ÇANKAYA UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
DEPARTMENT OF ECONOMICS

MASTER THESIS

STOCK MARKET VOLATILITY AND MACROECONOMIC PERFORMANCE IN THE NIGERIAN ECONOMY

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JUNE 2014

Title of the Thesis : **Stock Market Volatility and Macroeconomic Performance in the Nigerian Economy**

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ABSTRACT

STOCK MARKET VOLATILITY AND MACROECONOMIC PERFORMANCE IN THE NIGERIAN ECONOMY.

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June 2014, 96 pages

This thesis seeks to investigate the impact of stock market volatility on macroeconomic variables, specifically on real GDP and inflation, in Nigeria using quarterly time series data from 1985Q1-2012Q4. To achieve this, the study establishes two equations: real GDP and inflation equations, and splits the analysis into two parts. In the first part, the study employs four volatility models: ARCH, GARCH, EGARCH and TGARCH models, and compares them based on both model selection criterion and forecast performance in order to choose among them the fittest model to All Share Index (ASI) series (which is used as a proxy of the Nigerian stock market index). The TGARCH model was then selected as the best model, and therefore, the Nigerian stock market volatility series were extracted from it. In the second part, the thesis applies Bounds test co-integration approach and ARDL model. The results from the Bounds test analysis suggest the existence of co-integration relationship between the Nigerian stock market volatility and macroeconomic variables. While, the results from the ARDL model indicate that the stock market volatility has no any significant effect on the real GDP in both long-run and short-run and on the inflation in the long-run in Nigeria. However, the results also show that in the short-run, the Nigerian stock market volatility has significant positive impact on inflation.

Keywords: Stock Market Volatility, Real GDP equation, Inflation equation, ARCH Family Models, Bounds tests, ARDL Model

ÖZET

NİJERYA EKONOMİSİNDE MENKUL KIYMETLER BORSASI OYNAKLIĞI VE MAKRO EKONOMİ PERFORMANSI

Musa Muhammad IBRAHIM
Finansal Ekonomi Yüksek Lisansı

Danışman: Prof. Dr. Mehmet YAZICI
Yardımcı Danışman: Dr. Hasan Murat ERTUĞRUL

Haziran 2014, 96 sayfa

Bu tez, Nijerya'nın 1985 1. çeyrek - 2012 4. çeyrek dönemleri zaman serisi verileri kullanılarak, menkul kıymetler borsasındaki oynaklığın, başta reel gayri safi yurt içi hasıla ve enflasyon üzerindeki etkileri olmak üzere, makro iktisadi değişkenler üzerindeki etkilerini araştırmaktadır. Bunun için iki denklem kurulmuştur: Reel gayri safi yurt içi hasıla denklemi ve enflasyon denklemi. Analiz iki bölüme ayrılmıştır. İlk bölümde ARCH, GARCH, EGARCH ve TGARCH oynaklık modelleri yer almaktadır. Bu modeller, hisse senedi endeksi (ASI) serilerinde (Nijerya menkul kıymetler borsası endeksi vekili olarak kullanılmaktadır.) en uygun modeli seçmek için model seçme kriterleri ve tahmin performansına dayalı olarak karşılaştırılmıştır. Daha sonra TGARCH modeli en iyi model olarak seçilmiş ve böylece Nijerya menkul kıymetler borsası oynaklığı serileri bu şekilde oluşturulmuştur. İkinci bölümde, sınır test analizi ko-entegrasyon yaklaşımı ve ARDL modeli uygulanmıştır. Sınır test analizi sonuçları, Nijerya menkul kıymetler borsası oynaklığı ve makro ekonomik değişkenler arasında ko-entegrasyon ilişkisi olduğunu göstermiştir. ARDL model sonuçları ise menkul kıymetler borsası oynaklığının reel GDP ve enflasyon üzerinde kısa ve uzun dönemde Nijerya'da etkisi olmadığını belirtmektedir. Buna karşılık, sonuçlar aynı zamanda kısa dönemde Nijerya menkul kıymetler borsası oynaklığının enflasyon üzerinde önemli pozitif etkisi olduğunu göstermektedir.

Anahtar Kelimeler: Menkul kıymetler borsası oynaklığı, reel GDP denklemi, enflasyon denklemi, ARCH aile modelleri, sınır testleri, ARDL modeli

ACKNOWLEGEMENT

My heartfelt gratitude goes to my late mother, Haj. Zainab Mahmud "*May her soul rest in perfect peace amen*" and my father, Alh. Ibrahim Muhammad for their encouragements, caring, prayers, moral and financial supports all to see that I become what I am today. I really-really love you and I will never forget your efforts.

My sincere appreciation goes to Kano state government of Nigeria under the leadership of his Excellency, Eng. Dr. Rabi'u Musa Kwankwaso for providing me with full scholarship to undergo this programme.

I am extremely grateful to my supervisor Prof. Dr. Mehmet YAZICI and co-supervisor Dr. Hasan Murat ERTUĞRUL for their constructive comments, encouragements, compliments, as well as untiring guidance and supports from beginning to the end of this thesis.

My special appreciation goes to my one and only brother, Sani (Baba) and my sisters, Haj. A'isha (Yaya), Haj. Salamatu (Mami), Hajara (Azumi), Habiba and Amina and their sons and daughters for their prayers, encouragements and supports.

I would like to thank Dr. Aliyu Mahmud (Ya Alaji), Dr. Mahmud (uncle Datti), Suleman Shehu K.K., Alh. Umar Koringo, Alh. Tijjani Zubairu, Alh. Muhammadu (Maikudi), Eng. Abdurrahman (B. Man) and Alh. Usman (Yango) for their good advice and guidance always.

I would also like to express my gratitude to all my relatives and friends especially my childhood friends Abdulkharim (Papalaje) and Al-Amin (Mukaram) for their prayers and best wishes.

Finally, my thanks go to all my fellow Kwankwasonians especially Çankaya University students.

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ABBREVIATIONS	MEANING
AIC	Akaike Information Criterion
AR	Autoregressive
ARCH	Autoregressive Conditional Heteroskedasticity
ARDL	Autoregressive Distributed Lag
ARMA	Autoregressive Moving average
ASI	All Share Index
CBN	Central Bank of Nigeria
CPI	Consumer Price Index
EGARCH	Exponential GARCH
ECM	Error Correction model
ECT	Error Correction Term
GARCH	Generalized Autoregressive Conditional Heteroskedasticity
LASI	Logarithm of All Share Index
MA	Moving average
NSE	Nigerian Stock Exchange
SC	Schwarz Criterion
TGARCH	Threshold GARCH
UECM	Unrestricted Error Correction model
VOL	Volatility

CHAPTER 1

INTRODUCTION

1.1 Background to the Study

Stock market has been seen as a complex institution infused with inherent mechanism through which the long-term funds of the major economic sectors such as households, government and firms are mobilised, harnessed and made available to various sectors of the economy [Nyong, 1997, as cited in Petros (2011)]. It is of great concern to the government, investors as well as other stakeholders (Olweny and Omondi, 2011), and it plays an important role in financial intermediation in both developed and developing countries (Lawal and Okunola, 2012; Govati, 2009). That is, it helps in channelling funds from surplus savings units to deficit units in the economy and ensures that the savings of the surplus units are mobilized and efficiently allocated so that it can assist in enhancing capacity utilization as well as promoting productive activities and consequently leading to economic growth and development in the country (Lawal and Okunola, 2012; Alajekwu and Achugbu, 2012).

A well-operating stock market helps a lot in reducing the principal agent problem as well as information asymmetry, thereby boosting an efficient allocation of resources and growth (Olweny and Kimani, 2011).

Stock market has also been seen as a place where most elements that could lead to country's economic development are working with one another (Oseni and Nwosa, 2011). It contributes to the nation's economic development by enhancing the liquidity of the capital market (Adenuga, 2010).

Stock market plays an important role in shaping the economic and political development of a country. The collapse of stock market always causes financial crisis which consequently lead to economic recession (Oseni and Nwosa, 2011).

Stock exchange and banking system work collectively to achieve the macroeconomic objective of the country. Therefore, the overall economic development of a country is a function of how well the stock market performs

(Lawal and Okunola, 2012). Also, Ali et al. (2010) states that activity in the stock exchange plays an important role in assisting to determine the effects of macroeconomic activities.

However, an important issue in the stock market which deserved special consideration is the issue of volatility, the existence of which may undermine the ability of stock markets to promote an efficient allocation of investment (Arestis et al., 2001).

Volatility refers to sharp fluctuations in the price of a financial asset or market in a short period of time. In other words, stock volatility can be defined as the possibility that a given stock will experience a drastic rise or fall in value within a predetermined time period (Okpara, 2011).The main problem of stock price fluctuations affecting stock market efficiency is destructive excess volatility that causes stock market crashes and or crisis (Goudarzi and Ramanarayanan, 2011).

Furthermore, stock market volatility is an un-diversifiable risk (i.e. systematic risk) faced by the investors holding a market portfolio- for example, stock market index fund (Guo, 2002).

Volatility is considered as an important concept in many economic and financial applications (Ahmed and Suliman, 2011). Rano (2010) states that volatility breads uncertainty, which impair effective performance of the financial sector as well as the entire economy at large. According to Bhowmik (2013) a very high degree of stock market volatility induces instability in the capital market, destabilize the value of currency and hampers international trade and finance. It is also proposed by some researchers that the raised stock market volatility might decrease future economic activity (Guo, 2002). Suleiman (2011) also states that stock market volatility affects business investment and economic growth.

According to Bhowmik (2013) there is a negative relationship between stock market volatility and growth rate of a country, i.e., a higher volatility decreases growth rate. He clearly shows evidence for the existence of such relationship using graph by plotting the U.S quarterly percentage growth of real GDP on Y-axis and U.S stock market volatility on X-axis. He also states three channels through which the stock market volatility may affect GDP growth as per the existing literature, such channels include; (1) its (stock market volatility) link with market uncertainty and thus economic activity, (2) association between stock market volatility and structural change (which consumes resources) in the economy, and (3) through cost of capital channel – that is, a rise in stock market volatility will make shareholders to demand higher reward for bearing systematic risk. And the higher expected return by the shareholders will result in the higher cost of capital in corporate sector, which consequently reduces investment and real GDP (Guo, 2002).

Similarly, Okpara (2011) states a mechanism through which the stock market volatility may affect inflation rate- that, the stock market volatility may result in portfolio adjustment which change the prices and returns of other financial assets. In addition to this, the prices of real goods and services will also go up and this may lead to a high rate of inflation resulting from supply shortage. But according to him, the working of this channel will, however, depend on how the investors are compensated for bearing the risk on the economy.

According to Kupiec (1991) stock market volatility may indirectly effects real economy through its effects on consumer and investor expectations. A rise in stock market volatility may cause a loss of consumer confidence and affect real consumption and investment decisions indirectly. Also, as stated in Petros (2011), the higher level of stock market volatility in less developed countries decreases the efficiency of the price signal in allocating investment resources.

Lastly, Mushtaq et al. (2011) state that the stock volatility has had large impact on the economic condition of a country, policy makers, financial managers, firms, investors as well as on other stakeholders.

Against the above background, this study attempts to investigate the impact of stock market volatility on macroeconomic variables (specifically, on real GDP and inflation) in Nigeria from 1985Q1-2012Q4.

1.2 Statement of the Problem

Although, the stock market plays a significant role in ensuring that the funds from surplus savings units are mobilized and efficiently allocated to various sectors of the economy, which helps in achieving economic growth and development in both developed and developing countries. The existence of volatility in such market may hinder the stock market from playing such a role properly. Suleiman (2011) states that volatility may impair the smooth functioning of the stock market and negatively affect economic performance.

The existence of excessive volatility may lead to an inefficient allocation of resources, increase pressures on interest rates in view of higher uncertainty, hampering both quantity and productivity of investment and consequently reducing growth [Federer 1993; Delong et al., 1989, as cited by Arestis et al. (2001)].

According to Verma and Mahajan (2012) if the country's stock market is highly volatile, the probability of both domestic and foreign investors to invest in such market is going to be less. This is because the returns in such market are liable to higher risk. And this may affect the economic growth of that country.

Schwert (1989) suggests that stock market volatility could be used as an additional factor in assessing the state of the economy.

In Nigeria, the recent problem faced by the stock market(financial crisis) caused many industrialized economies suffered a significant decrease in economic activity, therefore, one can authoritatively say that the stock market volatility is the most important factor in the economic growth in both developed and less developed countries like Nigeria (Oseni and Nwosa, 2011).

According to Bhowmik (2013) some recent studies show that a rise in stock market volatility depresses economic activity and output.

As the empirical findings of some studies such as, Ahmed (2009); Olowe (2009); Emenike (2010); Suleiman (2011); Okpara (2011); Onwukwe et al. (2011); Emenike and Aleke (2012); Babatunde(2013) and Ezepue and Omar (2013) show evidence of high and persistence volatility in the Nigerian stock market, and this according to Babatunde (2013) might distort growth of the economy. Therefore, this study intends to investigate whether the stock market volatility has any significant impact on macroeconomic variables in Nigeria. Specifically, the study attempts to examine whether the Nigerian stock market volatility has any significant impact on real GDP and inflation.

1.3 Objectives of the Study

This thesis focuses on the relationship between stock market volatility and macroeconomic variables in Nigeria. It utilizes quarterly time series data from 1985Q1-2012Q4 to achieve the following objectives;

i. To examine whether there exists any long run co-integration relationship between Nigerian stock market volatility and macroeconomic variables

ii. To investigate the long-run and short run impact of stock market volatility on real GDP in Nigeria.

iii. To find out the long run and short run impact of stock market volatility on inflation in Nigeria.

1.4 Hypothesis of the Study

Based on the above objectives, the following hypothesises are formulated for testing in this study;

- $H0_1$: There exists no long run co-integration relationship between stock market volatility and macroeconomic variables in Nigeria
- $H0_2$: The Nigerian stock market volatility does not have any significant impact on real GDP in both long run and short run.
- $H0_3$: The Nigerian stock market volatility does not have any significant impact on inflation in both long run and short run.

1.5 Significance of the Study

The findings of this thesis would help in alerting the policy makers on the effects that the existence of volatility in the stock market could have on the key macroeconomic variables, which might negatively affect the performance of the entire economy as well as impairing the smooth functioning of the market. Thus, this thesis could be of great significance to the Nigerian government. The results are also of great benefit to the stock market regulatory bodies, investors and other market players, domestic and international security analysts, as it can help them to know the degree of volatility presence in the Nigerian stock market. Lastly but not the least, the thesis is also of great benefit to the future researchers, as it would serve as a reference material to them.

1.6 Scope of the Study

This thesis only attempts to examine the effect of stock market volatility on macroeconomic variables in Nigeria. It does not in any away attempt to investigate the effects of volatility in other financial market (such as bound, derivative markets etc.) on macroeconomic variables in Nigeria. Also, the study only examines the effects of such volatility on macroeconomic variables, but not on microeconomic variables. However, the empirical investigation of such effect is limited to the period 1985-2012, this is because the variable (i.e. ASI) used to represents the Nigerian stock market index was introduced in 1984.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter provides a historical background of the Nigerian stock exchange market, an overview of the real GDP and inflation performance as well as the Nigerian stock market volatility. It also provides a review of related empirical literature and theoretical framework of the volatility models.

2.2 Historical Background of the Nigerian Stock Exchange Market

The history of the Nigerian stock exchange (NSE) dates back to 15th of September, 1960, when the Lagos stock exchange was established, which began its operation on 5th June, 1961 with 19 securities listed on its floor for trading. In December 1977, it was renamed as the Nigerian Stock Exchange (NSE). Presently, the exchange has 13 branches spread across the key cities of Nigeria, with its head office located in Lagos state. Such cities include; Abuja, Abeokuta, Bauchi, Benin, Ibadan, Ilorin, Kaduna, Kano, Onitsha, Owerri, Uyo, Port-Harcourt, and Yola. Each of these branches has electronic trading floor. Moreover, the exchange currently has about 258 listed securities, which comprise of equities, corporate bonds/debentures, federal government bonds, state and municipal bonds, exchange traded fund and supranational bond, and also has about 200 listed companies in twelve diverse sectors, including several global brands (NSE- FAQs; NSE-Gateway to African Markets; NSE-Q3 2013 Fact Sheet). The NSE has two Equities markets: First tier securities market (the Main Board) and Second tier securities market [Alternative Securities Market Board (ASeM)]. The second tier securities market (i.e. ASeM) was established by exchange in 1985 in order to help the Nigerian small and medium companies with high potential of growth to raise long-term capital at relatively low cost from the market (NSE-FAQs; Chigozie, 2009). The difference between the two equities market segments: the Main Board and the ASeM, can be seen in their listing requirements.

The general requirements for listing on either of the two markets (Boards) are as follow:

1. The company must be a public limited liability company
2. The date of company's last audited financial statements must not exceed nine months
3. The application for listing will only be accepted if sponsored by a dealing member of the exchange.
4. A maximum of 10% of an offering will be allowed to staffs of a company or its associated or subsidiaries companies
5. The securities must be fully paid-up at the time of allotment
6. After being listed on either of the two boards, the company can raise unlimited amount of capital from the general public, subject to the borrowing power of the directors of the company. And
7. The company must every year submit quarterly, semi-annual and annual financial statement

However, the following additional requirements for listing on the two markets differ:

1. For a company to be listed on the Main Board, it must have been in operation for a minimum of three years. Whereas, only a minimum of two years the company is required to have been in operation before listing on the ASeM, and must also provide a comprehensive business plan covering not less than two years periods.
2. For a company to be quoted on the Main Board, a minimum of 20% of company's issued share capital must be offered to the general public. While in the case of ASeM, the company is required to make only a minimum of 15% of its issued share capital available to the public.

3. The companies that are quoted on the Main Board are required to pay an annual quotation fees based on the market capitalization. While a flat annual quotation fee of ₦200,000 is required to be paid by the companies listed on the ASeM.
4. To be quoted on the Main Board, the number of company's shareholders must be at least 300. While in the case of ASeM, the number of company's shareholders must reach at least 51.
5. Before listing on the Main Board, the company must have a minimum of ₦3billion shareholders' equity. While this requirement is not applied on any company that want to be listed on the ASeM. (NSE-Green Book; NSE-FAQs)

The NSE maintains All Share Index (ASI), which was introduced since 3rd January, 1984 with 100 points base value. The ASI is a market capitalization weighted index. The index includes only fully paid ordinary shares of all the companies listed on the NSE. Therefore, it tracks the general market movement of all quoted equities on the Exchange (NSE). Initially, the index stood at 111.3 points in January 1985. Since then, it has been increasing slightly, until June 1985, when it fell to 116.3 points. From July 1985 to June 1988 the index fluctuated between 116.9 and 206 points, and then rose to 211.5 points in July 1988. It keeps on increasing until May 1989 when it declined to 257.1 points and then continue increasing for three months before it fell again to 279.9 point in September 1989, and then began to rise again. This increasing trend lasted for over three years. After reaching its peak points of 65652.38 in February 2008, in the next month i.e. march 2008, the index starts diminishing up to December 2009 except for February, April and March of 2009 were some positive changes are recorded in the index. It was ended with 28078.81 points as at December 2012. Figure 1 below, shows the trend in the NSE-ASI from 1985M1-2012M12.

During the period under review, the NSE went through a number of developmental stages and challenges, ranging from the indigenization policy in 1977, financial system deregulation in 1986, privatization of some public companies in

1988, internationalization of the Nigerian capital market in 1995 to banking sector consolidation spanning between 2005 and 2007 (Rano, 2010; Chigozie,2009).

In a moved to make the market more efficient and transparent, the exchange had since 27th April, 1999 introduced Automated Trading System (ATS), with bids and offers now matched by the dealers/stockbrokers on the trading floors of the market through a network of computers connected to a server. In order to achieve an online global dissemination of stock market information such as All Share Index, trading statistics, company news (corporate actions and accounts statements) and investment ratios of the companies, the exchange link-up with the Reuters Electronic Contributor system since 2nd June of 1987.

Before the deregulation of the capital market in 1993, the legislations such as Exchange Control Act 1962 and the Nigerian Enterprise Promotion Decree 1989 restricted the participation of foreigners in the Nigerian capital market regarding to the percentage of share they could have in the quoted companies as well as serving as operators in the market. After the deregulation of the market in 1993, the Nigerian government internationalized the capital market in 1995, with the abolition of those legislations that constrained the participation of foreigners in the market. Consequently, the foreigners can presently participate in the Nigerian stock market both as operators and investors without any limit. In order to meet the challenges of internationalization and enhance the service delivery, the NSE launched its internet system; CAPNET (intranet facility), in November 1996.

The transactions on the NSE are regulated by the Securities and Exchange Commission (SEC), which is a government agency mandated to regulate and develop the Nigerian capital market. In the process of regulating the market, the commission undertakes various activities that will provide adequate protection to investors as well as the market operators and also ensure market integrity (SEC-Website). Furthermore, the NSE as a self-regulatory organization (SRO) also regulates the transection in the market.

The prices of new securities (e.g. stocks) are determined by the issuing houses and stockbrokers, whereas the prices of the stocks on the secondary market are made only by the stockbrokers. The quoted prices together with the All Share Index and other NSE Indices are published every day in the NSE-CAPNET, The

Stock Exchange Daily Official List, Newspapers, the NSE website and on the stock market page of the Reuters Electronic Contributor System (Wikipedia, 2014).

The Clearing, Settlement and Delivery of the market's transactions are done electronically by the associate company to The NSE, Central Securities Clearing System (CSCS) Plc, which serves as a clearing house of the exchange and also offers custodian services (NSE-FAQs).

The Nigerian Stock Exchange is currently an observer at meetings and affiliate member of the International Organization of Securities Commissions (IOSCO), an affiliate member of the World Federation of Exchanges (WFE), a founding member and executive committee member of the African Securities Exchanges Association (ASEA), as well as a foundation member of the World Economic Forum (WEF) (NSE-FAQs). Furthermore, it is also the leading exchange in West Africa, the second largest financial centre in sub-Saharan Africa and the third largest stock exchange by capitalisation in Africa (NSE website).

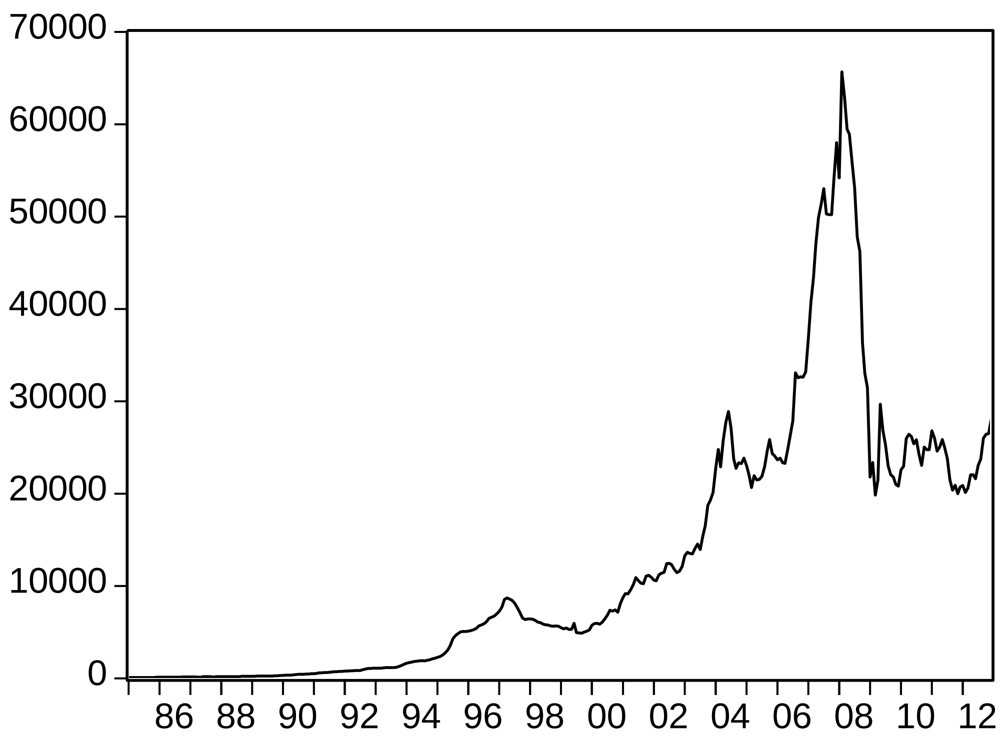


Figure 1: Trend in Monthly NSE-All Share Index from 1985M1-2012M12

Source: *Drawn using Data extracted from 2012- CBN Statistical Bulletin*

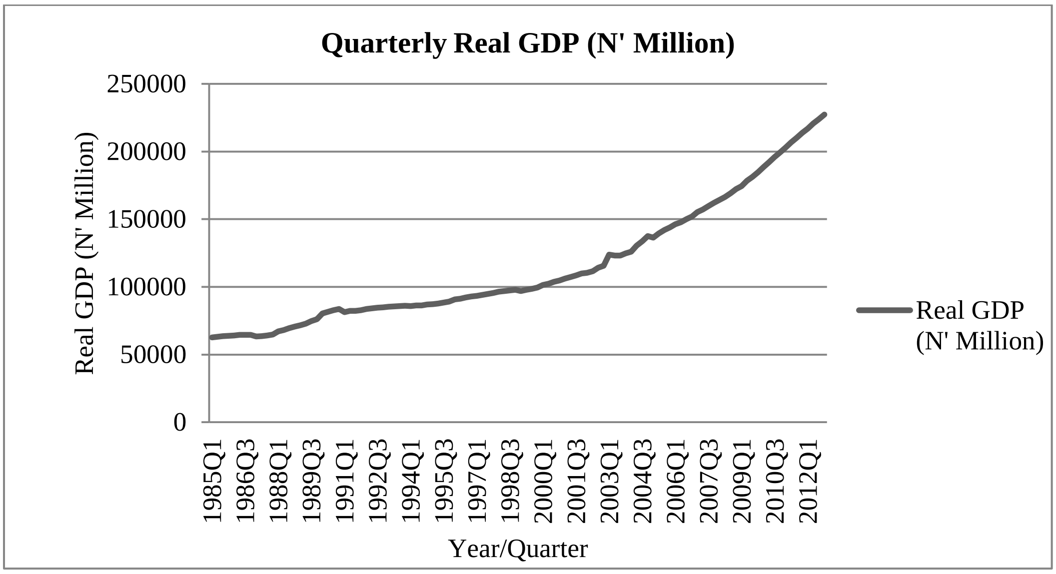
2.3 Overview of the Nigerian Real GDP and Inflation Performance

The performance of real GDP and inflation over the sample period are briefly discussed below.

Real GDP

The average quarterly real GDP of ₦115,176.4989 million with an average growth rate of 1.71% were recorded over the sample periods (1985Q1-2012Q4). Initially, in the first quarter of 1985, the amount stood at ₦63,303.301 million. This was slightly fell to ₦63,021.689 million in the second quarter of the same year, which was the minimum amount of real GDP ever recorded during the period under review, indicating a negative growth rate of -0.44%. The amount was slightly rose to ₦63,095.2001 million and then to ₦63,593.08178 million, showing a positive quarterly growth rate of 0.12% and 0.79% in the third and fourth quarter of the same year, respectively. Since then, the quarterly growth rates of real GDP have been fluctuating over the period. The highest growth rate recorded during the sample period was 21.77% in the third quarter of 2010 with its level real GDP amount stood at ₦212,771.6788 million. Compared to this, the growth rate of the preceding quarter and corresponding quarter of the preceding year i.e. 2009, were 9.13% and 21.58% with their level real GDP amounted to ₦174,733.9713 million and ₦197,084.3269 million, respectively. However, within periods, the economy experienced the lowest quarterly growth rate of -26.10% in the first quarter of 2012, showing level real GDP of ₦182,119.4361 million, which was far lower than the growth rate of 7.88% (with level GDP-₦246,447.0951 million) recorded in the preceding quarter and slightly less than the one recorded in the corresponding quarter of the preceding year i.e. -25.12% in 2011, but higher than its level GDP amount of ₦171,265.8567 million. The peak amount of the level real GDP during the periods was reached in the last quarter of 2012 i.e. fourth quarter, which stood at ₦263,678.9108 million, higher than ₦243,263.0954 million and ₦246,447.0951 million recorded in the third quarter of the same year and corresponding quarter of the preceding year i.e. 2011, respectively. However, its growth rate of 8.39% is lower than 21.73% recorded in the preceding quarter (i.e. 3rd quarter of 2012). The trends in seasonally adjusted quarterly real GDP level and growth rate are shown in panels (a) and (b) of figure 2, respectively.

Panel -(a)



Source: *Drawn using 2012-CBN Statistical Bulletin Data*

Panel-(b)

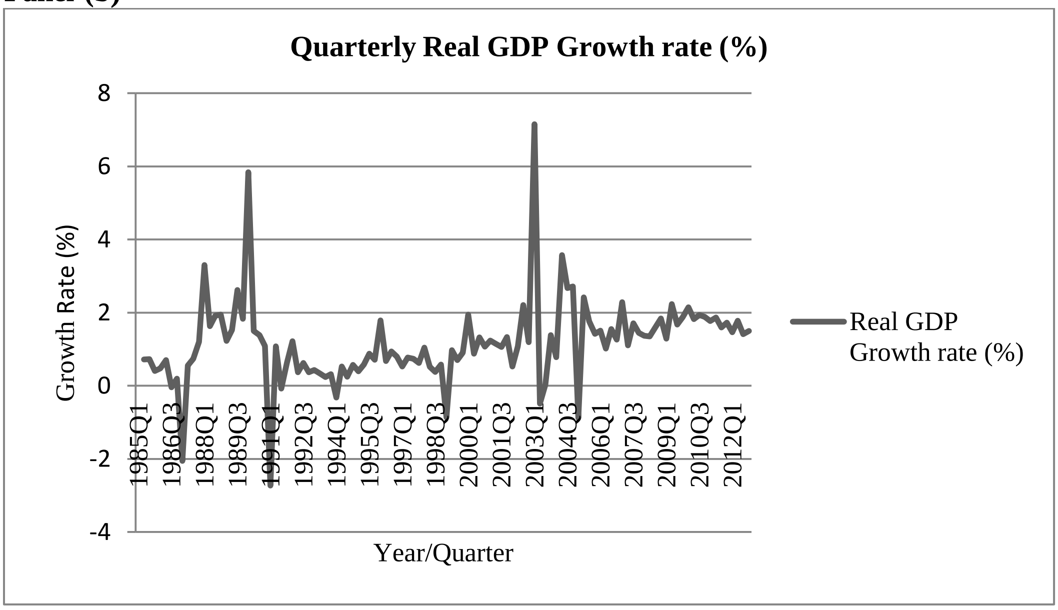


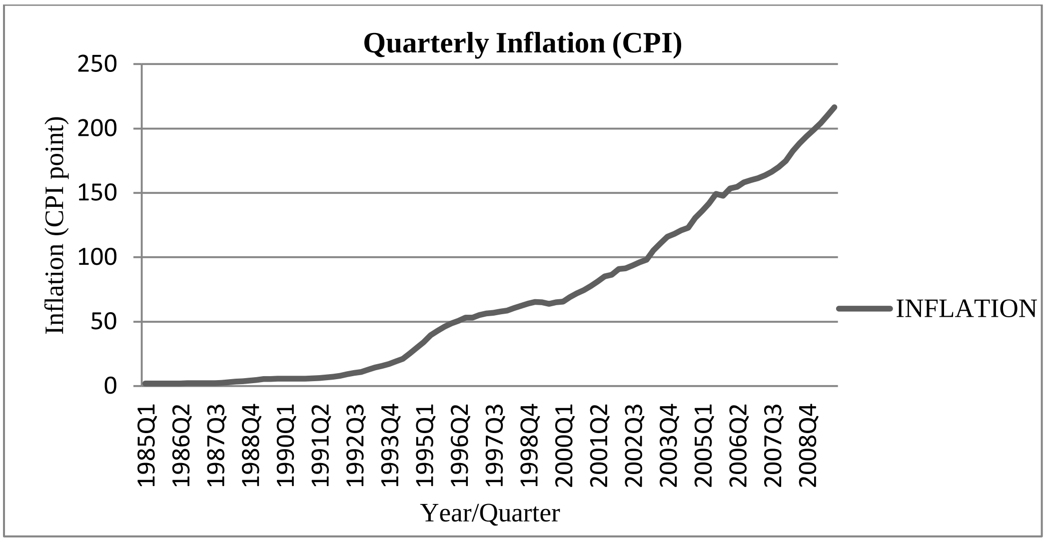
Figure 2: Trends in seasonally adjusted quarterly real GDP level (N' Million) and growth rate [quarterly change in Real GDP (%)], 1985Q1-2012Q4

Source: *Computed and Drawn by author using 2012-CBN Statistical Bulletin Data*

Inflation

Over the period of 1985Q1-2009Q4, the average quarterly inflation rate (percentage change in quarterly CPI) was recorded at 5.08%, whereas, the average quarterly CPI (as a measure of inflation) stood at 67.41 index points. The index was slightly rose by 0.39% in the second quarter of 1985 from 1.96 index points recorded in the first quarter. The inflation rate fell from 0.39% recorded in second quarter of 1985 to -2.46% and then to -1.31% in the third and fourth quarters of the same year, respectively. It declined further to -0.10% in the first quarter of 1986 and then accelerated to 7.05% in the second quarter and slightly fell again to 6.97% and largely to -0.62% in third and fourth quarter of 1986 respectively. It keeps on fluctuating before reaching peak of 31.26% in the first quarter of 1988. However, the least quarterly inflation rate over these periods (1985Q1-2009Q4), stood at -5.98%, which was recorded in the fourth quarter of 2005. Over these periods, the highest CPI (inflation) points were recorded at 215.6 in the last quarter of 2009, which was 1.51% higher than that of preceding quarter. While the least CPI was recorded at 1.89 index points in the first quarter of 1986, which was 0.10% lower than that of the preceding quarter. The trends in seasonally adjusted quarterly inflation, proxy by CPI, and inflation rate (quarterly change in CPI (%)) are shown in panels (a) and (b) of figure 3, respectively.

Panel-(a)



Source: *Drawn using 2009-CBN Statistical Bulletin Data*

Panel-(b)

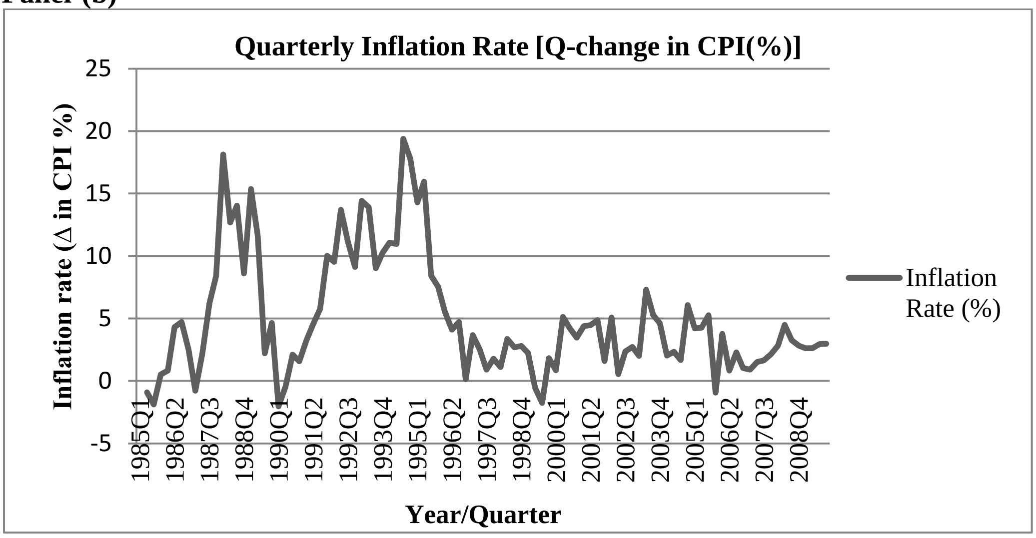


Figure 3: Trends in seasonally adjusted quarterly Inflation (CPI) and Inflation rate [quarterly change in CPI (%)], 1985Q1-2009Q4

Source: *Computed and Drawn by author using 2009-CBN Statistical Bulletin Data*

2.4 Nigerian Stock Market Volatility

Figure 4 below, shows monthly volatility of the Nigerian stock market over the sample periods (1985M1-2012M12), which were derived from the TGARCH(1,1) model estimated for the ASI series using EViews 5.0. It can be observed from the figure that the market experienced higher level of volatility during the period of 1986-1988, 1995, 1999, 2004-2006 and 2008-2009. The higher volatility recorded from the end of 1986 to 1988 could be attributed to the financial system deregulation in 1986 and privatization of some public companies in 1988. The occurrence of higher volatility in 1995 could said to be as a result of internationalization of the Nigerian capital market by the Federal Government of Nigeria in 1995, which enable the foreigners to fully participate in the Nigerian capital market whether as operators or investors without any restriction regarding to the percentage of shares they could hold in the registered companies in Nigerian. This attracts more investment into the stock market. Whereas, the higher volatility in 1999 could be attributed to the positive inflow of the foreign portfolio investment into the Nigerian capital market in 1999 after being negative for about nine years (spanning 1989-1998). While, the higher volatility recorded in the market from 2004-2006 could be attributed to the banking reforms in July 2004 as well as the insurance reforms in September 2005. In July 2004, the Central Bank of Nigeria (CBN) required the Nigerian banks to increase their capital base from ₦2 billion to a minimum of ₦25 billion. Similarly, in September 2005, the insurance and reinsurance companies were required by the Nigerian government to increase their capital base to the minimum of ₦2 billion, ₦3 billion, ₦5 billion and ₦10 billion for life insurance companies, non-life insurance companies, composite insurance companies and re-insurers respectively. In the process of meeting-up with these capital requirements, both of those banks and insurance companies that survived raised substantial part of such capital from the capital market. Finally, the extremely highest level of volatility experienced by the market within the sample periods was recorded between 2008 and 2009, and this could be attributed to the Nigerian stock market crash since March 2008 up to December 2009 coupled with the well-known global financial crisis of 2008. Since March 2008 up to December 2009, the prices of stock on the Nigerian stock market have been falling, which also lead to decline in the ASI as well, (although there were some positive changes in the index in February, April and March of 2009).

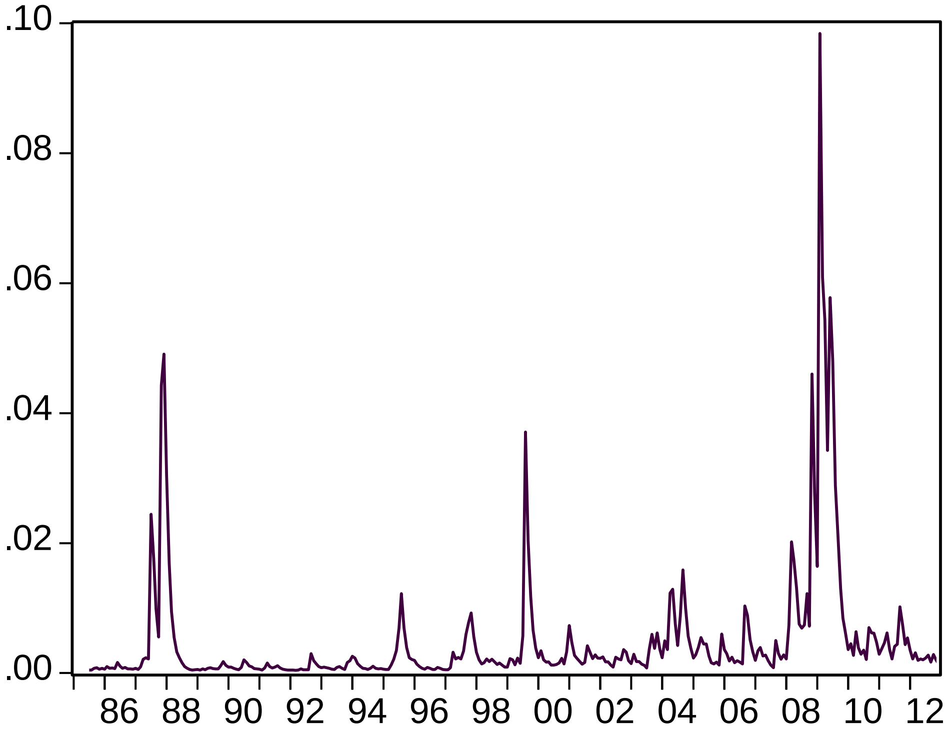


Figure 4: Monthly Nigerian Stock Market Volatility from 1985M1-2012M12

Source: *Derived from TGARCH (1,1) model estimated for ASI series by author using EViews 5.0*

2.5 Review of Related Empirical Studies

A number of empirical studies have been conducted to examine the relationship between stock market and macroeconomic variables. Only few of these studies examine the effect of stock market volatility on real GDP. Whereas other studies focus on the effect of macroeconomic variables or their volatility on stock market index, returns or volatility, other group of the studies focus on the impact of stock market development or performance on macroeconomic variables, and another group of the studies focus on the causal relationship between macroeconomic variables or their volatility and stock market index, returns or volatility. These studies apply various econometric methods such as: ARCH family models, VAR models VECM, Granger causality test, OLS, Impulse Response Function, Variance

Decomposition etc. However, only few of such studies have been conducted for African countries in general and Nigeria in particular.

2.5.1 Stock market volatility and Real GDP

Some few empirical studies that attempt to examine the effect of stock market volatility on real GDP are briefly reviewed below:

Arestis et al. (2001) investigate the relationship between stock market development and economic growth in five developed countries; Germany, Japan, U.S, France and U.K, while controlling for the effects of stock market volatility and banking system. They use quarterly data on real GDP, sock market development (measure by the stock market capitalization ratio), stock market volatility and the indicators of banking system development for all the five countries and apply VAR framework. Their findings indicate among other, that the stock market volatility has negative and significant effect on real GDP in Japan, France and U.K, while in the case of Germany; the stock market volatility has positive but insignificant effect on real GDP.

Guo (2002) investigates the link between stock market returns and volatility and later examines their relative forecasting power for real GDP growth. He uses the squared deviations of daily returns as a measure of stock market volatility, and employs OLS to regress one-quarter-ahead of real GDP growth on the one period lagged real GDP growth, excess stock market return, stock market volatility and their one quarter lags respectively. The results show that while the stock market return affects real GDP growth positively, the stock market volatility affects it negatively. The results suggest further that both the stock market returns and volatility have significant forecasting ability for real GDP growth. Based on this, he concludes that stock market volatility forecasts real GDP growth because volatility affects the cost of capital through its link with the expected stock market returns. However, the author failed to use ARCH family models to estimate the stock market volatility. Similarly, in their study titled “Have individual stock become more volatile?”, Campbell et al. (2001) examine whether the three components of volatility i.e. stock market, industrial and firm-level volatility have any significant power to forecast real GDP growth, using OLS regression with the real GDP growth as dependent variable while the lags of GDP growth, CRSP index returns and the three components of volatility series as regressors. The results show that all the volatility series are negatively correlated with the GDP growth and also have significant forecasting power for it (real GDP growth).

Valadkhani and Chen (2014) examine the impact of U.S stock market and output growth volatility on those of three Anglo-Saxon countries: U.K, Australia and Canada, using quarterly data of stock market price indexes and real GDP growth covering the period 1961Q1-2013Q1 for all the three countries. Firstly, the authors apply GARCH model to generate the stock market and real GDP growth volatility series for all the four countries, and then use them in the second part of the analysis to examine the effect of the U.S stock market and real GDP growth volatility on those of the three countries, using Markov switching model. Their findings reveal that the U.S stock market volatility has significant influence on the real GDP growth volatility for both Australia and U.K, and also significantly affects the stock market volatility of all the three countries. However, the findings also indicate that the U.S real GDP growth volatility has significant impact on Canada's output volatility only, and does not have any influence on the stock market volatility of both the three countries.

Beetsma and Giuliodori (2011) explore the relationship between stock market volatility, real GDP growth and its major components (consumption and investment growths) in U.S. That is, they examine how the stock market volatility shock affect U.S GDP growth and its major components (consumption and investment growth), using long period quarterly data from 1950Q2-2011Q2. They apply VAR framework through Variance Decomposition and Impulse Response Function analysis, and use variables such as real GDP growth, inflation, federal funds rate, stock market volatility (proxy by Dow-jones index volatility) and stock market return (proxy by return on Dow-jones index). They later replaced the real GDP with the consumption and investment growths in the VAR system to see how the stock market volatility shock affects them (as major components of GDP). Their results indicate that the GDP growth responded negatively to stock market volatility shock. They also confirmed that an increase in U.S stock market volatility lead to slowdown of both U.S real GDP growth as well as its major components (i.e. consumption and investment growths). However, the authors failed to use any one of the volatility models (i.e. ARCH family models) to generate the volatility series for their analysis.

Instead, they used a sample standard deviation as a measure of volatility, which is unconditional and does not capture some characteristic of volatility.

2.5.2 Stock market and Macroeconomic variables

In this sub-section, our empirical literature review briefly focuses on: the empirical literature that examine the effect of macroeconomic variables or their volatility on stock market index, returns or volatility and the literature that investigate the impact of stock market development or performance on macroeconomic variables.

In Nigeria, some few researchers examine the relationship between stock market and macroeconomic variables. For instance, Olasumbo (2012) examines the impact of macroeconomic variables on the Nigerian stock market index using All Share Index as a proxy. The macroeconomic variables employed in the study comprise of interest rate, inflation, exchange rate and real GDP. She utilises the annual time series of these variables from 1991 to 2010 and applies multiple regression model. The result of the regression indicates that the selected macroeconomic variables explain 93.4% of the variation in the All Share Index. The results also show that interest, inflation and exchange rates have negative impact on the All Share Index while the real GDP has positive impact on it. Izedonmi and Abdullahi (2011) obtain contrasting results after utilising three macroeconomic variables: inflation rate, exchange rate and market capitalization and the stocks of sixty firms from twenty different sectors in the Nigerian stock exchange market. They use monthly data for the period 2000 to 2004 to analyse the effects of macroeconomic factors on the Nigerian stock market returns. They conclude that the selected macroeconomic factors have no significant influence in the Nigerian stock exchange market.

Rano (2010) investigates whether inflation has any impact on stock returns and volatility in the two West African countries: Nigeria and Ghana, using monthly time series data (for stock market indices and inflation rates) covering the period 1998M1-2010M5 and 1999M12-2010M5 respectively. Because of the nonlinearity of these series according to him, the study adopts step-wise approach; firstly, the standard linear GARCH (1,1) model is applied to capture the stock returns volatility and then Quadratic GARCH (QGARCH) model is applied to test nonlinearities in the effect of asymmetric information. The results reveal that bad news has larger impact on stock market volatility than good news in Nigerian case while the opposite holds in the case of Ghana and that the inflation rates and its 3-month average have significant effect on stock market volatility in both two countries.

Olugbenga (2011) attempts to distinguish his study from the previous studies on the relationship between stock price and macroeconomic variables by using microeconomic approach instead of macroeconomic approach that have been used in the preview studies. Hence, he examines the impact of macroeconomic variables on 36 selected stock prices out of 93 equity stocks as at 1985 in the Nigerian stock market, instead of on stock market All Share Index that have been used in the previous papers. The six macroeconomic variables used in the study include: inflation rate, exchange rate, broad money supply, interest rate, oil price and GDP. The study uses quarterly data on the selected firm's stock price and the aforementioned macroeconomic variable covering period 1985:1-2009:4 and applies panel model. The results indicate that all the macroeconomic variables used in the study have significant impact on stock price in Nigeria except for inflation rate and money supply and that the impact of the variables on the individual firm's stock price varies.

Adenuga (2010) hypothesizes that stock market development promotes economic growth in Nigeria. To confirm the validity of this hypothesis or otherwise, he uses quarterly data on indicators of stock market development and economic growth (proxied by the rate of change in real GDP) from 1990:1 to 2009:4, and employs Johansen co-integration and VECM techniques. The results confirm that the stock market development promotes economic growth in Nigeria over the sample period. This is because the models show positive relationship between the measures of stock market development and economic growth. However, the Johansen co-integration technique used in the study is inappropriate, since some of the variables used in the analysis were I(0) while others were I(1).

Bernard and Achugbu (2012) use stock market capitalization, value traded ratio and turnover ratio as measures of stock market devolvement to investigate the role of stock market development on economic growth in Nigeria. The time series data used in the study cover sample period 1994-2008 and OLS technique is employed to examine the correlation among the variables. Their findings suggest that market capitalization and value traded ratio have weak negative correlation with economic growth while very strong positive correlation exists between turnover ratio and economic growth in Nigeria. Similarly, Osinubi (2002) investigates whether the stock market promote economic growth in Nigeria, using secondary data on stock market development indicators and economic growth for the period 1980 to 2000 and employs OLS method. He found a positive but statistically insignificant relationship between economic growth and the measures of stock market development utilises in the study.

Ihendinihu and Onwuchekwa (2012) employ OLS technique to examine long-run and short-run impact of stock market performance on economic growth in Nigeria. They use annual data of growth rate of GDP, as a proxy for economic growth, and All Share Index, Market Capitalization, Value of Transaction and Total number of Listed Companies, as indicators of stock market performance, for the period 1984-2011. The results indicate that Market Capitalization and Value of Transaction have significant impact on economic growth in both long-run and short-run in Nigeria, while the Total Number of Listed Companies remain insignificant. They conclude that the All Share Index fails to sustain its predictive power in the long-run.

By using annual time series data from 1981 to 2009 and employing OLS regression method, Johansen co-integration test and error correction mechanism in their study titled "The Impact of Capital Market Reforms on Economic Growth in Nigeria", Ojo and Adeusi (2012) recommend that government should objectively evaluate enacted laws and reforms agenda in a manner that will enhance economic growth rather than considering political issue before embarking on reforms. They make this recommendation while their result indicates that the capital market reform positively impact on the economic growth in Nigeria.

Some of the empirical studies that examine the relationship between stock market and macroeconomic variables for other countries include the work of Olweny and Omondi (2011), Diebold and Yilmaz (2008) , Chinzara (2011), Choo (2011), etc. Olweny and Omondi (2011) investigate the effect of macroeconomic factors on the Nairobi stock market (NASE) volatility, Kenya. They use monthly time series data on NASE All Share Index and three macroeconomic variables including: foreign exchange rate, interest rate and inflation rate for the period of 10years, 2001:1 to

2010:12, and employ EGARCH and TGARCH models. They conclude that the selected macroeconomic variables affect stock return volatility at Nairobi stock market, Kenya. Similar results are obtained by Diebold and Yilmaz (2008) after investigating the relationship between stock market volatility and macroeconomic variables volatility for the entire world using approximately forty countries as samples. They utilise major stock market index for each sample country and use real GDP, real consumption expenditure and inflation, as macroeconomic variables. The annual data for the period 1983-2002 are used as a benchmark sample period. They found evidence of link between macroeconomic variables volatility and stock market volatility where the volatility in macroeconomic variables lead to stock market volatility. Similarly, Chinzara (2011) examines the impact that macroeconomic variables volatility have on four selected sectors: financial, industrial, mining and general retails sectors as well as on the stock market as a whole in South Africa, using monthly data on All Share Index for the aggregate market and indies for each of the aforementioned sectors, and utilises seven macroeconomic variables namely: industrial production, consumer price index, broad money supply, exchange rate, oil price, treasury bill and gold price. The sample period covers 1995M8-2009M6. The techniques of analyse employed by the study include ARCH family models and VAR model. Dummies for 1997-1998 Asian and 2007-2009 global financial crises are also included in the analysis to investigate whether these financial crises affect the relationship between macroeconomic variables' volatility and stock market volatility. He found that the macroeconomic variables volatilities have significant impact on the stock market volatility and that the financial crises increase volatility in stock market and in most of the selected macroeconomic variables, and consequently strengthening the effect that macroeconomic variables volatility have on stock market volatility. Choo et al. (2011) obtained contrasting result after employing GARCH models to examine the impact of three macroeconomic variables: gold price, crude oil price and exchange rate, on Japanese stock market volatility using daily data on closing prices of Nikkei 225 index and the macroeconomic variables for about 12years (from May 1997 to July 2009). His findings suggest that the selected macroeconomic variables have no impact on the Japanese stock market volatility. However, although the author did very well in selecting the fittest volatility model to his data by comparing various alternative volatility models base on both model selection criterion as well as forecast performance of the models, but he failed to include in his analysis the first introduced modern volatility model (i.e. ARCH model) from which all other modern volatility models were extended to.

Arnold and Vrugt (2006) empirically examine the link between stock market volatility and macroeconomic uncertainty using quarterly data on S&P 500 and ten macroeconomic variables from 1969Q1 to 1996Q4. They calculate cross-sectional standard deviations for each of the ten variables in each quarter as measure of uncertainty. They found that U.S stock market volatility significantly relates to macroeconomic uncertainty over the sample period, and conclude that this link is much stronger than that of between stock market volatility and more traditional time series measure of macroeconomic volatility, but disappear after 1996.

Engle et al. (2013) in an attempt to suggest several new component model specifications with direct link to economic activity, they revisit the relationship between stock market volatility and macroeconomic activities using new class of model: GARCH-Mixed Data Sampling (GARCH-MIDAS). Using inflation and industrial production growth, they found that both level and volatility of industrial production growth and inflation contain much information about the future stock market volatility.

Dopke et al. (2006) investigate whether forecasting stock market volatility base on real-time macroeconomic data is comparable to forecasting of such volatility base on revised macroeconomic data in Germany, using monthly data on VDAX-new index and macroeconomic variables such as growth rates of industrial production, orders inflow, output gap and other relevant variables covering the period 1995:1-2005:3. They employ recursive modelling approach to analyse whether macroeconomic variables help to forecast stock market volatility in real time: applying monthly average of square stock market returns and GARCH model as first and second alternative estimators, respectively. They use statistical, utility-base and option-base criterions to evaluate the accuracy of the forecast implies by recursive modelling approach. Their main results suggest that the value of volatility forecast base on real-time macroeconomic data is roughly comparable to the value of volatility forecast base on revised macroeconomic data.

Hsing (2011) examines the impact of selected macroeconomic variables on the stock market index in South Africa. He applies EGARCH model. The results reveal that growth rate of real GDP, U.S stock market index and the ratio of the money supply to GDP have positive effect on South Africa's stock market index and negatively impacted by ratio of the government deficit to GDP, nominal effective exchange rate, real interest rate, inflation rate and the U.S government bond yield. Similarly, Sariannidis et al. (2010) examine the role of macroeconomic variables in U.S. stock market. Specifically, they investigate the impact of Yen/U.S dollar exchange rate, 10-years bond value, crude oil return and non-farm payrolls (U.S) on Dow Jones sustainability and Dow Jones Wilshire 5000 (U.S) indices. They use monthly data from February 1999 to January 2008 and apply GARCH model. The results reveal that crude oil return and exchange rate negatively affect U.S stock market and positively affected by 10-years bond value. The findings of the study also suggest that all selected macroeconomic indicators influence Dow jones sustainability index with a month delay.

Rahman et al. (2009) explore short-run and long-run dynamic relationship between five macroeconomic variables namely: real exchange rate, money supply, industrial production index, reserves and interest rate, and Malaysian stock market, proxy by Kuala Lumpur composite index, using monthly data from 1986:1 to 2008:3. They employ VAR framework to investigate the existence of long-run equilibrium and short-run dynamic adjustment relationship between the variables. Specifically, they apply Johansen methodology and VECM followed by variance decomposition (VD) analysis and impulse response function (IRF). They found that all the selected macroeconomic variables have significant long-run effect on Malaysia's stock market in a VECM framework. This is also supported by the results of IRF and VD, which indicate that the Malaysian stock market responded to change in these variables. Based on these findings they conclude that the Malaysian stock market is sensitive to change in the macroeconomic variables. The same results are obtained by Adam and Tweneboah (2008), who also examine the long-run and short-run dynamic relationship between stock prices movement (with the databank stock index as a market index) and selected macroeconomic variables (such as interest rate, inflation, net foreign direct investment and exchange rate) for Ghana, using quarterly data from 1991Q1 to 2006Q4 and apply Johansen's multivariate co-integration test and Innovation accounting techniques i.e. Impulse Response Function and Variance Decomposition, which are derived from VECM estimation. The results show evidence of co-integration between stock price and macroeconomic variables, indicating the existence of long-run relationship between them. The results also show that the selected macroeconomic variables significantly influence share price movement in the short-run in Ghana. Harper and Jin (2012) also obtain similar results for Indonesia when they investigate both short-run and long-run relationship between stock return (using Jakarta composite index) and five selected macroeconomic variables (including; inflation, interest rate, money supply, industrial production index and exchange rate), using multivariate co-integration framework and VECM and monthly time series data for the period 2001M1-2010M2. They found the existence of co-integration relationship between the market index and the selected macroeconomic variables, and this suggests evidence of long-run equilibrium relationship between the variables. The result from VECM show that the short-run deviations return to their long-run properties. Similarly, Mahmood and Dinniah (2009) examine the dynamic short-run and long-run equilibrium relationship between stock prices and selected macroeconomic variables such as inflation rate, industrial production index and foreign exchange rate in six Asian-pacific: Malaysia, Korea, Thailand, Hong Kong, Japan and Australia, using monthly data on stock price indices and aforementioned macroeconomic variables spanning from 1993M1 to 2002M12 for all sample countries except for Hong Kong and Australia, where the quarterly data are used. They apply Engle and Granger (1987), Johansen and Juselius (1990) as well as Error Correction Model. The study provides evidence to support the existence of long-run equilibrium relationship between and among the variables for all the sample countries except for Malaysia and Thailand. However, the findings show no evidence of short-run relationship among the variables for all selected countries except for Hong Kong, where the relationship is only between exchange rate and stock prices, and Thailand, where the relationship is only between real output and stock price.

Ibrahim (2011) while conducting a study on the relationship between stock market development and macroeconomic performance in Thailand, uses real GDP, as a measure of the level of economic performance, and market capitalisation as a ratio of GDP represents the level of stock market development, while investment to GDP ratio and aggregate price level (represented by GDP deflator) are used as a controlled variables. The study applies VAR model to capture the existence of co-integration among the variables. The VAR framework is also used to obtain Variance Decompositions and Impulse Response Function analyses. The co-integration test's results suggest evidence of long-run relationship among the variables, while Impulse Response Function indicates bidirectional causality between stock market development and real GDP. This is also affirmed by the Variance Decompositions test, which show that a sizeable percentage of variation in real GDP accounts by shock in stock market development and vice versa.

Elly and Oriwo (2012) attempt to investigate whether there exist any relationship between macroeconomic variables and stock market performance in Kenya, using three macroeconomic variables such as lending interest rate, inflation rate and 91-day Treasury bill and Nairobi securities exchange's All Share Index(NASI), as a proxy for the stock market. The study utilises monthly time series data for the period 2008:3-2012:3. To avoid dubious regression results according to the authors, the ARDL bound test approach of co-integration is applied to find the existence of long-run relationship among the variables. Their findings suggest a weak positive relationship between inflation and NASI, while 91-day Treasury bill negatively relates with NASI.

Becker and Clements (2007) apply Spline GARCH and Modified-Spline GARCH models to daily returns of S&P500 index from 3rd January, 1957 to 31st December, 2004. In order to demonstrate how macroeconomic variables can be used for longer-term forecasts of volatility within the Spline-GARCH framework, the macroeconomic variables such as GDP growth, growth in industrial production, inflation, 3-month treasury bill rate, 10-year treasury note and 10-year corporate bond rate are considered as independent variables. The results of the model indicate that a number of macroeconomic variables have significant explanatory power for explaining variation in unconditional volatility. They conclude that with the application of this model to S&P500 index the forecast of macroeconomic variables can be easily incorporated into volatility forecast for share index returns.

The studies of Azeez et al. (2012) and Polodoo et al. (2011), which have been done on the exchange rate volatility and macroeconomic performance are similar to but quite different from my study. Azeez et al. (2012) use real GDP, as unexplained variable, while Exchange rate volatility, Balance of payment and Oil revenue as explanatory variables, to examine the effect of exchange rate volatility on macroeconomic performance in Nigeria. The sample period cover 25 years (i.e. 1986-2010), and they apply OLS and Johansen co-integration methodology to test for the short run and long run effect, respectively. The results indicate that oil revenue and exchange rate volatility are positively related to real GDP in a short run and that Oil revenue and Balance of payment exert negative effect, while exchange rate volatility contributes positively to real GDP in the long run. However, the authors failed to employ one of the modern volatility models in order to model the volatility of exchange rate. Instead, they use nominal effective exchange rate as a representative of the exchange rate volatility. Furthermore, the Johansen methodology employed by the authors is inappropriate method to be used in their study, this is because some of their variables were I(0) while others were I(1). Similarly, Polodoo et al. (2011) investigate the impact of exchange rate volatility on the macroeconomic performance for fifteen Small Island Developing States using yearly data spanning 1999-2010. The macroeconomic variables used in the study includes: economic growth rate, external trade (current account) and foreign direct investment. They formulated three equations for each of these variables, in which each of them serves as a function of exchange rate volatility with some variables included in each equation as controlled variables. To obtain the exchange rate volatility, they use monthly data to compute the yearly z-scores which are then used as a measure of exchange rate volatility in the study. OLS with robust standard errors were run by the authors for all the three equations and then continue with two sets of panel regression: the first set comprises of fixed and random effect estimation, while the second set comprises of generalised method of moments estimation. The results from OLS show that the exchange rate volatility negatively impact on current account balance but positively impact on the economic growth rates of the sample state. Whereas, the exchange rate volatility has no impact on the macroeconomic variable as evidencing in the dynamic setting. However, the authors failed to employ one of the commonly use and popular volatility models (i.e. ARCH family models) to get the exchange rate volatility series therefrom for their analysis.

2.5.3 The causal relationship between Stock market and Macroeconomic variables

Here, the empirical literature briefly reviewed below focuses on: the studies that investigate the causal relationship between macroeconomic variables or their volatility and stock market index, returns or volatility and the literature that investigate both causal relationship as well as long-run/or short-run relationship between them.

For Nigeria, such studies include the works of Oseni and Nwosa (2011), Ajao (2012), Asaolu and Ogunmuyiwa (2010), and Lawal and Okunola (2012).

Oseni and Nwosa (2011) employ AR (k)-EGARCH (p, q) model to examine the volatility in the stock market and three macroeconomic variables: real GDP, interest rate, and inflation rate in Nigeria. They also apply LA-VAR Granger Causality test to investigate the nexus between stock market volatility and the macroeconomic variables volatility using annual data for the period 1986 to 2010. They found evidence of bidirectional causality between stock market volatility and real GDP volatility, whereas no causal relationship exists between stock market volatility and the volatility in interest rate and inflation rate. However, the researchers failed to disclose the sources of their data, and this may lead to several questions on the reliability of their results.

Ajao (2012) uses quarterly data of closing point of all share index, inflation, financial openness and exchange rate for the period 1985Q1-2009Q4, and applies GARCH model and Granger causality test to examine the impact of inflation, financial openness and exchange rate on stock market volatility in Nigeria. Based on the findings, he concludes that both present and previous periods' exchange rate and financial openness have significant impact on and Granger cause Nigerian stock market return volatility. He also concludes that it is only the previous period's inflation has significant impact on stock market return volatility. While the results from the causality test indicate that the inflation does not Granger cause stock market return volatility in Nigeria. However, the researcher failed to compare and choose the fittest volatility model to his data among the ARCH family models. Similarly, Asaolu and Ogunmuyiwa (2010) while investigating the impact of macroeconomic variables on the movement of Nigerian stock exchange market, use the average share price (ASP) of 25 quoted company as proxy for the market and a set of nine macroeconomic variables for the period 1986-2007 and apply Johansen co-integration, Error Correction Method and Granger causality test. The result of the co-integration indicates the existence of long-run relationship between ASP and macroeconomic variables. However, they conclude that ASP is not a leading indicator of macroeconomic variables in Nigeria and that stock price movement cannot actually be explained by the macroeconomic factors. This is because the Granger causality test shows only unidirectional causality running from exchange rate to ASP while no causal relationship between ASP and the remaining eight variables is established. However, the Johansen co-integration method employed by the authors is not appropriate. This is because some of the variables used in the analysis were found to be I(0), while others were I(1).

Lawal and Okunola (2012) examine the causal relationship between stock price, stock market operation and economic growth in Nigeria using annual time series data covering period 1985-2011. They employ Granger causality test, OLS and Error Correction model, and then conclude that the stock prices and stock market operation have a tendency to increase economic growth in Nigeria.

Some of such studies that have been conducted for other countries include the studies of Mushtaq et al. (2011), Zakaria and Shamsuddin (2012), Pilinkus (2009), Tripathy (2011) and Ali et al. (2010).

Mushtaq et al. (2011) investigate the relationship between stock market volatility and macroeconomic variables volatility in Pakistan, and employ EGARCH model to measure the impact of macroeconomic indicators such as exchange rate, foreign direct investment (FDI), inflation and treasury bill on stock market volatility, and apply Granger causality test of La-VAR model to examine the causal relationship between them using monthly data on Karachi stock exchange-100 index (as a proxy for the market index) and above mentioned macroeconomic variables for the period of 2000M6-2010M6. The results indicate that both inflation and FDI are positively related to stock market volatility while exchange rate and T-bill are inversely related to stock market volatility. The Granger causality tests reveal bidirectional causality between stock market volatility and both FDI and exchange rate, while a unidirectional causality exist with the direction running from stock market volatility to T-bill. But no causal relationship between inflation and stock market volatility is found. However, Zakaria and Shamsuddin (2012) obtain contrasting results after examining the relationship between stock market volatility and macroeconomic volatility for Malaysia using five selected macroeconomic variables such as GDP, inflation, exchange rate, interest rate and money supply, while Bursa Malaysia composite index is used as a proxy for Malaysian stock market index. The data used in the study are on monthly basis spanning from January 2000 to June 2012. Firstly, they apply GARCH (1,1) model to obtain the volatility series of all the variables and then later conduct a Granger causality test in bivariate and multivariate VAR model to investigate the causal relationship between the volatility of the variables. Furthermore, in order to determine the direction as well as the magnitude of the impact of macroeconomic variables' volatility on stock market volatility, they also estimate multiple regression analysis. The results indicate that only one out of the five variables (i.e. inflation) found to be Granger cause stock market volatility. The results also reveal unidirectional causality running from stock market volatility to interest rate volatility, but no causal relationship between the volatility of the macroeconomic variables as a group and stock market volatility is established. This weak relationship between the stock market volatility and macroeconomic variables volatility is also confirm in the regression analysis's results, which show that it is only the money supply's volatility has a significant positive impact on the stock market volatility. The results also show that the volatility of macroeconomic variables as a group have no significant impact on the stock market volatility.

Pilinkus (2009) investigates whether stock price may serve as a leading indicator for macroeconomic variable or a group of macroeconomic variables may serve as a leading indicator for stock return in Lithuania. He utilises monthly data for OMX Vilnius index and a set of 40 macroeconomic variables from 1999:12-2008:3 and applies Granger causality test. The results indicate among others, that GDP deflator, net export and foreign direct investment lead Lithuania stock market return, whereas GDP, construction volume index and material investment led by OMXV index. Also, Granger Causality tests reveal bidirectional causality between OMXV index and money supply, balance of payment, index of durable consumer good, among other. Tripathy (2011) utilises weekly time series data from January 2005 to February 2011 on four macroeconomic variables comprising of short-term interest rate (represented by 91-day treasury bill), inflation rate, S&P 500 index (as international market index) and trading volume, and on BSE Sensex index (as a proxy for Indian stock market), to examine the relationship between Indian stock market and macroeconomic variables. The results of the Granger causality test reveal bidirectional causality between stock market and two variables: interest rate and exchange rate, while unidirectional causality running from international market to domestic market, trading volume to stock market and inflation rate to stock market exist. Ali et al. (2010) however, find the results that contrast with the findings of Pilinkus (2009) and Tripathy (2011), while using Johansen's co-integration methodology and Granger causality test to analyse the causal relationship between macroeconomic indicators and stock exchange price for Pakistan. The four macroeconomic variables used are inflation, exchange rate, balance of trade and industrial production index, and the general price index of Karachi stock exchange is used as the stock market price. The study utilises monthly data from June 1990 to December 2008. They found evidence of co-integration between Industrial production index and stock exchange price, but the results of causality tests indicate no causal relationship between selected macroeconomic indicators and stock market price. However, the Johansen's co-integration technique employed in the study by the authors is not appropriate to be used in their analysis. This is because while some of their variables were I(0) others were I(1) and I(2).

2.5.4 Stock market volatility

In this sub-section, the empirical literatures that examine the volatility in the stock market using various volatility models are briefly reviewed below;

In Nigeria, several researchers attempted to examine the volatility in the Nigerian stock market. For example, Ahmed (2009) uses All Share Index (ASI) and employs ARCH model to model its (ASI) volatility while attempting to examine the effect of liberalization on the stock return volatility in the Nigerian stock market. The sample period covers 1987 to 2008 and is divided into three segments: 1987-1994, 1995-2004 and 2005-2008. He then examines the volatility in each of these sub-sample periods. He found evidence of high volatility in the Nigerian stock market which becomes more pronounce between 2004 and 2008. However, the author failed to compare various volatility models and select the fittest model to his data among them. Similarly, Gabriel and Ugochukwu (2012) try to understand the Nigerian stock market with regard to volatility and prediction using month end stock prices of four major companies covering period from January, 2005 to December, 2009 and apply ARCH model. Their results reveal the presence of volatility in all the four stock prices of the companies used as proxy. Based on the results, they conclude that stock prices in Nigerian capital market do not follow a random walk and therefore, not efficient in the weak form. They also conclude that contrary to most opinion, volatility should not be feared; it should be recognized as a necessary part of the risk and return relationship. However, Chigozie (2009) obtained contrasting result after investigating whether the Nigerian stock market follows a random walk or not. To achieve this, he uses monthly price index from 1984 to 2006 and employs GARCH (1,1) model. He concludes that the Nigerian stock market is weakly efficient. This is because the result shows that it follows random walk.

Suleiman (2011) uses daily market capitalization index for trading period 21st April, 2008 to 8th June, 2011, (totalling 756 number of observations), to examine whether the Nigerian stock exchange market is volatile. The GARCH (1,1) applied in the study shows volatility presence and persistence shock in the Nigerian stock exchange market.

Okpara (2011) while investigating the relationship between the stock market return and volatility in Nigerian stock market concludes that there is presence of volatility in the Nigerian stock market and that the forecast of variance cannot be used to predict expected return. The result of EGARCH-in-mean model applied by the author using month-end All Share Index from 1984-2009 also reveals the existence of leverage asymmetric effect in the Nigerian stock market during the sample period of the study. Olowe (2009) also obtained similar results after employing EGARCH-in-mean model to investigate the relationship between stock returns and volatility in Nigerian stock market in the light of 2004 banking reform, 2005 insurance reform, Nigerian stock market crash since 1st April 2008 to 16th January, 2009 and 2008 global financial crisis. Using daily time series data on the Nigerian stock market index for the period 2nd January, 2004 to 16th January, 2009, his findings indicate the existence of volatility persistence, volatility clustering and leverage effect in the Nigerian stock market. The results of the study also show positive but insignificant relationship between stock return and its volatility.

Furthermore, the results indicate that 2004 Nigerian banking reform and 2008 Nigerian stock market crash negatively impact on the stock market return, while 2005 insurance reform and 2008 global financial crisis have no impact on the stock market return. The author concludes that 2008 Nigerian stock market crash contributed more to the high volatility persistence in the Nigerian stock market especially during the period of global financial crisis. Similarly, Emenike (2010) uses monthly All Share Index (ASI) from January, 1985 to December, 2008 as an empirical sample to investigate the behaviour of stock return volatility in the Nigerian stock exchange market. He employs GARCH (1,1) to capture the stock return volatility clustering and GJR-GARCH model to capture the presence of leverage effect in the ASI series. The overall results indicate evidence of volatility clustering, fat-tailed distribution and the existence of leverage effect in the Nigerian stock exchange market return series. However, the author failed to compare and choose the best fit volatility model to his data between the asymmetric volatility models.

Emenike and Aleke (2012) in an attempt to examine the volatility of Nigerian stock exchange market for the presence of asymmetric effect using daily closing prices of the weighted All Share Index from January 2, 1996 to December 30, 2012, they employ GARCH (1,1), EGARCH and GJR-GARCH model and report volatility clustering, and high volatility persistence in the Nigerian stock exchange market (NSE). They also found the presence of asymmetric effect in the NSE return series. However, contrary to theoretical expectation for the sign of asymmetric parameter with regard to leverage effect, both EGARCH and TGARCH results show positive and negative asymmetric parameter, respectively, indicating the absence of leverage effect in both the two models. Results also contradict the findings of Ayodeji (2009) and Emenike (2010). However, the researchers failed to show the best fit asymmetric volatility model to their data between the two models.

Onwukwe et al. (2011) in their study titled ‘’On Modelling the Volatility of Nigerian Stock returns using GARCH models’’, employ three volatility models namely: GARCH (1,1), EGARCH(1,1) and GJR-GARCH(1,1) models, in order to choose among them the best fitting model to daily stock return series of the four listed firms used as a proxy for the Nigerian stock market for the period 2nd January, 2002 to 31st December, 2006. Their empirical results suggest GJR-GARCH (1,1) as superior to EGARCH and GARCH models based on both AIC and forecast performance. The results also indicate high volatility persistence in the Nigerian stock market. However, although the authors did well in trying to come up with the best fit volatility model to their data, they failed to include ARCH model in their analysis from which all other volatility models used in the study are developed.

Ezepue and Omar (2013) employ ARCH family models to examine the characteristic of the Nigerian stock market and focus on six key issues in financial economic, (namely; volatility, efficiency, bubbles, normalities, valuation and predictabilities), in the light of 2004 Nigerian banking reform and 2008 global financial crisis, using All Share Index for the period 2000- 2010. They split the sample period into 4 sub-sample periods: pre-reform, post-reform, post-reform-pre-crisis and post-reform-post-crisis periods, and choose the fittest volatility model for each sub-sample period as well as for the whole sample period base on AIC. Their results show excessive volatility in the Nigerian stock market associated with some significant variables and the volatility varies subtly across the sub-sample period mention above. However, the researchers only used the model selection criterion as a basis for selecting the best fit volatility model to their data, failing to understand that by comparing the models based on both model selection criterion and forecast performance they may come up with strong fittest model. However, if there is conflict between the two bases, selecting the fittest model based on forecast performance may be seen as superior.

Some of the empirical studies on stock market volatility for other countries include the works of Verma and Mahajan (2012), Goudarzi and Ramanarayanan (2011), Ahmed and Suliman (2011) and Nazarian et al. (2013). In order to examine whether 2008 U.S. financial crisis which extended to global financial crisis has an impact on the stock return volatility of Indian stock market, Verma and Mahajan (2012) use daily closing figure of Bombay stock exchange index (BSE-Sensex index) from 2nd January, 2007 to 9th November, 2010 and employ both traditional and modern approaches for measuring the volatility, represented by standard deviation and ARCH family model (EGARCH model in this study), respectively, to capture the presence of volatility in BSE-Sensex index series. The results of both traditional and modern approaches show high volatility in Indian stock market returns during the global financial crisis period. However, the advantages of EGARCH model over GARCH model given by the authors as a justification for using EGARCH model in the study is not sufficient. The models need to be compared and be selected based on model selection criterion and/or forecast performance of the models.

Goudarzi and Ramanarayanan (2011) use two popular asymmetric volatility models: EGARCH and TGARCH, to investigate which one between good and bad news impact more on the Indian stock market volatility than the other using daily closing data for BSE 500 price index covering the sample period from 26th July, 2000 to 20th January, 2009. To choose the best fit volatility model to their data, they compare the two models base on model selection criterion such as AIC and SBIC, where the TGARCH model emerged as superior to EGARCH model. The result of both two models indicate the presence of leverage effect and base on this, they conclude that bad news increases the volatility in Indian stock market more than the good news. However, although the authors tried a lot to come up with the asymmetric volatility model that best fit their data, the authors failed to compare the two models base on forecast performance, the selection base on which may be regard as superior to the selection of the model base on model selection criterion.

Ahmed and Suliman (2011) use both symmetric (GARCH and GARCH-M) as well as asymmetric (EGARCH, TGARCH and PGARCH) volatility models to model the Sudanese stock market return volatility using daily closing price of Khartoum stock exchange index covering period from 2nd January, 2006 to 30th November, 2010. The overall result of the study indicates the presence of high volatility in the Sudanese stock market during the sample period. However, the researchers failed to compare the volatility models utilised in the study to show which one among them fit their data (i.e KSE index) best.

Nazarian et al. (2013) in an attempt to develop a new hybrid model that could give more accurate forecasts of the return series, combine two type of models: classic (conditional Heteroscedasticity) and neural models, to forecast the volatility of Tehran stock exchange index for Iran using daily time series data from 25/03/2009 to 22/10/2011. They found that based on MSE and RMSE criteria for comparing forecast performance, the accuracy of hybrid model of neural network and best GARCH model is higher than each one of these models. However, authors only consider MSE and RMSE criteria for comparing forecasting performance of the models and neglect MAPE and Theil coef. Criteria, which are also important criterion to be considered while comparing the forecast performances of the models

However, the following observations have been made on the empirical literature discussed in sub-sections 2.5.1, 2.5.2, 2.5.3 and 2.5.4 above:

It was observed from the above empirical studies that only few studies have been conducted on the effect of stock market volatility on macroeconomic variables, and all of them focus on the effect of stock market volatility on real GDP in developed countries. However, to the best of my knowledge, none of the previous studies attempt to examine the effect of stock market volatility on macroeconomic variables in Nigeria, and in African countries at large. Although, a number of studies have been done on the causal relationship between stock market and macroeconomic variables, where some of such studies, for example, the work of Oseni and Nwosa (2011), Tripathy (2011) and Pilinkus (2009), founds bidirectional causality between them, which simply indicate that the stock market index, returns or volatility has significant influence on macroeconomic variables and vice versa. While other studies like Abiodun and Elisha (2012), Mushtaq et al. (2011) and Zakaria and Shamsuddin (2012) founds unidirectional causality running from stock market index, returns or volatility to macroeconomic variables or their volatility. However, the results of causality test do not show the sign (positive or negative) as well as the magnitude of these effects. The test also does not show the influence of one variable on the others alone, but the influences of the variables on one another. Also, some empirical studies have been carried out on the effect of stock market development or performance (not stock market volatility) on macroeconomic variables.

Lastly, it was also observed in the empirical literature, that examine the stock market volatility and those studies that employ ARCH family model to explore the relationship between stock market volatility and macroeconomic variables, that while modelling the volatility of the variables, some of the authors arbitrarily select any volatility model without justifying their selection, while other researchers give the advantages of their selected model over one or more alternative volatility models as their justification for such selection [like in Verma and Mahajan (2012)]. However, given the advantages of a particular volatility model over other alternative models is inadequate. The models need to be compared, and then choose among them the fittest model to the data of the study. Whereas, some researchers, like Ezepue and Omar (2013) and Goudarzi and Ramanarayanan (2011), selected the model among the alternative volatility models based on model selection criterion (AIC and SC) only. However, selecting the fittest volatility model base on selection criterion alone is not sufficient. This is because by comparing the alternative volatility models based on both model selection criterion and forecast performance of the models, you may come up with the fittest model to your data than selecting the model based on selection criterion alone. Moreover, if there is conflict between the two bases, the selection of the model based on forecast performance of the models may be seen as superior.

Only works of Nazarian et al. (2013), Onwukwe et al. (2011) and Choo (2011) among the empirical studies reviewed above, compared the alternative volatility based on both model selection criterion and forecast performance of the models. However, even these authors, failed to include ARCH model in their analysis, which is the first introduced modern volatility model and can emerge as the best fit model to their data, unless if their objective is to use asymmetric volatility model.

Therefore, this study intends to fill these gaps by investigating the impact of stock market volatility on macroeconomic variables, specifically on real GDP and inflation, and also by comparing alternative ARCH family models based on both model selection criterion and forecast performance (in-sample and out-sample forecast performance) of the models, so as to choose the volatility models that will best fit All Share Index series. Other gaps to be filled by this thesis can also be seen in the area of the country for which the study is conducted as well as the variables and methodology used in the study.

2.6 Theoretical Framework of Volatility Models

Volatility is defined as the spread of all likely outcomes of an uncertain variable. Typically, in financial markets, we are concerned with the spread of asset returns (Poon, 2005). According to Tsay (2010) volatility means the conditional standard deviation of the underlying asset return. Traditionally, a sample standard deviation or variance has been used as a measure of volatility in the following forms (Poon, 2005).

$$\sigma = \sqrt{\tfrac{1}{T-1}\sum_{t=1}^{T}(r_t - \eta)^2} \qquad \text{Or} \qquad \sigma^2 = \tfrac{1}{T-1}\sum_{t=1}^{T}(r_t - \eta)^2 \tag{1}$$

Where r_t is the return at time t and η is the average return over the t-time period. However, this method of measuring volatility is unconditional and does not capture some characteristics of volatility, such as volatility clustering [i.e. large shocks tend to be followed by similar large shocks and small shocks tend to be followed by a similar small shocks (Rano, 2010)], asymmetry or leverage effect (i.e. the different impact that positive and negative shocks of the same magnitude have on volatility) and time-varying, which are usually found in most of the financial time series data. Therefore, in order to resolve these weaknesses of the traditional measure of volatility, a number volatility models referred to as conditional heteroscedastic models were proposed by various researchers, such models among others, are ARCH, GARCH, EGARCH and TGARCH models. Each of these models has two equations: conditional mean equation and volatility (or conditional variance) equation. Depending on the ARMA structure used, the specification of mean equation is the same for all the models and remain so irrespective of the model's order used (for example, the mean equation's specification for AR (2)-ARCH (1) is the same as the mean equation's specification for AR (2)-ARCH(2), AR(2)-ARCH(3) e.t.c in these cases, only the values of the coefficients(in the mean equation) vary while estimated).

2.6.1 The Autoregressive Conditional Heteroskedasticity (ARCH) Model

The first model that provides a systematic framework for volatility modelling is the ARCH model proposed by Engle (1982). The basic idea of ARCH models is that (i) the error term or shock (ε_t) of a time series data (e.g. an asset return) is serially uncorrelated, but dependent, and (ii) the dependence of the shock (ε_t) can be described by a simple quadratic function of its lagged values (Tsay, 2010).

According to Agung (2009) the model (ARCH model) is specifically designed to model and forecast the volatility.

In the ARCH model, the volatility is expressed as a linear function of lag of square residuals obtained from the mean equation. Mathematically, the general specification of ARCH(p) is as follows:

$$y_t = \psi + \sum_{i=1}^{k} \theta_i y_{t-i} + \varepsilon_t \, ; \tag{2}$$

$\varepsilon_t = \sigma_t a_t$ Where $a_t \sim$ iid N(0,1) i.e with the $\eta_{a_t} = 0$ & $\sigma^2{}_{a_t} = 1$

$$\sigma_t^2 = \lambda + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 \tag{3}$$

Equation (2) above is a conditional mean equation of ARCH(p) model for any time series variable *y* at time *t* (i.e. y_t), and it might be an autoregressive (AR), moving average (MA) process or the combination of the two i.e ARMA process. In the equation, ε_t is heteroskedastic error term, which is a product of two elements: a_t (a sequence of independent and identically distributed (iid) random variables with zero mean and variance equal to 1) and σ_t (conditional standard deviation).

Note that the conditional means equation specified above [i.e. equation (2)] remain the same specification for the other volatility models discussed in this section. Thus, we focused only on their volatility equations.

Equation (3) above is the volatility or conditional variance equation of ARCH(p) model for y_t variable, where λ is a constant term and must be greater than zero, '*p*' is the number of lagged ε^2 terms, α_i is the ARCH parameter and must be greater than or equal to zero for any i > 0 and ε_{t-i}^2 is the ARCH term. These constraints are imposed on the parameters to ensure that the volatility of any time series variable is positive. However, despite its success, the ARCH model has some weaknesses among which include:

1. Its failure to capture the asymmetry or leverage effect in the volatility of the time series data.

2. The ARCH model is rather restrictive. For example, α_1^2 of an ARCH(1) model must be in the interval [0, $\frac{1}{3}$] if the series has a finite fourth moment. The constraint becomes complicated for higher order ARCH models. In practice, it limits the ability of ARCH models with Gaussian innovations to capture excess kurtosis.
3. It does not provide any new insight for understanding the source of variations of a financial time series. It merely provides a mechanical way to describe the behaviour of the volatility. But it does not give indication about what causes such behaviour to occur.
4. And it is likely to over-predict the volatility because they respond slowly to large isolated shocks to the return series. (Tsay, 2010pp. 119).

Moreover, ARCH model often requires many parameters to adequately describe the volatility process of the variable (Tsay, 2010). To correct some of these weaknesses, the GARCH model was introduced.

2.6.2 The Generalized Autoregressive Conditional Heteroskedasticity(GARCH) Model

GARCH model was proposed by Bollerslev (1986) to reduce a more complicated dynamic structure for time-varying, conditional, higher order moments of ARCH model by simply adding lagged conditional variance term in the ARCH model's volatility equation (Choo, 2011). In general, GARCH *(p, q)* model can be shown as follows;

$$\sigma_t^2 = \lambda + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 \qquad (4)$$

Where λ is constant and must be greater than zero, '*p'* is the number of lagged ε^2 term and must be $p > 0$, so that even if q=0, ARCH model will remain. While '*q'* is the number of lagged σ^2 terms and should be $q \geq 0$. β_j is GARCH parameter and is expected to be greater than or equal to zero ($\beta_j \geq 0$ for j= 1, 2…l), while σ_{t-j}^2 is the GARCH term. Similarly, the restriction on ARCH parameter in ARCH model is also the same in GARCH model, i.e. $\alpha_i \geq 0$. Jointly, $\alpha_i + \beta_j$ is refers to as volatility persistence parameter, this is because it measures the persistence in the volatility shocks taking values between 0 and 1. The more the sum of these parameters moves close to one, the greater the persistence of shock to volatility, which is known as volatility clustering (Emenike, 2010). Therefore, $\sum_{i=1}^{\max(p,q)}(\alpha_i + \beta_i) < 1$. The constraints imposed on the parameters: λ, α_i, β_j and $(\alpha_i + \beta_j)$, meant to ensure that the volatility or conditional variance of a series is non-negative. However, some weaknesses of GARCH model are the same with that of ARCH model (Tsay, 2010). For instance, the main drawback of the two models is their inability to capture the asymmetry or leverage effect in the volatility of financial time series. Another weakness shared by the models is the restrictions imposed on their parameters to ensure that the conditional variance (volatility) is non-negative. Furthermore, the GARCH model does not take into account the non-linearity in the volatility (Varma & Mahajan, 2012). Therefore, in order to correct the weaknesses of ARCH and GARCH models, particularly with regard to their failure to address the issue of asymmetric effect in the volatility and the restriction imposed on their parameters to ensure the volatility of the series is non-negative, among others, the asymmetric volatility model such as EGARCH and TGARCH were proposed.

2.6.3 The Exponential GARCH (EGARCH) Model

In order to remedy some of the weaknesses of GARCH model in handling financial time series, the first asymmetric volatility model, EGARCH model, was developed by Nelson (1991), particularly to allow for asymmetric effect between positive and negative shocks of the same magnitude on the volatility (Tsay, 2010). A number of refinements were introduced on the GARCH model by Nelson (1991) in using EGARCH model to detect asymmetric volatility in the financial data series: the first of these refinements was to model the log of the variance, rather than the level. This ensures that the estimated volatility is strictly positive, and therefore, the restrictions of ARCH and GARCH models for ensuring non-negative conditional variance are no longer important. Secondly, the asymmetric parameter γ_i typically responds differently to positive and negative shocks of the same size (Emenike and Aleke, 2012). Generally, the EGARCH (p, q) model specification is as follows;

$$\ln(\sigma_t^2) = \lambda + \sum_{i=1}^{p} \alpha_i \frac{|\varepsilon_{t-i}| + \gamma_i \varepsilon_{t-i}}{\sigma_{t-i}} + \sum_{j=1}^{q} \beta_j \ln(\sigma_{t-j}^2) \qquad (5)$$

Where α_i & β_j are interpreted the same way as in the GARCH(p, q) model, while γ_i is the asymmetric parameter. When ε_{t-i} is positive (i.e. $\varepsilon_{t-i} > 0$), we say that there is "good news", and therefore, the total effect of good news on the log volatility is $\alpha_i(1+\gamma_i)|a_{t-i}|$. Whereas, if ε_{t-i} is negative (i.e. $\varepsilon_{t-i} < 0$), we say that there is "bad news", and the total effect of bad news is $\alpha_i(1-\gamma_i)|a_{t-i}|$, where $a_{t-i} = \varepsilon_{t-i}/\sigma_{t-i}$. For bad news to have larger impact on volatility than the good news, the asymmetric parameter (γ_i) is expected to be negative, in this case therefore, we say that there exists leverage effect.

2.6.4 The Threshold GARCH (TGARCH) Model

Similarly, another asymmetric volatility model known as TGARCH model was introduced independently by Glisten, Jagannathanand Runkle (1993) and Zakoian (1994). Like EGARCH model, the TGARCH model also captures asymmetry but the specification and interpretation of the two models are different. The TGARCH model is simply a re-specification of GARCH model with an additional term to account for asymmetry (Chinzara, 2011). In general, the TGARCH *(p, q)* has the following form:

$$\sigma_t^2 = \lambda + \sum_{i=1}^{p} (\alpha_i + \gamma_i s_{t-i}) \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 \qquad (6)$$

Where s_{t-i} is an indicator for negative ε_{t-i}, that is,

$$s_{t-i} = \begin{cases} 1 & \text{if } \varepsilon_{t-i} < 0, (i.e \text{ if it is bad news}) \\ 0 & \text{if } \varepsilon_{t-i} \geq 0, (i.e \text{ if it is good news}) \end{cases}$$

While γ_i is the asymmetric parameter, s_{t-i} is asymmetric component. α_i, γ_i and β_i are nonnegative parameters satisfying conditions similar to those of GARCH model (Tsay, 2010). In this model, when ε_{t-i} is positive (i.e. $\varepsilon_{t-i} > 0$ – good news), the total impact on the volatility is given by $\alpha_i \varepsilon_{t-i}^2$. Whereas, if ε_{t-i} is negative (i.e. $\varepsilon_{t-i} < 0$ – bad news), the total impact on the volatility is given by $(\alpha_i + \gamma_i)\varepsilon_{t-i}^2$. Therefore, the leverage effect exists if the asymmetric parameter (γ_i) is positive, indicating that the bad news has greater impact on the volatility than the good news.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

The objective of this thesis is to empirically investigate the relationship between stock market volatility and the key macroeconomic variables. Specifically, the study investigates the long-run and short-run impact of stock market volatility on real GDP and inflation. Therefore, this chapter intends to explain how this research work was conducted. That is, the chapter focuses on explaining the population and sample of the study, data sources and method used in collecting the data for the study, describing the data used, the econometric methodology employed as well as justifying the research method applied.

3.2 Population and Sample of the Study

Since the study aims at examining the effect of stock market volatility on the performance of macroeconomic variables, the population of the study made up of all key macroeconomic variables. However, the two most important key macroeconomic variables; real GDP and inflation, were chosen to represent the sample of this study. The real GDP was selected because it is the number one most important macroeconomic variable, as it measures the total production of good and services of a country. It shows the general performance of the country's economy for a particular period of time. A rapidly growing real GDP indicates an expanding economy (Bodie et al., 2009). Other studies that examine the effect of stock market volatility on real GDP include the work of Campbell et al. (2001), Arestis et al. (2001), Guo (2002), Beetsm and Giuliodori (2012) and Valadkhani and Chen (2014).

A persistance rise in general price level is called inflation. The study also uses inflation as one of the sample of the study. This is because it measures the monetary instability that affects the economic performance of a country (Petros, 2011). It can negetively affact the economic growth of a country as well as the living standard of the people in the country. It has been one of the most crucial macroeconomic problems in Nigeria over the years (Bayo, 2011).

The Nigerian Stock Exchange (NSE) All Share Index(ASI) was used to represent the Nigerian stock market index, as has been used by other researchers such as Emenike (2010), Ajao (2012), Olasumbo (2012), Emenike and Aleke (2012).

3.3 Data Sources and Method of Data Collection

The type of data used in this study is secondary data and were therefore obtained from two secondary sources; Central Bank of Nigeria (CBN) Statistical Bulletin and International Financial Statistics (IFS). Being a secondary data, the method applied for collecting the data was extraction. The data on All Share Index(ASI), real GDP, and inflation (proxied by CPI) were extracted from CBN statistical bulletin (i.e from two diffrent issues; 2009 and 2012), while interest rate (lending rate) and exchange rate (period average) were extracted from IFS.

3.4 Data Description

The sample period covered by the study ranges from 1985 to 2012. The use of these periods was necessitated by the period from which the variable (i.e. ASI) used to represent the Nigerian stock market index was available. It was introduced in January 3, 1984 with the base value of 100 point. Moreover, this sample period also covers periods of some important events in Nigeria such as; the financial deregulation in 1987, privatization of some public companies in 1988, internationalization of the Nigerian capital market in 1995, positive and significant increase in foreign portfolio investment into Nigerian capital market in 1999, banking reforms in 2004, insurance reforms in 2005, the Nigerian stock market crash coupled with the global financial crisis in 2008. During these periods, the trading activities on the Nigerian stock market were increased, and this could have affected the volatility of the Nigerian stock market (Olowe, 2009).

The All Share Index (ASI) was used as a proxy for the Nigerian stock market index because it includes only fully paid common stock (ordinary shares) of all the listed companies on the Nigerian Stock Exchange. It therefore tracks the general market movement of all listed equity on the exchange (NSE-equity market structure). Other researchers that use ASI as the Nigerian stock market index are Ahmed (2009), Emenike (2010), Okpara (2011), Ajao (2012), and Olasumbo (2012).

The empirical analysis of this study is conducted in two different parts; in the first part, we use monthly ASI series to estimate the volatility models. Before that, we firstly converted it into natural logarithm and then use its logarithmic first difference (i.e. stock market returns) to estimate the models. The first difference of ASI was used because it was found to be I(1). The monthly Nigerian stock market volatility series were then derived from TGARCH (1,1) model, which was later converted into quarterly volatility series using Frequency Conversion methodology in Eviews 5.0 program and then used in the second part of the analysis to investigate its long-run and short-run effect on the quarterly real GDP and inflation. The monthly stock market returns were also converted into quarterly series using the same method.

Due to the unavailability of quarterly data on CPI (which is used as a proxy for inflation) up to 2012 in one published CBN statistical bulletin, the quarterly CPI for the period 1985Q1-2009Q4 was obtained from CBN statistical bulletin of 2009, while the monthly CPI available in the CBN statistical bulletin of 2012 (which starts from 1995M1-2012M12) were converted into quarterly series (using the same method applied in converting monthly volatility series) in order to obtain quarterly CPI for the period 2010Q1-2012Q4. The two CPIs were then merged to have a complete inflation data set for 1985Q1-2012Q4 like other variables have. Some of the authors that use CPI as a proxy for inflation include Adam and Tweneboah (2008), Mahmood and Dinniah (2009) Rano (2010), Oseni and Nwosa (2011), Bayo (2011) and Beetsm and Giuliodori (2012).

After having quarterly data series for all the variables covering the same period, the real GDP, inflation and exchange rate series were seasonally adjusted using Tramo-seats methodology in Eviews 5.0 program (as used by Ertuğrul and Kenar, 2013), and all the variables were then transformed into natural logarithm.

3.5 Econometric Methodology

As explained above, the empirical analysis of this study was carried out in two different parts; the first part deals with the estimation, comparison and selection of the volatility model that best fits ASI variable among the four ARCH family models; ARCH, GARCH, EGARCH and TGARCH models. While the second part, deals with the Bound test approach for co-integration and ARDL Model using volatility and return series obtained from the first part of the analysis together with other variables mentioned above.

To avoid having spurious regression estimates, the study starts with examine the time series properties of the variables using three unit root tests; Augmented Dickey-Fuller (ADF) Phillips-Perron (PP) Ng-Perron (NP) tests. This is necessary because if the stationarity of the variables for the analysis are not established, you may end up with spurious regression.

After ensuring the stationarity and knowing the order of integration of ASI series in the first part of the analysis, we employ four ARMA structures among which the AR1AR5 was selected as true ARMA structure for the estimation of volatility models. Based on this, four volatility models namely; ARCH, GARCH, EGARCH and TGARCH models were estimated for the monthly ASI return series using Eviews 5.0 software. The TGARCH (1,1) was selected among the four volatility models as the model that best modelled the ASI return series. Other researchers like Mgbame and Ikhatua (2013), Goudarzi and Ramanarayanan (2011), Ahmed and Suliman (2011), Olweny and Omondi (2011) also use TGARCH model in modelling the volatility of the stock market. Thus, The Nigerian stock market volatility series were generated from TGARCH (1,1) model and used in the second part of the analysis.

Similarly, in the second part of the analysis, the study applies three unit root tests, i.e. ADF, PP and Ng-Perron tests, in order to establish the order of integration of each variable before investigating the relationship among them. The variables were found to have different orders of integration. While some of the variables like volatility series and returns were I(0), other variables such as real GDP, inflation, exchange rate and interest rate were I(1). Hence, we employ Bound test co-integration approach and ARDL model to investigate the relationship among them.

In this part (i.e in the second part of the analysis), there are two dependent variables; real GDP and inflation, on which the effect of stock market volatility were examined. This implies that in the second part of the analysis we have two equations; the real GDP equation and inflation equation.

As preliminary requirement for Bound test approach developed by Pesaran et al. (2001), the study applies Unrestricted Error Correction model (UECM) with 8 and 4 number of lags for the first and second equation respectively. Thus, to investigate the existence of long-run co-integration relationship among the variables, we employ Bound test approach. Based on the estimated UECM, we conducted a Wald test (F-test) using Eviews 5.0 program for both two equations and the F-statistic value derived from the Wald test were then compared with the upper and lower Bound critical values tabulated in Pesaran et al. (2001). The study further applies Autoregressive Distributed Lag (ARDL) model to determine the long-run and short-run coefficients of the impact of stock market volatility on Real GDP and inflation based on Akaike Information Criterion (AIC) using Microfit 4.0 software package.

3.6 Justification of the Econometric Methodology Employed

Some authors criticized that the ADF and PP unit root tests often have problems of lower power in rejecting the null of a unit root (Rahman 2009; Ndako 2010; Petros 2011). To avoid this problem, this study employs three unit root tests; ADF, PP and Ng-Perron tests. As cited in the work of Chinzara (2011), according to Perron and Ng (1996) and Ng and Perron (2001) the properties of Ng-Perron test are more suited in finite samples where ADF tests have low power.

Contrary to previous studies that employed standard deviation or variance as a measure of volatility, which is unconditional and does not capture some characteristic of volatility, and those studies that arbitrarily select any volatility model, as well as those studies that compare and choose between/among two or more volatility models based on model selection criterion only, this study selects the fittest model after comparing four volatility models based on both model selection criterion (i.e AIC and SC) and based on in-sample and out-sample forecast performance of the models. Thus, in this study, the TGARCH(1,1) was chose as the best fitted volatility model to ASI variable. This is because it performed very well in both in-sample and out-sample forecasting for the ASI series than other three volatility models. However, the EGARCH model emerged as the best based on AIC and SC.

Since the variables for the analysis in this thesis have different order of integration, i.e., while some are I(0) others are I(1), this study applies Bound test co-integration approach to investigate the existence of long-run co-integration relationship among the variables. This is because, unlike the conventional co-integration testing approaches such as Engle and Granger (1987), Johansen (1988), Johansen-Juselius (1990), Gregory and Hansen (1996), which require that the variables must have a common order of integration (i.e all of them must be I(1)), the Bound test approach can be used irrespective of whether all the variables are I(0) or I(1) or the mixture of the two. However, the Bound test approach cannot be used where some of the variables are I(2) or integrated of higher order (Afzai et al. 2013). Furthermore, the Bound test approach has superior properties in small sample size compared to other co-integration approaches. Therefore, for these reasons, the Bound test approach is considered as the appropriate technique to be used in this thesis.

Similarly, due to the different orders of integration of the variables for the study, we also apply ARDL model to determine the long-run and short-run coefficients for the relationship between stock market volatility and real GDP on one hand, as well as stock market volatility and inflation on the other. By employing ARDL model, you can easily estimate the long-run and short-run coefficients for the relationship between the variables simultaneously. It helps in selecting the optimal lag length for each variable on the basis of model selection criterion such as SBC, AIC RBC and HQC. Furthermore, the ARDL model is based on a single equation framework, and this makes it simple to implement and interpret (Giles, 2013). Its estimation results also come alongside its diagnostic test results (such as Serial correlation, Heteroscadasicity e.t.c.).

The models (ARDL models) were estimated based on AIC for both real GDP and inflation equations with maximum lag order set to be 8 and 5, respectively, using MICROFIT 4.0 software package.

3.7 Model Specification

This section presents the specifications of volatility model, UECM and ARDL model for the estimation of the Nigerian stock market volatility and its relationship with real GDP and inflation.

As mentioned before, there are two equations in this study; firstly, the real GDP equation and secondly, inflation equation. The first equation is formulated following Beetsma and Givliodori (2011), who conducted their study on macroeconomic response to stock market volatility shocks. Thus, in the first equation, real GDP is the dependent variable, while stock market volatility is independent variable with interest rate, inflation and stock market return as control variables.

For the second equation, we include the stock market volatility in the exchange rate pass-through to inflation equation to see whether the stock market volatility has any significant impact on the inflation in Nigeria or not. Therefore, in the second equation, inflation is the dependent variable while stock market volatility is independent variable with exchange rate as control variable.

3.7.1 Volatility model

The TGARCH(1,1) model based on AR1AR5 estimation for the logarithmic first difference of monthly NSE-ASI series is specified as follows;

$$\Delta LASI_t = \mu + \phi_1 \Delta \mathrm{LASI}_{t-1} + \phi_2 \Delta LASI_{t-5} + \varepsilon_t$$

$$h_t = \omega + \alpha_1 \varepsilon_{t-1}^2 + \gamma \varepsilon_{t-1}^2 I_{t-1} + \beta_1 h_{t-1} \tag{7}$$

Where $h_t = \sigma_t^2$ and

I_{t-1} is an indicator for negative ε_{t-i}, that is,

$$I_{t-i} = \begin{cases} 1 & \text{if } \varepsilon_{t-i} < 0, (i.e \text{ if it is bad news}) \\ 0 & \text{if } \varepsilon_{t-i} \geq 0, (i.e \text{ if it is good news}) \end{cases}$$

The 1st and 2nd equations above, are mean and volatility (conditional variance) equations of the TGARCH(1,1) model for monthly ASI series, respectively. In the mean equation, $\Delta LASI_t$ is the logarithmic first difference of monthly *ASI* series at time *t* (i.e. $\Delta LASI_t = \log ASI_t - \log ASI_{t-1}$), which represents monthly stock return at time *t*, μ is constant and ε_t is error term. In the 2nd equation (i.e. volatility equation), $h_t = \sigma_t^2$ is the conditional variance or volatility, ω is constant, α_1 is ARCH parameter (i.e. news about the previous period volatility) while β_1 is GARCH parameter (i.e. persistence coefficient) (Emenike, 2010), whereas ε_{t-1}^2 and h_{t-1} are ARCH and GARCH terms, respectively. While γ is the asymmetric parameter, I_{t-1} is asymmetric component. $\alpha_1, \gamma,$ and β_1 are both non-negative. In this model, when ε_{t-1} is positive ($\varepsilon_{t-1} > 0$), it is a good news (i.e. unexpected increase in the index) and therefore, the total impact of good news on the volatility is given by $\alpha_1\varepsilon_{t-1}^2$. Whereas if ε_{t-1} is negative ($\varepsilon_{t-1} < 0$), it is a bad news (i.e. unexpected decline in the index) and the total effect of bad news on the volatility is given by $(\alpha_i + \gamma_i)\varepsilon_{t-i}^2$. The null hypothesis of no asymmetric effect is that $\gamma = 0$, which implies that the good and bad news of the same size have equal effect on the stock market volatility. Thus, the null hypothesis is rejected if $\gamma \neq 0$ (i.e. asymmetric effect). Also if $\gamma > 0$, this indicates that the bad news has a larger impact on volatility than the good news and this suggests the presence of leverage effect.

3.7.2 Unrestricted Error Correction model (UECM) for Bound test Co-integration Analysis

As a prerequisite for Bound test analysis, first of all, we establish UECM. The UECM specifications used for testing the existence of long-run co-integration relationship among the variables in this study are shown in the following equations:

For real GDP equation, the UECM specification is;

LGDP = f(LINF, LINT, VOL, RETURN)

$$\Delta LGDP_t = \alpha_0 + \alpha_1 T + \sum_{i=1}^{n} \alpha_{2i} \Delta LGDP_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta LINF_{t-i} + \sum_{i=0}^{n} \alpha_{4i} \Delta LINT_{t-i} + \sum_{i=0}^{n} \alpha_{5i} \Delta VOL_{t-i} + \sum_{i=0}^{n} \alpha_{6i} \Delta RETURN_{t-i} + \alpha_7 LGDP_{t-1} + \alpha_8 LINF_{t-1} + \alpha_9 LINT_{t-1} + \alpha_{10} VOL_{t-1} + \alpha_{11} RETURN_{t-1} + \zeta_t \tag{8}$$

Where;

LGDP = Log of real GDP

LINF = Log of inflation (proxied by CPI)

LINT = Log of interest (lending) rate

VOL = Stock market volatility series

RETURN= Stock market returns–which is calculated as (Return$_t$ = $\log ASI_t - \log ASI_{t-1}$)

"Δ" is the first difference operator, "*T*" represents trend, "n" is the lag length and "ζ_t" is error term.

For inflation equation, the UECM specification is;

LINF = f(LEXC, VOL)

$$\Delta LINF_t = \alpha_0 + \sum_{j=1}^{m} \alpha_{1j} \Delta LINF_{t-j} + \sum_{j=0}^{m} \alpha_{2j} \Delta LEXC_{t-j} + \sum_{j=0}^{m} \alpha_{3j} \Delta VOL_{t-j} + \alpha_4 LINF_{t-1} + \alpha_5 LEXC_{t-1} + \alpha_6 VOL_{t-1} + \zeta_t \tag{9}$$

Where;

LINF = Log of inflation (proxied by CPI)

LEXC = Log of exchange rate (Nigerian Naira per US dollar, Exc.- period average)

VOL = stock market volatility series

"Δ" is the first difference operator, "m" represents number of lags and "ζ_t" is error term.

Therefore, the study uses equation (8) and (9) above to conduct a Wald test (F-test) using Eviews 5.0 in order to obtain the F-statistics which could be compared to lower and upper bound critical value tabulated in Pesaran et al. (2001), so that the conclusion regarding the existence of long-run co-integration relationship among the variables can be reached. The null hypothesis for no co-integration among the variables in equation (8) is; H_{0GDP}: $\alpha_7 = \alpha_8 = \alpha_9 = \alpha_{10} = \alpha_{11} = 0$, against the alternative hypothesis; H_{1GDP}: Some of the $\alpha's$ are not equal to zero. While in equation (9), the null hypothesis for no co-integration among the variables is H_{0inf}: $\alpha_4 = \alpha_5 = \alpha_6 = 0$, against alternative hypothesis H_{1inf} : Some of the $\alpha's$ are not equal to zero. In both cases, the rule is that, if the F-statistics obtained from Wald tests are greater than their respective upper bound critical values, then we can reject the null hypothesis of no co-integration and accept the alternative hypothesis suggesting the existence of co-integration among the variables. Whereas if the computed F-statistic is less than lower bound critical value, we cannot reject the null hypothesis of no co-integration among the variables. However, if the calculated F-statistic is in between the upper and lower bounds i.e. it is neither above the upper bound nor below the lower bound critical values, here, we cannot reach any conclusion about the existence of co-integration among the variables.

3.7.3 ARDL model

After conducting Bounds test analysis, the study further applies ARDL model to determine the long-run and short-run dynamic coefficients for the effect of stock market volatility on real GDP and inflation. In general, the ARDL model specifications for this study are as follow;

For real GDP as dependent variable, the specification is:

$$LGDP_t = \alpha_0 + \alpha_1 T + \sum_{i=1}^{k} \alpha_{2i} LGDP_{t-i} + \sum_{i=0}^{l} \alpha_{3i} LINF_{t-i} + \sum_{i=0}^{p} \alpha_{4i} LINT_{t-i} + \sum_{i=0}^{q} \alpha_{5i} VOL_{t-i} + \sum_{i=0}^{z} \alpha_{6i} RETURN_{t-i} + \zeta_t \quad (10)$$

Where, k, l, p, q and z represent the optimal lag length for variables respectively. "T" is the trend and "ζ_t" is error term.

For inflation as dependent variable, the specification is:

$$LINF_t = \alpha_0 + \sum_{j=1}^{k} \alpha_{1j} LINF_{t-j} + \sum_{j=0}^{l} \alpha_{2j} LEXC_{t-j} + \sum_{j=0}^{m} \alpha_{3j} VOL_{t-j} + \zeta_t \qquad (11)$$

Where, *k*, *l*, and *m* represent the optimal number of lags for LINF, LEXC and VOL respectively. And "ζ_t" is error term.

The ARDL model specification for short-run dynamic relationship of this study can be shown in the form of ECM version of ARDL model as below;

For real GDP as dependent variable:

$$\Delta LGDP_t = \alpha_0 + \alpha_1 T + \alpha_2 ECT_{t-1} + \sum_{i=1}^{k} \alpha_{3i} \Delta LGDP_{t-i} + \sum_{i=0}^{l} \alpha_{4i} \Delta LINF_{t-i} + \sum_{i=0}^{p} \alpha_{5i} \Delta LINT_{t-i} + \sum_{i=0}^{q} \alpha_{6i} \Delta VOL_{t-i} + \sum_{i=0}^{z} \alpha_{7i} \Delta RETURN_{t-i} + \zeta_t \qquad (12)$$

For inflation as dependent variable:

$$\Delta LINF_t = \alpha_0 + \alpha_1 ECT_{t-1} + \sum_{j=1}^{k} \alpha_{2j} \Delta LINF_{t-j} + \sum_{j=0}^{l} \alpha_{3j} \Delta LEXC_{t-j} + \sum_{j=0}^{m} \alpha_{4j} \Delta VOL_{t-j} + \zeta_t \qquad (13)$$

Where "ECT_{t-1}" is the error correction term and "Δ" is the lag operator.

3.8 Variables and Expected Signs

Inflation:- a higher inflation rate is expected to reduce real GDP via a reduction in investment and vice versa. This is because an increase in inflation reduces real income and this will cause a decrease in the marginal propensity to save and consequently reduces investment and hence real GDP (Govati, 2009). Therefore, inflation is expected to have negative effect on real GDP.

Interest rate:- interest rate is expected to relate negatively to real GDP. For example, a higher interest rate reduces the present value of future cash flows, thereby decreasing the attractiveness of investment opportunity and hence reduces real GDP (Bodie et al., 2009).

Returns:- stock market returns are expected to impact positively on real GDP(Guo, 2002). All things being equal, an increase in the stock market returns attracts more investments. A rise in an investment increases real GDP.

Stock market volatility:- may affect real GDP through cost of capital channel. An increase in stock market volatility induces shareholders to demand higher compensation for bearing un-diversifiable risk (i.e. systematic risk). And the higher expected returns by shareholders will lead to a higher cost of equity capital in the corporate sector and this consequently reduces investment and hence real GDP (Guo, 2002). Therefore, stock market volatility is expected to have negative effect on Real GDP

In summary, the expected sign for each variable in GDP equation is shown in the parenthesises as follows;

$LGDP = f[LINF\ (-), LINT\ (-), VOL\ (-), RETURN\ (+)]$

For inflation equation;

Exchange rate:- it is obvious that the exchange rate has a positive impact on the inflation. If there is depreciation in the country's exchange rate, it means more of its currency will be used to buy less foreign currency and this will cause the imports of finished good to be more expensive and hence raise inflation. On the other hand, the exchange rate depreciation makes imported inputs to become more expensive and this will lead to higher production cost which will then cause higher price of goods and services and consequently increases inflation.

Stock market volatility:- may result in portfolio adjustments which change the prices and returns of other financial asset. In addition to this, the price of real goods and services will also go up and this may lead to high rate of inflation resulting from supply shortage (Okpara, 2011).

The expected sign for each variable in the inflation equation is shown in the parenthesises as below;

$LINF = f[LEXC\ (+), VOL\ (+)]$

CHAPTER 4

EMPIRICAL RESULTS, ANALYSIS AND DISCUSSIONS

4.1 Introduction

This chapter presents the empirical results of the study, its analysis and discussions in two different parts: in the first part, four volatility models: ARCH, GARCH, EGARCH and TGARCH models, are estimated for ASI variable, and then compared based on model selection criterion (AIC and SC) as well as based on their forecasting performance so that to choose the fittest model to ASI series among them. While, in the second part of this chapter, the volatility series derived from the selected model, among the four aforementioned models, was used to examine its effect on real GDP and inflation in both long-run and short-run using ARDL model, after applying the Bounds tests co-integration approach to establish the long-run co-integration among the variables.

4.2 Part-One

Under this part, the study starts by checking the stationarity of ASI series. After the unit root tests, as mentioned above, four volatility models: ARCH, GARCH, EGARCH and TGARCH models, are estimated for ASI series, and then analysed, compared and chose the fittest model to ASI series among them.

4.2.1 Unit root tests

In order to estimate the volatility models, first of all, we investigate the stationarity of the variable [i.e. All Share Index(ASI)] to find out whether its stationary in its level form or not. It is important to carry out unit root test on the variables, because if regressions are run on non-stationary variables we will end up having spurious regressions which are meaningless (Govati, 2009). Moreover, to estimate the volatility models (e.g. ARCH, GARCH, EGARCH & TGARCH) the variables must be stationary. But before applying the stationarity test on the data (i.e.

ASI), firstly, it was transformed into natural logarithm which was done in line with the evidence in the empirical literature. Therefore, the natural logarithm of All Share Index in this study is denoted as 'LASI'. Three unit root tests are applied to establish the stationarity of LASI series. These are Augmented Dickey-Fuller (ADF, 1979), Phillips-Perron (PP, 1988) and Ng-Perron (2001) tests. The result of the unit root tests for LASI series are shown in table 4.2.1 below;

Table 4.2.1: Unit Root Tests

ADF Test Results at level (with Intercept)		**ADF Test Results at 1^{st} Difference (with Intercept)**	
ADF t-Statistic	-1.860276	ADF t-Statistic	-6.000626*
Test (ADF) critical values for LASI: %1= -3.449977 and %5= -2.870084		Test (ADF) critical values for ΔLASI: %1= -3.449977 and %5= -2.870084	

PP Test Results at level (with Intercept)		**PP Test Results at 1^{st} Difference (with Trend & Intercept)**	
PP t-Statistic	-1.927493	PP t-Statistic	-16.67552*
Test (PP) critical values for LASI: %1= -3.449679 and %5= -2.869952		Test (PP) critical values for ΔLASI: %1= -3.985773 and %5= -3.423336	

Ng-Perron Test Results

	MZ_a	MZ_t	MSB	MPT
Ng-Perron t-Statistic at level	-3.37977	-1.07335	0.31758	22.9822
Ng-Perron t-Statistic at 1^{st} diff.	-50.2626	-5.00402	0.09956	1.85878

Ng-Peron critical values for LASI series at level; MZa, MZt, MSB, MPT respectively;
%1 significance level -23.8, -3.42, 0.143 and 4.03.

%5 significance level for -17.3, -2.91, 0.168 and 5.48.

Ng-Peron critical values for ΔLASI series at 1^{st} Difference MZa, MZt, MSB, MPT respectively;
%1 significance level -23.8, -3.42, 0.143 and 4.03

%5 significance level for -17.3, -2.91, 0.168 and 5.48.

The asterisk, * denote %1 significance level

Source: *Eviews result output*

Table 4.2.1 above shows that on the application of both ADF and PP tests, LASI variable was non-stationary in its level form. This is because the calculated t-statistics (in absolute term) are less than critical values for both ADF and PP tests at all level of significance i.e. the ADF and PP statistics are less negatives than the critical values at all significance levels. This indicates that, the null hypothesis suggesting that the series include unit root cannot be rejected. However, the same table shows that, after taken the first difference in both ADF and PP tests, LASI series became stationary, as the calculated t-statistics for both ADF and PP tests are more negatives than critical values at all levels of significance, suggesting that the variable is integrated of order I(1) according to both ADF and PP tests. This necessitated the rejection of the null hypothesis which suggests that the series has a unit root at the 1^{st} difference.

Similarly, the same table 4.2.1 presents the result of Ng-Perron unit root test. For this test, since the calculated Ng-Perron t-statistic (in absolute term) for MZ_a, MZ_t tests are less than the critical values and for MSB and MPT tests the calculated t-statistics for LASI are greater than the critical values, thus, for MZ_a, MZ_t tests the null hypothesis stating that the series has unit root cannot be rejected, while for MSB and MPT tests, we can reject the null hypothesis suggesting that the series is stationary. Using this test also, LASI series became stationary after taken the 1^{st} difference, where the results indicate that for MZ_a, MZ_t tests the calculated t-statistic(in absolute term) are greater than the critical values, while for MSB and MPT tests the calculated t-statistics for LASI are less than the critical values at all level of significance, suggesting that the LASI series is I(1) according to Ng-Perron.

In summary, the result of all the three unit root tests applied show that the LASI series is stationary after differencing, thus, LASI series is I(1).

4.2.2 Model selection

After ensuring the stationarity of the variable (LASI), which was found to be I(1) i.e. ΔLASI, before running the ARCH family models (ARCH, GARCH, EGARCH & TGARCH) for comparison and choosing the best fit model to our data among them, firstly, we defined the true ARMA structures. Based on the observation made from correlogram of the ΔLASI, four models were estimated. These are AR1AR5, ARMA(1,5), ARMA(5,1) and ARMA(5,5). However, the autocorrelation were found in the residuals of all the models mentioned above when the serial correlation LM test was applied except for AR1AR5, which the results of the test indicate that there is no autocorrelation in its residuals. Therefore, we selected AR1AR5 as our true ARMA structure on which the ARCH-LM test was also applied to find out whether there is ARCH effect in its residuals. The result showed the presence of ARCH effects in the model's residuals, and therefore, suitable for running the ARCH family models. If there are no ARCH effects in the residuals, then the ARCH model is unnecessary and misspecified (Goudarzi, 2011). Thus, the ARCH family models; ARCH, GARCH, EGARCH & TGARCH, were estimated. The model diagnostic test (ARCH-LM test) was applied and the model selection criterion such as Akaike Information Criterion (AIC) and Schwarz Criterion (SC) values as well as the forecasting performances of these four models were compared to choose the volatility model that best modelled the conditional variance of the ΔLASL series. All these are discussed in the following sections.

4.2.2.1 ARCH model estimation result

To model the Nigerian stock market volatility, firstly, we estimated ARCH model for ΔLASI series. The mean and variance equation based on ARCH(2) model is shown in equation (14) below. The values in parentheses indicate the standard errors of the terms.

$$\Delta LASI_t = \mu + \phi_1 \Delta \mathrm{LASI}_{t-1} + \phi_2 \Delta LASI_{t-5} + \varepsilon_t$$

$$\Delta LASI_t = 0.025209 + 0.049507 \Delta LASI_{t-1} + 0.024781 \Delta LASI_{t-5} + \varepsilon_t$$

(0.002308) (0.050248) (0.041256)

$$h_t = \omega + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \varepsilon_{t-2}^2$$

$$h_t = 0.001022 + 0.425392 \varepsilon_{t-1}^2 + 0.580037 \varepsilon_{t-2}^2$$

(9.44E-05) (0.105827) (0.145632)

(14)

The above equations are mean and variance equations of ARCH (2) model. The coefficients (α), i.e. ARCH parameter, are all statistically significant at 1 percent level. To check the adequacy of the model, ARCH-LM test was applied to find out whether there are ARCH effects left in the series. The result of the test indicated that no ARCH effects remain. Thus, we concluded that ARCH(2) is adequately modelled the volatility of ΔLASI series.

4.2.2.2 GARCH model estimation result

Secondly, the GARCH model for ΔLASI series was estimated to model the stock market volatility. The model's equations are shown in equation (15) below:

$$\Delta LASI_t = 0.025453 + 0.181726\Delta LASI_{t-1} + 0.068266\Delta LASI_{t-5} + \varepsilon_t$$

(0.002000) (0.050931) (0.048007)

$$h_t = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1}$$

$$h_t = 0.000157 + 0.583959\varepsilon_{t-1}^2 + 0.535338 h_{t-1}$$

(4.79E-05) (0.104821) (0.048539)

(15)

The above equations are means and variance equations of GARCH (1,1) model with the coefficients of both ARCH term, (α), and GARCH term, (β), remain statistically significant at 1 percent level. While the persistence parameter is greater than one (i.e. $\alpha + \beta$ >1). Where $\alpha + \beta$ >1, this imply increasing volatility persistence over time and covariance stationarity is violated (Kargi, 2011). To check the adequacy of the model, the ARCH-LM test was applied to make sure that no ARCH effect left in the series. The result of the test reveals that no ARCH effects remain.

Asymmetric volatility models

It is commonly assumed that volatility is likely to be increase during periods of falling growth and likely to decrease during periods of intensifying growth. However, neither the ARCH nor the GARCH models is capable of capturing this asymmetry or lop-sidedness (Oseni & Nwosa, 2011). The two commonly used asymmetric volatility models capable of demonstrating the existence of asymmetry in volatility are Exponential GARCH model (EGARCH), developed by Nelson (1991) and Threshold GARCH (TGARCH) model, introduced independently by Glosten et al.(1993) and Zakoian(1994) . The results of these asymmetric volatility models for ΔLASI are also analysed below:

4.2.2.3 EGARCH model estimation result

The result of EGARCH model established for the ΔLASI series is shown in equation (16) as follows:

$$\Delta LASI_t = 0.025257 + 0.223626\Delta LASI_{t-1} + 0.040984\Delta LASI_{t-5} + \varepsilon_t$$

(0.002069) (0.059327) (0.046249)

$$\ln(h_t) = \omega + \alpha_1 \left| \left(\frac{\varepsilon_{t-1}}{h_{t-1}^{0,5}}\right) \right| + \gamma_1 \left(\frac{\varepsilon_{t-1}}{h_{t-1}^{0,5}}\right) + \beta_1 \ln(h_{t-1})$$

$$\ln(h_t) = -1.208917 + 0.765330 \left| \left(\frac{\varepsilon_{t-1}}{h_{t-1}^{0,5}}\right) \right| - 0.050419 \left(\frac{\varepsilon_{t-1}}{h_{t-1}^{0,5}}\right) + 0.894338 \ln(h_{t-1})$$

(0.173201) (0.087513) (0.050555) (0.024120)

(16)

Equation (16) above comprises of mean and variance equations of EGARCH (1,1) model. The asymmetric parameter (γ) in the variance equation was found to be negative and statistically insignificant. The negative sign of -0.050419 suggests that there are leverage effects in the All Share Index series, which imply that bad news has more impact on the Nigerian stock market volatility than good news. However, being insignificant implies that these effects are not pronounced during the sample periods. The ARCH and GARCH parameters (α & β) were statistically significant both at 1 percent level, indicating the evidence of volatility in the ΔLASI series. The intercept (ω) was also statistically significant at 1 percent. To test the fitness of the model, ARCH-LM test was applied to see whether there is any ARCH effect left in the series. The result confirmed that no ARCH effect remains. Thus, we concluded that EGARCH (1,1) is adequately indicates the volatility asymmetry in the All Share Index of the Nigerian stock market. This was similar to the conclusion reached by Goudarzi (2011).

4.2.2.4 TGARCH model estimation result

The results of TGARCH model estimated for ΔLASI series is shown in equation (7) below:

$$\Delta LASI_t = 0.023923 + 0.200729\Delta LASI_{t-1} + 0.069715\Delta LASI_{t-5} + \varepsilon_t$$

(0.002703) (0.054887) (0.047728)

$$h_t = \omega + \alpha_1\varepsilon_{t-1}^2 + \gamma\varepsilon_{t-1}^2 I_{t-1} + \beta_1 h_{t-1}$$

$$h_t = 0.000169 + 0.452712\varepsilon_{t-1}^2 + 0.213457\varepsilon_{t-1}^2 I_{t-1} + 0.542419 h_{t-1}$$

(5.44E-05) (0.101126) (0.171970) (0.050045)

(7)

The bove equation shows the mean and variance equations of TGARCH(1,1). In the variance equation of the model, the asymmetric parameter (γ) was found to be positive and statistically insignificant. The positive sign of 0.213457 suggests that there are leverage effects in the All Share Index series, and this indicates that the bad news has greater impact on the Nigerian stock markert volatility than good news. However, being insignicant implies that these effects are not pronounced during the sample priods. in the model, ARCH and GARCH parameters(α & β) were statistically significant both at 1 percent level, indicating the evidence of volatility in the ΔLASI series. The intercept (ω) was also statistically signicicant at 1 percent. To check the adequacy of the model, we applied ARCH-LM test to investigate whether the ARCH effects are left in the series. The result of the test shows that there are no remainng ARCH effects left in the series. Thus, we concluded that TGARCH(1,1) is adequately indicates the volatility asymmary in the ΔLASI series. This conclusion coincided with the one reached by Goudarzi (2011).

4.2.2.5 Comparison of the models

Table 4.2.2 summarised the results of four volatility models discussed above.

Table 4.2.2: Models Estimation Results

Variable	**ARCH(2)**	**GARCH(1,1)**	**EGARCH(1,1)**	**TGARCH(1,1)**
Mean Equation				
Constant(μ)	0.025209*	0.025453*	0.025257*	0.023923*
Y_{t-1}	0.049507	0.181726*	0.223626*	0.200729*
Y_{t-5}	0.024781	0.068266	0.040984	0.069715
Variance Equation				
Constant(ω)	0.001022*	0.000157*	-1.208917*	0.000169*
$\varepsilon_{t-1}^2(\alpha_1)$	0.425392*	0.583959*	0.765330*	0.452712*
$\varepsilon_{t-2}^2(\alpha_2)$	0.580037*	———	———	———
$h_{t-1}(\beta_1)$	———	0.535338*	0.894338*	0.542419*
EGARCH(γ)	———	———	-0.050419	———
TGARCH(γ)	———	———	———	0.213457

The asterisk, * denote %1 significance level

Source: *Eviews result output*

To determine which among these models will best fit the ASI series, the values of the model selection criterion such as AIS and SC of these four models as well as their in-samples and out-sample forecast performance for the ASI return series were compared in order to choose the model that can best modelled the volatility of the Nigerian stock market among them as discussed below.

Table 4.2.3: Comparison of the Models base on Model Selection Criterion

MODELS	Log likelihood	AIC	SC
ARCH (2)	509.8779	-3.053805	-2.984731
GARCH (1,1)	538.5913	-3.227826	-3.158752
EGARCH(1,1)	541.9208	-3.241944*	-3.161357*
TGARCH(1,1)	539.4414	-3.226917	-3.146331

The asterisk, * denote the lowest values of AIC and SC

Source: *Eviews result output*

From table 4.2.3 above, it can be observed that based on both AIC and SC, EGARCH model emerged as the best fitted model to ΔLASI series, this is because it has the lowest values of both AIC and SC than other three models.

Table 4.2.4: Comparison of the Models base on their In-sample Forecast Performance for ASI series.

MODELS	RMSE	MAE	MAPE	Theil I. Coeff.
ARCH (2)	0.062013	0.041183	333.2603	0.698134
GARCH (1,1)	0.062043	0.041206	335.2837	0.696784
EGARCH(1,1)	0.062015	0.041169	333.1162	0.697960
TGARCH(1,1)	0.061845	0.040939	318.1011	0.706696

Source: *Extracted from the models' forecasting result for ΔASI using Eviews 5.0*

Table 4.2.4 above, presents the in-samples forecast (i.e. forecasting for full sample periods: 1985M1-2012M12) performance of the four models for the ΔASI series. While making comparison between/among the models for their forecasting performances, the rule is that: the model with the lowest value of RMSE, MAE, MAPE and Theil I. Coeff. forecasts the series very well than the others. Thus, it can be seen from table 4.2.4 that TGARCH(1,1) model has the lowest values of RMSE, MAE and MAPE than the other models, and therefore, it performs better in an in-samples forecast for ΔASI series than other three model.

Table 4.2.5: Comparison of the Models base on their Out-sample Forecast Performance for ASI series.

MODELS	RMSE	MAE	MAPE	Theil I. Coeff.
ARCH (2)	0.052799	0.041821	249.4298	0.704476
GARCH (1,1)	0.052627	0.041750	242.0369	0.716631
EGARCH(1,1)	0.052446	0.041681	239.5525	0.716646
TGARCH(1,1)	0.052084	0.041497	231.2458	0.724025

Source: *Extracted from the models' forecasting result for ΔLASI using Eviews 5.0*

Table 4.2.5 above, shows the performance of the four models in forecasting the ΔASI series i.e. Out-sample forecasting, where all the models are estimated for 1985m1-2010m12 and forecasting the ΔLASI series for the 2011m1-2012m12 periods. From the table, it can be observed that the TGARCH (1,1) model again, has the smallest value of RMSE, MAE, and MAPE, and therefore, performs very well in an Out-sample forecast for the ΔASI series than other three models.

Thus, based on the results shown in table 4.2.4 and 4.2.5 i.e. in-samples and out sample forecast performance of the four models, respectively, the study selected TGARCH(1,1) model as the best model to be use in modelling the Nigerian stock market volatility using All Share Index (ASI) as a proxy. This is because it appeared to be superior to three other models and best fitted the ΔASI series, since it performs better in both in-samples and out sample forecasting for the ΔLASI variable than the three other models. The choice of this model also coincided with the volatility model used in modelling the stock market volatility in the works of Mgbame and Ikhatua (2013), Goudarzi and Ramanarayanan (2011), Ahmed and Suliman (2011), Olweny and Omondi (2011).

4.3 Part-Two

After chosen the volatility model in part-one of this chapter that can best modelled the conditional variance of the ASI series, which was TGARCH (1,1) model, the Nigerian stock market volatility series was then derived from it and used to find out its impact on the real GDP on one hand and inflation on the other hand. Similar to part-one, here also we start the analysis and discussions of empirical results with the unit root tests. This is followed by Bounds tests approach for co-integration analysis. Finally, the long-run and short-run effects of stock market volatility on real GDP and inflation are examined using ARDL model.

4.3.1 Unit root tests

To investigate such relationship, firstly, we start by checking the stationarity characteristics of the variables. This is necessary in order to avoid having spurious regression, and also as a necessary requirement for any type of co-integration testing approach. Like Bound test approach, for example, the unit root test is applied on the variables first, to ensure that none of the series is I(2) or integrated of higher order. This is because, the Bound test approach become inefficient method to be used, if any one of the variables involved in the analysis is I(2). Similarly, as in the first part of this chapter, three unit root tests were also employed in this part, namely; ADF, PP and Ng-Perron. According to Ndako (2010) the works of some authors have shown that both ADF and PP tests exhibit high size distortion: i.e., a wrong probability of rejecting a null that is true. To avoid these problems, the Ng-Perron unit root test was also applied. This is because it does not over-reject the null hypothesis of a unit root [Ng-Perron, 2001; Omisakin, 2008, as cited by Afzal et al. (2013)].

Table 4.3.1 and 4.3.2 below, present the unit root tests results for all the variables at the level and first difference, respectively:

Table 4.3.1: Unit Root Tests: Level

Variables	ADF Test t-statistic	PP Test t-statistic	Ng-Perron Test t-statistics			
			MZa	MZt	MSB	MPT
LGDP	3.100	3.100	2.327	3.909	1.679*	236.220*
LINF	-2.717***	-2.315	0.732	1.234	1.686*	175.024*
LINT	-2.753***	-2.799***	-1.314	-0.754	0.574*	17.079*
LEXC	-2.846***	-2.953**	0.765	1.186	1.550*	150.133*
VOL	-5.362*	-3.132*	-57.604*	-5.357*	0.093	1.629
RETURN	-8.255*	-8.399*	-52.633*	-5.128*	0.097	1.743

The asterisk, *, ** and *** indicate significance at 1%, 5% and 10% levels respectively

Source: *Eviews 5.0 result output*

Table 4.3.2: Unit Root Tests: First Difference

Variables	ADF Test t-statistic	PP Test t-statistic	Ng-Perron Test t-statistics			
			MZa	MZt	MSB	MPT
LGDP	-4.984*	-9.302*	-35.040*	-4.185*	0.119	2.604
LINF	-8.821*	-8.821*	-47.933*	-4.896*	0.102	1.901
LINT	-9.956*	-9.972*	-58.951*	-5.429*	0.092	1.546
LEXC	-9.687*	-9.658*	-55.811*	-5.283*	0.095	1.633
VOL	----------	---------	------------	----------	----------	--------
RETURN	----------	---------	------------	----------	----------	--------

The asterisk, * denotes significance at 1% level

Source: *Eviews 5.0 result output*

The results from table 4.3.1 above, show that based on all the three unit root tests, all variables are non-stationary in their level form except for VOL and Return, which are stationary at 1% level of significance, while LINF, LINT and LEXC were also found to be stationary at the level at 10% based on ADF test. However, based on PP test, only LEXC and LINT among these three variables were found to be stationary in their level form at 5% and 10% level of significance, respectively. All other variables became stationary at 1% significance level based on all the three unit root tests after first difference as shown in table 4.3.2 above. Thus, it is concluded that based on all the three unit root tests applied, VOL and Return series are I(0), while LGDP, LINF, LINT and LEXC are I(1) series, both at 1% level of significance respectively.

4.3.2 Bounds tests co-integration approach

After establishing the order of integration of all the variables, we carried out Bounds tests co-integration analysis. The Bounds test approach for co-integration was employed in this study because the variables for the analysis in the study were found to be integrated of different orders i.e. while some were I(0), others were I(1). And unlike the conventional co-integration approaches, which required that the variable must be integrated of the same order, the Bounds test method can be applied irrespective of whether the underlying variables are both I(0) or I(1) or the mixture of the two and also performs better in small sample size than the conventional approaches. Therefore, as a prerequisite for Bounds test analysis, the study firstly established the UECM necessary for conducting the Wald test from which the F-statistic is derived and then compared to the upper and lower bounds critical values tabulated in Pesaran et al. (2001) before reaching any conclusion on the existence of co-integration among the variables. If the calculated F-statistic is greater than upper bound critical value, then, we can conclude that there is long-run co-integration relationship among the variables. On the other hand, if the computed F-statistic is less than the lower bound critical value, then, we say that there exists no long-run co-integration relationship among the variables. However, if the F-statistic is nether greater than the upper nor less than the lower bounds critical values, here, we cannot reach any conclusion regarding the existence of long-run co-integration relationship among the variables.

4.3.2.1 Co-integration analysis for Real GDP equation

In order to determine the best lag structure for equation (8) i.e. real GDP equation (UECM), the lag orders up to maximum of 8 was set for the model. After estimated, the UECMs with lag order 4, 5 and 6 were found to have serial correlation problem when the Breusch-Godfrey Serial Correlation LM test was applied, therefore, I disregard them. The key assumption in the Bounds testing method is that the residuals of the equation (8) i.e. UECM, must be serially uncorrelated (Giles, 2013). Other alternative UECMs estimated, which do not have serial correlation problem were then compared and chose the one with minimum value of AIC as the best model as shown in table 4.3.3 below. The selected UECM was then used to conduct a Wald test. The null hypothesis for the Wald test based on equation (8) below, is established as H_{0GDP}: $\alpha_7 = \alpha_8 = \alpha_9 = \alpha_{10} = \alpha_{11} = 0$. This simply means that there is no co-integration among the variables in equation (8)

$$\Delta LGDP_t = \alpha_0 + \alpha_1 T + \sum_{i=1}^{n}\alpha_{2i}\Delta LGDP_{t-i} + \sum_{i=0}^{n}\alpha_{3i}\Delta LINF_{t-i} + \sum_{i=0}^{n}\alpha_{4i}\Delta LINT_{t-i} + \sum_{i=0}^{n}\alpha_{5i}\Delta VOL_{t-i} + \sum_{i=0}^{n}\alpha_{6i}\Delta RETURN_{t-i} + \alpha_7 LGDP_{t-1} + \alpha_8 LINF_{t-1} + \alpha_9 LINT_{t-1} + \alpha_{10} VOL_{t-1} + \alpha_{11} RETURN_{t-1} + \zeta_t \quad (8)$$

Table 4.3.3: Determination of Appropriate Lag Length for Equation (8)

n	AIC	χ^2_{BG}
1	-6.069499	2.268201
2	-6.064099	0.365821
3	-5.986185	0.288139
4	-5.952749	3.541464**
5	-6.000393	6.694906*
6	-6.071129	4.664444**
7	-6.117279	1.898168
8$^{\surd}$	**-6.142679**	**0.227437**

"n" represents number of variables' lags in equation (8)

χ^2_{BG} = Breusch-Godfrey Serial Correlation LM test statistic. * and ** imply 1% and 5% levels of significance respectively. It is simply means there is autocorrelation in the error terms of the respective models

Source: *Extracted from UECMs outputs estimated by the author in Eviews 5.0*

From table 4.3.3 above, it can be observed that the UECM [i.e equation (8)] with 8 lags length is the best model, as it has the minimum value of AIC and does not have serial correlation problem. Based on this, the study therefore applied Wald test to equation (8) using 8 lag order to obtain F-statistic which was then compared to lower and upper bound critical values tabulated in Pesaran et al. (2001) as shown in table 4.3.4. Therefore, the Bounds test analysis for real GDP equation is presented in table 4.3.4 as follows:

Table 4.3.4: Bounds Test Results for Real GDP Equation

k_8	Wald test F-statistic	Critical values at 5% significance level	
		Lower bound [I(0)]	Upper bound [I(1)]
4	5.245	3.47	4.57

"k_8" indicates the number of independent variables in equation (8).

The critical values are obtained from table C1.v, i.e. the table titled "with unrestricted intercept and unrestricted trend" in Pesaran et al. (2001)

It can clearly be seen from table 4.3.4 above, that the computed F-statistic derived from the Wald test is higher than the upper bound critical value at 5% level of significance. This suggests that the null hypothesis of no co-integration among the variables in equation (8) can be rejected. Therefore, based on this, we found the evidence of significant long-run co-integration relationship between real GDP and Nigerian stock market volatility together with the control variables.

4.3.2.2 Co-integration analysis for Inflation equation

Here, to obtain the appropriate lag structure for equation (9), the UECM with the lag orders up to the maximum of 5 were estimated, out of which the model with lag order 1, 2, and 3 were found to have autocorrelation problem when the serial correlation LM test was applied, and therefore, they were not considered. For the other two models i.e. the UECM with 4 and 5 lag length, the test indicate no serial correlation in their residuals. Thus, the study compared them and chose the one with smaller value of AIC as superior, as presented in table 4.3.5 below. The selected model was then used to conduct a Wald test. The null hypothesis for the Wald test, which suggests no co-integration among the variables in equation (9), is formulated as $H_{0inf}: \alpha_4 = \alpha_5 = \alpha_6 = 0$.

$$\Delta LINF_t = \alpha_0 + \sum_{j=1}^{m} \alpha_{1j} \Delta LINF_{t-j} + \sum_{j=0}^{m} \alpha_{2j} \Delta LEXC_{t-j} + \sum_{j=0}^{m} \alpha_{3j} \Delta VOL_{t-j} + \alpha_4 LINF_{t-1} + \alpha_5 LEXC_{t-1} + \alpha_6 VOL_{t-1} + \zeta_t \quad (9)$$

Table 4.3.5: Determination of Appropriate Lag Length for Equation (9)

m	AIC	χ^2_{BG}
1	-2.215754	13.93997*
2	-2.308774	11.80116*
3	-2.380163	11.96303*
4$^{\surd}$	**-2.536379**	**0.145100**
5	-2.473440	0.184280

"m" represents number of variables' lags in equation (9)

χ^2_{BG} = Breusch-Godfrey Serial Correlation LM test statistic. * denotes 1% levels of significance. It is simply means there is autocorrelation in the error terms of the respective models

Source: *Extracted from UECMs outputs estimated by the author in Eviews 5.0*

The results from table 4.3.5 above show that the model with 4 number of lags has a smaller value of AIC and has also passed the serial correlation LM test. Based on this, therefore, the study conducted a Wald test for equation (9) with 4 lags length. The F-statistic derived from Wald test was then compared to the lower and upper bound critical values introduced by Pesaran et al. (2001), as shown in table 4.3.6. Thus, the Bounds test analysis for inflation equation is presented in table 4.3.6 as follows:

Table 4.3.6: Bounds Test Results for Inflation Equation

k_9	Wald test F-statistic	Critical values at 5% significance level	
		Lower bound [I(0)]	Upper bound [I(1)]
2	5.201	3.79	4.85

"k_9" indicates the number of independent variables in equation (9).
The critical values are obtained from table C1.iii, i.e. the table titled "with unrestricted intercept and no trend" in Pesaran et al. (2001)

It can be observed from table 4.3.6 above, that the calculated F-statistic obtained from the Wald test is greater than the upper bound critical value at 5% level of significance. This suggests the rejection of the null hypothesis, which says there is no co-integration among the variables in equation (9). Thus, based on this, the study also found evidence of significant long-run co-integration relationship between inflation (used as dependent variable) and Nigerian stock market volatility (as independent variable) together with exchange rate as control variable.

Therefore, based on the results in Table 4.3.4 and Table 4.3.6 above, the study rejected the null hypothesis (i.e. $H0_1$) established in chapter one, which states that there exists no long-run co-integration relationship between stock market volatility and macroeconomic variables in Nigeria.

4.3.3 ARDL model

After finding the evidence of long-run co-integration among the variables, we use ARDL model to determine the long-run and short-run coefficients for the impact of stock market volatility on real GDP on one hand and inflation on the other hand. Some of the advantages of ARDL model among other, are (a) It can be used irrespective of whether the underlying variables are both I(0) or I(1) or the mixture of I(0) and I(1), (b) It helps in determining the optimal lag length for each variable in the model on the basis of model selection criterion such as AIC, SBC etc., (c) Using MICROFIT program, the long-run and short-run coefficients for the relationship between the variables can easily be estimated by the use of ARDL approach, (d) It is based on single equation framework, thus, it is simple to implement and interpret

(Gile, 2013) and (e) Lastly, the ARDL model estimates appear alongside its diagnostic test results.

4.3.3.1 Model estimates for Real GDP equation

Equation (10) below, is the ARDL model specification for real GDP equation with maximum lag order set to 8 and the optimal lag length for each variable in the equation was selected on the basis of AIC.

$$LGDP_t = \alpha_0 + \alpha_1 T + \sum_{i=1}^{k} \alpha_{2i} LGDP_{t-i} + \sum_{i=0}^{l} \alpha_{3i} LINF_{t-i} + \sum_{i=0}^{p} \alpha_{4i} LINT_{t-i} + \sum_{i=0}^{q} \alpha_{5i} VOL_{t-i} + \sum_{i=0}^{z} \alpha_{6i} RETURN_{t-i} + \zeta_t \quad (10)$$

Table 4.3.7: ARDL(7,0,0,0,0) Model (selected based on AIC)

Variable	Coefficient	T-Ratio
LGDP(-1)	1.006	9.750*
LGDP(-2)	0.227	1.559
LGDP(-3)	-0.266	-1.960***
LGDP(-4)	-0.331	-2.442**
LGDP(-5)	0.464	3.404*
LGDP(-6)	0.141	0.954
LGDP(-7)	-0.177	-1.771
LINF	-0.010	-2.968*
LINT	-0.003	-0.447
VOL	0.160	1.307
RETURN	0.038	1.426
C	0.858	2.967*
T	0.001	3.139*

Diagnostic Tests Statistic	
R^2	0.99928
$\overline{R}^2$	0.99918
F-statistic	10250.2[0.000]
Durbin-Watson statistic	2.0564
χ^2_{BG}	5.379[0.251]
χ^2_{HS}	0.372[0.542]

The asterisk, *, ** and *** indicate significance at 1%, 5% and 10% levels respectively.
[ ] shows probability value.
χ^2_{BG} and χ^2_{HS}, are Serial correlation LM and Heteroscedasticity tests statistic, respectively.

Source: *MICROFIT 4.0 result output*

Table 4.3.7 above, shows the empirical result of ARDL model estimates for real GDP equation. As it can be seen from the table, the ARDL(7,0,0,0,0) Model, which comprises optimal lag length for each variable in the equation out of the 8 maximum lag order used, was selected as the best model based on AIC. Importantly, from the model, the diagnostic tests indicate no evidence of autocorrelation in the residuals. The results of the tests also show that the residuals of the model are homoscedastic. Since the residuals of the model passed the serial correlation LM and ARCH-LM (Heteroscedasticity) tests, this suggests that the result of the model is true and could therefore be trusted and interpreted. Furthermore, in the model, the $\overline{R}^2$ shows that the explanatory variables account for 99.93% variation in the real GDP. The F-statistic indicates that the overall model is statistically significant at 1% level. Finally, Durbin-Watson statistic confirmed the absence of serial correlation in the residuals of the model.

Thus, having confirming the goodness of the model [i.e. ARDL(7,0,0,0,0) Model], we then went ahead to determine the long-run and short-run coefficients for the relationship between stock market volatility and real GDP as discussed in the following sub-headings.

4.3.3.1.1 Long-run coefficients of Real GDP equation

Based on the ARDL(7,0,0,0,0) Model estimates and AIC, the long-run coefficients were estimated for real GDP equation as presented in table 4.3.8 below:

Table 4.3.8: Estimated Long-run Coefficients of Real GDP Equation based on ARDL(7,0,0,0,0) Model and AIC

Variable	Coefficient	T-Ratio
LINF	-0.134	-4.503*
LINT	-0.039	-0.443
VOL	2.101	1.197
RETURN	0.496	1.298
C	11.275	40.172*
T	0.017	11.331*

* denotes 1% level of significance

Source: *MICROFIT 4.0 result output*

From the table above, it can be seen that the coefficients of all variables were found to be statistically insignificant except for inflation, which is significant at 1% level. The result indicates that a 1% increase/decrease in inflation lead to a 0.13%

reduction/increase in real GDP, respectively. The volatility, which is the main focus of the study, was found to be statistically insignificant, and this is consistent with the empirical finding of Arestis et al. (2001), who found similar result for Germany in their attempt to examine the relationship between stock market development and economic growth while controlling for the effects of stock market volatility and banking system in five developed countries. However, the result is in contrasts to their findings for Japan, France and UK, which reveal that the stock market volatility has negative and significant effect on real GDP in these countries. Other studies such as Campbell et al. (2001), Guo (2002) also found contrasting results. Therefore, being insignificant implies that the stock market volatility does not have any significant impact on real GDP in the long-run in Nigeria.

The absence of significant effect of stock market volatility on real GDP in Nigeria is not surprising. This is because the stock market in less developed countries like Nigeria is not as influential and important as in the developed countries. Therefore, this insignificant effect of stock market volatility on real GDP in Nigeria could be attributed to the less number of companies listed on the NSE, which are about 200 companies. Such number of companies is negligible compared to about 2000,000 registered companies and businesses that are operating in Nigeria [News Agency of Nigeria (NAN) on 13th Feb., 2012 quoted the Registrar-General of Corporate Affairs Commission (CAC)]. So, it is not surprising, if the stock market volatility arises from only these 200 companies does not show significant effect on real GDP, which serves as a measure of total monetary value of all goods and services produced in a country during a particular period of time. Furthermore, the insignificance could also be attributed to the fact that the oil producing companies, whose sector contributes significantly to GDP and also serves as the major sources of Nigerian government revenue, are not yet fully listed on the NSE, as the market is dominated by the financial services sector.

4.3.3.1.2 Short-run coefficients of Real GDP equation (ECM version of ARDL model)

After determining the long-run coefficients, we obtain the short-run coefficients for the relationship between stock market volatility and real GDP. We therefore apply the ECM version of ARDL model specified in equation (12) below. Table 4.3.9 presents the error correction representation for real GDP equation based on ARDL(7,0,0,0,0) Model as selected based upon AIC.

$$\Delta LGDP_t = \alpha_0 + \alpha_1 T + \alpha_2 ECT_{t-1} + \sum_{i=1}^{k} \alpha_{3i} \Delta LGDP_{t-i} + \sum_{i=0}^{l} \alpha_{4i} \Delta LINF_{t-i} + \sum_{i=0}^{p} \alpha_{5i} \Delta LINT_{t-i} + \sum_{i=0}^{q} \alpha_{6i} \Delta VOL_{t-i} + \sum_{i=0}^{z} \alpha_{7i} \Delta RETURN_{t-i} + \zeta_t \quad (12)$$

Table 4.3.9: Error Correction Representation for ARDL(7,0,0,0,0) Model based on AIC(Estimated short-run coefficients of real GDP equation)

Variable	Coefficient	T-Ratio
DLGDP(-1)	0.083	0.829
DLGDP(-2)	0.309	3.251*
DLGDP(-3)	0.0436	0.460
DLGDP(-4)	-0.287	-3.020*
DLGDP(-5)	0.177	1.843***
DLGDP(-6)	0.177	1.771
DLINF	-0.010	-2.968*
DLINT	-0.003	-0.447
DVOL	0.160	1.307
DRETURN	0.038	1.426
C	0.858	2.967*
T	0.001	3.139*
ECT(-1)	-0.076	-2.920*

* and *** indicate significance at 1% and 10% levels respectively.

***Source:** MICROFIT 4.0 result output*

The result from table 4.3.9 above, shows that the coefficient of error correction term, ECT(-1), is correctly signed (negative) and statistically significant (as expected) at 1% level, which is also a confirmation of the existence of long-run relationship among the variables in equation (8). The ECT(-1), also known as speed of adjustment, is a one period lagged value of error terms derived from the long-run equilibrium relationship. The coefficient of ECT(-1), shows the rate of speed of adjustment back to the long-run equilibrium after the short-run disequilibrium. The estimated ECT(-1)'s coefficient of the model is -0.076, which means 7.6% of disequilibrium from the previous quarter shock is corrected in the current quarter. Therefore, it attain long-run equilibrium at approximately 13^{th} quarter, (1/0.076) or 3.29years, [(1/0.076)/4]. Similarly, the short-run result is also consistent with the long-run finding, that all the explanatory variables are rightly signed except for volatility. However, only the coefficient of inflation was found to be statistically significant, indicating that a 1% increase/decrease in inflation reduces/increases real GDP by 0.010%, respectively. As for the volatility, the effect of which is the main concerned of this study was found to be statistically insignificant, suggesting that the Nigerian stock market volatility does not have any significant effect on real GDP in the short-run.

Therefore, based on the results in table 4.3.8 and 4.3.9 above, we fail to reject the null hypothesis formulated in chapter one i.e. $H0_2$, which states that the stock market volatility does not have any significant impact on real GDP in Nigeria in both long-run and short-run.

4.3.3.2 Model estimates for Inflation equation

Equation (11) below presents the ARDL model specification for inflation equation. The maximum lag order of 5 was used to select the appropriate lag length combination of the variables in the equation based on AIC.

$$LINF_t = \alpha_0 + \sum_{j=1}^{k} \alpha_{1j} LINF_{t-j} + \sum_{j=0}^{l} \alpha_{2j} LEXC_{t-j} + \sum_{j=0}^{m} \alpha_{3j} VOL_{t-j} + \zeta_t \qquad (11)$$

Table 4.3.10: ARDL(4,3,5) Model (selected based on AIC)

Variable	Coefficient	T-Ratio
LINF(-1)	1.027	11.366*
LINF(-2)	0.047	0.386
LINF(-3)	0.131	1.089
LINF(-4)	-0.243	-3.029*
LEXC	0.021	0.532
LEXC(-1)	-0.060	-1.090
LEXC(-2)	-0.059	-1.040
LEXC(-3)	0.122	3.051*
VOL	-0.290	-0.240
VOL(-1)	3.581	2.036**
VOL(-2)	-3.495	-1.861***
VOL(-3)	2.796	1.488
VOL(-4)	-10.237	-5.718*
VOL(-5)	6.320	4.707*
C	0.085	3.238*

Diagnostic Tests Statistic	
R^2	0.99815
$\overline{R}^2$	0.99786
F-statistic	3468.0[0.000]
Durbin-Watson statistic	2.104
χ^2_{BG}	5.955[0.203]
χ^2_{HS}	0.0162[0.899]

The asterisk, *, ** and *** indicate significance at 1%, 5% and 10% levels respectively.
[ ] shows probability value.
χ^2_{BG} and χ^2_{HS}, are Serial correlation LM and Heteroscedasticity tests statistic, respectively.

Source: *MICROFIT 4.0 result output*

Table 4.3.10 above presents the result of ARDL model estimates for inflation equation. It can be observed from the table that the ARDL(4,3,5) Model was selected as appropriate model based on AIC. The model's diagnostic tests result suggests that the residuals of the model are serially uncorrelated and Homoscedastic. This indicates that the results for the model are valid and could therefore be trusted and interpreted. The explanatory variables account for 99.78% variation in the inflation as revealed by $\overline{R}^2$. The overall model is statistically significant at 1% level as indicated by F-statistic. Lastly, the Durbin-Watson statistic also confirmed that there is no autocorrelation in the residuals of the model.

Therefore, after confirming the fitness of the model [i.e. ARDL(4,3,5) Model], the study then proceeded to determine the long-run and short-run coefficients for the relationship between stock market volatility and inflation as discussed in the following sub-headings.

4.3.3.2.1 Long-run coefficients of Inflation equation

Based on the ARDL(4,3,5) Model estimates and AIC, the long-run coefficients were estimated for inflation equation as presented in table 4.3.11 below;

Table 4.3.11: Estimated Long-run Coefficients of Inflation Equation based on ARDL(4,3,5) Model and AIC

Variable	Coefficient	T-Ratio
LEXC	0.654	3.096*
VOL	-35.479	-1.010
C	2.284	1.965***

* and *** denote 1% and 10% level of significance

Source: *MICROFIT 4.0 result output*

The empirical results from table 4.3.11 above show that the exchange rate variable is correctly signed as expected and statistically significant at 1% level. According to the results, a 1% depreciation in exchange rate lead to 0.65% increase in an inflation. However, as for the main concerned of the study i.e. the volatility, the results reveal that it is statistically insignificant. This simply means that the stock market volatility does not affect the inflation in the long-run. This insignificant effect of volatility on inflation could be attributed to the weak link between stock market and real sector of the economy of Nigeria. Furthermore, the same reasons given for the effect of stock market volatility on real GDP to be insignificant in Nigeria can also be applied here.

4.3.3.2.2 Short-run coefficients of Inflation equation (ECM version of ARDL model)

Here, to determine the short-run coefficients for the effect of stock market volatility on inflation, the ECM version of ARDL model specified in equation (13) below was applied. Thus, the Error correction representation for inflation equation based on ARDL(4,3,5) Model selected based upon AIC is shown in table 4.3.12 as follows:

$$\Delta LINF_t = \alpha_0 + \alpha_1 ECT_{t-1} + \sum_{j=1}^{k} \alpha_{2j} \Delta LINF_{t-j} + \sum_{j=0}^{l} \alpha_{3j} \Delta LEXC_{t-j} + \sum_{j=0}^{m} \alpha_{4j} \Delta VOL_{t-j} + \zeta_t \qquad (13)$$

Table 4.3.12: Error Correction Representation for ARDL(4,3,5) Model based on AIC(Estimated short-run coefficients of Inflation equation)

Variable	Coefficient	T-Ratio
DLINF(-1)	0.065	0.731
DLINF(-2)	0.112	1.337
DLINF(-3)	0.243	3.029*
DLEXC	0.021	0.532
DLEXC(-1)	-0.063	-1.662
DLEXC(-2)	-0.122	-3.051*
DVOL	-0.290	-0.240
DVOL(-1)	4.617	3.364*
DVOL(-2)	1.122	0.779
DVOL(-3)	3.917	3.031*
DVOL(-4)	-6.320	-4.707*
C	0.085	3.238*
ECT(-1)	-0.037	-2.552**

* and ** indicate significance at 1% and 5% levels respectively.

Source: *MICROFIT 4.0 result output*

The results from table 4.3.12 above, indicate that the sign of the coefficient of error correction term, ECT(-1), is in line with the expectation, i.e. it is negative and statistically significant at 5% level. This also confirmed the existence of long-run relationship among the variables in equation (9). However, the speed of adjustment seems to be too slow, as the coefficient of ECT(-1) is only -0.037, which mean it will take up to approximately 27 quarters, (1/0.037) or 6.76years, [(1/0.037)/4], before the disequilibrium from the previous quarter shock could be fully adjusted back to the long-run equilibrium. In contrast to the long-run results, the short-run results from the table show that out of the optimal lag length selected based on AIC for the exchange rate, only its 2nd period lagged coefficient was found statistically significant (at 1% level) and negative. Similarly, as for the effect of volatility, which is the main concerned of the study, interestingly, the results reveal that the coefficients of three out of five lag order selected based on AIC are statistically significant. The 1st and 3rd period lagged coefficients of volatility were both positive (as expected) and statistically significant at 1% level. The results indicate that a 1%

increase or decrease in the 1st and 3rd period lagged of volatility result in an increase or reduction in an inflation by 4.62% and 3.92%, respectively. However, its 4th period lagged coefficient was found to be negative and statistically significant at 1% level. Therefore, the evidence from these results indicates that the Nigerian stock market volatility has significant effect on inflation in the short-run.

Thus, based on the results in table 4.3.11, the study fails to reject part of the null hypothesis i.e. $H0_3$, which says that the Nigerian stock market volatility does not have significant impact on inflation in the long-run. However, based on the results presented in table 4.3.12, the study rejected the other part, which states that Nigerian stock market volatility does not have any significant effect on inflation in the short-run.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

Stock market plays a significant role in achieving economic growth and development of a country through mobilization and efficient allocation of funds obtained from individuals, firms and government to various sector of the economic. However, the presences of excessive volatility in the stock market impair its effective performance and therefore, undermine its ability to play such role effectively. The findings of some researchers such as Ahmad (2009); Emenike (2010); Suleman (2011); Ezepue and Omar (2013) etc. suggest the presence of high and persistence volatility in the Nigerian stock market. These, therefore, motivated the author to investigate whether the stock market volatility has any significant impact on macroeconomic variables in Nigeria. Specifically, the thesis investigates the impact of Nigerian stock market volatility on real GDP and inflation both in long-run and short-run using quarterly time series data from 1985Q1-2012Q4. To achieve this, the study established two equations; real GDP equation, which comprises of real GDP, as dependent variable, stock market volatility, as independent variable, and inflation, interest rate, and stock market returns, as control variables. And inflation equation, which consists of inflation, as unexplained variable, stock market volatility, as explanatory variable and exchange rate, as control variable. The analysis of the study was conducted in two parts. In the first part, unlike the previous studies that use the standard deviation or variance as a measure of volatility, which is unconditional, and those studies that arbitrarily select any volatility model or those studies that only compare and choose between/among two or more volatility models based on model selection criterion (AIC and SC), this study estimated four volatility model; ARCH, GARCH, EGARCH and TGARCH models for the NSE-ASI series, and then compared them based on both model selection criterion (i.e. AIC and SC) and also based on their performance in an in-samples and out-samples forecasting for ASI returns series in order to choose the fittest model to ASI series among them. The

TGARCH(1,1) was then chose as the best model that can modelled the volatility of the Nigerian stock market than the three other models. This is because it performed better in both in-samples and out-samples forecasting for the ASI returns series than the other models. Thus, the Nigerian stock market volatility series were then derived from it and used in the second part of the analysis to investigate its relationship with the real GDP and inflation.

In the second part of the analysis, the order of integration of all the variables in the two equations were established using three unit root test; ADF, PP and Ng-Perron. The result of the tests revealed that the variables are integrated of different order i.e. some were I(0), while others were I(1). After establishing the stationarity of all the variables in the two equations, the study employed Bounds tests approach for co-integration to investigate the long-run co-integration among the variables. Unlike the conventional co-integration approaches, which required that the variables for the analysis must have same order of integration, the Bounds test approach can be used irrespective of whether all the variables have the same or different order of integration. The results of the Bounds test analysis show evidence of long-run co-integration relationship among the variables in both real GDP and inflation equations. Therefore, the study then applied ARDL model to estimate the long-run and short-run coefficients for the effect of Nigerian stock market volatility on real GDP on one hand and inflation on the other hand. The findings from the real GDP's ARDL model revealed that the effect of stock market volatility on real GDP is positive and statistically insignificant in both long-run and short-run. Similarly, for the inflation model, the findings show negative and statistically insignificant effect of stock market volatility on inflation in the long-run. However, in the short-run, the findings suggest that the 1st and 3rd period lagged of volatility have positive and statistically significant effect on inflation, while its 4th period lagged coefficient found to be negative and statistically significant.

5.2 Conclusions

From the findings of the study summarized above, it can therefore be concluded that there exists a long-run co-integration relationship between Nigerian stock market volatility and macroeconomic variables. However, it can also be concluded that the stock market volatility does not have any impact on the real GDP in Nigeria both in long-run and short-run. This is because the number of listed companies on the Nigerian stock market, which is about 200 companies, is negligible compared to the total number of the companies operating in Nigeria. This lack of significant effect of stock market volatility on real GDP could also be as a result of the fact that the oil producing companies, whose sector contributes significantly to GDP and also serves as the major source of the Nigerian government revenue, are not fully quoted on the NSE, as the market is dominated by the financial service sector. Similarly, the study can also be concluded that the stock market volatility does not have significant effect on inflation in Nigeria in the long-run. This is also because of the same reasons given above. Furthermore, the insignificance effect could also be as a result of the weak link that exists between the Nigerian stock market and real sector of the economy. However, based on the findings, the study further concluded that the Nigerian stock market volatility has significant positive impact on inflation in the short-run.

5.3 Recommendations

Based on the findings of the thesis, the following recommendations are made;

a) The Nigerian stock market regulatory agencies should review and modify the listing requirement and other relevant rules and regulations in such a way that might encouraged more companies, especially oil companies (both those that are operating in upstream and downstream sectors) as well as small and medium companies, to be listed on the market. So that the performance of the market, like in some developed and emerging economy, could be reflected in the economic performance of Nigeria. Furthermore, the financial education programs should be introduced via various media available in order to attract more investors to participate in the market by enlightening them about the benefits or profits that they might get for taking part in the market. Because having more investors in the market may also attract more companies, especially small and medium companies, to apply for quotation in the market, since they will find it easier and cheaper to raise any amount of funds they required.

b) Appropriate policy measures should be put in place to ensure that the Nigerian stock market is properly linked to real sector of the economy of Nigeria,

c) Although, the findings of the study show no evidence of significant effect of stock market volatility on real GDP in both long-run and short-run and inflation in the long-run. However, since the results indicate evidence of significant positive impact of stock market volatility on inflation in the short-run, it is also recommended that the policy makers should input the stock market volatility when formulating the policies regarding macroeconomic stability.
d) The study also recommended that while modelling the volatility of stock market series (e.g. the volatility of stock market index/returns), various volatility models should be employed and compared based on both model selection criterion (i.e AIC and SC) and based on the performance of the models in forecasting the variable, so as to choose the fittest model to the series. This is because the volatility of different variables could be modelled very well by different volatility models.
e) Finally, since the findings from Bounds tests analysis suggest the existence of long-run co-integration relationship between stock market volatility and macroeconomic variables in Nigeria, it is recommended that further research should be carried out to examine whether the stock market volatility has any significant effect on some other key macroeconomic variables in Nigeria.

REFERENCES

Adam, A. M. and Tweneboah, G. (2008). Macroeconomic factors and stock market movement: Evidence from Ghana. *MPRA Munich Paper No. 13699.*

Adaramola, A. O. (2011). The impact of macroeconomic indicators on stock prices in Nigeria. *Developing Country Studies*, 1(2), 1-14.

Adenuga, A. O. (2010). Stock market development indicators and economic growth in Nigeria (1990-2009): Empirical investigations. *CBN Economic and Financial Review, 48*(1), 33-70.

Agung, I. G. N (2009). *Time series data analysis using EViews*. Singapore: John Wiley & Sons (Asia) Pte Ltd.

Ahmed, A. E. M. and Suliman, S. Z. (2011). Modeling stock market volatility using GARCH models evidence from Sudan. *International Journal of Business and Social Science, 2*(23), 114-128.

Ahmed, I. (2009). *Effects of liberalization on stock return volatility in Nigerian stock exchange.* Seminar paper submitted to the Department of Business Administration, Ahmadu Bello University, Zaria,Nigeria.

Ajao, M. G. (2012). Inflation, financial openness, exchange rate and stock market volatility. *Indian Journal of Economics and Business,* 11(3).

Alajekwu, U. B. and Achugbu, A. A. (*2012*). The role of stock market development on economic growth in Nigeria: A time series analysis. *An International Multidisciplinary Journal, Ethiopia,* 6(1), 51-70.

Ali, I., Rehman, K. U., Yilmaz, A. K., Khan, M. A. and Afzal, H. (2010). Causal relationship between macro-economic indicators and stock exchange prices in Pakistan. *African Journal of Business Management, 4*(3), 312-319.

Arestis, P., Demetriades, P. O., and Luintel, K. B. (2001). Financial development and economic growth: The role of stock market. *Journal of Money, Credit, and Banking, 33*(1), 16-41.

Arnold, I.J.M and Vrugt, E. B (2006). Stock market volatility and macroeconomic uncertainty: Evidence from survey data. NRG Working Paper No. 06-08.

Asaolu, T. O. and Ogunmuyiwa, M.S. (2011). An econometric analysis of the impact of macroecomomic variables on stock market movement in Nigeria. *Asian Journal of Business Management*, 3(1), 72-78.

Azeez, B. A., Kolapo, F. T. and Ajayi, L. B. (2012). Effect of exchange Rate volatility on macroeconomic performance in Nigeria. *Interdisciplinary Journal of Contemporary Research in Business,* 4(1), 149-155.

Babatunde, O. A. (2013). Stock market volatility and economic growth in Nigeria (1980-2010). *International Review of Management and Business Research*, *2*(1), 201-209.

Bayo, F. (2011). Determinants of inflation in Nigeria: An empirical analysis. *International Journal of Humanities and Social Science, 1*(18), 262-271.

Becker, R. and Clements, A. (2007). Forecasting stock market volatility conditional on macroeconomic conditions. NCER Working Paper #18.

Beetsma, R. and Giuliodori, M. (2011). The changing macroeconomic response to stock market volatility shocks. CESIFO Working Paper No. 3652.

Bhowmik, D. (2013). Stock market volatility: An evaluation. *International Journal of Scientific and Research Publications, 3*(10), 1-17.

Bodie, Z., Kane, A. and Marcus, A. J. (2009). *Investments,* 8th edition. New York, NY: McGraw-Hill/Irwin.

Campbell, J. Y., Lettau, M., Malkiel, B. G., and Xu, Y. (2001). Have individual stocks become more volatile? An empirical exploration of idiosyncratic risk. *The Journal of Finance, 56*(1), 1-43.

Central Bank of Nigeria (2009). Statistical Bulletin. Available at: http://www.cenbank.org/documents/Statbulletin.asp

Central Bank of Nigeria (2012). Statistical Bulletin. Available at: http://www.cenbank.org/documents/Statbulletin.asp

Chigozie, O. G. (2009). Analysis of weak-form efficiency on the Nigerian stock market: Further evidence from GARCH model. *The International Journal of Applied Economics and Finance*.

Chinzara, Z. (2011). Macroeconomic uncertainty and conditional stock market volatility in South Africa. *South African Journal of Economics, 79(1),* 27-49.

Chizea, J. J. (2012). *Stock market development and economic growth in Nigeria: A time series study for the period 1980-2007.* Unpublished Ph.D.Dissertation, University of Northumbria, Newcastle.

Choo, W.C., Lee, S.N., and Ung, S.N. (2011). Macroeconomics uncertainty and performance of GARCH models in forecasting Japan stock market volatility. *International Journal of Business and Social Science, 2*(1), 200-208.

Diebold, F. X. and Yilmaz, K. (2008). Macroeconomic volatility and stock market volatility, worldwide. (NBER Working Paper 14269). Cambridge, MA: National Bureau of Economic Research.

Döpke, J., Hartmann, D., and Pierdzioch, C. (2006). Forecasting stock market volatility with macroeconomic variables in real time. Discussion Paper Series 2: Banking and Financial Studies No. 01/2006.

Elly, O. D. and Oriwo, A. E. (2012). The relationship between macro economic variables and stock market performance in Kenya. *DBA Africa Management Review, 3*(1), 38-49.

Emenike, K. O. (2010). Modelling stock returns volatility in Nigeria using GARCH models. *MPRA Munich Paper No*. 23432.

Emenike, K. O. and Aleke, S. F. (2012). Modeling asymmetric volatility in the Nigerian stock exchange. *European Journal of Business and Management*, 4(12), 52-59.

Engle, R. F., Ghysels, E. and Sohn, B. (2013). Stock market volatility and macroeconomic fundamentals. *Review of Economics and Statistics*, *95*(3), 776-797.

Eniekezimene, A. F. (2013). The impact of foreign portfolio investment on capital market growth: Evidence from Nigeria. *Global Business and Economics Research Journal*, *2*(8), 13-30.

Ertuğrul, H. M. and Kenar, A. (2013). External debt and GDP relationship: A dynamic analysis for Turkey. *Trakya University, Economics & Administrative Sciences Facuty, 2*(1), p78.

Ezepue, P. O. and Omar, M. T. (2013). *ARCH/GARCH structural time series modelling and characterisation of the Nigerian stock market in light of financial reforms and global financial crisis*. Report Number: AFRR 2013/02, Sheffield Hallam University, UK.

Gabriel, A. M. and Ugochukwu, W. M. (2012). Volatility estimation and stock price prediction in the Nigerian stock market. *International Journal of Financial Research*, 3(1), 2-14.

Giles, D. (2013). ARDL models-Part II - Bounds tests. Econometrics Beat. Available at: http://davegiles.blogspot.com.tr/2013/06/ardl-models-part-ii-bounds-tests.html

Goudarzi, H. and Ramanarayanan, C.S. (2011). Modeling asymmetric volatility in the Indian stock market. *International Journal of Business and Management, 6*(3), 221-231.

Govati, C. (2009). *Examining the effects of macroeconomic variables on the Malawi stock exchange*. Unpublished Master's Thesis, University of Malawi, Zomba.

Guo, H. (2002). Stock market returns, volatility, and future output. *The Federal Reserve Bank of St. Louis Review,* 84, 75-86.

Harper, A. and Jin, Z. (2012). Stock returns and macroeconomics factors: An examination of the Indonesian domestic economy. *International Research Journal of Applied Finance, 3*(4), 426-434.

Hsing, Y. (2011). The stock market and macroeconomic variables in a BRICS country and policy implications. *International Journal of Economics and Financial Issues,1*(1), 12-18.

Ibrahim, M. H. (2011). Stock market development and macroeconomic performance in Thailand. *Inzinerine Ekonomika-Engineering Economics, 22*(3), 230-240.

Ihendinihu, J. U. and Onwuchekwa, J. C. (2012). Stock market performance and economic growth in Nigeria (1984 - 2011). *Journal of Emerging Trends in Economics and Management Sciences*, 3(6), 971-977.

International Financial Statistics (1985-2012). Available at: http://elibrary-data.imf.org/QueryBuilder.aspx?key=1445290&s=322

Izedonmi, P. F. and Abdullahi, I. B. (2011). The effects of macroeconomic factors on the Nigerian stock returns: A sectoral approach. *Global Journal of Management and Business Research*, 11(7), 25-29.

Kupiec, P (1991). Stock market volatility in OECD countries: Recent trends, consequences for the real economy, and proposals for reform. *Economic Studies No. 17. Autumn.*

Lawal, N. A. and Okunola, O. E. (2012). Stock prices, stock market operations and Nigerian economic growth: A Granger Causality Modelling. *Global Advanced Research Journal of Management and Business Studies,* 1(10), 375-383.

Mahmood, W. M. W. and Dinniah, N. M. (2009). Stock returns and macroeconomics variables: Evidence from the six Asian-Pacific countries. *International Research Journal of Finance & Economics,* 30, pp154.

Mushtaq, R., Shah, A. S. Z., Rehman, M. Z. U., and Murtaza, G. (2011). The relationship between stock market volatility and macroeconomic volatility: Evidence from Pakistan. Available at SSRN:

http://ssrn.com/abstract=1888073.

Nazarian, R., Alikhani, N. G., Naderi, E. and Amiri, A. (2013). Forecasting stock market volatility: A forecast combination approach. *MPRA Munich Paper No*. 46786.

Ndako, U. B. (2010). *Financial development, economic growth and stock market volatility: Evidence from Nigeria and South Africa*. Unpublished Ph.D.Dissertation, University of Leicester, Leicester.

Nigerian Stock Exchange (2014) *Frequently asked questions*. Available at: http://www.nse.com.ng/investorrelation/Pages/NSE-e-Brochures.aspx

Nigerian Stock Exchange (2014) *Gateway to African markets*. Available at: http://www.nse.com.ng/investorrelation/Pages/NSE-e-Brochures.aspx

Nigerian Stock Exchange (2014) *Listing requirements (The Green Book)*. Available at: http://www.nse.com.ng/investorrelation/Pages/NSE-e-Brochures.aspx

Nigerian Stock Exchange (2013) *Q3 Fact sheet*. Available at: http://www.nse.com.ng/investorrelation/Pages/NSE-e-Brochures.aspx

Oke, M. O. and Adeusi, S. O. (2012). Impact of capital market reforms on economic growth: The Nigerian experience. *Australian Journal of Business and Management Research*, 2(02), 20-30.

Okpara, G. C. (2011). Volatility modelling and the Nigerian stock return relationship in EGARCH –in – mean framework. *International Journal of Current Research*, 3(8), 176-185.

Olasumbo, O. A. (2012). *Impact of macroeconomic variables on Nigerian stock market index*. Unpublished Master's Thesis, Ahmadu Bello University, Zaria, Nigeria.

Olowe, R. A. (2009). Stock return, volatility and the global financial crisis in an emerging market: The Nigerian Case, *International Review of Business Research Papers*, 5(4), 426-447.

Olweny, T. and Omondi, K. (2011). The effect of macro-economic factors on stock return volatility in the Nairobi stock exchange, Kenya. *Economics and Finance Review*, *1*(10), 34-48.

Onwukwe, C. E., Bassey, B. E. E. and Isaac, I. O. (2011). On modeling the volatility of Nigerian stock returns using GARCH models. *Journal of Mathematics Research*, 3(4), 31-43.

Oseni, I. O. and Nwosa, P. I. (2011). Stock market volatility and macroeconomic variables volatility in Nigeria: An Exponential GARCH Approach. *European Journal of Business and Management*, 3(12), 43-53.

Osinubi, T. S. (2002). Does Stock Market Promote Economic Growth In Nigeria?. Retrieved from: http://www.uwi.tt/conferences/financeconference/Conference%20Papers/Session%202/Does%20the%20Stock%20Market%20promote%20Economic%20Growth%20in%20Nigeria.pdf

Pesaran, M.H., Shin, Y., and Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*, 289-326.

Petros, J. (2011). The effect of the stock exchange on economic growth: A case of the Zimbabwe stock exchange. *Research in Business and Economics Journal.*

Pilinkus, D. (2009). Stock market and macroeconomic variables: evidences from Lithuania. *Economics & Management*, 884-890.

Polodoo, V., Seetanah, B. and Padachi, K. (2011). Exchange rate volatility and macroeconomic performance in small island developing states. Presentation at the UOM-WCP International Conference at Le Meridien, Mauritius.

Poon, S. H. (2005). *A practical guide to forecasting financial market volatility*. West Sussex: John Wiley and Sons Ltd.

Rahman, A.A., Sidek, N.Z.M. and Tafri F.H. (2009). Macroeconomic determinants of Malaysian stock market. *African Journal of Business Management, 3*(3), 095-106.

Rano, A. S. U. (2010). Does inflation has an impact on stock returns and volatility? evidence from Nigeria and Ghana. *MPRA Munich Paper No*. 30091.

Sariannidis, N., Giannarakis, G., Litinas, N., and Konteos, G. (2010). A GARCH examination of macroeconomic effects on U.S. stock market: A distinction between the total market index and the sustainability index. *European Research Studies*,*13*(1), 129-142.

Schwert, G. W. (1989). Business cycles, financial crises and stock volatility. *Carnegie-Rochester Conference Series on Public Policy, 31*, 83-126.

Securities and Exchange Commission (2012). What we do. Available at http://www.sec.gov.ng/

Suleiman, H. K. (2011). *Stock return and the volatility persistence in the Nigerian capital market*. PhD. Seminar Paper submitted to the Department of Accounting, Ahmadu Bello University, Zaria-Nigeria.

Tripathy, N. (2011). Causal relationship between macro- economic indicators and stock market in India. *Asian Journal of Finance & Accounting, 3*(1), 208-226.

Tsay, R. S. (2010). *Analysis of financial time series,* 3rd edition. Hoboken: John Wiley & Sons, Inc.

Valadkhani, A. and Chen, G. (2014). An empirical analysis of the US stock market and output growth volatility spillover effects on three Anglo-Saxon countries. *International Review of Applied Economics.*

Verma, S. and Mahajan, N. (2012). Stock return, volatility and the global financial meltdown: The behavior of Indian stock market. *International Journal of Arts and Commerce, 1*(7), 166-178.

Wikipedia (2014) Nigerian Stock Exchange. Available at: http://en.wikipedia.org/wiki/Nigerian_Stock_Exchange [Last modified on 4 June 2014 at 16:51]

Zakaria, Z. and Shamsuddin, S. (2012). Empirical evidence on the relationship between stock market volatility and macroeconomics volatility in Malaysia. *Journal of Business Studies Quarterly, 4*(2), 61-71.

APPENDICES

Table 4.2.1A: AR1AR5 Model Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.016845	0.005362	3.141252	0.0018
AR(1)	0.167603	0.053428	3.136982	0.0019
AR(5)	0.222201	0.053552	4.149250	0.0000

R-squared	0.072032	Mean dependent var	0.016626
Adjusted R-squared	0.066357	S.D. dependent var	0.061511
S.E. of regression	0.059435	Akaike info criterion	-2.798807
Sum squared resid	1.155146	Schwarz criterion	-2.764270
Log likelihood	464.8032	F-statistic	12.69149
Durbin-Watson stat	2.026206	Prob(F-statistic)	0.000005

Source: *Eviews result output*

Table 4.2.2A: ARCH-LM test for AR1AR5 Model

F-statistic	8.502260	Probability	0.003792
Obs*R-squared	8.337481	Probability	0.003884

Source: *Eviews result output*

Table 4.2.4A: Wald test result for Real GDP Equation

Test Statistic	Value	df	Probability
F-statistic	5.244778	(5, 54)	0.0005
Chi-square	26.22389	5	0.0001

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(43)	-0.178869	0.041877
C(44)	-0.026139	0.007159
C(45)	-0.011404	0.008076
C(46)	0.797889	0.366233
C(47)	0.072331	0.097742

Table 4.2.5A: Wald test result for Inflation Equation

Test Statistic	Value	df	Probability
F-statistic	5.200806	(3, 89)	0.0023
Chi-square	15.60242	3	0.0014

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(14)	-0.043865	0.015829
C(15)	0.027396	0.016291
C(16)	-1.286090	1.121461

Source: *Eviews result output*

Table 4.2.3A: ARCH-LM test for TGARCH (1,1) model

F-statistic	0.099051	Probability	0.753172
Obs*R-squared	0.099626	Probability	0.752278

Source: *Eviews result output*

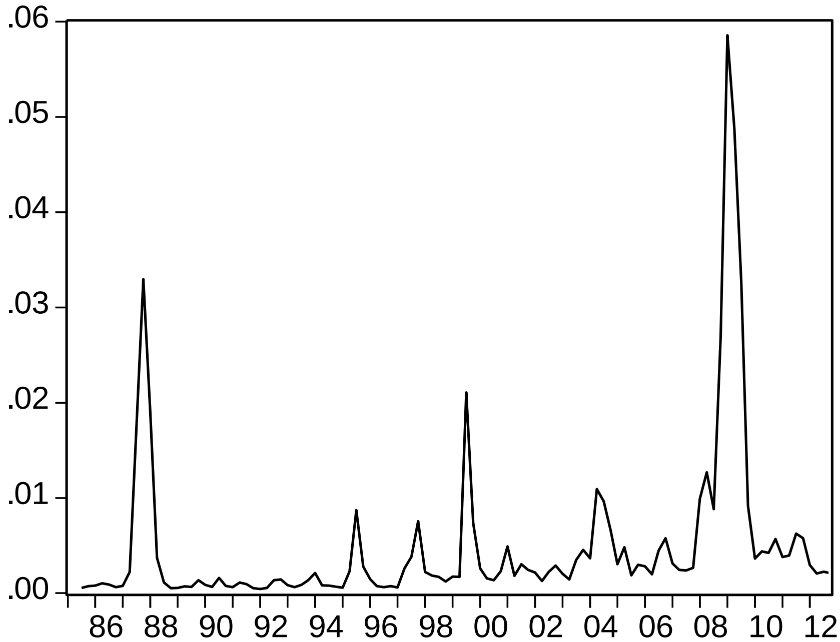


Figure 1A: Quarterly Stock Market Volatility series
(Converted into from Monthly volatility series)

Source: *Derived from TGARCH (1,1) model estimated for ASI series by author using EViews 5.0*

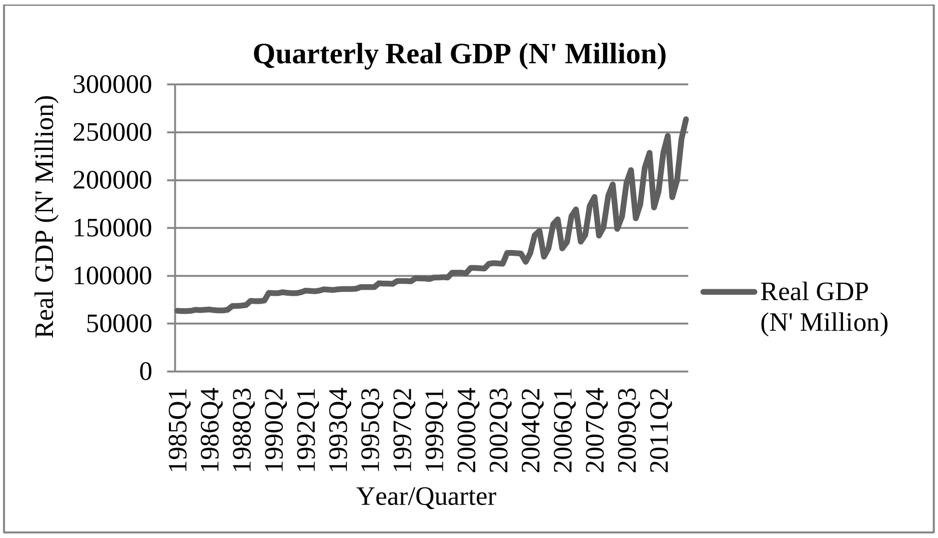


Figure 2A: Trends in Quarterly Real GDP (N' Million)
(Before adjusting for Seasonality), 1985Q1-2012Q4

Source: *Drawn using 2012-CBN Statistical Bulletin Data*

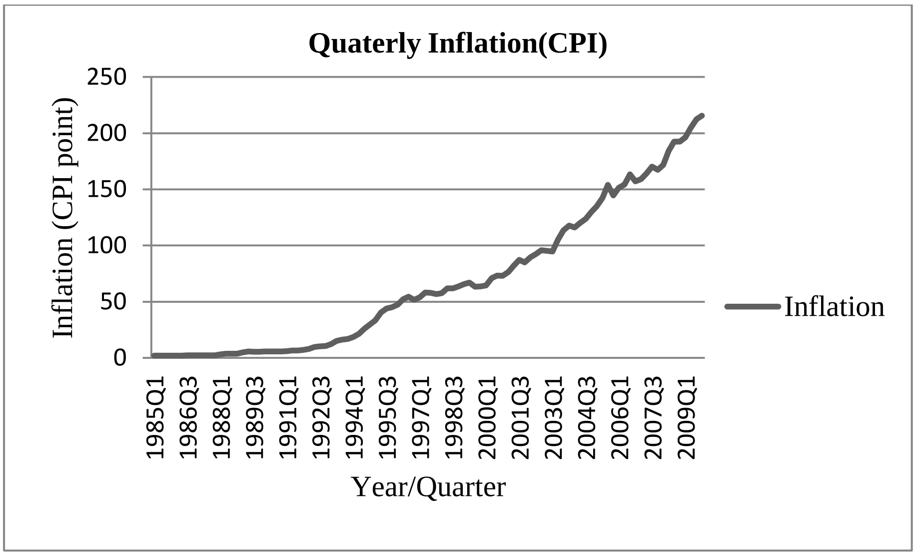


Figure 3: Trends in Quarterly Inflation (CPI)
(Before adjusting for Seasonality), 1985Q1-2009Q4

Source: *Drawn using 2009-CBN Statistical Bulletin Data*

CURRICULUM VITAE

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