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A Test of Asymmetric Volatility in the Nigerian Stock Exchange

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Abstract: This study seeks to test for the presence of asymmetric effect in the Nigerian Stock Exchange. In order to achieve the objective of the study, the researcher obtains the average market return, the equilibrium market returns generated by the risk factors of the APT, and then subjects them to asymmetric tests using the TAR-GARCH technique. Findings from the study reveal that equilibrium market return generated by pre-specified APT does not significantly respond to information asymmetry. This implies that is volatility does not really change with information. However, the equilibrium market return generated by statistical APT exhibits the presence of information asymmetry whereby the volatility of stock returns significantly responds to information. This reveals the presence of leverage effect in the Nigerian stock market whereby stock returns volatility increases with bad news but the volatility reduces with good or positive news. The researcher recommends that government agents in respect of this market should provide more adequate means of information diffusion into the market at zero cost to all participants.

Keywords: Information Asymmetry, Stock Exchange, Pre-specified APT Model, Statistical APT, TAR-GARCH, Market Return

1. Introduction

Information drives prices of securities in the market. As a matter of fact many informational factors influence the changes in stock prices. This is market efficiency which, according to Brealey and Meyers (2003) [1], stipulates that stock prices are informationaly efficient which means that prices correctly reflect all available information and quickly respond to any new information at the moment it becomes available. These informational factors include information about the company fundamentals, external factors and market behaviours. Company fundamentals include factors like changes in management, creation of new assets, changes in dividends and earnings, and so on. On the other hand, external factors include the monetary policy which influences macro-economic variables like inflation and money supply. These have been proven by Anokye&Tweneboah, 2008 [2]; Chen, Roll & Ross, 1986 [3] among others, to have significant influence on changes in stock returns.

The response of volatility to information (either good or bad) is referred to asymmetry. Chiang and Doong, (2001) explaining the asymmetric effects, points out that negative shock to stock return tend to bring about higher volatility than a positive shock of equal magnitude [6]. They also point out that recent empirical evidence has indicated asymmetry in the impact of news whereby bad news and good news may have different impacts on predicting future volatility.

Avramov, et al. (2006) point out that asymmetric effects result from stock trading activities.[8] They explain that informed investors sell stock after prices rise leading to a decline in volatility; while the uninformed traders however, sell stock when prices drop which increases stock return volatility.

Many other studies have also reported asymmetric relationship between volatility of securities and returns whereby positive returns bear a lesser effect on future stock volatility than negative stock returns of similar magnitude. The two main explanations being advanced for this behavior are leverage effect and volatility feedback effect.

Although, extensive studies have been carried out on the asymmetric effect on conditional variance in the advanced and other emerging markets, not much however, has been done in the Nigerian capital market. Prominent among these studies include the studies of Nelson, (1991) using the Exponential

GARCH model [9] as well as the Threshold Autoregressive GARCH (TAR-GARCH) model of Glosten, Jagannathan & Runkle (1993) [11]. It is reported that the TAR-GARCH specification appears attractive as it requires fewer parameters to be estimated. Corroborating this, Engle and Ng (1993) study daily stock returns in the Japanese stock market and find the parameterization of the TAR-GARCH most promising one. [12]

In the light of this, the present study shall employ the Threshold Autoregressive GARCH (TAR-GARCH) model of GJR (1993) to test the presence of asymmetric effect in the Nigerian Stock Exchange.

2. Literature Review

Information asymmetry is the response of volatility to negative or positive news. Although several studies have reported asymmetric volatility in the developed and emerging stock markets, mix reports have also been documented by some other studies. For instance, Alagidede and Panagiotidis, (2009)[13]; Charlse, (2010)[14]; Oskooe and Shamsavari, (2011)[15], among others reported the absence of asymmetric volatility in the emerging stock markets. While others like Aliyu, (2011)[16], Saleem, (2007) document evidence that positive returns however bring about a higher volatility than negative returns of the same magnitude.[17]

There are few but growing literature on asymmetric volatility in the Nigerian stock markets. For example Ogum, Beer and Nouyrigat (2005) show evidence that the asymmetric volatility and volatility clustering observed in the developed market is also found in the Nigerian stock market.[18] Their findings also showed a positive and significant asymmetric volatility in Kenya stock market which implies that positive shocks are associated with a higher volatility than negative returns of the same magnitude. In the same vein, Emenike and Aleke, (2012) use daily closing prices of stocks on the Nigerian Stock Exchange to examine how volatility responds to positive and negative shocks. [19] The result of the EGARCH showed a positive and significant asymmetric volatility. Their overall result shows that positive news generates higher volatility than negative returns of the same magnitude in Nigeria.

Also, while Olowe (2009) document the persistence of volatility and leverage effect in Nigerian stock market [20], Okpara and Nwezeaku (2009) show that though there is presence of asymmetric effect but volatility is not persistent in the NSE. [21] They point out that unexpected drop in stock price i.e bad news increases predictable volatility more than unexpected rise in stock price i.e good news of the same magnitude.

Emenike and Aleke, (2012) submit that the majority of the empirical studies in Nigeria document the presence of volatility clustering as well as asymmetric effect , although a mix results were reported on the persistence of volatility. [19] The empirical regularity in volatility literature from Nigeria is the existence of volatility clustering and asymmetric volatility, but volatility persistence is contended.

The findings from Onwukwe, Bassey and Isaac (2011) show evidence of volatility clustering and the presence of leverage effect in UBA, Guiness, Mobil and Unilever returns series [22]. Okpara (2011) also documents an evidence of low persistence of volatility clustering and presence of leverage effect in the NSE. [23]

Asymmetric effects have been explained in terms of leverage effect and volatility feedback effect. The most celebrated of the asymmetric effects is the leverage effect which was first documented by Black (1976) [24]. Leverage effect means that a negative shock causes greater increase in volatility than a positive shock of the same magnitude. It postulates that a large negative return leads to increase in financial as well as operating leverage, which in turn, increases stock returns volatility. Black (1976) explains that a fall in the price of a firm's stock will lead to a negative return on that stock, and this will increase the leverage (i.e debt-equity ratio) of the firm. [24] The firm becomes more risky with increased leverage because as the shareholders perceive the stream of their future cash flow to be relatively more risky thereby bringing about further increase in volatility. Several empirical studies have also reported the existence of leverage effect in different stock markets both in the developed as well as emerging markets (see, Black, 1976 [24]; Christie, 1982 [26], Nelson, 1991; [9]etc).

Another explanation for asymmetric effect is volatility feedback effect documented by Campbell &Hentschel (1992) [27]. They describe volatility as a measure of risk, and as such an increase in volatility implies increased risk and and also the expected future risk will be higher. An investor requires higher return to compensate for the increased risk. According to them, an increase in risk premium of the market with increased volatility will lead to large negative returns which in turn will increase the future volatility of stock returns by more than proportionate (Campbell & Hentschel, 1992). [27] In the same vein, other studies like Berry and Howe, 1994 [28]; Connolly and Stivers, 2000[29]; French and Roll, 1986 also reported factors like mispricing, private information, news ambiguity as well as dispersion in beliefs as major determinants of volatility. [30]

Several studies have found significant asymmetric effect in market-wide equity index returns, and point out the volatility feedback effect as the cause of the observed asymmetric effect in the aggregate market returns (see Glosten, et al., 1993 [11] and Nelson, 1991[9], e.t.c).

Andersen, Bollerslev, Diebold and Ebens, (2001) note that little is known about the distribution of correlation of returns on individual stocks. [32] According to them, if leverage effect is the cause of the volatility asymmetry in individual stock, then a change in financial leverage may also affect the covariance between different stocks, which in turn is likely to impact the correlations. Hence, it was noted that the different multivariate ARCH models estimated in Kroner & Ng (1998) result in significant asymmetric effect in the conditional covariance matrices for weekly returns on well diversified large and small portfolios of stock. [33]. In the same vein, Ang and Chen, (2002) find significant asymmetries in the

correlation between the market and other industry, size and book-to-market portfolios[34]. Braun, Nelson and Sunier (1995) document an evidence that the overall market volatility responds in asymmetric manner to both negative and positive shocks. However, symmetric effect was reported for time-varying conditional betas for size and industry-sorted portfolios. Cho and Engle (1999) document asymmetric effects for a set set of daily returns of individual stocks. [36]

3. Methodology

The study made use of time series secondary data on stock returns and some macro-economic variables like exchange rate (ER), Interest rates (risk-free rate), Consumer price Index (CPI), market capitalization and reserves. The data were sourced from the National Bureau of Statistics, Nigerian Stock Exchange, and the Central Bank of Nigeria over a period of 120 months from January 2004 to December 2013. All data were taken on monthly basis.

First differences of monthly stock prices were computed to derive returns while first differences of other macro-economic variables were also taken.

The descriptive statistics that reveal the properties of the time series data used in this study were computed.

In determining the presence of asymmetry in the Nigerian stock market the researcher obtains the average market return, the equilibrium market returns generated by the pre-specified APT and the equilibrium market returns generated by the statistical APT; and then subjects them to asymmetric tests using the TAR-GARCH technique.

3.1. Asymmetric Model

Threshold Autoregressive GARCH (1,1)-in-mean Model

Recent studies have indicated asymmetry in the impact of news in the sense that good and bad news having different effects on volatility prediction in future. According to Attari and Safdar (2013), volatility tends to increase during the period of decrease in growth, while it however, falls during high growth. [37] However, neither ARCH nor the GARCH model can capture this asymmetry. Therefore, there is the need for a more accurate model that can better explain the existence of asymmetry in volatility.

Studies have been carried out to extensively investigate the asymmetric effect on conditional variance by employing models like the Exponential GARCH model (Nelson, 1991 [9]; Pagan and Schwert,1990) [10] and the Threshold Autoregressive GARCH model as in Glosten, Jaganatha&Runkle,(1993) [11], etc. According to Chiang &Doong, (2001), the Threshold Autoregressive GARCH model is very attractive as it requires few parameters to be estimated. [7] Also, Engle and Ng (1993) study daily stock market returns in Japan and find the parameterization of the Threshold Autoregressive GARCH model most promising. [12] This study therefore, employed the TAR-GARCH model in tandem with the objective of the study.

The researcher has hypothesized that the Nigerian capital market is characterized with information asymmetry; which makes arbitrage practices to be effective. To test this hypothesis, the asymmetry model of Glosten, et al (1993) [11] was employed in a modified version as stated below:

$$\sigma_t^{\,2} = \mathrm{y}_0 + \mathrm{y}_1 e_{t-1}^{\,2} + \mathrm{y}_2 (1 - D) e_{t-1}^{\,2} + \mathrm{y}_3 \sigma_{t-1}^{\,2} \quad (1)$$

Where:

$e_{t-1}^{\,2}$ is ARCH

$\sigma_{t-1}^{\,2}$ is GARCH

(1-D) is asymmetric term represented by Dummy. Dummy variables take values from 0-1. When Dummy value is insignificant, the market will be efficient and there would not be room to take the advantage for arbitrage opportunity. However, when it is significant, the market will be inefficient and arbitrageurs could take the advantage for arbitrage opportunity. Hence, there is need to test whether the arbitrage risk factors are priced.

3.2. Test of Hypothesis

The following hypotheses shall be tested:

H_0: There is no information asymmetry in the Nigerian capital market.

H_i: There is information asymmetry in the Nigerian capital market.

4. Descriptive Statistics

The relevant descriptive statistics in the context of this study are mean, standard deviation, skewness, kurtosis and Jarque-Bera test. These statistics were computed for the series of capitalization rate, exchange rate, reserves, risk free rate and inflation rate from Jan 2004 to Dec 2013. Table 1 below presents the summarized results of the descriptive statistics:

Table 1. *Descriptive Property of Capitalization rate, Reserve, Exchange Rate, InflationRate and Risk free Rate.*

	CR	RV	ER	IR	RF
Mean	0.028393	0.006476	-0.006997	0.000242	0.010580
Std. Dev.	0.167760	0.103696	0.092938	0.093491	0.248982
Skewness	5.243110	-7.655747	-10.24362	-10.32158	1.816801
Kurtosis	49.05782	75.41625	110.5164	111.0389	16.56472
Jarque-Bera	11156.42	27392.78	59897.51	60492.74	986.0231
Probability	0.000000	0.000000	0.000000	0.000000	0.000000
Observation	120	120	120	120	120

Source: Computed by the researcher using E-view window 7.0.

The average values of capitalization rate, reserves, inflation rate and risk-free rate are approximately 0.03, 0.006, 0.0002 & 0.01 respectively; while exchange rate has mean value of -0.007. These suggest that the variables maintain increasing tendency except exchange rate over the period from January 2003 to December 2013. Risk-free rate has the highest standard deviation (25%). This means that the most volatile rate among these variables is risk free rate. The kurtosis values of all the variables are positive and appear to be larger than 3 implying strongly that the variables are all leptokurtic in nature but they are differently skewed. While capitalization rate and risk free rate are positively skewed towards normality, the rest are found to be negatively skewed. However, in all cases the probabilities of the JB statistics are zeros less than the alpha value of 1%. Thus, the null hypothesis which states that the series are not normally distributed is accepted at 99% confidence level.

5. Results and Discussion

The statistical results of the TAR-GARCH specifications which indicate the asymmetric effects or leverage effects of these volatilities are presented in the table below; while the asymmetry graphs in respect of these returns are depicted in the appendix (see appendix).

Table 2. *Result of the Test Conducted on the Presence of Asymmetric Effects in theMarket Average Return, Market Equilibrium Returns Generated by Statistical and Pre-specified APT.*

Variable	Market Return		Statistical APT Return		Pre-specified APT Return	
	Coefficient	z-Statistic	Coefficient	z-Statistic	Coefficient	z-Statistic
C	0.001497	3.901564	0.000483	3.681424	0.077427	0.741674
RESID(-1)^2*(RESID(-1)<0)	-0.028116	-0.393207	0.014683	0.033284	-0.184096	-0.222111
RESID(-3)^2*(RESID(-2)<0)	0.210607	0.437578	-0.082754	-0.920983	0.023351	0.025055
RESID(-3)^2*(RESID(-3)<0)	0.111214	0.660864	0.056948	0.162183	-0.247797	-0.427675
RESID(-4)^2*(RESID(-4)<0)	-0.042654	-0.795684	0.110067	0.316732	-0.401639	-0.622235
RESID(-5)^2*(RESID(-5)<0)	-0.124377	-0.674177	-0.153301	--3.02681*	0.492811	0.565968
RESID(-6)^2*(RESID(-6)<0)	-0.106343	-1.50439	-0.157463	-1.266208	0.118254	0.120395
RESID(-7)^2*(RESID(-7)<0)	-0.004577	-0.025967	-0.139716	-0.468054	0.197777	0.148603
RESID(-8)^2*(RESID(-8)<0)	0.085502	0.343886	0.188439	1.093992	-0.091988	-0.089335
RESID(-9)^2*(RESID(-9)<0)	0.144668	1.03265	0.07062	0.357552	0.252221	0.36216

Source: Computed by the researcher, using E-view window 7.0.
Note: *The significant variable in astericks(*)*

The researcher examines the asymmetric effects of these series up to lag 9 which is the maximum lag permissible in E-view. The results thereof are presented on table 2 From the table, asymmetric coefficient is significant at lag 5 only for the return generated by the statistical APT. This suggests that there is asymmetric effect in the equilibrium market return generated by the statistical APT and therefore, the volatility of the return generated by the statistical APT responds significantly to information in the Nigerian stock market. However, volatility of the market return nearly responds to information asymmetry at lag 6. Hence, the null hypothesis that there is no information asymmetry in the market is rejected while the alternative hypothesis of the presence of information asymmetry is accepted.

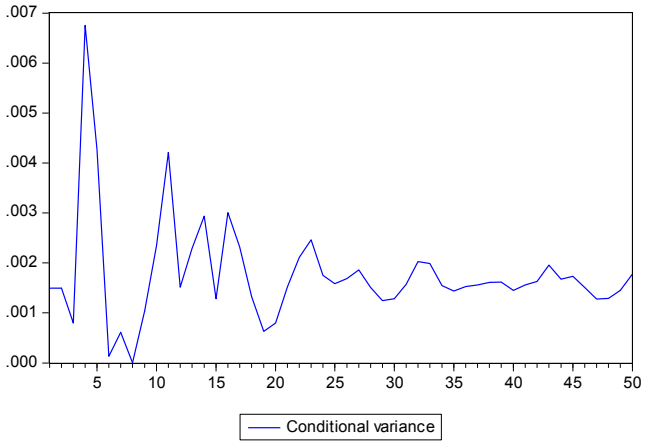
This study therefore reveals that equilibrium market return generated by pre-specified APT is not sufficiently explained by its volatility and this volatility does not significantly respond to information asymmetry. The implication of this is that the equilibrium market return generated by pre-specified APT does not generate much leverage effects, that is volatility does not really change with information. However, the equilibrium market return generated by statistical APT exhibits the presence of information asymmetry i.e that volatility of stock returns significantly responds to information. This reveals the presence of leverage effect in the Nigerian stock market whereby stock returns volatility increases with bad news but the volatility reduces with good or positive news. This is in tandem with Ederington& Lee (1993, 1996) [38], Andersen and Bollerslev (1996) [32], Almeida, et al. (1997) [39] and Chen et al. (1999) who posit that the release of public information is an important driver of market volatility. [3]

6. Conclusion and Recommendation

Although the volatility of average market return does not respond to asymmetric information, but the volatility of the discount rate imputed to the statistical APT exhibits such tendency. Asymmetry only clusters significantly in the case of statistical APT. Thus, it is further concluded that arbitrage portfolio discount rate volatility increases with negative information but decreases with positive news. In view of this, the researcher recommends that government agents in respect of this market should provide more adequate means of information diffusion into the market at zero cost to all participants. News about prices should be disseminated as quickly as possible through appropriate channels.

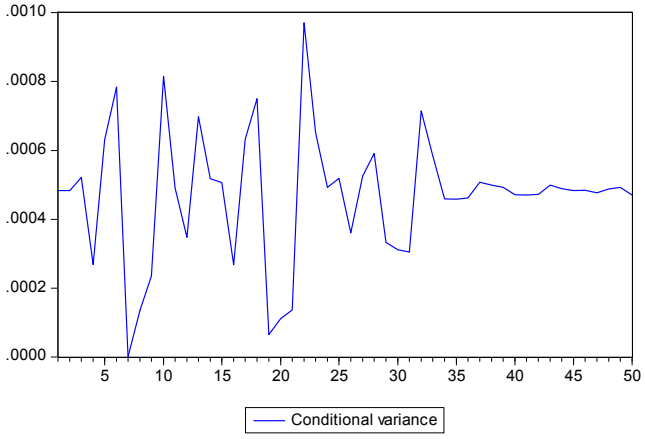
Appendix 1

Asymmetric graph of the Market



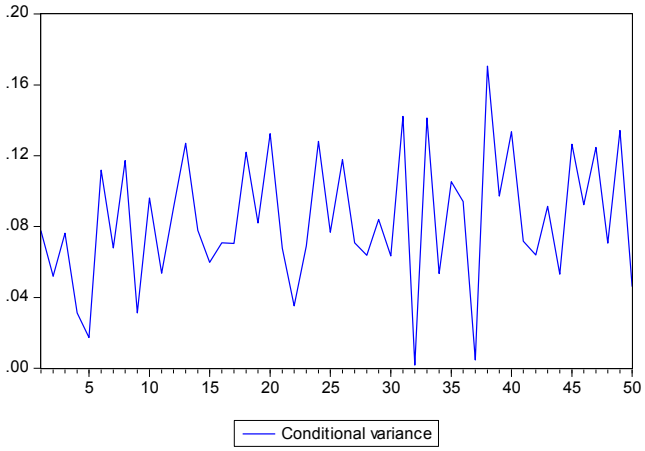
Appendix 2

Asymetric graph of Statistical APT



Appendix 3

Asymmetric Graph of the Prespecified APT



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