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Stock Market Volatility and Economic Growth in Nigeria (1980-2010)

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Abstract

The study examines the relative contributions of stock market volatility on economic growth in Nigeria for the periods of 1980 to 2010 using Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH). The study reveals that the volatility shock is quite persistent in Nigeria and this might distort growth of the economy. In the light of the above, the study recommends that for the stock market to be less volatile, Securities and Exchange Commission (SEC) itself should be strengthen both in terms of number of manpower and quality of the professionals involved with special focus on independent research, monitoring mechanism and prompt decision making.

Keywords: Volatility, Stock Market, Economic Growth, Arch and Egarch.

Introduction

A common problem plaguing the low and slow growth of developing economies is the lack of depth of the financial sector. Although, financial markets play an important 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. In the submissions of Poterba (2000), the unpredictability impairs the smooth functioning of the financial system and negatively affects economic performance. Also, it has been claimed that volatility in the stock market signals growth. It reflects 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 Wang (2010). It is however clear from the literature that the issue of stock market volatility and economic growth still cause controversy among scholars and the results are therefore mixed.
Evidently, there is need for more research on the volatility in stock market. Most related studies (see Abugri, 2008; Pierdzioch, et al 2008 and Vrugt, 2009) fail to model the instability in stock market. Also, very little attention is paid on the use of appropriate model selection criteria including pre-test as suggested by Engle (1982) to determine the choice of volatility model and validate the preferred model over other competing models. Although the importance of stock market volatility on economic growth has received much attention, the studies with respect to Nigeria have been few. This study intends to address these issues. In the next section, we present the review of literature while an overview of the Nigerian capital market is presented as Appendix 1.

Literature Review

The stock market is an ever-growing important feature of the economy. One of the most enticing and long-lasting debates in economics revolves around whether or not there is a link between stock market volatility and economic growth. Many researches focus on the relationship between stock market volatility and macroeconomic performance (real output, inflation, investment). The recent empirical investigations provide mixed results.

On one hand is the view that stock market volatility is significantly and positively correlated to economic growth (see Ahmed & Samad, (2008); Levine & Zervos, 1998), while on the other hand, there is still doubt on its contribution to long-run-economic-growth. Indeed, some analysts even claim that stock market volatility has an adverse effect on the economy (Adjasi & Biekpe, 2006). Most studies however tend to focus mainly on the developed countries (Ahmed 2005; Levine & Zervos, 1998) while existing literature in African regions is scarce (Osinubi, & Amaghionyeodiwe, (2003); Rahman & Rahman, 2007; Chinzara, 2011).

Though the importance of stock market volatility on economic growth has received much attention, a highly inadequate number of research works have been done to investigate whether or not there is a relationship between stock market volatility and economic growth in the case of Nigeria economies.
Campbell *et al.* (2001) suggests that stock market volatility has significant predictive power for real GDP growth. However, Guo (2002) shows that the relationship between stock market volatility and economic activity is not fully robust to deserve model specifications. In regressing GDP growth on contemporaneous stock market volatility, Guo finds a significant and negative effect on GDP growth. However, once controlled for the current stock market return or for the current and past return jointly, the effect of instability tends to weaken or becomes insignificant. Hence, the conclusion from his work is that stock market returns drive out stock market volatility in forecasting output and, therefore, beyond stock market returns the volatility of the stock market provides no additional information about future output.

Our model differs in two fundamental ways from the models adopted by Bloom (2009) and Alexopoulos and Cohen (2009). Whereas the aforementioned authors utilized 2 lags in their regressions, this study allow for 4 lags in our model. Secondly, through the use of a VAR we also allow for feedbacks among the endogenous variables. The role of the feedback effect of stock market volatility via the stock market return can be explored by taking the stock market return out of the vector of endogenous variables and entering it as an exogenous variable. Hence, the stock market return is no longer allowed to react to the stock market volatility. This is equivalent to an experiment in which in response to volatility shock of the impulse response of the stock market return is counterfactually held fixed at its baseline value.

Raju and Ghosh (2004) in attempting to calculate the volatility of stock prices for a number of countries came into conclusion that both in Indian and Chinese stock market volatility is higher compared to other emerging economies. Döpke et. al. (2005) using monthly data of Germany concluded that volatility in the stock market can be explained by the performance of major macroeconomic indicators which have influence on business cycles.

Wang (2010) investigates the time-series relationship between stock market volatility and macroeconomic variable volatility for China using Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) and Lag-Augmented VAR (LA-VAR) models and found evidence that there is a bilateral relationship between inflation and stock prices. In addition, a unidirectional relationship exists between the interest rate and stock prices, (from stock prices to the interest rate). However, a significant relationship between stock prices and real GDP was absent. Our study however is an archetype of this study but the structure of Nigerian economy is quite different from China. China today is known to be an emerging country in the world whereas Nigeria is still a developing nation.

Gupta and Modise (2011) estimate the predictive power of selected macroeconomic variables for South Africa. They report that for in-sample forecasts, interest rates, the money supply and world oil production growth have some predictive power in the short run, that for out-of-sample forecasts, interest rates and the money supply exhibit short-run predictability, and that the inflation rate shows a strong out-of-sample predictive power. Chinzara (2011) studies macroeconomic uncertainty and stock market volatility for South Africa. He indicates that stock market volatility is significantly affected by macroeconomic uncertainty, that financial crises raise stock market volatility. In addition, volatilities in the exchange rates and short-term interest rates were reported as the most influential variables affecting stock market volatility whereas volatilities in oil prices, gold prices and inflation play minor roles in affecting stock market volatility.

In Nigeria, Augustine and Pius (2010) examined the impact of stock market development on long-run economic growth in Nigeria using time-series data for 21 years, 1986 to 2006. The paper used Ordinary Least Square technique to analyze various models employed. The GDP per capita growth was adopted as the dependent variable. The independent variables include total market capitalization, total value of shares traded, and turnover ratio. Other variables that may introduce bias in the results were controlled. Augustine and Pius found that stock market size and turnover ratios are positive in explaining economic growth, while stock market liquidity coefficient was negative in explaining long-run growth in Nigeria. The volatility measures of stock market returns in Nigeria from 1980 to the first quarter of 2010 is presented in Figure 1. The trend tends to be upward and rightward leaning from 1980 up till the first quarter of 2008. Thereafter, the stock market crash manifested itself with the loss of confidence as part of a global recession.

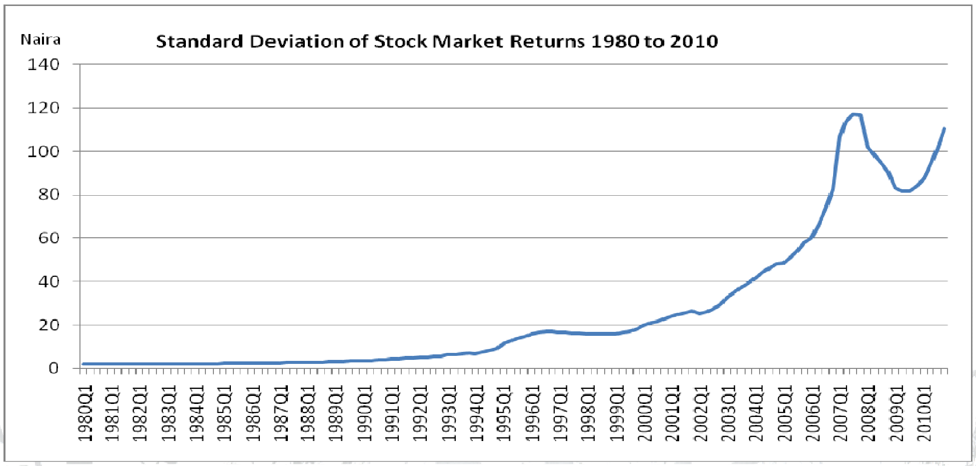

Figure 1 : Volatility measures of Stock Market Returns
Source: Authors' Computation from Central Bank of Nigeria (2010)

In summary, the relationships between stock markets and economic growth have been examined in several developed and developing countries. The jury is still out on the matter. In this study, we examine the asymmetric relationships between stock market volatility and macroeconomic variable volatility based on Nigerian data for the periods 1980 to 2010. Furthermore, we used AR (k) - EGARCH (p, q) model to estimate the volatility of the stock market and of real GDP. The model is presented in the next section.

Model

Theoretically, heterosecdasticity is often associated with cross-sectional data, while time series are usually employed when studies are concerned with homoscedastic processes. However, in analyzing macroeconomic data, Engle (1982) found evidence that the disturbance variances in time-series models were less stable than usually assumed for some kind of data. Such instance is the changes over time in the uncertainty of stock market returns, which are measured using variance and covariance. Hence, more attention is paid on the heteroskedasticity when performing the time series analysis. It is necessary to specify the variance dynamics (volatility) for this problem. Engle (1982) recommended the ARCH (autoregressive conditional heteroskedasticity) model as an alternative to the standard time series treatments when a phenomenon known as 'volatility clustering' exists. Volatility clustering refers to the observation, as noted by Mandelbrot (1963), that "large changes tend to be followed by large changes, of either sign, and small changes tend to be followed by small changes." A quantitative manifestation of this fact is that, while returns themselves are uncorrelated, absolute returns $|rt|$ or their squares display a positive, significant and slowly decaying autocorrelation function: corr($|rt|$, $|rt+\tau|$) > 0 for τ ranging from a few minutes to several weeks. The ARCH model takes the high persistence of volatility into consideration and so has become one of the most common tools for characterizing changing variance and volatility.

Bollerslev (1986) extended the ARCH model into the Generalized ARCH (GARCH) model. The advantage of the GARCH model is that a small number of terms seem to perform better than an ARCH model with many terms. It is commonly assumed that volatility is likely to rise during periods of falling growth and fall during periods of intensifying growth. However, neither the ARCH nor the GARCH model can capture this asymmetry or lopsidedness.
The Exponential GARCH (EGARCH) model developed by Nelson (1991) has the capacity to demonstrate the existence of asymmetry in volatility with respect to the direction of real growth. The EGARCH (*p*, *q*) model is given by

$$\log \sigma_t^2 = \psi + \sum_{i=1}^{p} (\lambda_i |z_{t-i}| + \varphi_i z_{t-i}) + \sum_{i-1}^{q} \beta_i \log \sigma_{t-i}^2 \qquad 1$$

where:

$z_t = \varepsilon_t / \sigma_t$ and

ε_t = error term.

The left-hand of equation 1 is the logarithm of the conditional variance. The logarithmic form of the EGARCH (p, q) model certifies the non-negativity of the conditional variance without the need to constrain the model's coefficients.
The asymmetric effect of positive and negative shocks is represented by inclusion of the term z_{t-i}. If $\varphi_i >$ 0 (< 0) volatility tends to rise (fall) when the lagged standardized shock, $z_{t-i} = \varepsilon_{t-i} / \sigma_{t-i}$ is positive (negative).
The persistence of shocks to the conditional variance is given by $\sum_{i=1}^{q} \beta_i$. As a special case, the EGARCH (1, 1) model is given as follows:

$$\log \sigma_t^2 = \psi + \lambda |z_{t-i}| + \varphi_i z_{t-i} + \beta_1 \log \sigma_{t-1}^2 \qquad 2$$

For a positive shock (z_{t-1}>0), equation (2) becomes:

$$\log \sigma_t^2 = \psi + (\lambda + \varphi_i) z_{t-i} + \beta_1 \log \sigma_{t-1}^2 \qquad 3$$

and for a negative shock (z_{t-1}<0), equation (2) becomes

$$\log \sigma_t^2 = \psi + (\lambda - \varphi_i) z_{t-i} + \beta_1 \log \sigma_{t-1}^2 \qquad 4$$

Thus, the presence of a leverage effect can be tested by the hypothesis that $\varphi = 0$. The impact is asymmetric if $\varphi_i \neq 0$. Furthermore, the parameter β governs the persistence of volatility shocks for the EGARCH (1, 1) model. There are several benefits to using the EGARCH model. First, since the log value of volatility is used as an explained variable, there is no need to impose non-negative constraint on the parameters of variance dynamics. Secondly, the EGARCH model can take into consideration the asymmetric effect of the volatility. Thirdly, only the coefficients of the GARCH term govern the persistence of volatility shocks.
Considering this role, it is useful to estimate the volatility of the stock market and of economic growth by applying the EGARCH approach. This analysis will provide empirical evidence regarding the asymmetric relationships between the volatility in the stock market and economic growths. This research study employs a secondary quarterly time series data for the periods of 1980:1 to 2010:4 on stock price index, real GDP and consumer price index as measure of economic activities. Also utilized are data on inflation and short-term interest rate which exert influences the economic activity and stock market for the same period.

Using the data described above, the study perform a two-step procedure to examine theoretically the relationship between stock market volatility and economic growth volatility. The first is the estimation of the volatility of each variable using the AR-EGARCH model and the second step being the descriptive statistic of the variables employed. The Exponential GARCH (EGARCH) Model estimated is given below:

$$\log(\sigma^2) = \omega + \sum_{j=1}^{q}\beta_j \log(\sigma_{t-j}^2) + \sum_{t=1}^{p}\alpha_i \left|\frac{\in_{t-i}}{\sigma_{t-i}} - E\left(\frac{\in_{t-i}}{\sigma_{t-i}}\right)\right| + \sum_{k=1}^{r}\gamma_k \frac{\in_{t-k}}{\sigma_{t-k}} \quad 5$$

the equation above is in line with Nelson (1991)'s specification for the restricted log conditional variance and is used to examine the asymmetric relationship between stock market volatility and macroeconomic volatility in Nigeria while the conditional mean is specified in an autoregressive process of order as follows:

$$y_t = \chi_0 + \sum_{i=1}^{k}\chi_i y_{t-i} + \varepsilon, \qquad E_t(\varepsilon_t) = 0, \qquad E_{t-1}(\varepsilon_t^2) = \sigma_t^2, \quad 6$$

The study estimates a series of univariate time-series model to allow for time variation in both the conditional mean and conditional variance. We used AR(k)-EGARCH(p, q) to model the dynamic in the real GDP growth, inflation rate, interest rate and stock returns in Nigeria. The study therefore estimates the volatility of real growth rates of GDP, inflation rate, interest rate and stock returns in Nigeria using maximum likelihood method. Hence, Schwarz Baysian Information Criterion (SBIC) is used for the selection of the best regression results with reference to smaller SBIC values.
In addition, ARCH Lagrange Multiplier Test was used to test for the presence of serial correlation in the residual. In using the SBIC and residual diagnostics, the following models are selected: the AR (1)-EGARCH (1,1) for real GDP growth model (GDP), the AR(2)-EGARCH(2,1) for the inflation rate (INFL), the AR(1)-EGARCH(1,2) model for the interest rate (IR) and the AR(4)-EGARCH(2,2) model for stock returns (SP). In the next section, we present the result and discussion on the estimated model.

Results and Discussion

Empirical Analysis of EGARCH result
The result of the estimation is presented in Table 1.

Table 1: Empirical Results of AR-EGARCH model

	GDP	**IR**	**SP**	**INFL**
Model	AR(1)-EGARCH(1,1)	AR(1)-EGARCH(1,2)	AR(4)-EGARCH(2,2)	AR(2)-EGARCH(2,1)
Mean Equation				
GARCH	2.68(1.14)*	-2.65(0.46)*	-15.04(4.67)*	1.05(0.21)*
χ_0	-0.33(0.13)**	0.58(0.08)*	1.80(0.39)*	-0.84(0.07)*
χ_1	0.17(0.08)**	-0.36(0.06)*	-0.28(0.15)**	0.46(0.05)*
χ_2			0.14(0.03)*	0.02(0.13)
χ_3			0.07(0.03)**	
Variance Equation				
Ω	-2.94(0.87)*	-2.57(0.16)*	-2.46(0.19)*	-0.64(0.17)*
α_1	-0.35(0.13)*	0.27(0.19)	0.04(0.06)*	0.36(0.07)*
α_2	0.08(0.12)	-0.84(0.06)*	-0.05(0.06)*	-0.28(0.11)*
α_3			-0.07(0.04)**	
α_4			0.04(0.03)	
β_1	-0.13(0.09)	-0.58(0.07)*	0.06(0.02)**	-0.04(0.05)
β_2		-0.08(0.01)*	-0.04(0.02)	0.15(0.04)*
γ	2.03(0.76)*	-1.76(0.28)*	-0.57(0.07)*	0.77(0.05)*

Note: 1. The numbers in parentheses are the standard errors.
2. *(**) indicates the statistical significance at the 1% (5%) level.
3. GED is the generalized error distribution parameter.

Table 1: Empirical Results of AR-EGARCH model contd.

	GDP	IR	SP	INFL
Model	AR(1)-EGARCH(1,1)	AR(1)-EGARCH(1,2)	AR(4)-EGARCH(2,2)	AR(2)-EGARCH(2,1)
Diagnostic				
GED	0.40(0.13)**	0.41(0.15)**	0.35(0.04)*	0.20(0.04)*
$O*R^2$	0.896	5.465**	0.066	0.054
LM	0.749	6.859**	0.053	0.056
SBIC	-1.57	-1.69	-3.37	-0.47

Note: 1. The numbers in parentheses are the standard errors.
2. *(**) indicates the statistical significance at the 1% (5%) level.
3. GED is the generalized error distribution parameter.

The results from the table above reveal the parameter estimates and their corresponding standard error, indicating that the coefficient of the GARCH term (β) is estimated to be -0.13 for the GDP, -0.58 and -0.08 for the interest rates, 0.06 and -0.04 for the stock returns, and -0.04 and 0.15 for the inflation rates. The results of interest rate are statistically significant at 1% level and one of the results of both stock returns and inflation rate is significant at 5% and 1% levels respectively.

The coefficient of the ARCH term (α) is estimated to be -0.35 and 0.08 for the GDP, 0.27 and -0.84 for the interest rates, 0.04, -0.05, -0.07 and 0.04 for the stock returns, and 0.36 and -0.28 for the inflation rate. One is significant at 1% level for the GDP and interest rate, three are significant at 1% and 5% levels for the stock returns and the two coefficients are significant for the inflation rate. The asymmetric parameter (γ) is estimated to be 2.03 for the GDP, -1.76 for the interest rate, -0.57 for the stock returns and 0.77 for the inflation rate. All are statistically significant at 1% level. Also, the table reveals that the null hypotheses of no autocorrelation for the standardized residuals is accepted for all variables except for interest rate whose $O*R^2$ is statistically significant at 5% level. In addition, LM, the Lagrange Multiplier test statistic for ARCH in residual, is distributed as chi-square. It is clear from the table that the null hypothesis of no further ARCH effect in the residuals is accepted for each variables except for interest rate. These results claim that the selected model specification of the AR-EGARCH model explains the data well.
As regards the parameters estimated based on the AR-EGARCH model in table 1, the volatility of Nigeria's GDP inflation rate, interest rate and stock returns can be calculated.

Table 2: Descriptive Statistics of Volatility

	GDP	INFL	IR	SP
Mean	0.176	0.024	0.014	0.208
Std. Deviation	0.227	0.752	0.269	0.313
Skewness	-0.193	-0.194	-0.190	-0.747
Kurtosis	5.084	3.940	2.902	3.842
Jarque-Bera	24.643	23.899	24.685	15.211
p-value	0.001*	0.008*	0.001*	0.011*

Note: * indicates the statistical significance at the 1% level.
Source: Authors' Computation, 2012

From the table 2, it can be observed that the mean and standard deviation of the stock returns (SP) volatility is fairly high compared to other variables. The table also shows that the volatility for the stock returns and the macroeconomic variables demonstrate negative skewness and relative high levels of kurtosis.

The Jarque-Bera normality test used to examine whether the disturbances are normally distributed shows that all the variables are normally distributed. The corresponding p-values also show that all the variables are significant at 1% level. for the variables. These results strongly confirm that Nigeria's stock prices are much more impulsive than the major macroeconomic variables.

Discussion

It is universally accepted that higher stock prices enhance household wealth which in turn encourages consumers to spend more. A rise in stock prices also makes it cheaper for firms to raise funds and invest more. Meanwhile, the rise in the value of collateral, such as real estate, increases banks' enthusiasm to lend. All these factors can swell domestic demand and accelerate the increase in real GDP growth.
Therefore, if stocks prices truthfully reflect the basic fundamentals, then the stock prices should be used as principal indicators of future economic activity. Similarly, since the value of corporate equity at the aggregate level depends on the state of the economy, it is plausible that a change in the level of uncertainty about future economic growth could produce a change in the stock market. However, the result of our empirical analysis suggests that there exists a bi-causal relationship between volatility of Nigeria's stock market and that of its real GDP.
This result reveals that small investors are more interested in short-term gains and ignore long-term investment opportunities. This makes Nigeria's stocks more volatile than those in mature markets like developed nations and less correlated to longer-term company performance and economic growth. Therefore, the stock market performance of the listed companies in Nigeria can hardly reflect their real economic competence. In fact, the Nigerian stock market is somewhat separated from the real economy, and the stock indexes do not reflect the actual situation of the economy.

Conclusion

This study examined the relationship between the stock market volatility and volatility in the real GDP, inflation, and interest rate. The study employed secondary data and analyzed the data using AR (k)-EGARCH (p, q) to estimate the volatility in each of the variable employed and found a bi-causal relationship between volatility of Nigeria's stock market and that of its real GDP.

Policy Recommendations

Thus, this study shows that Nigerian Stock market is not responsive to changes in macroeconomic factors in spite of the sizable proportion of stock market capitalization as a share of the country's GDP. Hence, predicting stock prices and returns via changes in macroeconomic performance becomes precarious and this affects economic forecast, planning and growth. It thus becomes obvious that Nigerian Stock market might be very sensitive to global macroeconomic factors or other salient issues in the Nigerian environment which of course warrants further investigation.
In order to make the stock market more stable and reduce the vagaries of its performance, the manpower and processes of the Securities and Exchange Commission (SEC) should be further strengthened. This should enable the organization improve on its oversight function of the capital market and engender improvement its performance.

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APPENDIX 1

The Nigerian Capital Market

The Nigerian capital market is regulated by the Securities and Exchange Commission (SEC). The Nigerian Stock Exchange (NSE), which is the main institutional operator of the market, is an automated exchange, established in 1960. It is the second largest financial centre in Saharan Africa. The Exchange is licensed under the Investments and Securities Act (ISA), and a full member and executive committee member of the African Securities Exchanges Association (ASEA), and an affiliate member of the World Federation of Exchanges (WFE).
The Exchange provides listing and trading services, as well as electronic clearing, settlement and delivery (CSD) services through its subsidiary - the Central Securities Clearing System (CSCS) Ltd. It also offers custodian services along with securities listing, trading services, market data dissemination services and market indices. The Nigerian capital market was deregulated in 1993, and in 1995, certain laws were repealed in favor of unrestricted foreign participation by investors. Since then, foreign flows into the Nigerian capital market have continued to rise, in the form of foreign portfolio investment. There are 103 companies listed on the Exchange with market capitalization valued at USD 52.6 billion as at October 5, 2012 (NSE, 2012).