetric effect on the Nigeria capital market. It discovered as well that the Nigerian stock market showed evidence of volatility persistence but not significant. The results confirmed that negative shocks increase volatility more than positive shocks of the same magnitude. Therefore, the researchers recommended among others that, Nigerian capital market should ensure timely disclosure and appropriate dissemination of company related information to the public or investors in order to avert escalation of bad news which increases volatility.*

Keywords: ***Volatility persistence, Asymmetric effects, Stock returns, EGARCH model****.*

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I. Introduction

The financial system is of any economy is the engine that propels growth and development, particularly by serving as the fulcrum that facilitates the flow mechanism between surplus and deficit units in that economy. The financial system is the hub of productive activities, as it performs the vital role of financial intermediation, anchors payment services and serves as the bedrock of monetary policy implementation. The structure of the financial system changes in tandem with the developments in the economy.

Therefore, as a component of the financial system, the capital market provides the platform for mobilizing long-term debt and equity capital investment in long-term projects through a variety of financial instruments. It is made of stock market and bond market. The stock market facilitates trading in long-term debt financing through the issuance of shares or common stock.

However, the return on these stocks is as a function of risk inherent in the market. The risk taker investor is expected to get a return that will compensate for the risk taken in providing such long-term fund. This will accentuate the cost of capital; which is the required rate of return anticipated by an investor for providing long-term sources of fund such as debentures, common share, bond and mortgage loan.

Although financial markets play an indispensable role in the process of economic growth and development by facilitating savings and channeling funds from savers to investors, the problem of high instability of the financial sector has adversely affected the proper functioning of the market. The high volatility of stock market is an indication of high risk of the market.

According to Poterba (2000) the unpredictability impairs the smooth functioning of the financial system and negatively affects economic performance. Besides, it is widely contended that variations in the stock market signal growth. It shows investors sorting out which entities are economically weak or unviable and which are strong and poised for growth. If the stock market only declined, the case could be made that growth too, was only declining. It is on this premise that research of this nature emerges, which confirmed on the need for more research on the variations or volatility and asymmetric effect in the stock market.

Therefore, this study seeks to evaluate volatility persistence and asymmetric effect in the Nigerian capital market using daily sock returns from 1999 to 2016. The data for the analysis were sourced from Nigerian Stock Exchange (NSE) annual reports and facts books.

Statement of Problem

Despite the unassuming roles of the Nigerian stock market, it seems inactive and free or adequate information are not available promptly and widely, the unscrupulous people would be able to manipulate particular prices for their own ends, hence make abnormal gain. Hence, brings about negative perception of the market which ignites asymmetric effects.

In any of these contingencies, the relative values of securities would no longer be 'true' values, so that the relative yields obtainable from them would be mutually distorted. The sign posts, which in a well regulated market show the way along which savings ought to move, would point in the wrong directions. Good business would get less, and indifferent or bad business more financed than they deserved. The savings of the community would be misdirected and wasted. In addition, some investors would incur losses which they might otherwise have avoided, and others might reap profits which otherwise could not have been made.

This assertion of volatility and presence of asymmetric effect in the capital market calls for empirical investigation and has therefore incited this study.

Conceptual/Theoretical Literature

In finance, volatility is the degree of variation of a trading price series over time as measured by the standard deviation of returns; the relative rate at which the price of a security moves up and down. Historic volatility is derived from time series of past market prices. An implied volatility is derived from the market price of a market traded derivative (in particular an option). The symbol 'σ' is used for volatility, and corresponds to standard deviation, which should not be confused with the similarly named variance, which is instead the square, σ^2.

Volatility is found by calculating the annualized standard deviation of daily change in price. If the price of a stock moves up and down rapidly over short time periods, it has high volatility. If the price almost never changes, it has low volatility.

The neoclassical growth model and its stochastic variants are a central construct in contemporary finance, public finance and business cycle theory. It has been used extensively by many scholars in the field of finance. In fact, much of our economic intuition is derived from this model class (Shiller,2000;Manda,2010).

The model has had some remarkable successes when confronted with empirical data, particularly in the stream of macro-economic research referred to as real business cycle theory, where researchers have found that it broadly replicates the essential macro-economic features of the business cycle. It is widely maintained that when this model is confronted with financial market data on stock returns, tests of these models have led, without exception, to their rejection. Most scholars show that for reasonable values of the discount factor, the implied equity is too low when the model is calibrated to reflect historically observed aggregate consumption growth rates.

A relate stream of research has feuded on stock price volatility. The majority of studies to date in this area have been micro studies. Quoting Okpara(2010) "this line of research has its origin in the important early work of Shiller(2000) which found evidence of excessive volatility of prices relative to the underlying dividend/earnings process. Using data for 100 years, Shiller (2000) in his analysis reported that the volatility of actual stock prices exceeded the theoretical upper bound by a factor of 5.59. But their joint studies use a constant interest rate, an assumption subsequently relaxed by Grossman and Shiller (1991) who addressed that, although this reduced the excess volatility, Shiller's conclusion could not be overturned for reasonable value of the co-efficient of relative risk aversion".

In their paper in 1973, Black and Scholes mentioned the parameter ϑ^2 which they said was the 'variance rate of return' on the stock prices. Black and Scholes(1973) took this as a known parameter that is constant through the life of the option.

In a paper prior to their seminal one, Black and Scholes(1973) gave more insight into the variance rate of return. There, they stated that they estimated the instantaneous variance from the historical series of daily stock prices. They thus defined volatility as the amount of variability in the returns and used that as a proxy for the expected volatility in the future. Black and Scholes(1973) assumed that financial asset price are random variables that are log normally distributed. Therefore, returns to financial assets, the relative price changes are usually measured by taking the difference between the logarithmic prices. These differences (the so-called log-relatives) are normally distributed. In that paper, they tested several implications of their model empirically by using a sample of 2039 and 3052 straddles traded on the New York Exchange between 1966 and 1969.

The result of their analysis revealed that the variance actually employed by the market is too narrow and that the historical estimates of the variance include an attenuation bias showing that the spread of the estimates is greater than the spread of the true variance. The implication is that for securities with a relatively high variance, the market prices underestimates the variance, while using historical price series would overestimate the variance and the resulting Black and Scholes model price would thus be too high; the converse is true for relative low variance securities. In further tests, Black and Scholes found that their model performed very well when the true variance rate of the stock was known(Black and Scholes,1973).

Economists have sought to understand the origin of volatility in stock market prices, which appears to exceed the prediction if simple models with rational expectations. Even after the fact, it is hard to explain changes in the stock market using only observable news (Okpara, 2016).

Gabaix, Plerous and Stanley (2003) presented a model in which volatility is caused by the trades of large institutions. Institutional investors appear to be important for the low-frequency movements of equity prices, as shown by Gompers and Metrick (2001). (Okpara,2011).

In their theory, spikes in trading volume and returns are created by a combination of news and the trades by large investors. Supposed news or proprietary analysis induces large investors to trade a particular stock, since his desired trading volume is then a significant proportion of daily turnover, he will moderate his actual trading volume to avoid paying too much in price impact.

Traditional measures such as variances and correlations are of limited use in analyzing spikes in market activity. Many empirical moments are infinite; moreover, their theoretical analysis is typically intractable. Instead, a natural object of analysis turns out to be the tail exponent of the distribution, for which some convenient analytical techniques apply.

Veronesi (1999) and Brennan and Xia (2001) have proposed models in which stock market volatility fluctuates as a result of a learning induced phenomenon. In these models, the growth rate of the economy is unknown and investors attempt to infer it from a variety of public signals. This inference process makes asset prices also depend on the investors' guesses about the dividend growth rate, and this reduces high return volatility.

Black(1976) formulated a model in which expected dividend growth is affected by some unobservable factor. This model also generates countercyclical stock market volatility. This property followed by the model's assumption that the volatilities of dividend growth and consumption are countercyclical. In contrast, in models with time-varying risk premia, countercyclical stock market volatility emerges without the need to impose similar features on the fundamentals of the economy. Remarkably, varying risk premia, countercyclical stock market volatility can be endogenously induced by rational fluctuations in the price-dividend ratio (Mele, 2008)**.**

Empirical Literature

In this section, the researcher made incisive excursion into volatility and stock-return relationship, hence, came out boldly to contradict the positions of Olowe (2009) and Emenike (2009), that few studies have been done on stock market volatility, though Emenike (2009) position is relative.

Meanwhile, Okpara (2016) in his research, "Speculative Financial Bubbles, Volatility and the Nigerian Economy" using month end all share index in naira value from 2000 to 2009, advocated that there is imperfection in Nigeria stock market. As supported by other researchers that Nigerian stock market is random walk efficient. He further revealed that high volatility of stock prices causes share prices not to be 'fundamentally valuation efficient' as they are always determined by speculative trading.

Rahman and Rahman (2007) in his research measuring stock market volatility, examined whether stock returns exhibit periods in which returns show wide swings for extended time period followed by periods of relative calm thus leading to contiguous periods of stability and volatility. The estimated ARCH (1) and GARCH (11) models reveal that it does. Those sources of such volatility are attributable to financial liberalization and behavioral factor. Rahman and Rahman (2007) showed evidence that Nigerian stock market exhibits volatility pooling, has implication for investors' decision making.

Suleiman (2011) investigates the time-varying risk return relationship within GARCH framework and the persistence of shocks to volatility in the stock market in Nigeria. Using GARCH type model, it reveals that NSE is volatile and there is a persistence shocks in the market like in other emerging markets.

Emenike and Aleke (2012) in their work modeling stock returns volatility in Nigeria using GARCH (1, 1), (EGARCH and GJR-GARCH) models. Asymmetric model (EGARCH and GJR-GARCH) were fitted to the daily returns data ranging 3rd January 2006 to 30th December 2011. The results obtained from GARCH (1,1) model show evidence of volatility clustering and volatility persistence in Nigeria.

Ogun, Beer, and Nouyrigat (2005) reports, amongst others that volatility clustering and asymmetric volatility found in the United States and other developed markets are also present in Nigeria. They also reported positive and significant asymmetric volatility coefficient in Kenya, which suggests that positive shocks increase volatility more than negative shocks of the same magnitude.

Olowe (2009) found, amongst others, evidence of volatility persistence and leverage effects. In contrast to Olowe (2009), Okpara and Nwezeaku (2009) contend that volatility clustering is not quite persistence but there exists asymmetric effect in the Nigerian stock market.

Okpara and Nwezeaku (2009) went ahead to conclude that unexpected drop in price (bad news) increase predictable volatility more than unexpected increase in price (good news) of similar magnitude in Nigeria.

Although Suleiman (2011) shows weak evidence for leverage effect in Nigeria but document strong evidence to show that positive news increase volatility more than bad news of the same magnitude in Ghana. Evidences abound to show that positive returns are associated with higher volatility than negative returns of the

same magnitude (Ogun, Beer and Nouyrigat, 2005; Saleem, 2007; Okpara and Nwazeaku, 2009; Suleiman, 2011; Okpara, 2011; Emenike and Aleke, 2012).

Njiforti (2015) revealed in his work the impact of the 2007/2008 global financial crisis on the stock market in Nigeria that 2007/2008 global financial crisis significantly impacted on the Nigerian capital market both in the short-run and in the long-run, hence increased stock return volatility.

Olowe (2009) investigated the relationship between stock returns and volatility in Nigeria using E-GARCH-in-mean model in the light of banking reforms, insurance reform; stock market crash and the global economic and financial crisis. Volatility persistence, asymmetric property and risk-return relationship are investigated for the Nigeria stock market.

It was found that the Nigeria stock market returns show persistence in the volatility and clustering and asymmetric properties. This similar result was found for other emerging markets (Karmakar, 2005; Pandey, 2005; Karmaka, 2005; Leon, 2008; Kumer and Singh, 2008). The result also shows that volatility is persistent and there is leverage effect (Nelson, 1991; Suleiman, 2011; Okpara and Nwezeaku, 2009; Okpara, 2011; Suleiman, 2011; Emenike and Aleke 2012).

Adamu (2009) in his study on the effects of global financial crisis on Nigerian economy disclosed among other things that financial crisis caused a fall in commodity prices and also fall in equity market.

Olowe (2009) contend that the stock market crash of 2008 is found to have contributed to the high volatility persistence in the Nigeria stock market especially during the global financial crisis period. The stock market crash also contributed to the sudden change in volatility.

Suleiman, (2011) in his study of stock return and volatility using GARCH model found the presence of volatility in the conditional variance and long-run volatility persistence in the Nigerian stock market. However, his analysis was based on market index and not on market return even when his work was on return and volatility.

Nwezeaku and Okpara (2009) examined the effect of the idiosyncratic risk and beta risk on the returns of 41 randomly selected companies listed on the NSE from 1996 to 2005. They used a two-step estimation procedure, sample data to determine the beta and idiosyncratic risk for each of the companies; second, a cross sectional estimation procedure was used employing EGARCH (1:3) model to determine the impact of these risks on the stock market returns. Nwezeaku and Okpara (2009) results revealed, among others, that volatility clustering is not quite persistent but there exists asymmetric effect in the Nigerian stock market. They concluded that unexpected drop in price (bad news), increases predictable volatility more than unexpected increase in price (good news) of similar magnitude in Nigeria.

Engle, Lilien and Robins (1987) introduced the GARCH-in-mean to examine relation between stock return and volatility to enable risk-premium trade-off to be measured. Many researchers following Engle, Lilien and Robins (1987) did the same study. Meanwhile, there is mixed evidence on the nature of this relationship. It has been found to be positive as well as negative (Kumar and Singh, 2008). French, Schwert and Stambaugh (1987) used daily and monthly returns on the NSE stock index to investigate the relation between risk and return. They found evidence that expected market risk premium is positively related to predictable volatility of stock returns.

Theodossiou and Lee (1995) reported a positive but insignificant volatility relationship between stock market volatility stock returns. In line with the asymmetric volatility argument, researches report negative and often significant relationship between the volatility and return (Nelson, 1990; Glosten et al, 1993; Bekaert and Wu, 2000; Brandt and Kang, 2003).

Chou, (1988) and Baillie and DeGennaro, (1990) rather found a positive relation between the predictable components of stock returns and volatility. But Campbell (1987) used an instrumental variance specification for conditional moments and found negativerisk-return trade-off.

Pagan and Hong (1991) used non-parametric techniques and found a weak negative relationship between risk and return. Harrison and Zhang (1991) found that the relationship between risk and return is significantly positive at longer horizons.

II. Materials and Methods

The summary of parameter estimates of the EGARCH-in-mean models of the market returns will be examined in order to determine asymmetric effect and volatility persistence of the market.

Specification of Analytical Model

The EGARCH-in-Mean Model:

If the conditional variance is introduced into the mean equation, the ARCH-in-mean (ARCH-M) model is derived.

$$Y_t = X_t Y_t + Y_2 \vartheta^2_{t-1} + \epsilon_t$$

This is often used in financial applications where the expected return on an asset is related to the expected asset risk. It is however often the case that the conditional variance, ϑ^2_t is not an even function of the past

disturbances, U_{t-1}, $U_{t-2},\ldots,U_{t-n}$, an important feature which often observed when analyzing stock market returns (Koulakiotis, Papasyriopuolos and Molyneux, 2006).

In order to arrest this important feature, Nelson (1991) proposed the EGARCH model which incorporates leverage effect and observed asymmetric volatility changes with the change in return sign. In this model, the log of conditional variance implies that the leverage effect is exponential, rather than quadratic and that forecast of the conditional variance is guaranteed to be non-negative.

The model for conditional variance is specified as follows:

$$\text{In } \vartheta^2_t = \omega + \beta_{in}\, \vartheta^2_{t-1} + \propto \left[\frac{\epsilon t-1}{\vartheta t-1} - \frac{2}{x}\right] + \Upsilon \left|\frac{\epsilon t-1}{\vartheta t-1}\right|$$

Where, ω, β, $\propto$, Υ are constant parameters,

In ϑ^2_t = the one period ahead volatility forecast

ω = the mean level, β = persistence parameter

$\propto$ = volatility clustering coefficient

In ϑ^2_{t-1} = the past variance, Υ = the leverage effect.

Unlike the GARCH model, the EGARCH model allows for leverage effect. The choice of this method stems from the fact that in a developing economy, the market consists of risk-averse investors as the opportunity to invest and diversify the investment is not much. Hence, the expected returns on asset should significantly move in the same direction with the expected risk of the asset.

Decision Rule

If the expected variance can be used to predict expected returns in, 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 imposes a non-negativity constant on market variable, and allows for conditional variance to respond asymmetrically to returns innovations of different signs. If γ is negative, leverage effect exists. 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 is called the 'sign effect'. If $\propto$ is positive, then the conditional volatility tends to rise (fall) when the absolute value of the standardized residuals is larger (smaller). $\propto$ is called the 'magnitude effect'.

Determination of Expected Returns

To capture the most reliable activities and returns overtime, the researcher resorted to using daily data index running from 1999 to 2016.

The daily stock prices of the entire listed companies were used to obtain daily stock returns over the period. The researcher therefore used the logarithm of relative prices multiplied by 100 to calculate continuously compounding monthly stock returns. In the words of Leon (2008), the use of logarithmic price changes prevents non-stationarity of the level of stock prices from affecting stock returns volatility. The computation is done as follows;

$$R_t = 100 \text{ In } (P_t / P_{t-1})$$

Where,

R_t = stock market returns

P_t = the stock market price index for the period t

P_{t-1} = the price index for the period t-1

Ln = the logarithm operator

This method is too common and has been used by so many authors (Leon, 2008; Koulakiotis, Papasyriopoulos and Molyneux, 2006; Okpara, 2011) and other researchers.

III. Results and Discussions

This section made use of data which are computed returns of Nigeria Stock Market from 1999 to 2016. The full data were analyzed and interpreted to ascertain the output of the analysis of EGARCH-in-Mean method.

Table 1: Parameter Estimates of the EGARCH-in-Mean models

Variance Equation			
ω	β	$\propto$	Υ
10.19150	0.009547	-0.345968	-0.033519
(0.0000)	(0.9561)	(0.0253)	(0.8273)

The figures in the bracket are the probability values

The results above were interpreted as follows;

From the above table 1, the persistent parameter (β) is positive, but not significant indicating that the Nigeria stock market volatility is not persistent. In support of the above assertion, government from time to time always monitors the activities of financial system which houses the stock market. Whenever there is a perceived crisis or fluctuations or dwindling in the market, an appropriate bailout plans or palliative measures will be introduced by the government to remedy the situation. This affirms why volatility is not persistent in the Nigeria stock market.

Also, from the above table 1, ϒ is negative and insignificant, implying that there is asymmetric effect in the Nigeria stock market. As seen in the review, Stock return volatility rises more following stock price declines (bad news), than following stock price increase (good news). There are a host of popular explanations for this well-known 'Asymmetry' in stock return volatility. For example, when news of global economic meltdown of 2007/2008(bad news) hit the market, it astronomically raised prices of stock in the stock market thereby increased volatility in the market. More so, the recapitalization exercise of Nigerian banking and insurance industries in July 2004 and September 2005 respectively(which was bad news to banks and insurance firms for the fear of losing their business and job), accentuated the number of securities in the stock market and at the time created an increasing public awareness and confidence on the stock market.

IV. Discussion of Findings

This study revealed that the persistent parameter (β) is positive, but not significant. This shows that the Nigeria stock market volatility is not significantly persistent. In support of the above assertion, government from time to time always monitors the activities of financial system which houses the stock market. Whenever there is a perceived crisis or fluctuations or dwindling in the market, an appropriate bailout plans or palliative measures will be introduced to remedy the situation. This affirms why volatility is not persistent in the Nigeria stock market.This result contradicts with the findings of Ogum, Beer and Nougriyat (2005), Olowe (2009), Suleiman (2011), and Emenike (2009) who found persistent volatility clustering in Nigeria.

The finding indicates ϒ is negative and insignificant, implying that there is asymmetric effect in the Nigeria stock market. As seen in the result, Stock return volatility rises more following stock price declines (bad news), than following stock price increase (good news). There are a host of popular explanations for this well-known 'Asymmetry' in stock return volatility. For example, when news of global economic meltdown of 2007/2008(bad news) hit the market, it astronomically raised prices of stock in the stock market thereby increased volatility in the market. This corroborates the works of Ogum, Beer and Nougriyat (2005), Okpara and Nwaezeaku and Okpara (2009), Olowe (2009), Emenike (2009) and Okpara (2010). The asymmetric effect advocates that negative shocks increase volatility more than positive shocks of the same magnitude.

V. Summary

The researcher employed EGARCH-in-Mean model in carrying out the study. The empirical analysis revealed the following;

i. that the Nigeria stock market volatility is not persistent.

ii. That there is asymmetric effect in the Nigeria stock market.

VI. Conclusion and Recommendation

This study provide strong evidence that negative shocks have higher effect on volatility than positive shocks of the same magnitude and the Nigerian capital is volatile but not persistence. Therefore, from the above premises, the following recommendations are made available;

i. From the findings it was observed that there is asymmetric effect in the stock market. Therefore, the Nigerian stock market should ensure timely disclosure and appropriate dissemination of company related information to the public or investors in order to avert escalation of bad news which increases volatility.

ii. These study revealed that Nigerian stock market is volatile, but not persistent. This is because of the timely interventions of government whenever such mayhem appears. As matter of fact, the concerned regulatory bodies in Nigeria should be consistent in promulgating such laws, rules, palliative measures, bailouts and procedure to instill trust and confidence in the Nigerian stock market.

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APPENDICES

Sample (adjusted): 2 4197

Included observations: 4196 after adjustments

Convergence achieved after 16 iterations

Presample variance: backcast (parameter = 0.7)

LOG(GARCH) = C(4) + C(5)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(6) *RESID(-1)/@SQRT(GARCH(-1)) + C(7)*LOG(GARCH(-1))

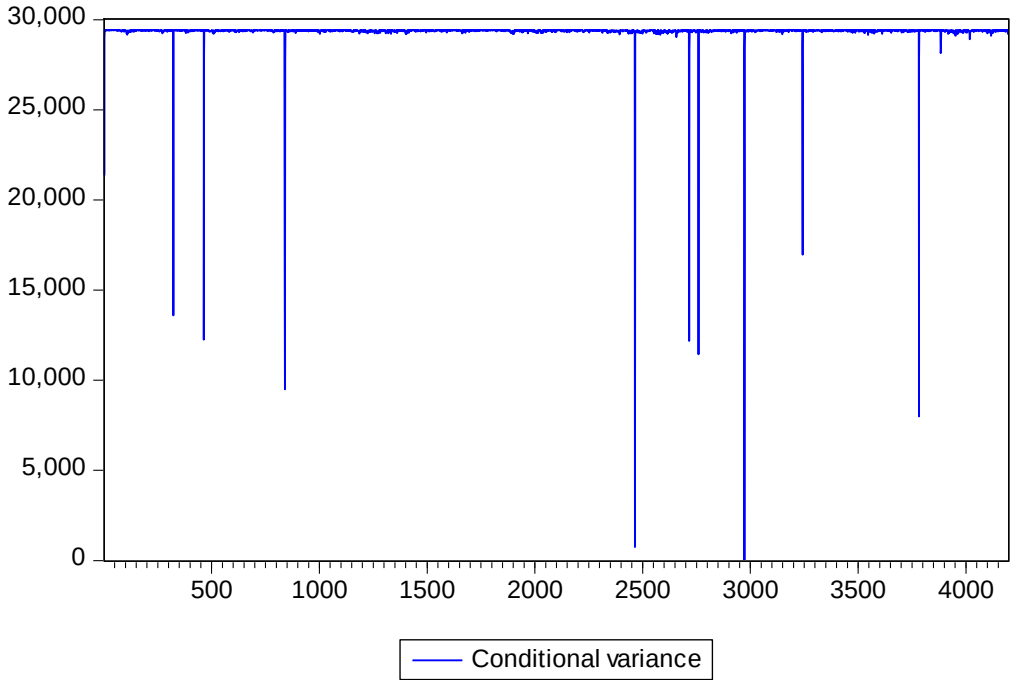
Variable	Coefficient	Std. Error	z-Statistic	Prob.
GARCH	0.000582	0.000270	2.157337	0.0310

RETURNS1	0.001652	0.001259	1.311453	0.1897
C	-17.06441	13.01291	-1.311345	0.1897

Variance Equation

C(4)	10.19150	1.784307	5.711743	0.0000
C(5)	-0.345968	0.154693	-2.236486	0.0253
C(6)	-0.033519	0.153647	-0.218156	0.8273
C(7)	0.009547	0.173413	0.055054	0.9561

R-squared	-0.000034	Mean dependent var	1.659336
Adjusted R-squared	-0.000511	S.D. dependent var	163.7153
S.E. of regression	163.7572	Akaike info criterion	13.03352
Sum squared resid	1.12E+08	Schwarz criterion	13.04410
Log likelihood	-27337.32	Hannan-Quinn criter.	13.03726
Durbin-Watson stat	1.998057		



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