Stock Market Performance of Firms in the Nigerian Petroleum Sector Using the ARIMA Model Approach

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Abstract  
The study was on stock market performance of quoted oil firms in the Nigeria using the ARIMA model approach. The problem of study is that that previous studies have questionable methodologies when measuring the impact of certain factors on stock market returns. Again, the existence of multiple competing models immediately calls into question the robustness of previous findings, the squared returns of some of the models also obscured by very noisy volatility indicators. The objective of study is to examine the impact of liquidity measured by turnover ratio on stock market returns of petroleum firms in the Nigerian Stock Market. In the methodology used was the ARIMA model, findings indicate evidence that AR is stationary and MA is invertible. For the three oil firms under study it was evident that there were significant relationship between their liquidity measured by market capitalization ratio and their respective stock market returns. Amongst the three quoted oil firms, Mobil Plc at 74.3% had the lowest R2 which indicates that liquidity had a positive and significant impact on stock market returns for the company shares but was much lower than the other quoted companies which could be attributed to lower stock trading in line with the works of Raghbendra (2003) and Ekanem (2003). It has been statistically proven that macroeconomic variables have a strong significance on changes in market performance and value of market capitalization. Hence the Nigerian Securities and Exchange Commission to encourage increase in after-tax profits of petroleum sector based firms. Recommendations include making strategies to be designed toward reaping abnormal returns by exploiting information and actions that enhance inefficiency in stock markets thus, firms and individuals should be encouraged to buy or sell securities outside their face values, as a means of encouraging business or economic activities in the economy this is due to large volatilities in some markets. As a risk control strategy knowledge of portfolio rebalancing can be seen where an informed investor acknowledges the usefulness of compounding effect of returns on his portfolio by calculating based on compound average and not simple average. Hence more research can be made in studying theoretical and empirical applications of models measuring weighty risk management strategies such as portfolio rebalancing.

1.0 Introduction  
Nigeria has been an oil producing giant in the last five decades to the detriment of their agricultural potential in export previously famed for its comparative advantage. These agricultural products, mostly cash crops like cocoa, groundnut, cotton and palm oil apart from
being the mainstay for earnings then were also administered at a period in the country’s history when the administration of these cash crops were not only regionally controlled but the revenue derived from these where not too concentrated at the center as it is seen today. Regions developed at their pace with minimum intervention from the central government. This not only made it is easy to measure performance of the different sectors of agriculture but it ensured some reasonable equity in distribution of rewards according to contribution. But more prominently, since the 1970s it has become apparent that Nigeria’s external reserves increased in leaps and bounds due to the earnings from oil with the attendant increase in government expenditure while the traditional sources of income were neglected.

By the 1970s there were macro-economic- indicators warning about the consequences to the Nigeria’s foreign reserves not just on near complete reliance on crude oil receipts but the increased government expenditure as well. This over-confidence in the policy of non-diversification away from oil was to have disastrous consequences following the oil glut of the early 1980s. Despite the direct and indirect monetary and fiscal policy instruments available to the government ranging from monetary restrictions, fiscal measures and direct interventions to salvage the worsening conditions at the time many blamed policy makers while the government blamed international conspiracy.

Multinational companies have been operating in Nigeria since the 1800s; however it was only after independence in 1960 that some of the multinationals included non-British companies. By the 1970s after the indigenization decree the capital holding of foreign companies plummeted. Considering the economic, military and strategic importance of the oil sector the Nigerian government broke the monopoly of Shell BP, a British company which had the sole license to operate in the entire onshore and offshore oil exploration and prospecting rights courtesy of the Colonial Mineral Ordinance of 1914 which was formally abrogated by the General Gowon’s regime fifty years ago in 1969 with the enactment of Petroleum Decree Act of 1969. This decree vets the entire ownership and control of all petroleum found under or upon Nigerian lands, territorial water or within Nigeria’s continental shelf with the Nigerian government or its agencies. The enactment of this decree was necessary to strengthen Nigeria’s hold on the oil industry through the issuing of oil exploration and prospecting licenses. Subsequently, there was more legislative backing through the necessary amendments to improve Nigeria’s influence in oil refining, distribution and price control.

In the 1960s and 1970s, there were attempts through legislation to increase Nigerian equity participation in the oil industry and to improve the joint oil venture relationship with the oil companies. There was production sharing contracts conveniently devised through policy to assist Nigerian stakeholders through technology and funding by foreign partners. To complement the production service contract was the Risk Service Contract which specifically mandates foreign oil companies to undertake all forms of investment on oil production. By 1971, Nigeria joined the Organization of Petroleum Exporting Countries (OPEC). An OPEC resolution No. XVI 90 of 1968 which obligated members to acquire 51% of the equity interest of foreign oil companies operating in their countries and to participate actively in all aspects of oil operations. Also in 1971 and in response to the resolution the Nigerian National Oil Corporation (NNOC) was established. The NNOC was granted oil leases over a large area and was allowed to take over the concessions withdrawn from foreign companies and also train sufficient number of quality staff such as engineers, geologists, hire foreign contractors to work for it on agreed terms. NNOC was not itself an Operating Company but a Holding Company which provided policy guidelines for its subsidiaries and implemented government decisions.
Decree No.33 of 1st April 1977 established the Nigerian National Petroleum Corporation (NNPC) which took over the assets and liabilities of NNOC. This was due to the increased participation of Nigeria in the oil industry it become imperative to establish a new oil company with wider powers and freed them from all restrictions imposed on NNOC.

Oil companies have been granted licenses for oil exploration or prospecting and mining licenses. In terms of overall economic growth, the oil sector has played a dominant role in the last forty five years. The GDP of the country soared due to greater activity in crude oil production and export of crude oil. Due to the decline of the country’s traditional exports (mostly agricultural) crude oil receipts accounted for about 90% of the national income. Should Nigerian oil reserves be depleted or face a significant fall in price then one can be certain that without diversification the income would certainly drop.

1.1 Statement of problem
Amihud et al (2005) in studying liquidity and asset pricing believes that the increasing importance of standard deviation inclusive models in measuring volatility and liquidity of stock market returns is not unconnected to the general understanding that there is a need to model risk measures that would capture the effect of liquidity and volatility on returns.

In theory the problem under investigation is that previous studies have questionable methodologies when measuring the impact of certain factors on stock market returns. Again, the existence of multiple competing models immediately calls into question the robustness of previous findings, the squared returns of some of the models also obscured by very noisy volatility indicators. Some research did not perform some tests such as diagnostic/post estimation tests, unit root tests or even the granger causality tests making it difficult to place complete reliance on the inference.

1.2 Objectives of study
The objective of study is to examine the impact of liquidity measured by turnover ratio on stock market returns of petroleum firms in the Nigerian Stock Market.

2.0 Literature review
Many models on liquidity and volatility had been developed based on empirical regularities in trading order flow in the various stock exchanges studied. Components of the model are validated against real data. Many of the models describe endogenous dynamics of liquidity and volatility. Engel R.F and Bollerslev (1986) fitted parameters of each component of the model using simulation to make predictions about volatility distribution and spread, and comparing the statistical properties of the simulation to the measured statistical properties of volatility and spreads in the data during the same period of time.

Serious interest in the functional form of the distribution of prices began with Mandelbrot’s (1963) study of cotton prices, in which he showed that logarithmic price returns are far from normal and suggested that they might be drawn from a levy distribution. Studies by Fama (1965) and Akgiray (1989) indicate that the cumulative distribution of logarithmic price changes has tails that are asymptotically large. It is important because it characterizes the risk of extreme price movements and corresponds to the threshold above which the moments of the distribution become infinite. Having a good characterization of price returns has important practical consequences for risk control and option pricing.
We find support for a negative relation between conditional expected monthly return and conditional variance of monthly return, using a GARCH-M model modified by allowing (1) seasonal patterns in volatility, (2) positive and negative innovations to returns having different impacts on conditional volatility, and (3) nominal interest rates to predict conditional variance. Using the modified GARCH-M model, we also show that monthly conditional volatility may not be as persistent as was thought. Positive unanticipated returns appear to result in a downward revision of the conditional volatility whereas negative unanticipated returns result in an upward revision of conditional volatility.

French, Schwert and Stambaugh (1987) wrote that the tradeoff between risk and return has long been an important topic in asset valuation research. Most of this research has examined the tradeoff between risk and return among different securities within a given time period. The relationship between risk and return has been examined by several authors—to name a few. This paper extends that research. There is general agreement that investors, within a given time period, require a larger expected return from a security that is riskier. However, there is no such agreement about the relation between risk and return across time. Whether or not investors require a larger risk premium on average for investing in a security during times when the security is more risky remains an open question.

At first blush, it may appear that rational risk-averse investors would require a relatively larger risk premium during times when the payoff from the security is more risky. A larger risk premium may not be required, however, because time periods which are relatively more risky could coincide with time periods when investors are better able to bear particular types of risk. Further, a larger risk premium may not be required because investors may want to save relatively more during periods when the future is more risky. If all the productive assets available for transferring income to the future carry risk and no risk-free investment opportunities are available, then the price of the risky asset may be bid up considerably, thereby reducing the risk premium.

Hence a positive as well as a negative sign for the covariance between the conditional mean and the conditional variance of the excess return on stocks would be consistent with theory. Since there are conflicting predictions about this aspect of the tradeoff between risk and return, it is important to empirically characterize the nature of the relation between the conditional mean and the conditional variance of the excess return on stocks as a group. The empirical literature on this topic has attempted to characterize the nature of the linear relation between the conditional mean and the conditional variance of the excess return on stocks. However, the reported findings are conflicting. Campbell and Ludger (1992) concludes that the data are consistent with a positive relation between conditional expected excess return and conditional variance, whereas Nelson (1991) fined a negative relation. Geert and Guojon (1997) find no significant variance effect for the United States, but implicitly find one of the world market portfolio. Hinich and Patterson (1985) provides empirical evidence suggesting that there are possibilities of sometime variation in the relation between risk and return. Most of the support for a zero or positive relation has come from studies that use the standard GARCH-M model of stochastic volatility. Other studies, using alternative techniques, have documented a negative relation between expected return and conditional variance. In order to resolve this conflict we examine the possibility that the standard GARCH-M model may not be rich enough to capture the time series properties of the monthly excess return on stocks. Hinich and Patterson (1985) considers a more general specification of the GARCH-M model.
In particular, (1) they incorporated dummy variables in the GARCH-M model to capture seasonal effects using the procedure first suggested by Glosten, Jagannathan, and Runkle (1988), (2) They also allowed for asymmetries in the conditional variance equation, following the suggestions of Glosten, Jagannathan, and Runkle (1988) (3) Also included is the nominal interest rate in the conditional variance equation, and (4) They considered the EGARCH-M specification suggested by Nelson (1991) with the modifications mentioned in (1) through (3) above.

These models suggest a weak but statistically significant negative relation between conditional variance and expected return. Two of their findings are somewhat at odds with the existing literature. First, the data provides little evidence to support the belief that the conditional volatility of the monthly excess return on stocks is highly persistent, while Nelson (1991) finds high persistence in the volatility of daily returns. There are no theoretical reasons for the properties of the monthly and daily returns to be the same. In particular, Nelson (1991) argues that as the frequency at which data are sampled becomes very high, persistence should become larger. Second, both unexpected positive and negative excess returns on stocks change the next period's conditional volatility of the excess return on stocks.

Unexpected positive returns result in a downward revision while unexpected negative returns result in an upward revision. In contrast, Nelson (1991) and Engle and Ng (1993) using daily data on stock index returns, find that large positive as well as negative unanticipated returns lead to an upward revision in the conditional volatility, although negative shocks of similar magnitude lead to larger revisions. Hence the time series properties of monthly excess returns are somewhat different from those of daily returns reported in Nelson (1991) and Engle and Ng (1993) and our results for monthly data along with the results for daily data reported by others provide a more complete characterization of the time series properties of stock index returns.

The fundamental role of stock market is to provide adequate guarantee to shareholders for the existence of market for their second hand securities. Adequate knowledge about the volatility, performance and efficiency of stock returns remains vital and essential information to investors. These will guide not only investment decisions but also planning for economic growth and development. The stock returns efficiency and volatility have generated heated debates and interests among economists, stock market analysts, government regulatory and policy makers. These interests and debates stem in part from the implication for market efficiency, stock market bubbling, market crash and recession in some sectors of the economy (Nyong, 2005).

In most advanced countries of the world, capital and financial markets have played pivotal roles in their economic development among others obtained quantitative evidence to justify the proposition that financial and capital markets positively influence the growth of American economy. Similar studies have been carried out in Japan, Australia, Belgium, Berlin, Budapest, Denmark, Finland, Luxembourg, Moscow, New York, Ottawa, Poland and Wellington with mixed conclusions. While some studies have focused solely on capital markets, others have dwelled on financial market role on economic growth and development.

The interaction between stock market returns and market performance is strongly related to the efficient market hypothesis put in place by Fama (1965). Having provided the most popular explanation of the dynamics of equity returns; the efficiency market hypothesis (EMH)
harbours useful information on how current stock return is already contained in the most recent previous stock data. For market performance, the stability of stock returns ought to be a major concern. This of course is linked to the efficiency of the market.

Forgha (2012) presents empirical evidence of the efficiency and volatility of stock returns in five stock markets in Africa namely, Cameroon, Nigeria, South Africa, Egypt and Kenya. Although the markets have proven to be inefficient based on Generalized Autoregressive Conditional Heteroskedasticity Mean (GARCH-M), Augmented Dickey Fuller (ADF) and the Variance Ratio tests, there are still supporting evidence to justify that, there are profit opportunities in these markets. Therefore, in as much as stock market is a medium for secondary securities, it is an agent of economic development.

The study by Alam et al (1999), used Lo (1991) and Mackinlay variance ratio test on monthly, quarterly and yearly stock process from 1970-1996 to demonstrate that random walk hypothesis cannot be rejected. Recent research by Ndikumana (2009) found strong presence of inefficiency and volatility of asset returns in six countries. Ndikumana regressed using stock returns on two periods, Lagged Stock Returns, Current and Lagged dividend yield, current and lagged growth rate of output and interest rate based on vector autoregressive (VAR) methodology. His findings reveal that inefficiency in stock returns increases in low frequency data compared to high frequency data.

Different approaches have been adopted to investigate the efficiency and volatility of stock returns in different markets. Most of these studies have adopted the capital asset pricing model, among which are the works of Nasri (2005), Aghetsiata (2003), Makina (2006). The ARCH approach and its various modifications have been shown to provide a good fit to many financial return time series (Poon and Taylor 1992; Bessembinder 1993; Engel and Bollersler 1986; Lo and Mackinlay 1988 and Najand and Yung 1991). This is because changes in the variability of returns over time are expected to impact on the risk or profit of an investment (Nyong, 2005).

Based on the limitations embodied in the ARCH, studies have also adopted the Generalised Autoregressive Conditional Heteroskedasticity (GARCH). Using the GARCH Engel et al (1995) observed that the coefficient of relative risk aversion is approximately 3.0 in the US stock market using monthly data for over thirty five years. According to Engel et al., Capital Pricing Model (CAPM) might have performed better in the French and Fama estimation if the betas were conditioned on contemporaneous information (Nyong, 2005).

The magnitude of fluctuations in the return of an asset is called its volatility. The prediction of volatility in financial markets has been of immense interest among financial econometricians. This interest is further rekindled by Bollerslev et al. (1994) when they established that financial asset return volatilities are highly predictable. It is true that unlike prices, volatilities are not directly observable in the market, and it can only be estimated in the context of a model.

It has been observed in early sixties of the last century (Mandelbrot, 1963) that stock market volatility exhibits clustering, where periods of large returns are followed by periods of small returns. Later popular models of volatility clustering were developed by Engle (1982). The autoregressive conditional heteroskedastic (ARCH) models (Engle, 1982) and generalized ARCH (GARCH) models (Bollerslev, 1986) have been extensively used in capturing volatility clusters in financial time series (Bollerslev et al., 1992). Using data on developed markets, several empirical studies (Akgiray, 1989; West et al., 1993) have confirmed the superiority of
GARCH-type models in volatility predictions over models such as the naïve historical average, moving average and exponentially weighted moving average (EWMA).

GARCH models can replicate the fat tails observed in many high frequency financial asset return series, where large changes occur more often than a normal distribution would imply. Financial markets also demonstrate that volatility is higher in a falling market than it is in a rising market. This asymmetry or leverage effect was first documented by Black (1976) and Christie (1982). Three popular GARCH formulations for describing this asymmetry are Power GARCH model (Ding et al., 1993), Threshold GARCH model (Glosten et al., 1993) and Exponential GARCH model (Nelson, 1991). Empirical results also show that augmenting GARCH models with information like market volume or number of trades may lead to modest improvement in forecasting volatility (Brock, 1992; Jones et al., 1994). The association between stock return volatility and trading volume was analyzed by many researchers (Karpoff, 1987).

The initial research on price-volume relation can be attributed to Osborne (1959) who attempted to model stock price change as a diffusion process with the variance dependent on the number of transactions. In a recent study on individual stocks in the Chinese stock market, Wang et al. (2005) showed that inclusion of trading volume in the GARCH specification reduces the persistence of the conditional variance dramatically, and the volume effect is positive and statistically significant in all the cases for individual stocks. However, another study on the Austrian stock market (Mestel et al., 2003) found that the knowledge of trading volume did not improve short-run return forecasts. Most of the studies on the relationship between return volatility and trading volume have used volume levels.

There have been a few attempts to model and forecast stock return volatilities in emerging markets. Gokcan (2000) finds that for emerging stock markets the GARCH (1,1) model performs better in predicting volatility of time series data. In another market specific study, Yu (2002) observes that the stochastic volatility model provides better volatility measure than ARCH-type models. A few studies were conducted (Varma, 1999 and 2002; Kiran Kumar and Mukhopadhyay, 2002; Raju and Ghosh, 2004; Pandey, 2005) on modeling stock return volatility in the world’s largest democracy, India. Varma (1999) showed, using daily data from 1990-1998 of an Indian stock index (Nifty), that GARCH (1, 1) with generalized error distribution performs better than the EWMA model of volatility. In a later study, Pandey (2005) showed that extreme value estimators perform better than the conditional volatility models. In another recent study, Varma, 1999) used conditional volatility models to estimate volatility of fifty individual stocks and observed that the GARCH (1, 1) model provides reasonably good forecast.

Empirical research across financial markets has noted regularities in intraday behavior of volume and volatility. Typically, both the volatility of returns and volume of trading is found to be “U-shaped”, i.e., more at the beginning and at the close of trading as compared to rest of the trading hours. In some markets, the increase towards the close of trading is less pronounced resulting in so called “reverse J” shaped pattern or even “L shaped” intraday pattern. Researchers have also explored the role of information flow and of the microstructure variables as determinants of intraday volatility.

Cross-listed stocks, where the foreign listing is in a market in different time-zone, present a case where the trading continues much after it has stopped for other stocks. Since these stocks are traded overnight (in foreign market), relatively more recent price quotes are available and
hence variance of price at opening should be low for these stocks, assuming that information can flow freely (Amihud and Mendelson 1991). Amihud and Mendelson (1987) observe that pricing errors at open are lower for cross-listed stocks vis-à-vis other stocks and conclude that available sequence of transaction prices from the trading day in other markets facilitates faster price discovery for cross-listed stocks.

Another phenomenon of empirical interest in the context of intraday dynamics is the effect of expiry of derivative contracts on prices, volume and volatility. Alkeback and Hagelin (2004) find high volumes but no price distortions in Swedish market. Vipul (2005), based on low-frequency data from Indian stock market, notes that the price and volatility are sometimes distorted near expiration day in the Indian market due to unwinding of cash positions by arbitrageurs in cash markets.

There is debate how introduction of index futures trading influence cash market volatility. One group of author's views argued that, the introduction of index futures trading decreases spot market volatility, due to speculative traders migrated from spot to futures market. Gokcan (2000) suggested that spot market volatility decreases by higher liquidity provided by speculators. This additional liquidity allows hedging the position and curb volatility attributes to order imbalance. There are several ways by which futures market increases the efficiency and smoothen price variations in the underlying spot market. Futures markets provide a mechanism for those who buy and sell the actual commodity to hedge themselves against unfavorable price movement.

Though the futures market spreads across a large number of investors and transferred away from those hedging spot position to professional speculators who are willing and able to bear it. The availability of risk transference afforded by the futures market reduces the spot price volatility because it eliminates the need to incorporate risk premium in the spot market transaction to compensate the risk of price fluctuations. Futures’ trading attracts more traders to spot market making it more liquid and therefore less volatile.

The debate about speculators and impacts of futures trading on spot price volatility suggests decreases volatility in stock market. Bologna (2002) argued that the speculation in the futures market also leads to stabilization of the spot prices. Since futures are characterized by high degree informational efficiency, the effect of the stabilization permits to the spot market. The profitable speculation stabilizes the spot price because informed speculators tend to buy when the price is low pushing it up and sell when the price is high causing it to fall. These opposing forces constantly check the price swings and guide the price towards to the mean level. Uninformed speculative traders are not successful and are eliminated from the market. This profitable speculation in the futures market leads to a decrease spot price volatility.

There are several empirical studies that shows that the introduction on index futures trading improves market efficiency and reduced informational asymmetries. Figlewaski (1981) argued that speculation in the futures market is transmitted to the underlying spot markets. The speculation produces a net loss with some speculators gaining (and others losing), thereby destabilizing the market. Uninformed speculative traders increase price volatility by interjecting noise to a market with limited liquidity. The inflow and existence of the speculators in the futures market produces destabilization forces, which creates undesirable bubbles. Kamara et al (1992) suggested that futures market activity increases the spot price variability when futures price is changed by technical factors or manipulations. Sometimes futures market
induces a significant amount of hedge trading without attracting enough speculation to permit the effective risk transfer.

Futures trading increases spot price volatility if traders in the futures market do not have good information as participant in the spot market even if futures prices accurately reflect the information available to the trader in the market, their collective actions pushes the spot market prices away from its most appropriate value. This situation presents profitable opportunities to better informed spot market participants whose trading acts to stabilize futures prices while allowing greater volatility in the spot market.

The temporal relation between stock Index and Index futures has been and continues to be of interest to regulators, academicians and practitioners alike for a number of reasons such as market efficiency, volatility and arbitrage. In perfectly efficient markets profitable arbitrage should not exist as prices adjust instantaneously and fully to new information. Hence, new information disseminating into the market place should be immediately reflected in spot and futures prices by triggering trading activity in one or both markets simultaneously so that there should be no systematic lagged responses. However, there is yet another reason that futures markets potentially provide an important function of price discovery to help improve efficiency of the market. If so, then futures prices and movements thereof should contain useful information about subsequent spot prices beyond that already embedded in the current spot price.

The concern over how trading in futures contract affects the spot market in underlying asset has been an interesting subject for investors, academicians, exchanges and regulators. Antoniou and Holmes (1995) found that the introduction of stock Index futures caused an increase in spot market volatility in the short run while there was no significant change in volatility in the long run. The apparent increase in volatility has been attributed to increased information flow in the market through the channel of futures trading. On the other hand, Kamara et al. (1992) found no increase in spot market volatility due to introduction of futures trading. Ross (1989) demonstrates that under conditions of no arbitrage variance of price change must be equal to the variance of information flow. This implies that the volatility of the asset price will increase as the rate of information flow increases. It follows therefore, that if futures increase the flow of information then in absence of arbitrage opportunities the volatility of the spot price must change and hence increase in volatility.

Engle and Granger (1987) extended this concept and showed that cointegrated series have an error correction representation. With the error correction representation, a proportion of disequilibrium in one period is expected to be corrected in the next period. The results of the effect of Index futures on the underlying spot market volatility are mixed. One view is that derivative securities increase volatility in the spot market due to more highly leveraged and speculative participants in the futures market. The introduction of stock futures causes an increase in volatility in the short run while there is no significant change in volatility in the long-run (Edwards, 1988). With increased volatility, regulatory bodies may interfere in the markets to enact further regulations. While these regulations are certainly costly they may or may not reduce stock price volatility.

An alternative view is that derivative markets reduce spot market volatility, by providing low cost contingent strategies and enabling investors to minimize portfolio risk by transferring speculators from spot markets to futures markets. The low margins, low transaction costs and
the standardized contracts and trading conditions attract risk taking speculators to futures. Hence, futures are expected to have stabilizing influence as it adds more informed traders to the cash market, making it more liquid and, therefore less volatile.

Harris (1989) examined volatility after introduction of Index futures by comparing daily return volatilities during the pre-futures (1975 - 1982) and post futures (1982 -1987) period between S&P 500 and a non S&P 500 group of stock controlling for differences in firm attributes. He found that increased volatility was a common phenomenon in different markets and Index futures by themselves may not be a cause. Chan et. al., (1991) estimated the intraday relationship between returns and returns volatility in the stock Index and stock Index futures. Their study covered both S&P500 and Major Market Index (MMI) futures. Bivariate GARCH models were used to estimate volatility. Their results indicate a strong inter market dependence in volatility of spot and futures returns.

In common financial parlance, volatility of a variable is understood to reflect the degree of fluctuation that the value of the variable is likely to show in it’s over time movements. For example, if the price of a stock is capable of large swings, it is said to have a high volatility. Formal models of stochastic volatility relate volatility of a variable to the auto correlated nature of its conditional variance. A basic observation about most (high frequency) time series data on financial variables like asset return is that a large value (of either sign) tend to be followed by a large value (of either sign), thus suggesting a strong temporal clustering of the high and low fluctuations of the variable concerned.

Andreou and Ghysels (2000) in studying volatility estimators states that volatility pattern of a variable that varies continuously over time may be modeled as a rolling-sample GARCH and analyzed by examining the overtime movements of the estimated parameters of the variance equation of the GARCH. An alternative is to use data driven non-parametric rolling sample estimators of spot or integrated volatility.

Given a time series data on a variable which is subject to volatile movements, three different aspects of observed volatility are implicit in the data set - viz., the excess of the average amplitude of fluctuations in volatile states over that in non-volatile states, the fraction of the total sample period the variable is observed to be in volatile states and the average duration (i.e., the average length of time) of a volatile state. These aspects may be called the strength, duration and persistence of volatility, respectively.

It may be noted that these three components/aspects completely characterize the nature/pattern of volatility of a given variable as contained in a given set of time series data on the variable. Also, the patterns of volatility of a variable in two or more situations or those of two or more variables may be compared in terms of these components/aspects of volatility. Needless to mention, a decomposition of volatility as mentioned above should help get a deeper insight into the nature of volatility on the basis of historical data. In Coondoo and Mukherjee (2004) this approach to the study of volatility has been used on the Indian data on foreign institutional investment (FII) and related variables.

Bekaert, Harvey and Lumsdaine, (2002) in their study on interrelationship between capital flows, returns, dividend yields and world interest rates in 20 emerging markets including India found that the shocks in equity flows initially increases returns which is consistent with a price pressure hypothesis but the effect immediately dies out and there is only incomplete reversal
suggesting some of feedback trading as the lagged returns are not significantly related with unexpected flows.

Bahmani-Oskooee and Sohrabian (1994) were among the first to use co integration and Granger causality to explain the direction of movement between exchange rates and stock prices and found FIIIs using positive feedback trading strategies; Causality may run from stock prices to foreign investment.

Banaji (2000) emphasized on the fact that the capital market reforms like improved market transparency, automation, dematerialization and regulations on reporting and disclosure standards were initiated because of the presence of the FIIIs. He opined that FII flows could be considered both as the cause and the effect of the capital market reforms. The market reforms were initiated because of the presence of FIIIs and this in turn has led to increased inflows. The Government of India gave preferential treatment to FIIIs till 1999-2000 by subjecting their long term capital gain to lower tax rate of 10 percent while the domestic investors had to pay higher long-term capital gains tax. The Indo-Mauritius Double Taxation Avoidance Convention 2000 (DTAC), exempts Mauritius based entities from paying capital gains tax in India- including tax on income arising from the sale of shares.

Kumar (2000) made an investigation regarding the stability of the foreign institutional investors in India from January 1990 to March 1998 at BSE and found that the volatility in return of Indian stock market before opening for FIIIs was 41.05 percent whereas the volatility after opening up was 22.66 percent. The study also checked the significance of the difference in both periods (pre and post entry) by applying the F-test and inferred that volatility of the Indian stock market has reduced after the arrival of FIIIs.

Chakrabarti (2001) has perceived a regime shift in the determinants of FII following the Asian financial crisis. He used the data of BSE for a period of 6 years from May 1993 to Dec. 1999. By applying the Granger Causality Test on the data he found that in the pre-Asian crisis period, any change in FII had a positive impact on equity returns, but it found a reverse relationship in post Asian crisis period. The study points out that the change in FII is mainly due to change in equity returns.

Froot and Seasholes (2001) also experienced the existence of price pressure along with persistence of flows. For the purpose of analysis the study classified the FIIIs flow into two parts expected flows and unexpected flows and on the basis of that classified data the analyst concluded that FIIIs do not seem to be at an informational disadvantage, they seem to experience an informational advantage. Secondly, the impact of the unexpected sales by the FIIIs on the respective market returns was considerably high. This shows that the market was very sensitive to the FIIIs trading, especially sales, which the policy makers should take into account. On the basis of degree of association between unexpected sales and respective market returns they found that BSE was more vulnerable to instability due to trading by FIIIs as the impact of unexpected sales at BSE (21.9 percent) reduce the stock price considerably when compared to that of NSE (11.4 Percent).

Pasricha and Singh (2001) evaluated the impact of FIIIs on stock market volatility between April 1998 to March 2000 on BSE and NSE both. They found that FIIIs have always remained net investors in the country except during 1998-99 and their investment has been steadily growing since their entry in the Indian market. They are here to stay and have become the
integral part of Indian capital market. Although their (FIIs) investment in relation to market capitalization is quite low, they emerged as market movers. The market had been moving, in consonance with their investment behavior. However, their entry has led to a greater institutionalization of the market and their activities have provided depth to it. FIIs have also contributed towards making Indian market modern and comparable with international standards. Their entry has brought transparency and simplicity in the market operations.

3.0 Methodology of research

Many researchers testing structural breaks applied unit root tests on variables by running the analysis on a constant and trend term. Results will either indicate the presence of unit roots or its absence at all levels of difference. This will form the basis of the decision to accept or reject the null hypothesis. Where there seems to be stationarity at first difference it implies that the work has to be further examined to test for the presence of possible cointegration relationship between the variables. Many studies on cointegration and cultural breaks adopt conventional and non-conventional methodologies.

But more specifically, the research applied various methods in testing the structural breaks such as using F Statistics suitable for null hypothesis since it is useful in comparing statistical models fitted to a data set to find out which model fits the population. The robustness of this test is further validated by unit root tests to examine the stationarity of values. If we established stationarity we will form an equation to capture seasonality given that the data is times series. We will use correlogram tests to find out if the error term is stationary and the level of significance of the Autocorrelation and the Partial Autocorrelation results.

In this study the analysis is based on Ordinary Least Squares (OLS), then several other tests would be conducted to test structural break results got to confirm earlier tests. Such tests include the Quant Andrews tests, Kwiatkowski-Phillips-Schmidt-Shin tests, Hansen 1997 model tests, Bai Perron’s test. If there is stationarity established then an equation will be formed to capture seasonality given that the data is times series. This will involve using the ARIMA model, but the level of differencing and ordering will follow the objectives of the research. In this case the researcher chooses a model that states thus:

ARIMA (1.1.1) 
\[ d \text{(or) c ar(1) ma(1) sar(1) and sma(4)} \]

An autoregressive model is one where the current value of a variable depends upon only its previous values and a white noise error term.

\[ ARp: Yt = a1Yt−1 + a2Yt−2 + \cdots + aPYt−p + \epsilon t \]
\[ = j=1paYt−j + \epsilon t \]

Using a lag operator \( L \) such that \( LkYt=Yt−k \)

The AR(p) is given as:

\[ Yt − j = 1paLjYt + \epsilon t \]

The term: \( 1−j=1paLj \) is the characteristics polynomial of the AR model.

AR1 is given as \( 1−aLYt=\epsilon t \) (3)

An MA(q) model a linear combination of white noise processes, so that \( yt \) depends on the current and previous values of a white noise disturbance term.

\[ MA q: Yt = \epsilon t + \vartheta 1\epsilon t−1 + \vartheta 2\epsilon t−2 + \cdots + \vartheta q\epsilon t−q \]
\[ = \epsilon t + j=1 \]
\[ q \theta_j \epsilon_{t-j} \]  
\[ = \theta(L) \epsilon_t \]  
For \( \theta L = 1 + j=1 \)  
\[ q \theta_j Lj \]  

The term: \( 1 + j=1 \)  
\[ q \theta_j Lj \] is the characteristics polynomial of the MA model. Where \( \epsilon_t \) are the independent and identically distributed innovations for the process.

MA(p) Model: A review

The distinguishing properties of the moving average process of order q given above are:

1. \( E y_t = \mu \)
2. \( var y_t = \gamma_0 = 1 + \theta_1 \)
3. \( \sigma^2 \)

For \( s = 1, 2, \ldots, q \)

\[ 0 \text{ for } s > q \]

ARMA model: A review

ARMA \( p, q \) is a combination of AR(p) and MA(q) as follows:

\[ ARMA \ p, q : Y_t = j=1 \]

\[ p \alpha_j Y_t - j + \epsilon_t + j=1 \]

\[ q \theta_j \epsilon_{t-j} \]  

ARMA (1,1) is given as: \( 1 - \alpha L Y_t = 1 + \theta L \epsilon_t \)  

Seasonal AR and MA Terms:

Due to seasonal patterns in most monthly and quarterly data, Box and Jenkins (1976) recommend the use of seasonal autoregressive (SAR) and seasonal moving average (SMA) terms in the ARMA process. SAR \( p \) is a seasonal AR term with lag \( p \) and it adds to an existing AR, a polynomial with lag \( p \) given as

\[ 1 - \emptyset : \]

A second order AR process for quarterly data can be written as:

\[ 1 - \alpha_1 L1 - \alpha_2 L2 1 - \emptyset_4 L4 \]

\[ Y_t = \epsilon_t \]  

AR, MA and ARMA: A review

(8) on expansion will give:

\[ Y_t = \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} - \emptyset_4 Y_{t-4} - \alpha_1 \emptyset_4 Y_{t-5} - \alpha_2 \emptyset_4 Y_{t-6} + \epsilon_t \]  

For seasonal moving average with lag q, the resulting MA lag structure is obtained from the product of the lag polynomial specified by the MA terms and the one specified by any SMA terms.

For a second order MA without seasonality, the process is written as:
\[ Y_t = \varepsilon t + \vartheta_1 \varepsilon t-1 + \vartheta_2 \varepsilon t-2 \]
\[ = \varepsilon t + \sum_{j=1}^{2} \vartheta_j \varepsilon t-j \]  
(10)

This in the lag form is given as: \( Y_t = 1 + \vartheta_1 L \vartheta_2 L^2 \varepsilon t \)  
(11)

**AR, MA and ARMA: A review**

If the data for (11) is quarterly for example, we introduce the SMA(4) given as \( 1 + \varphi_4 L^4 \) in the MA term.

This will give: \( Y_t = 1 + \vartheta_1 L \vartheta_2 L^2 1 + \varphi_4 L^4 \varepsilon t \)  
(12)

Expansion of Eq (12) will give:

\[ Y_t = \varepsilon t + \vartheta_1 \varepsilon t-1 + \vartheta_2 \varepsilon t-2 + \varphi_4 \varepsilon t-4 + \vartheta_1 \varphi_4 \varepsilon t-5 + \vartheta_2 \varphi_4 \varepsilon t-6 \]  
(13)

The parameter \( \varphi \) is associated with the seasonal part of the MA process.

**ARIMA and ARIMAX models**

The AR, MA and ARMA models discussed before assumes that the series in question is at least weakly stationary. (see Gujarati, 2004, pp. 840). Since most time series are not stationary, there is need to account for this in our ARMA model. Hence, the need for ARIMA model. In our previous class, a series that must be differenced \( d \) times for it to become stationary is said to be integrated of order \( d \) i.e. \( I(d) \) ARIMA (p,d,q) is an ARMA(p,q) model of non-stationary series differenced \( d \) times to make it stationary. Estimating ARIMA models: The BJ [Box–Jenkins] Methods Revisited will help one to identify the value of \( P, d \) and \( q \) for an ARIMA(p, d, q) models. The BJ methodology has an answer and consists of the following steps:

- Differencing to achieve Stationarity
- Identification
- Estimation
- Diagnostic Checking
- Forecasting
### 4.0 Data analysis and discussions of findings

**Mobil Plc**

Dependent Variable: D(MCAP)

Method: ARMA Maximum Likelihood (OPG - BHHH)

Date: 01/02/19   Time: 10:25

Sample: 2001-2018

Included observations: 4393

Convergence achieved after 296 iterations

Coefficient covariance computed using outer product of gradients

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
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</thead>
<tbody>
<tr>
<td>C</td>
<td>0.964606</td>
<td>1.659069</td>
<td>0.577196</td>
<td>0.5646</td>
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<tr>
<td>AR(1)</td>
<td>0.963926</td>
<td>0.104379</td>
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<td>0.006656</td>
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<td>SMA(4)</td>
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<tr>
<td>SIGMASQ</td>
<td>2.264966</td>
<td>0.258185</td>
<td>8.888629</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared   | 0.743465    | Mean dependent var | 0.957734 |

Adjusted R-squared | 0.736971 | S.D. dependent var | 3.000169 |

S.E. of regression | 1.538788 | Akaike info criterion | 3.773483 |

Sum squared resid | 374.0697 | Schwarz criterion | 3.868384 |

Log likelihood  | -302.5389 | Hannan-Quinn criter. | 3.812012 |

F-statistic     | 114.4752  | Durbin-Watson stat   | 1.988057 |

Prob(F-statistic) | 0.000000 |

---

**Conoil Plc.**

Dependent Variable: D(MCAP)

Method: ARMA Maximum Likelihood (OPG - BHHH)

Date: 01/02/19   Time: 12:01

Sample: 2001-2018

Included observations: 4393

Convergence achieved after 294 iterations

Coefficient covariance computed using outer product of gradients

<table>
<thead>
<tr>
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<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
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<td>0.0000</td>
</tr>
<tr>
<td>SIGMASQ</td>
<td>2.492954</td>
<td>0.258185</td>
<td>8.888629</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared   | 0.773577    | Mean dependent var | 0.957424 |

Adjusted R-squared | 0.755431 | S.D. dependent var | 3.000566 |

S.E. of regression | 1.643804 | Akaike info criterion | 3.773483 |

Sum squared resid | 374.0697 | Schwarz criterion | 3.858294 |

Log likelihood  | -292.5649 | Hannan-Quinn criter. | 3.732894 |

F-statistic     | 116.4752  | Durbin-Watson stat   | 1.983459 |

Prob(F-statistic) | 0.000000 |
OANDO Plc.
Dependent Variable: D(MCAP)
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 01/02/19   Time: 13:27
Sample: 2001-2018
Included observations: 4393
Convergence achieved after 282 iterations
Coefficient covariance computed using outer product of gradients

<table>
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<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
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<tbody>
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<td>0.5734</td>
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<td>MA(1)</td>
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</table>

R-squared 0.893493  Mean dependent var 0.966535
Adjusted R-squared 0.887623  S.D. dependent var 3.000634
S.E. of regression 1.729854  Akaike info criterion 3.983233
Sum squared resid 367.0555  Schwarz criterion 3.921997
Log likelihood -298.7236  Hannan-Quinn criter. 3.893240
F-statistic 117.6734  Durbin-Watson stat 2.092029
Prob(F-statistic) 0.000000

5.0 Discussion of findings and conclusions
There are sufficient indications that there are different scenarios for the different quoted companies analyzed. There is sufficient goodness of fit demonstrated in the coefficient of determination (R-square). Which means that the R2 measures how well variations in the dependent variables are explained by the independent variables for the period while being commensurate with performance. The adjusted R2 moderates the Rs indicating that there may be other variables other than our explanatory variables that might have an impact on the dependent variable but not represented in the equation. The Durbin Watson statistics is meant to reveal if there are signs of serial correlation and to what extent. The AIC, or Schwarz criterion, shows that the difference between the two is very negligible, an indicator of a near perfect model convergence near zero. The smaller they are the better the fit of your model is (from a statistical perspective) as they reflect a trade-off between the lack of fit and the number of parameters in the model. That the differences between the R2 and adjusted R2 are negligible is an indicator that the regression line approximates the real data points and so is a very good fit and also shows how well observed outcomes in the analyses are replicated in the model.

The R2 and adjusted R2 for the Mobil Plc (74.3% & 73.6%), Conoil Plc (96.4% & 96.3%), Oando Plc (89.3% & 88.7%) For the three oil firms under study it was evident that there were significant relationship between their liquidity measured by market capitalization ratio and their respective stock market returns. Amongst the three quoted oil firms, Mobil Plc at 74.3% had the lowest R2 which indicates that liquidity had a positive and significant impact on stock market returns for the company shares but was much lower than the other quoted companies which could be attributed to lower stock trading in line with the works of Raghbendra (2003) and Ekanem (2003). However, it is most likely that the level of competition in the petroleum
sector of the exchange for the year under study may have reduced the returns average growth rate. In theory there is a possibility of investor misspecification about future earnings or illiquidity of low volume stocks in the oil sector may be responsible for the high variations seen in its analysis according to Khan S.U and Rizwan F (2008).

6.0 Policy Recommendations
1. It has been statistically proven that macroeconomic variables have a strong significance on changes in market performance and value of market capitalization. Hence the Nigerian Securities and Exchange Commission to encourage increase in after-tax profits of petroleum sector based firms.

2. Recommendations include making strategies to be designed toward reaping abnormal returns by exploiting information and actions that enhance inefficiency in stock markets thus, firms and individuals should be encouraged to buy or sell securities outside their face values, as a means of encouraging business or economic activities in the economy this is due to large volatilities in some markets.

3. As a risk control strategy knowledge of portfolio rebalancing can be seen where an informed investor acknowledges the usefulness of compounding effect of returns on his portfolio by calculating based on compound average and not simple average. Hence more research can be made in studying theoretical and empirical applications of models measuring weighty risk management strategies such as portfolio rebalancing.

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